International Energy Agency

Ukraine 2012

Energy Policies Beyond IEA Countries

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Facing unprecedented energy sector challenges but with a large untapped potential, Ukraine's energy policies are at crossroads. The country has the unique opportunity to undertake an energy revolution to modernise its energy sector, reform its energy markets, create employment and drive economic growth, which over the 1990s and 2000s, did not enjoy the same priority. Each of which will, in turn, strengthen energy security, diversify its economy and foster sustainable development. This will require a radical and swift transformation of energy supply and demand side policies.

On the supply side, this review estimates that Ukraine can eliminate its natural gas import dependency in the foreseeable future by substantially increasing domestic gas production, both conventional and unconventional, developing the country's biomass potential and maximising the energy efficiency gains. Conversely, the review also estimates that there is strong potential to attract investors to the modernisation of Ukraine's coal, electricity and heat generation sectors as well as heat and gas transmission sectors.

On the demand side, the potential for energy efficiency and energy savings is large, especially in the industry and residential sectors. This potential, however, remains largely untapped and insufficiently addressed in Ukraine's present energy policy framework. By prioritising energy efficiency policies, Ukraine could save large volumes of energy, especially gas. To do so will require a framework that frees up private and public funding while at the same time progressively removing subsidies for gas consumption in households and district heating systems, which are unsustainable and an obstacle to investment. Furthermore, Ukraine would benefit in the long term from reallocating the resources directed towards subsidies at present to funding mechanisms that can realise the country's energy efficiency potential.

The transition needs to be based on a comprehensive strategy that includes exploitation of indigenous energy resources, modernisation of infrastructure, augmented approaches to improve energy efficiency, prompt progress on effective market reform and good governance. This includes fair administrative procedures, transparent use of public funds, effective competition safeguarded by independent regulatory and competition authorities, and effective measures against corruption and conflicts of interest. A vast improvement in the business climate is needed to support the substantial levels of investment that are required.

Energy policy in Ukraine is showing signs of a shift to foster the further development of domestic resources and to strengthen the energy market framework to European Union levels. Adoption and full implementation of Energy Community Treaty provisions could provide Ukraine with a competitive, transparent and predicable market framework that will help to attract investment and underpin efficiency improvements in the energy sector. While a number of steps are already underway, further room for improvement and reform remains. This review outlines issues that need to be addressed for Ukraine's energy transformation to succeed and makes recommendations for effective frameworks that are fundamental to evolve the energy sector as well as specific recommendations applicable to energy demand and supply elements.

ENERGY POLICY CHALLENGES

This review identified a number of energy sector challenges that limit Ukraine's economic and social development, and energy security. The main issues are highlighted here while the eleven chapters of the report provide fuller analysis and detail.

High energy intensity and poor efficiency. Energy-intensive industries are crippled by ageing capital stock throughout the energy supply chain. District heating systems that supply half of the heat used in industry and space heating to some 55% of households are in dire need of refurbishment and need a tariff system that is consumption-based and reflects full costs. The building stock is poor quality. Attracting investments to modernise assets and improve energy efficiency is a key challenge.

Declining production of domestic natural gas resources. Ukraine's domestic oil and gas production is stagnating, if not declining, whereas the country has untapped conventional and unconventional gas resources. The country has potential to meet its gas consumption with domestic production by 2030. Yet, without comprehensive reforms and foreign investment, it will not be able to increase domestic gas production and significantly increase Ukraine's security of energy supply.

Energy consumption subsidies. The high level of public expenditure to subsidise gas, heat and electricity consumption is unsustainable. The challenge is to mobilise political and public support for a plan to move to market-based prices in a socially acceptable manner and ensure that energy companies can become economically viable.

Market and regulatory framework. Ukraine's oil, gas and electricity providers are dominated by state entities. Current energy markets are designed to maintain their predominance and to subsidise energy consumption in the household and public sectors. The challenge is to design and implement an effective regulatory framework that increases competition, strengthens the efficiency of markets and is attractive to investors.

Investment climate. Ongoing concerns over transparency in the energy sector, poor metering of energy flows, limited accountability and controls, weak implementation of the rule of law and price regulations have impeded foreign and domestic investment. Improving good governance is a necessary framework condition for attracting investment.

Natural gas and oil transit. The development of alternative gas and oil supply routes from Russia to Europe and shifts in gas demand in Europe are lowering volumes in transit through Ukraine and the revenues from that transit that constitute a significant element in Ukraine's fiscal regime. Maintaining its current transit importance is a challenge for energy policy.

Reducing environmental impact of fuel combustion. Ukraine has huge potential for greenhouse-gas emission reductions through expanded access to international carbon finance. Moreover, Ukraine has committed to implement the European Union Large Combustion Plant Directive by 2018. Making progress on these fronts also underscores the importance of attracting investment.

Institutional capacity. As in many transition economies, Ukraine's current institutional setting favours supply-side policies. The challenge is to adjust the institutional structure in order to improve the formulation, co-ordination and effective implementation of demand-side policies, especially in the energy efficiency and district heating segments.

POLICY DEVELOPMENTS

Ukraine's government is engaged in a process to reform the energy sector and address challenges identified in the *Programme of Economic Reforms for 2010-2014*. The programme recognises that Ukraine's energy sector is in poor condition owing to ageing assets, inefficient power generation and transmission, inefficient public companies, market opaqueness and inconsistency of regulation, price distortions, subsidies and lack of incentives for energy efficiency investments. Fostering energy efficiency through price signals and improving the competitiveness and reliability of the power sector are the main objectives of the economic reform programme in the energy sector. The main approaches to achieve these aims are to update the national energy strategy, ensure regulatory independence, raise tariffs to be more cost-reflective, initiate the phase-out of subsidies and provide incentives for energy efficiency improvements by the end of 2012.

In 2012, the national energy strategy is being revised. The draft *Updated Energy Strategy of Ukraine for the Period till 2030* was released for consultation in June 2012. Its stated strategy to address challenges in the energy sector includes: developing an integrated and effective regulatory framework to facilitate more competition, deregulation and diversity in energy supply sources; increased development of domestic energy resources; measures to drive energy efficiency; cost-reflective pricing; and improved conditions to attract private investment. The strategy is a step in the right direction, but it is still dominated by supply-side policies. More emphasis on efficiency and demand-side measures, where the potential savings are large and could be achieved at relatively low cost – certainly in comparison with building new energy production and delivery assets – would help to reduce import dependence, mitigate the impact of rising energy prices and develop a service portion of the economy that can create jobs and stimulate growth. The role of the government's draft *Updated Energy Strategy of Ukraine for the Period till 2030* is important as this document should drive energy policy reforms based on a thorough assessment of markets and informed projections, and set parameters for the restructuring of Ukraine's energy policies and markets. The Ukrainian government has already made progress in transforming its energy sector. Steps are being taken to restructure the electricity and gas sectors. The IEA welcomes these steps and the recommendations in this review aim to build on this progress. As highlighted in the full report, these advances include:

- Progress to incorporate and implement some Energy Community Treaty provisions into Ukrainian legislation to foster competition in the electricity and natural gas sectors, notably through preparations for the restructuring of Naftogaz and a stronger role for the National Commission for State Energy Regulation.
- Reform of the upstream oil and natural gas regimes where there have been open consultations with interested market participants. Tender procedures for conventional and unconventional gas exploration were organised in 2012, which attracted interest from major international oil companies whose technologies and experience are necessary to boost domestic gas production. This marks an important step and opens the way for production-sharing agreements to be signed.
- Increased efforts to diversify gas supplies via interconnections with European markets and reverse pipeline flows; and pledges to modernise the gas transmission system in co-operation with European institutions.
- Improved regulation of district heating systems that aims to implement a tariff regime which recovers the full cost of production.
- Simplification of the tax code to support investments in the energy sector.

In other important policy areas, such as restructuring the coal sector and the phase-out of subsidies in gas and electricity sectors, progress has been slower. For example, the *2010 Programme of Economic Reforms 2010-2014* called for increasing regulated consumer prices. Indeed there was a 50% rise in tariffs for district heating systems and residential consumers in 2010, but no further modifications have been taken despite an approved schedule to do so. Meanwhile gas import prices have increased.

KEY ENERGY POLICY PRIORITIES

Ukraine needs a transformation of its energy sector to a more efficient, secure and sustainable energy system. While a number of initiatives are underway, further steps for reform are needed. It is crucial to deepen and streamline the reform programme and to address all of the challenges with equal determination. Concerted efforts are needed to strengthen two complementary pillars: boost domestic energy production; and enhance efforts to achieve energy efficiency gains and phase out subsidies.

Effective energy policy, in any country, requires good data, sound analysis, political leadership, public dialogue, consensus building, professional planning and implementation, and benchmarks to monitor progress. The arena must be a fair and transparent legal and regulatory framework with adequate oversight and incentives for public and private players to invest in and deliver efficient and affordable energy services to businesses, factories, hospitals and housing blocks.

The key energy policy priorities for Ukraine are briefly outlined here, with much more background and analysis included in the sector chapters in the full report.

Tap the enormous energy efficiency potential

The transformation of Ukraine's energy sector needs to start with a radical change to its approach to energy efficiency. This potential should be thoroughly assessed in order to identify its contribution to the lowest cost energy supply profile over time. The national energy strategy should take a comprehensive approach to supply and demand-side policies for each sector and provide more details about the measures that will deliver demand reductions and how overall demand can be met in the most secure and efficient manner in the next two decades. Reducing energy demand should be a key priority for government.

Given Ukraine's financial constraints and the urgency to make progress, energy policies should focus more on improving energy efficiency in buildings and in district heating systems through regulatory approaches and financial incentives. Building codes should be strengthened, their coverage enhanced and enforcement assured. Tighter energy efficiency standards for appliances should be put in place. Homeowner associations should be facilitated and empowered to secure energy efficiency investments and install energy consumption meters with the support of public or private banks. Energy management systems and techniques should be more widely employed in energy-intensive industry. Energy audits for small and medium-size enterprises can help them to identify and implement energy efficiency improvements. Building from the experience of other transition economies and specialised donor organisations, more effort is needed to develop technical capacities and to amplify public awareness campaigns to stimulate energy efficiency gains.

Ambitious and effective programmes are needed for district heating, particularly to ensure the installation of building level metering sub-stations and move to tariffs that provide for cost recovery including system maintenance and improvements. It is important that residential and other buildings have metering and the possibility to adjust their

consumption accordingly. These areas need stronger institutional capacity at central and local government level to develop strategies and programmes. Enhanced co-operation with the municipalities and local stakeholders should help to map problems, quantify potential, collect better data, develop policies and monitor progress.

Expand development and production of indigenous energy sources

Ukraine has significant potential to further develop its hydrocarbon energy resources including conventional natural gas and unconventional sources such as shale gas and coalbed methane. To boost domestic production Ukraine needs to attract companies that have the appropriate technologies, expertise and financial capabilities. The institutional arrangement should include an enhanced one-stop shop approach to encourage and facilitate international company participation and investment. Further it should increase the number of tender and licensing rounds and carry them out under fair and transparent conditions.

The government must ensure that there is an appropriate and transparent legal and regulatory regime, including non-discriminatory third-party access to networks. Gas production from existing fields by state-owned companies could be encouraged by allowing them to sell the gas at a more market-based, rather than a regulated set price, which would improve their investment capacity and access to technologies. The benefits to the country can be even greater if such an approach is combined with measures to curb gas demand. Ukraine should also focus on realising its potential for biomass, particularly biogas and waste-to-energy resources.

In addition, Ukraine needs to devise an appropriate regulatory framework for shale gas to provide the basis for resource assessment and development of this, as yet, untapped domestic resource. The IEA has developed a set of "Golden Rules" that suggest principles that can allow policy makers, regulators, operators and interested parties to address issues relative to unconventional gas resource development.[1] These can provide useful guidelines for policy makers in Ukraine.

Modernise the energy supply chain

Ukraine's energy sector is in need of large and sustained investment to ensure its modernisation, security and competitiveness. The scale of investment required is on the order of Ukrainian hryvnia (UAH) 1 700 billion (EUR 170 billion) in the period to 2030.[2] In the upstream, investment is needed to realise oil and gas potential. Natural gas transmission and distribution infrastructure, as well as storage and gas-fired units for district heating systems, need capital investment. The coal sector requires considerable investment. In the power sector, investment is needed to refurbish, replace and develop generation units and networks, and new renewable energy generation. Investment is also required to reduce energy consumption by households. Modernising Ukraine's district heating systems and poorly insulated building stock will require both public and private funding.

The modernisation of Ukraine's energy production, transmission and end-use segments has barely started. In addition to the vast investment outlined above, significant sums

1. International Energy Agency (2012), *Golden Rules for a Golden Age of Gas – World Energy Outlook Special Report on Unconventional Gas*, OECD/IEA, Paris.

2. For currency conversion rates used in this review, refer to the currency conversion table in Annex D.

will be needed to implement the European Union Large Combustion Plant Directive as planned by 2018. A fundamental condition is a dramatic improvement of Ukraine's business climate, including the rule of law, independent and strong competition oversight and progress towards market-based prices. Ukraine ranks very low in international rankings such as the World Bank's 2011 *Doing Business Report* and Transparency International's 2011 Corruption Perception Index. It is imperative that Ukraine remove obstacles to attract foreign direct investment and create a business environment to underpin the needed energy reforms. Moreover, Ukraine should join the Extractive Industries Transparency Initiative to foster revenue transparency and investor confidence. Expanding access to international carbon finance is another important opportunity.

Having the largest gas transit infrastructure in the world and transiting huge volumes of Russian gas to European markets, Ukraine plays an important role for European energy security and in turn benefits from substantial transit revenues. In order to maintain its gas transit role and related revenues, Ukraine will have to attract funding for the modernisation and optimisation of the gas transmission system as well as in the transparency and predictability of its operation. The restructuring of Naftogaz and the unbundling of gas transmission and distribution systems in line with EU requirements would mark a very important development in this regard.

Ensure regulatory reform

Another important condition is to advance regulatory reforms and ensure full implementation of Energy Community provisions, such as fair third-party access to networks, and independent and effective regulation. Not only does Ukraine need to ensure that the appropriate legislation is in place – progress has been made in recent years with that regard – but also to ensure that legislation is properly implemented. An appropriate regulatory framework that supports competition in energy markets, accountability and predictability is decisive for attracting investments and ensuring that Ukraine's energy consumers will benefit from efficient, competitive and secure energy supplies. These conditions will help to strengthen energy security and economic growth.

Phase out subsidies

Another strategic priority is the progressive and predictable removal of subsidies for gas, coal and electricity consumers and reallocation of budget resources towards energy efficiency support measures. Although this may be perceived as socially difficult, it can deliver manifold benefits. These include: improving public finances and redirecting resources to support energy efficiency; providing price signals to industrial and residential customers to modernise equipment and practices, and to invest in efficiency improvements; and improving the financial situation of public companies that are burdened with the high costs of subsidies. Efforts to reform energy subsidies need to be accompanied with targeted support programmes to protect vulnerable communities from the full impact of higher energy prices and in parallel to create a strong policy framework to support energy efficiency improvements. They also need to be accompanied by the systematic installation of meters and the possibility to adjust consumption accordingly.

Over time, subsidies to the coal industry will also need to be removed. They will need to be accompanied by social programmes to support areas where mines are closed and support schemes for structural adjustment of the concerned regions.

Enhance policy-making and implementation

More emphasis can be put on effective policy making, accountability and implementation of energy policy measures. To succeed, Ukraine's energy reforms will need to rely on broad public consensus. The current consultation process for the *Updated Energy Strategy to 2030* would benefit from a stronger and more open stakeholder engagement to build consensus and increase public accountability. It would be improved with the elaboration of clear statements of intended outcomes and the time scales within which they can be delivered. The strategy should outline a more balanced set of policy priorities with stronger emphasis on improving the efficiency of energy use.

Energy policy making would benefit from enhanced institutional arrangements and co-ordination of the various objectives with one lead Ministry. Relying on better and more comprehensive underlying data, including greater transparency and information on the quality of service for consumers, would support energy policy planning, assessments including cost-benefit analysis, and monitoring and evaluation with clear benchmarks. Ukraine has made good progress in developing legislation, but the key is to ensure effective implementation. This includes a number of critical elements such as an effective competition regulator to monitor market developments, and greater accountability and controls across government and public companies.

Delivering sector reform

Energy sector structural reform in Ukraine requires time to develop and take hold. This review suggests a broad timeframe along the following lines:

Within three to four years:

- the subsidy burden can be eased and progressively removed as prices are raised to marked-based levels; and
- energy efficiency improvements can take effect as the investment climate improves in response to more market-based price signals (subject to safeguards for the most vulnerable).

Within five to eight years:

- domestic production of unconventional gas and biomass resources can increase substantially, reducing import dependence and enhancing energy security;
- natural gas consumption in the district heating sector can be reduced; and
- improvements in residential and industrial energy efficiency can bring concrete results and lead to job creation and the development of new small and medium size companies.

Within fifteen years:

- Ukraine could be nearly self-sufficient in natural gas; and
- energy market reform can have formed the basis for a vibrant and more diversified energy sector that drives robust and sustainable economic growth.

This review recognises that some of the recommendations require difficult political decisions, such as phasing out fossil-fuel subsides, but handled sensitively and if the public trusts that it will benefit from these reforms in the long term, they can be delivered in a socially acceptable way. Ukraine's well-educated workforce and often dynamic companies could

support the government's drive for this effort and the country's energy market and economy could undoubtedly attract very large private sector and foreign investment due to its huge potential. The development of small- and medium-size companies to carry out energy efficiency improvements will also help the diversification of the Ukrainian economy.

KEY RECOMMENDATIONS

The government of Ukraine should:

- ***Foster consensus building**. Continue its efforts to increase transparency and levels of consultation on proposed strategies, policies and legislation for public, industry and stakeholder comment. Policy development should build consensus and reflect stakeholder comments, and result in a coherent and comprehensive strategy with clear objectives and a timetable for implementation, prior to developing legislation.*
- ***Strengthen the formulation of energy policy within government**. All ministries, agencies, and regulators who have a stake in energy policy should be involved in its formulation. Responsibility for developing the energy strategy, monitoring progress and implementation of all energy policies should be vested in one lead ministry.*
- ***Improve data and statistics collection and use**. Ensure that an accurate energy balance is a cornerstone of the Updated Energy Strategy of Ukraine to 2030 so future trends in energy production, supply and consumption can be developed with clear policies for reaching targets and allow for international comparison.*
- ***Foster energy efficiency**. Strengthen energy efficiency policies to reduce energy use by households, businesses, transport and the public sector. Modernise district heating systems to reduce energy use, ensure heat supply and deliver consumer benefits in terms of reliability and, in the longer term, lower energy bills.*
- ***Enhance energy security**. Improve energy security through increased oil and natural gas production; lower gas consumption in the district heating sector (reducing gas import dependency); upgrade the gas transmission system to improve its efficiency and diversify supplies via interconnections with Central European markets. In addition, make full use of the country's potential for renewable energy development, particularly biogas and municipal waste for heat and power generation.*
- ***Ensure affordability**. There will be economic benefits from the increased exploitation of domestic energy sources and improved tax collection through oil quality controls, widespread and systematic metering and transparency. The progressive introduction of market-based prices should be managed alongside energy efficiency and social programmes to safeguard the most vulnerable households.*
- *Modernise **the energy supply chain**. Encourage and mobilise investments in infrastructure necessary to improve the performance and efficiency of the energy supply chain. This will require an attractive business climate, a competitive and fair regulatory framework and market-price incentives. Strengthening the rule of law and improving transparency as well as implementing the Energy Community Treaty provisions are further conditions.*
- ***Move towards a low carbon future**. Introduce a balanced framework for promoting renewable energy sources (particularly biomass and biogas) and maintain a nuclear electricity capability; attract more carbon investments and take steps to implement the EU Large Combustion Plant Directive.*

2. GENERAL ENERGY POLICY

Key data (2011)

Population: 45.6 million

GDP (current USD): USD 165 billion

GDP per capita: USD 7 200

TPES: 130.5 Mtoe (2010)

Energy import dependency: 39.1% (2010)

COUNTRY OVERVIEW

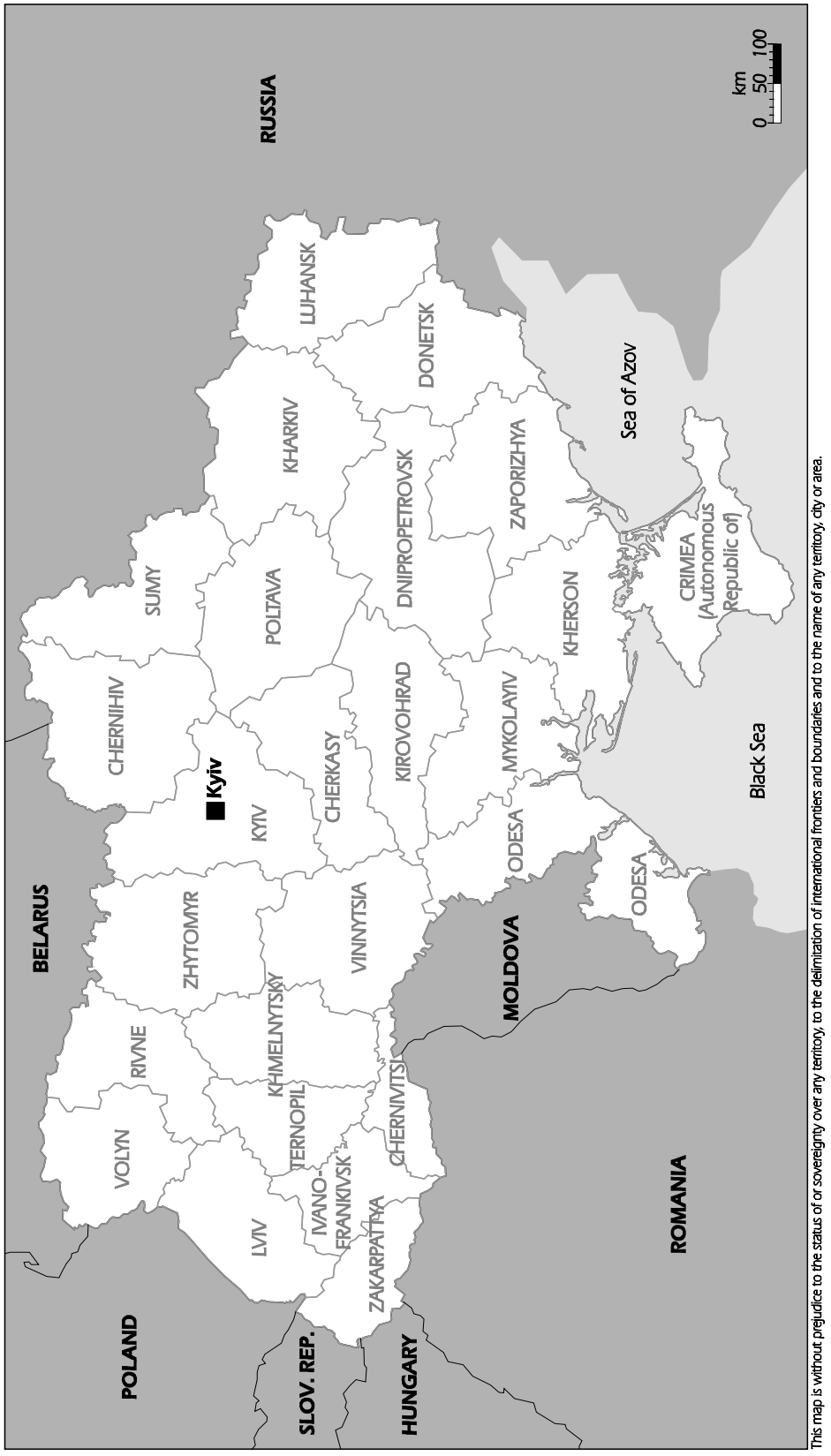
POLITICAL AND ECONOMIC OVERVIEW

Ukraine, with a population of 45.6 million, is the second-largest country in Europe by area. It is strategically located at the crossroads of the European Union, Russian Federation, and Black Sea and Caspian regions (Figure 2.1). Ukraine has access to abundant mineral resources, including energy resources – oil, gas, coal, hydro and biomass – and is a large energy market in its own right. It is an important transit country for natural gas from Russia to European markets. Ukraine has potential to substantially increase its production of natural gas and reduce demand, particularly in the residential sector, to fully meet domestic demand by 2030 and thus entirely cut imports.

Ukraine's political and economic priorities are for its national interest while it tries to maintain good relations with its strategic partners, the Russian Federation and the European Union (EU). For example, a number of agreements have been concluded with Russia such as an extension of Russia's lease of military facilities in Crimea in exchange for reduced gas supply prices (Kharkiv agreements, April 2010) and Ukraine has ruled out NATO membership which Russia had strongly opposed. Ukraine places the integration process with the European Union as a priority and an official strategic goal.[1] Major achievements in that regard include its accession to the Energy Community Treaty in 2011. Ukraine co-operates with the European Union under the Eastern Partnership umbrella which aims to create the conditions to accelerate political association and deepen economic integration between the European Union and the Eastern European partner countries, including Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.

1. Ministry of Foreign Affairs of Ukraine, 2012, Foreign Policy Priorities; *www.mfa.gov.ua/france/fr/35729.htm* (accessed 23 July 2012).

Figure 2.1 **Map of Ukraine**



In terms of regional economic integration, Ukraine is juxtaposed between an EU model and a Russian one. For example, negotiations concerning an EU-led Association Agreement including a Deep and Comprehensive Free Trade Area (DCFTA) were finalised in December 2011 and the Agreement was initialled on 30 March 2012, a step in the complex ratification process. Yet, there have been no signatures or ratifications of that Agreement because of the political situation created by the trials against opposition politicians and members of the former government.[2] At the same time, Russia proposed that Ukraine join the Customs Union it has initiated. On 9 August 2012, President Yanukovych signed law No. 5193-VI on the ratification of a free trade agreement with the Commonwealth of Independent States.

Russia will remain an important influence for Ukraine's energy sector. There will be a continuing need to work with Russian companies because of Ukraine's demand for natural gas imports and its role as a transit country, as well as Russian interests in its oil and nuclear sectors. Russian institutions and banks finance energy sector investments in Ukraine.

Closer collaboration with the European Union offers opportunities for Ukraine including development and integration with EU energy markets. Today, EU programmes and institutions provide finance for investments, assistance to help the government design an effective energy market framework and offer sector budget support measures that are conditioned on commitments to reform. European companies and banks provide technology support and financing for Ukraine's energy and industry sectors. Modernisation of Ukraine's energy sector can benefit from more Russian and European investment; however, this requires clear, predictable and fair market rules and an attractive economic and effective regulatory framework.

In recent years Ukraine has increasingly developed its trade and foreign relations with the United States, Turkey, China as well as other Asian, Middle Eastern and Latin American countries. At a global level, Ukraine joined the World Trade Organization in 2008.

Ukraine's economy is quite depending on exports. Yet as an export-oriented economy it is exposed to regional and global trends. For instance, steel accounts for about 50% of total exports. Other key export products are fertiliser and grain. In addition, the country depends heavily on oil and gas imports. As a consequence, variations in external construction, agriculture and energy supply trends can have a substantial impact on its domestic economy.

Ukraine has been severely affected by global economic and financial crises since 2008: it was hard hit by the drop in steel prices and the loss of confidence in its currency and banking system, which led to a large capital outflow. This created balance of payments difficulties, and fiscal and liquidity crises. As a consequence, Ukraine descended into a deep recession, with industrial output collapsing almost 22% in 2009. The Ukrainian hryvnia (UAH) largely depreciated against the US dollar and real GDP contracted by almost 15% in 2009 following a sharp drop in investments, consumption and production. With the fall in output, the external debt ratio increased and the government budget deficit as a percentage of GDP widened from 3.1% in 2008 to 8.7% in 2009. Given the global recession, funding dried up and external sources of financing became hardly

2. Former Prime Minister and opposition party leader Yulia Tymoshenko has been charged with abuse of office for her role in the 2009 Naftogaz-Gazprom gas agreements which have been denounced as harmful to Ukraine. She was sentenced to a fine, ineligibility and seven years imprisonment in October 2011 after a trial which the European Union and the United States consider did not meet international standards.

available to the banks, leading to significant liquidity problems in the domestic banking system. Households and companies that had benefited from generous US dollar nominated credits that had fuelled consumption and the real estate sector struggled to meet loans payment, further aggravating the banking crisis.[3]

The International Monetary Fund (IMF) offered support to Ukraine and agreed to a USD 16.4 billion Stand-by Arrangement in November 2008 to stabilise the banking system and mitigate the impact of the collapse in output. The package was subject to specific conditions such as reducing the budget deficit, applying a more flexible exchange rate regime and increasing the price of natural gas for households and district heating companies. The IMF disbursed three tranches of funds, but suspended this arrangement when domestic policy reforms stalled and the government did not meet IMF's spending cut demands. In total, about USD 11 billion was released by the IMF under the 2008 arrangement and about USD 3.4 billion under a second Stand-by Arrangement that was agreed in mid-2010. Discussions concerning resumption of the programme took place in 2011 and are ongoing in 2012.

In November 2011, the IMF stressed that sovereign default was avoided and noted the gradual economic recovery, but highlighted that "no major shift in policy making occurred and political economy considerations continue to drive policy making in Ukraine. Efforts to tackle the underlying structural and institutional weaknesses stalled. Bank resolution remained incomplete, the exchange rate regime returned to pre-crisis practices, the energy sector remained largely unreformed with quasi-fiscal deficits widening and legal and governance reform fell short of objectives".[4] In January 2012, the World Bank found that there are "structural weaknesses left unaddressed … Despite export led recovery over the past two years, output is still below pre-crisis levels and the economy remains vulnerable to volatile commodity prices and dependent on foreign financing".[5]

Although the economic situation has since improved – GDP growth was healthy in 2010 and 2011 driven by a recovery in industrial production and abundant grain production – Ukraine has not yet returned to pre-crises levels of output. Obstacles to strong and sustained economic growth remain. GDP forecasts by the IMF and the World Bank are in a range of 2% to 4 % per year for the period 2012-15, down from about 5% in 2010 and 2011.[6] Ukraine's 2012 budget is based on a GDP growth projection of 3.9%. The banking system is still fragile (due to a lack of liquidity and a large amount of risky loans), there are still large capital outflows, and the level of foreign direct investments is low compared with the country's needs and potential. The budget deficit has been reduced by 4.2% in 2011, but there remains considerable scope for further reductions by progressively removing subsidies for household gas tariffs. Ukraine's trade and current account deficits remain very large given high oil and gas import costs.

3. International Monetary Fund (IMF) (2011), *First Review Under the Stand-By Arrangement*, IMF Country Report No. 11/52; *www.imf.org/external/pubs/ft/scr/2011/cr1152.pdf* (accessed 23 July 2012).

4. International Monetary Fund (IMF) (2011), *Ukraine: Ex Post Evaluation of Exceptional Access under the 2008 Stand-By Arrangement*, IMF Country Report No. 11/325, p. 3; *www.imf.org/external/pubs/ft/scr/2011/cr11325.pdf* (accessed 23 July 2012).

5. World Bank (2012), *Country Partnership Strategy 2012-2016 for Ukraine for the Period FY12-FY16*, World Bank, Washington DC., p. 4.

6. IMF World Economic Outlook Database; *www.imf.org/external/pubs/ft/weo/data/changes.htm* (accessed on 12 June 2012). The World Bank (2012). *Ukraine, Economic Update*; *www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/07/20/000333038_20120720014421/Rendered/PDF/712980NEW0Macr00Box370065B00PUBLIC0.pdf* (accessed on 12 August 2012).

SUPPLY

Ukraine's total primary energy supply (TPES) was 130.5 million tonnes of oil equivalent (Mtoe) in 2010 (Table 2.1). This is a 0.9% decline from 2010, and a 7% decrease from 2004. From 1990 to 2010, TPES dropped by 47% primarily due to Ukraine's economic depression during the 1990s and a shift in the economy with a decline in manufacturing and an increase in the service sector in the 2000s, leading to lower energy consumption levels. Over this period, consumption of gas and coal has strongly decreased (figures 2.2 and 2.4).

Ukraine is well-endowed with energy resources, especially coal. It is a major coal producer (ranking thirteenth in the world in 2010). Coal production declined significantly from 1990 to 1996 before and has stabilised since the end of the 2000s. While Ukraine's coal production covers most domestic demand, Ukraine is very dependent on gas and oil imports. Total energy import dependency is 39%.

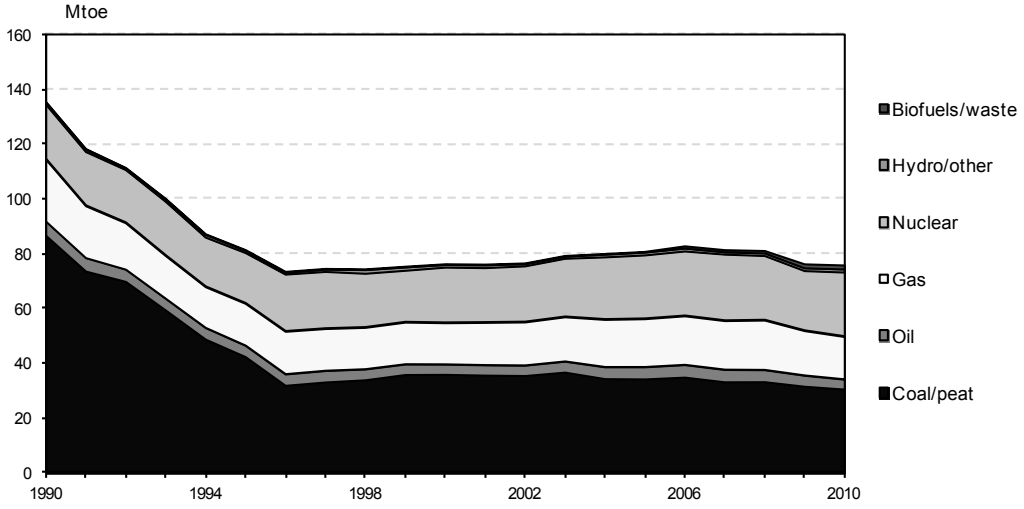
Table 2.1 **Economic and energy indicators, 2000-10**

	Popula-tion (million)	GDP (USD billion, 2005)	Production (Mtoe)			TPES (Mtoe)	TPES/ capita (toe/capita)	CO_2 from fuel combustion (Mt CO_2)
			Oil	Gas	Coal			
2010	45.9	90.6	3.6	15.4	31	130.5	2.84	266.59
% change 2000-10	-6.7	52.1	-3.2	2.9	-14.7	-0.9	6.2	-3.9
% of world in 2010	0.7	0.2	0.1	0.6	0.9	1	-	0.9
World ranking in 2010	31	57	50	30	13	18	44	131

Notes: TPES = primary energy supply including indigenous production and imports, minus exports and transfers between energy commodities; toe = tonne of oil equivalent; MT = million tonnes.

Source: International Energy Agency (IEA) databases.

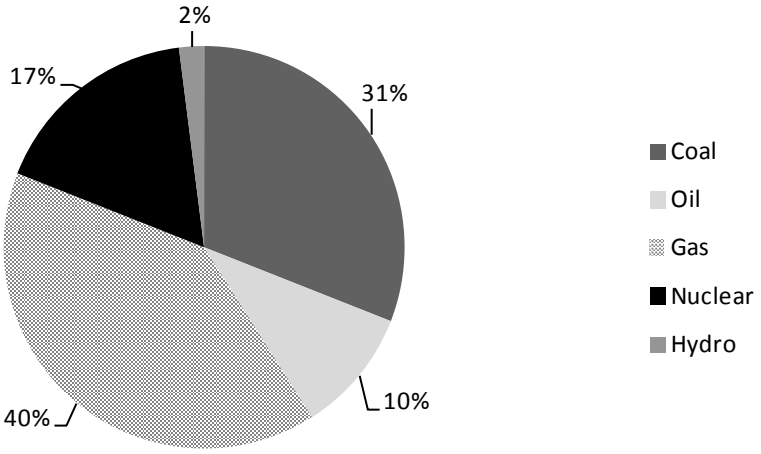
Figure 2.2 **Domestic primary energy production, 1990-2010**



Source: IEA databases.

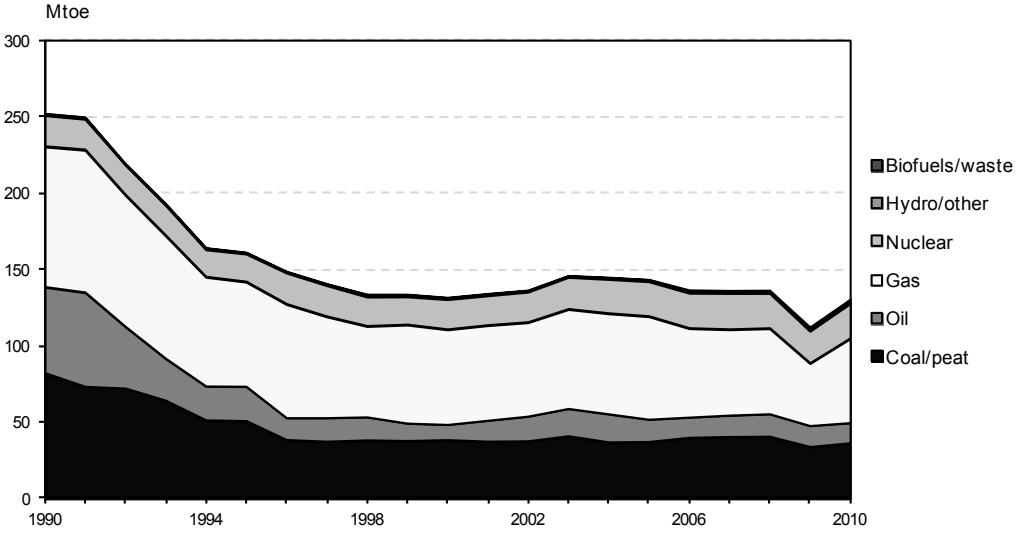
Ukraine's energy mix is dominated by natural gas, which accounted for 40% of TPES in 2010, down from 47% in 2004 (figures 2.3 and 2.4). Coal accounted for 31% in 2010, compared with 23.6% in 2004. Nuclear was 17% of supply in 2010. Hydro contributed 2% to TPES, with only marginal supply amounts from other renewable energy sources. However, as reliable data on heat production from renewable sources is difficult to collect and as official statistics may underestimate real consumption of biomass products, the share of renewable energy in the primary energy mix might be slightly higher.

Figure 2.3 **Primary energy mix, 2010**



Source: Naftogaz.

Figure 2.4 **Total primary energy supply**



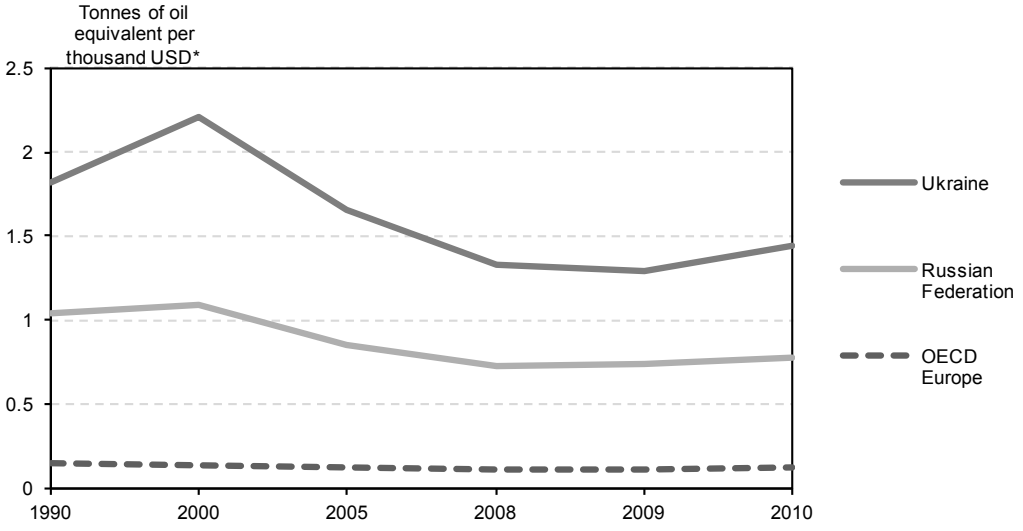
Note: excludes electricity trade.

Source: IEA databases.

Ukraine's economy remains one of the most energy-intensive in the region, despite progress in energy efficiency in the industry sector and closure of some of the most energy intensive industries in the 1990s. Ukraine's energy intensity, *i.e.* the ratio of TPES

to GDP, is ten times more than the OECD average (in purchasing power parity terms – 3.2 times more than the OECD average). While the situation improved notably during the 2000s when GDP growth was 1.5 times higher than energy demand, there has been deterioration in the broad energy intensity indicator in recent years (Figure 2.5). This TPES to GDP ratio may nonetheless be more favourable than indicated if the value of the shadow economy is taken into account. Ministry of Economy estimates for value creation not represented in official data are 34% of Ukraine's GDP in 2012.[7]

Figure 2.5 **Energy intensity indicators in select countries (TPES/GDP)**



* GDP in 2005 US dollars.

Source: IEA (2012), *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris.

INSTITUTIONS

The institutional framework for energy policy has been reorganised in recent years with the Cabinet of Ministers designated as the ultimate decision-making body. The Cabinet of Ministers is the institutional body responsible for policy co-ordination and oversight of state energy companies. Energy policy is high on its political agenda with the parliament and the president also involved in the decision-making process. The main national level institutions with energy policy responsibilities include:

- The Ministry of Energy and Coal Industry is responsible for most energy supply policies and for co-ordinating energy policy across government and providing advice to parliament.
- The Ministry of Ecology and Natural Resources is responsible for licensing and production-sharing agreements for hydrocarbon development and for climate change policy. The co-ordination and implementation of all climate policy-related measures defined by this ministry falls under the responsibility of the State Environmental Investment Agency of Ukraine which also has overall responsibility for implementation of the provisions of the Kyoto Protocol and the UNFCC Convention.

7. Interfax Ukraine, 21 August 2012, "Economy Ministry: Level of Shadow Economy in Ukraine Grows by 0.4% in the first quarter of 2012".

- The Ministry of Finance is responsible for taxation relevant to the energy sector.
- The Ministry of Economy and Trade Development is the lead for energy efficiency policies, but responsibilities for energy efficiency policies are shared among numerous ministries and agencies. The State Agency on Energy Efficiency and Energy Saving has the role of advancing energy efficiency and promoting the deployment of renewable energy sources.
- The Ministry of Regional Development, Construction and Housing of Ukraine develops policy and programmes relevant at local levels.
- The National Commission for State Energy Regulation supervises the natural gas and electricity markets.
- The Anti-Monopoly Committee is responsible to prevent excessive concentration of market power.
- The State Nuclear Regulatory Inspectorate has regulatory responsibility for the operation of nuclear facilities including uranium mining, radioactive waste storage and decommissioning at Chernobyl.

KEY ENERGY POLICY DIRECTIONS

In 2006, the IEA conducted an Energy Policy Review of Ukraine analysing Ukraine's energy sectors and providing recommendations to the government on how to improve domestic energy security and reduce natural gas imports. The review had identified energy efficiency, cost-reflecting pricing and transparency as key priorities to meet the country's challenges.[8] Since then, a number of global and domestic economic and political developments took place that brought new constraints and opportunities for Ukraine's energy policies and changed some structural trends in domestic energy sectors.

Ukraine acceded to the Treaty Establishing the Energy Community in September 2010 and undertook a number of commitments to reform its energy sector (Box 2.1). This includes pledges to align its energy sector with the European Union's internal energy market and the *acquis communautaire* related to energy.

In 2010, the government set out the *Programme of Economic Reforms for 2010-2014* that covers many sectors of the economy.[9] It indicates that the government is well aware of the key security, social and economic challenges stemming from the energy sector and the need to reform, in particular to attract investment and to move to cost recovery tariffs. The programme recognises that Ukraine's energy sector is in poor condition owing to ageing assets, inefficient power generation and transmission, inefficient public companies, lack of financial resources, market opaqueness and inconsistency of regulation, price distortions, subsidies and lack of incentives for energy efficiency investments.

8. IEA, Ukraine Energy Policy Review 2006, OECD/IEA, Paris, available at: *www.iea.org/publications/freepublications/publication/ukraine2006-1.pdf*.

9. Government of Ukraine, *The Programme of Economic Reforms for 2010-2014* "Prosperous Society, Competitive Economy, Effective Government" (*Programa ekonomichnykh reform na 2010-2014 roky* "Zamozhne suspilstvo, konkurentospromozhna ekonomika, efektyvna derzhava"); *www.president.gov.ua/docs/Programa_reform_FINAL_1.pdf*, (accessed 11 March 2012). English translation at: *www.usubc.org/site/files/Ukraine_Program_of_Economic_Reforms_2010-2014.pdf* (accessed 11 March 2012).

Box 2.1 **Ukraine's membership in the Energy Community**[10]

The Treaty Establishing the Energy Community (Energy Community Treaty) entered into force in 2006. It brings together the European Union and Balkans countries with Ukraine and Moldova to foster energy security, stability, development and solidarity through energy market integration, interconnections, harmonisation of rules, norms and policies in line with the European Union, and policy co-ordination.

Ukraine became an observer in the Energy Community Treaty in November 2006. Since then, it has applied for full membership, under which participants commit to implement the *acquis communautaire* on energy, namely the respective legislative frameworks for the electricity and gas sectors and in the areas of renewable energy, competition and environment. Negotiations with the European Union were successfully concluded and Ukraine joined the Energy Community Treaty in October 2009 with the signature of a memorandum. This was followed by an Energy Community Ministerial Council decision on the accession of Ukraine to the Energy Community Treaty in December 2009. This decision outlined the terms and conditions for accession, such as the adoption and enactment of laws for the gas sector that are compliant with EU Directive 2003/55/EC.

Ukraine formally became a member of the Energy Community Treaty in September 2010 with the signature of a protocol that also outlined the timetable for the implementation of the *acquis communautaire*.

Article 2 of the Treaty relates to network energy, which includes the electricity and gas sectors falling within the scope of the European Community Directives 2003/54/EC and 2003/55/EC, and sets the following objectives:

The task of the Energy Community shall be to organise relations between the parties and create a legal and economic framework in relation to network energy, in order to:

(a) Create a stable regulatory and market framework capable of attracting investment in gas networks, power generation, and transmission and distribution networks, so that all parties have access to the stable and continuous energy supply that is essential for economic development and social stability.

(b) Create a single regulatory space for trade in network energy that is necessary to match the geographic extent of the concerned product markets.

(c) Enhance the security of supply of the single regulatory space by providing a stable investment climate in which connections to Caspian, North African and Middle East gas reserves can be developed, and indigenous sources of energy such as natural gas, coal and hydropower can be exploited.

(d) Improve the environmental situation in relation to network energy and related energy efficiency, foster the use of renewable energy, and set out the conditions for energy trade in the single regulatory space.

(e) Develop network energy market competition on a broader geographic scale and exploit economies of scale.

10. Treaty Establishing the Energy Community Treaty; *http://www.energy-community.org/portal/page/portal/ENC_HOME/ENERGY_COMMUNITY/Legal/Treaty*; Protocol Concerning the Accession of Ukraine to the Treaty Establishing the Energy Community, *www.energy community.org/pls/portal/docs/728177.pdf* (accessed 1 March 2012).

Fostering energy efficiency through price signals and improving the competitiveness and reliability of the power sector are the main objectives of the programme in the energy sector. The main approaches to achieve the aims are to update the national energy strategy which has a horizon of 2030, ensure regulatory independence, raise tariffs to be more cost reflective and initiate the phase out of subsidies and provide incentives for energy efficiency improvements by the end of 2012. The *Programme of Economic Reforms for 2010-2014* could have articulated the strong relationship between energy sector reforms with its employment and economic growth goals and focussed more on the urgent need to attract foreign investment, improve transparency, strengthen competition and define priorities, policies and measures to best serve the objectives.

In 2012, the energy strategy is being revised. The draft *Updated Energy Strategy of Ukraine for the Period till 2030* (hereinafter referred to as the draft *Updated Energy Strategy to 2030*) was released for review by relevant institutions and the public in June 2012.[11] This document is a more comprehensive and balanced strategy than its predecessor as it recognises the need for a stronger focus on energy efficiency, more competition and transparency in energy markets and increased consideration of the environmental impacts of energy consumption. It sets out a number of objectives including increased energy security and reliability, energy efficiency improvements and reduced environmental impacts. The strategy to achieve those aims includes: developing an integrated and effective regulatory framework to facilitate more competition, deregulation and more diversity in energy supply sources; increased exploration and development of domestic energy resources; measures to drive energy efficiency; cost reflective pricing; and improved conditions to attract private investment. The draft *Updated Energy Strategy to 2030* commits to regular reviews with updates of the energy forecast and strategy every five years and annual progress reviews to take stock of implementation.

The Ukrainian government has already made important progress in transforming its energy sector. The IEA welcomes these steps and the recommendations in this review aim to build on this important progress. As highlighted in the in-depth review process, these advances include:

- Progress to incorporate and implement Energy Community Treaty provisions into Ukrainian legislation to foster competition in the electricity and natural gas sectors, notably through preparations for the restructuring of Naftogaz and a stronger role for the National Commission for State Energy Regulation.
- Reform of the upstream oil and natural gas regimes where there have been open consultations with interested market participants. Fair tender procedures for conventional and unconventional gas exploration were organised in 2012, which attracted interest from major international oil companies whose technologies and experience are necessary to boost domestic gas production. This marks an important step and opens the way for production-sharing agreements to be signed.
- Increased efforts to reduce gas consumption; preparations to diversify gas supplies via interconnections with European markets and reverse pipeline flows; and pledges to modernise the gas transmission system in co-operation with European Union and international financial institutions (European Investment Bank, European Bank for Reconstruction and Development and the World Bank).

11. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

- Improved regulation of district heating systems that aims to implement a tariff regime which recovers the full cost of production.
- Simplification of the Tax Code in 2010 to support investments in the energy sector.[12] The changes provide for reduction of value-added tax (VAT) and corporate income tax rates.[13]

In other important policy areas, such as the phase out of subsidies in gas and electricity sectors, progress has been slower. The *Programme of Economic Reforms 2010-2014* called for increasing regulated prices. Indeed there was a 50% rise in tariffs for district heating systems and residential consumers in 2010, but no further modifications have been taken despite an approved schedule to do so and increases in gas import prices. Generous feed-in tariffs for solar and wind energy generation and an obligation for state companies to connect new units to the grid have given a boost to Ukraine's renewable energy developments, but raised concerns about the cost-effectiveness of such measures.

CRITIQUE

Ukraine needs a transformation of its energy sector to a more efficient, secure and sustainable energy system. While a number of initiatives are underway, further steps for reform are needed. It is crucial to deepen and streamline the reform programme and to address all of the challenges with equal determination. Concerted efforts are needed to strengthen two complementary pillars: boost domestic energy production; and enhance efforts on the demand side to achieve energy efficiency gains and phase out subsidies. The transition should be based on a comprehensive strategy that includes exploration and production of indigenous energy resources, modernisation of infrastructure, augmented approaches to improve energy efficiency, prompt progress on effective market reform (including the reduction of state subsidies and a shift to marked-based prices) and good governance. A more expedited transformation of its energy sector is possible and can deliver large-scale benefits to the Ukrainian people.

ENERGY SECTOR MODERNISATION AND INVESTMENT REQUIREMENTS

Ukraine's energy sector is in need of large and continued investments to ensure its modernisation, sustainability, security, self-sufficiency and competitiveness. The scale of investment required is on the order of UAH 1 700 billion in the period to 2030. In the upstream, investment is needed to realise oil and gas potential. Natural gas transmission and distribution infrastructure, as well as storage and gas-fired units for district heating systems and heat transmission infrastructure, need capital investment. The coal sector requires considerable investment. In the power sector, investment is needed to refurbish,

12. *www.zakon2.rada.gov.ua/laws/show/2755-17* (accessed 21 August 2012).

13. VAT rates are 20% from 1 January 2011 to 31 December 2013 and will decline to 17% from 1 January 2014.
Corporate income tax rates in 2011 were 25%. From 1 January to 31 December 2012, they are 21%. From 1 January to 31 December 2013, corporate income tax rates will decline to 19%; and from 1 January 2014, the rate will be 16%.
Since August 2011, the code exempts from taxation actual expenses that do not exceed the total annual amount of:
expenditures included in investment programmes approved by the regulatory authority for capital investments in electricity and natural gas cross-border, main and distribution networks, including the installation of residential gas meters and loan repayments; and
expenditures stipulated by projects financed by monopoly entities, heat and/or electricity producers in compliance with decisions taken by the Cabinet of Ministers.

replace and develop generation units and networks, and to foster renewable energy generation, especially from biomass and waste. Investment is also required to reduce energy consumption by households. Modernising Ukraine's district heating systems and poorly insulated building stock will require both public and private funding.

To reduce its import dependency, more oil and gas exploration tenders and successful production-sharing agreements will be needed to turn Ukraine into a vibrant place for upstream production. Ukraine should focus in particular on shale gas and coalbed methane, but also on the country's large biomass potential which is largely untapped and could prove competitive when compared with market prices for gas in applications such as heat generation, provided that these areas are attractive for investments and that technologies are available. Managing municipal waste is a challenge in Ukraine and this offers opportunities to be used for fuel in heat and power generation. Moreover, Ukraine should join the Extractive Industries Transparency Initiative to foster revenue transparency and investor confidence.

Having the largest gas transit infrastructure in the world and transiting about 100 billion cubic metres per year of Russian gas to European markets, Ukraine plays an important role for European energy security and in turn benefits from substantial transit revenues. In order to maintain its gas transit role and related revenues, Ukraine will have to attract funding for the modernisation and optimisation of the gas transmission system. Indeed, Ukraine's gas transit position is a key pillar of its energy security policy and that of the European Union.

Ukraine's electricity infrastructure is ageing and deteriorating: many power plants are working far beyond their technical life and at low efficiency levels. Furthermore, limiting emissions of air pollutants from large combustion plants as required under the Energy Community Treaty will require investments estimated at USD 10 billion to USD 12 billion. Conforming to these requirements provides an opportunity to reduce harmful air pollution and improve plant efficiency. The Ministry of Energy and Coal Industry needs to carry out careful analysis of the costs of investment to install pollution control technology versus the cost of building new power plants that will provide greater efficiency.

The draft *Updated Energy Strategy to 2030* sets out the scale of the investment challenge in broad terms for the energy sector. It estimates that over the period 2012-30 Ukraine needs to invest UAH 1 700 billion (in year 2010 prices), at a rate of about UAH 90 billion per year. This amount is split among the energy sectors: electricity and heat UAH 720 billion; oil and gas UAH 510 billion; nuclear power UAH 390 billion; and coal UAH 80 billion. Clearly this amount represents a huge financial challenge that will require foreign and private investment as well as a strategic reallocation of budget support measures.

ENERGY SECTOR REFORM

A number of conditions must be in place to attract the investments required for the successful transformation of Ukraine's energy sector. First, is regulatory reform that provides independent and effective regulation and full implementation of Energy Community Treaty provisions, such as fair third-party access to energy networks. A stable regulatory and policy framework, which supports competition in energy markets, and provides accountability and predictability, is decisive for attracting investments and ensuring that Ukraine's energy consumers will benefit from efficient, competitive and secure energy supplies. These will help to improve energy security and provide greater stability for Ukraine and its neighbours. Not only does Ukraine need to ensure that the

appropriate legislation is in place or prepared in consultation with the Secretariat of the Energy Community – progress has been made in recent years in that regard – but also to ensure that legislation is properly implemented.

It is also of utmost importance that the independence of the regulatory authority, NERC, and the competition monitor, Anti-Monopoly Committee, is ensured. It is essential that these bodies have sufficient resources to effectively manage their increasingly complex duties and responsibilities.

Another strategic priority should be the progressive and predictable removal of subsidies for gas, coal and electricity and reallocation of budget resources towards energy efficiency support measures. Although this may be perceived as socially difficult, it can deliver manifold benefits. These include improving public finances and redirecting resources to support energy efficiency: provide price signals to industrial and residential customers to modernise equipment and practices and to invest in efficiency improvements; and improve the financial situation of public companies that are burdened with the high costs of subsidies. Efforts to reform energy subsidies need to be accompanied with targeted support programmes to protect vulnerable communities from the full impact of higher energy prices and in parallel to create a strong policy framework to support energy efficiency improvements.

Ukraine also needs to dramatically improve its business climate to underpin energy reforms. In international comparisons, Ukraine performs poorly. The World Bank's 2011 Doing Business Report puts Ukraine at the bottom among countries in the region and ranks it 145th out of 183 countries.[14] Transparency International's 2011 Corruption Perception Index that gives 10 points for the most desirable situation awards only 2.3 points to Ukraine.[15]

Against this backdrop, actions needed to improve the business climate include:

- clearly specify the conditions for foreign participation in energy infrastructure investment;
- ensure that legislation related to public procurement meets European standards and fully covers the energy sector;
- observe the guiding principles of non-discrimination, proportionality, transparency, accountability and predictability;
- improve transparency, take effective measures against corruption, strengthen the rule of law, ensure independence of regulatory and law enforcement organisations;
- foster public-private consultations on business-related legislation and regulations with the business community, including foreign investors;
- ensure further development of an effective banking system able to provide local currency funding at affordable rates for long-term investment projects, which includes banking regulations, hedges and corporate governance issues; and
- monitor monopolistic tendencies in markets and foster competition.

Making greater use of carbon finance opportunities is another important policy direction. In the context of the United Nations Framework Convention on Climate Change (UNFCCC), Ukraine pledged to keep its greenhouse-gas emissions (GHG) 20% below 1990 levels and declared a long-term goal of a 50% reduction by 2050 from 1990 levels. While reaching the near-term target appears likely, projected growth across emissions-intensive economic

14. *www.doingbusiness.org/data/exploreeconomies/ukraine* (accessed 13 July 2012).

15. *www.cpi.transparency.org/cpi2011/results* (accessed 15 July 2012).

sectors would shift the GHG emissions pathway upwards. Ukraine has participated in the UNFCCC flexibility mechanisms and as a result has attracted significant foreign investment especially in demand-side energy efficiency. Yet as Ukraine's energy and carbon intensity per unit of GDP are still among the highest in Europe, there is significant potential yet to be realised and further reduce emissions if Ukraine implements many of the measures suggested in this review and makes greater use of Kyoto mechanisms to attract investments. Due consideration should be given to a domestic emissions trading system with links to the EU Emission Trading System.

CO-ORDINATION OF ENERGY EFFICIENCY POLICY

Responsibility for energy efficiency policy is vested in numerous government ministries and agencies. This makes coherent and consistent energy efficiency policy formulation and implementation difficult. The government needs to strengthen the capacities of the lead ministry on energy efficiency to enable it to more effectively co-ordinate with the other relevant bodies. This is indispensable in order to quickly and effectively realise Ukraine's large energy efficiency potential and benefit from related opportunities to foster economic growth and employment. The government should take measures to ensure strong political leadership and co-ordination of energy efficiency policy at central government and local levels, including municipalities.

MORE CENTRAL ROLE FOR ENERGY EFFICIENCY

The draft *Updated Energy Strategy to 2030* is an important document to guide energy policy formulation in the coming years. It would benefit from giving energy efficiency a more central role as there is substantial scope to reduce demand in all sectors. This potential should be thoroughly assessed in order to identify its contribution to the lowest energy supply profile over time. The strategy should take a comprehensive approach to supply and demand-side policies for each sector and provide more details about the measures that will deliver demand reductions and how overall demand can be met in the most secure and efficient manner in the next two decades.

Given Ukraine's important financial constraints and the urgency to make progress, the draft strategy – and energy policies – should focus more on improving energy efficiency in buildings and in district heating systems through regulatory approaches and financial incentives. Building codes should be strengthened, their coverage enhanced and enforcement assured. Tighter energy efficiency standards for appliances should be put in place. Homeowner associations should be facilitated and empowered to secure energy efficiency investments and install energy consumption meters with the support of public or private banks. Energy management systems and techniques should be more widely employed in energy-intensive industry. Energy audits for small and medium-size enterprises can help them to identify and implement energy efficiency improvements. Building from the experience of other transition economies and specialised donor organisations, more effort is needed to develop technical capacities and to amplify public awareness campaigns to stimulate energy efficiency gains.

BUILDING BLOCKS FOR MORE EFFECTIVE POLICY

Any energy strategy needs to be based on good quality data that measure past trends in energy supply and demand. This needs to cover the whole of the energy sector and will take time to develop and refine, particularly on the demand side. There are a number of

steps that need to be taken that range from improvements to the quality of basic supply and demand statistics to developing data systems that can monitor the impact of policy measures and formulating models for energy projections, particularly to evaluate the impact higher natural gas prices on demand in the residential sector. These are essential tools to assess policy options and what impact they may have on energy supply and demand.

Energy balances provide a foundation for medium and long-term energy projections and scenarios, which can assist governments in making and evaluating policy decisions. Ukrstat, the state agency responsible for statistics, with the assistance of the IEA, has been working to establish an energy balance for Ukraine for 2010, (due to be published by end 2012). Ukrstat has committed to produce timely energy balances in future years. The government should adopt international standards for constructing energy balances and the definition of sectors to enable international comparisons. An accurate energy balance is a cornerstone for assessing historic trends in energy production, supply and consumption and using that data as a basis upon which to build projections for coming years. Such building blocks can support government actions to more effectively develop clear policies for achieving targets and then monitor progress towards meeting those targets.

It is positive that the government initiated early informal consultation with experts as it developed the draft *Updated Energy Strategy to 2030* and in mid-2012 is undergoing a period of public consultation. This is important and the government should continue to ensure a more open and transparent consultation process to enable all stakeholders, including industry, business, non-governmental organisations and the public to have the opportunity for meaningful input to the strategy and policy developments as well with the annual assessment of implementation process.

Once a strategy and policy framework have been agreed, the government should commit to publish an annual progress report. Its coverage should be across the relevant government ministries and agencies. The report would set out the latest figures on energy supply and demand trends, monitor progress on implementation and highlight areas that needed additional attention.

The section below offers an overview of all the policy recommendations for every energy sector analysed in the different chapters of this review.

3. ENERGY EFFICIENCY

Key data (2010)

TPES per GDP: Ukraine uses around 3.2 times more energy per unit of GDP (PPP) than the average in OECD countries

Energy saving potential: 27 Mtoe per year (about one quarter of TPES)

Key sectors: industry and buildings: 75% of buildings were built before 1970, with 70% of them in need of full modernisation

OVERVIEW

Ukraine is one of the most energy-intensive countries in the world largely because of its high concentration of energy-intensive sectors, inefficient industrial processes and old equipment, inefficient district heating systems and poor quality building stock. Ukraine's ratio of total primary energy supply (TPES) to gross domestic product (GDP) is ten times more than the OECD average. Calculated in purchasing power parity (PPP) terms, Ukraine uses around 3.2 times more energy per unit of GDP than the average in OECD countries.[1] Energy imports cover almost half of Ukraine's energy consumption. If Ukraine were to increase energy efficiency to the European Union (EU) average level, annual energy savings would be about 27 million tonnes of oil equivalent (Mtoe), or about 34 billion cubic metres (bcm) of natural gas.[2] For a country highly dependent on fuel imports, energy efficiency should be a cornerstone of energy security and a strategic priority. The challenge facing Ukraine's policy makers lies in creating the framework conditions to ensure that investments in housing, commercial and public buildings and industry are channelled to energy efficient technologies and systems.

Ukraine has declared strong commitments to work towards increased energy efficiency and energy savings. Accelerating the rate of energy savings is increasingly seen as essential to ensure energy security. Improving energy efficiency will also contribute to climate change mitigation by reducing greenhouse-gas (GHG) emissions. Furthermore, energy efficiency improvements are essential to ensure industrial competitiveness, which is of particular importance for a country where more than 40% of GDP relies on exports.

Despite numerous strategies, action plans, programmes and an extensive body of legislation, progress in improving energy efficiency has been limited. There are two underlying reasons: Ukrainian energy policy is very focused on supply-side issues and insufficient priority is placed on energy efficiency; and the country lacks effective governance in the energy efficiency area. In this context, energy efficiency governance is the combination of legislative frameworks and funding mechanisms, institutional arrangements

1. Organisation for Economic Co-operation and Development (OECD) (2011), *Investment Policy Reviews: Ukraine 2011,* OECD, Paris.

2. Radeke, M. and Naumenko, D. (2012), *Towards Higher Energy Efficiency in Ukraine: Reducing Regulation and Promoting Energy Efficiency Improvements*, German Advisory Group, Institute for Economic Research and Policy Consulting, Policy Paper Series (PP/01/2012), Kyiv/Berlin.

and co-ordination mechanisms, which work together to support the implementation of energy efficiency strategies, policies and programmes. The government should remove obstacles such as a complex and contradictory legal framework and weak price signals due to energy subsidies.

ENERGY EFFICIENCY POTENTIAL

There are numerous estimates of energy efficiency potential in Ukraine. However, disaggregated energy end-use statistics are not yet available, which makes it difficult to make reliable projections. The draft *Updated Energy Strategy to 2030* proposes a reduction of energy intensity of 30% to 35% by 2030 and foresees an increase in energy consumption.

ENERGY EFFICIENCY INSTITUTIONS AND ORGANISATIONS

Shifting organisational responsibilities, a large number of stakeholders and unclear distribution of responsibilities, hinder transparency and co-ordination of policies and programmes to advance energy efficiency in Ukraine. The institutional framework for energy efficiency has undergone a number of changes. The National Agency of Ukraine on Ensuring of Efficient Use of Energy Resources (NAER) established in 2006 was replaced by the State Agency on Energy Efficiency and Energy Saving (SAEE) in April 2011. SAEE is tasked with the dual role of promoting energy efficiency and renewable energy deployment. The responsibility for energy efficiency was moved from the Cabinet of Ministers to the Ministry of Economy and Trade, which must approve draft legislation developed by SAEE. Due to the reorganisation, there was a standstill of much of the energy efficiency work. Currently an evaluation of government institutions is underway and it is possible that the set-up of the agency responsible for energy efficiency will again be subject to change.

In 2010, the Interagency Commission on Energy Development was formed. Among other objectives, the Commission is tasked to organise work to improve the ratios of the national energy balance and establish positive economic conditions for attracting both domestic and foreign investors to the energy sector.

Each relevant ministry also has its own energy efficiency programme and local authorities are developing regional energy efficiency programmes. Co-ordination related to energy efficiency is mainly on an ad hoc basis: no formalised structure for on-going co-ordination and information sharing has been established.

Some non-governmental organisations and several research and educational institutes are active in energy efficiency. These organisations have played a large role in promoting energy efficiency and contributing to awareness-raising. There are numerous international and bi-lateral programmes for promoting energy efficiency in Ukraine, ranging from awareness campaigns and subsidised loans to large-scale investments and retrofits. Stakeholder consultations in energy efficiency policy and strategy developments could be held more frequently.

POLICY FRAMEWORK

In 2006, Ukraine set out its *Energy Strategy to 2030* (2006) to provide an all-encompassing overview of the energy sector and a comprehensive strategy for its development in the years to come. The strategy called for achieving a 50% reduction in energy intensity compared with 2005 by 2030. The efficiency gains were anticipated to derive

from structural shifts in the economy – moves away from heavy industry and towards the tertiary sector – and significant technological improvements. The 2006 strategy put strong emphasis on supply measures. It did not spell out detailed, specific and concrete actions including demand-side measures, financing and regulatory changes needed to meet its stated objectives, thus making it difficult to assess its progress towards the target.

A Cabinet resolution in 2008 required the relevant ministries to elaborate sectoral energy efficiency programmes for the period 2010-14.[3] Targets were set to reduce both the country's energy intensity (TPES per unit of GDP basis) and energy consumption in the public sector by 20% by 2014 from 2009 levels. Subsequently, sectoral programmes have been developed, including for industry, construction, housing, municipalities, education, transport and agriculture.

The *State Target Economic Programme on Energy Efficiency and Energy Savings of Ukraine for 2010-2015* was approved by the Cabinet in 2010. This programme describes priorities and determines measures for improving energy efficiency. In April 2011, it was expanded and renamed The *National Targeted Economic Programme on Energy Efficiency and Development of the Sphere of Energy Production from Renewable Energy Sources and Alternative Fuels for 2010-2015*. This programme contains a five-year investment programme with total expenditures of about USD 43 billion. In order to deliver this initiative, 15 sector branch energy efficiency programmes, 27 regional energy efficiency programmes and 56 programmes for energy efficiency in public institutions were developed which include regular assessment mechanisms.

The projected results by 2015, from 2008 levels, include:

- 20% decrease in the energy intensity ratio;
- 20% reduction in natural gas consumption;
- 20% reduction of the energy intensity of gas transportation, storage, and distribution;
- 15% to 20% reduction of harmful emissions; and
- 50% decrease in the national budget expenditures for energy supply to public organisations (such as schools, hospitals).

A National Energy Efficiency Action Plan (NEEAP) was released in line with Energy Community commitments in mid-2012. The NEEAP is designed to identify energy efficiency investments, barriers to implementation and agencies responsible for implementation. As well, a separate NEEAP for the buildings sector is being drafted.

It is not clear if the 2010 programme will be reassessed in light of the NEEAP and the draft *Updated Energy Strategy to 2030* (2012).[4] The national programme, the draft strategy and the draft action plan each include different targets.

At present, there is a large body of law, some 200, related to energy issues in Ukraine. These include, *inter alia*, the tax code, laws on energy, alternative fuels, combined heat and power and waste energy. Some streamlining efforts are underway. A law on energy efficiency is being drafted, but it is not clear how long it will take to be effective.

Ukraine has state rules, regulations and standards in the field of efficient use of energy resources, energy conservation and renewable energy. In these areas, there are about

3. Cabinet Resolution on the Energy Efficiency Increase and Energy Resource Consumption Reduction Programmes, December 2008.

4. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

50 national standards, including on energy efficiency issues such as method definition, construction and analysis of energy balances, regulation of specific consumption and loss of fuel, energy labelling of household electrical equipment, energy auditing and management, and energy performance standards for certain types of equipment. These standards successively will have to be aligned with EU standards in accordance with the Energy Community Treaty.

ALIGNMENT WITH EUROPEAN UNION EFFICIENCY POLICIES

In September 2010, Ukraine signed the Energy Community Accession Protocol. It signals Ukraine's political will to align the principles of its energy policy with that of the European Union and to achieve a reduction of energy demand of 9% by 2020. To fulfil its commitments under the protocol, the SAEE developed a draft plan to implement some of the EU directives on energy efficiency. These include:

- the Energy End-use Efficiency and Energy Services Directive (2006/32/EC) (transposition deadline 31 December 2011);
- the Energy Performance of Buildings Directive (2010/31/EC) (transposition deadline 30 September 2012); and
- the Labelling and Standard Product Information on the Consumption of Energy and Other Resources by Energy-related Products Directive (2010/30/EC) (transposition deadline 31 December 2012).

While deadlines have been missed, some transposition work is underway and some crucial tasks remain: the Law on Energy Conservation of 1994 needs to be updated to reflect the changing energy policy objectives, the Energy Labelling Regulation of 2010 requires amendments and the draft Law on Efficient Utilisation of Fuel and Energy Resources of 2010 has yet to be adopted. Ukraine submitted a final draft national plan to the Energy Community secretariat in mid-2012. According to the SAEE, there are also plans to align policies with the European Ecodesign Directive, but the timeframe has not yet been established.

FINANCING

Energy efficiency improvements will require significant investment across all sectors. The *2010 Energy Efficiency Programme for 2010-2015* foresees investment needs of USD 43 billion for the five-year period.[5] It is estimated that the state budget will only be able to cover a very little amount of these energy investments; other sources of financing are needed. In 2012, UAH 502 million (USD 63 million)[6] were allocated in the state budget for energy efficiency measures. Private investment, both domestic and foreign, or in the form of private-public partnership arrangements, is thus essential.[7]

5. Annex 3 with changes introduced according to the Resolution of the Cabinet of Ministers (No.587) July 2010; amended by the Resolution of the Cabinet of Ministers (No. 477) April 2011 and Resolution (No. 105) January 2012.

6 For currency conversion rates used in this review, refer to the currency conversion table in Annex D.

7. OECD (2011), *Investment Policy Reviews: Ukraine 2011*, OECD, Paris.

Box 3.1 **Examples of international financing organisation activities**

The Eastern European Energy Efficiency and Environment Partnership (E5P) is a EUR 90 million multi-donor fund that was initiated in 2009 and is managed by the European Bank for Reconstruction and Development (EBRD). The European Union has pledged EUR 40 million to the E5P fund. The partnership promotes investments in energy efficiency through grants that can be combined with loans from international financing institutions. Initial priority is given to district heating projects.

Ukraine Energy Efficiency Programme (UKEEP) is a credit facility developed by the EBRD for energy efficiency projects. The credit facility and associated technical assistance is accessible to small- and medium-size companies in all sectors. The first phase of UKEEP was completed in 2011 with projects financed for a total loan amount of more than USD 100 million.

The Nordic Environment Finance Corporation (NEFCO) has provided EUR 19 million since 2003 for 29 projects valued at EUR 55 million. The projects have mainly been in the energy, agriculture, industry and banking sectors. The projects have included technical measures to reduce energy consumption and emissions of carbon dioxide or other GHGs.

In 2008, the Nordic Investment Bank (NIB) and the State Export-Import Bank of Ukraine (UkrEximBank) signed a USD 50 million eight-year loan facility. The loan facility is for financing energy efficiency projects and promoting emission reductions.

In 2011, the World Bank, through its Ukraine Energy Efficiency Project, provided a USD 200 million financial intermediary loan to UkrEximBank. The loan will finance investments in energy saving measures in industrial companies, municipalities and municipally owned enterprises and energy service companies. In addition, UkrEximBank will lend the funds to other banks to create a financial market for energy efficiency projects.

In February 2012, the EBRD provided a USD 50 million five-year loan to UkrEximBank to support lending to small businesses across the country. Eligible small- and medium-size enterprises will be able to receive loans from UkrEximBank of up to USD 3 million to implement energy efficiency projects.

In May 2012, the Global Climate Partnership Fund disbursed USD 30 million to the UkrEximBank under a seven-year senior unsecured loan facility. The funding will be used to finance investments in energy efficiency measures as well as renewable energy production. Projects to be financed cover a broad range and include investments in building insulation, lighting system modernisation or efficiency improvements of ventilation and heating systems. While targeting small and medium enterprises, improvements in production facilities of larger corporations can also be covered.

The International Finance Corporation (IFC) is working with Ukrainian banks to develop and market financially viable energy-efficient housing loan products targeted at homeowner associations and housing management companies for renovations of multi-family buildings.

In 2011, the Cabinet of Ministers approved support for energy efficiency measures through tax deductions for expenses related to energy efficiency projects, particularly those associated with lower natural gas consumption. In accordance with the tax code, vendors who sell energy efficient equipment, materials and products can qualify for a tax exemption of 80% of the profits derived from their sale. The tax code also provides for a

tax exemption of 50% of revenue related to energy efficiency measures implemented by enterprises, institutions and organisations. Entities that want to get the tax exemptions must officially register with the state, a procedure that is slow and cumbersome, and has deterred some enterprises from taking advantage of the benefits.

The tax code also exempts imported products such as energy saving equipment and materials, measuring and control devices from import duties and value-added tax (VAT). The Law on Energy Conservation makes provision for the introduction of accelerated depreciation on certain types of energy saving equipment. There is a current proposal to include specified energy efficiency equipment in the asset category with a depreciation rate of 15%, but the necessary secondary legislation has yet to be implemented.

The activity of local banks in terms of energy efficiency finance is limited. Currently banks focus on short-term loans. The majority of commercial loans are for working capital purposes with maturities of up to one year, whereas energy efficiency financing may need longer term and lower cost financing. There are ongoing projects that are contributing to building local capacity for energy efficiency financing. Access to finance is hindered by lack of capacity to develop bankable energy efficiency projects in municipalities and companies.

There is considerable donor support for the implementation of energy efficiency measures in Ukraine. In 2012, it is estimated that UAH 324.8 million (approximately EUR 31 million or USD 40.5 million) of European Union budget support is earmarked for energy efficiency projects in the Ukraine.[8] A number of international financing organisations such as the European Bank for Reconstruction and Development (EBRD), the World Bank and Global Climate Partnership Fund are active in the Ukraine (Box 3.1).

DATA, MONITORING AND ENFORCEMENT

Much of the ongoing energy efficiency work is constrained by a significant lack of data. Reliable data is of particular importance when calculating potential efficiency gains, setting targets and evaluating effectiveness. Effective energy efficiency policy implementation requires robust systems for monitoring, verification and enforcement, as well as clear measures for dealing with non-compliance. While numerous targets are in place, lack of data on energy savings achieved is a clear indication that greater attention should be paid to the collection and analysis of end-use energy data at sufficient levels of disaggregation.

POLICIES AND MEASURES

While progress in energy efficiency policies and measures has been made in recent years, a co-ordinated policy framework with a portfolio of programmes has yet to be established. This is required if Ukraine is to realise its energy efficiency potential and ensure that the huge investments foreseen in the 2010 *Energy Efficiency Programme for 2010-2015* materialise. An effective and balanced policy framework would include a move towards market-based prices, regulatory and control mechanisms, fiscal measures and tax incentives, technology development and financial schemes.

The IEA has developed 25 key energy efficiency recommendations for its member countries and non-member countries. These recommendations could further guide Ukraine's energy efficiency policies (Box 3.2).

8. State Agency on Energy Efficiency and Energy Savings, *www.saee.gov.ua/en/archives/4275* (accessed 24 March 2012).

Box 3.2 **IEA 25 energy efficiency policy recommendations**

To support governments with their implementation of energy efficiency, the IEA recommended the adoption of specific energy efficiency policy measures to the G8 summits in 2006, 2007 and 2008. The consolidated set of recommendations covers 25 fields of action across seven priority areas for which the IEA recommends action on:

***Cross-sectoral*:**

- data collection and indicators;
- strategies and action plans;
- competitive energy markets, with appropriate regulation;
- private investment in energy efficiency; and
- monitoring, enforcement and evaluation.

Buildings, which account for about 40% of energy used in most countries:

- mandatory buildings codes and minimum energy performance requirements;
- net-zero energy consumption in buildings;
- improved energy efficiency in existing buildings;
- building energy labels or certificates; and
- energy performance of building components and systems.

Appliances and equipment, which are one of the fastest growing energy loads in many countries:

- mandatory minimum energy performance standards and labels;
- test standards and measurement protocols; and
- market transformation policies.

***Lighting technology*:**

- phase-out of inefficient lighting products; and
- energy-efficient lighting systems.

***Transport*:**

- mandatory vehicle fuel-efficiency standards;
- measures to improve vehicle fuel efficiency;
- fuel-efficiency non-engine components; and
- transport system efficiency.

***Industry*:**

- energy management;
- high-efficiency industrial equipment and systems;
- energy efficiency services for small- and medium-size enterprises; and
- complementary policies to support industrial energy efficiency.

Box 3.2 IEA 25 energy efficiency policy recommendations (continued)

***Energy utilities*:**

- utility end-use energy efficiency schemes.

Implementation of IEA energy efficiency recommendations can lead to huge cost-effective energy and CO_2 savings. The IEA estimates that, if implemented globally without delay, the proposed actions could save around 7.6 Gt CO_2 per year by 2030. This is equivalent to 17% of annual worldwide energy consumption in 2010. Taken together, these measures set out an ambitious road-map for improving energy efficiency on a global scale.

BUILDINGS

Ukraine has 600 000 buildings, including 17.5 million households (with an average of 2.6 people), out of which 10 million live in about 232 000 housing blocks. About 36% of these (82 500 housing blocks) have more than five levels and are almost entirely located in cities. About 93% of the residential housing stock is in private ownership.

A large proportion of Ukraine's building stock requires renovation. Almost three-quarters of the stock was built before 1970 of which 70% is in need of complete modernisation. Construction of new apartments and houses over the last decade reached 8 million square metres (m^2) a year on average (up from just over 5 million m^2 in 2000). Construction has slowed due to the economic crisis.[9]

In 2009, the residential buildings consumed about 25% of the country's electricity and 40% of its heat production, accounting for about 34% of total final energy consumption (22.1 kilotonnes of oil equivalent).[10] Space heat and hot water account for about two-thirds to three-quarters of total residential energy consumption. About 7.5 million households are connected to central district heating systems. Energy consumption in buildings is estimated to be in the range of the equivalent of 250 kilowatt hours per square metre (kWh/m^2) to 275 kWh/m^2.[11] The scope for energy savings in existing buildings varies. It is estimated that energy efficiency measures in the residential sector could reduce heating demand by 30% to 40% and reduce gas consumption by 25% to 30%.[12]

A sectoral programme of energy efficiency and energy conservation in housing for 2010-14 was set out by the Ministry of Regional Development, Construction and Housing and Communal Services. It has led to the implementation of some measures. For example, Ukraine has had a mandatory building energy code for new buildings since 2007.[13] However, as with all building codes in the Ukraine, compliance remains a problem.

9. Worley Parsons (2011), *Market Assessment – Residential Sector of Ukraine: Legal, Regulatory, Institutional, Technical and Financial Considerations,* prepared for the European Bank of Reconstruction and Development, Reading, United States.

10. International Energy Agency (IEA) databases, Energy Balance for Ukraine – 2009.

11. World Bank (2012), *Modernization of the District Heating Systems in Ukraine: Heat Metering and Consumption-Based Billing*, Report No. 64989-UA, Sustainable Development Department Europe and Central Asia Region, World Bank, Washington, DC.

12. International Finance Corporation, Ukraine Residential Energy Efficiency Project*, www.inogate-ee.org/sites/default/files/news/Leaflet_EN.pdf* (accessed 26 March 2012).

13. Ukrainian building code (2006), Thermal Protection of Buildings, DBN V.2.6-31:2006, *http://energycodesocean.org/sites/default/files/%20é%202.6-31-2006.pdf* (accessed 12 September 2012).

A plan to install metering and regulating devices in all buildings by 2007 has not been achieved. Today only 20% of buildings have modern building-level heat meters. The process for installing meters is relatively complex and entails numerous permits and processes, which may act as a deterrent. New initiatives for metering and regulation devices are underway and associated regulations are being drafted. It is expected that progress in this area will be made by the end of 2012. Radiator distributors and thermostatic regulators are rarely used.

Residential heat tariffs are low. They are calculated on the basis of apartment size rather than actual consumption. The lack of opportunities for homeowners to regulate heating and no price signals means that consumers have little incentive to conserve energy or to invest in energy efficiency measures.

Ukraine is working towards the transposition of the EU Energy Performance of Buildings Directive. In May 2012, a proposed law on energy efficiency performance labels for new buildings and those to be refurbished or leased passed its first legislative reading. It would set minimum energy performance requirements by providing calculated or actual energy efficiency indices of buildings; recommendations for energy efficiency improvements that take into account local climatic conditions; and technical and economic feasibility. Implementation of such a regulation would require a system for training and certifying auditors, as well a system for monitoring and verification.

Public sector buildings (larger than 1 000 m^2) are obligated to conduct regular energy audits, a requirement which aligns with the European Performance in Buildings Directive. A framework for certification of energy auditors has been established. However, there is currently no legislation which sets out how energy audits of buildings during their commissioning and subsequent use should be conducted.

The market in Ukraine for energy efficiency services, building insulation technologies, metering and control equipment is still relatively small. While the tax code does include measures to decrease the costs of energy efficient equipment and products, it is unclear if it has had an impact on the uptake of energy efficiency equipment and services.

The legal and administrative roles of municipal housing maintenance enterprises, known as ZhEKs, are unclear. Furthermore, the lack of a responsible entity, *e.g.* a homeowner association, to decide on energy efficiency measures for apartment buildings poses a significant barrier to energy efficiency investments.

A legal basis for the establishment of homeowner associations in buildings with more than five levels was set out in 1995, but by early 2012 only 13 000 homeowner associations had been formed, covering only a fraction of existing multi-story apartment buildings. The 2010 *Programme of Economic Reforms for the Period 2010-2014* aims to have mandatory homeowner associations by 2014; while projections estimate 80% coverage by 2015, yet the required legislation has not been developed.

A further barrier is that the privatisation process for housing has not been fully completed: while apartments have been privatised, the process of privatising public spaces in buildings has not. Commercial banks are not willing to give loans for energy efficiency to homeowner associations since they are set up as not-for-profit legal entities, lack balance sheets and have neither guarantees nor income streams. Revision of the homeowner association legislation is planned for late 2012. In addition to administrative and regulatory barriers, there is also a lack of knowledge about the benefits of residential energy efficiency and a lack of technical expertise needed to develop bankable energy efficiency projects.

Currently, the energy service company (ESCO) market is limited in Ukraine, but could expand once an increased number of homeowner associations have been established. However, this requires that the enabling legislation for homeowner associations and for performance contracting is put in place. The large number of similar multi-story buildings, high prices of imported energy-efficient equipment and the urgent need for large-scale renovations constitutes a good business opportunity for local manufacturers and the building industry.

The European Bank of Reconstruction and Development is implementing a pilot project to contribute to the development of the necessary contractual and policy framework to enable performance contracting for public buildings. This could potentially form the basis for energy performance contracting for residential buildings. An Interagency Working Group on the Action Plan to Implement Energy Saving Projects through the Mechanism of Energy Service Companies has been established to promote the implementation of energy efficiency measures in the buildings sector. The group held its first meeting in May 2012.

APPLIANCES AND LIGHTING

Consumers are buying more appliances and this trend is expected to increase in line with growth of household disposable income. Residential electricity prices in Ukraine are low compared with European countries and do not provide an incentive to invest in energy-efficient appliances.

Ukraine has a number of national standards and requirements for energy-using products in place. It has implemented a system of energy labelling of household electric equipment, in accordance with the Law on Energy Savings and efforts to align with EU directives.[14] To avoid barriers to trade with the European Union, work on the harmonisation of Ukraine's legal framework for energy labelling of household electric equipment is underway. In 2011, actions were initiated to align with EU legislation on labelling and technical regulations for household refrigerators, freezers and washing machines. Transposition of the EU labelling directive is expected at the end of 2012. Implementation will require the development of a robust system for monitoring, verification and enforcement.

Lighting accounts for about 20% of electricity use, a relatively large share. By switching to more efficient lighting products, savings of about 40% are possible.[15] While there are a number of laws and regulations in place to start phasing out inefficient lamps, it is not clear to what extent these have been implemented and what their impact has been. Incandescent lamps still constitute a considerable share of the lighting market.

INDUSTRY

Industry offers the largest potential energy savings in Ukraine. The sector accounts for 40% of total final energy consumption or 23.3 kilotonnes of oil equivalent (ktoe) in 2009. Electricity demand in industry is growing 2% per year and in 2009 it accounted for about 50% of total electricity consumption, 133 terawatt-hours (TWh).[16]

14.Labelling and Standard Product Information on the Consumption of Energy and Other Resources by Energy-related Products Directive (2010/30/EC).

15. Estimate based on IEA (2006), *Light's Labour's Lost: Policies for Energy-efficient Lighting,* OECD/IEA Paris.

16. IEA databases, Energy Balance for Ukraine, 2009.

Low energy costs in the past contributed to the development of heavy energy-intensive industry in Ukraine. This segment, in particular, has significant energy efficiency potential. For example, more than 40% of Ukrainian steel (about 16.6 million tonnes in 2010) is produced using inefficient open-hearth technology, which has been replaced in many countries.[17] The introduction of blast furnaces or electric-arc furnace technology could reduce energy consumption per unit of output by more than four-fold. Manufacturing sub-sectors such as chemical, agricultural and food production also have significant energy savings potential. For instance, glass-making and sugar production require roughly twice as much energy input per unit of final product in Ukraine as the EU average.[18]

Systematic improvements in energy efficiency in industry are typically associated with a range of co-benefits including improved productivity, enhanced product quality, optimised processes and better use of raw materials. International practices indicate that replacing system components with more efficient alternatives can provide savings in the range of 2% to 5%, while the savings potential of systems improvements can exceed 30%.[19] Increasing energy efficiency levels to match those of the EU benchmarks could bring savings on the order of 17 Mtoe per year, valued at EUR 7.3 billion in year 2010 values.[20]

Energy efficiency is an important consideration from an industrial competitiveness and growth perspective.[21] Some industrial branches are already experiencing loss of competitiveness and market share due to increased energy prices as electricity tariffs for industrial users have been risen sharply in recent years.

Effective energy management programmes, whether mandatory or voluntary, include energy management systems, audits, reporting, drivers to encourage implementation, capacity building, and information and guidance. Energy management programmes have been shown to cut energy use by more than 10% in participating enterprises in a short timeframe, followed by continuous annual savings in the range of 2% or more.[22] Part of such a programme should aim to ensure that enterprises have information on energy efficiency opportunities including through benchmarking data, best practice applications, and monitoring and evaluation techniques.

Ukrainian companies lack energy management capacity and protocols, as well as sufficient information to identify energy savings opportunities. Practices such as automated and sub-metering are limited. Energy efficiency improvements in industry require investment. Access to financing is constrained by the reluctance of local financial institutions to invest in energy efficiency, as well as by the lack of capacity on the part of companies to develop bankable energy management projects. International financial institutions and donors are implementing programmes and providing financing and technical capacity to overcome these challenges (Box 3.1).

17. Based on figures from the Metallurgprom Production-Economic Association and State Statistics Committee of Ukraine.

18. OECD (2011), *Investment Policy Reviews of Ukraine 2011*, OECD, Paris.

19. IEA/Institute for Industrial Productivity (IIP) (2012), *Energy Management Programmes for Industry: Gaining through Saving*, IEA/OECD, Paris.

20. Indicated by a study based on the pilot Ukrainian Energy Index rating, which was initiated by System Capital Management with rating methodology developed by BEST Analytical Center, *www.energy-index.com.ua/media/report/pdf/UEI-en.pdf* (accessed 12 April 2012).

21. European Bank of Reconstruction and Development (EBRD) (2010), *Sustainable Energy Initiative – New Instruments* estimates the economic market potential of energy efficiency in industry in Central and Eastern Europe and Commonwealth of Independent States between 20% and 40% at current energy prices.

22. IEA/IIP (2012*)*.

The State Agency of Ukraine for Energy Efficiency and Energy Conservation (SAEE) has been tasked to develop and maintain a system for energy auditing and implementation of energy management, in accordance with a presidential decree. As of April, 2012 there are 108 specialised entities that are certified to conduct energy audits in the industry, public and residential sectors. In 2011, only 30 energy audits were conducted. Auditors supply SAEE with technical reports that include energy savings potential estimates, as well as an update on results twice a year.

Large energy-intensive enterprises are mandated to provide annual energy consumption reports to the government, but inspections are rare. Large energy consumers (with annual energy consumption exceeding 10 000 megawatt-hours) are obligated to conduct regular audits. However, there are currently no requirements to implement the identified energy efficiency opportunities. A database on best available technologies has been created within SAEE and there is a plan to establish regional centres that provide energy advisory services to industry. However, it is not clear to what extent this database is used and by whom. There are currently no government-led programmes to stimulate the uptake of energy management systems in industry.

TRANSPORT

Energy consumption in the transport sector in Ukraine is relatively small. Rail transport plays a leading role in freight and passenger transportation. The rail system length is 22 800 kilometres (km), of which 8 300 km are electrified. The rail system transports over 300 million tonnes of freight and more than 500 million passengers per year. Ukraine has 18 ports, 8 shipyards and more than 100 airports.

Road-based transport energy consumption in Ukraine is about 7 ktoe, 10% of total final consumption (compared with 34% in the OECD).[23] Motor transport has been on the increase to reach more than a billion tonnes of freight and 2.5 billion passengers per year. The length of general-purpose motorways totals 169 000 km. In the last 20 years, the level of car ownership has risen and passengers have shifted away from public transport. Several cities have electricity-driven public transport systems (trams, trolleybuses). These systems are in need of upgrading. Lack of timely modernisation may accelerate a further modal shift at a time when many cities around the world are establishing electricity-based public transport systems due to climate and energy efficiency considerations.

The *Transport Strategy of Ukraine for the Period to 2020* (2010) sets energy efficiency objectives, but does not provide for the actions to achieve them.[24] The objectives include:

- promote the use of energy efficient and alternative types of liquid and gas fuels;
- apply international standards for vehicles and engine fuel;
- optimise vehicle service life and maintenance;
- adjust the tax system to promote energy efficiency of vehicles; and
- provide and operate energy-efficient modes of transport (electrical, rail, river) in cities.

23. IEA databases.

24. Cabinet of Ministers of Ukraine (No 2174-r) October 2010, *Transport Strategy of Ukraine for the Period to 2020*. Unofficial translation available at: Support to the Integration of Ukraine in the Trans-European Transport Network TEN-T; *www.ten-t.org.ua/main/en/news/top.htm* (accessed 15 March 2012).

According to the strategy, expected results are 15% to 20% lower transport fuel consumption. This includes cutting road freight transport from 43.6 to 34.8 grammes of coal equivalent per 1 tonne/km; rail transport from 10.32 to 8.75 grammes of coal equivalent per 1 tonne/km. No interim assessment of progress has been made.

PUBLIC SECTOR AND LOCAL GOVERNMENTS

Ukraine is subdivided into 27 regions: 24 oblasts (an administrative unit), one autonomous republic and two cities with special status. Some local governments are actively working to increase energy efficiency awareness, developing their own programmes and have successfully implemented some energy efficiency projects. Some ongoing initiatives address municipal energy management, such as in the framework of the European Covenant of Mayors, which is a voluntary agreement to promote energy efficiency and mitigate climate change. The Covenant has 25 signatories in Ukraine. Initiatives include data collection, energy monitoring, development of municipal energy plans and provision of assistance in the preparation and implementation of measures.

Most municipalities, however, lack policies and plans for sustainable energy management and the capacity to develop and implement them. Financing is a major barrier. Municipal budgets are allocated as part of the national budget on a yearly basis. Currently there are no provisions in place to ensure that financial savings made due to energy efficiency measures can be used to further efficiency improvements or diverted to other areas. Instead, savings made may lead to a corresponding decrease in the budget for the next year. This creates a disincentive for municipalities. Municipalities are unable to provide the collateral or guarantees required for loans, a further barrier to energy efficiency investment.

Public sector buildings (larger than 1 000 m^2) are obligated to conduct regular energy audits. While a framework for energy auditor certification has been put in place, further work is needed to establish a standardised system for auditing. Provided that access to financing is facilitated and incentives are created, such audits could promote the implementation of energy efficiency measures.

There is scope for increasing the role of the public sector to stimulate markets for energy efficiency solutions and technologies, *e.g.* through public procurement. Municipalities could also play an important role in the implementation of demonstration projects in municipal housing or public buildings.

Energy performance contracting (EPC) is a performance-based procurement method and financial mechanism for energy efficiency measures whereby energy savings that result from the measures pay for the cost of the project. EPC could play an important role in enabling municipalities to implement energy efficiency projects. However, the regulatory and contractual frameworks for such mechanisms need to be developed. The European Bank of Reconstruction and Development is implementing a pilot project to contribute to the development of the necessary contractual and policy framework for enabling performance contracting for public buildings. While energy performance contracting can provide a mechanism for financing, stringent energy requirements are needed so as not to create a technology lock-in through sub-optimal energy efficiency measures.

ENERGY GENERATION, TRANSMISSION AND DISTRIBUTION

Considerable investments are needed to improve the efficiency of the energy generation, transport and distribution systems. While progress is being made towards cost-reflective

tariffs for electricity, those for heating and fuels are not sufficient to cover operating costs and allow for the recovery of investments in modernisation and energy efficiency.

Data on losses in generation, transmission and distribution vary considerably. Nonetheless, it is clear that there is significant scope for improvement. For instance, network district heat losses are on average 15%, but losses of 50% have been noted. Natural gas transmission line losses have been estimated to be in the range of 2% to 3% of total gas consumption in Ukraine. Electricity transmission and distribution losses are on average around 13%, but have reached near 20% in some years.

Many energy facilities and networks are coming to the end of their design life or have obsolete technologies. For example, it is estimated that about 30% of Naftogaz' compressor plants are operating beyond their design life. This out-of-date technology is operating at roughly 25% efficiency, well below that of replacement compressors with efficiency rating of 35% to 40%. Approximately 40% of the electricity network (about 410 000 km) requires reconstruction. Losses in generation, transmission and distribution are expected to increase without sufficient and timely investments.

Utilities and energy suppliers are not active in promoting demand-side energy efficiency. There is scope to establish policies such as obligations to promote energy supplier delivered energy efficiency, especially in the area of district heating.

CRITIQUE

In light of Ukraine's high level of energy consumption, its large untapped potential for energy efficiency gains and the related benefits for energy security and economic growth, Ukraine's energy policies should put more emphasis on energy efficiency improvements. There is considerable potential for energy savings in all sectors, particularly in industry, district heating and buildings.

Progress is expected as a number of energy efficiency strategies have been developed and revised at regular intervals. However, these typically focus on defining potential savings and setting targets rather than on a framework of energy efficiency policies and action plans that can effectively and quickly deliver. Implementation is lacking, partly due to a lack of co-ordination between national, regional and local level institutions and effective energy efficiency governance

It is essential that energy efficiency strategies are integrated into the broader policy framework of economic development. Those strategies and related action plans need to ensure a stable source of financing for the required energy efficiency investments. The new energy strategy that is being developed in 2012 could contribute to ensuring that energy efficiency is a strategic priority and that greater co-ordination is achieved. Concerted action is needed to ensure that the political prioritisation of energy efficiency is translated into practice.

Ukraine's commitment in 2010 to align some policies with EU directives as part of its accession to the Energy Community will drive progress in energy efficiency. It is important that Ukraine engages in the necessary preparatory steps to comply with those commitments within the set timeframes.

Ukraine should prioritise the development of an effective energy efficiency policy package that includes the progressive increase of prices to full market-based levels, regulatory and control mechanisms, fiscal measures and tax incentives, technology

development and financing mechanisms. The development of such a policy package requires the active participation of all relevant stakeholders, including the Ministry of Energy and Coal Industry, Ministry of Regional Development, Construction and Housing Services, National Commission for State Energy Regulation, Ministry of Finance, Ministry of Economic Development and Trade, and the State Agency for Environmental Investment (SAEE), under the supervision of the Cabinet of Ministers. The State Agency of Ukraine for Energy Efficiency and Energy Conservation could potentially take on a stronger co-ordinating role, support the development of an energy efficiency policy package and get the country on track to realise energy efficiency potential. However, the SAEE may not have sufficient political clout to take on a lead and co-ordinating role. Furthermore, SAEE has in its initial stages of operation, placed more focus on encouraging the growth of renewable energy rather than promoting energy savings. International experience shows the importance of consultation processes. There could be clear benefits in establishing a practice of stakeholder consultation including non-governmental organisations, research institutes and the private sector as well in Ukraine.

There is a large body of law in Ukraine related to energy efficiency, but greater effort is needed to ensure that legislation is streamlined and does not create barriers to implementation. There is scope to review the current legislative framework in terms of impacts on energy efficiency improvements.

Currently there are numerous targets proposed in the various strategies, programmes and plans, however, it is not clear how these have been developed. There is a tendency to focus on energy intensity targets; however, from an energy security perspective, it is of relevance to secure primary energy savings in absolute terms. Energy efficiency targets should be based on solid statistical data at a sufficient level of disaggregation and modelling. In order to develop effective policies and track progress, efforts should be made to establish and maintain energy supply and demand databases covering all sectors and sub-sectors. Furthermore, to track progress, baselines should be established. Ukraine should take into consideration international experience and standards in this area.

Local governments can play an active role in promoting energy efficiency. This should be avidly promoted by the central authorities. Greater effort should be made in the area of capacity building to ensure that local governments can successfully apply for donor funding and leverage private funding. The need for state guarantees or clear procedures for ensuring that local governments can act as guarantors should be established.

While there are indications that the interest of foreign investors and local banks in energy efficiency projects is growing, much remains to be done in terms of establishing a favourable investment climate. In particular, further efforts are needed to ensure transparency in the legislative framework, as well as strengthening systems for monitoring and verification of energy savings.

Energy pricing in Ukraine remains a barrier to energy efficiency investments. While some progress has been made, further steps are needed to address low average tariff levels, particularly for the residential sector, opaque price setting mechanisms and uncertainties concerning future price levels. Furthermore, work should continue to phase out the complex and non-transparent system of subsidies and cross-subsidies. International experience shows that there are more effective ways of addressing fuel poverty without negative impacts on energy efficiency investments. Tariff increases should be coupled with energy efficiency and social safety measures.

Investments in energy efficient technologies and measures require tariff systems that enable cost-recovery. While progress is being made in regard to establishing cost-reflective tariffs, more needs to be done especially in light of the current state of energy generation assets. To systematically decrease losses, the system for metering and tracking energy flows should be improved, particularly in district heating.

Large-scale progress in energy efficiency requires stable sources of long-term financing. Ukraine could explore the use of energy and carbon taxes. Such taxes have shown to promote energy efficiency, while at the same time enabling the government to generate revenues that can be earmarked to support energy efficiency measures. The government should consider establishing a sustainable financial mechanism such as an energy efficiency revolving fund to finance municipal projects. International donor and financial institution support should be used to effectively leverage private funding and to build local capacity.

Key barriers to residential energy efficiency in Ukraine include: the undeveloped status of homeowner associations; absence of targeted state support; and lack of end-user control over energy consumption. Other issues include subsidised energy prices and the inability of financial institutions to lend to the residential sector because of contradictions in legislation concerning homeowner associations. Current heating tariff systems do not provide residential homeowners with incentives to invest in energy efficiency measures.

A systemic view of district heating systems is necessary, in which technical and policy changes on both the supply and demand sides are considered simultaneously. Policies for energy efficiency in buildings and district heating should be co-ordinated so that long-term system wide-energy efficiency gains are promoted. Lack of co-ordination can potentially result in a situation where increased building energy efficiency renders district heating systems over-sized and inefficient. Furthermore, energy efficiency measures can be used to effectively counteract increasing heating costs.

Policies that strengthen the role of homeowner associations could play a significant role in ensuring that the benefits of energy efficiency measures are widely known, understood and adopted through practical implementation. Further efforts are also needed to ensure that homeowner associations have an appropriate organisational set-up to enable them to access financing for efficiency improvements. Enabling legislation for homeowner associations and performance contracting is needed.

Transposition of the EU directive on labelling and standard product information is an important step that will require review of existing legislation. Co-ordination with the European Ecodesign Directive is important. At a minimum, the timelines and tiers of the Ecodesign Directive should be used. Robust systems for monitoring, verification (including test procedures and measurement protocols) and enforcement are essential to ensure compliance. International harmonisation should be sought particularly in regard to test procedures and measurement protocols.

There is significant untapped energy efficiency potential in industry. By actively pursuing industrial energy efficiency, Ukraine could save considerable amounts of energy in a short timeframe while boosting industrial competitiveness. Today, the main instrument for promoting energy efficiency in industry is subsidies for equipment and projects. However, international experience indicates that such subsidies have a limited impact at promoting the uptake of an energy management culture in industry which is needed to sustain continuous improvements. There is further scope to develop policies and programmes that promote the uptake of energy management systems both in large

energy-intensive industries and in small- and medium-size enterprises. There is considerable international experience that could be used as a basis to design programmes that are appropriate in the Ukrainian context.

International experience indicates that energy efficiency delivered via the energy supplier can overcome many barriers as well as leading to the creation of new business opportunities. There are numerous options to stimulate demand-side management. However, a key to enabling utilities and energy suppliers to take an active role in delivering end-use energy efficiency is that the metering systems and methodologies are in place to measure and verify energy consumption and savings.

While the government has an important role to play in creating enabling conditions and programmes for increased energy efficiency, other actors, such as international financial institutions, can effectively contribute. International and bi-lateral programmes for promoting energy efficiency in Ukraine constitute an important opportunity for the acceleration of Ukrainian energy efficiency. However, to utilise the potential of these programmes and ensure long-term sustained impacts, more effective government co-ordination is needed.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Develop a much more effective energy efficiency programme that will lead to the modernisation of the gas, electricity and heat networks, and energy savings in final use, particularly in the industry and buildings sectors.*
- ☐ *Ensure that energy efficiency is comprehensively covered in the new national energy strategy and is complemented by specific measures to meet its stated objectives, including clear targets, timeframes and assessment methodologies.*
- ☐ *Require the development of sector specific action plans that include comprehensive assessment of energy efficiency potential, barriers and opportunities, clear energy-saving targets, priority setting, timeframes, required actions and initiatives, allocation of responsibilities, awareness campaigns and financing strategies.*
- ☐ *Improve the availability and reliability of disaggregated energy statistics to facilitate development of meaningful energy efficiency indicators. Ensure the collection and use of end-use data based on international experience and data collection efforts, particularly the International Energy Agency's annual statistical questionnaires and the energy efficiency data template. This includes establishing a robust system of indicators for monitoring progress in the area of energy efficiency and energy savings.*
- ☐ *Strengthen institutional capacity and governance in the area of energy efficiency and establish mechanisms to monitor progress and track results against targets, including strong enforcement mechanisms. This includes strengthening co-ordination and co-operation between central, regional and local institutions and providing them with sufficient resources, technical expertise and a mandate to develop, implement and monitor energy efficiency programmes.*
- ☐ *Work in close and continuous collaboration with partners in the Energy Community to live up to its obligations under the Energy Community Treaty. In this way Ukraine can benefit from valuable support and advice which will facilitate the preparation and adoption of new legislation and measures, and their implementation.*

- *Develop incentive and financing programmes at national and local levels including promoting access to credit and eliminating legal constraints to energy efficiency investments.*
- *Develop programmes and partnerships aimed at building the capacity of local lenders, municipalities and homeowner associations to develop bankable energy efficiency projects.*
- *Establish strict building energy codes for new buildings, as well as buildings undergoing renovation. Enforce and regularly strengthen the performance requirements. Establish timelines and renovation rates for energy efficiency retrofits in existing buildings.*
- *Accelerate the transformation of the appliance and equipment market through minimum energy performance requirements and labelling schemes to support the introduction and uptake of new technologies and high-efficiency appliances and equipment.*
- *Adopt lighting quality, reliability and minimum energy performance standards for new and existing lighting products. Continue to work towards a full phase out of inefficient lighting products and promote improved lighting system design.*
- *Take measures to stimulate the uptake of energy management systems in energy-intensive industry. Develop and implement a package of policies and measures to promote energy efficiency in small- and medium-size enterprises including improving access to energy audits.*
- *Adopt and regularly update fuel-efficiency standards for road vehicles. Adopt measures such as labelling incentives and taxes to accelerate market penetration of more efficient vehicles.*
- *Remove barriers and create incentives for energy suppliers to invest in energy efficiency and to engage in end-use energy efficiency.*

4. DISTRICT HEATING

Key data (2011)

Households connected to central district heating systems: 43% (7.5 million)

Total installed capacity of district heating systems: 162 million Gcal/year

Heat supplied by district heating companies: 147 million Gcal, but huge losses in generation, distribution and end-use

Gas consumed for district heating: 13 bcm/year

OVERVIEW

District heating is of significant economic and social importance in Ukraine. It accounts for a large share of total primary energy use, particularly natural gas, and district systems supply heat to about 43% of its residences. About 50% of heat produced is used in industry.

District heating systems in Ukraine are characterised by excessive capacity and inefficient and outdated technologies: the capital stock is in a critical state with most assets close to or beyond the end of their design life. Energy losses are considerable and operating costs are high, largely due to inadequate maintenance. In 2011, it is estimated that about 13 billion cubic metres (bcm) of natural gas were consumed for total heat production, of which almost 9 bcm was for district heating systems including 1.9 bcm used by Kyivenergo, a major combined heat and power (CHP) plant.[1] Owing to insufficient investment, which is needed to modernise the district systems and improve end-use energy efficiency, more than half of the input fuel is wasted, which corresponds to a value of about USD 2 billion at a gas import price of USD 400 per thousand cubic metres (tcm).[2]

Ukraine is currently in a situation where prompt and comprehensive action is needed in order to avoid the risk of partial collapse of district heating systems and a loss of related energy efficiency opportunities. Reducing natural gas consumption is central in Ukraine's transition towards increased energy security and independence. Furthermore, there is a risk that already indebted utilities may not have sufficient funds to buy fuel and other necessary resources. The government, district heating providers and other stakeholders have acknowledged the urgent need to modernise the district heating systems, however, progress in this area has been slow due to a number of challenges and the lack of a comprehensive strategy for the sector.

1. Ministry of Regional Development, Construction and Housing of Ukraine, Concept for the Programme of Modernisation and Development of Heat Supply Systems of Ukraine for the Period 2012-2022, 21 December 2011. (Концепція Державної цільової програми модернізації та розвитку систем теплозабезпечення України на 2012-2022 роки) *www.minregion.gov.ua/index.php?option=com_k2&view=item&id=715:концепція-державної-цільової-програми-модернізації-та-розвитку-систем-теплозабезпечення-україни-на-2012-2022-роки&Itemid=190&lang=uk* (accessed 10 May 2012).

2. This text uses "tcm" to denote "thousand cubic metres"; the substitution of a capital "T" (Tcm) indicates "trillion cubic metres".

DISTRICT HEATING: MAIN CHARACTERISTICS

District heating is defined as heat produced at centralised heat production (such as combined heat and power plants, heat-only boilers, industrial waste heat) and transported via heat networks. Combined heat and power generation (also known as co-generation) saves about 30% of the fuel compared with separate production of heat and power. District heating systems, if properly adapted, could also provide opportunities to use local heat sources that would otherwise be wasted such as industrial waste heat, municipal waste or biomass. District heating plants can also offer flexibility by using various fuels such as natural gas, fuel oil and renewable fuels, thereby playing an important role in energy security. District systems can meet residential, commercial and industrial needs for heat. Typically, buildings need space heating and hot water, while industrial companies need steam and hot water.[3]

PRODUCTION AND SUPPLY

Total thermal energy demand in Ukraine is about 130 to 140 million gigacalorie per year (Gcal/year). In 2011, total thermal heat supplied by district heating companies amounted to 147 million Gcal, with 97.5 million Gcal produced by heat-only plants in urban and rural areas and mostly supplied to residential users (Table 4.1). In 2011, district heating systems installed capacity was 162 million Gcal/year, with 120 million Gcal/year in heat-only plants located in urban and rural areas. Heat losses amounted to 13.5 million Gcal in 2011.[4]

District heating accounts for a large share of total primary energy use in Ukraine. Its main fuel is natural gas using about 9 bcm per year, which corresponds to almost 50% of Ukraine's domestic production of natural gas or 23% of total imports in 2011. Several initiatives are underway to convert some district heating systems to use renewable sources for fuel (Box 4.1).

Table 4.1 **Heat production and supply by heat-only plants in urban and rural areas, 2011 (million Gcal)**

Total thermal power produced	Thermal power supplied for own consumers	Including:			Supplied to another enterprise
		residential	municipal	industrial	
97. 5	87.5	54.7 (62%)	22.5 (25.8%)	10.3 (11.8%)	9.9

Source: State Statistics Committee of Ukraine.

Heat generation sources in Ukraine include:

- CHP plants account for about 22% of heat production. Out of about 250 CHPs, five are very large and 200 are small industrial facilities. CHPs are fuelled by natural gas (76% to 80%), fuel oil (8% to 15%) and coal (5% to 6%).

3. International Energy Agency (IEA) (2004), *Coming in from the Cold: Improving District Heating Policy in Transition Economies*, OECD/IEA, Paris.

4. Ministry of Regional Development, Construction and Housing of Ukraine (2011), Concept for the Program of Modernisation and Development of Heat Supply Systems of Ukraine for the Period 2012-2022, Kiev.

- Heat-only plants account for about 60% of heat production. As of December 2011, there were 35 073 heat-only boiler facilities, about 60% of which are in urban areas and 40% in rural areas. About 85% of installed capacity is located in urban areas. The majority, about 64%, use natural gas and about 30% use coal, and most have a production capacity lower than 3 Gcal/year. These facilities employ 79 746 heat-only boiler units of various types. They are installed at industrial enterprises, municipal systems and district heating companies.[5]
- A very marginal amount of heat is produced by nuclear power plants (0.01%).
- Individual units at the household level represent about 10% of total heat generated.

In December 2011, Ukraine had 33 122 kilometres (km) of heat transmission and distribution networks. Transmission pipelines are owned by the Ministry of Fuel and Energy and constitute about 3 500 km (pipes with diameter 125 millimetre [mm] to 1 400 mm). Distribution pipelines (diameter 50 mm to 800 mm) are owned by municipalities and constitute about 20 800 km. In addition, industrial pipeline networks are about 12 400 km.[6]

HEAT MARKET

STRUCTURE AND OWNERSHIP

There were 8 250 enterprises producing heat in Ukraine at the end of 2011. The state-owned Naftogaz holds shares in large CHP plants as well as smaller CHP plants that are typically controlled by regional electricity distribution companies ("oblenergos") or industrial companies. There are almost 900 local heat supply companies, called teplokomunenerhos (TKEs) that operate heat plants and district heating networks. TKEs are mainly owned and managed by local governments. TKEs buy gas, coal and heavy fuel oil to produce heat at their own plants. They also purchase heat from CHP plants and from heat plants belonging to others. The TKEs supply heat to final consumers. However, in most cases, municipal service companies, known as ZhEKs, handle billing and collection. Low tariffs, non-payment, inefficiencies and rising fuel prices have resulted in a critical financial situation for many district heating providers. There are a number of cases of district heating system closures; for example, in Uzghorod. Most district heating providers are indebted to Naftogaz, thereby negatively affecting a company which produces one-eighth of the GDP and provides one-tenth of the state budget revenues.

The Law on Heat Supply (2005) and several other legislative and policy documents envisage the introduction of competition in the heat market. This law introduces equal access to heat transmission lines and requires companies that operate district heating networks to purchase heat from other sources, based on competitive bidding principles. The bidding must be organised by local authorities. If a heat transmission company also owns heat generation assets, by law, it must participate in the bidding process. However, it is not clear whether this requirement is being implemented in practice. International experience shows that this type of competition can stimulate improved production performance and encourage efficient, low-cost production in large systems. The heat law also

5. Ministry of Regional Development, Construction and Housing of Ukraine, statistical data, State Statistics Committee of Ukraine.

6. *Ibid*.

envisages giving customers a choice of heat suppliers, where possible. However, many Ukrainian district heating systems are too small for meaningful wholesale competition.

CONSUMERS AND DEMAND

There is no detailed data on heat demand in Ukraine. Industry uses around a half of the district heating output, while residential, commercial and public buildings use the other half.

Ukraine has about 17.5 million households of which about 43% are connected to district heating (7.5 million households). The remaining households have individual heat supply systems, such as individual gas and electric boilers. In 2011, total heat consumption by households was about 52 million Gcal for rural and urban areas and 35 million Gcal for medium-size regional cities. Additional heat is produced by autonomous and individual boilers for 25% of households and the rest by stoves.[7]

Heat demand has been on a slightly declining trend since 1990. The reasons are a transformation of the primary sector, population decrease and more efficient building stock constructed in the last decade. However, there are indications that district heat demand may grow in line with urbanisation and increased demand in the non-residential sectors.

The service quality in district heating is perceived as poor with insufficient heat supply and frequent disruptions and accidents. As a consequence, the level of consumer trust is low. Furthermore, due to the architecture of the system, most consumers cannot regulate the temperature apart from opening windows. Low quality service has caused consumer dissatisfaction, which prompts disconnections from the system to install independent heating systems. Individual gas boilers are seen as an attractive option since natural gas is supplied at heavily subsidised prices and thus offers heat and hot water supply at about one-third of the current average district heating price. This trend can negatively affect the district heating systems as it contributes to overcapacity and corresponding negative effect on system efficiency. (Overcapacity leads to excessive fuel consumption because boilers and other system components are less efficient when operating at partial capacity.) Switching to other forms of heating, the removal of central hot water supply systems in many buildings and changes in industrial structure contribute to reduce demand for district heating services which leads to further overcapacity and inefficiency.

In most cases, residential consumers have no direct contract with the district heating provider; they pay for heat via a municipal maintenance organisation, ZhEKs. Payments are based on the size of the residence and end-users do not receive any information on their consumption levels. As the housing stock is poor, a significant proportion of heat delivered is lost due to insufficient insulation. Consequently, there are no incentives to invest in energy efficiency measures.

METERING

There is a lack of metering throughout the district heating sector. Only 9% of boilers have meters at the entrance and exit. Only 60% of boilers of TKEs are equipped with meters at the boiler exit, with more than 2 500 still needing to be installed as of January 2012. A law is being prepared that will forbid the supply of heat and hot water without metering by 2016.

7. Ministry of Regional Development, Construction and Housing of Ukraine (2011), Concept for the Program of Modernisation and Development of Heat Supply Systems of Ukraine for the Period 2012-2022, Kiev.

A plan to install end-use metering and regulating devices by 2007 has not been achieved. Functioning building-level heat metering is installed in less than 20% of buildings, although plans exist to promote further installations. To measure individual apartment energy consumption, modern heat cost allocators are needed. Other metering alternatives include the potentially cheaper option of metering the water with the added advantage of creating incentives for customers to extract as much heat as possible, thereby leading to lower return temperature, which increases the efficiency of the system. Bulk purchasing of metering equipment is another option to lower prices.

ENERGY SAVINGS POTENTIAL AND INVESTMENT NEEDS

According to the Ministry of Regional Development, Construction and Building, about 3 bcm/year of gas could be saved by modernisation of the district heating systems and energy efficiency measures. This is worth USD 1.2 billion at a USD 400/tcm gas import price.

The district heating sector in Ukraine was designed to have significant excess capacity; meanwhile demand has been decreasing. Large portions of the networks are nearing the end of their design life and most need refurbishment. More than 5 400 km out of 33 000 km of heat distribution pipelines and equipment need replacing.[8]

Due to overcapacity, lack of maintenance and insufficient investment in system upgrades, losses are considerable. Most boilers have low efficiency factors, resulting in heat losses of 10% to 15%. While there is insufficient metering to accurately calculate, losses in the distribution network, mainly due to leaks and lack of pipe insulation, are estimated to be in the range of 17%, but could be considerably higher. Leaks also lead to the need to add additional water more frequently, which constitutes an extra cost for the heat supplier. In modern networks of comparable size, losses are typically less than 10%. Breakdowns are frequent in Ukraine's district heating systems and are estimated to exceed 1.6 breakdowns per km of network in operation, which is approximately ten times higher than in well-maintained modern systems. In addition, up to 70% of delivered heat is lost in the end-use phase because of insufficient building insulation and the inability to adjust heat delivery to consumer requirements.

Comprehensive modernisation of the existing system would provide savings in the form of reduced thermal losses and water leakage, as well as savings on reduced pumping energy (due to reduced flow from lower thermal loss) and decreased maintenance and repair costs. Modernising the system would also lead to improved reliability and higher quality of service. However, the costs of investment needed on both the supply and demand sides are high.

It is essential to co-ordinate supply and demand-side requirements as the implications of mismatching are significant. When systems have excess capacity, they cannot operate efficiently, which raises costs. Then they have added pressure to sell more in order to justify and pay for these assets. Likewise, they have less incentive to promote energy conservation, either in their own facilities or for end-users. In addition, overcapacity makes it more expensive to respond to demand changes because fixed costs are a high share of total costs.

In existing housing blocks, the installation of individual heating sub-stations equipped with automated control systems enables average energy savings of about 20% to 30% compared with a situation where there are no such sub-stations. These include installing

8. Ministry of Regional Development, Construction and Housing of Ukraine.

meters, computerised metering and temperature control and dispatching systems which allow heat regulation on a time and weather sensitive basis for a very small number of buildings. These also include laying smaller heat supply pipes with fewer losses to connect to the buildings and improved hydraulic balancing. Further savings could be attained by installing apartment-level heat meters and systems for thermoregulation, however, in most existing apartment blocks, this would require changing the whole heat supply system.

The law requires that new buildings include heat and water meters. Individual heating sub-stations are being installed in most new housing blocks, where meters at the apartment level are also installed.

Considerable work needs to be done to improve the energy efficiency of the existing building stock. Some projects to install meters have been implemented, mainly with the support of foreign donors. Modernising the district heating systems and implementing end-use energy efficiency measures requires significant investment. For instance, large-scale deployment of building level sub-stations would require investments in the range of EUR 1.5 billion to EUR 2 billion. Such measures could provide natural gas savings of 1 bcm/year (worth USD 426 million at second quarter 2012 import prices). Additional investments on the order of Ukrainian hryvnia (UAH) 150 billion are needed to finance energy efficiency measures in the housing blocks.

INSTITUTIONAL, LEGAL AND REGULATORY FRAMEWORK

INSTITUTIONS

District heating is characterised by unclear distribution of responsibilities and a lack of co-ordination between the central and local government institutions that deal with its various aspects. The Cabinet of Ministers defines the national policy for heat supply, organises supervision and co-ordinates the various ministries' activity for the development of state and regional heat supply programmes and tariffs setting, and defines the authorities that are entitled to issue licences. Other relevant policy institutions include:

- the Ministry of Energy and Coal Industry: develops general energy policy and deals with issues related to CHP;
- the Ministry of Regional Development, Construction and Housing of Ukraine: develops energy efficiency strategies and policies for the building sector and district heating;
- the State Agency on Energy Efficiency and Energy Saving: develops energy efficiency and renewable energy action plans and policies;
- the National Commission for State Energy Regulation: issues licences, regulates activities and tariffs for heat from CHP and renewable-based plants;
- the National Commission for Regulation of Municipal Services: regulates utilities including district heating in large cities;
- municipalities: own district heating systems and regulate district heating from heat-only plants; and
- the Ministry of Regional Development, Construction and Housing of Ukraine: submits proposals to the Cabinet of Ministers concerning the price and tariff setting procedures for residential housing and communal services that are not covered by other regulators.

LEGAL FRAMEWORK

There is a large body of national law relating to district heating and important efforts have been made in recent years to develop the legislative framework and facilitate reforms in the sector:

- The Law on Housing and Communal Services (No. 1875-IV, June 2004) defines the fundamental organisations principles of economic relations pertaining to the supply and consumption of housing services between their producers, performers and consumers, as well as their rights and responsibilities.
- The Law on Heat Supply (No. 2633-IV, June 2005) defines major legal, economic and organisational principles of activity at the heat supply facilities and regulates relations in the sphere of heat production, transmission, supply and use.[9] It provides for obligatory licensing of heat-related activities and requires local authorities to develop and implement heating plans for a period of five to seven years. These plans must consider both district heating and decentralised/individual heating alternatives, and select the most cost-effective options. However, there are no requirements to compare life-cycle costs and benefits of new supply options (including maintenance and replacement costs) against energy efficiency options in district heating systems or end-use applications.
- The Law on Housing and Public Utility Services (No. 1875-IV, June 2004) regulates price/tariff setting for public utility and housing services. These are developed and approved by central administrative authorities, national committees that perform state regulation in the respective spheres and local governments.
- The Law on State Regulation of Communal Services (No. 2479-VI, July 2010) sets out the tasks of National Commission for Regulation of Municipal Services of Ukraine.
- Resolution of the Cabinet of Ministers (No. 869, June 2011) on providing a unified approach to the formation of tariffs for housing and communal services: the resolution provides a unified approach to the formation of tariffs.

REGULATORY FRAMEWORK

Until 2010, the district heating sector was regulated by the then National Electricity Regulatory Commission – now renamed National Commission for State Energy Regulation (NERC) and by the municipalities. NERC was tasked with issuing licences and regulating tariffs for heat for CHP plants, thermal plants and renewable energy sources. Oblast (district) administrations were tasked with issuing licences and municipalities with regulating heat tariffs for local heat-only plants. Such a regulatory division can be problematic. A major problem is that municipal politicians have a vested interest in keeping tariffs low and thus not setting prices at full cost recovery and enforcing quality of service standards. Similarly, it is inefficient to have two entities regulate tariffs for heat from different sources and can lead to distorted price signals.

The Law on State Regulation of Communal Services (July 2010) established a new and dedicated regulatory body, the National Commission for Regulation of Municipal Services,

9. *www.zakon1.rada.gov.ua* (accessed 23 February 2012).

which started work in late 2011.[10] It states that the commission shall conduct licensing of heat production from thermal energy (except for the production of the heat energy from thermal power plants, CHPs, nuclear power plants and installations using unconventional or renewable energy sources) and its transportation through thermal transmission systems. It is further tasked with the establishment of tariffs for communal services for those heat supply systems. Thus, it issues licences and regulates heat supply for utilities and companies that operate boiler plants with total installed capacity of more than 20 Gcal/hour, which excludes small and big cities.

The National Commission for Regulation of Municipal Services had licensed 268 district heating companies (entities with total capacity over 20 Gcal/hour) as of January 2012. Municipalities set tariffs for the district heating utilities that have sales volumes and production capacities below those that are under the regulatory authority of the Commission.

In line with the Law of Ukraine on Heat Supply, NERC issues licenses, regulates and sets prices of heat generated from thermal power plants, CHP, nuclear power plants and plants using alternative or renewable energy sources. Important work has thus been done in recent years to improve the regulatory framework of district heating systems.

Changes in the methodology for setting tariffs are needed to ensure profitability; measures also need to be taken to ensure that system-wide energy efficiency is promoted. This could be accomplished with measures such as accurate metering, decoupling sales and profits, *e.g.* through revenue caps, or rate of return on demand-side investments. Cost-reflective pricing is crucial; not only to ensure the continued viability of the district heating systems, but also to generate much needed private investment. This includes an attractive rate of return and full amortisation of modernisation investments as opposed to only technical maintenance costs. Regulators also need to adapt the tariff methodology to include a quality of service component.

Internationally, there is a range of basic incentive mechanisms employed by regulators to enable energy providers to deliver energy efficiency. Technical donor support programmes, such as the US Agency for International Development (USAID), have provided the new regulatory authority with capacity building and training on best practice tariff methodologies.

TARIFF SYSTEM

Historically, tariffs have been set at a level which is too low to generate sufficient funds to invest in modernisation. Furthermore, the tariff system has created disincentives for investments in energy efficiency measures. Savings made may lead to a decrease in tariffs for the next year with no or insufficient provisions made to cover the cost of investments. While tariffs have been raised over the last decade, they are still below full cost-recovery level and do not allow for investments needed to improve or replace assets.

Average payment rate of residential consumers for heat bills is 75% to 85%. About 70% of residential district heat customers are billed based on the size of living space rather than by actual consumption. Consumers with no heat meters pay a fixed monthly

10. Operation is governed by the Law on the National Commission of the State Public Utilities Regulation (No. 6419, May 2010), and the Decree of the President of Ukraine on Establishment of the National Commission of the State Public Utilities Regulation (No. 743/2011, July 2011). (Закон №2479-VI от 9.07.10 г. «О Национальной комиссии регулирования рынка коммунальных услуг Украины).

amount based on apartment size. Some form of consumption-based billing is provided to 30% of residential district heating customers. These are based on building-level metering and a division of consumption according to apartment size.

As of early 2012, the average residential payment for heat in Ukraine is UAH 244 (EUR 24.4)/Gcal/month including VAT and has remained largely unchanged over the past two years. Heat costs for an average apartment in Kiev are around UAH 380 (EUR 38)/Gcal/month including VAT. Average residential tariffs, estimated in a range of UAH 350 to UAH 450 (EUR 35 to EUR 45)/Gcal/month, cover 70% of district heating supply costs including generation, but excluding modernisation investment. In some cases, prices vary depending on fuel type. For example, the price for heat in Kiev, where primarily gas is used, is UAH 2.5 (EUR 0.25)/m^2/month, while the corresponding price can be up to UAH 7 (EUR 0.70)/m^2/month in cities where fuel oil is used. In 2010, heating tariffs for the public sector were doubled and are currently in the range of UAH 900 to UAH 1 000 (EUR 90 to EUR 100)/Gcal/month. Heating costs for industrial customers are cost-reflective.

The National Commission for Regulation of Municipal Services is tasked with establishing tariffs for heat, based on the unified tariff system established by the Cabinet of Ministers Resolution (No. 869, June 2011).[11] A unified tariff system methodology has been established in line with a plan to successively increase tariffs to enable cost recovery and investment in the systems. Licensees, mostly large companies in major cities have to apply to the regulator for tariff setting. As of January 2012, out of 268 licensees only 22 had applied and 20 of these were not accepted by the Commission due to procedural issues. In addition, district heating companies not regulated by the municipal regulator have kept their own tariffs, often subsidised at the municipal level. In consequence, changes to the tariff situation have not yet delivered their potential.

SUBSIDIES

Subsidies and cross-subsidies at various levels create distortions in the heat market. District heating companies receive natural gas that is used for the needs of the residents at below-market prices. As heating tariffs do not cover costs, differences are covered by direct subsidies to heat providers from national or local budgets. However, it often happens that these subsidies are not paid in time or in full, further deteriorating the district heating companies' finances and limiting their ability to pay their operating expenses such as fuel bills. Many cities, for political reasons, set tariffs far below the needed levels and commit to compensate the difference to district heating companies from the municipal or regional budget.

Residential tariffs are also cross-subsidised by industrial tariffs. The government allocated around UAH 800 to UAH 900 million (EUR 80 to EUR 90 million) in subsidies to compensate heat and hot water providers with high fuel costs in 2011. In addition, many groups (more than 100 different designated privilege classes or groups) such as army personnel, civil servants and retirees receive direct subsidies or discounted tariffs for utility services; UAH 5 to UAH 7 billion (EUR 500 to EUR 700 million) in subsidies are allocated for this purpose. These privilege discounts are currently provided without regard to ability of the recipients to pay.

11. Cabinet Resolution (No.869, June 2011) on the "Development of a Unique Methodology for Price Setting in Municipal Housing Services" (КАБІНЕТ МІНІСТРІВ УКРАЇНИ ПОСТАНОВА від 1 червня 2011 р. № 869 Про забезпечення єдиного підходу до формування тарифів на житлово-комунальні послуги).

POLICY DIRECTIONS

The 2010 *Programme of Economic Reform for the Period 2010-2014* assessed the district heating systems. It identified major problems such as the tariff system, weak housing and utility services, insufficient housing and service markets, and poor working regulation for homeowner associations (see Chapter 3). Plans have been made to remove subsidies, strengthen competition in the market for housing association services, improve efficiency of the sector and reduce debts.[12] In addition, the Ministry of Regional Development, Construction and Housing has formulated a reform plan for the period 2012-22 which aims to cut natural gas consumption in district heating from 13 bcm/year today to between 7 bcm/year and 8 bcm/year by 2022.[13] This was also reflected in the National Action Plan for 2012. A working group on district heating reform was established in June 2011 under the supervision of the First Vice-Prime Minister. In addition, in March 2010, Ukraine adopted an energy efficiency programme for the period 2010-15. An energy efficiency action plan is being developed in 2012. A draft Law on the Commercial Measuring of Heat and Water is being prepared by the National Commission for Regulation of Municipal Services.

A key policy development was the recent adoption by the Cabinet of Ministers of an Action Plan for the Regulatory Support to the Implementation of the Energy Efficient Heat Consumption Policy and Modernisation of the Heat Supply Sector (Resolution of the Cabinet of Ministers No. 588, 30 July 2012). It aims to support the transparency, quality of operation and investment attractiveness of the heat supply companies. Envisaged measures include achieving full metering of heat and water supply, development of tariff incentives to finance the deployment of meters and special budget support measures for heat generation companies and end-consumers to conduct energy efficiency modernisation investments, provided that full metering is in place.

INVESTMENT AND MODERNISATION POLICIES

The current regulatory framework and tariff policy make it difficult to attract private investment in district heating. Yet the main stakeholders, *i.e.* municipalities and residents, lack the necessary financing capacity. While progress is underway, more effort is needed to create an adequate policy framework to stimulate investment in the heat sector and enable municipalities to access credits at an affordable rate.

Financing possibilities include:

- dedicated funds for investment;
- loan guarantees;
- leasing or concession agreements;
- contracts with energy service companies (ESCOs); and
- commercial loans.

12. www.president.gov.ua/docs/Programa_reform_FINAL_1.pdf (accessed 1 March 2012); English translation at *www.usubc.org/site/files/Ukraine_Program_of_Economic_Reforms_2010-2014.pdf* (accessed on 1 March 2012).

13. Ministry of Regional Development, Construction and Housing of Ukraine (2011), Concept for the Program of Modernisation and Development of Heat Supply Systems of Ukraine for the Period 2012-2022, Kiev.

However, a number of barriers need to be overcome. District heating companies lack resources to fund major investments. Only municipalities can attract such funding from banks. However, there are legal obstacles that prevent municipal-owned district heating companies from taking credit from banks and offering the required guarantees. According to Ukraine's commercial code, a public enterprise needs to ask its supporting authorities for the right to provide guarantees based on assets or to assume debt. The Law on Mortgage sets similar limitations, as does the Law on Collaterals. The State Property Fund must give its consent to any guarantee or privatisation if the state holds even one share in a given entity. Moreover, most of the infrastructure that participates in the district heating process cannot be privatised as stipulated in the Law on Privatization of State Property. As a consequence, these assets cannot be an object of mortgage or collateral, nor can they be privatised whereas private ownership is typically the most efficient and economical way to introduce a more efficient management and operation of district heating systems.

Improving the legal framework for the regulation of concessions could enable more investments in the district heat sector.[14] Key elements needed include transparency of tenders for concessions, and stability of the legal and fiscal framework. Some progress has been made in this area, such as a 2010 Law on private-public partnerships but not only concessions are options for public private partnerships that could improve district heating systems.

Energy performance contracting and energy service companies (ESCOs) can play an important role to advance the transition towards more efficient district heating systems and buildings. This necessitates further work in creating a stable and predictable legal framework. The ESCO and energy performance contracting market is limited in Ukraine where only about ten pilot ESCO projects have been initiated. The legal basis for the development of ESCOs is weak and the regulatory environment needs to be improved.[15] Both USAID and the European Bank of Reconstruction and Development (EBRD) are conducting technical assistance projects to support the development of ESCOs in Ukraine and to introduce energy performance contracting programmes. The market for energy services is expected to grow as energy prices will increase in Ukraine, especially in combination with stringent energy efficiency requirements and enforcement policies.

The 2010 *Programme of Economic Reforms for the Period 2010-2014* sets the objective to have mandatory homeowner associations that could allow driving energy efficiency and savings investments by 2014, but this has yet to be translated into law. About 17 000 homeowner associations had been established in Ukraine as of August 2012. The current legislation foresees such associations only for apartment blocks with more than five levels. Current legislation does not enable housing associations to assume credit. Furthermore, the banking sector lacks experience with homeowner associations and is unwilling to provide loans. There is a need for an effective regulatory and financial framework to allow homeowner associations to invest in energy efficiency by taking loans or entering into contracts with ESCOs. Relevant legislation is currently under revision.

While the responsibility for modernising Ukraine's district heating sector lies heavily with municipalities, the government and central authorities play a major role to set an appropriate fiscal and legal framework to attract investment, ensure transparency, support the tariff increase to full-cost recovery, co-ordinate district heating reform with energy efficiency in building measures and facilitate access to financing.

14. Including the 1999 Law on Concession and Law on Privatisation.

15. *www.esco.co.ua* (accessed 13 April 2012).

Recent projects supported by international donors or banks, such as USAID, EBRD and the World Bank, show that there is a strong awareness and interest in many municipal institutions to proceed with the modernisation of district heating systems, including to allow for fuel switching (Box 4.1). They further show that the population can be supportive of these measures, and are willing to pay reasonably higher prices, as long as there is understanding and trust in the policies, transparency in consumption and tariffs, and better quality of service.[16]

Box 4.1 **Potential for renewable sources of fuel in district heating systems**

Ukraine has unexploited potential for replacing conventional fuels with renewable sources, such as straw, biogas and municipal waste for heat generation. Ukraine may also have potential to develop geothermal-based district heating. However, the current regulatory framework and market do not provide incentives for the investments required. For instance, biomass boilers are on average three times more expensive than gas boilers.

Yet, some projects are underway. For example, the municipality of Zhytomir, which supplies heat and hot water services to about 75 000 residential apartments, is refurbishing its district heating utility. Total investment is EUR 18 million to install mini CHP for heat and electricity, allow fuel switching from gas to locally available wood wastes, modernise the heat transmission network, install individual heating sub-stations at building level and convert distribution networks from four-pipe to two-pipe system.

The European Bank for Reconstruction and Development (EBRD) provided a ten-year loan to Zhytomir. In addition, the project is supported by a grant from the Eastern Europe Energy Efficiency and Environment Partnership. The municipality managed to offer its own financial guarantees.

It is estimated that every year up to 3.7 million cubic metres of gas, worth EUR 3 million, will be saved. The payback period is in the range of five to seven years based on the assumption that heat and hot water prices are increased by 10% and that natural gas prices to the public sector are also increased. Similar projects are underway in Lviv, Ternopyl, Kiev and Ivano-Frankivsk.

To avoid tension between fuel and farming concerns, it is important that a comprehensive survey of biomass resources be undertaken. Currently in Ukraine, biomass is used as a fertiliser in agriculture. While in some countries biomass is used as a local fuel resource, in others such as Poland, a biomass fuel market has been established, partly due to favourable pricing and subsidy policies. If biomass is to be used in district heating on a larger scale in Ukraine, attention needs to be placed on balancing the needs of different sectors, developing supply chains and markets.

CRITIQUE

There has been progress to improve the framework in which district heating systems are financed and operated. Important legislative and regulatory acts have been passed to prepare a framework for the sustainability and modernisation of district heating systems.

16. World Bank (2012), *Modernization of the District Heating Systems in Ukraine: Heat Metering and Consumption-based Billing* Report N. 64989-UA, World Bank, Washington DC.

Recent positive steps include the creation of a new regulatory authority for public utility services and the adoption of an action plan for improving energy efficiency in district heating systems. Aware of the challenges and reform requirements, the regulator has developed a new framework and is starting to move prices to full cost-reflective levels. Technical assistance and support from international donors and financial institutions have outlined clear priorities for action and initiated some demonstration projects.

Reforms to cut natural gas consumption and decrease public subsidies are needed to improve the viability of the heat sector and the sustainability of public finances at the local and state level. With high gas import bills, the urgency to progressively phase out subsidies and decrease gas consumption has become even more pressing and should be an urgent governmental priority. Modernisation of the system will require significant funding. It should be a government priority to establish favourable conditions to attract private investment. Upgrading the district heating sector should be a high priority in actions undertaken for the draft *Updated Energy Strategy of Ukraine to 2030* (2012) and in government policies. A comprehensive action plan for district heating modernisation should be developed in co-ordination with policies and plans in the areas of natural gas and energy efficiency. Clear and realistic benchmarks are needed to regularly assess progress and achievements and identify obstacles.

Further policy and regulatory changes are needed including effective reform of the tariff system to move to cost-reflective and consumption-based tariffs and to focus on implementation and delivery. Properly sequencing of reforms to focus first on metering and energy efficiency at the residential level combined with progressive price increases is very important. Ukraine urgently needs to take measures to achieve clear and full cost-reflective tariffs for all district heating systems, accelerate the installation of automated meters at building-level and heat metering and temperature control equipment to enable consumption-based billing and ensure full independence and capabilities of the regulators.

Further measures are needed to create a supportive climate for investments in supply and demand elements. While the supply side urgently needs investment to avoid breakdowns and further depreciation of assets, it is essential that a co-ordinated approach is ensured so that successive demand-side energy efficiency improvements do not lead to overcapacity and system-wide inefficiency. Co-ordination of district heating reforms with policies for energy efficiency measures in buildings is essential to promote long-term system-wide energy efficiency gains. The priority in terms of modernisation, policy support and investments should be placed on the consumption segment. In particular, the focus should be on installing individual sub-stations for heat metering and thermoregulation, coupled with investments for building energy efficiency improvements. Furthermore, energy efficiency policies can be used to effectively counteract the social implications of increasing heating costs. Once individual heating sub-stations have been installed and the potential for energy savings in buildings has been assessed, it becomes possible to plan the most optimal heat generation capacity of boilers and optimise their design and investment plans. Moving to increased use of combined heat and power plants and increasing natural gas prices can encourage switching to alternative and possibly cheaper fuels, and reduce generation costs.

The government of Ukraine, along with local authorities, has a key role to play in setting the policy framework and supporting reforms through legal, fiscal, regulatory and financial incentives. It needs to ensure that municipal level planning includes comprehensive mapping of the distribution and condition of district heating plants and pipelines including

assessment of risks and opportunities such as the availability of local renewables and combined heat and power. It should also support capacity building and awareness among municipal authorities and the population on how best to modernise the sector and improve the quality of service, and ensure that co-operation with donors brings full benefits. This includes capacity building to prepare feasibility studies, establish priorities and develop bankable projects. An appropriate institutional framework to enable access to financing should be established. New crediting mechanisms should be developed and implemented to allow private or public banks to provide financing to homeowner associations and municipalities at affordable levels. Appropriate changes in legislation on service provision and homeowner associations are crucial and so is effective implementation.

Ukraine has made important progress by starting to increase district heating prices and shifting the regulation of heat tariffs to a specific institution at the national level. The regulator needs to have enough resources to prepare and implement clear methodologies, collect technical and economic data, conduct analysis, form unified technical and economic norms and standards, develop clear and transparent licensing systems and other regulatory mechanisms. While the end-goal should be to move towards cost-reflective pricing, this needs to be done in a socially acceptable manner, *e.g.* through targeted subsidies in combination with energy efficiency measures and successive reduction of subsidies. Cost-reflective pricing is crucial; not only to ensure the continued viability of the district heating systems, but also to generate much needed private investments.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Develop a comprehensive strategy for the district heating sector including defining objectives, instruments, assigning responsibilities, fixing timelines for transitioning to cost-reflective tariffs, timelines for modernisation, as well as establishing methods for monitoring and evaluating progress.*
- ☐ *Integrate and co-ordinate policy in the areas of district heating, natural gas and energy efficiency.*
- ☐ *Ensure that municipal level planning includes comprehensive mapping of the condition of district heating plants, distribution networks and pipelines including assessment of risks and opportunities such as the availability of local renewable fuel sources and combined heat and power.*
- ☐ *Ensure that the regulatory authority is independent, has sufficient resources and capacity to fulfil its responsibilities, in particular to establish a tariff system that enables the recuperation of costs and allocation of necessary funds for modernisation and energy efficiency measures.*
- ☐ *Ensure co-ordinated and consistent regulation in the district heating sector, possibly in a single regulatory body.*
- ☐ *Remove obstacles to transition to cost-reflective consumption-based tariffs. This includes removal of cross-subsidies and redesign of tariff system privileges to ensure that these are directed towards households that will be most affected by increases in heating tariffs.*

- *Accelerate the installation of modern metering devices throughout the system including building-level heat metering and explore possibilities for moving towards apartment-level metering.*
- *Create enabling conditions for enhanced building and end-user energy efficiency. This includes completion of privatisation processes, establishing required legislation to ensure the creation of homeowner associations and that these are able to be the beneficiaries of loans for energy efficiency either directly or via a residential management company. Provide the necessary legislation to enable local banks to offer affordable loans for energy efficiency improvements.*
- *Develop schemes to make financing available for district heating companies to be able to invest in programmes for individual metering and building-level energy efficiency measures. Consider the creation of a dedicated fund to support, through credit lines or guarantees, the modernisation of the district heating sector and energy efficiency in buildings.*
- *In co-operation with international and local financial institutions and municipalities, design effective mechanisms for financing the modernisation of district heating systems and stimulate private-public partnerships, enable energy performance contracting, provide guarantees for subsidised commercial loans and promote concession agreements.*

5. CLIMATE CHANGE AND ENVIRONMENT

Key data (2010)

GHG emissions: 383.2 million tonnes of CO_2-eq, 59% lower than 1990 level

Carbon intensity: 1.5 toe per 1 000 USD of GDP in 2010

Registered Joint Implementation projects: 102 projects that delivered around 86 million Emission Reduction Units by mid-2012

Cumulative foreign investment in Kyoto Protocol related mechanisms: about EUR 1.1 billion in 2012

OVERVIEW

Ukraine is an Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC). Under the UNFCCC Kyoto Protocol, Ukraine committed to keeping its greenhouse-gas (GHG) emissions at the base year (1990) level during the first commitment period 2008-12. Even according to the "without measures" scenario, which incorporates significant growth in the use of coal, Ukraine expects to meet its Kyoto Protocol target. According to the Ukraine's national inventory of GHG emissions and removals of submitted to the UNFCCC in 2012, GHG emissions in 2010 were 383.2 million tonnes of carbon-dioxide equivalent (CO_2-eq), which is 59% less than in 1990.

In the Copenhagen Accord, Ukraine announced its intention to decrease its GHG emissions by 20% (equivalent to an annual emissions level of 736.7 Tg CO_2-eq) by 2020 compared with the base-year level. Ukraine proposes to take this target as its commitment under the Kyoto Protocol second commitment period. The available projections suggest that Ukraine will meet its proposed 2020 target of a 20% reduction with domestic measures only.

Currently Ukraine participates in two Kyoto Protocol mechanisms: Joint Implementation (JI) and international emissions trading of Assigned Amount Units (AAUs). Ukraine has made significant progress in setting up the necessary legal and institutional frameworks and in implementing these mechanisms. As of mid-2012, Ukraine had registered 102 JI projects that delivered around 86 million Emission Reduction Units (ERUs). Additional 30 million carbon units were sold as AAUs and Ukraine invested some of this money into domestic GHG reduction projects through the Green Investment Scheme. Ukraine is one of the most active countries in the JI market. As of June 2012, 41% of the world's ERUs were GHG reduction units from Ukraine. It is estimated that foreign investments in Ukraine's ERUs totalled about EUR 650 million by mid-2012; an additional EUR 470 million have been attracted into the Green Investment Scheme projects.

Despite all these activities targeted at GHG emissions reduction, Ukraine remains one of the most energy and carbon intensive European countries per unit of GDP. It has huge potential for GHG emissions abatement. More efforts need to be made by the government and industry to realise this potential through power sector modernisation and energy efficiency improvements, which will also contribute to energy security.

An out-dated power sector equipment fleet as well as a lack of pollution control technologies also contribute to high emissions of local pollutants. In 2009, the emissions of dust, sulphur and nitrogen oxides produced by thermal power stations in Ukraine exceeded by several times the respective emission standards in the European Union (EU). The government recently decided to harmonise its pollution standards with those in the EU Large Combustion Plant (LCP) Directive by 2012 and aims to achieve some of them by 2018. This is a very ambitious goal and can only be reached if the government and industry pool their resources to upgrade, retrofit and replace the majority of Ukraine's power stations and heavy industry facilities.

GHG EMISSIONS

GHG emissions in 2010 totalled about 383.2 million tonnes of carbon dioxide equivalent (Mt CO_2-eq) or 59% below 1990 levels and 4.9% higher than in 2009.[1] In 1990, Ukraine's emissions were 927 Mt CO_2-eq. The largest fall in emissions occurred between 1990 and 1999, it was followed by an increase during the 2000s when emissions grew at a rate of 1.6% per year prior to the onset of the economic crisis in 2008-09.[2]

Trends in total GHG emissions were mostly underpinned by emissions from the energy sector, which on average comprised around 70% of total national GHG emissions.[3] Between 1990 and 2010, GHG emissions from the energy sector decreased by 60%, driven mainly by a sharp economic decline in the 1990s and the consequent decrease in primary energy consumption (Figure 5.1). In 2010, emissions in the energy sector were 290.9 Mt CO_2-eq or around 76% of all GHG emissions in Ukraine (not including sequestration from land use, land-use change and forestry) and increased by 4.4% from 2009 levels. The increase was due to economic recovery after the global financial crises and increased fuel consumption.[4] Around 85% of the energy sector emissions come from fuel combustion and about 15% are fugitive emissions. The main drivers of GHG emission trends in Ukraine have been the transition from a centrally planned to a market-based economy, structural changes in the economy (shift from energy-intensive production sectors towards services) and the decrease in energy consumption, as well as the changes in the structure of primary energy use with reduced use of coal and increased use of natural gas.

Since 2001, GHG emissions have been increasing due to the growing demand for energy to meet the needs of the recovering mining sector, metal production, chemical industries and the growing number of vehicles. Recently, the drop in the output of export-related industries resulting from the financial and economic downturn in the second half of 2008 resulted in a slowdown in the growth of GDP from 7.9% in 2007 to 2.3% in 2008. This financial and economic downturn led to a decrease in GHG emissions, mainly from the manufacturing, industrial process and construction sectors.

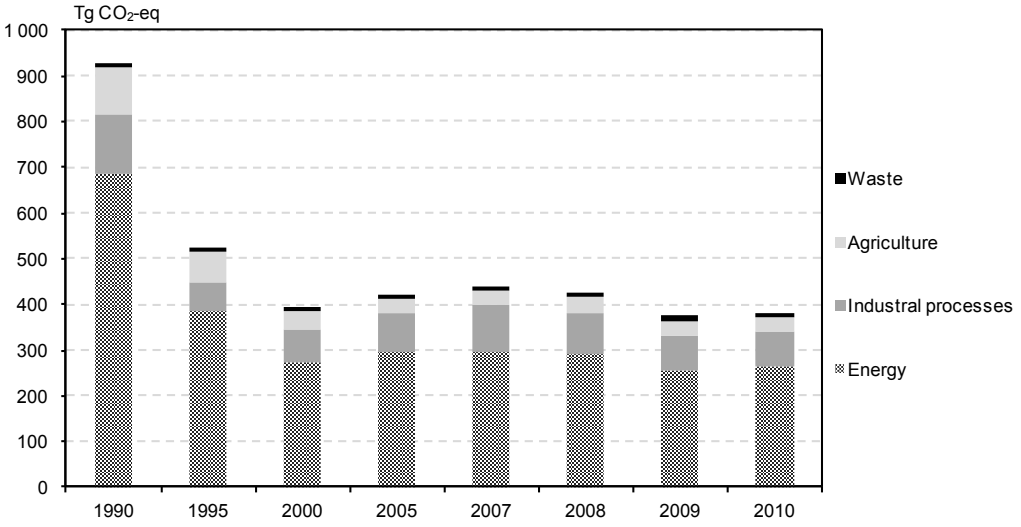
1. Ministry of Ecology and Natural Resources (MENR) (2012), *National Inventory Report of GHG Emissions in Ukraine for 1990-2010*, MENR, Kiev; and State Agency for Environmental Investments (SAEI) (2012), *Report on State Agency Investments in the First Half of 2012*, Kiev.

2. European Bank for Reconstruction and Development (EBRD) (2012), *Demand for Greenhouse-Gas Emissions Reduction Investments: An Investors' Marginal Abatement Cost Curve for Ukraine*, EBRD, London.

3. Energy sector includes emissions from carbon containing fuel combustion and fugitive emissions during fuel extraction, handling, storage, transportation and consumption.

4. MENR (2012) and SAEI (2012).

Figure 5.1 **GHG emissions by sector, 1990-2010**



Note: does not include land use, land-use change and forestry.

Source: Ukraine National Inventory Report to the UNFCCC, 2012.

In the last two years, GHG emissions have started to rise again. Projections developed by Ukraine for its Fifth National Communication to the United Nations Framework Convention on Climate Change suggest that GHG emissions could grow up to 755 Tg CO_2-eq (with emissions from the energy sector more than doubling from 2010) by 2020 if no GHG mitigation measures are implemented, coal consumption increases and GDP increases by 6.5% to 9% per year.

CARBON INTENSITY

The energy intensity of Ukraine, in GDP terms, has fallen substantially over the past two decades. Following an initial increase, as GDP dropped faster than energy use in the early 1990s, energy intensity has been declining since 1996, reaching 1.3 tonnes of oil equivalent (toe) per 1 000 USD of GDP in 2009. However, in recent years it has increased again and was close to 1.5 toe per 1 000 USD of GDP in 2010. For comparison, this indicator ranges between 0.1 and 0.2 in OECD European countries (Figure 2.5).

However, energy intensity per capita in Ukraine is at levels comparable with OECD Europe. Per capita energy intensity in Ukraine fell sharply between 1990 and 1998, but has since remained relatively stable at just under 3 toe/capita in 2008, or 40% below the 1990 level. The EU average is 2.7 toe/capita.

The intensity of Ukraine's GHG emissions follows a profile similar to that of energy intensity. Emission dropped by more than 50% between 1990 and 2000 (Table 5.1). Since 2000, emission intensity per capita has grown from 8 tonnes of carbon dioxide equivalent per capita (tCO_2-eq/capita) in 2000 to 9.2 tCO_2-eq/capita in 2008, a level similar to that of OECD Europe. In GDP terms, however, Ukraine's GHG emissions intensity is very close to Russia's, and more than three times higher than OECD Europe.[5]

5. European Bank for Reconstruction and Development (EBRD) (2012), *Demand for Greenhouse-Gas Emissions Reduction Investments: An Investors' Marginal Abatement Cost Curve for Ukraine*, EBRD, London.

The carbon intensity per unit of GDP (CO_2/GDP unit using PPP) decreased by 47.4% in the period 1996-2008, from 1.73 kilogramme (kg) to 0.91 kg per USD (year-2000) of GDP, mainly as a result of changes in the structure of the economy. This decrease was also influenced by changes in the structure of the primary energy supply, including an increase in natural gas consumption and a decrease of coal and oil consumption in the 1990s, and a later increase in the use of coal owing to the rise of the market price of gas from 2006. Ukraine forecasts a decrease of energy intensity per unit of GDP by 25.6% by 2020 as a result of planned energy efficiency measures and efforts to improve the environmental performance of the energy sector.

Table 5.1 **Indicators relevant for GHG emissions and removals**

	1990	1995	2000	2005	2008	Change 1990-2000 (%)	Change 2000-08 (%)	Change 1990-2008 (%)
Population (million)	51.9	51.5	49.2	47.1	46.3	-5.2	-5.9	-10.9
GDP (USD billion using PPP)	456.9	219.3	198.5	287.2	339.5	-56.6	-71.0	-25.7
TPES (Mtoe)	251.7	163.8	133.8	149.0	136.0	-46.9	1.7	-46.0
GDP per capita (thousand USD using PPP)	8.8	4.3	4.0	6.1	7.3	-54.2	81.8	-16.6
TPES per capita (toe)	4.9	3.2	2.7	3.2	2.9	-43.9	8.1	-39.4
GHG emissions without LULUCF (Tg CO_2-eq)	928.1	525.4	393.1	423.1	427.8	-57.6	8.8	-53.9
GHG emissions with LULUCF (Tg CO_2-eq)	859.6	478.9	341.6	383.0	411.3	-60.3	20.4	-52.2
CO_2 emissions per capita (Mg)	13.8	7.6	5.9	6.8	7.0	-57.4	19.7	-49.0
CO_2 emissions per GDP unit (kg per 2 000 USD using PPP)	1.6	1.8	1.5	1.1	0.9	-7.0	-34.1	-38.8
GHG emissions per capita (Mg CO_2-eq)	17.9	10.2	8.0	9.0	9.2	-55.3	15.7	-48.3
GHG emissions per GDP unit (kg CO_2-eq per USD using PPP)	2.0	2.4	2.0	1.5	1.3	-2.5	-36.4	-38.0

Notes: PPP= purchasing power parity; LULUCF = land use, land-use change and forestry; Mg = megagramme (or tonne), in year-2000 US dollars.

Source: UNFCCC, 2011.

INSTITUTIONS

The responsibility for climate change policy-making lies within the Ministry of Ecology and Natural Resources (MENR). The co-ordination and implementation of all climate policy-related measures defined by MENR falls under the responsibility of the State Environmental Investment Agency of Ukraine (SEIA), created in 2007, which also has overall responsibility for implementation of the provisions of the Kyoto Protocol and the UNFCC Convention. A number of national ministries and agencies as well as regional administrations and the Ukrainian Academy of Sciences are involved in the development and implementation of climate change-related policy at the national and regional levels.

To strengthen the implementation of Ukraine's commitments under the UNFCCC and its Kyoto Protocol, an inter-agency committee (IAC) was established in 1999. The IAC includes representatives of the Ministry of Environment, Ministry of Economic Development, Ministry of Energy and Coal Industry, Ministry of Infrastructure and other ministries and departments. The IAC undertakes the following tasks:

- co-ordination of the implementation of the national plan of measures for the provisions of the UNFCCC and Kyoto Protocol (2005, revised in 2009);
- approval of official submissions to the UNFCCC secretariat; and
- preparation of draft regulations and legislation for consideration by the Cabinet of Ministers.

In 2011, an inter-agency working group was established to prepare a draft national plan of adaptation to climate change to be effective between 2012 and 2015.

POLICIES AND MEASURES

Ukraine has significant GHG mitigation potential, mainly in the energy supply sector, and related to energy consumption in the residential and commercial sectors, primarily buildings and appliances, and in industry. However, little of this potential has been tapped, owing to a number of regulatory, economic, technical and infrastructure barriers. In addition, the lack of systematic planning, monitoring and evaluation of the programmes and measures at the national and sectoral levels, is a challenge that needs to be addressed in order to tap this mitigation potential.[6]

POLICY FRAMEWORK

Policy framework and cross-sectoral measures include the following key documents:

- the national Plan for the Implementation of Provisions of the UNFCCC and Kyoto Protocol (2005, updated 2009);
- the strategy of National Policy for Environmental Protection to 2020 (2010);
- the national Action Plan on Environmental Protection for 2011-2015; and
- the state Environmental Monitoring Programme for 2008-2012.

Ukraine's national plan is an overarching strategic document that outlines the general framework and actions to implement the Climate Change Convention and its Kyoto Protocol. In addition, there are some initiatives to develop a national mitigation plan, several sectoral programmes and regional initiatives. These initiatives are mostly driven by the development goals of economic sectors and not necessarily by climate policy objectives. The national plan includes provisions for the preparation of the annual submission of Ukraine's GHG inventory, the development of joint implementation infrastructure and creation of a legal basis for regulating GHG emissions, including development of national and regional plans, research and public awareness programmes.

In 2009, the national plan was revised to reflect the outcome of the international climate change negotiations. Among the sectoral programmes, energy-related programmes play

6. United Nations Framework Convention on Climate Change (UNFCCC), 2011, *Report of the In-depth Review of the Fifth National Communication of Ukraine*, FCCC/IDR.5/UKR, 27 September 2011, UNFCCC, Bonn, Germany.

the key role for climate change mitigation. Ukraine highlighted in its Third, Fourth and Fifth National Communications to the UNFCCC a major focus on energy efficiency programmes, which aim to reduce the country's dependence on primary energy imports while also providing emissions reductions. Energy efficiency is one of the key themes in the primary energy-related policy strategies, programmes and plans at the national and regional levels, namely the *Energy Strategy of Ukraine to 2030* (both the 2006 version and the draft update in June 2012) and the *Energy Efficiency Programme for 2010-2015*.

Recently Ukraine launched a number of initiatives aimed at further implementation of climate change-related policies, mainly in the context of the overall environmental policy. The key law underpinning Ukraine's climate change policy is the Law on Main Principles of State Environmental Policy of Ukraine for the period to 2020, adopted by the parliament in 2010.

Regulatory instruments (requirements and standards) play a key role in Ukraine's climate change-related policy. Since Ukraine's emissions are far below its Kyoto targets for the 2008-12 period, Ukraine's position is that it does not urgently need an overarching national GHG emissions reduction strategy. Nevertheless, there have been some initial steps taken towards consideration of economic instruments in addition to regulations and standards in Ukraine's climate change policy portfolio. Currently Ukraine is considering a domestic GHG emissions trading scheme. The government has drafted a regulation, but it was not approved by the Parliament. A new regulatory framework needs to be developed in order to create a mechanism for GHG emissions trading. Such a regulatory framework could be the draft law on the Fundamentals of State Policy on regulation of anthropogenic emissions of GHGs and adaptation to climate change, which is currently being drafted by the SAEI and the Ministry of Environment. The main driver for consideration of economic instruments is the goal to increase the security of the energy supply through enhancing energy efficiency and increasing the use of renewable energy.

As around 70% of the national GHG emissions stem from the energy sector, Ukraine is setting priorities in energy and climate-related policies to increase the use of renewables, nuclear and efficiency in fuel and energy consumption. Ukraine has established a set of new regulations in the energy sector, such as the Law on Power Industry (1997, with amendments in 2010), which introduced feed-in tariffs for renewables and the tax code (effective January 2011), which includes a number of instruments to promote renewables and energy efficiency: tax exemptions and reductions to stimulate the use of energy-efficient technologies and appliances and CO_2 taxation to stimulate GHG emissions reduction from the supply side.

The planned measures for GHG emissions reduction focus on technological measures such as modernisation of existing power plants, promoting new combined heat and power plants, and implementation of energy efficiency programmes. They also include structural measures such as increases in nuclear power and renewable energy sources, and collecting and using the methane from coal mining for heat and power production.

The total economically feasible emissions reduction potential of Ukraine's policies and measures (PaMs) is estimated at 23.1 Tg CO_2-eq in 2010 (calculated as the sum of the economically feasible GHG emissions reduction potential of implemented and adopted measures by sector) and 119.1 Tg CO_2-eq in 2020 (Table 5.2). PaMs implemented in the energy sector have the largest emissions reduction potential, followed by measures in the industrial process sector and those in the transport sector.

According to the forecasts by the Ukrainian government, GHG emissions by 2020 would be 20% below 1990 levels even if no GHG reduction measures were undertaken (Figure 5.2).

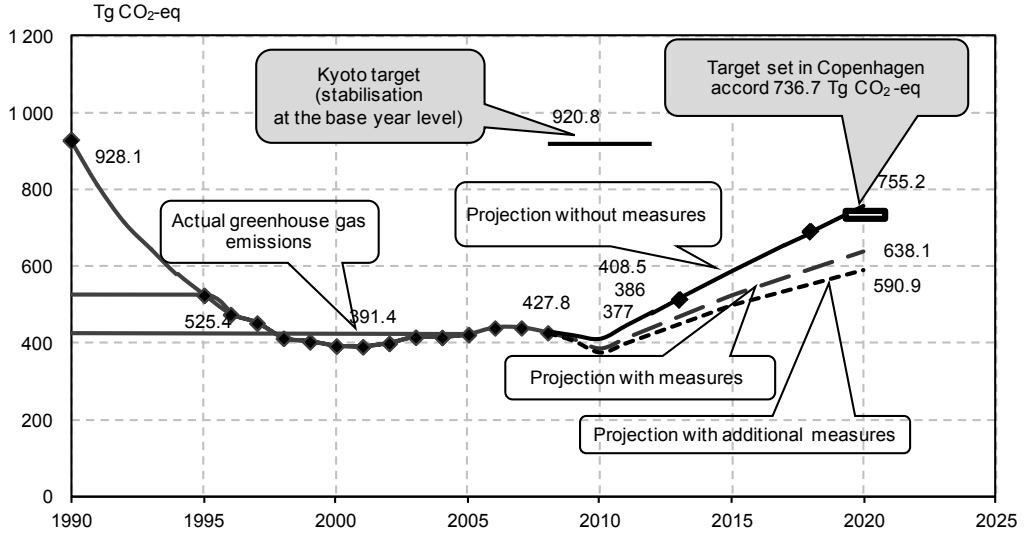
Scenarios with measures and with additional measures show a possibility of 31% to 36% GHG emission reduction from 1990 by 2020. These estimates suggest that with the right set of incentives, Ukraine could significantly over-achieve its Cancun pledge and take advantage of various forms of international carbon markets that are currently being discussed in the UNFCCC negotiations.

Table 5.2 **Estimated emission reduction potential of policies and measures by sector, 2010 and 2020**

Sector	2010 (Tg of CO_2-eq)	2020 (Tg of CO_2-eq)
Energy	9.9	86.1
Industry	11.6	20.3
Transport	0.7	8.9
Other	0.8	3.8
Total	23.1	119.1

Source: United Nations Framework Convention on Climate Change (UNFCCC), 2011, *Report of the In-depth Review of the Fifth National Communication of Ukraine*, FCCC/IDR.5/UKR, 27 September 2011, UNFCCC, Bonn, Germany.

Figure 5.2 **GHG emissions projections**



Note: emissions are without land use, land-use change and forestry.

Source: United Nations Framework Convention on Climate Change (UNFCCC), 2011, *Report of the In-depth Review of the Fifth National Communication of Ukraine*, FCCC/IDR.5/UKR, 27 September 2011, UNFCCC, Bonn, Germany.

INTERNATIONAL MECHANISMS

Ukraine has also been successfully using the Kyoto Protocol international mechanisms to incentivise GHG emissions reductions. Ukraine participates in international Joint Implementation activities and also in the assigned amount units (AAUs) trading at government level.

In Ukraine, Joint Implementation (JI) is co-ordinated by SEIA and is regulated by a number of legislative acts adopted in the period 2006-08 that established the necessary legal basis. Ukraine has in place a number of JI projects, which are at different stages of preparation and implementation. As of 1 July 2012, 275 JI projects had received letters

of endorsement; letters of approval had been issued to 126 JI projects; and 102 projects had been registered with the UNFCCC secretariat. These projects are relatively large-scale, with project level emissions reductions ranging from 0.2 Mt CO_2-eq to 8.5 Mt CO_2-eq for the period 2008-12. Most of the JI projects target energy efficiency improvements in industrial facilities. For example, there are 73 projects in fuel combustion facilities with expected emission reductions of 37 Mt CO_2-eq.

The majority of JI projects are supported by European Union countries (including Denmark, Germany, Ireland, Netherlands and United Kingdom).The remaining projects are supported by Japan and Switzerland. JI is an important mechanism for Ukraine to attract foreign investment for the implementation of GHG emission reduction measures in industry.

Around 113 million carbon units (of which around 29 million are AAUs and 84 million are Emission Reduction Units [ERUs]) were issued and delivered by SEIA as of mid-2012. The ERUs were delivered by 79 out of 102 registered JI projects of which 21 are track 2 projects and 81 are track 1.[7] Ukraine is one of the most active countries in the JI market. As of mid-2012, 41% of global ERUs are GHG reduction units from Ukraine. It is estimated that cumulative foreign investment in Ukraine's AAUs and ERUs reached around EUR 1.1 billion in 2012, (of which EUR 650 million are investments in ERUs and EUR 470 million – investments from AAUs sales in Green Investment Scheme projects).

With regard to participation in an international emission trading scheme, Ukraine has set up a Green Investment Scheme (GIS) that is funded from the revenues from the international emission trading of AAUs and aims to fund GHG emissions reduction projects. GIS is co-ordinated by SEIA. It is operational and regulated by a number of legal acts adopted in 2008-10. So far, the key partners of GIS have been Japan and Spain. As of mid-2012, SEIA had received 1 909 project proposals from 25 regions of Ukraine seeking environmental (green) investment. Most of the 1 909 proposed projects focus on thermo-insulation and energy efficiency improvements of public facilities, *e.g.* schools, hospitals and kindergartens, with measures that include thermal insulation of facades and roofs, and replacement of windows and doors. Other projects aim to replace boilers to use alternative fuels in educational institutions and health care facilities.

AIR QUALITY

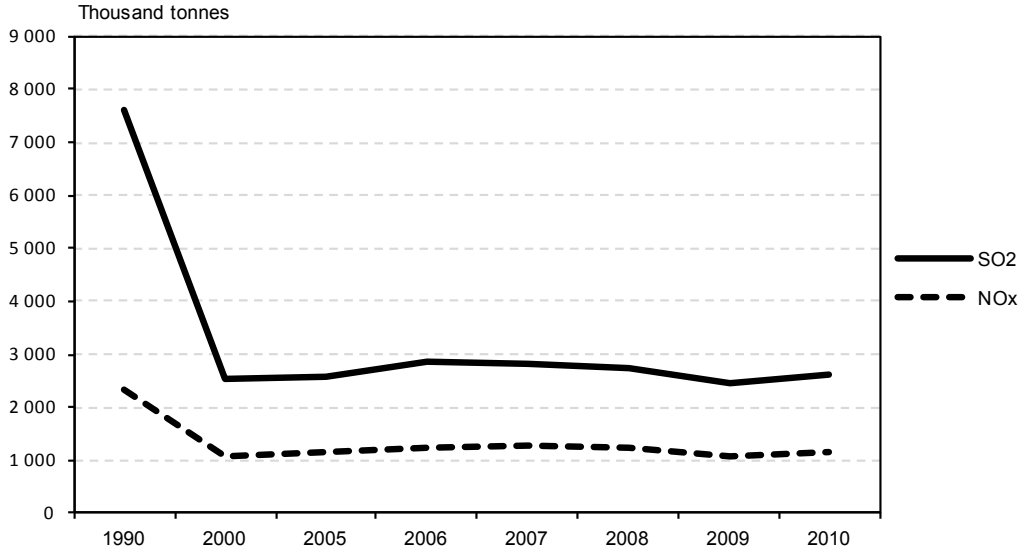
One of the most pressing challenges that Ukraine faces today is the need to drastically reduce emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM) from large thermal power plants. In 1990, 97% of NO_x and SO_2 emissions came from the energy sector, and the remaining 3% from industrial processes. Between 1990 and 2010, SO_2 emissions decreased faster than GHG emissions due to significant reduction in the consumption of fuel oil which was replaced by natural gas; however, these emissions remain much higher than European standards (Figure 5.3).

In 2009, emissions of dust, SO_2 and NO_x produced by thermal power stations in Ukraine significantly exceeded the respective emission standards in developed countries (Figure 5.4). The environmental performance of pulverised coal power plants in Ukraine is well below standards in the European Union:

7. To participate in track 1 Joint Implementation (JI) projects, a host country has to meet six eligibility requirements established by the UNFCCC. If a country does not meet these eligibility requirements, it can still host JI projects, but under track 2 that requires verification by the Joint Implementation Supervisory Committee.

- dust abatement measures in Ukraine allow PM concentration levels of 1 000 milligrammes per cubic metre (mg/m^3) to 1 500 mg/m^3, while the EU standard is 30 mg/m^3 to 50 mg/m^3;
- there is no sulphur dioxide abatement so SO_2 emissions are 3 000 mg/m^3 to 8 000 mg/m^3 in Ukraine compared with EU standards of 200 mg/m^3 to 400 mg/m^3; and
- partial NO_x abatement occurs through technological parameters, however, end-of-pipe technologies are not used in Ukraine, and concentrations of NO_x emissions are 600 mg/m^3 to 1 400 mg/m^3, while the EU standard is 200 mg/m^3 to 600 mg/m^3.[8]

Figure 5.3 **Trend in SO_2 and NO_x emissions, 1990-2010**



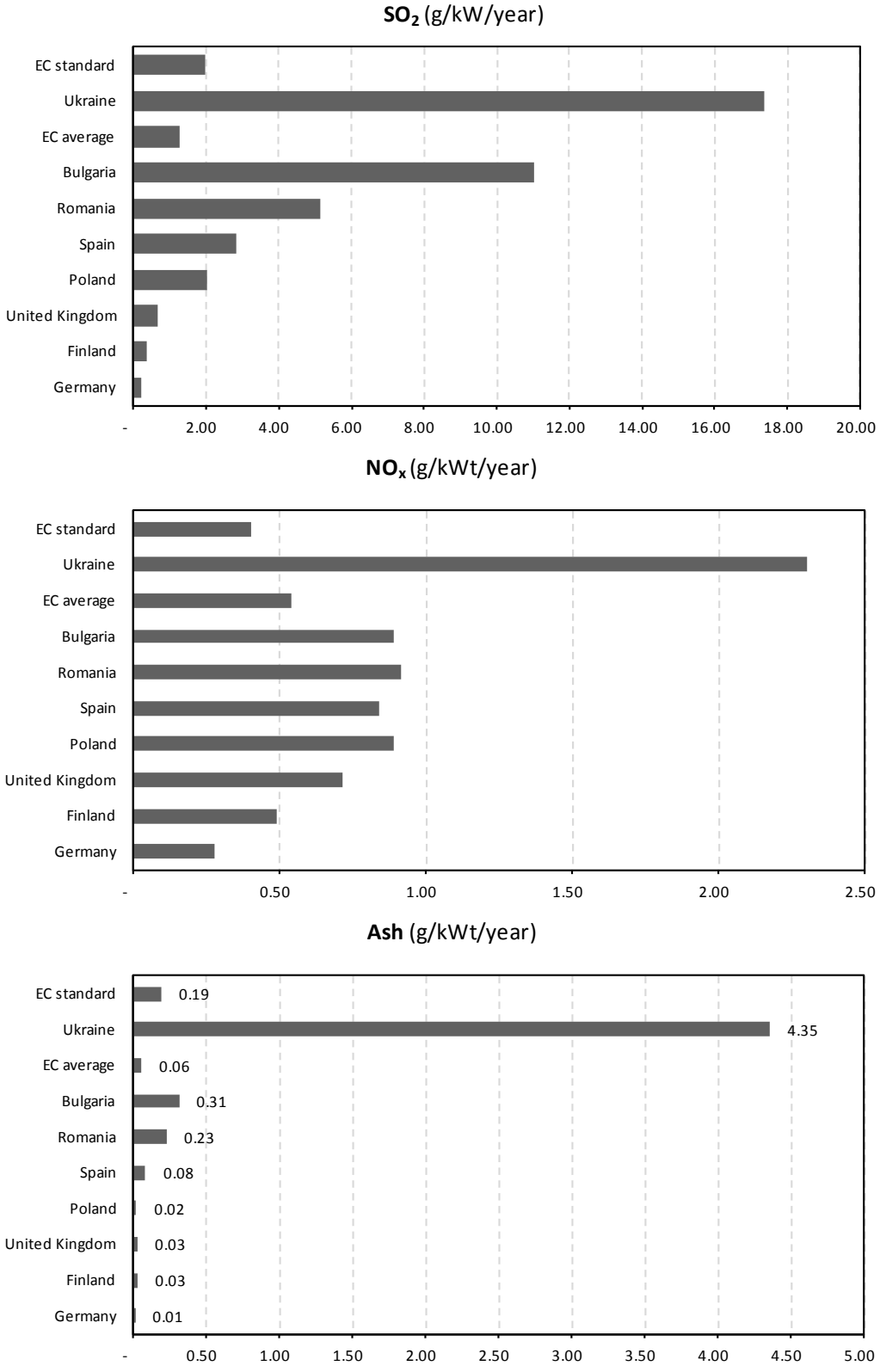
Source: Ukraine National Inventory Report to the UNFCCC, 2012.

Some 92% of Ukraine's thermal power plants and combined heat and power units have reached the end of their design life (100 000 hours), and 64% of them are far past their service life limit (200 000 hours), plus they have no gas treatment systems.[9] To advance environmental policy in Ukraine, the Ministry of Ecology and Natural Resources has developed several strategic documents since 2007, for example, the *Concept of the National Environmental Policy for Ukraine for the Period to 2020* and *Action Plan on Environmental Protection for 2011-2015*. In addition, Ukraine has made a decision to harmonise its legislation with the EU directive that limits certain emissions from thermal power plants above 50 megawatts (EU Directive 2001/80/EC). This decision was made as part of the process of Ukraine's ratification of the Protocol on accession to the Treaty establishing the Energy Community in 2010. Under this Protocol, Ukraine has committed to comply with the standards set in that directive.

8. Donetsk Energy Company (DTEK) (2012), Data and information provided by DTEK, Donetsk, Ukraine.

9. Verbitskaya, I.(2011), *Highlights of the National Target Programme on the Limitation of Emissions of Certain Pollutants into the Air from Large Combustion Plants of the Energy Generation Sector of Ukraine*, All Ukrainian Seventh Scientific Conference proceedings, Kiev.

Figure 5.4 **Emissions of local pollutants by major thermal installations**



Note: data for European Union countries are from 2006. Data for Ukraine are from 2009.

Source: draft *Updated Energy Strategy of Ukraine to 2030*.

In 2008, new regulations were set for power plants with a rated thermal capacity above 50 megawatts (MW) to equip them with dust and gas cleaning installations to reduce dust, sulphur dioxide and nitrogen oxides emissions to the EU standards by the end of 2017.[10] Compliance with these requirements is especially important in the context of Ukraine's national policy aimed at European integration, active negotiations with the European Union on the association and the creation of a free trade zone, and Ukraine's accession to the Treaty establishing the Energy Community.

Being fully aware of the importance and scale of the set targets and the complexity of their achievement, the Ministry of Energy and Coal Industry has initiated the development of a National Target Programme on the Limitation of Emissions of Certain Pollutants into the Air from Large Combustion Plants in the Energy Sector. The general purpose of the programme is stipulated as to facilitate Ukrainian energy companies' achievement of the EU atmospheric pollutant emissions levels and to develop and introduce high-performance gas treatment plants and technologies.

The objectives are to be achieved by the following measures:

- Maintain the operating dust collectors in normal working conditions and take low-cost measures to reduce emissions for plants that cannot be upgraded and are due to be decommissioned by 2015.
- Carry out major overhauls and take additional measures to enhance dust collection, or install up-to-date electric precipitators to reduce dust content to 50 mg/m^3; apply technological measures to reduce NO_x emissions for plants that cannot be upgraded and are due to be decommissioned by 2020, as well as plants that need low-cost upgrades to extend their service life by ten to fifteen years.
- For plants that will be decommissioned by 2030 and upgraded plants with prolonged service life of 15 to 20 years: high performance electric precipitators will be installed; desulphurisation ($DeSO_x$) systems will be introduced that comply with the requirements of EU Directive 2001/80/EC. NO_x emissions will be reduced, first of all, by taking technological measures; further treatment can be by catalytic or homogeneous reduction. From 2012 to 2015, it is planned to launch pilot projects of high-performance gas treatment facilities. From 2016 to 2020, proven basic designs of gas treatment plants are planned to be applied at the upgraded power units and new flaring plants. From 2021 to 2030, high-performance gas plants are planned to be installed at new and upgraded capacities.
- Equip new thermal power plants with a full set of high-performance dust treatment, $DeSO_x$ and $DeNO_x$ (NO_x emission reduction) technologies.

The concept for the National Target Programme proposes such measures as the upgrade of pulverised coal-fired energy units with a total capacity of 14 000 MW, construction of an additional 8 000 MW and an increased share of flexible capacity (mainly construction of pumped storage hydropower plants) to 14.6% of the total power generation sector capacity. If the concept is approved, its proposed measures will allow cutting down specific consumption of standard fuel by approximately 15% and contributing to pollution emission reductions. The cost of installing pollution control equipment on modernised power plants could be as high as 60% of the cost of the energy equipment. The amount of investment required for installation of the dust and gas cleaning equipment in the operating thermal power plants during their reconstruction will amount to UAH 37 billion (EUR 3.7 billion).[11]

10. Ministry Order No. 541, 2008.

11. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

According to the estimates of the Fund of Effective Governance, the cost of end-of-pipe emission control measures necessary to comply with the EU standards could be around USD 1.5 billion per year in the next five years reaching USD 7.5 billion by 2017.[12] Once the concept is approved, the government will start preparing a programme for its implementation taking into account best practices and international experience in environmental modernisation of electric power to facilitate cost effectiveness.

Combustion of solid fossil fuels at power plants produces ash and slag wastes. Ukraine needs to consider pre-combustion coal treatment before transportation and combustion to mitigate local pollution and waste from coal-fired power plants. This could preferably be done at the place of extraction to save money on transport, additional exhaust air cleaning and ash and slag disposal. It is important to note that this measure is considered to be ineffective for sulphur cleaning due to the chemical characteristics of the Ukrainian coals, but this issue is dealt with in Chapter 9.

The State Fund for Environmental Protection is the main source of funding for environmental protection measures. Its activities are regulated by the Law on Environmental Protection and the Ordinance on the State Environmental Fund from 1998. Revenues of the fund come from an environmental tax, voluntary payments by organisations and enterprises, and environmental fees for pollution. The most stable source is revenues from the environmental tax, which replaced collections for environmental pollution that existed until 2011. The Tax Code of Ukraine adopted the environmental tax in 2010. It is based on the actual volume of emissions into the atmosphere at these rates:

- NO_x: UAH 1 329.67/tonne;
- PM: UAH 50.09/tonne; and
- SO_2: UAH 1 329.67/tonne.

Revenues from the Environmental Fund are small compared to the financial needs of the power sector for air pollution abatement. Moreover they have to be spent on a variety of environmental issues such as water and waste matters, and environmental monitoring.

CRITIQUE

Ukraine's energy sector is the largest source of its GHG and local pollutant emissions. The power generation sector with its outdated and inefficient fleet of plants and equipment, lack of pollution control and aging infrastructure makes it the largest contributor to these emissions. The need for modernisation of the power generation sector has never been more urgent to bring Ukraine's energy sector to international standards, enhance energy security and support economic growth, improve energy efficiency and address local pollution as well as global climate change.

In the last several years, Ukraine has made important efforts to participate in the UNFCCC flexibility mechanisms and to comply with inventory and reporting provisions under the UNFCCC and the Kyoto Protocol. As a result, it has attracted significant foreign investment in GHG mitigation efforts. Due to economic restructuring and the significant decline in industrial output compared to 1990 levels, Ukraine's energy demand has decreased, as have the associated GHG emissions. Today its GHG emissions are almost 60% below 1990 levels. However, Ukraine's energy and carbon intensity per unit of GDP are still among the highest

12. DTEK (2012).

in Europe and it has huge potential for energy efficiency and GHG emissions reductions. They could be realised through continuous and even expanded access to international carbon finance (*e.g*. reformed JI in a post-2012 regime, international emissions trading). For example, a European Bank for Reconstruction and Development study shows that implementation of a domestic emissions trading system, which is under consideration, and linking such a system to the EU Emissions Trading System would boost the commercial viability for significant investment in energy efficiency and low-carbon energy sources.[13]

Ukraine pledged to keep GHG emissions 20% below 1990 levels and declared its intention to reduce emissions by 50% from 1990 levels by 2050 at the UNFCCC climate negotiations in Cancun, Mexico in 2010. While the 2020 target seems easily achievable, projected economic growth across emissions-intensive sectors would shift emission pathways on an upward trajectory especially given today's not very ambitious policies. According to the EBRD analysis, Ukraine's emissions commitment for 2050 will be very challenging to achieve even with EU-compatible policies and known technologies. These conclusions call for a more pro-active, ambitious and long-term climate mitigation strategic policy by the government. To meet long-term ambitious GHG emissions reductions goals while maintaining or even increasing the rate of coal consumption, high efficiency, low emissions technologies – including combustion of coal under supercritical and ultra-supercritical conditions, integrated gasification combined-cycle and carbon capture and storage – have an essential role to play.

Ukraine's local air pollution is alarming and is mostly caused by the energy sector. Concentrations of local pollutants in exhaust air of power stations can sometimes be as much as 50 times higher than the EU standards. This problem can only be addressed through retrofitting power stations with more efficient equipment, replacing old coal-fired stock with efficient modern technologies and installing end-of-pipe pollution control. Ukraine made an important step in this direction by adopting the EU Large Combustion Plant Directive and incorporating its requirements in national plans and legislation. However, the targets set for 2018 can only be achieved if incentive policies are developed to assist the power sector with major modernisation efforts.

Such policies and finance provisions have not yet been developed. For example, the draft *Updated Energy Strategy of Ukraine to 2030* includes important discussions on environmental problems and provides guiding principles to address them.[14] However, its recommendations are very general and cannot be taken as serious signals for action. In addition, the strategy does not address financing issues. Concrete targets and timeframes need to be set as well as suggestions on how the government and industry can work together to reduce emissions in the most cost-effective manner. International co-operation on new technologies and materials could be beneficial to Ukraine's efforts on power sector modernisation. The government should also promote domestic research and development efforts.

RECOMMENDATIONS

The government of Ukraine should:

Address local air pollution and GHG emissions from the energy sector in five key policy areas, as listed below, to further the efforts made so far.

13. European Bank for Reconstruction and Development (EBRD) (2012), Demand for Greenhouse-Gas Emissions Reduction Investments: An Investors' Marginal Abatement Cost Curve for Ukraine, EBRD, London.

14. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

- *Continue and expand participation in the UNFCCC mechanisms to enhance efforts to reduce GHG emissions.*
  - *Continue participating in the Kyoto Protocol mechanisms, Joint Implementation and AAU trading, during the second commitment period; invest revenues in cost-effective GHG reduction projects: demand-side energy efficiency, coalbed methane, waste and public transport infrastructure. Energy production requires a special attention and an investment strategy.*
  - *Scope out Ukraine's participation in a post 2012 UNFCCC agreement, in particular in global GHG emissions trading, any other market-based mechanism and the technology mechanism. Negotiate provisions that would facilitate Ukraine's participation taking into account its status as a transitional economy. Develop capacity to be able to participate in these mechanisms once they are in place.*
- *Set clear goals and allocate public support resources for power sector modernisation to address both GHG and local pollution emissions reductions and to increase the overall efficiency of Ukraine's economy.*
  - *Set a clear and realistic retirement schedule for old inefficient power plants and equipment.*
  - *Retrofit suitable power generation facilities.*
  - *Ensure that if new coal plants are to be built, they employ the most efficient technology available, such as supercritical and ultra-supercritical coal-fired power plants and circulating fluidised bed power stations.*
  - *Make new supercritical and ultra-supercritical coal-fired power plants CO_2 capture ready for the future when more aggressive and costly GHG emission reductions will be required from Ukraine.*
- *Develop a clear and concrete national action plan to specify tools, timeframes and financial resources for the implementation of the Updated Energy Strategy of Ukraine to 2030 that specifies short-term clear objectives, resources, responsibilities, progress evaluation metrics and timeframes.*
- *Create policy conditions to spur innovation and domestic technology development in pollution control and new efficient power plant technologies.*
  - *Require installation of SO_2, NO_x and PM emissions control systems on retrofitted and new power plants.*
  - *Set long-term emissions control targets and a national policy package so that domestic pollution control technologies could be incentivised and developed (long-term emissions control targets would also allow energy companies to strategically plan their investments).*
  - *Investigate international partnership options to purchase licences of new technologies and/or new materials.*
  - *Provide tax reductions and subsidies for industrial research and development.*
- *Consider economic instruments in addition to standards and direct financing of abatement measures through the State Environmental Fund, such as loan guarantees, tax credits, subsidies (e.g. through power purchase agreements), a domestic GHG emissions trading scheme to address local and GHG emissions cost-effectively.*

6. UPSTREAM OIL AND GAS

Key data (2011)

Hydrocarbon reserves: 9 billion tonnes of oil equivalent

Natural gas production: 20.1 billion cubic metres

Crude oil and condensate production: 3.3 million tonnes

OVERVIEW

With a century-long history of oil and gas production, Ukraine has substantial hydrocarbon reserves, both conventional and unconventional, which are mostly untapped. Once an energy exporter, Ukraine's domestic production only covered about 20% of oil demand and about 33% of natural gas demand in 2011. Today, Ukraine is heavily dependent on oil and gas imports. The country's upstream oil and gas industry is dominated by the state-owned National Joint Stock Company Naftogaz of Ukraine (Naftogaz), which with its subsidiaries accounts for approximately 90% of all domestic production, mainly producing from mature fields. Enhancing production from depleted fields and opening prospective fields for production requires substantial investment.

A combination of import dependency, high import prices, the shortcomings of having a single supplier and considerable potential for domestic production, has triggered a government focus on gaining energy independence. Ukraine strives to diversify energy supply sources and pursues ambitious plans for a two-fold increase in domestic gas production by 2030.[1]

Despite the vast potential of untapped hydrocarbon reserve which, together with an effective policy to increase energy efficiency, could move Ukraine to energy self-sufficiency in the foreseeable future, achieving this potential requires time, and predictable and robust policies. Ukraine's government encourages development of new sources of natural gas and has set a target of producing 3 billion cubic metres (bcm) to 5 bcm of unconventional gas by 2020. Coalbed methane is the most likely source of unconventional production growth in the short to medium term, but, if the necessary conditions are in place, shale gas also offers considerable promise. In a recent projection by the International Energy Agency (IEA), the Golden Rules Case, production of unconventional gas in Ukraine reaches 3 bcm in 2020 and ramps up to around 20 bcm by 2035, provided that supportive measures are adopted to facilitate investment in the gas sector.[2] According to the draft *Updated Energy Strategy of Ukraine to 2030* (2012), even in its optimistic scenario, a significant increase in production only starts from 2025.

Significant improvements in the government's strategy for increasing domestic oil and gas production have been made in 2012. In addition to a number of legislative changes aimed

1. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period until 2030*, June 2012, Kiev.

2. International Energy Agency (IEA) (2012), *Golden Rules for a Golden Age of Gas: World Energy Outlook Special Report on Unconventional Gas*, OECD/IEA, Paris.

at attracting foreign direct investment, Ukraine conducted tenders for opening its upstream oil and gas sector to international oil companies. For example, in May 2012, tenders for the giant Yuzivska and Oleska oil and gas blocks in the east and west of Ukraine awarded exploration and production rights to Royal Dutch Shell and Chevron, which are now in the process of negotiating the terms of production-sharing agreements (PSAs) with the government of Ukraine. Tenders were also announced for the development of the Black Sea and Azov Sea offshore Foros and Skifska fields. In August 2012, Ukraine selected ExxonMobil and Royal Dutch Shell to lead exploration and development of the Skifska deepwater natural gas field offshore of the Black Sea, together with Romania's OMV Petron and NJSC Nadra Ukrayny. No bids were submitted for the development of the Foros Field.

Undoubtedly the Ukrainian government's focused moves towards achieving energy independence have attracted significant attention both in the country and beyond. The direction set out in the draft *Updated Energy Strategy of Ukraine to 2030*, which is currently under public consultation, aims to lay the groundwork for this challenging period of transition from a key energy transit country to a major energy producer.

OIL AND GAS EXPLORATION AND PRODUCTION

HISTORICAL OVERVIEW

Natural gas exploration and production in Ukraine dates back to 1912, but with only a moderate level of development until the mid-1950s. Commercial gas production began in 1924 at the Dashava gas field and with construction of the first gas pipeline, Dashava-Striy. Natural gas production on a large scale started towards the end of the 1950s and beginning of the 1960s with the development of the major Shebelinske gas field with 650 bcm of proven reserves, followed by the opening of new fields for exploration and production. Production reached its peak of 68.7 bcm in 1975, after which gas production declined dramatically and since 1998 has levelled off at 18 bcm to 21 bcm per year.

Although commercial oil production in Ukraine began as far back as the 18th century, reaching 2 million tonnes (Mt) in 1909 in the Pre-Carpathian region, intensive oil exploration and production only started in the late 1940s in the area of the Dnipro-Don Valley, and the Pre-Carpathian and Northern Black Sea-Crimea regions. Oil production reached a maximum of 14.4 Mt (with condensate) in 1972.

Ukraine was the first country in the world to initiate natural gas exports, with deliveries to Poland in 1945. Natural gas exports to Czechoslovakia began in 1967 and, later, to Austria. Oil transit to Czechoslovakia via Ukraine began in 1962.

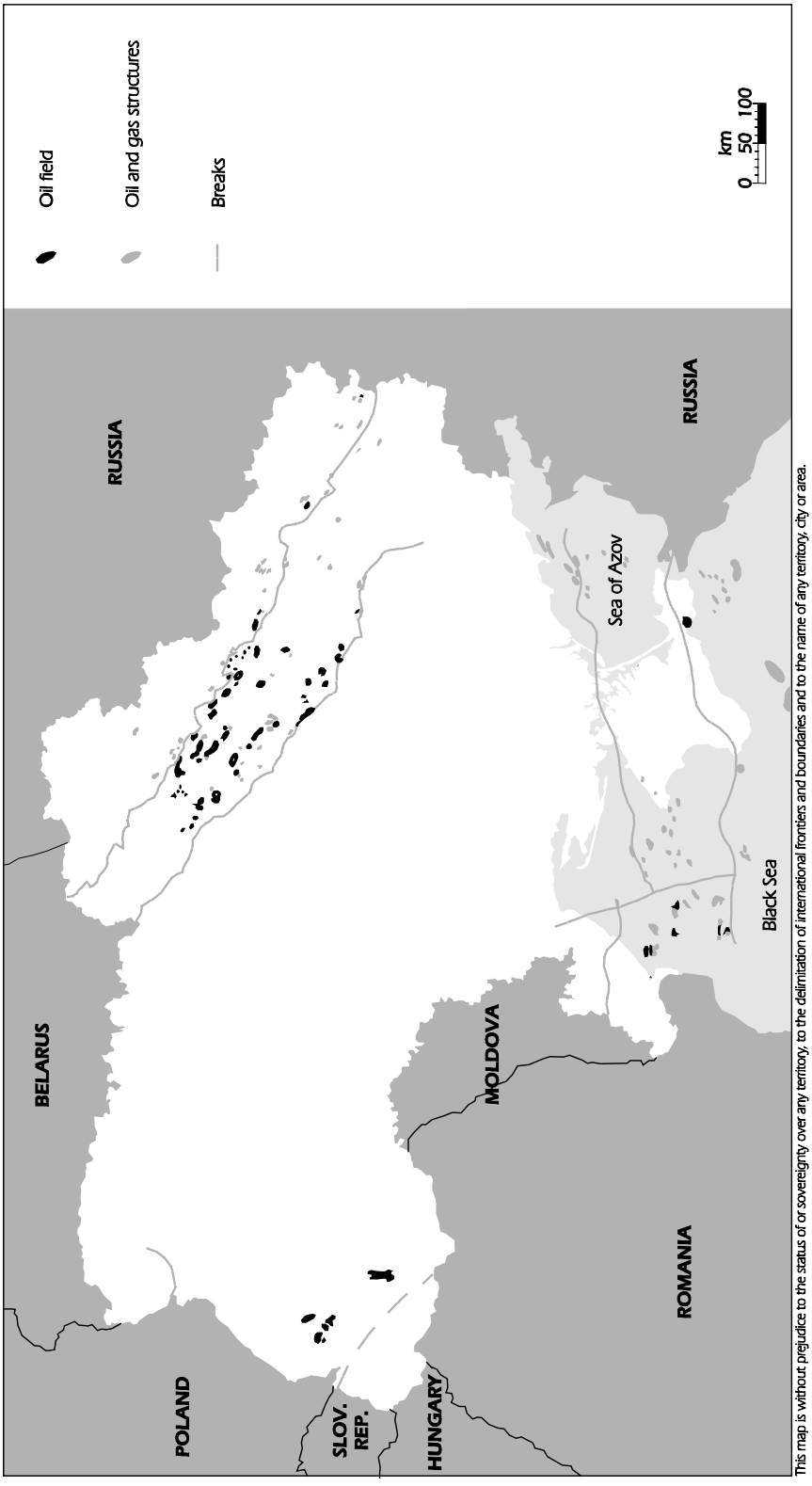
HYDROCARBON RESERVES

Government estimates for Ukraine's hydrocarbon reserves are 9 billion tonnes of oil equivalent (toe).[3] Natural gas reserves are estimated at 5.4 trillion cubic metres (Tcm)[4], with proven reserves of 1.1 Tcm of natural gas, more than 400 Mt of gas condensate and 850 Mt of oil reserves.

3. State Service for Geology and Mineral Resources of Ukraine, *www.dgs.kiev.ua/palivno-energetichna-sirovina.html* (accessed 18 July 2012).

4. This text uses "tcm" to denote "thousand cubic metres"; the substitution of a capital "T" (Tcm) indicates "trillion cubic metres".

Figure 6.1 **Hydrocarbon resource map of Ukraine**



Source: State Service for Geology and Mineral Resources of Ukraine.

Hydrocarbon resources in Ukraine are concentrated in three regions: the Carpathian region in the west; Dnipro-Donetsk region in the east; and Black Sea-Azov Sea region in the south (Figure 6.1). The Dnipro-Donetsk region accounts for 80% of proven reserves and approximately 90% of gas production. The Carpathian region has 13% of proven reserves and accounts for 6% of production. The remaining 6% of proven reserves are located in the southern region, where production is conducted both onshore and offshore in the shallow shelf of the Black and Azov Seas. The aggregate production in this region is 5% of the total oil and gas produced in the country.

Ukraine has considerable unconventional gas potential in the form of coalbed methane in the main coal mining areas of eastern Ukraine and in two shale gas basins: a portion of the Lublin Basin, which extends into Poland and the Dnieper-Donets Basin in the east. Coalbed methane resources are estimated at close to 3 Tcm and technically recoverable shale gas resources at 1.2 Tcm.[5] The Ukrainian section of the Lublin Basin is large and reportedly has higher average total organic content than the Polish section and lower average depth. The Dnieper-Donets Basin, which currently provides most of the Ukraine's conventional oil, gas and coal production, also has high organic content, but is deeper.

Box 6.1 **Unconventional hydrocarbon resources**

Shale is a geological rock formation rich in clays, typically derived from fine sediments, deposited in fairly quiet environments at the bottom of seas or lakes, having then been buried over the course of millions of years. When a significant amount of organic matter has been deposited with the sediments, the shale rock can contain organic solid material called kerogen. If the rock has been heated to sufficient temperatures during its burial history, part of the kerogen will have been transformed into oil or gas (or a mixture of both), depending on the temperature conditions.

This transformation typically increases pressure within the rock, resulting in part of the oil and gas being expelled from the shale and migrating upwards into other rock formations, where it forms conventional oil and gas reservoirs. Shale is the source rock for the oil and gas found in such conventional reservoirs. Some, or occasionally all, of the oil and gas formed in the shale can remain trapped there, thus forming shale gas or light tight oil reservoirs.

Coalbed methane is natural gas contained in coal beds.

Tight gas is a general term for natural gas found in low permeability formations. Generally it includes low permeability reservoirs that cannot produce economically without the use of technologies to stimulate flow of the gas towards the well, such as hydraulic fracturing.

Source: IEA (2012), *Golden Rules for a Golden Age of Gas: World Energy Outlook Special Report on Unconventional Gas*, OECD/IEA, Paris.

It is estimated that Ukraine holds significant resources of unconventional gas, including deep-water shelf gas in the Black Sea (Box 6.1). According to various sources, the total resource potential of solid rock gas, shale gas, coalbed methane and gas from the deep-water Black Sea shelf may be 20 Tcm to 50 Tcm.[6] It is necessary to take into account that these

5. International Energy Agency (IEA) (2012), *Golden Rules for a Golden Age of Gas: World Energy Outlook Special Report on Unconventional Gas*, OECD/IEA, Paris.

6. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

are preliminary estimates, hence the actual amount, as well as the possibility of extracting these resources, is subject to verification. However, this significant resource potential should be sufficient incentive for active exploration of all these types of unconventional gas.

CURRENT PRODUCTION

Production regions

The Dnipro-Donetsk Basin is a major producing region, accounting for 90% of Ukrainian production from more than 120 oil and gas fields. The potential production from the basin is estimated at more than 1.47 Tcm of gas and 177 Mt of oil. Over 3 000 wells have been drilled in the basin to date and it offers the potential for deep gas exploration (deeper than 3 800 metres [m]).

The Carpathian Basin is relatively large, with proven reserves of more than 95 Mt of oil and 226 bcm of natural gas. The Carpathian fore-deep has been explored to depths of 4 000 m to 4 500 m. Despite the extensive activity, the deeper parts of the basin offer very good potential for further exploration.

The Black Sea and Azov Sea Basin is predominantly gas-prone and includes natural gas fields. The Ukrainian part of the Black Sea shelf may have substantial oil and gas reserves, with a maximum water depth of 100 m and mild weather. The hydrocarbon potential of the Ukrainian Black Sea shelf is substantial and has not been well explored, *i.e.* large structures in deep waters have been bypassed due to the lack of offshore technology during the Soviet period.

Production levels

In 2011, gas production in Ukraine amounts to 20.1 bcm and just under 3.3 Mt of crude oil and condensate. Domestic production covers approximately 33% of the domestic demand for natural gas and 20% of the demand for crude oil.

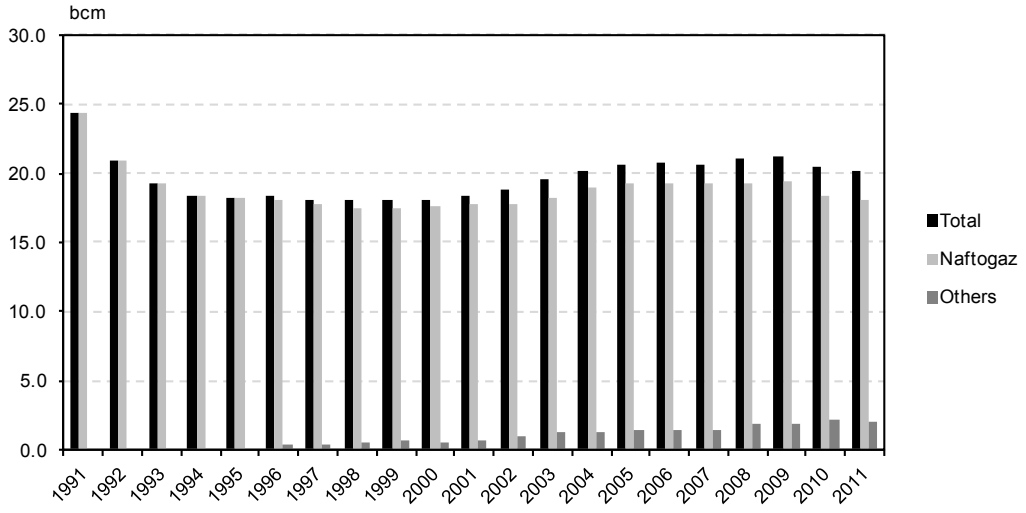
The state-owned company, Naftogaz, and its subsidiary companies Ukrgazdobyvanya, Ukrnafta, and Chornomornaftogaz operate 234 oil, gas, gas-condensate and oil-condensate fields. Many of those have reached their final stage of development, and the geological and technological conditions present a number of operational challenges.

Total natural gas production in 2011 was 20.1 bcm, of which Naftogaz produced 18.1 bcm (Figure 6.2). The independent oil and gas producers, among which the largest are JKX PPC, Geo Alliance, Regal Petroleum and Kub-Gaz, accounted for 2 bcm production in 2011.

Ukraine's crude oil and condensate production have declined since 2006 (Figure 6.3). In 2011, it produced 3.3 Mt of crude oil, out of which the Naftogaz subsidiary company, Ukrnafta's, share was 2.3 Mt (69.7% of total oil output). The decline in oil and gas production is due to the substantial exhaustion of hydrocarbon reserves in the largest fields and to insufficient development of new oil fields.

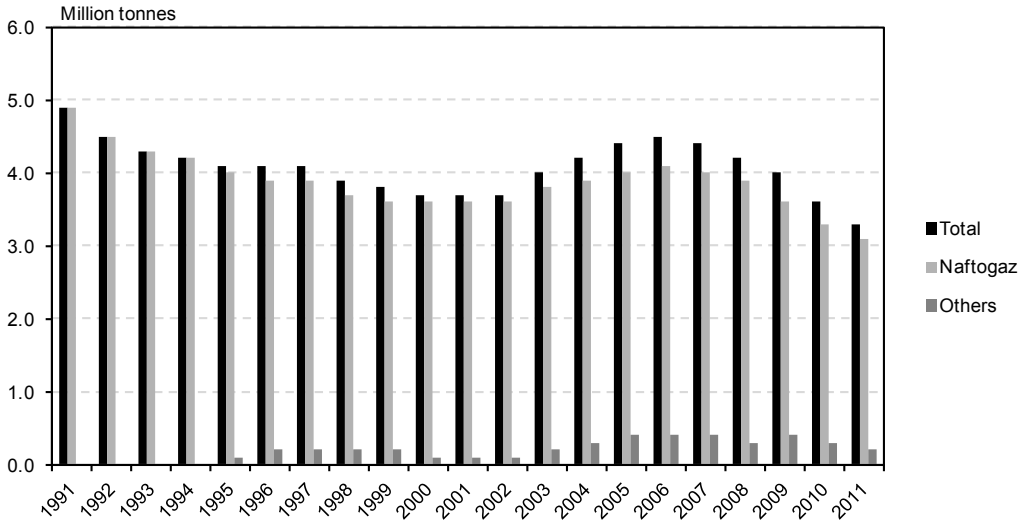
A shale gas tender led to some exploration drilling. Hawkley, an independent Australian company, drilled a shale gas well in the Dnieper-Donets Basin in 2011. Kulczyk Oil, an international upstream company, announced in November 2011 that it had successfully completed the hydraulic fracturing of a well in a previously non-commercial zone of the Dnieper-Donets Basin, yielding 65 000 cubic metres per day (2.3 thousand cubic feet per day) of gas and condensates.

Figure 6.2 **Natural gas production, 1991-2011**



Source: Naftogaz

Figure 6.3 **Oil and gas condensate production, 1991-2011**



Source: Naftogaz.

Public sector

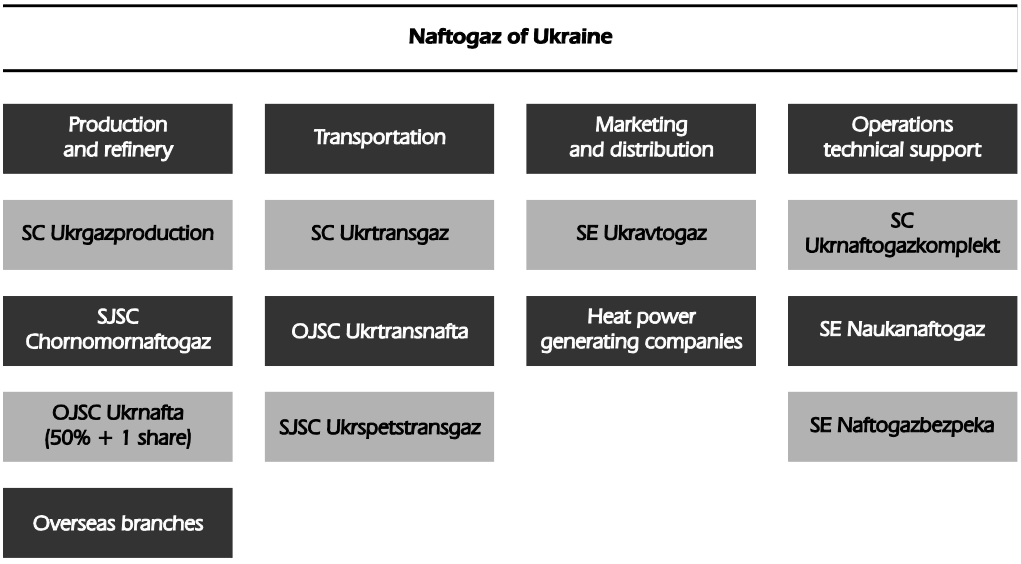
The state-owned Naftogaz is one of the largest companies in Ukraine, producing one-eighth of the country's gross domestic product and accounting for one-tenth of state budget revenues. At present, Naftogaz and its subsidiary companies account for more than 90% of all the oil and gas produced in Ukraine.

Naftogaz is a vertically integrated oil and gas company engaged in the full cycle of operations in gas and oil field exploration, drilling, development and production; gas and oil transport and storage; and the supply of natural gas and liquefied petroleum gas (LPG) to consumers. Naftogaz has eleven subsidiaries (Figure 6.4).

Naftogaz is currently being restructured. The Cabinet of Ministers Resolution (No. 360-p, June 2012) on Restructuring of Subsidiary Companies of the NJSC "Naftogaz of Ukraine"

instructed the Ministry of Fuel and Coal Industry and the NJSC "Naftogaz of Ukraine" to reform the subsidiary companies "Ukrtransgaz" (gas transit) and "Ukrgazvydobyvannya" (gas production) into public joint stock companies. The shares of these two companies will remain with NJSC "Naftogaz of Ukraine".

Figure 6.4 **Naftogaz structure and subsidiaries**



Source: Naftogaz

State participation in oil and gas exploration and production activities is carried out by the National Joint Stock Company Nadra Ukrayny (NJSC Nadra Ukrayny). It was established in 2000 under the Decree of the President (No. 802, June, 2000) on the measures directed at the rise of management effectiveness of enterprises in geological sphere and it merged thirteen geological and specialised mining enterprises. NJSC Nadra Ukrayny conducts geological surveys, provides geological and economic estimations of the deposits, enters into joint-venture agreements with private investors and represents the state in geological surveys and oil and gas exploration activities.

Private sector

At present, seventeen independent oil and gas producers are operating in Ukraine, with a total share of oil and gas production at just under 10%. Among these, the biggest producers are: JKX Oil and Gas (United Kingdom); Cadogan Petroleum Plc (United Kingdom), now 60% in Zagoryanskaya Petroleum BV and 30% in Pokrovskoe Petroleum BV, owned by ENI; Regal Petroleum (United Kingdom); Kulczyk Oil Ventures; Kuwait Energy Company; 3P International Energy (Tysagaz) and Transeuro Energy; Hawkley Oil and Gas; and Shelton Petroleum (45% in Kashtan Petroleum, joint venture with Ukrnafta).

The international majors TNK-BP, Lukoil, ExxonMobil, ENI, Shell, Chevron, as well as the independent US company Vanco have established business operations in Ukraine, with a substantial interest in obtaining upstream development rights. In May 2012, Shell won the Production Sharing Agreements (PSA) tender for exploration in the Yuzivska block, Chevron for the Oleska block, and ExxonMobil and Shell for Skifska deepwater natural

gas field and they anticipate concluding PSAs in 2012. Vanco International is expected to settle a dispute amicably with the government over PSA rights and to start developing the Prykerchenskaya block in Ukraine's Black Sea shelf before the end of 2012.

Projected volumes

The draft *Updated Energy Strategy of Ukraine to 2030* estimates a moderate annual increase for oil and gas production until 2020. Projections to 2030 largely depend on potential progress in developing unconventional gas (deepwater shelf gas, solid rock gas, shale gas and coalbed methane) domestic resources. Government estimates for gas production by 2030 are in the range of 30.2 bcm/year to 46.7 bcm/year.[7]

INSTITUTIONAL FRAMEWORK AND INDUSTRY STRUCTURE

Ukraine's upstream oil and gas industry remains complex and heavily regulated. State supervision in the upstream oil and gas sector has multiple layers and it remains challenging to fulfil the inconsistent requirements of the numerous legislative acts that are applicable to hydrocarbon exploration and production activities. Figure 6.5 illustrates the complex framework.[8]

The division of government responsibilities for the oil and gas sector are:

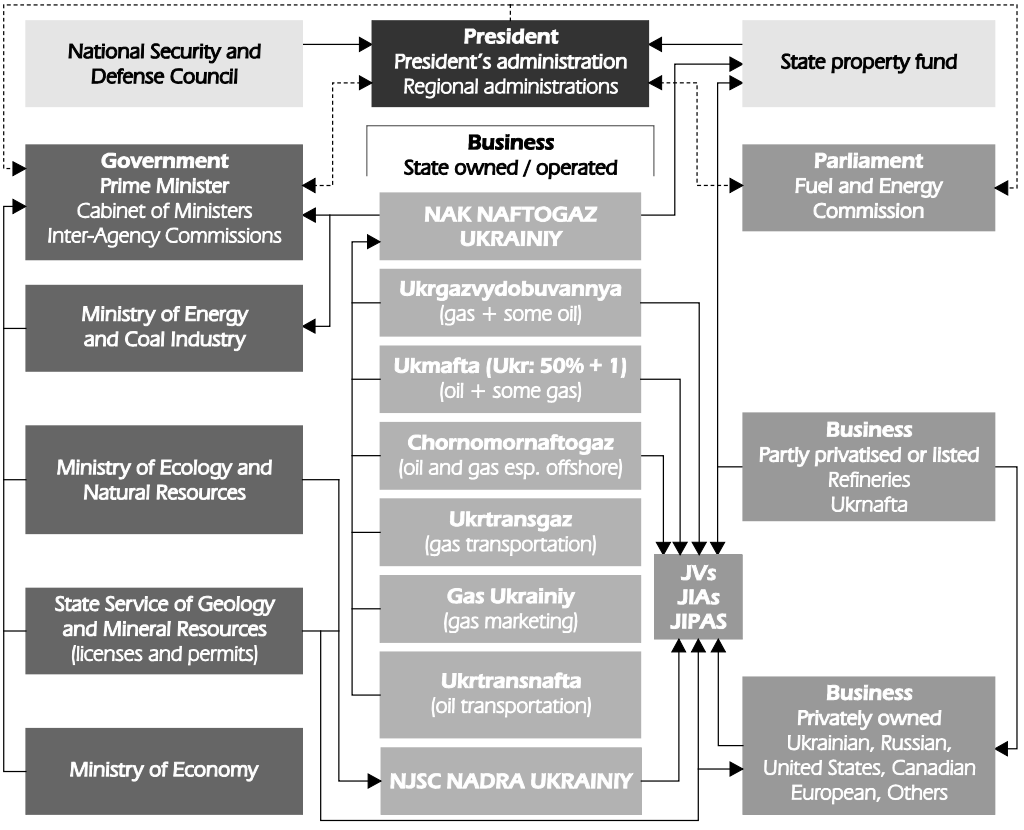
- The general framework for hydrocarbon development policy is the responsibility of the Cabinet of Ministers. It can also enter into a PSA with an investor, although state participation in PSAs is ensured through a state-nominated commercial partner under joint venture arrangements with an investor.
- The Ministry of Energy and Coal Industry commissions deposits for commercial production and is authorised to approve estimates of reserves.
- The Ministry of Ecology and Natural Resources is a licensing authority that supervises compliance with environmental regulations and licence conditions, and approves subsoil areas.
- The State Service of Geology and Subsoil issues special geological permits, supervises geological programmes and participates in developing conditions for production-sharing tenders.
- The State Fund of Geological Information (Geoinform) stores, administers and manages geological information.
- The State Service for Mining Supervision and Industrial Safety (Mining Authority) supervises compliance with mining, health, safety and environmental regulations, and conditions for special permits.
- The State Environmental Inspections authority audits compliance of companies with numerous health, safety and environmental standards and guidelines.
- Local authorities issue operational permits and land permits and, in some cases, pipeline construction permits.

7. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

8. *www.thedeanegroup.com/Ogstructure.html* (accessed 23 June 2012).

- The tax authorities oversee compliance with statutory tax duties and payments of royalties and subsoil use charges.
- The National Commission for State Energy Regulation (NERC) supervises the gas market and is responsible for gas supply and transportation licences, and tariff regulation.
- The Ministry of Economy sets maximum gas prices for residential and industrial customers, and the tax code provides for rates as well as methodologies for rate increases, with explicit multipliers used for calculating tariffs for residential, industrial and commercial customers.

Figure 6.5 **Oil and natural gas sector structure**



Source: The Deane Group.

There remains a great level of concern regarding the absence of clear order and the likelihood of duplicate authority being granted to different institutions. This can be discouraging to investors in need of a long-term commitment for this capital-intensive sector.

PROCEDURES FOR ACCESSING RESOURCES

The exploration and production of mineral resources in Ukraine are subject to a special permit, issued by the State Service for Geology (Geoservice). As a general rule, these are issued following a competitive tender for a specific field. However, there are certain

exceptions where non-competitive permits are allowed. These are cases where production-only licences are offered to those companies that have already conducted geological surveys at their own expense and have potential reserves approved by the State Reserve Commission; where the Commission considers a subject field to have insignificant resources; and when a production licence is offered under the PSA regime.

The state defines rights under the special permit as non-transferable and, in the case of subsidiary company involvement in the production stage, Geoservice can re-issue the licence without announcing a separate auction. Investors are also eligible for a special permit transfer in the case of acquiring a company in possession of such special permit or in cases of entering into a joint activity agreement with the permit holder.

The conditions of subsoil use are defined in the special permit and are subject to negotiations with the issuing authority. The required investments as well as the work programme are also negotiated and agreed upon during this period as part of the permit conditions.

In 2011, two Cabinet of Ministers resolutions (Nos. 594 and 615) extended the term of special permits, which had been limited to one year. Further they clarified conditions for non auction-based special permits (with at least 25% state participation) and for transferring rights under the special permits.

In addition, the following authorisations are required for development of subsoil resources:

- a mining lease, issued by the State Service for Mining Supervision and Industrial Safety of Ukraine;
- land rights, obtained in the form of land lease or ownership, granted by the local authorities;
- permits related to construction and commissioning of oil and gas wells and other production or transportation facilities:
  - consent of local authorities for construction of hazardous objects;
  - audit of the construction project by a certified auditing organisation;
  - permission for construction works issued by the construction authority;
  - commissioning certificate issued by the construction authority;
  - registration of production facilities as hazardous objects with the Mining Authority;
  - conclusion of environmental audit issued by the Ministry of Environment;
  - emissions permit issued by the Ministry of Environment; and
  - public health compliance issued by the State Public Health and Epidemiological Service of Ukraine.
- decommissioning of mining facilities requires a number of consents from local authorities and approval of the mining authority.

In recent years, the government has taken significant steps towards making Ukraine's business climate attractive to investors. Removing activity licences, expanding the term of exploration licences, offering stabilisation provisions under the Production Sharing Law, and reflecting this significant fiscal guarantee in the tax code, demonstrate the government's clear commitment to offer favourable conditions to investors interested in participating in Ukraine's upstream hydrocarbon developments. The government has streamlined the

requirements for the numerous licences and permits required for commercial activities and it has clarified conditions for obtaining and transferring these duties to third parties.[9]

Although significantly improved, procedures for obtaining the necessary rights for hydrocarbon exploration and production remain ambiguous and require further streamlining. With the numerous legislative acts and government orders, it is difficult to ascertain whether the existing structure is consistent throughout; is fully harmonised with the national legislation; and is in compliance with country's international undertakings.

TERMS FOR ACCESS

Terms of the special permits are five years for exploration and pilot production for onshore fields and ten years for offshore fields. Special permits for production are issued for 20 years for onshore production and 30 years for offshore. The PSA regime, however, allows for a longer special permit period for a maximum of 50 years.

Areas for exploration and production can be either nominated by a company or selected for auction by the State Geological Service. Special permits for auctioned fields are awarded to the eligible bidder submitting the highest competitive bid. Conditions for issuing a special permit require the winning company to obtain land rights for exploration and production activities from the local authorities.

Obtaining exploration and production rights under the production-sharing scheme differ from this general procedure. Special permits for oil and gas exploration and production, as well as health, safety and environmental permits, and land rights are given automatically to a company that is successful in a PSA auction. Changes to the PSA law have allowed existing special permit holders to switch to the PSA regime.

Other forms of access under the Ukrainian legislation are joint agreement (joint venture or consortium) with a state-owned company holding a special permit or joint activity agreements (JAAs), commonly referred to as a farm-in agreement, operating a field jointly with Naftogaz subsidiaries or NJSC Nadra Ukrayny. Benefits of these arrangements include access to the existing licensed areas and geological information, local knowledge and experience and co-operation of the government authorities. Incorporated companies, in which the state holds a stake of 25% or more, are allowed to bypass the subsoil auctions for oil and gas special permits. However, a discouraging factor of these joint developments is the mandatory domestic gas supply obligation for companies in which the state holds an interest of 50% or more. Gas has to be sold to Naftogaz at a price set by the regulator which is substantially lower than the price for imported gas.

PRODUCTION-SHARING AGREEMENTS

The Production-Sharing Agreement Law (No. 1127-XIV, October 1999) has been in place for more than a decade. However, only one production-sharing agreement (PSA) had been executed by 2012. And that one was revoked due to a dispute over licence transfer rights to a subsidiary company (Box 6.2).

The PSA law initially included a stabilisation clause which protects investors from unfavourable regulatory changes for the duration of the PSA (except for legislative changes related to national defence, national security, civil and environmental safety).

9. Law on the List of Permitting Documents for Commercial Activity, (No.3392-VI) May 2011.

This essential condition for long-term capital intensive developments was removed in 2010, an act that caused a sharp decline in the confidence of investors interested in participating in the development of Ukraine's upstream sector. Amendments to the PSA Law on 17 June 2011 reinstated this critical provision and changes were also embedded in related legislation. This change preceded recent tenders for the Oleska and Yuzivska blocks, and the Black Sea offshore development.

Winners of these PSAs are granted an "all-inclusive" special permit for exploration, pilot production and commercial production of natural gas, shale gas, tight gas, coalbed methane, oil and gas condensate for a period of 50 years. Selected companies are required to enter into a Joint Development Agreement at the exploration stage through a joint venture with NJSC Nadra Ukrayny and SPK Geoservice. Terms for the profit split vary, depending on tender conditions and negotiations.

Box 6.2 **The Vanco PSA dispute**

Vanco International Ltd. won an international tender to develop the Prykerchensky block of the Black Sea shelf in April 2006. This section is considered to be one of the best prospective areas of the Ukrainian deep-water shelf. The Prykerchensky block, with an area of 12 960 km^2 and water depth of 300 m to more than 2 000 m, is located in the Ukrainian economic zone around 13 km from the shoreline of the Kerch Peninsula and is thought to have geological conditions similar to the Caspian Sea. Vanco undertook negotiations with the government of Ukraine on the terms of the Production Sharing Agreement, which lasted 18 months. In October 2007, the parties signed a Production Sharing Agreement for a 30-year term, with a 65/35 split for cost recovery oil and gas and 50/50 split for profit. Over the ten-year exploration licence, Vanco International was expected to conduct a full geologic survey of the Prykerchensky block and to agree a development plan with the government. The project was reported to require investments of up to USD 15 billion.

In May 2008, the US-owned (Bermuda registered) Vanco registered its subsidiary offshore project company Vanco Prykerchenska Ltd. (British Virgin Islands registered) and started negotiations with potential financial partners for developing the block. The government considered this development a breach of Vanco International's licence terms and in July 2008 revoked the company's exploration and production licence and terminated the PSA.

Vanco suggests that the PSA allowed it to assign its rights to its affiliate. Vanco Prykerchenska, which is 75% non-US owned and 25% owned by a Bermuda-based subsidiary of Vanco Energy Company, appealed to the Stockholm Court of Arbitration. After five years of litigation, Vanco International is expected to settle a dispute amicably; in which case, Vanco Prykerchenska could start exploration works in the Black Sea in late 2012.

PIPELINE CONSTRUCTION AND ACCESS

Clear rules for pipeline construction are required to market domestically produced hydrocarbon resources. Such procedures should include requirements for connecting to the existing networks and pipeline access rules. Whereas gas pipeline construction and transportation licensing is envisaged under the NERC regulatory scheme, similar requirements and structures are lacking for the construction of oil or oil product

pipelines. It is in the interest of both investors and the government to address this issue in a timely manner to avoid uncertainty in the legal and regulatory regime that may affect investment in oil field developments. This includes gathering pipes and low-pressure connection lines within the existing infrastructure.

DEVELOPMENT OF UNCONVENTIONAL HYDROCARBON RESOURCES

TENDERS

Ukraine holds sizable untapped reserves of unconventional oil and gas. The government has pursued vigorous legislative changes to amend existing regulations to make these reserves attractive for investors. For example, it has streamlined PSAs and in 2012 offered tenders for the Oleska and Yuzivska blocks and the Black Sea shelf under this regime allowing for the exploration and production of natural gas, shale gas, tight gas, coalbed methane, crude oil and oil and gas condensates for a 50-year period. These tenders are considered potential game-changers for the Ukrainian economy and have attracted high interest among international majors. Bidders included Royal Dutch Shell, TNK-BP, ExxonMobil and Eni.

The Oleska block, located in the western part of Ukraine, covers an area of 6 324 km^2. The minimum investments required at the exploration stage of this field are estimated to be USD 163 million and for the commercial production stage at USD 3.13 billion. The cost of the tender package for potential bidders was valued at USD 1.3 million and the winning bid was submitted by Chevron.

The Yuzivska block is in the eastern part of Ukraine with an area of 7 886 km^2. The minimum investments required during the exploration stage are estimated at USD 200 million and for the commercial production stage at USD 3.7 billion. Tender package cost for this field was USD 1.9 million and Royal Dutch Shell won the tender.

The Foros and Skifska areas are oil and gas fields on the Black Sea shelf, near the Ukrainian-Romanian border and the Crimean Peninsula respectively. Estimated recoverable reserves are 3 bcm/year to 4 bcm/year of natural gas at Skifska and 2 bcm/year to 3 bcm/year of gas at Foros.[10] The reserve depth of 10 000 m required a minimum investment of USD 200 million in the tender process. With a participation fee of USD 125 000, the cost of the tender package for the Foros area are USD 1.25 million and USD 1.5 million for Skifska. The term of the tenders are for 50 years and allow for natural gas, oil and oil condensate development. The tender was announced in June 2012. In August 2012, the government selected ExxonMobil and Royal Dutch Shell to lead development of the Skifska deepwater natural gas field offshore of the Black Sea, together with Romania's OMV Petron and NJSC Nadra Ukrayny. No bids were submitted for the development of the Foros field.

The terms for the tender for the four areas require joint development at the exploration stage with 50% state partner participation. Shell and Chevron are required to set up a joint venture with the Ukrainian state partner (a joint venture between NJSC Nadra Ukrayny, the state mineral resources company, and SPK-Geoservice, a service company). SPK-Geoservice was chosen by the Ukrainian authorities to take a 10% minority share in

10. CMS Cameron McKenna, *www.documents.jdsupra.com/057856f0-739c-42ee-9062-10f5d4076453.pdf* (accessed 13 June 2012).

a partnership with NJSC Nadra Ukrayny for the multi-billion dollar shale exploration projects. Profit sharing terms at the commercial production stage require a minimum share for the state of 15% for Oleska, 16.5% for Yuzivska, and 20% for the Foros and Skifska areas. Details for state participation as well as the work programme and licence terms are negotiated with the government as part of the PSA agreement.

FISCAL STRUCTURE

The Tax Code of Ukraine sets royalty payments and subsoil use tax rates. Amendments to the Tax Code, in force from 1 January 2011, have raised royalty payments by 16% for natural gas and by 29% for oil and gas condensate. It also increased the level of subsoil use tax by 66% per tonne of oil and gas condensate and almost 90% per thousand cubic metres of natural gas.

Different ranges of royalty payments are set for natural gas production from offshore and onshore fields and for oil and gas condensates. For onshore production, the rates are differentiated based on the depth of production (below or above 5 000 m) and also between the supply to two categories of customers: residential and commercial/ industrial. Oil and gas producing companies and joint ventures with a minimum of a 50% state interest have the statutory requirement to supply domestically produced natural gas to domestic residential, commercial and industrial customers.

The Tax Code fixes the base price of natural gas at USD 179.5/tcm. The methodology for calculating the royalty payment for domestically produced natural gas to residential customers is based on a multiplier, calculated by dividing the average customs value of natural gas imported into Ukraine during the previous reporting month by the base price.

In May 2012, the parliament approved a legislative proposal that would replace the existing royalty scheme for oil and gas extraction with higher mineral extraction taxes effective 1 January 2013. The proposed new tax on oil producers is linked to the Urals oil price and the tax on gas producers is tied to their sale price. Oil tax rates were set at 39% and 17% depending on reservoir depth (up to or below 5 000 m). For gas extraction, a wider range of tax rates was proposed. Companies whose gas is supplied to households face tax rates of 28% and 25% based on the 5 000 m depth threshold (but not less than Ukrainian hryvnia (UAH) 101.3 (EUR 10)/tcm from reservoirs above 5 000 m and UAH 89.45 (EUR 8.9)/tcm from reservoirs below 5 000 m). Offshore gas production is to be taxed at 15%, but not less than UAH 53.9/tcm. For other gas producers, rates of 17% and 9% were proposed based on reservoir depth (but no less than UAH 594.64/tcm from reservoirs above 5 000 m and UAH 18.34/tcm from reservoirs below 5 000 m). Companies operating under production-sharing agreements would be taxed at 2% for oil and 1.25% for natural gas.

If signed into law, the bill will have a mostly neutral impact on oil and gas producers such as Ukrnafta and JKX at current oil and gas prices, as the proposed taxes are close to what these companies currently pay (royalties plus mineral extraction tax). Yet the proposed minimum taxes on gas production are close to the rates implied by current gas prices, hence should gas prices for industrial consumers decline from their current level of USD 438/tcm (*e.g.* in case of revision of the gas contract with Gazprom), gas producers would still pay the same minimum rate, implying an increased amount of taxes in relation to revenues.

PRICING DOMESTIC PRODUCTION VERSUS IMPORTS

The government and the National Commission for State Energy Regulation (NERC) have made significant efforts in developing natural gas pricing policy. However, under the existing regime it is extremely difficult for domestic producers to compete with imported gas prices. One of the most significant steps to encourage investment in the upstream gas sector is to remove the two-tier tariffs for natural gas, allowing domestically produced gas to be marketed at the same price as imported gas. Current arrangements for a non-economic fixed purchase price (in Ukrainian legislation referred to as "minimum fixed purchase price") for domestic gas are a serious hurdle for domestic production. Investors will need to have confidence in the market structure and in obtaining a return on gas production. Moving to economic-based gas pricing should be considered in order to encourage the development of domestic production potential.

TRANSPARENCY

A resolution concerning compliance with the Extractive Industries Transparency Initiative (EITI) was approved by the Cabinet of Ministers in 2009 (see Box 7.3 in Chapter 7). Joining the Extractive Industries Transparency Initiative is a much needed step to increase transparency in gas market functioning and operation. It would be highly attractive for potential investors to see the adoption of greater transparency relating to both domestic production and trade in gas and other commodities as a prerequisite for improved accountability.

CRITIQUE

The Ukrainian government's determined moves towards opening the upstream hydrocarbon sector for investment have been significant. Streamlining the PSA regime and reflecting those changes throughout the relevant legislation provided sufficient grounds to spur increased interest among major international companies to bid in recent tenders for both conventional and unconventional oil and gas resources developments.

Although the tender processes were reported to have been conducted in a transparent manner and in accordance with international best practice, specialised small and medium companies, which are also interested in participating in these hydrocarbon resource developments, noted unfair treatment as the tender processes excluded them entirely from participating in Ukraine's largest bidding processes to date for such resource development. The PSA tenders required the formation of joint ventures with state-owned entities and were structured in such a way that no small- or medium-size companies were able to participate. These specialised companies are left to continue developing mature and mostly depleted fields, where potential for sizable output could only be achieved by employing expensive advanced technologies for enhanced developments. Although all companies are given the possibility to convert their existing licences to PSAs, conditions offered under this regime may not be attractive for small- and medium-size companies. For instance, as the tariff structure for gas supplied to domestic consumers does not reflect cost-recovery prices, it is difficult for small- and medium-size firms to secure the investment needed to obtain and employ up-to-date technologies. As well, the requirement for field developments with a state-nominated commercial partner could prove largely discouraging.

Developers operating outside the PSA regime are also required to obtain numerous authorisations and permits for exploration and production rights, which, albeit lawful,

are cumbersome and prone to errors and infringement of applicable regulations. Attracting capital-intensive investment to Ukraine's hydrocarbon resource development requires improved investor confidence, which can only be achieved by providing clear, transparent, consistent and predictable procedures. The government proposal in 2011 for the development of a one-stop shop (single window) structure for upstream oil and gas developments could certainly facilitate the process throughout the licence term.

Ukraine does not have a specific legal and regulatory framework for unconventional oil and gas resource developments nor an established definition of unconventional resources. Although the production-sharing scheme is widely recognised among the international community to be the most investor friendly, it is not clear if existing legislation in Ukraine covers all aspects of this capital-intensive development throughout the PSA term.

Ukrainian legislation does not provide for a definition of unconventional gas, it is therefore unclear whether the term "unconventional gas" includes shale gas, tight gas, coalbed methane and gas hydrates. Currently the natural gas market law defines "natural gas" as natural gas, associated gas, coalbed methane or shale gas. Both shale gas and tight gas are classified as mineral "resources of national importance". This classification is not defined further, and that ambiguity is a cause for concern as it opens up the scope for the government to introduce special regime/conditions later, treating "resources of national importance" differently from other mineral resources.

Current regulations do not restrict or prohibit hydraulic fracturing, and some companies have already applied this technology to intensify gas production from conventional wells. There are no specific regulations on water use for hydraulic fracturing. The use of non-potable ground waters that cannot be used for commercial or domestic purposes do not require a special permit for water use, while special water permits are required to acquire water from nearby reservoirs and dispose of it thereafter and for subsoil use to extract industrial (mineral) waters.

Despite numerous legislative and regulatory changes, Ukraine has yet to clarify whether current technical, environmental, health and safety regulations for hydrocarbon developments cover the wide range of technical requirements necessary for developing unconventional gas resources. A template for core social, technical and environmental considerations that governments need to take on board when developing a sound regulatory framework for unconventional gas developments is highlighted in Box 6.3.

A stabilisation clause in the PSA law guarantees that adverse changes in legislation will not have an effect on the agreed fiscal terms of a production-sharing agreement, but has a waiver for environmental provisions. This could have wide financial implications, while the absence of a clear environmental framework required for unconventional resource development increases the likelihood of such costs being incurred at a later stage and trigger changes in the PSA terms.

The PSAs for unconventional gas developments are offered for a 50-year term. Yet, the absence of an established regulatory framework could lead to regulatory changes later that adversely impact the terms of PSAs that are agreed in the present situation. Shell and Chevron, the successful bidders in the recent tenders for the Oleska and Yuzivska blocks, are in the process of negotiating PSA terms with the government of Ukraine, which provides for the possibility for necessary requirements/restrictions to be specified in the subsoil use agreement (licence), work programme or the PSA itself. Such requirements, among others, should include the compulsory disclosure of chemical composition of the fracturing fluid (respecting commercial sensitivities), technologies to prevent ground water contamination, air pollution and an obligation to ensure maximum use of non-potable waters.

Box 6.3 **Golden rules for a golden age of unconventional gas**

Measure, disclose and engage:

- integrate engagement with local communities, residents and other stakeholders into each phase of a development starting prior to exploration; provide sufficient opportunity for comment on plans, operations and performance; listen to concerns and respond appropriately and promptly;
- establish baselines for key environmental indicators, such as groundwater quality, prior to commencing activity, with continued monitoring during operations;
- measure and disclose operational data on water use, on the volumes and characteristics of waste water and on methane and other air emissions, alongside full, mandatory disclosure of fracturing fluid additives and volumes; and
- minimise disruption during operations, taking a broad view of social and environmental responsibilities, and ensure that economic benefits are also felt by local communities.

Watch where you drill:

- choose well sites so as to minimise impacts on the local community, heritage, existing land use, individual livelihoods and ecology;
- properly survey the geology of the area to make smart decisions about where to drill and where to hydraulically fracture: assess the risk that deep faults or other geological features could generate earthquakes or permit fluids to pass between geological strata; and
- monitor to ensure that hydraulic fractures do not extend beyond the gas producing formations.

Isolate wells and prevent leaks:

- put in place robust rules on well design, construction, cementing and integrity testing as part of a general performance standard that gas bearing formations must be completely isolated from other strata penetrated by the well, in particular freshwater aquifers;
- consider appropriate minimum-depth limitations on hydraulic fracturing to underpin public confidence that this operation takes place only well away from the water table; and
- take action to prevent and contain surface spills and leaks from wells, and to ensure that any waste fluids and solids are disposed of properly.

Treat water responsibly:

- reduce freshwater use by improving operational efficiency; reuse or recycle, wherever practicable, to reduce the burden on local water resources;
- store and dispose of produced and waste water safely; and
- minimise use of chemical additives and promote the development and use of more environmentally benign alternatives.

Box 6.3 **Golden rules for a golden age of unconventional gas** (continued)

Eliminate venting, minimise flaring and other emissions:

- target zero venting and minimal flaring of natural gas during well completion and seek to reduce fugitive and vented greenhouse-gas emissions during the entire productive life of a well; and
- minimise air pollution from vehicles, drilling rig engines, pump engines and compressors.

Be ready to think big:

- seek opportunities for realising the economies of scale and co-ordinated development of local infrastructure that can reduce environmental impacts; and
- take into account the cumulative and regional effects of multiple drilling, production and delivery activities on the environment, notably on water use and disposal, land use, air quality, traffic and noise.

Ensure a consistently high level of environmental performance:

- ensure that anticipated levels of unconventional gas output are matched by commensurate resources and political backing for robust regulatory regimes at the appropriate levels, sufficient permitting and compliance staff, and reliable public information;
- find an appropriate balance in policy-making between prescriptive regulation and performance-based regulation in order to guarantee high operational standards while also promoting innovation and technological improvement;
- ensure that emergency response plans are robust and match the scale of risk;
- pursue continuous improvement of regulations and operating practices; and
- recognise the case for independent evaluation and verification of environmental performance.

Source: IEA (2012), *Golden Rules for a Golden Age of Gas: World Energy Outlook Special Report on Unconventional Gas*, OECD/IEA, Paris.

Ukraine needs to develop a clear, transparent and predictable regulatory framework for the exploration and production of unconventional gas resources. For this, Ukraine will need to closely monitor the development of unconventional gas regulations worldwide and particularly in Europe. Ukraine also needs to develop regulations for unconventional gas mining, property rights, land use, freshwater use, habitat and biodiversity concerns, waste management, recovery and liability.

Ukraine will also need to clarify if existing conventional gas regulations are applicable to unconventional gas production, and to develop a clear and transparent regulatory regime for the associated aspects related to mining, water use, social and environmental impacts. It will be essential to adequately address issues related to property rights, right-of-way access and powers of eminent domain as the surface owner and subsurface mineral or mining licensee may be different entities. The government should also encourage wider public consultation on environmental, water and land-use matters.

RECOMMENDATIONS

The government of Ukraine should:

- *Develop a clear, transparent and predictable regime for oil and gas exploration and production, including transparent tender/auction procedures, licence terms, fiscal regimes and regulatory requirements. The regime should ensure stability and predictability of exploration and production throughout the licence terms.*
- *Develop and implement predictable procedures for government representation throughout the exploration and production licence term and develop the government-proposed "single window" approach for hydrocarbon development activities.*
- *Develop policies and measures to encourage private investment in the recent technologies that are required to maximise production from mature fields. Streamline contractual and fiscal regimes, and allow fiscal incentive schemes for technology related investments.*
- *Remove the two-tier natural gas tariff and replace non-economic minimum fixed purchase price requirement for domestically produced gas with economically justified gas prices.*
- *Establish a clear and transparent regulatory framework for unconventional gas development, including technical and environmental regulations.*
- *Develop pipeline construction procedures (including permits, standards and technical requirements) and guarantee fair and predictable third-party access to existing pipelines.*
- *Develop a framework for transportation licensing and transportation tariff methodologies for crude oil and oil product pipelines.*

7. NATURAL GAS MARKET

Key data (2011)

Share in TPES: 40%

Import dependency: 67% (44.8 bcm imported)

Gas consumption by industry: 24.6 bcm

Households connected to natural gas: 77%

Storage capacity: 31 bcm in 11 sites

Gas transit to European markets: 104 bcm

OVERVIEW

The share of natural gas in Ukraine's energy mix has been declining over the past decade from 47% of total primary energy consumption in 2000 to 40% in 2010. Gas demand is down from 76.4 billion cubic metres (bcm) in 2005 to 59.3 bcm in 2011 reflecting the structural elements of lower industrial output and energy efficiency improvements in industry, especially in the metallurgical sector, as well as an increase in imported gas prices. Domestic gas production has been level at 20 bcm/year for the last two years, accounting for 33% of total gas consumption in 2011 compared with about 25% in the early 2000s. Ukraine's gas imports were 44.8 bcm in 2011, down from 57.4 bcm in 2005. All imports come from a single supplier, Gazprom. Today, gas market reforms are being driven by Ukraine's commitments under the Energy Community Treaty.

DEMAND

Natural gas demand in Ukraine has declined from 76.4 bcm in 2005 to 51.9 bcm in 2009 and 59.3 bcm in 2011. This results from a combination of higher gas import prices, fuel switching from gas to coal, some energy efficiency improvements in industry and the economic crisis. The greatest potential for further gas demand reduction lies in Ukraine's public sector, but its scope and speed will depend on the development and implementation of a strategy focussing on effective energy efficiency and alternative fuel production. Gas demand in 2012 is estimated at 54.9 bcm by the Ministry of Energy and Coal Industry.

PUBLIC SECTOR

Gas demand in the public sector decreased by about 20% from 34 bcm in 2003 to about 27 bcm in 2011. (In Ukraine, the public sector includes households, district heating companies (teplokomunenerhos), institutions such as schools and hospitals, as well as state-owned companies.) This resulted mostly from a 2 bcm/year decrease in gas demand from the district heating sector, plus modernisation and some fuel switching to coal at the large

Kyivenergo combined heat and power (CHP) plant, and the increased use of individual gas heating in residences (which falls into another statistical category). The district heating segment consumed 13 bcm in 2011, including 1.9 bcm for the Kiyvenergo CHP plant alone. Gas consumption by households is down slightly from 18 bcm/year in the early 2000s to about 17.4 bcm in 2011 as only very small investments have been made to improve energy efficiency of the housing sector and modernise district heating systems. It must be noted that the overall number of households increased by 7% between 2007 and 2011 but there are no available data on whether they are using gas.

Out of Ukraine's 17.5 million households, 13.43 million apartments and houses are connected to the natural gas system, representing 78.1% of urban households and 38.2% of rural households, according to Naftogaz data. By early 2012, nearly 8.24 million individual gas meters in residences had been installed, slightly above half of all consumers. Data suggest that from 2008 to 2009, some 500 000 gas meters were installed but there is still a large part of consumers that consume gas without meters.[1]

The public sector has great potential to reduce gas consumption, especially district heating systems (see chapters 3 and 4). New housing blocks that are being built with more than eight levels are not connected to natural gas networks, which could further reduce gas demand. However, the tendency to switch to individual gas boiler heating, and the gasification policy of Naftogaz, may slow this trend of lower gas demand in the public sector, along with delays in installing individual gas meters for households and raising gas tariffs. The draft *Updated Energy Strategy of Ukraine to 2030* projects that gas consumption by households will decrease by 30% by 2030 to 12 bcm/year, following improvements in energy efficiency, the increase of gas prices and the construction of new buildings that will not be connected to the gas infrastructure.

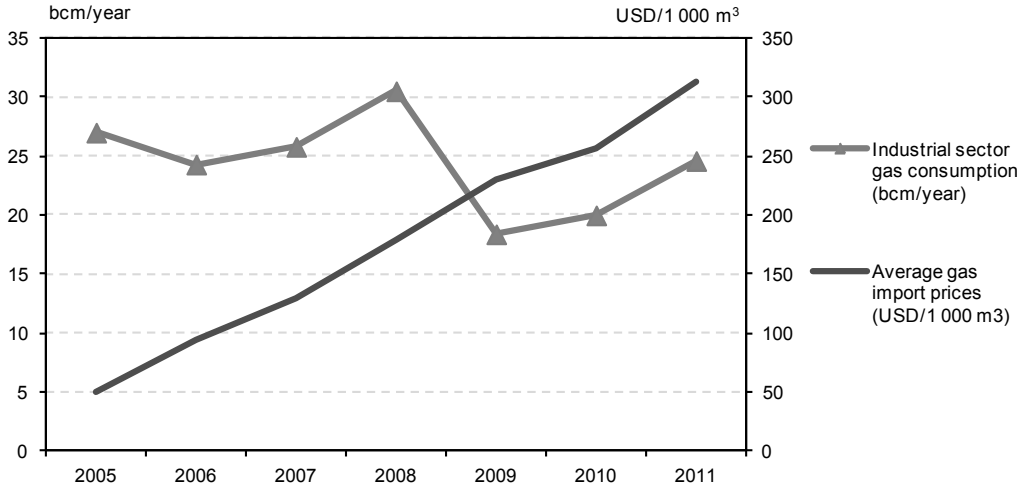
INDUSTRY SECTOR

Gas consumption in the industry sector has substantially declined from 35 bcm in 2004 to 30.5 bcm in 2008, down to a record low of low of 18.4 bcm in 2009 and 24.6 bcm in 2011. In addition to the impact of the economic crises, there is a correlation between surging annual gas import prices and a decrease of gas demand in the industry sector where gas prices reflect import costs (Figure 7.1). Over the past three years, GDP growth has been less correlated with industrial sector gas demand as GDP grew at a much quicker pace, reflecting a trend of structural transformation of the Ukrainian economy: the service sector is developing, industrial output was reduced and higher gas prices provided incentives to reduce consumption or realise energy efficiency investments. The correlation between variations of industrial output, gas consumption by sector and GDP is shown in Figure 7.2.

The chemical industry sub-sector is Ukraine's largest natural gas consumer. There are six major fertiliser plants mainly producing ammonia: four are controlled by Ostchem Holding Limited (Stirol, Rivneazot, Cherkassy Azot, Severdonetsk Azot); one by the Privat Group (Dneproazot); and one by the state (Odessa Priportovy Zavod which alone consumes about 1.3 bcm/year). Following a sharp drop in demand in 2009, the chemical industry has been progressively increasing its gas consumption to approach pre-crisis levels (8.5 bcm in 2007 to about 6 bcm in 2011), in spite of the surge in industrial gas prices (Figure 7.1) which have raised production costs.

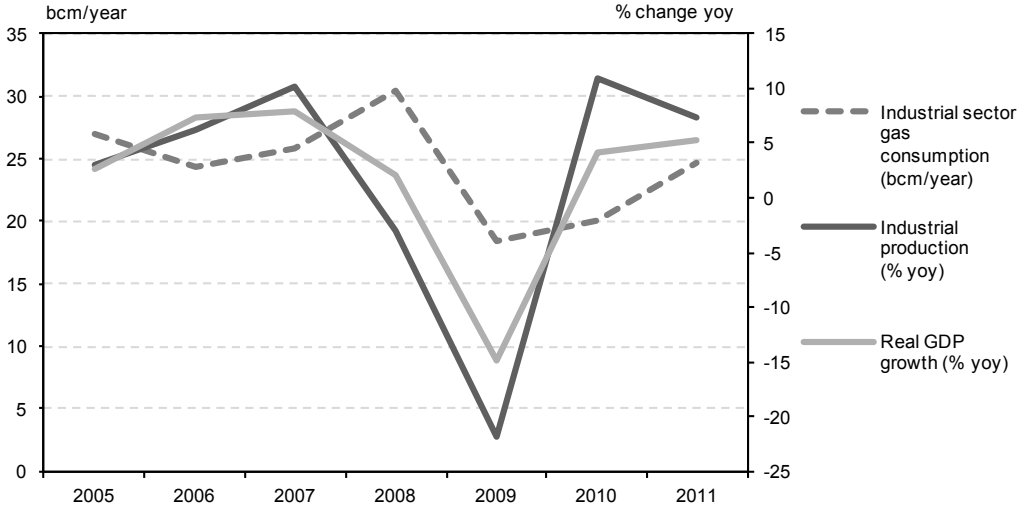
1. Sergijenko.A. (2010), "For Whom – the Tariffs, and for Whom – the Gas", Weekly Mirror (Zerkalo Nedeli), Kiev. (Александр Сергиенко. Кому – тарифы, а кому – газ. *Зеркало недели* №26, 10/7/2010).

Figure 7.1 **Impact of gas import prices on industrial gas demand, 2005-11**



Source: Naftogaz.

Figure 7.2 **Impact of production levels and GDP growth on industrial gas demand, 2005-11**



Note: yoy = year-on-year.

Sources: International Monetary Fund; World Bank; Naftogaz.

The chemical industry benefitted from some specific gas price reductions through an exemption from value-added tax (VAT) in 2009 and 2010 and the possibility to directly import gas to circumvent Naftogaz's monopoly as from April 2011.[2] Natural gas now represents about 80% of fertiliser production costs, so the industry has a strong incentive to reduce gas consumption if it cannot secure lower cost long-term gas supplies or higher product sale prices. Yet efficiency gains may be offset by higher production volumes, leaving total gas consumption unchanged.

2. Cabinet Decree (No. 880, 2009).

The metallurgical industry is very important to Ukraine's economy as it represents about 50% of exports. In 2011, Ukraine ranked eighth in the world for crude steel production, totalling 35.3 million metric tonnes.[3] The metallurgical sector has substantially reduced its gas demand following increases in gas import prices. In anticipation of rising international competition and increasing gas prices, energy efficiency improvements have been made, such as replacing some outdated furnace technologies. Production was slashed due to the 2009 economic crisis and had not yet fully recovered by mid-2012. However, just less than one-third of Ukraine's steel production still uses open hearth furnaces, which are highly inefficient. Since 2008, many investments have also been for fuel switching, often replacing gas with coal. Whereas the metallurgy industry consumed almost 10 bcm of natural gas in 2004, the volume was down by a third in 2011 to about 7 bcm.

GAS SYSTEM CONSUMPTION

Ukrtransgaz, the Naftogaz-affiliated company operating the country's gas transmission system, reports that the system's own consumption, mainly for compressor stations, has been much reduced in recent years from 6.6 bcm in 2005 to 3.3 bcm in 2010. Losses represented about 0.1 bcm in 2010. Some of the reduced gas demand is related to replacement of gas pumping stations with electrical units to operate the compressor stations. About 35% of the pumping units were electric by end 2011. Ukrtransgaz indicates that this allowed the company to save 0.41 bcm of gas in 2011 alone. If this modernisation work is further pursued, some experts estimate that the system could further reduce gas demand to 2.5 bcm/year while retaining volumes transported at a similar level as 2012.

GAS METERING

There are no measuring stations installed on entry points of the gas transmission pipelines on the Ukrainian side of the Russian-Ukrainian border. Measurements take place on the Russian side, with Ukrainian officials present, but at a far distance from the border crossing points. This raises issues of accountability and transparency.

Domestic gas consumption is also poorly monitored. Metering at the housing block level is not provided as a rule, so it is impossible to know gas consumption even at a building level. Progress in installing meters has been slow. A 2011 Law on Commercial Accounting of Natural Gas provides for 100% metering for water and heating by 1 January 2016. The gaps in gas metering, in a system with a tariff structure that subsidises gas prices for the public sector, a large part of the market, represent an obvious incentive for possible illegal gas diversion operations from the public sector to the industry sector. This is at the expense of Naftogaz and the state budget and to the benefit of some industrial gas consumers who obtain gas supplies at lower prices.

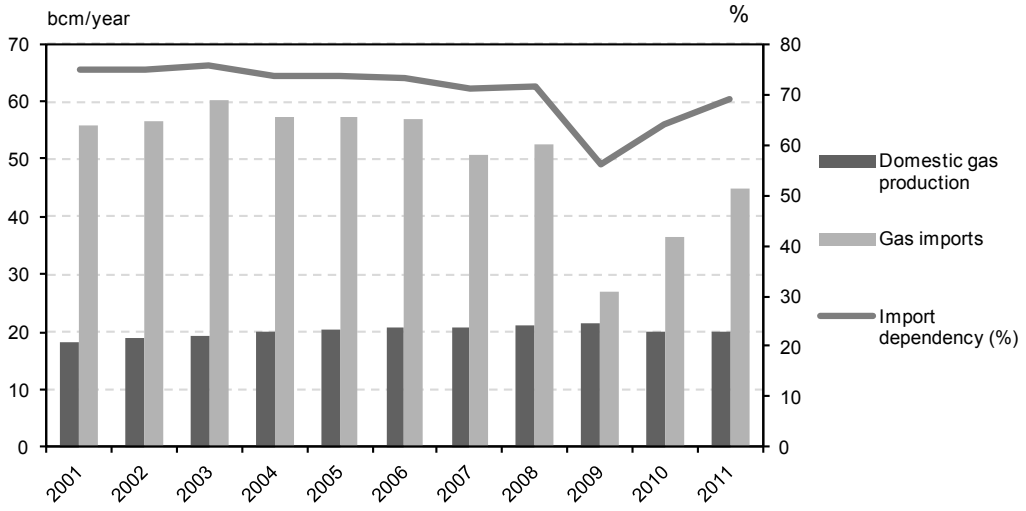
3. www.worldsteel.org/media-centre/press-releases/2012/2011-world-crude-steel-production.html (accessed April 2012).

SUPPLY

DOMESTIC PRODUCTION AND IMPORTS

In 2011, domestic gas production met about 33% of demand. Ukraine is a net gas importer. All imports come from Russia's Gazprom.[4] Natural gas imports have been declining over the past decade in line with lower total gas demand (Figure 7.3).

Figure 7.3 **Natural gas production, imports and import dependency, 2001-11**



Sources: Naftogaz; Ukrstat.

In 2011, Naftogaz purchased 40 bcm from Gazprom under the terms of the 2009 ten-year gas supply contract (Box 7.1). Previously, Ukraine imported mainly central Asian gas supplied by intermediary companies linked to Gazprom and private businesses, such as EuralTransGaz until 2005 and RosUkrEnergo from 2005 to 2009.

In April 2011, a government decree ended Naftogaz's monopoly on gas imports. This has enabled Ukraine's main chemical group, Ostchem, which controls four out of six of the main chemical plants, to start importing gas of central Asian origin, but marketed by Gazprom, to reach a total of 4.78 bcm for the year, with a value of USD 1.68 billion.[5] Ostchem announced that in 2012 it would directly import between 6.5 bcm and 8 bcm to supply its chemical plants. According to data from the Ukrainian customs service, Ostchem enjoyed more favourable import prices in the second and third quarters of 2011 than Naftogaz, in a range of USD 13/thousand cubic metres (tcm) to USD 47/tcm less. However, this trend reversed in the forth quarter of 2011 and the first quarter of 2012. Naftogaz has received a temporary right to import gas without VAT payment according to a resolution in September 2011 and valid until July 2012.

4. Gazprom (2012*)*, *Gazprom Annual Report 2011*, Moscow, p. 78.

5. According to the Ukrainian Statistical Service, in 2011 gas imports from Turkmenistan amounted to 1.74 bcm (worth USD 618.36 million), from Uzbekistan to 1.53 bcm (USD 530.42 million) and from Kazakhstan to 1.53 bcm (USD 536.08 million).

Box 7.1 **Gazprom-Naftogaz gas supply and transit contract**

The natural gas supply and transit ten-year contract (2009-19) between Gazprom and Naftogaz ended an unprecedented gas crisis which led to a halt in Russian gas supplies to Ukraine from 1 to 17 January 2009 and an interruption of Russian gas transit through Ukraine from 7 to 17 January 2009.

The 2009 gas contract marked a very important step towards more stable and secure supplies both to Ukraine and for transit to European markets. It ended the system of cross-subsidies whereby Ukraine would subsidise the transit of Russian gas through its territory by offering low transit tariffs and Russia would subsidise Ukrainian gas consumption by offering low gas supply prices. The contract also removed intermediary companies, such as RosUkrEnergo, which until then were selling a mix of Russian and central Asian gas to Ukraine at a fixed price. The contracts also ended annual winter negotiations concerning supply and transit modalities.

The main contract provisions include:

- Gas prices set according to an oil-indexed formula, based on Rotterdam oil product prices (50% gasoil/50% fuel oil) with a nine-month lag preceding the month of delivery, including a base price of USD 450/1 000 m^3 and its equivalent in hryvnia based on the official exchange rate of the national bank.
- Transit tariffs were substantially raised according to a formula as from 2010.
- Take-or-pay penalties were introduced, but not for ship-or-pay obligations. Gazprom committed to transit 110 bcm/year.
- Annual supply volumes were set at 52 bcm and the minimum take-or-pay level at 41.6 bcm, with an option to reduce this volume by 20%, if Naftogaz makes a request before July of the year that precedes the contract year.[6]
- All gas, including gas for storage, has to be paid before the seventh day after the month of delivery; otherwise a pre-payment mechanism can be introduced, along with penalties.
- Gazprom is allowed to access the domestic Ukrainian market via its 100% subsidiary, Gazprom-Sbyt Ukrainy.

GAS SUPPLY CHALLENGES

Negotiations with Gazprom

Gas import prices increased in 2009 and reached even higher levels in 2010 and 2011, following global oil market trends reflected in the oil-linked gas price formula established in the 2009 supply contract. In early 2010, Ukraine took steps to negotiate a gas price discount, which was arranged through the Kharkiv agreements in April 2010.[7]

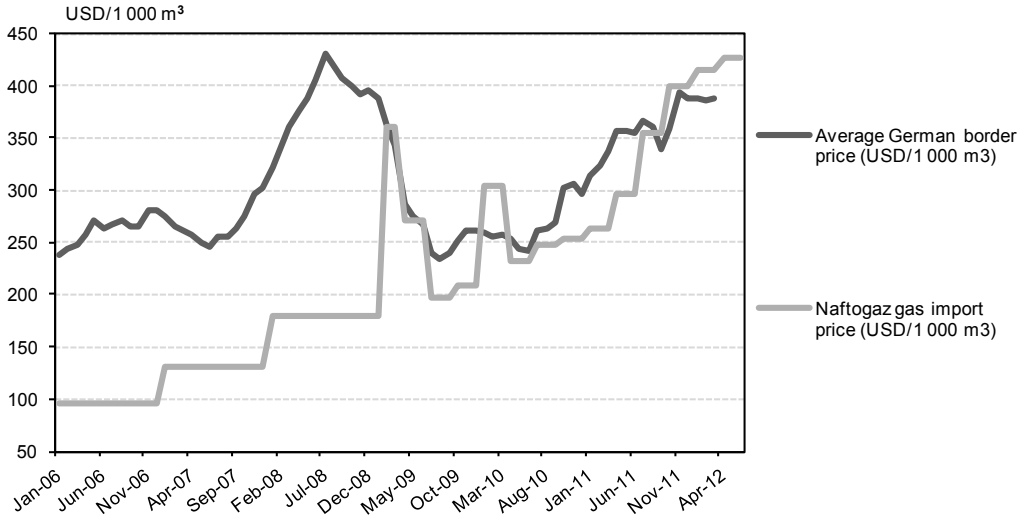
6. In November 2009, in the midst of the economic crisis, Gazprom agreed via a contract amendment to reduce the take-or-pay level to 27 bcm for 2009 and to 33.75 bcm for 2010. In April 2010, Gazprom and Naftogaz agreed that Naftogaz would increase its purchase level to 36.5 bcm in 2010, with Gazprom confirming that Naftogaz off-takes in the first quarter were in line with the contract.

7. In return for an extension of the stationing of Russian forces in Crimea until 2042 instead of 2017, a gas price discount valid until 2019 was agreed for volumes under 40 bcm/year: if the gas price is higher than USD 333.33/1 000 m^3, the discount amounts to 30%, with a cap at USD 100/1 000 m^3. According to Gazprom, the discount equals a reduction in the export duty

However, even with the Kharkiv price discount, quarterly gas import prices charged by Gazprom have been steadily rising over the last three years to reach USD 426/tcm in the second quarter of 2012, for reasons that include increases in global oil prices.

In 2011, gas imports were 44.8 bcm of which Naftogaz imported 40 bcm of natural gas costing USD 12.36 billion, and Ostchem imported 4.78 bcm costing USD 1.68 billion, so that Ukraine's total gas import bill was almost twice as much as it was in 2008 when the volume of gas was higher. Gas import payments have largely deteriorated Ukraine's current account balance and increased the challenge of maintaining the state's gas subsidy policy. The government considered that Naftogaz was paying an unfair import price as the USD 450/mcm base price included in the contract formula did not reflect the changing market fundamentals and economic reality that resulted from the economic crises. Prices charged by Gazprom to Naftogaz were denounced as being higher than for Germany or Turkey.[8] This is difficult to determine, however, as these prices are commercial secrets, although an average Germany border price is made public (Figure 7.4).

Figure 7.4 **Naftogaz gas import prices compared with average German border prices, 2006-first quarter 2012**



Sources: Naftogaz; German Federal Office of Economics and Export Control BAFA; IEA.

Gazprom is the monopoly supplier for Ukraine's gas imports, making Naftogaz its largest or second-largest (before or after Germany, depending on the year), and possibly its best, foreign customer, as Naftogaz pays a price indexed to oil and takes huge annual volumes at Russia's border. As Gazprom did not meet Ukraine's demands to obtain a major gas price reduction, negotiations were taken to the level of heads of state in mid-2011. Russia proposed that Gazprom and Naftogaz should merge and also accelerated its South Stream pipeline project. Ukraine in return stressed that it could take the case to arbitration, reduce

levied by the Russian government. Government of the Russian Federation, Decision No. 291 on the Rates of Export Customs Duties for Supplies of Gas from the Territory of Russian Federation to the Territory of Ukraine, Moscow, March 2010. *www.gazprom.com/press/news/2010/april/article97663/* (accessed March 2012).

8. Ukrainian News, 25 June 2012. "Azarov said that there is no claim from Ukraine against Russia's actions about the conclusion of gas contracts". Азаров заявляет об отсутствии претензий Украины к действиям России при заключении газовых контрактов в 2009, Українські новини, 25/6/12).

its purchases of Russian gas, build a liquefied natural gas (LNG) terminal, import gas from the central European gas hub, Baumgarten, export its own gas or even put Naftogaz in bankruptcy and cancel the 2009 gas supply and transit contract. As import prices reached the USD 400/1 000 m^3 level in the forth quarter of 2011 and thus increased the pressure on Naftogaz' finances and Ukraine's current account balance, discussions seemed to have moved on to the project of creating a gas consortium in exchange for a gas price reduction. However, as of mid-2012, discussions remained unsuccessful.

Diversity of supply sources

Until the ten-year supply and transit contract in 2009, Ukraine had no economic incentive to try to diversify gas import sources and transport routes. Until then, gas import prices from Russia, be it from Gazprom or its affiliated companies, were lower than those of potential alternative options that would charge full market price levels (Figure 7.4).

A strategic project to build an LNG terminal on Ukraine's Black Sea coast was developed as a priority project with the support of the Ukrainian government (Cabinet of Ministers Decree No. 2360, December 2010). The National Project LNG Terminal Company was established and put under the responsibility of the State Agency for Investment and National Projects. The terminal is planned to be built at the Yuzhny port and commissioned in the period 2015-16. Its capacity is to be progressively raised from 2 bcm to 5 bcm and ultimately, 10 bcm/year (maximum extension to four tanks), with a cost estimated of EUR 1 billion to EUR 1.7 billion, with the first phase estimated at EUR 969 million. An operating company is to be set up, which will secure loans and issue bonds. The state will invest about EUR 55 million and offer an additional EUR 121 million in guarantees via Naftogaz or Ukrtransgaz. Gas importing companies from Ukraine could buy LNG shipments from suppliers including the United States, Libya, Egypt, Algeria, Qatar and Azerbaijan. The estimated service cost for regasification could be USD 40/1 000 m^3 to ensure a quick return on investment.[9]

Rationale for this ambitious project include: diversify gas import sources; access lower priced gas supplies; strengthen Naftogaz's bargaining position vis-à-vis its traditional supplier; and strengthen Ukraine's energy security in the event of a supply disruption. In addition it aims to create business synergies in combination with Ukraine's storage facilities. Among the challenges is the Bosporus crossing as Q-flex tankers are too large and political and economic problems may arise as environmental concerns, congestions and queues or bad weather can delay crossing of the strait. Although the Montreux 1936 Convention enshrines the freedom of passage, Turkey in 1998 has put in place new rules of navigation in the strait to manage increasing traffic.

In parallel to the LNG project, Naftogaz is working to import gas from Central Europe or Turkey via reverse flows. The parliament approved amendments in April 2012 that authorise Naftogaz to buy gas directly without government approval, potentially enabling the company to conduct purchases on spot markets. A Memorandum of Understanding with a German company for gas supplies from Baumgarten was signed in May 2012.[10]

9. Energobiznes, 4 April 2012, "Expensive Regasification", based on results from the study on the construction of a LNG terminal in Ukraine. (Дорогая регазификация. Обнародованы результаты ТЭО строительства LNG-терминала в Украине, Энергобизнес, 4/4/12).

10. Naftogaz, Press Release, 11 May 2012.

Discussions are underway to make physical reverse flows possible from Slovakia. Ukraine could possibly buy gas during the low demand summer period with a view to store it for the winter, and thus benefit from seasonal price variations.

GAS SYSTEM INFRASTRUCTURE

GAS TRANSMISSION SYSTEM

When gaining its independence in 1991, Ukraine inherited a gas transmission system (GTS) with unique characteristics, such as a dense network of multiple primary and secondary pipelines coupled with major storage facilities (Figure 7.5). The system includes a total of 38 600 km of pipelines, including 22 200 km of main transmission pipelines and 16 400 km of distribution pipelines. It is powered by 72 compressor stations, with a total capacity of 5 442.9 megawatts (MW). The GTS can transport up to 80 bcm/year for Ukraine's domestic gas consumption, including gas from domestic production and imports, and can transit a maximum of 142.5 bcm/year of gas entering from Russia and Belarus to European countries.

STORAGE

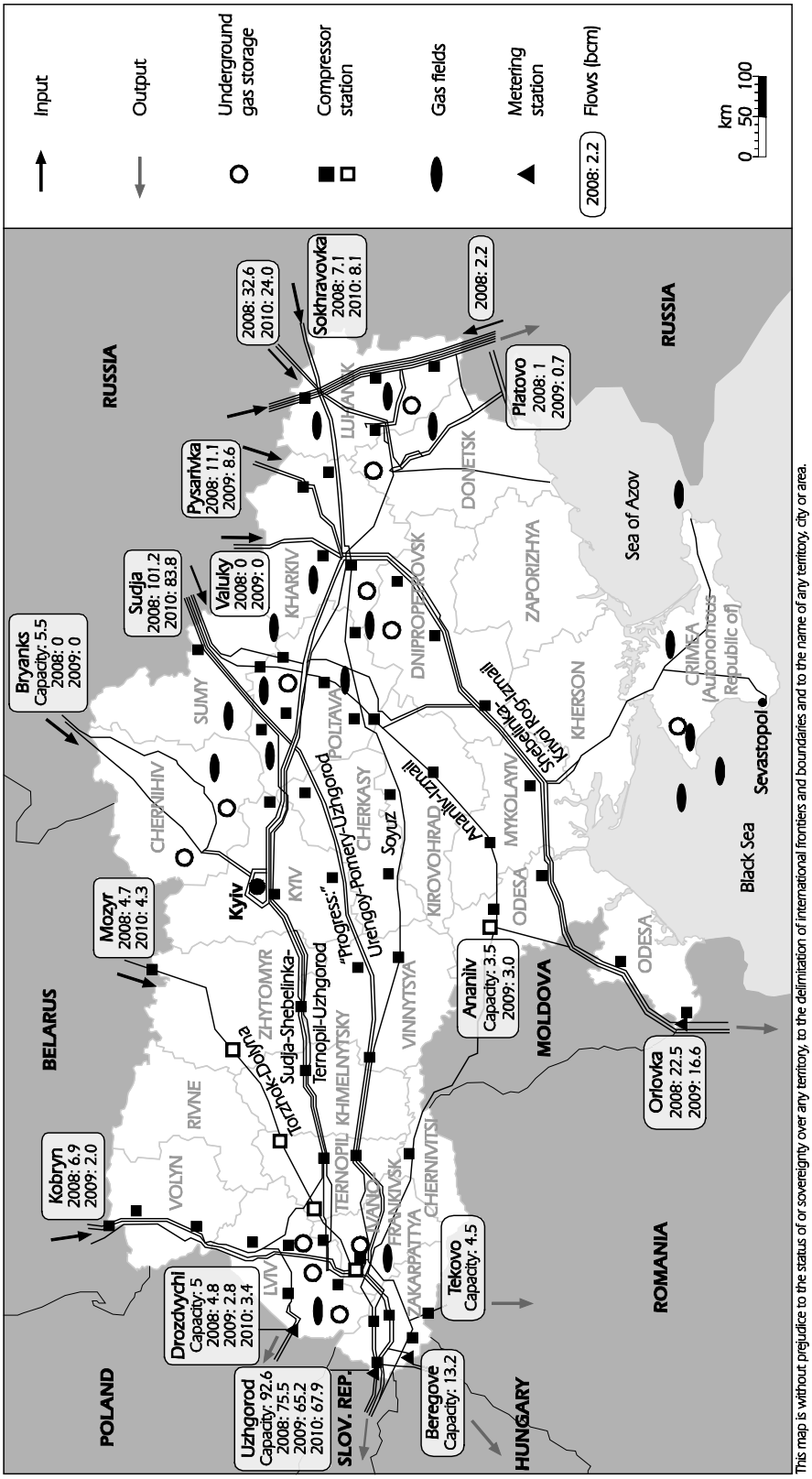
Ukraine's GTS has the second-largest storage capacity in Europe, after Russia. Storage plays a key role for the secure and stable operation of domestic supply operations as well as a critical role for the operation of the gas transit system. The thirteen underground gas storage facilities have total working capacity of 30.9 bcm/year. Ukrtransgaz, an affiliated company of Naftogaz, operates twelve of them, and Chornomorneftegaz, another affiliated company of Naftogaz, operates the facility located in Crimea. Five storage sites located in the west are pivotal in enabling the secure transit of Russian gas to Europe during peak demand in winter and gas supplies to Ukraine's regions. Two other facilities are located in the north-central area, two in the east and two in the south.

MODERNISATION OF THE GAS TRANSMISSION SYSTEM

Ukraine's gas transmission system was built during the Soviet era and part of it is in need of renovation or replacement to ensure its efficient and secure operation for another two decades. Since 2004, the European Union and Ukraine have collaborated to assess the state of the pipeline system, estimate the investments needed to upgrade and modernise it and to promote such investments. Key objectives are to: allow the safe operation of the system; increase its reliability and efficiency; improve environmental performance; and optimise and expand capacity, if needed.

At the March 2009 Joint EU-Ukraine International Investment Conference on the Modernisation of the Ukrainian Gas Transit System, a Joint Declaration was signed by Ukraine, the European Commission, European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB) and the World Bank to support the modernisation of the Ukrainian Gas Transit System with loans from the International Financial Institutions and technical assistance from the European Union in return for Ukraine committing to reform its gas market, increasing transparency and restructuring Naftogaz in line with the European Union (EU) directives. A technical co-ordination unit with representatives of Naftogaz, the European Commission, EBRD, EIB and the World Bank was set up.

Figure 7.5 **Gas transmission system and volumes, 2008-10**



Source: Naftogaz.

A feasibility study on the modernisation options and costs of the pipelines and storage facilities was financed by the European Union's Neighbourhood Investment Facility and undertaken in 2011 by the engineering and development consultancy Mott MacDonald. The study estimated design parameters and costs for three options:

- high transit volumes with average physical flows of 110 bcm/year, peak design capacity of 145 bcm and estimated cost of USD 7.6 billion to 10.6 billion;
- business-as-usual scenario with average volumes of 80 bcm/year, peak capacity of 110 bcm and estimated cost of USD 5.3 billion; and
- low volumes with average flows of 30 bcm/year, peak design capacity of 80 bcm/year and estimated cost of USD 2.65 billion.[11]

It identified a priority investment programme that would require a USD 3.2 billion investment, including USD 342 million for storage and USD 2.85 billion for pipelines and compressors.[12] The EBRD, EIB and Naftogaz set out in a July 2011 Memorandum of Understanding that EBRD and EIB would each issue loans of USD 154 million by end 2011 (total USD 308 million in loans) with Ukraine state guarantees. This was to finance the first part of the upgrade, reconstruction of the Urengoi-Pomary-Uzhgorod main gas pipeline, with the balance of the estimated first phase project costs of USD 518 million to be provided by Naftogaz. While noting that there has been progress on gas sector reforms by Ukraine, particularly during 2012, further work on gas sector reforms will be necessary before a first loan can be realised. In mid-2011, Ukrtransgaz announced that it had started modernising the Urengoi-Pomary-Uzhgorod pipeline on its own. In addition, Naftogaz signed a Memorandum of Understanding with Ferrostaal Industrieanlagen for a pilot project to upgrade Ukraine's GTS.[13]

Since 2002, Ukraine and the European Commission have been involved in a co-operative project to develop and expand the Boyarka Oil and Gas Metrology Centre and turn it into a state-of-the-art competitive international organisation. The key objective is to expand existing Boyarka Metrology Centre capabilities to include oil, oil products, liquefied gas metrology and international training services. In 2009-11, the European Union funded a project with total value of EUR 1.4 million to assess commercial, technical and environmental viability of this extension. Complementary tasks are optimisation and control of hydrocarbons transit flows and leakage monitoring options. The geographical area for new services should cover Ukraine, Belarus, Moldova, other former Soviet Union countries and EU neighbouring countries (Hungary, Poland, Romania and Slovakia). Client target groups include oil and gas exploration, transportation, processing and retail operators. Once its international certification is obtained, the Centre intends to play an important role for the transparency and accountability of gas supplies and transit.

11. Yeromenko, A. (2011), "Ukraine's Southern Gas Transportation Corridor Instead of the Russian South Stream. Not too late yet?", Mirror Weekly (Zerkalo Nedeli), 11 November 2011. (Алла Еременко. Украинский «Южный газотранзитный коридор» вместо российского «Южного потока»: еще не поздно?, Зеркало недели №41, 11/11/2011).

12. Shaukat, A. (2011), "Ukraine – EU: On the Way towards the Single Energy Market", presentation by MottMcDonald to the EU-Ukraine Conference, September 2011, Brussels, Belgium.

13. *www.ost-ausschuss.de/modernisierung-des-ukrainischen-gasnetzes* (accessed 12 July 2012).

GAS TRANSMISSION SYSTEM OPERATION

Ukraine's gas transmission system is owned by the state and leased to Ukrtransgaz, a 100% affiliated company of Naftogaz. Ukrtransgaz is responsible for the transportation of natural gas to domestic consumers via the main pipelines, gas transit to European markets, gas storage, and system operation and maintenance. Based on bilateral contracts, Gazprom nominates daily transit volumes within a technical range in the morning as well as the gas entry and exit points, and Ukrtransgaz ensures their secure transit through the gas transmission system. An operational framework agreement is signed every year between Gazprom and Naftogaz on technical issues and procedures regulating gas transit operations. Chornomorneftegaz, a 100% subsidiary of Naftogaz, carries out the same activities on the pipelines and storage facility located in the territory of the Autonomous Republic of Crimea.

The GTS has many large gas entry points on the Russian-Ukrainian border, allowing both Russian transit gas and gas shipped for domestic consumption to be dispatched to Ukraine's eastern regions. Gas is then added in the transit pipelines from Ukraine's storage sites to the remaining gas shipped from east to west to make up for the gas taken out for domestic supply. Storage facilities hold both gas from domestic production and imported from Russia. These swap operations are an essential technical aspect of system operations that allow rapid response to peak winter demand in Ukraine and European markets and enable the shipment of more Russian gas to European markets and to Ukraine's eastern regions. During winter peaks, Ukraine's five storage sites at the western border can supply up to 40% of daily transit volumes. On average during this period, Ukraine imports about 120 mcm to 130 mcm/day, produces about 55 mcm/day from its own fields, extracts between 85 mcm and 100 mcm/day from its storage, with a peak capacity of about 140 mcm/day.

Domestic and imported gas is injected into Ukraine's storage facilities during the period from 15 April to 15 October and withdrawn during the winter months. Over the past five years, annual injections into gas storage have been in the range of 11 bcm to 18 bcm with annual withdrawals of 12.27 bcm to 17.49 bcm. In order to be able to rapidly meet peak withdrawal requests from its European customers in winter and avoid the congestion in main transmission pipelines, Gazprom stored gas in Ukraine via affiliated companies such as RosUkrEnergo to withdraw that gas close to neighbouring European countries. However, since 2009, it no longer does so and instead withdraws gas from its own storage sites in Russia and the European Union.

GAS TRANSIT: PAST TRENDS

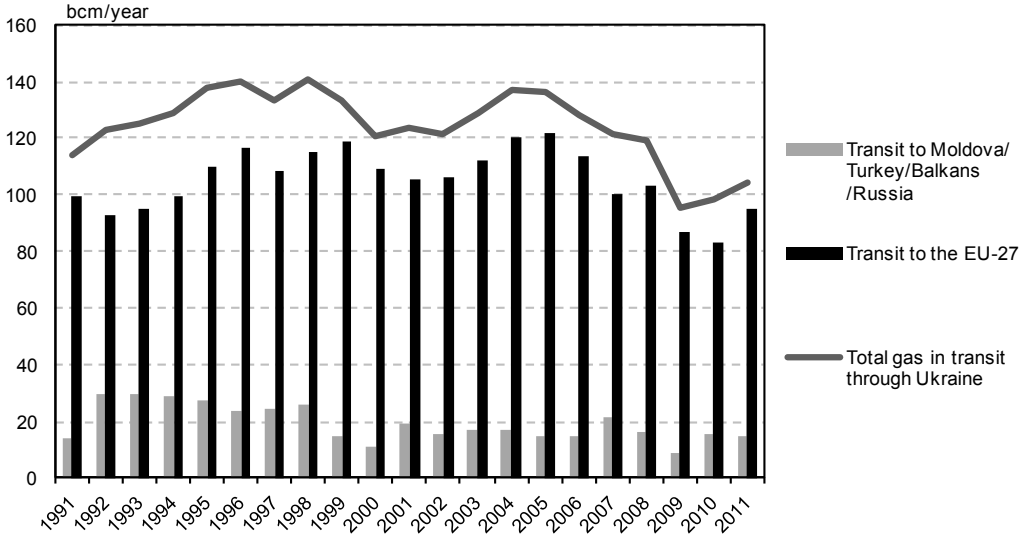
Since the mid-1990s, Russia has pursued a strategy to diversify its gas export routes to European markets in order to increase available capacity and reduce its dependence on transit through Ukraine. Until 2008, the successful development of two alternative routes had no major impact on gas transit volumes through Ukraine since increased demand for Russian gas loaded alternative routes and minimised potential reduction in transit volumes through Ukraine. A third pipeline line was added along the Ananyev-Tiraspol-Izmail route in 2003, increasing Russia's export capacity to south-eastern Europe and Turkey.

The situation for Ukraine changed with the opening of the Blue Stream pipeline to Turkey in 2006. Russian gas transit volumes through Ukraine have progressively fallen over the last decade because of the Blue Stream pipeline, Gazprom's construction of a

bypass to supply the Rostov oblast and commissioning of the Yamal pipeline. Ukraine transit volumes were down from 137.1 bcm in 2004 to 104.19 bcm in 2011. A record low of 95.8 bcm was experienced in 2009, but largely due to a decline in European demand.

Two decades of gas transit volumes via Ukraine are shown in Figure 7.6. Major transit flows in 2010 entered Slovakia (67.9 bcm), Moldova (16.7 bcm) and Hungary (7.1 bcm). Since 2009, changes in European gas markets, including LNG developments, increased supply from North Africa, lower than expected demand levels and Gazprom-promoted alternative gas transportation routes, have contributed to a decline in gas transit volumes through Ukraine. Nevertheless, Ukraine so far remains a key corridor for the transit of Russian gas to European markets.

Figure 7.6 **Gas transit volumes via Ukraine, 1991-2011**



Sources: Naftogaz; Ukrtransgaz.

While transit volumes are in decline, revenues have increased over the last decade as gas transit tariffs were raised in line with imported gas prices. The average transportation distance is about 1 200 km. The price rose from USD 1.09/1 000 m^3/100 km in 2005 to USD 1.7/1 000 m^3/100 km in 2008. The transit tariff is set according to a formula in the 2009 Gas Supply and Transit contract and reached about USD 2.86/1 000 m^3/100 km in 2011 and USD 3.11/1 000 m^3/100 km in Q3 2012.

GAS TRANSIT: OUTLOOK

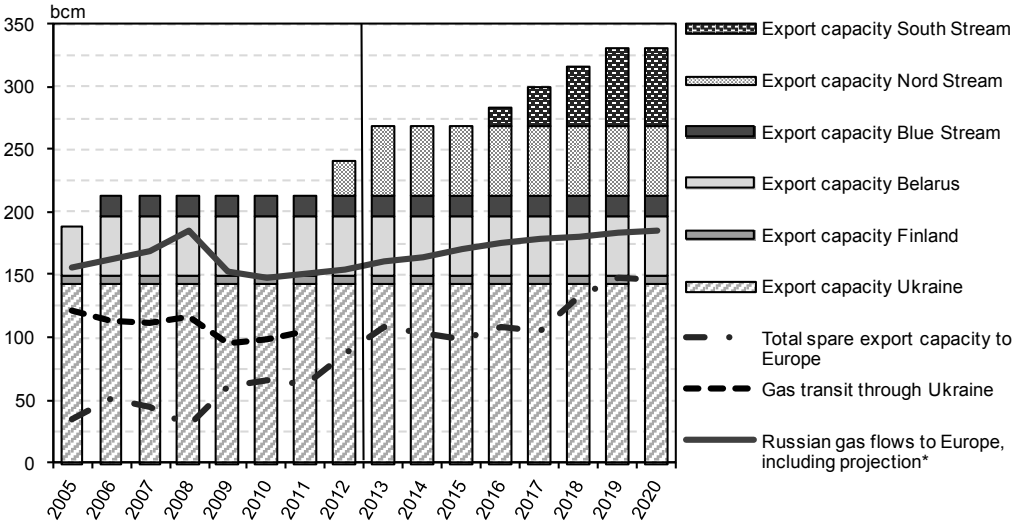
Two main factors will affect the future of Ukraine as a transit route for Russian gas: the evolution of demand for Russian gas in European markets and the construction of alternative routes, their capacities and ship or pay obligations (Figure 7.7).

In the period 2009-11, Russian gas supplies to Europe were flat, if not slightly decreasing and below what had been forecast in the 2005-08 period. Factors influencing the demand for Russian gas in Europe include: the level of economic growth; demand for fuel in power generation; availability of alternative sources including whether shale gas production materialises and its scope; and Gazprom's pricing policy.

A key game changer for Ukraine's role as a transit country for Russian gas has been the commissioning of line 1 of the Nord Stream pipeline at the end of 2011. Its line 2 is expected to open by the end of 2012, with total capacity expected to be 55 bcm/year. Physical volumes transported are likely to be in an average range of 48 bcm/year to 50 bcm/year.

As from 2013, the Czech Republic will import all its Russian gas supplies via the Nord Stream pipeline. In order to meet its ship-or-pay obligations on Nord Stream, Gazprom is also likely to reroute part of its supplies to its German, French and Belgian customers away from Ukraine. In addition, Gazprom's purchase of 100% of Beltransgaz, the gas transmission company in Belarus, at the end of 2011 should also give the Russian supplier additional incentive to load the Belorussian Yamal or the Northern Lights routes as transportation costs would be lower.

Figure 7.7 **Gas export pipeline capacity to Europe, exports volumes to Europe, transit volumes via Ukraine, 2005-20**



* Projection is based on Gazprom data and IEA estimates.

Sources: Gazprom; IEA.

The Slovakian transmission system operator Eustream is already planning for reduced volumes of Russian gas in transit after commissioning of the Nord Stream pipeline. Eustream is progressively scaling back technically available capacity by 20% in 2017, down to 75 bcm/year from about 100 bcm/year. The operator foresees a decline in booked capacity from 281.5 mcm/day in 2012 to 213.8 mcm/day in 2013 and down to 189.9 mcm/day in 2014, a 40% decline in the short term. In the longer term, the expected decline is 50% compared with 2012.[14] In line with this planning, Gazprom has stated that when operating at full capacity, Nord Stream will be carrying 22 bcm/year of gas under new contracts and about 30 bcm/year under old contracts.[15] The take-over of Beltransgaz was conditioned

14. Note that booked capacity does not correspond to physical volumes as contracts allow some ship-or-pay flexibility, *www.tis.eustream.sk/TIS/#/?nav=bd.ltc* (accessed March 2012).

15. Interfax, 18 November 2011.

with Gazprom commitment to ship 43 bcm/year via Belarus during the period 2012-14, with unknown volumes after that. The gas transit price was raised to USD 2/tcm/100 km.[16] Gazprom is likely to have a strong incentive to fully load the Nord Stream pipeline in order to fulfil its ship-or-pay commitments, then load the Belarus route to make the most out of this investment as far as it is compatible with its gas delivery points, (this gas is primarily sold in northern Europe, but could be shipped through Germany to central Europe as well, with additional transportation costs), and only then, use the Ukrainian route. The volumes of Russian gas in transit through Ukraine and the Slovakian route may be reduced by about 20 bcm/year to 25 bcm/year by 2013 or 2014 as a consequence of Nord Stream and the Beltransgaz takeover by Gazprom.

If the South Stream pipeline is to be built with a capacity of 63 bcm/ year, then Russian gas volumes in transit through Ukraine are likely to be further reduced. South Stream would substitute gas in transit through Ukraine to an extent that would depend on how much additional Russian gas Gazprom and its partners would be able to sell in Europe. A final investment decision on the South Stream pipeline is projected for November 2012. The draft *Updated Energy Strategy of Ukraine to 2030* forecasts that South Stream will be built with only a 30 bcm/year capacity (two pipelines) and transit on average 20 bcm/year by 2030.[17] The strategy estimates that by 2030 Ukraine would still transit about 70 bcm/year to 80 bcm/year. A key issue will be to tailor the modernisation of Ukraine's pipeline system to the future transit flows and imports to make sure that the system will operate in an efficient manner.

INSTITUTIONAL FRAMEWORK

Ukraine's natural gas sector is dominated by the state-owned Naftogaz and its affiliated companies, which produce, import, transport and supply gas to all categories of consumers. The Naftogaz Company is supervised by the Cabinet of Ministers which nominates the members of its supervisory board. Key gas agreements with Russia are often directly supervised or negotiated by the president and/or the prime minister and the minister of energy, while technical work is prepared by Naftogaz. The Parliamentary Committee on Fuel and Energy, Nuclear Policy and Security prepares legislation related to the oil, gas and electricity sector.

Responsibilities of other authorities include:

- the Ministry of Energy and Coal Industry develops and implements natural gas policy, conducts planning activities such as a yearly gas balance projection, co-operates with the Ministry of Finance on issues related to demand, imports, subsidies and Naftogaz's budget, collects information on the gas sector, interacts with foreign institutions and leads negotiations on gas supplies and transit with foreign stakeholders;
- the National Commission for State Energy Regulation (NERC) is responsible for preparing and implementing the economic regulation of the natural gas sector and setting tariffs under the supervision of the Ministry of Economy. NKRE conducts state regulation of natural monopolies and business entities operating in related markets, including markets of natural gas and unconventional gas, oil and petroleum products; and
- the Anti-Monopoly Committee monitors competition and market issues.

16. In 2011, total transit capacity through Belarus was 33 bcm through Yamal and 16 bcm through the Northern Lights system.

17. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

MARKET ORGANISATION

In Ukraine's gas market, the key stakeholders are Naftogaz and its affiliated companies, especially Ukrtransgaz, the transportation entity (Figure 7.8). Partially privatised regional gas transmission and wholesale supply companies, known as oblgazes, also play a role. Private companies are increasing their involvement in regional gas transmission and wholesale supply to some industries, including some very small operations owned by foreign companies.

Naftogaz

The National Joint Stock Company, Naftogaz, is the dominant gas company in Ukraine. Via its affiliated companies, it produces about 90% of domestic natural gas and gas condensate products, is involved in gas transmission (Ukrtransgaz) and gas distribution to all categories of final consumers. Gas transit through Ukraine is performed by Ukrtransgaz, which manages and operates the main transmission pipelines. Distribution of gas to domestic consumers is operated and realised by Ukrtransgaz through main transmission lines and by regional distribution companies, called oblgazes, in regional and local low pressure gas pipelines.

The retail supply function within Naftogaz was for a long time realised by Gaz Ukrainy, a full subsidiary company, before it was liquidated at the end of 2011 and the functions were directly taken over by Naftogaz. In 2011, Naftogaz supplied gas to 100% of the public sector and about 75% of the industry sector. Naftogaz has the right to import gas without paying VAT, which is a privilege other companies do not enjoy (law adopted in September 2011 and valid until the end of 2012).

Other wholesale distributors

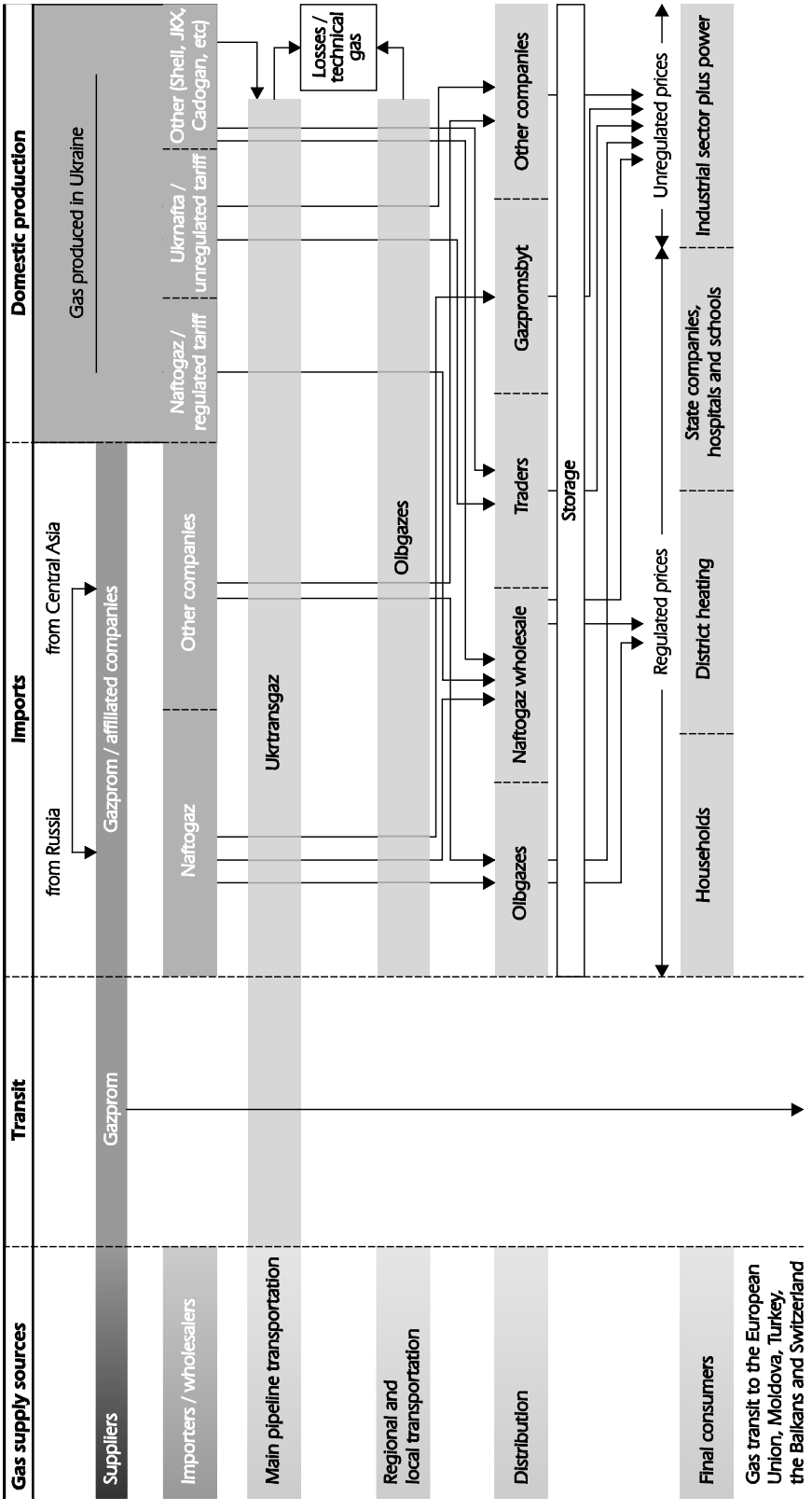
Since April 2008, Gazprom-Sbyt Ukrainy, a Gazprom affiliated company, has been supplying gas directly to industrial customers in Ukraine. The company holds a five-year licence obtained from NERC in 2008 to supply 7.5 bcm/year at a non-regulated tariff. Gazprom-Sbyt Ukrainy supplied 1.85 bcm in 2009 and 3.24 bcm in 2010. The company buys gas from Naftogaz, in line with the 2009 Gazprom-Naftogaz Gas Supply and Transit contract which foresees that this company should supply 25% of the industrial gas segment of the market.[18] Another company, UkrHazEnergo, obtained a licence from NERC in March 2011 to supply 4.8 bcm of gas valid for a five-year period to 2016. This company sold 0.835 bcm in 2011 to industrial consumers.[19]

While a hundred companies have licences to distribute gas, Ukraine counts about twenty gas companies who effectively produce, buy and sell some very limited amounts of gas. Shell and Ukrnafta are the major ones, but many others operate on the market, often in specific regions. Combined they do not supply more than a total of 2 bcm/year.

18.Gazprom (2010), Annual Report 2009, Moscow, p.65, *www.gazprom.com/f/posts/05/285743/annual-report-2009.pdf* (accessed May 2012).

19. Interfax Ukraine, 29 May 2012. UkrHazEnergo was created as a 50-50 joint venture between Naftogaz and RosUkrEnergo in 2006 to import and distribute gas in Ukraine instead of Naftogaz. A Ukrainian Court ruled in September 2011 that Naftogaz's control of 50% of UkrHazEnergo was illegal, thus transferring total control of the company to RosUkrEnergo, a 50-50 joint venture between Gazprom and Centragas Holdings.

Figure 7.8 **Natural gas market organisation**



Source: IEA.

Regional gas transmission and distribution

Ukraine has 53 regional gas transmission companies (oblgazes). While Naftogaz holds shares in 48 of them, experts and the press often report that most of them are controlled by one Ukrainian businessman.[20] According to a government decree in October 2011, all shares held by Naftogaz in 48 oblgazes were to be transferred to the State Property Fund in view of their privatisation in May 2012 (the value of these shares is reported to be about USD 1.5 billion).[21] The decree mandated that Naftogaz would either sell shares to only keep 25% of their control, or fully sell off all its interests in oblgazes in which it owns less than 25% of shares.[22]

Gas distribution companies perform transportation activities in accordance with NERC regulation. (Oblgazes hold permits from Ukrtransgaz to transport gas through main transmission pipelines). Gas transmission and distribution tariffs set by NERC vary in a range of UAH 70.2 (EUR 7)/1000m³ to UAH 300.5 (EUR 30)/1000m³, depending on the distance and geographical area.[23]

In past years, regional gas companies collected payments for gas on behalf of Naftogaz. Over a decade these oblgazes accumulated considerable debts to Naftogaz, reported to be around UAH 10 billion (USD 1.3 billion) by January 2010. On the grounds of non-payment, the government in 2008-09 attempted to dispossess the owners of regional gas companies of their licences and transfer their activities to a new company, Naftogazmerezhy, a 100% Naftogaz subsidiary. This process failed due to legal resistance from the oblgazes. In 2010, the government offered oblgazes to cancel their debts provided that they ensure 100% payment over the year. Oblgazes complain that the gas transportation tariff set by the regulator does not fully cover expenses necessary to maintain the gas pipeline system. In turn, the regulator on some occasions has threatened to impose fines or withdraw licences for failing to properly maintain pipelines and ensure the stable and secure transportation of natural gas. As of February 2012, the oblgazes had built up new debts to Naftogaz: oblgazes only transferred 86% of due payments to Gaz Ukrainy in 2011. As of February 2012, the oblgazes owed Naftogaz UAH 788.7 million (about USD 98 million).[24]

REGULATION

The National Commission for State Energy Regulation (NERC)[25] was reorganised and renamed in November 2011 and given regulatory authority over the entire energy sector.[26] (The authority was previously called the National Electricity Regulatory Commission.) NERC is responsible for economic regulation of the market and to ensure its transparent, predictable, non-discriminatory and efficient functioning. It is subordinate to the President of Ukraine, who appoints its head, and is accountable to the parliament. Its main powers and duties in the natural gas sector are to:

20. Krimov, V. (2012) “Offshore Fog”, Energobiznes, 15 May 2012 (Виталий Крымов. Оффшорный туман. Energobiznes №18-19, 15/5/2012).

21. Decree No. 1053, October 2011.

22. Interfax Ukraine, 7 February 2012. The State Property Committee intends to start privatisation of oblgazes in May (ИНТЕРФАКС-УКРАИНА, ФГИ намерен начать приватизацию облгазов в мае, Киев. 7/2/2012.).

23. *www.utg.ua/ru/tariffs/* (accessed March 2012).

24. Interfax Ukraine, 8 February 2012. Gaz Ukrainy asks oblgazes to pay for their gas debts. (ИНТЕРФАКС-УКРАИНА. "Газ Украины" требует от облгазов оплатить задолженность за газ, 8/2/2012).

25. In Ukrainian: Національна комісія, що здійснює державне регулювання у сфері енергетики (NKRE); *www.nerc.gov.ua*.

26. Presidential Decree No. 1059, November 2011.

- issue licences for natural gas transportation, distribution and storage of gas;
- issue licences for gas distribution at regulated tariff and non-regulated tariff levels;
- control compliance of licence holders with licence regulations;
- set the methodology and regulate tariffs for gas transmission, and regional and local distribution, as well as storage (injection, storage and off-take), with the exception of transit, which is governed by intergovernmental agreements or contracts between Naftogaz and Gazprom;
- set the methodology and the level of gas prices for the public sector (households, district heating, public organisations), which is agreed by the Cabinet of Ministers;
- propose gas prices for domestic gas production by public companies and joint ventures with public companies;
- set the maximum tariff level for the industrial sector (based on the cost of imported gas, VAT, other costs and margins (typically about USD 40/tcm in addition to the imported price); and
- organise and ensure fair and transparent access to pipeline capacity by publishing and implementing pipeline access regulations and procedures.

The regulatory authority has to be fully independent, both financially and politically, to be in line with the EU Energy Community provisions (Box 7.2). This implies that NERC should be able to set tariffs without interference from political influences and to effectively perform all its duties. Tariffs and methodologies need to be published *a priori* to their entry into force and be cost-based and non-discriminatory, as required by Directive 2003/55/EC. Capacity allocation mechanisms, rules and procedures to access the networks need to be clear, non-discriminatory and allow for fair access.

The regulatory authority is widely perceived to have made strong progress in recent years to take full ownership of its responsibilities and prepare for the changing legal environment. It has benefitted from training and capacity building support from the European Commission and other EU member states and institutions. Its institutional framework has also been improved to enable it to realise its tasks. However, its financial autonomy could be further strengthened.

Ukraine's Anti-Monopoly Committee is, according to the Law, an independent authority controlled by the President and reporting to the Parliamentary of Ukraine. It has a key role to play in accompanying the market liberalisation process and ensuring that no stakeholder puts obstacles to fair and effective competition. The Committee can impose fines of up to 10% of a company's turnover. In some cases, it might not be in a position to rely on sufficient legal and institutional support, such as information sharing from other state agencies, to properly conduct its functions whereas it has a key role to play in ensuring that no stakeholder takes a dominant position in the market.

MARKET REFORM

Energy Community provisions and implementation

In moving to join the Energy Community, Ukraine has sought to develop co-operation with the European Union, strengthen its energy security, obtain EU funding and support

for energy market reforms and the modernisation of its gas transmission system. Ukraine also views its membership as a means to convince the European Commission and EU member states that the Ukrainian GTS should be preferred over the South Stream gas pipeline construction, based on solidarity and energy policy co-ordination principles.

Ukraine's Energy Community membership has become the main driving force for gas market reform. As part of its accession to the Energy Community Treaty, Ukraine is expected to implement EU directives relative to natural gas (Box 7.2).

Box 7.2 **Energy Community Treaty natural gas provisions**

The Energy Community Treaty requires the adoption of following key EU gas directives and regulations:

- common rules for the internal market in natural gas (Directive 2003/55/EC): legally binding as of 1 January 2012;
- conditions for access to the natural gas transmission networks (EC Regulation No. 1775/2005): legally binding as of 1 January 2012;
- measures to safeguard security of natural gas supply (Directive 2004/67/EC): legally binding as of 1 January 2012;
- common rules for the internal market in natural gas (Directive 2009/73/EC): legally binding as of 1 January 2015; and
- conditions for access to the natural gas transmission networks (Regulation No. 715/2009): legally binding as of 1 January 2015.

Source: Energy Community Treaty.

A new law on the natural gas market was adopted in 2010 to align Ukrainian legislation with EC Directive 2003/55.[27] The European Union made this adoption a prerequisite for Ukraine's accession to the Energy Community Treaty. Thus its adoption was a very important step, although it has not simplified the complex legislative framework of Ukraine's gas sector.

The new law provides consumer choice of gas supplier from 1 January 2012 for qualified categories, mainly industrial consumers. This is extended to all categories of consumers from 1 January 2015, although some additional clarifications are needed in secondary legislation on how this would work. With some delay, NERC adopted a resolution precising the schedule for the liberalisation of the gas market.[28] Pursuant to the resolution, industrial users and other entities are able to choose their gas supplier as of 1 May 2012, public institutions and organisations as from 1 January 2013, businesses that produce heat as from 1 January 2014, all residential consumers as from 1 January 2015.

A resolution in April 2012 addresses third-party access to the GTS.[29] It is a major step forward but leaves open a number of key questions and potential problems of compatibility with the EU *acquis communautaire* (Directives 1775/2005 and 715/2009). These include

27. Law on the Principles for Functioning of the Natural Gas Market (No. 2467-VI, July 2010).

28. Resolution on Determination of the Qualifications of Consumers of Natural Gas" (No. 305, March 2012).

29. NERC, Approval of Access to the Unified Gas Transmission System of Ukraine (Resolution No. 420, April 2012). *www.zakon2.rada.gov.ua/laws/show/z0721-12* (accessed 12 July 2012).

provisions pertaining to non-discriminatory access to pipelines since in the resolution priority is given to public sector supplies, pipeline capacity allocation mechanisms, physical balance and security of gas transmission operations, and the transparency of information, registration and capacity booking. It is also not clear where the dispatcher functions will be and how these will be controlled.

These main elements had yet to be adopted or implemented as of May 2012:

- Freedom to choose gas supplier by all categories of consumers.
- Reform of Naftogaz and its network of companies. In line with Ukraine's Energy Community commitments and EU Directive 2003/55/EC, an independent transmission system operator (TSO) has to be established. This includes the unbundling of gas transportation/storage/production and distribution activities, and ensuring the financial viability and greater transparency of the company and its subsidiaries. The TSO must be unbundled legally and functionally and have independent management, financial autonomy and ownership of the dispatching functions.
- Legal and functional unbundling of the oblgazes (proposed by 2015).
- Provisions guaranteeing the total independence of the regulator and authority for its key duties. NERC should be able to set full cost-recovery tariffs especially for the public sector; set the gas transmission tariff for transit flows and align it with internal transmission; ensure fair and non-discriminatory access to pipelines and storage; and effectively regulate the TSO. A key unresolved issue is the compatibility of the gas transit contracts between Gazprom and Naftogaz and the intergovernmental framework of agreements between Russia and Ukraine which set the gas transit tariff, and the requirement to abolish districting between transmission and transit flows within the Ukrainian gas market legislation.
- Liberalisation of prices and phase out of subsidies in the transition to market and cost reflective prices.

Challenges and opportunities for Naftogaz reform

The Ukrainian government has taken some steps to prepare the restructuring of Naftogaz, with the objective to finalise this process by 2014. The European Union, in co-operation with the World Bank, has offered a technical assistance project on the corporatisation and restructuring of Naftogaz.

Preparations for this are slow but nonetheless underway. In 2011, Ukrainian authorities announced that they are planning to conduct an initial public offering with the objective to collect up to USD 10 billion for the sale of Naftogaz assets.[30] Funds received from privatisation were to be directed to energy efficiency measures and increased gas production.[31] The government also put forward an initiative to reform Naftogaz by dividing it into three distinct companies for oil and gas production, wholesale supply and transportation of oil and gas. A working group was established following a governmental decree (No. 886) in September 2011.[32] The president ordered the government to prepare

30. Interfax Ukraine, 28 September 2011.

31. Boyko, Y. (2011), Speech of the Minister of Energy and Coal Industry of Ukraine at the International Conference "Ukraine-EU: On the Way towards Single Energy Market", Kiev, September 2011.

32. This group is chaired by the vice prime minister and includes the leaders of the relevant government bodies and Naftogaz.

different reform options by 1 November 2011. On 27 October 2011, the government decided by decree (No. 656) to liquidate Gaz Ukrainy, the former subsidiary of Naftogaz responsible for gas distribution, and to transfer its functions to Naftogaz. At the same time, the government ordered Naftogaz to prepare an inventory of all its assets categorised by valuable and non-valuable assets. In March 2012, Baker Tilly International, an accountancy and business advisory company, won a tender to make a financial evaluation of Ukraine's gas transmission system to be completed by August 2012.

In April 2012, the parliament adopted the Amendments to the Law of Ukraine on Pipeline Transport with Regard to the Reform of the Oil and Gas Complex (No. 9429-1).[33] It sets a framework for the restructuring of the Naftogaz Company in line with Energy Community requirements, particularly for unbundling and corporatisation of Ukrtransgaz. It allows the company to be split into separate entities according to specialised functions. These amendments further prohibit any privatisation or alienation of assets, such as in the form of a concession.

In June 2012 the government passed a resolution instructing the Ministry of Fuel and Coal Industry and Naftogaz to reform the subsidiary companies Ukrtransgaz (gas transportation and storage) and Ukrgazvydobyvannya (gas production).[34] The shares of these two companies will remain with Naftogaz. A subsequent action plan has determined steps and deadlines for the establishment and registration of two new public joint stock companies by the end of 2012. The government has also discussed plans to reform Naftogaz and conduct an initial public offering and privatise some of its assets, although these assets were not specified.

Efforts to restructure Naftogaz should improve the transparency of the company's activities, financial flows and subject it to greater control by the Committee on Fuel and Energy, Nuclear Policy and Security. They should also help to ensure the economic viability of Naftogaz and its subsidiaries and to raise the efficiency of their operations.

A major challenge for market reform is the huge debt accumulated by Naftogaz. Outstanding credits and bonds still have to be paid back, particularly Eurobonds that were restructured in 2009. Market reform initiatives cannot jeopardise the payment of these debts.

Naftogaz's critical financial situation represents a further call not only to reform the tariff system, but also to restructure Naftogaz. This task is extremely challenging and sensitive as Naftogaz is a vertically integrated company employing 175 000 people with a dominant position in all segments of the oil and gas business.

It the current market segmentation is maintained, whereby a large portion of gas is sold at regulated prices, market reform could further deteriorate the financial situation of Naftogaz. Indeed, gas importing and distribution companies connected to Gazprom would have an incentive to offer more competitive prices to industrial consumers than Naftogaz can do based on its own import contract in order to gain market share. In a fully liberalised market environment, some of Ukraine's industrial consumers could switch supplier, forcing Naftogaz to progressively reduce its share of this market segment and concentrate its activities on supplying gas to the loss-making public segment. This would be even more challenging as Naftogaz is facing take-or-pay contract clauses until 2019, which were designed for a situation where Naftogaz faces no major competition to supply the industry sector, about 45% of Ukraine's total gas consumption. Restructuring

33. *www.w1.c1.rada.gov.ua/pls/zweb_n/webproc4_1?id=&pf3511=41861* (accessed 12 July 2012).

34. Resolution on Restructuring of Subsidiary Companies of the NJSC Naftogaz (No. 360, June 2012).

Naftogaz and reforming the gas market thus can only work if Naftogaz is allowed to import less gas and to be able to sell to the public sector at a more cost reflective price, which requires progressive removal of state subsidies. As of mid-2012, no such gas price increase to the public sector is on the horizon, making the prospect for the restructuring of Naftogaz uncertain.

Moreover, there is a risk that gas supplies to Ukraine's industrial sector will be more and more dominated by integrated private holding companies with affiliated companies involved in gas production – be it in Ukraine or Russia – and gas distribution to large industrial gas consumers in order to create synergies, reduce costs and increase profit opportunities. But some industrial companies could loose from such a development if the private holding companies gain dominant positions and if there is not enough competition on the market.

Box 7.3 **Extractive Industries Transparency Initiative**

The Extractive Industries Transparency Initiative (EITI) sets a global standard for revenues from natural resources. It aims to strengthen governance by improving revenue transparency and accountability in the extractive sector. The EITI standard has two main elements: companies publish what they pay and governments publish what they receive in an EITI Report; and this process is overseen by a multi-stakeholder group of governments, companies and civil society. To date, 21 countries have achieved EITI Candidate status and fourteen countries are EITI Compliant: Azerbaijan, Central African Republic, Ghana, Kyrgyz Republic, Liberia, Mauritania, Mali, Mongolia, Peru, Nigeria, Niger, Norway, Timor-Leste and Yemen.

To become an EITI Candidate, a country must meet five requirements. It then has 1.5 years to publish an EITI Report that reconciles what companies say that they pay in taxes, royalties and signature bonuses, with what governments say they have received. To achieve EITI Compliant status, a country must complete an EITI Validation. It provides an independent assessment of the progress achieved and what measures are needed to strengthen the EITI process.

The EITI requirements and rules, among others, require countries to ensure that:

- companies comprehensively disclose all material payments in accordance with the agreed reporting templates;
- government agencies comprehensively disclose all material revenues in accordance with the agreed reporting templates;
- the multi-stakeholder group must be content that the organisation contracted to reconcile the company and government figures did so satisfactorily;
- the reconciler must ensure that that the EITI Report is comprehensive, identifies all discrepancies, where possible explains those discrepancies, and where necessary makes recommendations for remedial actions to be taken; and
- the government and multi-stakeholder group must ensure that the EITI Report is comprehensive and publicly accessible in such a way as to encourage that its findings contribute to public debate.

Source: *www.eiti.org*.

Restructuring Naftogaz and privatising it, or some of its assets, requires legislative changes. For example, the Naftogaz Company is included in a list of strategic assets which legally cannot be privatised. A law on pipeline transport forbids the reorganisation and privatisation of state-owned enterprises related to the main pipeline transmission system. This law also bans any form of concession, lease or management of any of the assets of Naftogaz and its affiliated companies.

Naftogaz undergoes regular audits which are made public, but this is not the case with its affiliated companies. Joining the Extractive Industries Transparency Initiative is a much needed step and needs to be quickly achieved (Box 7.3). A resolution concerning compliance with the Extractive Industries Transparency Initiative (EITI) was approved by the Cabinet of Ministers in September 2009 (No. 1098). Not much progress has been made except for the creation of a working group in 2011 and its first session in March 2012, with three of the five sign-up indicators fulfilled. Joining the EITI was also a commitment taken under the International Monetary Fund co-operation programme.

PRICES AND SUBSIDIES

DUAL TARIFF STRUCTURE

Ukraine natural gas consumers are divided into two categories: regulated tariff customer class and a non-regulated tariff category. Regulated tariffs apply to the public sector (residential consumers, district heating sector, public organisations such as schools and hospitals and state-owned companies) and are set much below cost-recovery levels (adequate to cover import costs and/or support investment for domestic gas production). Within this category, prices are set below full cost recovery levels for households and publically funded organisations: although they benefit from the gas produced by state-companies in Ukraine at a cost much lower than the imported price, the regulated price is set at a level that does not allow public companies to finance major investments and technologies for the upstream development and expansion of production. District heating systems' gas consumption is mostly covered by imports and these companies buy their gas at a price much lower than the imported price paid by Naftogaz, which is a subsidy to the district heating systems. Non-regulated tariffs apply to the industrial sector and are based on a cost-plus principle including import costs, VAT, transportation and distribution costs.

Price differences among the two tariff categories are huge. Industrial consumers paid about UAH 3 509/tcm for gas (about USD 440/tcm) in the first quarter of 2012, which includes the import price + VAT + a USD 20/tcm mark up by Naftogaz. The public sector benefiting from regulated tariffs pays much less although some increases have been passed on in their tariffs.

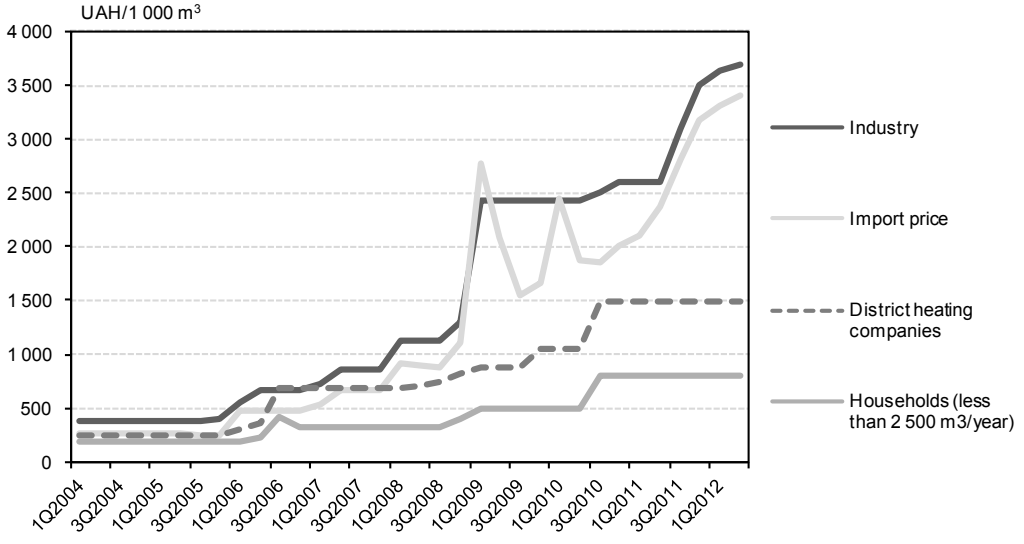
In 2007, Ukraine moved from a unified tariff for the public sector to differentiated tariffs depending on consumption level. A tariff increase in 2008 was 35%. In August 2010, a substantial gas price increase of 50% went into force for households and municipal district heating systems. No further tariff increases have been instituted (as of September 2012), although this had been agreed under the March 2011 Naftogaz financial plan adopted by the Cabinet of Ministers. That plan foresaw a 20% increase in April 2011 and a 10% increase in July 2011.

Since August 2010, households that do not have meters pay UAH 798/tcm (USD 100/tcm) for consumption of annual volumes below 2 500 m^3. Households without meters and annual consumption levels between 2 500 m^3 and 6 000 m^3 pay UAH 1 207/tcm (about USD 150/tcm). This segment of the market accounts for about 10% of total gas volumes consumed by households. (About 98% of households consume less than 6 000 m^3 of gas/year. Some 86% of households consume less than 2 500 m^3/year of gas and account for about 12 bcm/year of gas demand out of a total of 17 bcm/year in the residential sector.) When inflation is accounted for, natural gas prices to the public sector have more or less remained flat since 2005.

Prices for gas supplies to district heating systems (part of the public sector) were also increased by 50% in August 2010. However, gas tariffs for the public sector have not kept pace with the increase in the gas import prices during the period 2006-12 (Figure 7.9). For example, in the period July 2010-March 2012, while gas prices to households and the heating sector were increased by 50%, gas import prices increased by 80% (from USD 248/tcm to USD 415/tcm).

Against this backdrop, only about 45% of gas demand in Ukraine, that purchased by the industrial sector, is sold at market prices reflecting import costs. About 30% of gas consumed in Ukraine, by households and public organisations, is sold at a regulated price that does not support sustainable gas production by state companies. About 15% of gas consumed in Ukraine by district heating systems is purchased at below market price levels, which represents an important burden on the economy. The cost of gas consumed for technical reasons and system losses are covered by the transmission tariffs.

Figure 7.9 **Import and end-user natural gas prices, 2004-12**



Note: prices include value-added tax.

Sources: Naftogaz; NERC.

This dual gas tariff structure where some 56% of gas consumption is at regulated prices that are either heavily subsidised or set below full cost recovery levels is a substantial burden on the national economy. In parallel, it creates a strong incentive for industrial

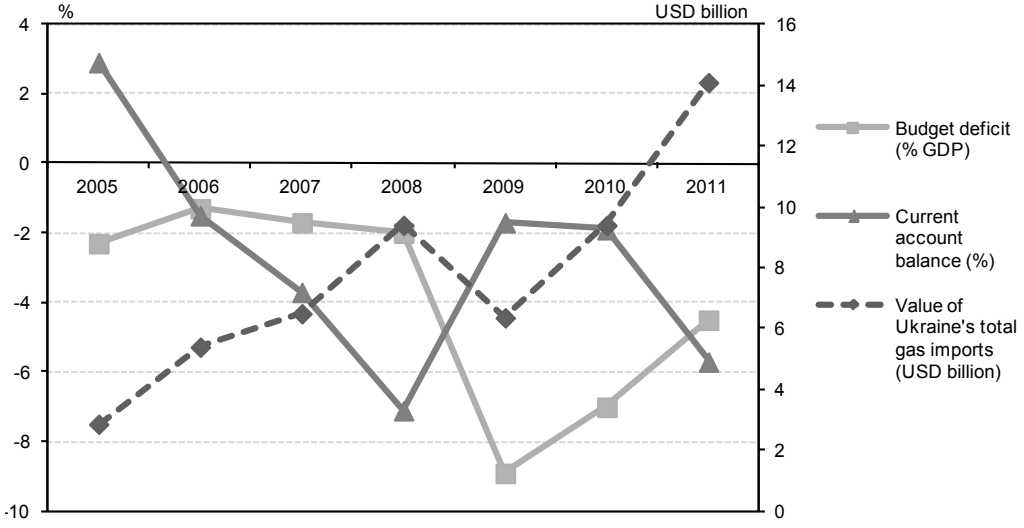
consumers to obtain the lower cost gas supplies that are available to the public sector through illegal supply arrangements, which take place at the ultimate expense of the consumer and the state budget.[35]

IMPACT OF GAS IMPORT PRICES AND SUBSIDY POLICY ON NAFTOGAZ AND THE ECONOMY

Providing natural gas at affordable prices to the residential sector is a core social policy of the Ukrainian government. That provision is performed by Naftogaz. This section aims to provide an indicative estimate of the cost of the subsidy policy and its importance to the state budget.

Rising gas import prices have an impact on Ukraine's macroeconomic stability, especially on the current account balance and the budget deficit, even if overall imports have decreased and if prices to the industrial sector reflect import cost levels. Figure 7.10 suggests that there is a correlation between rising gas import costs and the widening deficit of the current account balance and also of the budget deficit in the period 2006-09.

Figure 7.10 **Impact of annual gas import costs on budget deficit and current account balance**



Sources: Naftogaz; IMF; World Bank.

Rising gas import prices also have an important impact on the sustainability of the state policy to subsidise natural gas consumption in the public sector. Considering that Ukraine's 2011 budget revenues amounted to about UAH 314.5 billion (USD 39.8 billion)[36] and total GDP to about USD 165 billion, the gas price subsidy policy and total deficits represents about 5.77% of budget revenues and about 1.6% of GDP (USD 2.3 billion), according to government data.[37] It can be assumed that this situation will not improve in 2012, especially if the regulated tariffs are not increased, if the average gas import price rises and import volumes are level, and if GDP and the budget do not grow substantially.

35. Sergijenko.A. (2010), "For Whom – the Tariffs, and for Whom – the Gas", Weekly Mirror (Zerkalo Nedeli), Kiev. (Александр Сергиенко. Кому – тарифы, а кому – газ. *Зеркало недели* №26, 10 июля 2010).

36. *www.kmu.gov.ua/control/en/publish/article?art_id=244913042&cat_id=244314975* (accessed March 2012).

37. RBK Ukraine, 17 January 2012.

In the state budget, the 2012 average gas price forecast is USD 400/tcm. GDP growth that may be lower than the 5.2% growth registered in 2011 and the government refusal to consider a gas price increase implies that the cost of subsidies may be higher in 2012, especially if gas demand by the residential sector is not reduced.

Naftogaz has to obtain annual budget transfers to cover losses related to selling gas at subsidised tariffs. This allocation totalled UAH 3.42 billion in 2010.[38] Yet since 2009, the annual allocations have not been sufficient to cover the losses and government institutions have regularly increased the share capital of Naftogaz. Under this mechanism, the National Bank of Ukraine (NBU) lends money to state-owned banks who in turn loan money to Naftogaz. Alternatively, Naftogaz issues bonds that are bought by state banks building on loans obtained from the NBU. Naftogaz then uses the liquidity from the state banks to purchase US dollars from the NBU to pay Gazprom. This system implies that Naftogaz has been increasingly relying on national currency reserves to pay its monthly gas import bills. When this system was started, the company's share capital was UAH 18.6 billion. By end 2011, it was UAH 49.5 billion. Ukraine's 2012 national budget includes a transfer of an additional UAH 12 billion to Naftogaz via share capital recapitalisation. Naftogaz received more than UAH 21 billion in direct or indirect financial transfers from the state in 2010 and about UAH 12 billion in 2011.

Even these capital increases were not enough. In 2011, Naftogaz borrowed money from Gazprombank to pay for its October gas imports with a USD 550 million one-year loan at an 8.5% interest rate.[39] Volumes in transit were given as a security. Gazprom also made an advance payment on gas transit in December 2010 to allow Naftogaz to pay back a debt to RosUkrEnergo, in line with an arbitration ruling. The credit to Naftogaz amounted to USD 1.8 billion, on a five-year term at 4% interest. The Chornomorneftegaz Company, a Naftogaz affiliate, took a UAH 465 million credit from Sberbank for one year. In July 2012, Naftogaz signed a credit agreement with Gazprombank for an additional credit line of USD 2 billion on a seven-year term (2012-19) with a total cost of USD 1.54 billion to pay for gas imports.[40] Prior to that, Naftogaz had also obtained a USD 2 billion advance payment by Gazprom on future transit service costs.[41] Interest rates for these credits added to the recapitalisation bonds lead to an even higher quasi fiscal deficit and a greater inefficiency.

CRITIQUE

Ukraine has made progress towards more secure and sustainable natural gas policies over the past three years in the areas of gas imports, production, subsidies to households and district heating systems as well as gas market regulation. Moving away from annual winter negotiations for gas imports and transit modalities following the 2009 Gazprom-Naftogaz Gas Supply and Transit Contract has strengthened the security of gas supplies to Ukraine and for transit to European markets by offering predictability and stability. The 50% increase in gas prices to households and district heating systems introduced in 2010 was a major step forward in moving to cost-recovery price levels and

38. BDO LLC (2011), *Consolidated Financial Statements for the Year Ended 31 December 2010*, Kiev.

39. Interfax Ukraine, 9 November 2011. Energy Ministry confirms USD 550 million credit from Gazprombank by Naftogaz.

40. Interfax Ukraine, 7 July 2012. Naftogaz raises USD 2 billion from Russia's Gazprombank.

41.www.naftogaz.com/www/2/nakwebru.nsf/0/EE762E1F4B13A7B4C2257A17003C4152?OpenDocument&year=2012&month=06&nt=%D0%9D%D0%BE%D0%B2%D0%BE%D1%81%D1%82%D0%B8& (accessed 14 June 2012).

temporarily reduced the burden of subsidies on the national budget. The *Programme of Economic Reform for the Period 2010-2014* clearly illustrates that the government is well aware of problems, deficits and reform requirements of the gas sector, especially removing the gas price subsidies, restructuring Naftogaz and liberalising the gas market. The adoption of a new gas law and accession to the Energy Community Treaty are very important steps to develop and implement a comprehensive framework on which to build a liberalised, transparent and efficient gas market. In line with these legal requirements and in response to budgetary constraints, plans are currently being developed for the restructuring of Naftogaz.

Nevertheless, much remains to be accomplished in order to achieve the needed structural changes in Ukraine's natural gas sector. Prompt attention is needed to advance the reforms, and clearly and realistically outline and pursue objectives.

Regulated natural gas tariffs for households and district heating customers have not been increased to account for inflation and higher gas import prices since August 2010 despite a schedule to do so in a plan approved by the Cabinet of Ministers. The two rate increases foreseen for 2011 were to help to reduce the gap to move towards cost-recovery levels. Against the background of rising gas import prices, the financial situation of the natural gas sector shows no signs of improvement.

Ukrainian experts suggest that there is potential to cut the deficits of the gas sector by half in the medium term, provided that consumers trust the reforms and are convinced that paying higher prices will bring long-term benefits. The impact on consumers can be mitigated in a number of ways, for example through parallel increases in energy efficiency. The government should have a credible strategy in place to progressively raise prices to full cost-recovery levels and allocate savings to support the poorest categories of consumers and to invest in energy efficiency, particularly in the housing sector. There is considerable potential for efficiency gains that would decrease household and district heating system natural gas consumption. The government needs to develop a comprehensive and effective strategy to achieve this potential. Actions to install gas meters are a step in the right direction. Yet the implementation plans face difficulties and may not deliver results as quickly as is needed. The government needs to make sure that the oblgazes install these meters promptly. Effective metering can serve to build trust from consumers and thwart possible illegal gas diversion activities from the public sector to the industrial sector. Near-term and effective actions are required. If the South Stream pipeline is operational by 2015 or 2016, transit volumes and revenues in Ukraine may decrease, putting additional strain on the subsidy policy.

The adoption and implementation of the Energy Community Treaty provisions, and more generally, the reform of the gas sector in view of ensuring a greater level of transparency, competition, predictability and efficiency, are of utmost importance to Ukraine's energy security, economic growth and development. The establishment of clear, non-discriminatory and predictable tariffs, network access regulations and effective regulation and the restructuring of Naftogaz and oblgazes will raise the attractiveness of Ukraine's gas market and gas transmission system. It will improve transparency, reduce state financial losses and attract investment into the modernisation of transmission assets, as well as also into gas production. The current legislative and regulatory framework needs to be further improved with that regard. This is of utmost importance as existing deficits and inconsistencies with the EU *acquis communautaire* can discourage investment in unconventional gas resources and prevent Ukraine from attracting European companies to make use of its exceptional gas storage capacities that will be accessible via reverse

flows of the Slovakian gas pipeline system. European companies will only store gas in Ukraine if it is commercially attractive and if they have the regulatory and contractual guarantees that they can withdraw the gas when needed. Ukrtransgaz, in particular, needs to be turned into a profitable and independent company that could ultimately finance on its own investments to ensure the most effective operation of Ukraine's GTS for the coming decades. This reform would also reinforce that Ukraine's GTS is reliable, predictable, effective and attractive to the current and potential upstream and downstream stakeholders. In addition, this requires the installation of gas metering devices at Ukraine's entry points at the Russian-Ukrainian and Belarussian-Ukrainian borders.

In the course of market restructuring, adequate market oversight will be essential to avoid monopoly behaviour by dominant actors, allow new market entrants and encourage companies to invest in the upstream by offering attractive and reliable business opportunities in the mid and downstream segments. This implies that Ukraine's Anti-Monopoly Committee and the regulatory authority, NERC, must be strengthened and gain full independence.

Transparency in gas market operation also needs to be strengthened. Joining the Extractive Industries Transparency Initiative is a much needed step and needs to be quickly achieved, building on the progress recently undertaken on the creation of the multi-stakeholder group. This group needs to be established alongside the drafting of an implementation action plan. Ukraine has committed to joining, but progress has been slow. This was also a commitment taken under the International Monetary Fund co-operation programme.

The government of Ukraine should carefully assess the rationale and viability of building an LNG terminal and ensure that this project relies on sound market analysis and a transparent business plan. In particular, Ukraine should weigh the expected costs and benefits of the LNG terminal with alternative investments for domestic biogas production or energy efficiency to reduce gas demand, in particular in the district heating sector. Buying relatively cheap spot cargoes is increasingly difficult in a tight LNG market and long-term contracts are oil-indexed. Challenges to building an LNG terminal include that Naftogaz certainly does not have the financial capacity to fund it or would need to rely on government guarantees or funding, which would increase the state's indebtedness. A private investor might be attracted to the project, but only if the plant is backed by a long-term ship-or-pay contract to use the facility at an attractive tariff. This would also require long-term and trustful business relations to be established with a major LNG exporter and obtain guarantees on the Bosporus crossing. Foreign banks are unlikely to provide credits if the current business environment in Ukraine does not improve. Another important issue is to ensure that capacity will be available to a variety of market players in Ukraine, alongside pipeline capacities to ship the gas to domestic consumers or to storage facilities.

As an alternative, Ukraine should concentrate on making technical, regulatory and commercial arrangements to access the Baumgarten hub via reverse flows and thus not only strengthen its supply security in the case of disruptions, but also diversify its gas supply to access possibly lower priced supplies in summer and take further advantage of its gas storage facilities. Ukraine should also ensure that its regulatory and commercial framework for gas storage is attractive to European and Russian companies in order to maximise use of the storage facilities and benefit from additional revenues.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Develop and implement a plan to progressively increase gas tariffs for households and district heating systems to full cost-recovery levels. It should include parallel measures to strengthen energy efficiency improvements and balance targeted social protection measures.*
- ☐ *Install gas meters in households as a high priority. Improve the transparency of gas consumption by conducting a transparent, independent and thorough audit of gas consumption by the public sector.*
- ☐ *Foster implementation of the Energy Community Treaty requirements. In particular, ensure that the unbundling of Naftogaz is carried out in such a manner as to guarantee the sustainability, transparency and efficiency of newly created entities and ensure that fair and non-discriminatory access to pipelines and storage is clearly guaranteed.*
- ☐ *Further strengthen the responsibilities and capabilities of the regulator in providing full financing autonomy and competence over gas transit tariffs.*
- ☐ *Carefully assess and weigh the LNG option to diversify gas supplies, especially with regard to costs, current take-or-pay obligations, LNG market projections, alternatives, and political and economic risks.*
- ☐ *Develop the required legal and technical framework to allow reverse flows from Slovakia and Baumgarten and facilitate the use of Ukraine's storage facilities by European companies.*
- ☐ *Join the Extractive Industries Transparency Initiative and apply its reporting mechanisms.*
- ☐ *Foster transparency of Ukraine's gas market by strengthening the capacity and guaranteeing the independence of the regulatory authority and the Anti-Monopoly Committee.*

8. OIL MARKET

Key data (2011)

Share in the primary energy mix: 20%

Domestic crude oil and condensate production: 3.3 Mt

Total oil product demand: 14.4 Mt, 57% imported

Refinery output: 9 Mt

OVERVIEW

Ukraine is a net importer of crude oil and refined oil products. In 2011, total oil product demand was 14.4 million tonnes (Mt) and 71% of products were processed by Ukrainian refineries. Diversification of crude oil imports was improved in 2010 and 2011 when small volumes of Azeri oil were imported. Since the initiation of the Customs Union in 2011 (which Ukraine has not joined), Ukraine has increased oil product imports, mainly from Belarus and Russia. Ukraine's refinery output has declined substantially in 2012 and only one of the country's large refineries was in operation in mid-2012. The volume of Russian oil in transit through Ukraine has declined. Temporary transit of some crude oil from Azerbaijan to Belarus in 2010 and 2011 did not compensate for lower volumes of Russian oil in transit. High oil prices in 2011 contributed to a slight decrease in oil product demand, but demand is projected to increase in the mid to long term. Record high retail prices, lack of transparency and quality controls in the oil market and price distortions have led to the development of significant illegal schemes in imports, processing and distribution, thus depriving the state of substantial revenue every year.

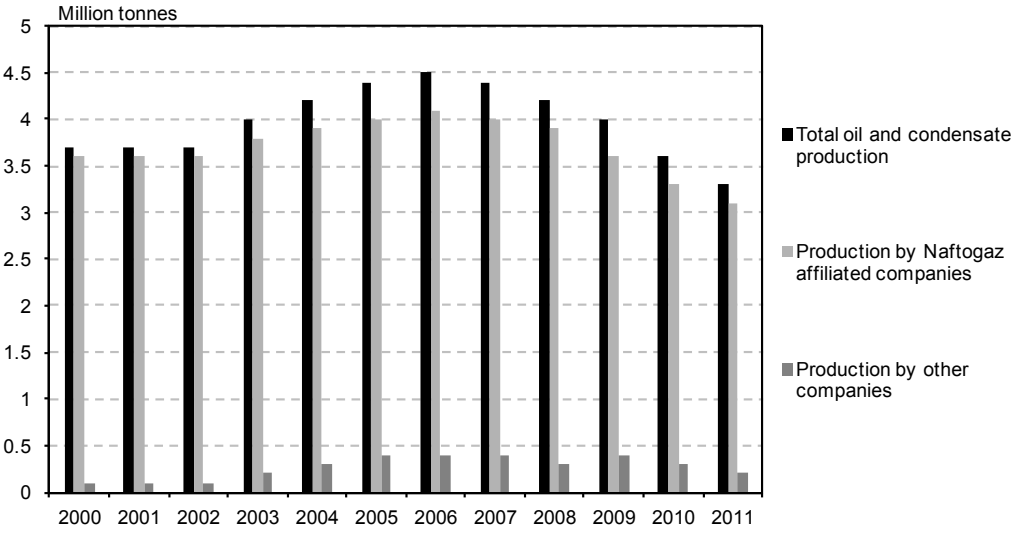
SUPPLY

DOMESTIC PRODUCTION

Domestic oil and gas condensate production has been declining since the peak of 4.5 million tonnes (Mt) in 2006 to a record low of 3.3 Mt in 2011, of which 2.4 Mt was crude oil (Figure 8.1). Naftogaz, the state-owned oil and natural gas company, accounted for the bulk of production, extracting about 3 Mt of oil and gas condensate. Most of the oil in the Ukraine is produced by Ukrnafta, in which Naftogaz holds a 50% plus one share. PrivatBank, based in Dnipropetrovsk, holds around 42% of Ukrnafta. Naftogaz also produces some crude oil in Egypt which is shipped to Ukraine and sold at a cost-plus price.[1]

1. Interfax Ukraine, 1 June 2012. Naftogaz is reported to have produced 787 000 barrels of oil in Egypt from 18 April 2010 to 31 March 2012.

Figure 8.1 **Oil and condensate production, 2000-11**



Source: Naftogaz.

IMPORTS

As domestic crude oil production is decreasing, the shortfall is covered by imports, mainly of heavy Russian Urals crude and oil products processed in Russia or in Belarus, also by crude oil from Kazakhstan, which is supplied by rail. In 2011, Azerbaijan supplied 0.7 Mt of light crude compared with 1.6 Mt in 2010. The bulk of this oil was supplied to the Kremenchug refinery.

In 2011, 57% of oil products consumed in Ukraine were imported. The bulk were from Belarus (2.8 Mt in 2011, up 150% from 2010), mostly diesel and A-95 grade gasoline, accounting for 17% of Ukraine's oil product imports in 2009 and 30% in 2011. Product imports from Russia, especially diesel, were 1.4 Mt in 2011, 14% of imports, and preliminary data for 2012 indicate increasing volumes. Lithuania's Mažeikiai refinery supplies about 10% of Ukraine's diesel by rail.

In 2009, Ukraine produced 70% its gasoline products; by 2011 it imported almost 62%. Diesel imports have increased the most, from 38% in 2009 to 54% in 2011. Ukraine also imports substantial volumes of A-95 gasoline from Lithuania. About 7% of its oil products, mainly A-95 gasoline, were from Romania in 2011.

In the coming decade, crude and refined products imports are likely to continue to grow. This is a consequence of declining domestic crude oil production, shrinking share of domestic oil processing and increasing demand.

EXPORTS

Ukraine has a record of exporting processed oil products, mainly to Russia. In 2010 and 2011, exports amounted to 4 Mt (about 20 000 barrels per day), with 70% supplied to Russia from the Lisichansk refinery. Indeed, the Lisichansk and Odessa refineries have been conducting tolling operations for product exports to Russia for a long time, either via rail or tanker from Black Sea ports. However, these exports have been reduced significantly with the introduction of the Customs Union tariff system (Box 8.1), which rendered the exports non-economic.

CONTRABAND AND TAX EVASION

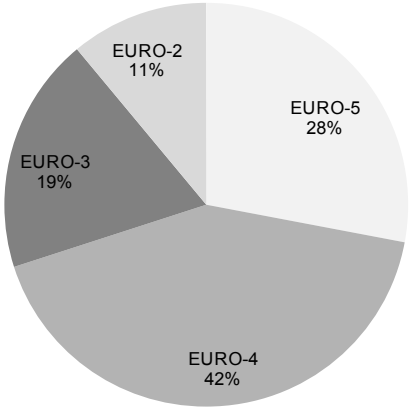
According to the Ministry of Energy and Coal Industry, oil contraband and illegal imports amount to 12% to 15% of total oil consumption in Ukraine. This amount is reported to have expanded in 2011 against the backdrop of the global high oil price. These activities allegedly take place in the Lugansk and Donetsk oblasts (oblasts are an administrative division at a regional level), via illegal oil pipelines that cross the border or smuggled in vehicles through customs, as well as via the Feodossia port. While the State Customs Service and the Secret Service (SBU) have pledged to fight these activities, this trend entails revenue losses for the state, illegal enrichment of certain individuals and related corruption.[2]

Another major problem relates to the activities of traders illegally importing oil from Russia without paying value-added tax (VAT) and excise taxes. This was the case with one company, which became the dominant importer of Russian crude oil from March to December 2010. The company's shareholder structure was not public. A parliamentary commission was set up to conduct an enquiry into the dealings. Some deputies have estimated losses to the state to be in the range of EUR 300 million to EUR 400 million. As of mid-2012, there had not been any prosecutions in the case.

PETROLEUM PRODUCT DEMAND

In 2011, total oil product demand in Ukraine was 14.4 Mt, down from 14.5 Mt in 2010. Weaker demand reflects the impacts of high oil prices. Ukraine consumed 4.3 Mt of gasoline and 5.7 Mt of diesel products in 2011. However, taking into account contraband, smuggling and illegal production, total demand may be higher than what official data suggests.

Figure 8.2 **Gasoline product consumption by fuel standard, 2011**



Sources: Gribanovski, A., Y. Eremin, (2012), "The outer ring", Delovaja Stalitsa, 5 March 2012.

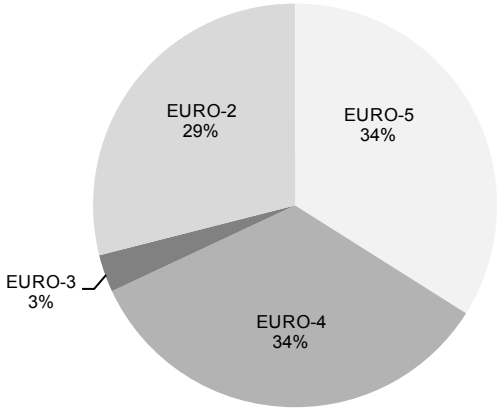
Estimates project demand increases over the decade could average 2% to 2.5%/year if economic growth is sustained at 4% and retail prices remain at a level of Ukraine hryvnia (UAH) 9.5 to UAH 10 (EUR 0.95 to EUR 1)/litre for gasoline. Liquefied petroleum gas

2. Gavrish, O., N.Neprijakhina (2011) "Contraband is Fueling Flows: The Illegal Import of Gasoil is Increasing in Ukraine", Kommersant-Ukraine, 15 November 2011 (Олег Гавриш, Наталья Непряхина. Контрабанда хлынула потоком. В Украине растет незаконный импорт бензина. КоммерсантЪ – Украина, 15/11/2011).

(LPG) is likely to grow the fastest, up to a level where LPG retail prices will equal diesel prices. It is noteworthy that in recent years, consumption of diesel has been increasingly substantially at the expense of gasoline. As a consequence, by 2020, Ukraine's total oil product and gas condensate consumption could increase by a third.

Ukraine legislation in place requires that vehicle fuel standards meet EURO-2 or higher levels. As from July 2013, they are required to meet EURO-4 standards or higher.[3] EURO-5 quality standards are rare in Ukraine and most cars and trucks use EURO-3 and EURO-4 standards, if not lower (figures 8.2 and 8.3).

Figure 8.3 **Diesel product consumption by fuel standard, 2011**



Source: Aleksei Gribanovski, Yuri Eremin. The outer ring. Delovaja Stalitsa. 05/03/2012.

MOTOR FUELS

Following a long-term trend, the demand for motor fuels is expected to grow by 1% to 3% a year with the diesel segment growing the fastest. As Ukrainians buy new cars, the demand for high quality fuels will increase. However, this trend has slowed with the substantial rise in gasoline and diesel prices in line with global oil price trends and higher motor fuel taxes in 2010 and 2011.

In January 2011, the average price for the most popular product, A-95 gasoline, was UAH 8.15/litre (USD 1/litre). By the end of that year, the price had increased 31% to UAH 10.30/litre (USD 1.25). Diesel fuel prices increased 35.5% during the same period to UAH 9.72/litre. As a consequence, there was a 10% drop in overall demand for motor fuels in 2011, with A-95 gasoline down 12% while diesel demand increased by 2.4%. The number of vehicles powered by A-92 gasoline is increasing as this fuel is cheaper than higher quality products.

JET FUEL

Air passenger transportation is increasing at a rapid pace in Ukraine, 15% to 20% per year, driving up demand for jet fuel. In 2010, 6.1 million passengers were transported by

3. Emission standards in the European Union that all new road vehicles must meet are classified by rank from EURO-1 to EURO-6. The standards increase in stringency over time: EURO-1 (1992); EURO-2 (1995); EURO-3 (1999); EURO-4 (2005); EURO-5 (2008); EURO-6 (2014).

air, compared with 1.17 million in 2000.[4] The 2012 UEFA European Football Championship organised in Poland and Ukraine also gave a boost to jet fuel demand.

Jet fuel consumption is likely to grow by 60% to 80% by 2020 compared with 2011. The biggest growth is expected at the Kiev Boryspil airport, which accounted for more than 60% of air traffic in Ukraine in 2011.

LIQUEFIED PETROLEUM GAS

Demand for liquefied petroleum gas (LPG) has been developing at a rapid pace in Ukraine as it is seen as a lower cost alternative to traditional motor fuels and the retail market is well developed. In 2010, Ukraine consumed 820 000 tonnes of LPG, among the highest in Europe, about 75% for use in cars. Total imports were 227 000 tonnes that year, including LPG for the chemical sector. Domestic production was 710 000 tonnes; Naftogaz-affiliated companies produced 374 900 tonnes of propane-butane. Ukrnafta's Gnidyntsi, Kachanivka and Dolyna gas processing plants specialise in LPG and stabilised gasoline.

The dynamism of Ukraine's LPG market, with a 5.4% demand increase in 2010 when other European markets witnessed a decrease, draws increasingly strong interest from investors. The chemical sector is largely driving this surge in consumption and accounts for 21.3% of total LPG consumption. Traditional motor fuel consumers in Ukraine are switching to LPG due to high gasoline and diesel prices: converting the vehicle motor to use LPG requires an investment of about EUR 600 to EUR 800; LPG is about 40% cheaper than diesel and has lower fuel consumption per kilometre driven. LPG now is used by about 1 million cars and buses. Naftogaz has a specialised affiliate, Ukravtogaz that operates 89 LGP filling stations to supply 70 000 cars per day with about 0.7 billion cubic metres (bcm)/year. The company holds a licence to supply half of this amount at regulated prices. As demand rises, domestic production is not keeping pace and imports are increasing.

Ukraine is also developing into a major LPG transit country: LPG enters the country via rail and is transported onwards to European markets via rail or ship on the Black Sea. About 2.5 Mt were transited in 2011, almost half via ship from Ukraine's Odessa and Kertch ports to Turkey, 25% to Poland, about 10% to Hungary and the remainder to other neighbouring countries. About 60% of this LPG comes from Russia, 40% from Kazakhstan.

FUEL OIL

Fuel oil demand has been declining over the last decade. In 2000, it was 1.2 Mt and had dropped to about 0.9 Mt by 2010.

RETAIL MARKET

STAKEHOLDERS AND COMPETITION

Retail oil prices in Ukraine are, on average, about 20% to 30% lower than the European Union (EU) average. Lower prices are linked to taxation policy, poor quality products and domestic oil production sold at prices below real market levels.

4. Ukraine State Committee for Statistics.

The retail market is dynamic but there is room to increase the competition especially within some regions to ensure that price differentials of fuels among regions in Ukraine are in a reasonable range. The number of filling stations is steadily increasing with close to 6 380 as of early 2012 and many companies are active in this segment.

The Privat Group, a privately held international business group based in Ukraine, is the dominant actor in the retail market. It operates about 1 588 petrol stations through different brands representing 25% of total filling stations in the country and 20% of the retail market. Ukrnafta, the largest producer of oil and gas in Ukraine, accounted for 9% of petrol stations as of year-end 2010. Other companies in this market segment are WOG (400 stations), Galnaftogaz (about 343 stations), Lukoil (about 276 stations), TNK-BP (150 stations, 250 franchises), Shell (171 stations), Naftogaz (91 stations), SKM (82). The State Oil Company of Azerbaijan Republic (SOCAR) is the most recent major market entrant with 250 filling stations planned in the short term and up to 1 000 by 2025.

It should be noted that a few companies control a substantial number of filling stations. Market observers often voice concerns over pricing arrangements between the biggest companies. Ukraine's Anti-Monopoly committee opened an inquiry into illegal pricing agreements following a sharp price increase that occurred in December 2010 to January 2011, which resulted in several companies, such as Lukoil, TNK-BP, Shell being fined UAH 150 million (about EUR 15 million).

OIL AUCTIONS

In Ukraine, crude oil produced by companies in which the state holds shares is sold at auction. Naftogaz, via its subsidiary, Ukrnafta regularly conducts auctions in which oil volumes are made available to bidders at a given price, alongside Chornomorneftegaz, which puts gas condensate up for auction. Auctions are conducted on the Ukrainian Interbank Currency Exchange. Ukrgazdobycha, another Naftogaz-affiliated company, regularly sells oil products from its Chebelinka refinery at auction. In most cases, oil products are sold excluding VAT, and storage and transportation costs. Prices are based on the import price and include VAT. A major problem for these auctions is that oil is physically made available at the Kremenchuk refinery, which limits the number of companies that can bid because it is difficult and expensive to move the oil to other refineries given constraints to fair access to pipeline capacities and reverse flow possibilities. As a consequence, companies bidding for these oil products are those participating in the refineries that can process the crude oil. This severely limits competition at the auctions since the only alternative is to transport the crude oil by road or rail, which is very costly and complicated.

Ukrtransnafta imports crude oil from Russia or Kazakhstan, tenders the processing and then sells refined products on the domestic market. Ukrtransnafta regularly holds tenders for amounts of 200 000 tonnes to 400 000 tonnes. A tender held in early 2012 was won by the Kremenchuk refinery which offered to process crude oil at UAH 670/tonne.

COUNTERFEIT PRODUCTS AND QUALITY CONTROL

The retail oil product market is tainted by substantial falsification of oil product quality sold at about 20% of petrol stations, according to various expert estimates. Misrepresentation of oil product quality is used to raise profits from retail activities, as is selling products from illegal mini-refineries and tax evasion. Low-grade product is sold as EURO-2

standard although they do not meet this requirement, or even as higher quality products. Oil quality control and inspections by the government's specialised agency, Gostandart, are an exception and too rare to deter the counterfeit system from expanding, at the expense of the consumer and the state budget. Gostandart lacks the funding necessary to monitor the country's petrol stations, and especially to buy the mobile laboratories needed to conduct tests. Budget allocations for these truck-mounted laboratories were not included in the 2012 budget. This implies that while the excise tax on gasoline and diesel has been raised to provide an important increase of state revenues, not even a small portion is destined to improve oil quality monitoring.[5]

AGRICULTURE SECTOR SUBSIDIES

Ukraine's agriculture sector benefits from discounted prices on low quality oil products, such as diesel or A-76 gasoline. Government sets the price which is typically 20% to 25% below market value for products mainly from state-owned refineries. About 600 000 tonnes of oil are consumed by the agricultural sector every year according to official data (about 5% of total annual consumption). Agriculture representatives regularly voice concern about oil prices and lobby to suppress the import tax to make their fuel cheaper. Insufficient controls result in portions of these oil products being resold at the refineries or by those involved in the agricultural sector for non-agricultural use.

OIL TRANSPORTATION SYSTEM AND TRANSIT

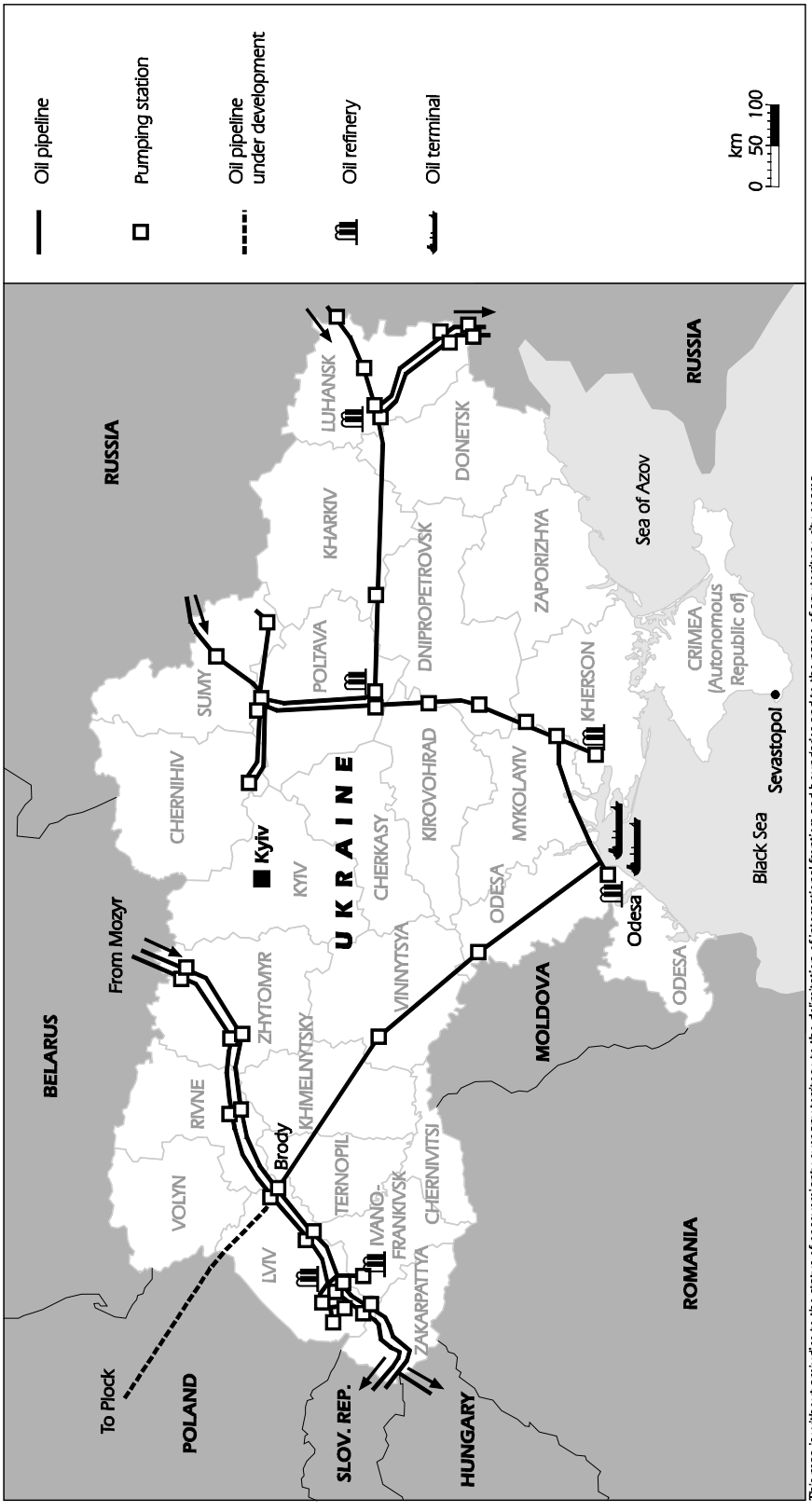
PIPELINE SYSTEM

Ukraine's main oil transportation system consists of 4 767 kilometres (km) of pipelines with a diameter of up to 1 220 millimetres (mm), 51 pump stations, 11 tank farms with 79 tanks with a cumulative rated capacity of about 1 million cubic metres (m^3) (Figure 8.4). The operation of oil pump stations is ensured with 176 pump units with a capacity up to 12 500 m^3/hour and electric drive with a total capacity of 356.5 megawatts (MW). The throughput capacity is 114 Mt/year at the inlet and 56.3 Mt/year at the outlet. About 65% of the pipelines are between 30 and 40 years old: 27% over 40 years, 6% between 20 and 30 years and only 2% between 10 and 20 years. In addition, there are about 4 625 km of smaller oil product pipelines, mostly privately owned, although their technical stage of operation is unclear.

Ukraine's oil pipeline system is operated by Ukrtransnafta, a state-owned company and an affiliate of Naftogaz. It serves to deliver crude oil supplies from Russia and Kazakhstan to oil refineries in Ukraine as well as to transit oil to central and eastern European countries (Table 8.1). The design input capacity is 84 Mt and the output capacity for transit is 36.2 Mt. The average utilisation level of the oil transmission system was about 25% in the period 2009-11.

5. Gavrish, O., N.Neprijakhina (2011) "Contraband is Fueling Flows: The Illegal Import of Gasoil is Increasing in Ukraine", Kommersant-Ukraine, 15 November 2011 (Олег Гавриш, Наталья Непряхина. Контрабанда хлынула потоком. В Украине растет незаконный импорт бензина. КоммерсантЪ – Украина, 15/11/2011).

Figure 8.4 **Oil transportation system**



Sources: Ukrtansnafta; Razumkov Center, 2007, National Security & Defence No. 4 (88), Kyiv.

Table 8.1 **Main oil pipeline characteristics**

Pipeline/route	Diameter (mm)	Distance (km)	Design capacity (Mt/year)	2010 capacity (Mt/year)
Samara (RF*)-Lysychansk	1 220	164.7	90	62
Michurinsk (RF)-Kremenchuk	720	355	18	18
Mozyr (Belarus)-Brody (two lines)	720	727.3	34	28
Snihurivka-Odessa	720/1 020	249.7	13.2	13.2
Lysychansk-Tikhoretsk (RF*) (two lines) (directed to Novorossiysk)	720	413.8	30	16.8
Brody-Uzhgorod (two lines)	530/720	325	25	25
Odessa-Brody	1 020	673.7	14.5	14.5

* RF= Russian Federation.

Sources: Ukrtransnafta; Gonchar, M., A. Duleba, O.Malynovskyi (2007), *Ukraine and Slovakia in a Post-Crisis Architecture of European Energy Security*, Kyiv/Bratislava; Research Center of the Slovak Foreign Policy Association (RC SFPA) (2011), *Prospects for Transport of Hydrocarbons and Bilateral Co-operation*, RC SFPA, Bratislava; Razumkov Center (2007), National Security & Defence No. 4 (88), Kyiv.

TRANSIT

Russian and Kazakhstani companies can transit crude oil through Ukraine via three pipelines: the southern branch of the Druzhba pipeline which enters Ukraine from Belarus (Atyrau-Samara-Unecha-Mozyr-southern Druzhba); the Samara-Lisichansk pipeline; and the Nizhnevartovsk-Lisichansk-Kremenchuk-Odessa pipeline. Volumes of oil in transit through Ukraine have been steadily decreasing in recent years. In 2000, volumes in transit were 56.4 Mt/year. However, oil transit volumes have decreased since then to 31.4 Mt in 2005 and 17.7 Mt in 2011. This reflects Russian companies' strategy to diversify oil transportation routes by building pipelines that bypass Ukraine.

The commissioning in December 2001 of the Baltic Pipeline System-I (BPS-I) pipeline with a capacity of about 75 Mt/year and construction of the Primorsk oil terminal on the Baltic Sea coast led to a progressive and significant reduction of the volumes of Russian oil in transit through Ukraine. In 2011, Transneft, Russia's state-controlled entity responsible for oil pipelines, built the Sukhodilna-Radionivka oil pipeline and the 310 km Sohranovka to Oktiabriska oil pipeline to connect the northern and southern parts of the Rostov oblasts to bypass Ukraine. Russian companies also decreased oil volumes shipped through the Odessa-Brody pipeline in reverse mode, ultimately leading to an end of these shipments in 2007. Previously they had proposed to guarantee supplies of 9 Mt/year via the Odessa-Brody pipeline while refraining from giving any such guarantee for the Druzhba southern route, prompting a refusal from the Ukraine. Transneft and the Russian government also stated that increased prices for oil transit through Ukraine provided additional reasons to reduce oil transit volumes.

In addition to the BPS-I pipeline, the Russian government in 2008 ordered the construction of another pipeline bypassing transit countries. The BPS-2 pipeline was commissioned in 2012, with a capacity of 30 Mt/year, along with the Ust-Luga oil terminal. When fully operational and if fully loaded, this has the potential to further re-route Russian oil in transit away from Ukraine and Belarus, especially volumes that used to be transported to the Polish Gdansk terminal and to the Pivdenny port for onwards exports via tanker. The BPS-2 pipeline can be expanded to 50 Mt/year.

In 2011, Ukraine transited 990 000 tonnes of Azeri oil to Belarus, much below the contracted volume of 4 Mt. Belarus refineries have not honoured their off-take commitments because of better price proposals from Russian companies. As a consequence, Ukrtransnafta did not renew its transit agreements with Belarus for 2012.

THE ODESSA-BRODY PIPELINE

In 2011, SOCAR, the Azeri national oil company, loaded small volumes of light oil at the Yuzhnyi terminal near Odessa into the Odessa-Brody pipeline, which has substantial capacity at 14.5 Mt/year and expansion potential to 20 Mt/year. Part of this oil was processed at the Kremenchuk refinery for sale in Ukraine, limited volumes were supplied to Ukraine's western refineries and the balance (about 1 Mt) was shipped to the Mozyr refinery in Belarus. One of the Mozyr-Brody pipelines, part of the Druzhba system, was operated in reverse mode to ship the oil. The importance of this development was twofold: it was the first time since its construction in 2002 that the Odessa-Brody pipeline was operated in direct mode, that is not shipping Russian Urals crude oil from Brody to Odessa but rather in the other direction from Odessa to Brody, as was initially planned when the project was conceived. This allowed Ukraine to diversify the oil transiting its territory and some of its own supplies.

Three key factors enabled the reversal for the Odessa-Brody pipeline and its first operation in direct mode. First was a steady decline in supplies of Russian oil via this pipeline to the Odessa refinery or to the Black Sea ports for onwards shipments via the Black Sea. Second was Belarus' agreement with Venezuela to import crude via Ukraine's ports, which subsequently lead to a swap agreement between Venezuela's PDVSA and SOCAR in 2010: after initial shipments via rail, Azeri light crude was supplied via the Odessa-Brody pipeline from early 2011. As a consequence, Belarus played a key role in the direct mode operation of the pipeline. However, Imports of light crude supplied by SOCAR in 2011 did not meet the volumes expected by Ukrainian officials and transit stopped in 2012. The third factor is the conflict over the Kremenchuk refinery among its Ukrainian and Russian shareholders. This led to a halt in delivery of Russian crude oil to the refinery and prompted the remaining Ukrainian shareholder of the refinery to look for alternative supplies from Azerbaijan. This oil is supplied via a different pipeline, Odessa-Kremenchuk, but has reinforced the interest of SOCAR in strengthening its business activities in Ukraine. These arrangements, however, appear unsustainable. For example, Belarus curtailed Azeri imports because it found a better price agreement with Russian suppliers.

A project known as the Eurasian Oil Transportation Corridor (EAOTC) has been under consideration for about nine years on the basis of the Odessa-Brody oil pipeline and its proposed extension to Plotsk (about 371 km) and Gdansk to supply Polish refineries. The direct mode use of the Odessa-Brody pipeline has revived this concept and Sarmatia, a Polish registered pipeline company, was designated to develop the extension. Sarmatia has gathered five shareholders to form a project consortium: Azerbaijan's SOCAR, the Georgian Oil and Gas Corporation, Lithuania's Klaipedos Nafta, Poland's PERN "Przyjaźń" and Ukraine's Ukrtransnafta.

Plans for expanding Azeri oil supplies via the Odessa-Brody oil pipeline and other smaller domestic pipelines or railroad envisage transit of 260 000 barrels per day (b/d) to 341 000 b/d. SOCAR could ship about 100 000 b/d to Brody and then to the southern branch of the Druzhba pipeline system to central European countries and refineries in Slovakia, Hungary and the Czech Republic, and to the Schwechat refinery in the future, if

an interconnector with Slovakia is built. Negotiations started in 2011 on the supplies needed, but much depends on transportation tariffs and interest shown by central European refineries.

The future of the Odessa-Brody route used in direct mode and its possible extension to Poland depends on a variety of factors. Following its membership in the Customs Union, Belarus is unlikely to import more Azeri oil, if any at all. It remains to be seen if supply contracts are signed with central European refineries or Polish refineries (refineries in the region can easily process the oil from a technical point of view), or whether SOCAR develops its own refinery operations in the region. This will require SOCAR and its counterparts to agree on a sustainable and attractive oil supply price compared with Russian Urals discounts. Ukraine will also have to offer SOCAR attractive transit conditions and oil unloading port service tariffs that are reasonable. A 50% price discount on port services at Yuzhnyi is to be implemented.[6] In addition, technical studies need to be completed and funding secured. Furthermore, technical consideration has to be paid to the possible need of batching to avoid a mixing of the light, higher value Azeri crude with the heavier Russian Urals crude on some portions of pipelines, which would represent higher costs.

If conditions are put in place, Ukraine may well become a transit country not only for Azeri oil, but also for oil from Kazakhstan. Ukrtransnafta has plans to transit Kazakh oil from the Tengiz and later Kashagan oil fields to central European markets. According to these plans, oil would be loaded either via the south Caucasus and Georgia's ports to Ukraine's Black Sea port of Pivdenny, near Odessa, or via the Russian port of Novorossiysk to Ukraine's Pivdenny terminal and then loaded into the Odessa-Brody pipeline.

Central European refinery markets could then diversify their supply sources as Hungary, Poland and Slovakia are almost totally dependent on Russian oil supplies. It would also offer solutions to the challenge stemming from the overloaded Transalpine Pipeline (TAL) and Ingolstadt-Kralupy-Litvinov (200 000 b/d capacity) pipeline to the Czech Republic and Adria-Wien Pipeline to Austria. Indeed, alternative oil import opportunities other than Russian heavy oil supplied through southern Druzhba are limited due to a lack of additional pipeline capacity from the Adriatic Sea. This would also offer a complementary option to current plans to build an additional section of the Adria pipeline from Hungary to Slovakia, enabling supplies of 6 Mt of oil from the Adriatic to the Slovnaft refinery in Bratislava.

Co-operation with Slovakia thus appears to be essential for the success of this project and some proposals have been voiced to work out a central European oil consortium on the basis of the assets of Ukrtransnafta (*e.g*. Pivdennyy terminal, Odessa-Brody pipeline, Southern Druzhba), Transpetrol, MERO, MOL with the participation of companies that operate oil refineries in the central European region.[7]

6. In line with provisions agreed in the 28 January 2011 intergovernmental agreement related to oil transport through Ukraine between Azerbaijan and Ukraine.

7. Gonchar (2011).

REFINERIES

REFINERY CAPACITY AND OWNERSHIP

Ukraine has seven refineries with a 50.4 Mt/year design capacity, which is about four times larger than Ukraine's oil product market. Information on refinery product yields is poor, *i.e.* gasoline production as a share of crude oil intake.

- The Kremenchuk refinery (Ukrtatnafta) is controlled by the Privat Group and in which Naftogaz has 43% of the shares. Its design capacity is 18.6 Mt/year, technical capacity is 8 Mt/year.
- The Nadvornaya-Naftokhimik Prykarpattia refinery (4 Mt/year design capacity, 2.2 Mt/year technical capacity) and the Drogobytch-NPK-Halychyna refinery (3.3 Mt/year design capacity, 2 Mt/year technical capacity). They are located in western Ukraine and are controlled by the Privat Group and Naftogaz, the latter holds 26% and 25% of shares in these refineries. Both refineries operate irregularly.
- The Chebelinka refinery and gas conversion plant in the Kharkov oblast (design capacity 1.2 Mt/year design capacity, 1 Mt/year technical capacity) is managed by Ukrgazvy-Dobuvannia, a state-owned company affiliated with Naftogaz.

As of mid-2012, three refineries stood idle:

- The Lisichansk refinery (16 Mt/year design capacity, 7.2 Mt/year technical capacity) is owned by TNK-BP, a Russian-owned vertically integrated oil company. The refinery was closed for long-term maintenance in March 2012.
- The Odessa refinery (3.9 Mt/year design capacity, 2.8 Mt/year technical capacity) is owned by Lukoil, Russia's second-largest oil company. In 2010, it produced about 1.49 Mt of oil but has been idle since October 2010. Odessa refinery underwent a major modernisation programme in 2005-07. Some press reports have hinted at a possible sale of this refinery or its use for tolling operations.
- The Khersonnaftopererobka (Kherson) refinery (7.1 Mt/year design capacity) is controlled by Russia's Continuum Group. Kherson refinery has been idle since August 2005. It is the oldest refinery in Ukraine and produced lower quality products. Plans were developed to reshuffle the ownership structure and to invest more than USD 800 million into modernising the refinery to produce 4.5 Mt/year at a depth of 78%, including A-98 and EURO-5 products. To date, these plans have not materialised.

In addition, the government acknowledges that there are many illegal small refineries in the country, some 120 according to expert estimates, which produce poor quality motor fuels and evade taxation. Most of them operate in the Poltova, Odessa, Sumy, Dnepropetrovsk and Kharkov oblasts, as well as in western Ukraine. An increase in excise tax in September 2011 provided additional incentive for the illegal small refineries to expand, using domestically produced oil, which in turn is often illegally produced without licences.

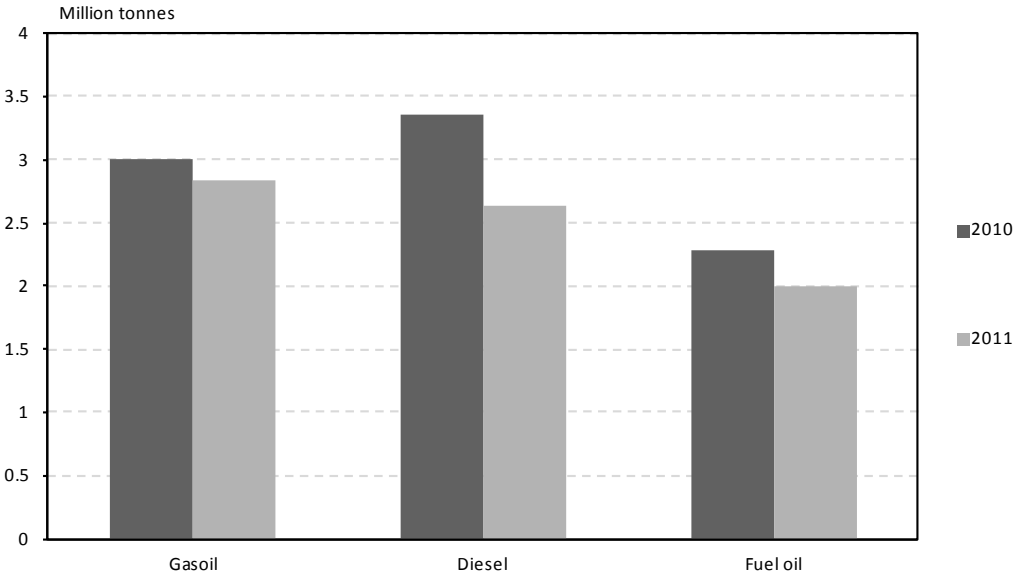
REFINERY PRODUCTION

Over the last decade, Ukraine's annual oil product production has been very irregular, ranging from a record low of 8.5 Mt in 2000 to a high of 21.2 Mt in 2002 and 2003. Yet there is a clear downward trend in refinery production, with output down to 11 Mt in

2010 and 9 Mt in 2011, a drop of 18.4%. In 2010, the average utilisation rate of the refineries was 17% (out of total design capacity of 52 Mt). The lowest level of refinery production since Ukraine's independence was in 2000 with only 8.5 Mt, and in 2011, refinery production was at its second lowest level.[8]

Ukraine's refineries produce a variety of motor fuels, diesel, fuel oil, asphalts, LPG, lubricants, and products used in the petrochemical sector, such as benzene, toluene and paraffin (Table 8.2). Production of petrol, diesel and jet fuel is insufficient to meet Ukraine's growing demand.

Figure 8.5 **Total refinery output, 2010 and 2011**



Sources: Nefterynok No. 5, February 2012; Ministry of Energy and Coal Industry of Ukraine.

Lukoil's Odessa refinery has stood idle since October 2010 because the pipeline that used to supply the refinery with Russia oil has been reversed following the conflict involving Ukrainian and Russian shareholders of the Kremenchuk refinery. To supply the Kremenchuk refinery, the Odessa-Kremenchuk pipe was reversed to ship Azeri oil, thus preventing any Russian oil from reaching Odessa via pipeline. Azeri oil is unloaded at the Yuzhnyi port and transported onwards via pipeline. Lukoil was thus forced to give way to SOCAR's oil supplies directed to the Kremechuk refinery. Azeri oil has only partly replaced the missing Russian oil and production has gone down. The Odessa refinery can only be supplied if the Kremenchuk refinery imports Russian oil instead of Azeri oil.

The main producers of A-95 gasoline products are Kremenchuk with 317 800 tonnes of production and Lisichansk with 390 000 tonnes in 2011. The main producers of lower quality A-92 gasoline are Lisichansk with 1.08 Mt, followed by Kremenchuk with 575 500 tonnes. As crude oil and retail oil prices rose in Ukraine in 2010 and 2011, the Kremenchuk refinery produced 9% more A-92 quality gasoline than in 2010 and so did the state-owned Chebelynka refinery. The largest drop in production was diesel, 28.3% lower in 2011 than the previous year. Naftogaz-affiliated refineries produced 791 600 tonnes of light oil products

8. Ukraine Ministry of Energy and Coal Industry.
www.mpe.kmu.gov.ua/fuel/control/uk/publish/article?art_id=216923&cat_id=35081 (accessed 12 March 2012).

and 374 900 tonnes of propane-butane in 2010. Most of the motor fuel production is supplied by the Shebelynka Gas Processing Plant, which uses exclusively Ukrainian crude oil products and manufactures unleaded high-octane gasoline of A-92 and A-95 class.

CHALLENGES TO SURVIVAL OF THE REFINERY INDUSTRY

Challenges to the survival of the Ukrainian refinery industry include a lack of investment to produce high quality European standard products and the Russian-led Customs Union. Provisions of the Customs Union came into force in mid-2011 and bring unprecedented challenges to the economic viability of the Ukrainian refinery industry (Box 8.1).

Box 8.1 **The Customs Union and its impact on Ukraine's refinery industry**

The Customs Union between Belarus, Kazakhstan and Russia came into existence on 1 January 2010. The three countries agreed to further economic integration and to remove all customs borders between each other from July 2011. The Customs Union challenges the Ukraine's refinery industry and government tax policies because Ukraine imports crude oil and oil products from Custom Union member countries.

The Customs Union tariffs are unified and designed to support the domestic refinery industry and its modernisation, avoid domestic supply shortages and to discourage crude oil exports to neighbouring states. Crude oil from Russia and Kazakhstan that is supplied to Custom Union refineries is duty-free. This allows these refineries to have a comfortable margin of about USD 100/tonne even with comparatively low technical capacities. Refinery capacity utilisation in the Customs Union is almost 90% with high margins, which stands in contrast to the situation in Ukraine, where refineries were built and designed to process Russian crude oil both for re-export to Russia and to supply the Ukrainian market.

The Customs Union tariff system, called the "60-66" regime, sets a higher export duty on crude oil at 60% of the Ural price (about USD 411/tonne in March 2012) than the duty on light and heavy refined products which is 66% of the export duty on crude oil. While the crude oil duty was reduced from 65% to 60%, this nonetheless encourages the export of oil products. As a consequence, Belarus, in particular, is processing much more oil than it is consuming with large quantities being exported to Ukraine. The Customs Union tariff system aims to compel refineries to invest in modernisation as favourable conditions allow them to collect sufficient revenues to finance the investments while making profits. As a consequence, the refinery margin for processing crude oil imported from the Customs Union in Ukraine is slightly negative, whereas it is largely profitable in the Customs Union countries.

The impact of the Customs Union tariff system is evident in the trends that while there is growing demand for jet fuel, A-95 and LPG in Ukraine, imports from Russia and especially Belarus are surging. At the same time, while Ukraine's refineries, with the exception of Lisichansk, have not invested in modernisation, Russian refineries will soon undergo large investments as fuels standards are progressively raised and EURO-5 standards will be enforced from 1 January 2016. There have been discussions to lift the oil export duties within the free trade zone that is being developed with the Commonwealth of Independent State (CIS) framework, although as of mid-2012, it was not clear whether Ukraine would sign and ratify the CIS free trade zone agreement and whether Russia and other exporters would actually agree to lift this ban, either completely or on a temporary basis.

This compounds the industry's structural problems, namely chronic under-investment to improve the depth of refining and oil quality products, with the exception of the Lisichansk refinery. (Depth of processing refers to the share of clean, light products obtained, compared with that of residual heavy fuel oil.) As it has become less and less profitable to process oil in Ukraine, refineries were shut: Lukoil initially because it could not be supplied with oil and Lisichansk as of March 2012 because of unprofitability compared to refineries in Belarus or Russia.

The average depth of processing in Ukraine refineries is about 63%, with Lisichansk being the highest at 75% to 78%, while the Belarusian Mozyr refinery operates at a depth of about 90%. Products to EURO-4 quality standards can only be produced in three Ukrainian refineries: Odessa, Kremenchuk and Lisichansk. None of the government-owned refineries can produce such products. Most Ukrainian refineries do not meet the fuel standards of neighbouring EU countries, which is a strong impediment to exports, especially for light Azeri oil processing in Ukraine and export to central European markets. Lisichansk is the only refinery in Ukraine where substantial investments have been made in the last decade and in 2011 it began production of EURO-5 motor fuels, especially diesel (about 100 000 tonnes). While Ukraine demand for A-95 gasoline is about 2.3 Mt/year, domestic production in 2011 was only 749 000 tonnes. There are also plans for modernisation at the Kremenchuk refinery, but these appear to be delayed.

On the other hand, refineries in Belarus have undergone major investments leading to much improved capabilities and efficiency, largely outpacing the Ukrainian refinery sector. Thus, refineries in Belarus have become strong competitors.

A key measure to provide strong incentives for modernising Ukraine's refinery sector is to make higher fuel quality standards compulsory and incentivise all market participants to start producing them.

PORTS AND STORAGE FACILITIES

Ukraine has three maritime oil terminals: Pivdenny, Yuzhnyi and Feodossia. The Pivdenny oil terminal is equipped with tanks containing up to 200 000 m^3 of oil storage. The terminal can receive large oil tankers with the maximum deadweight of 150 000 tonnes and maximum draught of 12.5 metres. The Pivdenny port is designed to accept and discharge crude oil which is transported by oil-trunk pipelines. Oil terminal capacity is 25.5 Mt/year of crude oil and oil products, including 15.3 Mt of crude oil. The Feodossia oil terminal can tranship about 10 Mt to 12 Mt of crude oil per year and its tanks can store 280 000 m^3 of oil. The terminal can accommodate ships with a draught of up to 16.5 metres and up to 125 000 tonnes tanker dread-weight. The Yuzhnyi terminal can accommodate vessels of 125 000 tonnes and a maximal draft of 13.8 metres. The terminal has storage facilities with a capacity of 60 000 m^3 and an average loading rate of 1 100 m^3/hour.

OIL MARKET REGULATION

INSTITUTIONAL FRAMEWORK

The Ministry of Energy is responsible for regulating the downstream oil sector and gathering statistics. It also establishes a price range, known as a "corridor", for oil products in which retailers set their prices. An Expert-Analytical Group on oil markets, oil

products and the development of the refining industry under the supervision of the Cabinet of Ministers regularly convenes to analyse market developments and advises the Ministry of Energy on the most appropriate corridor. Although the market determines the price, and the government has no direct price-setting role, there is a view among the industry that setting prices outside the corridor may draw the attention of the Anti-Monopoly Committee or the state tax administration. Tariffs for international transit are set in intergovernmental agreements. Table 8.2 shows the main government agencies and responsibilities in Ukraine's oil market.

Table 8.2 **Institutional framework for downstream oil market**

Institution	Responsibility
Intergovernmental Commission for International Trade	Set oil import duties
Ministry of Finance	Set taxation level
Ministry of Economy and Trade	Set fuel standards
State Committee for Technical Regulation and Consumer Policy	Enforce fuel standards and provide quality checks
Cabinet of Ministers	Set rules for fuel auctions
Head of State	Signs amendments to the tax code which concern oil product taxation levels
Anti-Monopoly Committee	Monitor competition, especially in the retail market
National Commission for State Energy Regulation	Set oil transmission tariffs depending on volume, distance and direction of transport

FISCAL REGIME

Taxation levels in Ukraine are much lower than average levels in the European Union. Taxes include:

- Excise tax (aktsiza): The government levies an excise tax on oil products. In September 2011, the tax was raised 40% from EUR 132/tonne to EUR 182/tonne for A-95 fuel, which raised the average gasoline tariff by UAH 0.5/litre. For diesel products, the tax was raised from EUR 65 to EUR 90/tonne. A 2011 law indexed the excise tax to the inflation level, so that the excise tax reached EUR 198/tonne in early 2012.[9] A new law introducing a floating excise tax was passed on 15 May 2012 in order to reduce the pressure on retail prices when global oil prices are high: the tax level falls when the oil price exceeds USD 125/barrel, is unchanged when the price is between USD105/barrel and 125/barrel, and increases when the price is under USD 105/barrel. Revenues collected from this tax finance road reconstruction.
- Value-added tax: 20%. Against the backdrop of the low refinery utilisation rate in Ukraine in 2011 and 2012, discussions were ongoing in mid-2012 as to whether to introduce VAT breaks on imports of crude oil to support Ukraine's refineries.

9. Law No. 4235, December 2011.

SECURITY OF SUPPLY AND EMERGENCY PREPAREDNESS

In accordance with legislation, the government has no right to interfere with the oil businesses and cannot distribute oil products produced by the refineries, which are marketed at their owner's discretion. Ukraine is reported to have only small oil stocks, levels of which are a state secret, and there is no oil emergency supply legislation in place that would regulate the use of strategic oil stocks in the case of supply disruptions. At present, stocks are managed by Derzhkomreserv, the State Committee of Material Reserve.

Discussions have taken place regarding building a minimum reserve of crude oil and petroleum products by 2020, especially against the backdrop of Ukraine's commitments under the Energy Community Treaty.

Box 8.2 **IEA member countries oil stocks**

IEA requires that its net oil importing countries hold the equivalent of at least 90 days of net oil imports, based on consumption in the previous year, at all times. IEA countries meet this requirement through three broad types of oil stockholding systems:

- Company stocks, including compulsory and commercial stocks.
- Government stocks, which are financed by the central government budget and held exclusively for emergency purposes.
- Agency stocks, which are under government authority and maintained for emergency purposes. These stocks are usually held by a public or private body under a co-operative, cost-sharing arrangement.

About two-thirds of total IEA stocks are held by the oil industry; the remaining one-third is held by governments and specialised agencies. Government stocks and agency stocks are often referred to as public stocks. Since 1980, the number of countries holding agency stocks has increased, whereas the number of countries with government stocks has decreased. The percentage of company stocks in total emergency stocks has declined.

To meet IEA requirements, stocks may be held either in oil products or as crude oil. One benefit of product stocks is that they are available even when refineries are inoperative. However, crude oil is cheaper to store as it is technically easier to maintain. It also provides more flexibility, in that it can be processed into the products needed at the time of the supply disruption. Industry stocks tend to include relatively high proportions of oil products, which are used to meet seasonal fluctuations in consumer demand.

During a supply disruption, IEA collective response actions would be initiated in which countries would use oil stocks only to assist the market. No such action would be taken for price management purposes, which could cause market distortions.

The Energy Community is currently evaluating whether to introduce an oil stock-holding mechanism to maintain minimum stocks of crude oil and/or petroleum products in line with the EU Directive 2009/119/EC. Ukraine would benefit from holding oil stocks equivalent to a minimum of 90 days of net imports or 61 days of inland consumption by 2020. These are similar to oil stock-holding commitments for members of the International Energy Agency except that the IEA has a collective action mechanism (Box 8.2). Building oil stocks would nonetheless be very expensive because it would require building large

storage tanks (total capacity of about 14 mcm) and buying large quantities of expensive oil and oil products. The costs of doing so are estimated to be in a range of USD 3 billion to USD 6 billion. However, existing oil tanks at ports and refineries, alongside military tanks, could be used for this purpose and Ukraine could build up these stocks progressively using for example, revenues from the excise tax or from other energy-related taxes.

CRITIQUE

Ukraine's oil market is facing many challenges: increased dependence on imports of crude oil and oil products, the necessity to raise quality standards and controls, and the need to ensure the modernisation and viability of its refinery industry. Conversely, the dynamism of the retail market is an asset with many domestic and foreign private companies operating and having strong interest to further develop their activities. The government of Ukraine is to be commended for its efforts to strengthen competition in the downstream oil market, mitigating the impact of high oil prices on final consumers via a floating excise tax while ensuring revenues to the state, developing the LPG market and diversifying oil imports.

Ukraine's oil market, however, is distorted by tax fraud, contraband and counterfeited products, and illegal processing of poor quality oil products. Fuel-quality controls and inspections are insufficient. This comes at the expense of the state budget, and ultimately consumers, which suffer losses from poor quality products and tax evasion. The government of Ukraine should take decisive action to close illegal refineries and increase quality controls at refineries and petrol stations by investing in the needed resources. The costs of such measures could be recovered from fines and additional tax revenue.

While the retail market shows dynamism, the Anti-Monopoly Committee should strengthen efforts to carefully monitor competition in the retail market. Concerted effort should be made to ensure that stakeholders have guaranteed access to the market and that consumers have better information on prices at different filling stations in regions.

Modernisation of Ukraine's refinery industry is of paramount importance. It is needed to facilitate diversification of oil imports, attract new companies, and ensure the efficiency and competitiveness of the Ukrainian oil market. Upgrading the refinery industry also brings employment and government revenue benefits.

Ukraine should use improved fuel quality standards and controls as well as targeted fiscal or taxation support measures to revive the refinery industry and encourage modernisation investments. However, quotas do not seem to be the option to follow as they may lead to an additional price burden passed on to the consumers and might encourage trade conflicts. Another option could be to lower taxation of high quality oil products to support demand while raising taxes on poor quality products to encourage consumer behavioural change.

To make the Ukrainian oil market more liquid and allow the entry of new stakeholders, the state-owned oil pipeline company, Ukrtransnafta, should be restructured and unbundled. The pipeline network needs to ensure fair and non-discriminatory access to capacity, including clear and non-discriminatory tariffs. Ukraine should also strengthen competition in oil auctions by providing fair and transparent access to pipeline capacity and develop reverse flow opportunities. Ukraine has the opportunity to import and transit greater volumes of Caspian oil via the Odessa-Brody pipeline and possibly the increasingly empty Druzhba South pipeline to central Europe, if it can offer competitive and predictable conditions to oil suppliers. Ukraine would become more attractive for Caspian and Russian oil producers and exporters.

Building strategic oil stocks and developing emergency regulation and response procedures would much improve Ukraine's oil supply security. Initial planning has started for building strategic oil stocks and developing an emergency response policy. The numerous challenges for Ukraine include developing the necessary capacities and mechanisms and ensuring adequate financing to build stocks and an appropriate management framework. With an aim to build minimum stocks by 2020, Ukraine will need to develop and implement a clear and realistic strategy on a priority basis. The Energy Community Treaty could provide an appropriate framework and Ukraine can also draw on the IEA's considerable experience.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Restructure and unbundle the activities of the state-owned oil pipeline company, Ukrtransnafta, in order to ensure transparent, efficient operation of the oil pipeline system and fair and transparent access to capacity, including reverse flows.*
- ☐ *Encourage the modernisation and more efficient use of the refinery industry through targeted economic measures, influencing demand for higher quality oil products through standards, strengthened quality controls and effectively combating illegal refining and the import of contraband oil products.*
- ☐ *Implement a price transparency and information system for the retail sector allowing motor fuel consumers to monitor and compare prices on the internet for different petrol stations.*
- ☐ *Make full use of Ukraine's potential to access Caspian oil supplies for domestic consumption or transit to central Europe: this requires offering attractive transit and possibly refining conditions to Caspian suppliers and co-operating with neighbouring markets.*
- ☐ *Develop a realistic strategic plan to develop oil emergency reserves, including a timeframe for progressively moving towards a stockholding of 90 days equivalent of imports and secure the necessary funding.*

9. COAL

Key data (2011)

Share of coal: 31% of energy mix

Domestic production: 82 Mt

Consumption: 71 Mt

Power generation: 50% of consumption in power generation, installed capacity in coal-fired power plants is 27 980 MW

OVERVIEW

Coal is viewed as a guarantee for energy, economic and political independence in the Ukraine. It is the country's the main indigenous fossil fuel energy resource. Coal production was about 82 million tonnes (Mt) in 2011.

The significance of Ukraine's coal resources has a long history. In the 1920s and 1930s, Ukrainian coal was a cornerstone of Soviet Union energy supply. Over the decades this significance waned with the development of oil and natural gas in Siberia and other regions where coal production was cheaper. When Ukraine became independent following the break-up of the Soviet Union, annual coal production was more than 100 Mt. Production has declined since, reflecting general economic condition in Ukraine and the availability of less expensive coal imports. Domestic production became unprofitable and dependent on government subsidies. In this regard, the coal sector in Ukraine is not very different from those in countries such as Germany, Spain and the United Kingdom. Generalised losses in the coal sector in Ukraine meant lack of investment that led to reliance on obsolete equipment, unsafe working conditions and low productivity. High accident rates and delays in wage payments fuelled workforce conflict and strikes. Tightening government budgets called for subsidies to be reduced and increased pressure for structural reform in the coal sector.

Today the coal sector in Ukraine is characterised by a mix of public and private ownership. Public ownership is decreasing as privatisation progresses. At of the end of 2011, public companies operated one-third of the production capacity. DTEK, a vertically integrated private holding company with a stake in coal production as well as power generation and distribution, represents around half of the coal production capacity in Ukraine. The government plans to advance the coal-sector privatisation process in the coming years.

RESOURCES

Ukraine is endowed with abundant coal reserves, which account for more than 90% of the country's fossil fuel reserves. They include the full range of coal types from anthracite

to lignite, including thermal and coking coal. Reserves of anthracite and bituminous coal are estimated to be about 32 gigatonnes (Gt), with 49 Gt of resources, ranking Ukraine sixth in the world for hard coal reserves, after the United States, China, Russia, Australia and South Africa.[1] Reserves of sub-bituminous coal and lignite are estimated to be about 2 Gt (fifteenth in global ranking of lignite reserves) with another 5 Gt of resources. Government estimates are 117 Gt of hard coal reserves (including sub-bituminous) and 8.6 Gt of lignite. Government estimates of ultimately recoverable reserves at existing mines are more than 6 Gt, which means around 75 years at current production levels.

Most coal in Ukraine is located in the Donbas (Donetsk Coal Basin) in eastern Ukraine (this basin continues into Russia) in the regions of Donetsk, Luhansk and Dnipropetrovsk. There are two other basins, the Lviv-Volyn Coal Basin in western Ukraine (this basin continues into Poland) and the Dnieper Coal Basin, a lignite basin in central Ukraine. Intensive mining for more than a century in the Donetsk region has exhausted the best deposits (Figure 9.1).

Geological conditions of most of the reserves are poor for exploitation. Coal lies in thin and very deep seams with high methane content and high risk for gas-dynamic manifestations, among other problems. More than 80% of the hard coal reserves are in seams with a thickness of less than 1.2 metres (m).

Today producing Ukrainian coal mines have an average mining depth of more than 700 m and one out of six mines are at a depth of greater than 1 000 m. Average seam thickness is 1.2 m. Approximately 90% of mines release significant amounts of methane. Specific methane emissions of 20 cubic metres per tonne (m^3/t) to 30 m^3/t and higher are common in Ukrainian coal mines. Some 60% of mines have possible coal dust outbursts. Possible outbursts and rock bumps affect 45% of mines, while 22% of mines are susceptible to possible coal spontaneous combustion. These conditions make Ukrainian coal mines among the most difficult and dangerous in the world (Box 9.1).

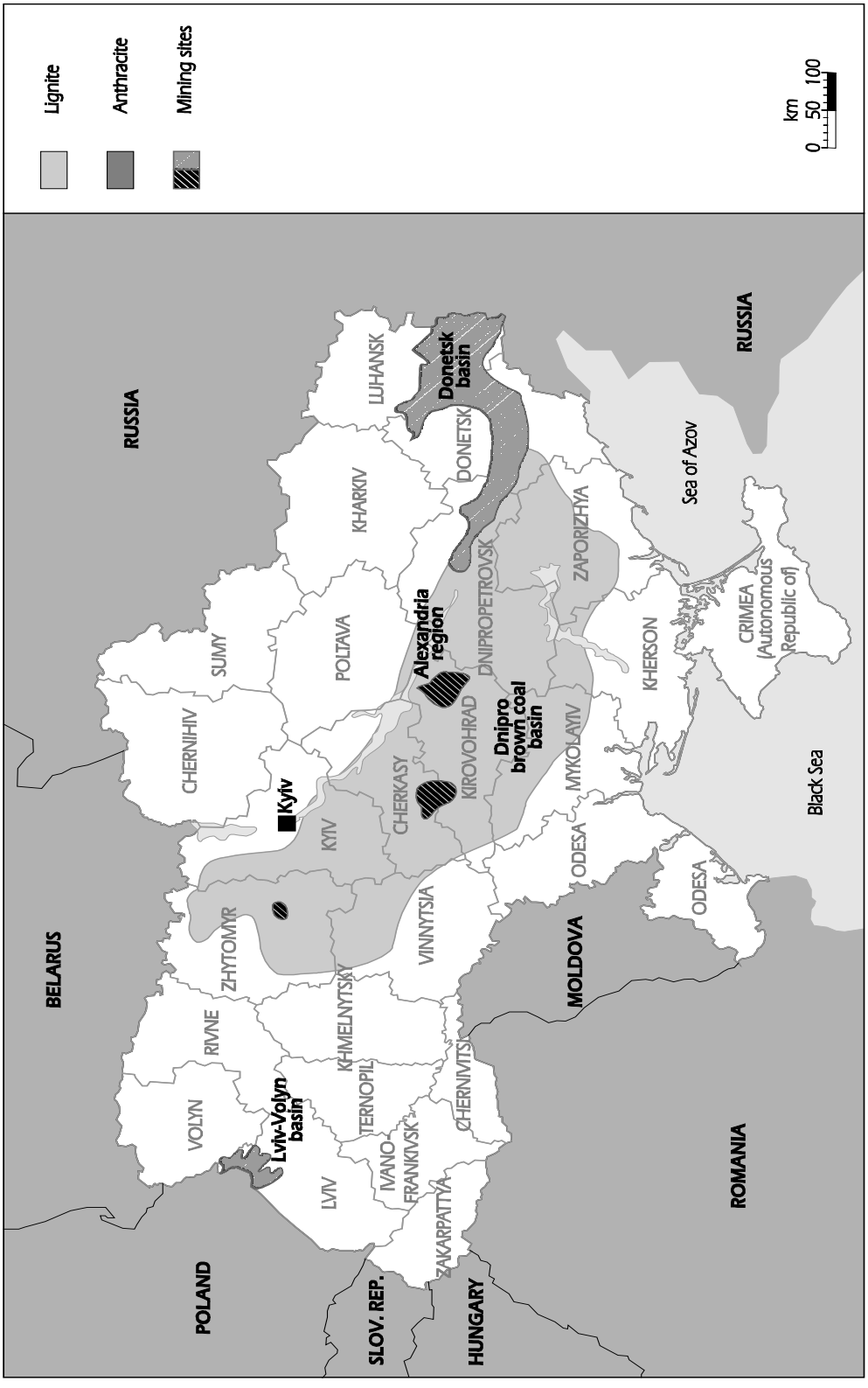
Box 9.1 **Coal mine methane and coalbed methane**

The high methane content of Ukrainian mines makes them dangerous to exploit and harmful for the environment due to greenhouse-gas (GHG) emissions. Tapping coal methane for fuel use offers an opportunity reduce natural gas imports and, in the case of coal mine methane, also to avoid GHG emissions. Although difficult to estimate, some studies predict more than 30 trillion cubic metres (tcm) of coalbed methane resources and about 3 tcm of reserves in Ukraine.

Recognising the potential economic, environmental and energy security benefits, Ukraine adopted laws in 2006 and 2009 that set out the legal, financial, environmental and organisational principles for coal mine and coalbed methane activities from exploration to commercial production. The purpose is to establish a framework of clear rules to attract investment and promote development. An example is the Zasyadko Mine where a cogeneration plant that uses methane from the coal seams to produce electricity and heat is in operation and there are plans for another installation.

1. International Energy Agency (IEA) (forthcoming in late 2012), *Resources to Reserves*, OECD/IEA, Paris.

Figure 9.1 **Ukraine's major coal basins**

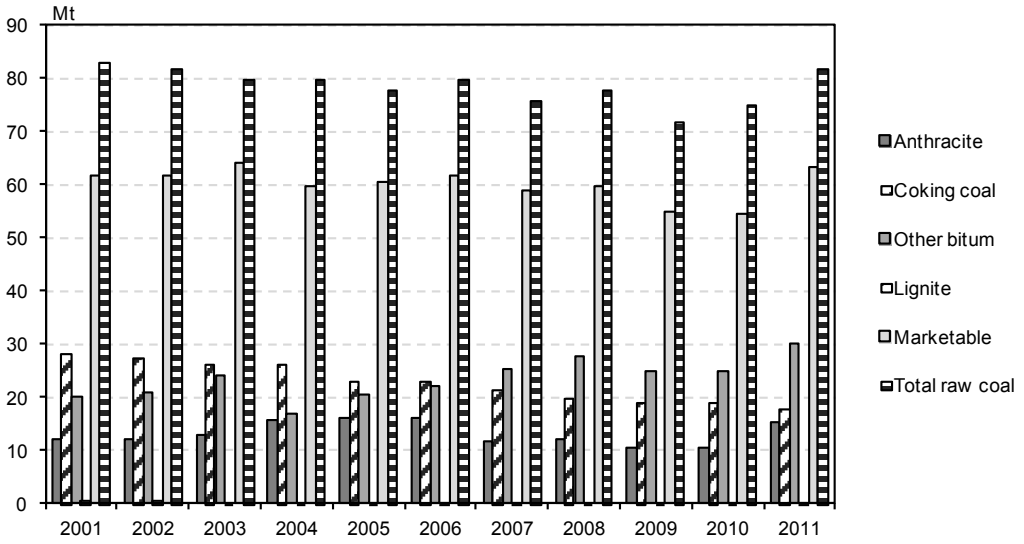


SUPPLY

PRODUCTION

Ukraine experienced a large decrease in coal production in the 1990s. Over the last decade, production levels have been relatively stable (Figure 9.2).

Figure 9.2 **Total coal production by type, 2001-11**



Source: IEA databases.

In 2010, total coal production in Ukraine was 75.2 Mt, of which 55.4 Mt was marketable coal. Estimates of coal production in 2011 indicate an 8.9% increase to about 82 Mt, with marketable coal at more than 63 Mt. Thermal coal production in 2011 was 57 Mt, up 11% from the previous year, and coking coal was 25 Mt, about a 4% increase. Production by region is shown in Table 9.1.

Table 9.1 **Coal production, 2011 (million tonnes)**

Region	Volume	Increase from 2010
Donestks	36.3 Mt	13.1%
Luhansk	27.3 Mt	9.7%
Dnipropestros	15.4 Mt	2%
Lviv	2.4 Mt	10.2%
Volyn	0.55 Mt	4.8%

Source: IEA databases.

OWNERSHIP

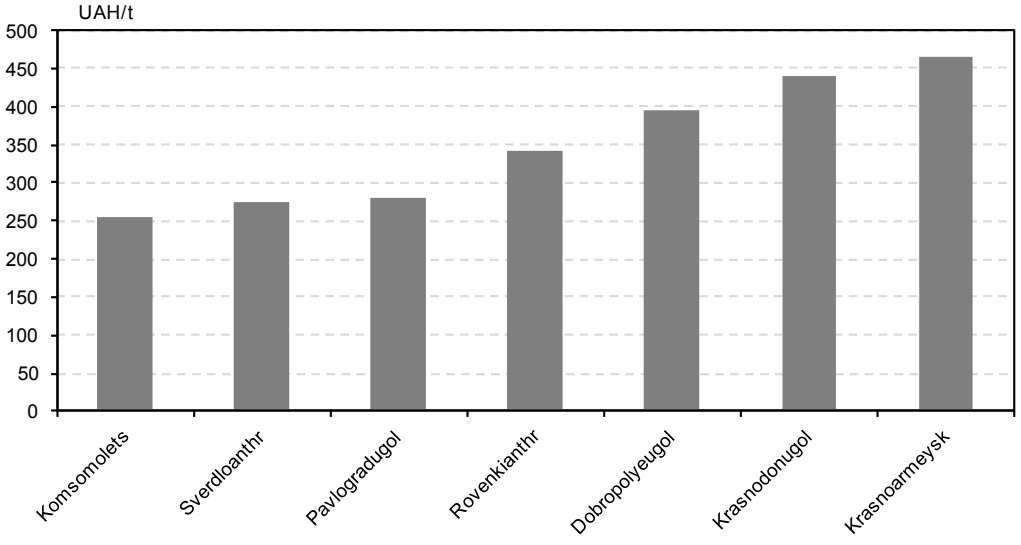
Narrowing the focus to production at state-owned mines, according to the Ministry of Fuels and Energy total production in 2009, was 38.8 Mt, more than a 10% drop from production in 2008 (43.4 Mt). Marketable coal in 2009 was 24.6 Mt, down 8% from the previous year. In 2010, estimates indicate production levels similar to those in 2009. This is indicative of how reduced investments in the state-owned mines are insufficient to sustain production levels.

Ownership patterns are changing as Ukraine restructures its coal sector. Recently, DTEK, the biggest private coal producer, obtained the concession of Sverdlovanthracite, a state-owned company with five mines and three preparation plants, and Rovenkianthracite, another state-owned company with six mines and three preparation plants. DTEK now controls around 50% of total coal production while production at public mines is about one-third.

PRODUCTION COSTS

In 2010, production costs of the largest coal mining companies ranged from UAH 250 per tonne to UAH 500/t (USD 31/t to USD 61/t) (Figure 9.3). These include both private and state-owned companies. These levels are well below international prices.[2] Definitive conclusions should not be drawn from these simple data, but they suggest that, with sufficient investment to increase mechanisation and improve productivity, many coal mines in Ukraine can be profitable in spite of the difficult geological conditions. For example, DTEK, by far the largest coal producer in Ukraine, has plans to increase mining productivity from the current 59 tonnes per person-month to 150 tonnes per person-month.

Figure 9.3 **Production costs in the main coal mining companies, 2010**



Source: DTEK (2010), *Annual Report*, Donetsk.

2. Based on a northwest Europe imported coal index in 2010 of USD 80/t to USD 130/t and an energy content of 6 000 kilocalories per kilogramme.

According to the Ministry of Energy and Coal Industry, in the mines they operate, the average production cost in 2010 was UAH 720/t (USD 91/t). This falls in the higher end of the range of imported coal in Europe. However, considering the scarce investments made in those mines there is considerable room for improvement.

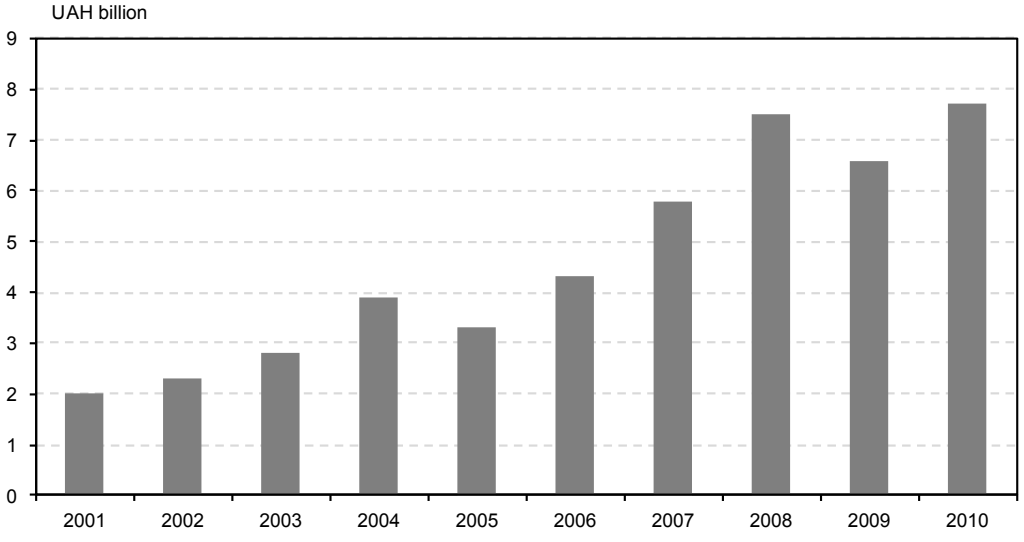
COAL QUALITY

Ukrainian coal is high in ash and sulphur. This limits its export options, although the availability of washing and preparation facilities can help. Poor coal quality constrains the efficiency of coal-fired power plant operations and increases emissions. The scarcity of high quality coking coal obliges Ukraine to import it for blending with domestic coal to produce coke.

MINE SAFETY

Safety is a significant issue in Ukraine coal mines where one in three mines is more than 50 years old. The majority of state-owned mines have not been modernised since Ukraine became independent in 1991. Most coal is extracted by pneumatic hammers with long-wall mining techniques only used occasionally. This lack of mechanisation combined with difficult coal deposits results in low productivity, poor economic profitability, and high accident and death rates. Coal deposits are thin with high gas content and are prone to coal dust explosions and outbursts. The restructuring of the coal sector is shifting the government role from owner to regulator with responsibility for safety conditions and procedures as well as monitoring and compliance. The death toll in Ukrainian mines went from 4.7 fatal injuries per million tonnes produced in 1998 down to 2 in 2005 and 2.2 fatal injuries per million tonnes in 2008.[3] The level of fatal injuries remains unacceptable.

Figure 9.4 **State subsidies for coal production, 2001-10**



Sources: draft *Updated Energy Strategy of Ukraine to 2030*; Ministry of Energy and Coal Industry of Ukraine.

3. Coal Sector Policy Support Programme Report (2008), EU Technical Assistance for the Commonwealth of Independent States (TACIS) Contract 2008/141-542.

SUBSIDIES

Over the last decade, subsidies for state-owned coal mining, mostly to cover the difference between production cost and sale price, have increased despite some sectoral reforms (Figure 9.4). In 2009, uncovered losses of the public sector mines amounted to UAH 2.4 billion (USD 308 million), accounts payable of coal companies increased by UAH 2.7 billion (USD 346 million) to reach UAH 11.1 billion (USD 1.4 billion). Yet even with substantial subsidies from the state budget, the financial situation of state-owned coal mines is very weak.

Privately-owned coal mines do not receive any direct subsidy, according to government sources. They may receive some preferential treatment, however, such as government loans at low rates or reduced electricity tariffs.

TRADE

Steam coal exports, mostly anthracite, were slightly under 6 Mt in 2010.[4] About half of these exports were to Bulgaria, 1 Mt to Turkey and 0.5 Mt to Poland. Steam coal exports increased to 6.5 Mt in 2011 and went to similar markets based on preliminary data. Coke exports were around 1.5 Mt in 2010 and almost 2 Mt in 2011, mostly to Iran. Coal imports to Ukraine were 15.5 Mt in 2010.[5] Imports were 13 Mt in 2008 and fell to 7.8 Mt in 2009 as the global economic downturn took its toll on industrial production in Ukraine. About half of the imports in 2010 were steam coal, mainly from Russia. Coking coal was also about half of imports with 71% from Russia and the rest from the United States. Ukraine is a net importer of coking coal. This is not likely to change, due to a scarcity of indigenous high-quality coking coal. Ukraine can be both an importer and an exporter of steam coal depending on seasonal factors and price. Successful restructuring of the coal sector could give rise to an increase in domestic production, although quality issues, particularly sulphur content, may be a constraining factor. Exports may increase, especially if Turkey maintains strong economic growth, as it is a very attractive market for Ukrainian anthracite. Other potential export markets for Ukrainian anthracite are Novocherkassk Thermal Power Plant (TPP) in Russia, Moldovan TPP in Moldova and Varna TPP in Bulgaria.

While international trade is generally beneficial for an economy, coal export trade for Ukraine is a dilemma. Huge subsidies go to maintain production at state-owned coal mines based on energy security and social reasons. Privately owned companies are exporting lower cost coal and have ambitious plans to increase exports, thereby leaving the heavy burden of the uncompetitive mine losses to the state budget.

DEMAND

Coal demand was 63.4 Mt in 2009. Of this amount, coking coal was 24.8 Mt, and other bituminous coal was 31.9 Mt, anthracite was 6.2 Mt, plus some lignite and peat. Most coal is used for electricity production, with 30.1 Mt for power plants and 0.5 Mt for auto-producers. Coking coal is used to produce coke to be used in iron and steel production. In 2011, coal demand increased to about 70 Mt as some thermal power plants switched from gas to coal.

4. IEA (2012), *Coal Information 2012*, OECD/IEA, Paris.

5. IEA (2012), *Coal Information 2012*, OECD/IEA, Paris.

POWER GENERATION

The fleet of coal-fired power plants is quite old (Table 9.2). Capacity of the coal-fired power plant fleet is 27 980 MW. The largest owner is Dneproenergo, with 8 400 megawatts (MW) of capacity. While most of these companies are state-owned, DTEK owns Shidenergo and controls Dneproenergo and Zahidenergo.

Based on available data on coal demand for power generation compared with fleet capacity, it appears that load factors are low, most under 50%.

Table 9.2 **Coal-fired power plants**

Name	Owner	Years of unit commissioning	Units	Capacity (MW)
Slavyanskaya	Donbassenergo	1955-69	2	880
Starobeshevskaya	Donbassenergo	1961-67	10	2 000
Pridneprovskaya	Dneproenergo	1959-66	8	1 800
Krivorozhskaya	Dneproenergo	1965-73	10	3 000
Zaporozhskaya	Dneproenergo	1972-77	7	3 600
Zmiyevskaya	Centrenergo	1960-69	10	2 400
Tripolskaya	Centrenergo	1969-70	6	1 800
Uglegorskaya	Centrenergo	1972-75	7	3 600
Dobrotvorskaya	Zahidenergo	1959-64	5	600
Ladyzhinskaya	Zahidenergo	1970-72	6	1 800
Burshtynskaya	Zahidenergo	1965-73	12	2 400
Luganskaya	Shidenergo	1956-69	8	1 500
Kurakhovskaya	Shidenergo	1972-75	7	1 400
Zuyevskaya	Shidenergo	1982-88	4	1 200

Note: capacity is approximate as some repowering is to be or has taken place. In addition, some units are mothballed or qualified as long-term reserve.

Source: information provided to IEA from several sources.

The aging coal-fired power plants have had insufficient maintenance and limited investment for many years. This hampers efficiency which is further challenged by the high ash content of Ukrainian coal. Although some 30 units are reported as supercritical units, efficiency values are far from the state-of-the-art levels. While some investments and upgrades in recent years have improved plant performance, much more is needed and efficiency improvements should be a priority. Another significant challenge is to reduce power plant emissions to comply with the EU Large Combustion Plants Directive in line with the commitments that Ukraine took when joining the Energy Community.

HEAT PRODUCTION

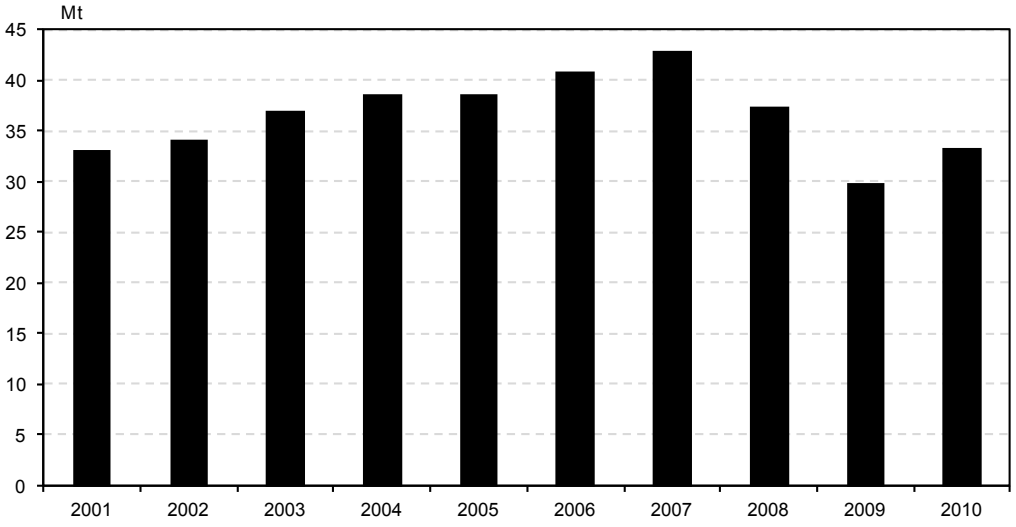
District heating is of significant economic and social importance in Ukraine. It accounts for a large share of total primary energy use and the government has launched a

programme to replace natural gas by coal in district heating plants. In 2011, several district heating plants switched from gas to coal. While the use of coal for heat production may be more economic than natural gas, the switch implies that local pollution will likely increase. There is no evidence that the government has assessed the environmental impacts, which can be of concern as district heating plants are generally located close to the demand centres including residences.

STEEL PRODUCTION

Ukraine is endowed with significant iron ore and coal resources. It ranks among the top ten steel producers in the world. Steel production accounts for 95% of coking coal consumption in Ukraine. The market for coking coal differs from that of steam coal, which is mostly used domestically for electricity generation, as steel products are more export oriented.

Figure 9.5 **Crude steel production in Ukraine, 2001-10**



Source: World Steel Association.

Steel production is more complex in relation to coal quality issues than is steam coal in power plant performance. There must be a balance in the blend used to produce coke, the pulverised coal injection (PCI) used in the blast furnace and the fuel (gas natural or coal) for auxiliary heating. Coking coals of high, medium and low volatility are typically blended with some steam coal and small amounts of petcoke in the coke oven. Different coal qualities and associated prices are taken into account to determine the optimal blend.

Steel production in Ukraine is export oriented. Production levels fluctuate in accordance with market demand (Figure 9.5). The ratio of steel production to coking coal consumption is not direct, as it depends on factors such as the amount of scrap steel and PCI used in steel making, coal blends for coking, coke oven performance and, in the case of Ukraine, coke exports. However, it is the best indicator of the coking coal demand.

POLICY AND INSTITUTIONAL FRAMEWORK

INSTITUTIONS AND POLICY FRAMEWORK

The government's draft *Updated Energy Strategy of Ukraine to 2030*, which is under public consultation in the third quarter of 2012, includes a strategy for coal industry development. Reform of the coal sector is a cornerstone. It sets an objective to increase coal production from the current 82 Mt to 130 Mt by 2030, with interim goals of 110 Mt in 2015 and 115 Mt in 2020. While production levels were more than 100 Mt in the Soviet era, to ramp up production levels to meet these aims requires the successful execution of coal sector restructuring together with very significant investment.

The Ministry of Energy and Coal Industry is responsible for the coal sector. Other relevant authorities include the president's Co-ordinating Centre for Economic Reforms, National Commission for State Energy Regulation (NERC) and the Anti-Monopoly Committee. Policy measures for state-owned mines and progressive privatisation of profitable mines are meant to enable the domestic coal industry to achieve the objectives of the government strategy.

Ukraine's *Programme for Economic Reforms 2010-2014* includes measures dedicated to the coal sector, such as improving the mechanism for state support, facilitation of company restructuring, social support for mining towns and workers made redundant, and attracting investment through privatisation. For the state-owned mines, which have experienced declining production levels, the initial element of the strategy is to stabilise production levels and then to gradually increase coal production. This requires modernisation and upgrading of mining equipment, including long-wall mining techniques. A good diagnosis of which coal mines are to be decommissioned and which ones to expand is required. The Ministry of Energy and Coal Industry has drawn up an inventory of the coal mines and identified the "black holes" which include depleted or, more generally, non-profitable mines in which no investment is planned and the "growth sites" in which the state will support investments in modernisation.

The focus of the strategy is privatisation of the profitable mines. This includes mines that are profitable today as well as those that can be made so with adequate investment and modernisation. Unprofitable mines need to be decommissioned at a pace that does not risk energy security and takes into due account the capacity of ports and rail to deliver imported coal.

The experience of other countries in coal sector restructuring suggests that significant resources and funds are needed for the safe and environmentally sound physical closure of mines, and for social measures. An important element of Ukraine's strategy is to address worker training and relocation, as privatisation and closures will have employment effects. Some resources are expected to be allocated to facilitate workforce mobility. While success of the strategy could deliver significant reductions in subsidy support, the budget to underpin the programme and its allocation is determined every year in accordance with the annual Budget Law, making it difficult to assess the likelihood of its potential outcomes.

SECTOR REFORM

The coal sector is vital to Ukraine as a source of energy in its economic dimension and in terms of energy security. An efficient and productive coal sector could underpin the entire economy. Rather than be a burden through today's heavy level of subsidies, it

could provide benefits both financial and social from taxes on economic activity and royalties from exports. Effective restructuring of the coal sector needs to be a high priority in Ukraine.

In tackling sector reform, an important issue is the lack of a real market for steam coal. In the current situation, around one-third of coal production is in state entities. State-owned mines sell their products through Vugillya Ukrainy, which is also a state-owned company that allocates coal and sets prices. The mechanism for price setting is not transparent. However, it seems that prices are established as a function of mining costs; hence, there is no incentive for the mines to reduce costs. This approach does not provide incentives to increase productivity, to reduce production costs and improve safety to reduce accident rates. The government should set the framework for a market in which prices are freely negotiated by producers and consumers. The liquidation of Vugillya Ukrainy by 2015, as proposed in the *Programme of Economic Reforms*, is a step in the right direction.

Coal production from private companies can be sold on a market basis. However, one company, DTEK, owns most of the private coal production capacity as well as many of the coal-fired power plants. Therefore the majority of coal from private companies is not traded on the market.

Generally, coal sector reform must address an array of concerns. It needs to balance government objectives to reduce subsidies, improve economic benefits, provide sufficient and safe employment opportunities, and ensure economic and secure energy services. It must adequately address the concerns of coal miners and mining communities. Powerful trade unions, readiness to take strike action and the fact that coal mining is concentrated in some regions make political power very sensitive to coal industry demands, especially when state-owned or state-subsidised mines are concerned. In addition, industrial lobbies with a stake in coal production or consumption also try to benefit their businesses.

Coal production costs suggest that with investment to modernise the mining process and increase productivity that coal mines in Ukraine can be profitable despite the difficult geologic conditions. Yet doubts about the profitability potential, large accumulated debts of some companies and the complex bureaucracy involved in the privatisation process may hamper investments in coal mines, especially from foreign investors.

The government is taking steps to facilitate the privatisation process. A recent law related to lease or concession of state-owned fuel and energy facilities provides for a concession or lease scheme under which a private operator and the state conclude an agreement whereby the company undertakes investments to modernise operation of a mine and the state assumes operating losses for a five-year period. This approach offers several advantages to a private company: it is more affordable than the full privatisation process, as not all the assets are included in the tender, although there are investment commitments, and the process is simpler and quicker. Theoretically, the state also benefits as investments should improve productivity and reduce economic losses, and taxes paid by the private companies should increase.

While the advantages of this approach cannot be overlooked, some drawbacks must be noted. There are concerns about the lack of transparency in how different companies are treated and selected to conclude an agreement. It is not clear when and on what conditions the mines would eventually be transferred to the private investor. It is

recommended to ensure transparency on how the concession and lease scheme is managed, in terms of pricing as well as loss and profit distribution through the whole value chain.

There is concern about potential monopolistic behaviour by the mining equipment industry, which could be increased by further privatisations to DTEK. It is not clear whether mining equipment is available in a market framework. Imports of mining equipment could be restricted in some way. Most mining equipment is bought from SPC Mining Machines, which appears to dominant the domestic market for mine equipment. DTEK is the lease or concession holder of most of the private mines which sell coal to the power companies it owns. Both DTEK and SPC are owned by System Capital Management, which is a holding company that also owns Metinvest and other companies in Ukraine.

Competition and transparency are needed in Ukraine's large coal sector to spur the substantial investment necessary to modernise it. It is important to avoid monopolistic behaviour by the industry. Without an effective framework and market, investors may be deterred from the privatisation process. The government should ensure that mining equipment imports are not restricted and foster competition in the provision of mining equipment.

ENVIRONMENT

COAL MINING

Coal mining has well known environmental impacts including modification of the landscape, potential water and air degradation and waste issues, among others. When coal mines are properly planned, designed and operated, environmental impact is minimised, by-product use is maximised and definitive closure is performed in an adequate manner. The "polluter pays" principle should govern. The mine operator must be responsible for adequate design, implementation, practice and remedial actions, underscored by strict independent monitoring and inspection. In a country such as Ukraine with a long history of coal mining, the inherited environmental issues are numerous.

The government should ensure that the "polluter pays" principle is applied to the private mines and that the use of by-products is fostered. An example of good practice using by-products includes the use of residual heat from the mine water at the Belorechenskaya Mine which has installed a heat pump to reduce fuel needs for heating.

CARBON CAPTURE AND STORAGE

Carbon capture and storage (CCS) has significant potential in Ukraine. Coal has been exploited for many decades and the existence of a well-established coal industry and technical expertise are factors that may catalyse future efforts. However, current priorities related to "clean coal" approaches are focused on technologies to increase coal-fired plant efficiency and emission reductions rather than for CCS.

Yet some CCS activities are in progress. The main one is a research project to identify potential geological storage sites. It is funded by the European Commission and implemented jointly between Ukraine's Donetsk National University and the French geological survey (Bureau de recherches géologiques et minérales, [BRGM]). The project is analysing storage options in industrial areas and matching them with major sources of CO_2. BRGM brings geological expertise and experience with conducting similar assessments in France and in Europe.

COAL-FIRED POWER PLANT EMISSIONS

Coal-fired power plants in Ukraine are generally old and inefficient. Increasing efficiency of the plants prolongs the life of coal resources, saves fuel costs and reduces emission at the local and global level. Some companies in Ukraine are making investments to improve efficiency as well as repowering. However, there are barriers to investment including that electricity tariffs do not allow for a return on investment and price distortions on fuels do not promote efforts to increase efficiency.

The government has committed to implement a number of European Union directives. Relevant for Ukraine's coal-fired power plants is the Large Combustion Plant Directive (LCPD), which must be implemented by 2018 in accordance with an agreement between the European Commission and the government of Ukraine.[6] The eventual fulfilment of the directive will have a very positive impact to reduce air pollution. The directive imposes dramatic emission reductions for Ukraine's coal-fired power plants (Table 9.3).

Table 9.3 **EU Large Combustion Plant Directive's emission reduction requirements**

Type	Limit	2010 actual value	% reduction
Sulphur	400 mg/m^3	6 768 mg/m^3	94%
Nitrogen	200 mg/m^3	1 575 mg/m^3	87%
Dust	50 mg/m^3	2 432 mg/m^3	96%

Source: Large Combustion Plant Directive, 2001/80/EC.

The investments required for compliance with the LCPD are on the order of UAH 100 billion (USD 12 billion). Clearly, this is a significant hurdle. If this level of investment were instead used for new state-of-the-art plants, they could generate about the same annual quantity of electricity as today's installed coal-fired capacity. The current tariff scheme does not allow sufficient return on investment. Therefore, it is difficult to conceive how this amount of money is going to be available in order to meet the 2018 deadline.

Other issues that could hinder implementation of the directive include equipment unavailability, insufficient skilled workforce capability, and lack of technical experience to design and operate environmental control technologies. In the case of some power plants, a lack of physical space for equipment may be a constraining factor. Nevertheless, the main barrier for compliance is economic.

COAL-FIRED POWER PLANT WASTES

Use of the by-products from the coal-fired plants should be promoted. Fly ash has good value for cement production. Bottom ash can be used for road making and gypsum from

desulphurisation units can be used as construction material. Policy should be oriented to promote a market in the use of by-products, which makes sense both from environmental and economic points of view.

6. Large Combustion Plant Directive, 2001/80/EC.

CRITIQUE

Ukraine is endowed with vast coal resources with the potential to underpin economic development and competitiveness and energy independence, plus contribute to the nation's wealth. Instead, subsidies to the coal industry consume several percentage points of the national budget. Furthermore, Ukrainian coal mines are among the most dangerous in the world and the environmental impact of present coal mining practices and use is significant.

The coal sector has been a challenge for the government for twenty years and will continue to be so. Harsh geological conditions together with scarce investment in mining and wide price distortions have produced an uncompetitive sector. The state dedicates huge sums to subsidise it. To date, efforts to reform the sector have been insufficient. Continued delay will increase the magnitude of the problems and make them more difficult to resolve.

Therefore, restructuring the coal sector is a necessary step to improve economic performance, particularly for the energy and industrial sectors. This is a challenging task that will require a set of strong and comprehensive government actions, which must embrace not only reforming the entire coal value chain, *i.e.* mining equipment, coal mining and power generation, but also improving the general governance situation in Ukraine, *i.e.* transparency and competitiveness. Currently, the former loss-making and state-owned sector is at a crossroads. How it will look like in the future depends on the actions of government. A profitable and competitive sector is desirable, but the wrong decisions could result in keeping the unprofitable portions of the coal sector in state ownership longer than desired or to turn the entire sector into a private monopoly.

The phasing out of Vugillya Ukrainy and introduction of free market conditions to liberalise the coal market is a must. To this end, the draft *Updated Energy Strategy of Ukraine to 2030* offers a number of positive opportunities for the sector, notably, proposals for the privatisation of the profitable coal mines and the elimination of Vugillya Ukrainy. To keep unprofitable mines operating, via subsidies, is no longer economically viable, nor is it sociably sustainable in the long term. Other European countries have faced similar challenges in the past, and the Ukrainian government can profit from the experience in these countries, especially the need to address the social and environmental impacts, the most challenging when closing down mines. To that end, subsidies could be allowed as an exception for some time.

The draft *Updated Energy Strategy of Ukraine to 2030* recommends the privatisation of the profitable mines. To date, state-owned mines have suffered from under investment often resulting in losses. Investments to increase the mechanisation of mining tasks and higher productivity may turn a loss-making mine into a profitable enterprise. Nevertheless, there are barriers preventing broad participation in the privatisation of the sector. These include price formation and fuel allocation; restrictions in the domestic market for mining equipment; and the current approach to power generation reform. Taken together with the general investment environment in Ukraine, these barriers deter investment and hinder the development of a competitive and profitable coal sector.

The privatisation process must fulfil general rules such as transparency and non-discriminatory treatment. Given current circumstances, including the mandate of Vugillya Ukrainy, DTEK's dominance in power generation and the dominant position of SPC

Mining Machines in the market for mining equipment, the government needs to make an additional effort to ensure a fair and effective market in order to attract needed investment and to curtail monopolistic behaviour and market concentration.

Investments in state-owned mines are declining. During the privatisation process, the state must keep investing in state-owned mines to maintain existing assets, to modernise facilities and to improve safety conditions. If investments are not made when needed, they result in more costly outcomes and have consequences such as poor working conditions and accidents.

Geological conditions of Ukrainian mines are difficult owing to their depth, narrow seams and gassy conditions. Safety remains a serious concern. Strong safety and environmental regulations and an accompanying monitoring enforcement regime are needed. With privatisation, the role of the government will shift from ownership to regulation and inspection which are crucial to health and safety performance.

When design and implementation of mining operations are not carried out in accordance with the best standards, the negative environmental impact of coal production is significant. Waste rock heaps, coal slurry ponds and heap from washery tailings, underground water pollution and superficial water pollution are some of the problems that plague coal mining areas in Ukraine. It is not clear whether if the “polluter pays” principle is applied to coal mines. To ensure that this principle is met, together with removing barriers which could prevent the use of by-products with a market value, is essential to minimise environmental impact at the least cost.

There have been some advances to manage coal mine methane with its use as a feedstock for house boilers, which are replacing old coal boilers. This brings a double benefit; it avoids methane emission to the atmosphere and accelerates the switch to cleaner boilers. Also there are plans to develop cogeneration from coal mine methane. The actions of government to promote such beneficial applications are encouraged.

Given their age and historically poor maintenance, Ukraine’s coal-fired power plants are inefficient and there are significant associated environmental concerns. The government has committed to complying with a series of European directives, the most challenging of which is the Large Combustion Plant Directive, to reduce harmful emissions. But Ukraine’s current tariff scheme does not allow a fair return for the required investments so full compliance by the 2018 goal looks extremely challenging.

Although carbon capture and storage (CCS) is not a priority in Ukraine, it has significant potential. There is a well-established coal industry, technical expertise and plans to reinforce coal use in the future, which will increase interest in clean-coal technologies. There are some activities in progress such as a research project financed by the European Union to match potential storage locations with carbon source but more will be needed to realise it.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Accelerate the restructuring of the coal mining industry. This process must include: establishing a time schedule for the phase out of subsidies for coal producer; full transparency and fairness to liberalise the coal market; further privatisation and the eventual closure of the remaining unprofitable mines.*

- *Restructure the sector in a progressive manner, addressing the social and environmental impacts of government decisions and be guided by best practices successfully applied in other countries.*
- *Monitor the privatisation process in both the coal and electricity sectors and avoid the emergence of potential monopolistic positions and abuse of dominant market position by any party in the supply chain, from coal mining to power generation, including mining equipment supply.*
- *Continue to invest in state-owned mines in order to improve health and safety and reduce accidents. Strengthen health and safety inspection, monitoring and enforcement activities in privately-owned mines.*
- *Promote the revalorisation of coal sub-products,* i.e. *increasing use of coal mine methane, and encourage use of those products which have market value, such as fly ash and bottom ash from coal-fired plants, coal slurries from ponds or coal recovery from tailing heaps.*

10. ELECTRICITY

Key data (2011)

Installed capacity: 53.3 GW

Final electricity consumption: 137.2 TWh

Electricity generation installed capacities: 51% thermal, 26% nuclear, 12% CHP, 10% hydro, 1% renewable

OVERVIEW

Ukraine's electricity sector is undergoing major change including privatisation and preparation for restructuring. The main motivation for the reform is to increase the economic efficiency of the sector in view of the high and rising costs of all the sources of electricity in Ukraine. In the years since independence, Ukraine has relied on cheap nuclear electricity from the fully amortised capital stock, but now, as demand is rising, the units are running close to full capacity and in the mid-term will need major investment. In thermal generation, Ukraine switched from natural gas to coal where possible as prices of imported gas have been steeply increasing since 2006.

Against this background of increasing challenges in supply of fossil fuels for generation, demand for electricity grew strongly in the years before the financial crisis started in late 2008. Demand is likely to increase if the economy recovers, which will make the electricity supply challenges even more acute. Since the last in-depth review in 2006, electricity prices for the industry sector have increased and are at the same level of some neighbouring countries such as Russia and Belarus; thus policy changes have to be very measured so as not to undermine growth and competitiveness of the export-oriented Ukrainian economy. Ukraine, as part of its membership in the Energy Community Treaty, has taken on obligations to adopt portions of the European Union (EU)'s electricity market legislation and reduce emissions from power plants that will entail significant investments in the electricity sector.

DEMAND AND SUPPLY

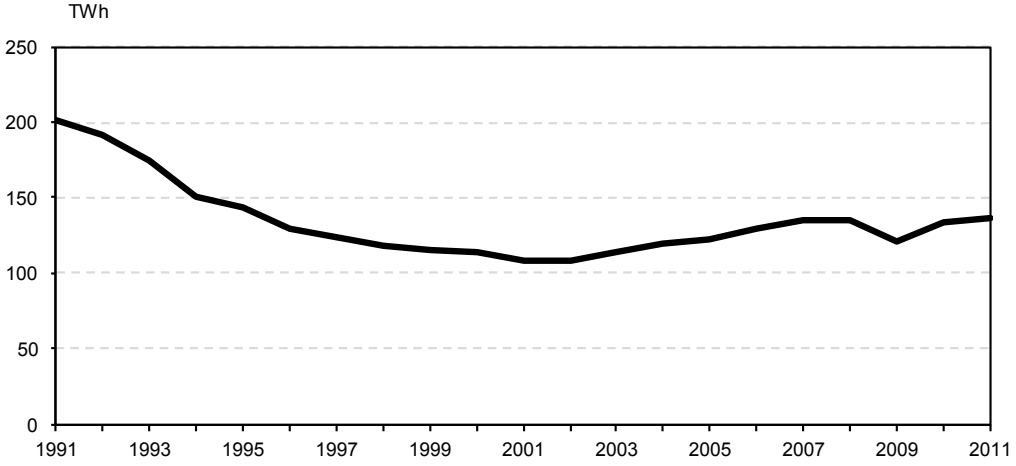
DEMAND

In 2011, demand for electricity in Ukraine was significantly less than at the time of independence in 1991. Final consumption of electricity fell sharply in the 1990s from about 200 terawatt-hours (TWh) in 1991 to 107 TWh in 2001 due to reduced economic activity in most sectors, especially in industry. As the economic activity in the industrial sector rebounded to some extent and consumption in residential and commercial sectors picked up in the 2000s, electricity demand (final consumption) grew strongly at 4.5% per year from 2002 to 2007, reaching 135 TWh that year. The economic crisis then

led to a decrease in demand to 121 TWh in 2009. In 2011, demand increased again to 137.2 TWh, the highest level in more than a decade (Figure 10.1).[1] This robust growth trend was not as steep as the 6% per year decline in the 1990s and so Ukraine has managed to cover growing demand without major investments in generation.

Given the depreciation of capital stock over the years, strong demand growth rates prior to the economic crisis and indications of higher demand for electricity of 10.2% in 2010 and 2.4% in 2011[2], it is less certain that Ukraine will have sufficient reserve capacity in the medium term to avoid significant capital investment in electricity supply assets. Whereas in 2006, the view was that capacity would be sufficient for another decade.[3]

Figure 10.1 **Final electricity demand**



Source: IEA statistics.

The industry share of electricity demand has been around 50% for many years which means that increases in demand will affect load factors more than peak levels, as the industrial demand profile is mostly base load while other sectors are driving mid-merit and peak load. Recent annual system peak loads are illustrated in Figure 10.2. (The spike in 2012 was due to extremely cold weather.) Over time, the load profile might change since structural shifts in the economy towards a higher share of services in gross domestic product (GDP) at the expense of industry are envisaged, which will mean faster growth in maximum loads and therefore in required capacity.

Power demand in the industrial sector is volatile because of the sector's exposure to uncertain external commodity markets. Ukraine's economy is quite open: exports contributed

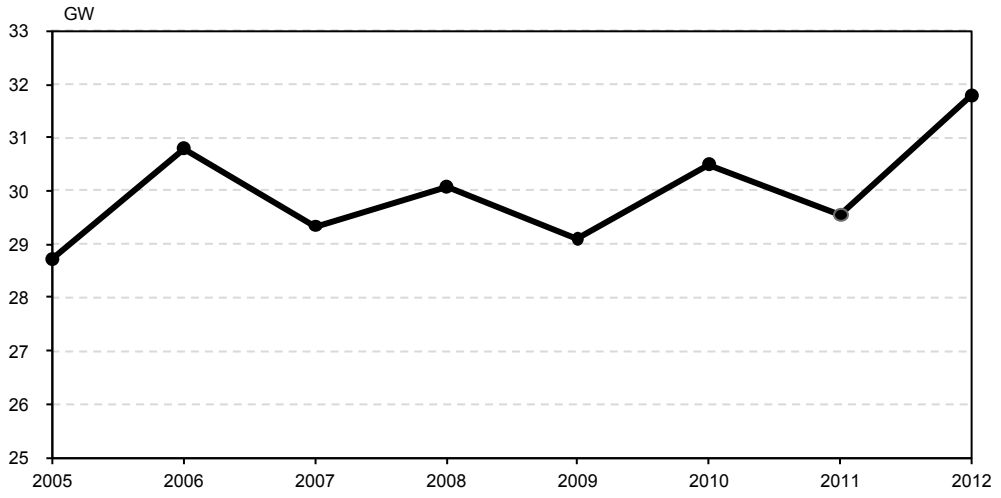
1. Some analyses consider generation minus net exports as a measure of demand for Ukraine, which gives a slower growth rate of around 2.5%. However, network losses have been reduced considerably over the years due to the government's targeted actions, which offset the very steep growth in final consumption. Since much has been achieved to reduce line losses, those savings cannot continue to counter-balance steep demand growth. Especially, given how quickly demand has grown in some sectors; for example, residential demand grew on average 7% per year between 2003 and 2010, according to National Electricity Regulation Commission (NERC) data.

2. *www.mpe.kmu.gov.ua/fuel/control/uk/publish/article?art_id=216629&cat_id=35081* (accessed 18 June 2012).

3. International Energy Agency (IEA) (2006), *Ukraine Energy Policy Review*, OECD/IEA, Paris.

more than 50% of GDP in 2010.[4] Because these exports are mainly commodities, (75% of exports are iron ore, steel, chemicals, agricultural and food products), Ukraine's GDP and electricity demand have fluctuated significantly driven by changes in commodities demand and prices.

Figure 10.2 **Annual maximum system load**



Source: Ukrenergo.

SUPPLY

The average age of Ukraine's thermal plant fleet is 47 years and there is a commonly used benchmark in the country for plant retirement called "physical wear-out age", which is set at 200 000 hours of operation. By this benchmark, the share of thermal units beyond retirement age increased from 64% in 2006 to 84% in 2010. However, the nominal design life is a conservative estimate and the real condition of plants depends on many factors; often plant life span can be extended by 50% to 100% in IEA countries.[5] Given the redundancy in the system, it is not clear how much capacity is mothballed and kept in "warm" reserve[6] but some studies estimate as low as 36 gigawatt (GW) of "working capacity" (which was 70% as of 2007). Nuclear plants are newer and were mainly built in the 1980s.

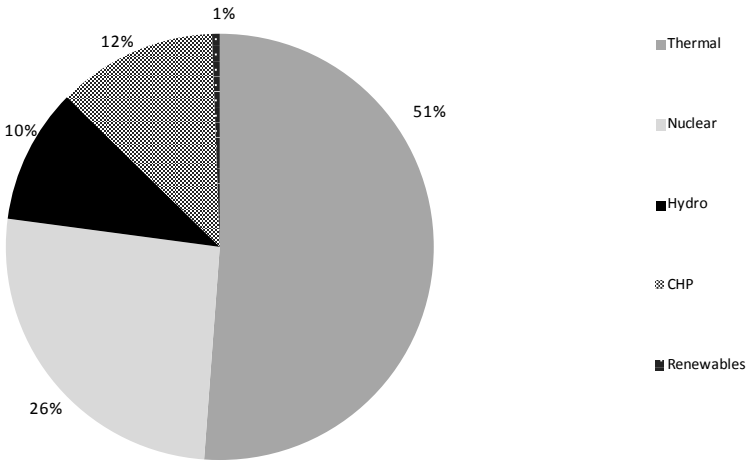
Due to sharp reductions in demand in the 1990s, there is still some spare generation capacity in the system (see Figure 10.7 for thermal plants). Thermal generation experienced the largest drop during the period while nuclear was still producing at a stable level. Moreover, two new blocks of 1 GW each were put into operation at Khmelnytsky and Rivne nuclear power plants in 2004.

4. Standard & Poor's (2012), *Ratings Direct: Ukraine*.

5. IEA Coal Research Centre, 2001, *Aging of Coal-fired Power Plants*, London.

6. World Bank (2008), *Ukraine Thermal Plants Rehabilitation: Assessment of Needs, Costs and Benefits Task 1*, World Bank, Washington DC.

Figure 10.3 **Installed generation capacity (53.3 GW), 2011**



Source: Ukrenergo.

Ukraine's generation capacity mix has changed since the IEA 2006 policy review mainly due to new hydropower and renewables assets. *Ukraine's Energy Strategy to 2030*, released in 2006, envisaged decommissioning of 4.1 GW of thermal capacity and refurbishment of 3.7 GW by 2010.

The power supply outlook for Ukraine is not certain as significant investments have not been forthcoming so far and the sector is in the middle of a restructuring; however, the major utility, DTEK, and the state-owned utility, Energy Company of Ukraine ECU, continue to invest in refurbishment of thermal plants. DTEK also has ambitious plans to construct new generation units valued at USD 12 billion by 2030.[7] As the financial situation of generators has improved with tariff increases in the years 2007-12, investment plans seem to have strengthened.[8] However, similar to the situation in the coal sector, the private sector is investing in plants that are already efficient or those that export to neighbouring countries, where large margins can be earned. Margins in electricity exports have increased since the government waived the cross-subsidy payment (dotatsionny sertifikat) for companies exporting electricity in 2012.[9]

PRICES AND TARIFFS

END-USER PRICES

Residential electricity prices in Ukraine remain low compared to OECD Europe, some of which import power from Ukraine, and on par with some other former Soviet Union neighbours such as Belarus and Russia (Figure 10.4). The government increased residential tariffs in 2006

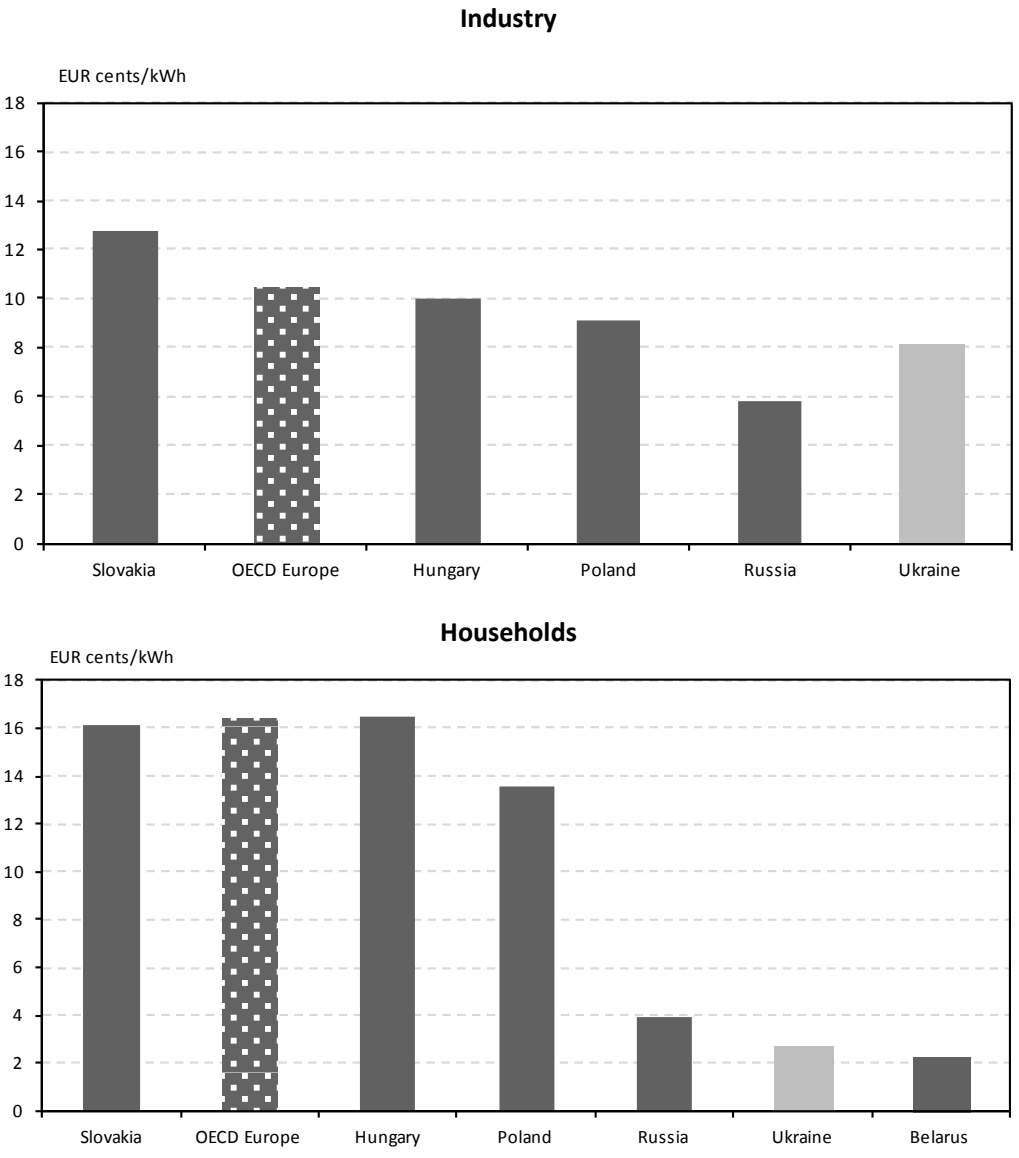
7. DTEK, 2011, *Looking to the Future*.

8. ECU presentation to the IEA 6 December 2011. DTEK's EBIDTA (Earnings before Interest, Taxes, Depreciation and Amortization) grew by 67% in 2011, *www.dtek.com/ru/media-centre/press releases/details/audirovannie-konsolidirovannie-finansovie-rezuljtati-dtek-v-2011-godu,* (accessed 2 July 2012).

9. *www.ua.ukrrudprom.ua/analytics/Ukraina_dotiruet_DTEK.html*, (accessed 15 May 2012).

and 2007, and in 2011; a parliamentary moratorium on price increases applied in the interim years. After the rate increase in 2006, the percentage of costs recovered by the residential tariff peaked at 60%, by 2011 it had fallen to 28%. The overall residential tariff increase over seven years is about 80%, below the consumer price index increase of 125% during the same period. The *Programme of Economic Reforms for 2010-2014* set mid-2012 as the deadline for removing cross-subsidies between rate classes, but implementation is delayed.

Figure 10.4 **End-user prices compared with neighbour countries, 2012**



Note: 2010 data for Russia.

Source: IEA statistics.

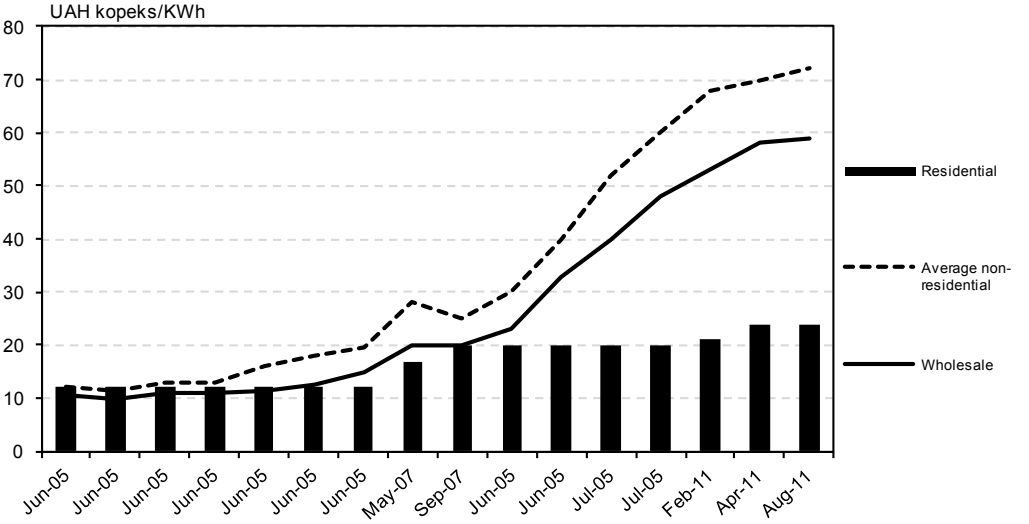
The low level of residential tariffs is maintained by cross-subsidies paid via the system of dotatsionny sertifikat, where higher tariffs are charged to industrial and commercial users. Tariffs are the same for the whole country, but the reform plan lists moving back

to region-specific pricing in its objectives. The National Commission for State Energy Regulation (NERC) is elaborating the rate structure; for example, in May 2012 it introduced tariffs for electric heating that vary by volume and season.[10]

Electricity prices for industrial users are significantly higher than for households, and are determined each month by NERC. Industrial consumers cross-subsidise residential users; the cross-subsidy is difficult to remove due to the high level of income inequality in Ukraine where a large proportion of the population cannot afford to pay significantly higher tariff for power while some privately-owned industries are very profitable and that could easily pay.[11] The cross-subsidy is estimated to be around USD 2.5 billion each year.[12] As a result, the tariff paid by the industry is 22% higher than it would pay if there were no cross-subsidy.[13]

Increasing coal prices have resulted in sharp increases in tariffs for industrial users and approach the average levels in the OECD Europe; if nuclear and hydro generators were not paid much lower prices compared to thermal plants – as they are now (Figure 10.5) – the price for industrial users would be even higher. Higher tariffs have already caused some serious problems for electricity-intensive industries.

Figure 10.5 **Wholesale electricity prices and tariffs**



Note: wholesale price includes transportation and other costs. 1 UAH kopek = 11.09 EUR cents in 2011.

Source: NKRE.

Customers have an option to pay tariffs varying by time of the day, with prices significantly lower in off-peak periods. However, new meters with technical capability to record time-varying load have to be installed at the expense of consumers. According to some accounts, the price of the meters are such that it makes it economical for small businesses to install them, but not for residential customers.

10.*www.kmu.gov.ua/control/uk/publish/article?art_id=245152998&cat_id=244277212*, (accessed 15 May 2012).

11. *www.data.worldbank.org/indicator/SI.POV.GINI/countries?display=graph,* (accessed 15 May 2012).

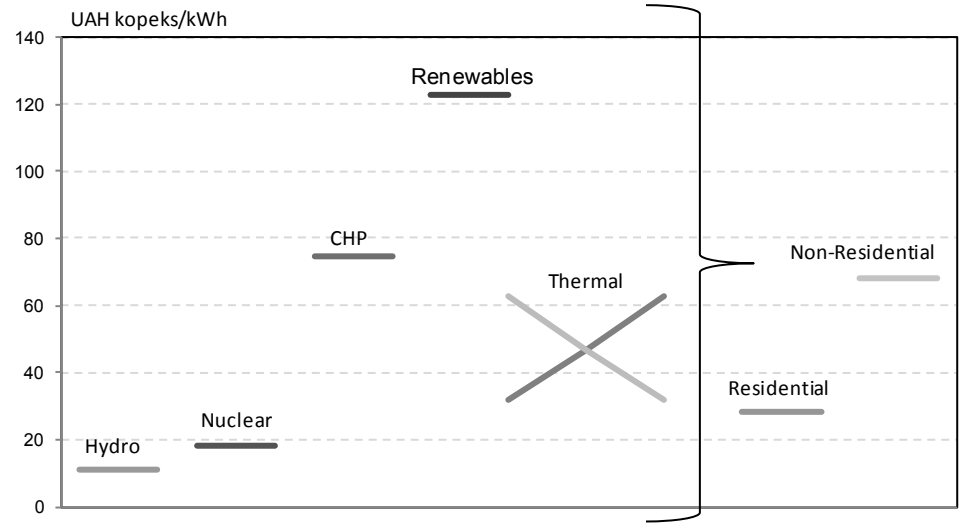
12. *www.zn.ua/ECONOMICS/tarifnye_tupiki_ukrainskoy_energetiki-87972.html*, (accessed 11 July 2012).

13. Interview with director of NKRE, *www.interfax.com.ua/rus/main/64403*, (accessed 11 July 2012).

WHOLESALE PRICES

The price formation mechanism in Ukraine is shown schematically in Figure 10.6, with prices as of February 2011. Hydro, nuclear, combined heat and power (CHP) and renewables generators are paid fixed prices set by NERC, while thermal plants compete for the residual demand in an energy-only market. NERC, however, sets a cap for the thermal marginal price and generators' bids are above the cap for some hours. NERC then calculates the weighted-average price, adds transportation and other costs (including the cross-subsidy) to arrive at the final price paid by non-residential customers. Prices paid to generators can also include an "investment component" for approved investment projects, which is decided by NERC. Generator bids are assessed by the market operator, Energorynok, as to whether they are in line with variable costs estimated by Energorynok.

Figure 10.6 **Prices paid to generators and end-user prices**



Note: prices as of February 2011.

Sources: NERC; Energorynok.

INDUSTRY STRUCTURE

Today, Ukraine's electricity sector is separated into generation, wholesale market, transmission system operation entities with the distribution and retail operations bundled together. The electricity sector has gone through several stages of reform: it was mostly unbundled and partially privatised in the 1990s; state-owned assets were consolidated in 2004; a further phase of privatisation and restructuring is underway in 2012. These activities are part of the *Programme of Economic Reforms for 2010-2014* that covers many sectors of the economy. The plan specifies that thermal generation and distribution/retail companies should be privatised by the end of 2012; so far this plan seems to be on course and large government-owned shares in generation and distribution companies had been sold by mid-2012.[14]

14. *www.president.gov.ua/docs/gr5.pdf,* (accessed 11 July 2012).

GENERATION

Generation capacity is located throughout the country and plants are connected to a unified electricity system. Most coal-fired plants are in the eastern region, where coal is mined and heavy industry is located, while nuclear units supply other regions. CHP plants were built to supply large residential areas and burn natural gas for environmental reasons. Ukraine is well endowed with hydro resources, mainly along the large Dnieper and Dniester rivers. There is potential for developing wind and solar photovoltaic generation in the southern Ukraine.

Nuclear units constitute 26% of installed capacity. Nuclear operates at much higher utilisation rates than thermal plants and generates about 47% of electricity in Ukraine. Most of the nuclear units were built in the 1980s, have been fully capitalised and thus are currently the lowest cost source of electricity in Ukraine. Given the difficulties associated with other sources of electricity, *i.e.* expensive imported natural gas and domestic coal resources that are difficult and expensive to mine but socially difficult to stop, Ukraine heavily depends on existing nuclear plants and options for future expansion. Nuclear plants are running close to their maximum capacity factors and so demand increases will have to be supplied largely by thermal generation. Longer term, two additional 1 GW units are planned at the Khmelnitskiy nuclear power plant to be built and financed by Russia's Atomstroyexport and Sberbank (completion dates are not specified by the Ukrainian nuclear operator Energoatom).

All nuclear plants are operated by the state-owned entity, Energoatom, although the economic reform plan prescribes corporatisation of Energoatom (turning into a state-owned corporation) by the end of 2012. If this leads to a future privatisation of Energoatom, coupled with moving to marginal pricing as a result of further liberalisation, the nuclear plants can become very profitable as electricity prices will increase, even if cross-subsidies for residential customers are removed. In a similar situation in France, concerns about raising prices paid to nuclear generators appear as the government strives to increase competition in the wholesale market in accordance with EU legislation while avoiding sharp price rises for end users.[15]

There are several large run-of-the-river and pumped storage hydropower stations along the Dnieper and the Dniester rivers. This hydropower capacity of 5.6 GW (about 10% of total installed capacity) has played an important role in the operation of the electricity system because of the lack of flexibility in old thermal plants.[16] In order to manage demand peaks and frequency control, a project funded by the World Bank carried out modernisation of six hydro plants and installation of a new control system. However, fixed prices paid to hydro generators do not provide an incentive for them to fully utilise their flexibility.[17] There is a USD 600 million hydropower plant refurbishment project underway, which is sponsored by various international bodies and is due to be finished by 2017. All the hydro plants belong to the joint-stock company, Ukrhydroenergo, with 100% of the shares owned by the state (via the Ministry of Energy and Coal Industry). To date, there are no plans for its privatisation.

15. *www.developpement-durable.gouv.fr/IMG/pdf/9-04-16_Rapport_Champsaur.pdf* (accessed 11 July 2012).

16. IMEPower (2008), *Ukraine Thermal Power Stations Rehabilitation: Assessment of Needs, Costs and Benefits*.

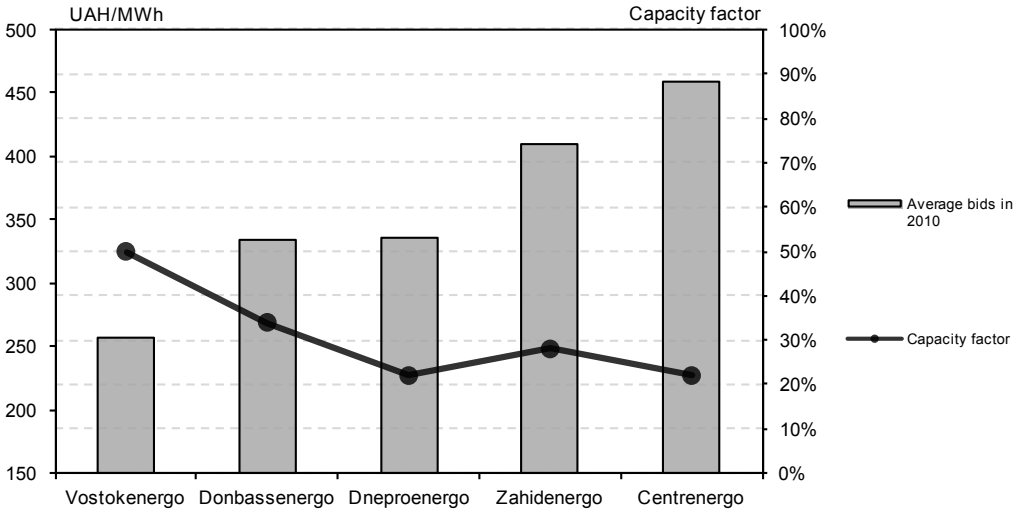
17. Batalov, Denisevich, Olefir, *Prospects for creating and development of balancing and auxiliary markets in Ukraine*. (Баталов А.Г., Денисевич К.Б., Олефір Д.О. Перспективи створення і розвитку балансуючого ринку та ринку допоміжних послуг в ОЕС України.)

Ownership of CHP plants in Ukraine is diversified; there are many plants already operated by private companies and a few are privately owned (often privatised after bankruptcy). In April 2012, the president ratified an amendment to the law which regulates privatisation of state assets, authorising the privatisation of 13 additional CHP plants; some of these plants are already operated by private firms.[18]

Total installed capacity of the thermal generators is 27 GW and the companies' assets range from 2.7 GW to 8.2 GW (see Chapter 9 for more details). Importantly, about 5.4 GW of this capacity burns gas or oil and has been conserved for use in times of extreme peak demand. Thermal power plants in Ukraine have been grouped to form five regional companies, (although Centrenergo has one plant in Uglegorsk in the east) (Figure 10.8). Most of the thermal plants burn coal.

Most of the spare generation capacity in Ukraine is thermal, which has to compete in the wholesale market. For illustration, during the cold spell across Europe in February 2012, the power load in Ukraine reached the historic maximum of 31.7 GW, but only 14 GW of this was covered by thermal plants (about 50% of nominal thermal capacity).[19] Large spare capacity in a market with a sufficient number of participants should lead to tight competition for dispatch and to lower submitted bids.

Figure 10.7 **Prices paid to generators and capacity factors**



Sources: Energorynok; company reports.

Yet, the following analysis of utilisation rates and generator-submitted prices shows that regulators must stay vigilant in monitoring possible abuse of market power. Although there is still a lot of spare thermal capacity (some of which might be more efficient than what is being dispatched), the price in 2010 was set by a generator producing at much higher prices than others (the average price in 2010 was 448 Ukrainian hrynia (UAH) per

18. *www.zakon2.rada.gov.ua/laws/show/4649-17* (accessed 14 May 2012).

19. Ukrenergo News Report, 12 March 2012, "Фактичний баланс потужності максимуму електроспоживання лютого 2012 р", 12/3/2012).

megawatt-hour (MWh) (Figure 10.7). Although more efficient thermal units are probably more flexible and might be required by the system operator to cover mid-merit load (instead of operating in base load), which can limit their utilisation rate.

Reform is planned for the current wholesale market: in 2012 a proposal for changes in the market design was submitted to the parliament by a member of the parliament. Given this on-going wholesale market reform and emerging competitive market structure, Ukrainian policy-makers should be concerned that the current privatisation of thermal plants may be concentrating ownership in very few companies and may not lead to the necessary investments and efficiency improvements. This already seems to be happening based on the available auction results (Figure 10.8 shows the current ownership shares following the recent privatisation). Also, if private owners increase efficiency and reduce costs, the benefits can disproportionately flow to generators.[20] Guaranteeing sufficient investment in generation capacity is often challenging even in countries with stable economic and political climate. Thus, privatisation needs to develop hand-in-hand with increased competitiveness and effective regulation, or, for a transition period, with legally binding investment contracts.

TRANSMISSION NETWORKS

Ukraine's electricity network is fully integrated with the exception of Burshtyn Island in the western part of the country, which is synchronised with Central European grids. The island facilitates direct exports to Slovakia, Hungary and Romania, while the rest of the system is interconnected with other neighbours in the region. The length of the transmission network of 220 kV to 750 kV lines is approximately 20 600 kilometres (km), while distribution networks are 1 184 600 km in length.

State-owned Ukrenergo owns and operates the transmission network including interconnections with neighbouring countries. The company maintains and invests in new capacity, including interconnections, and investment costs are included in the transportation tariffs set by NERC. Ukrenergo also provides technical and information support to the wholesale market operator Energorynok.

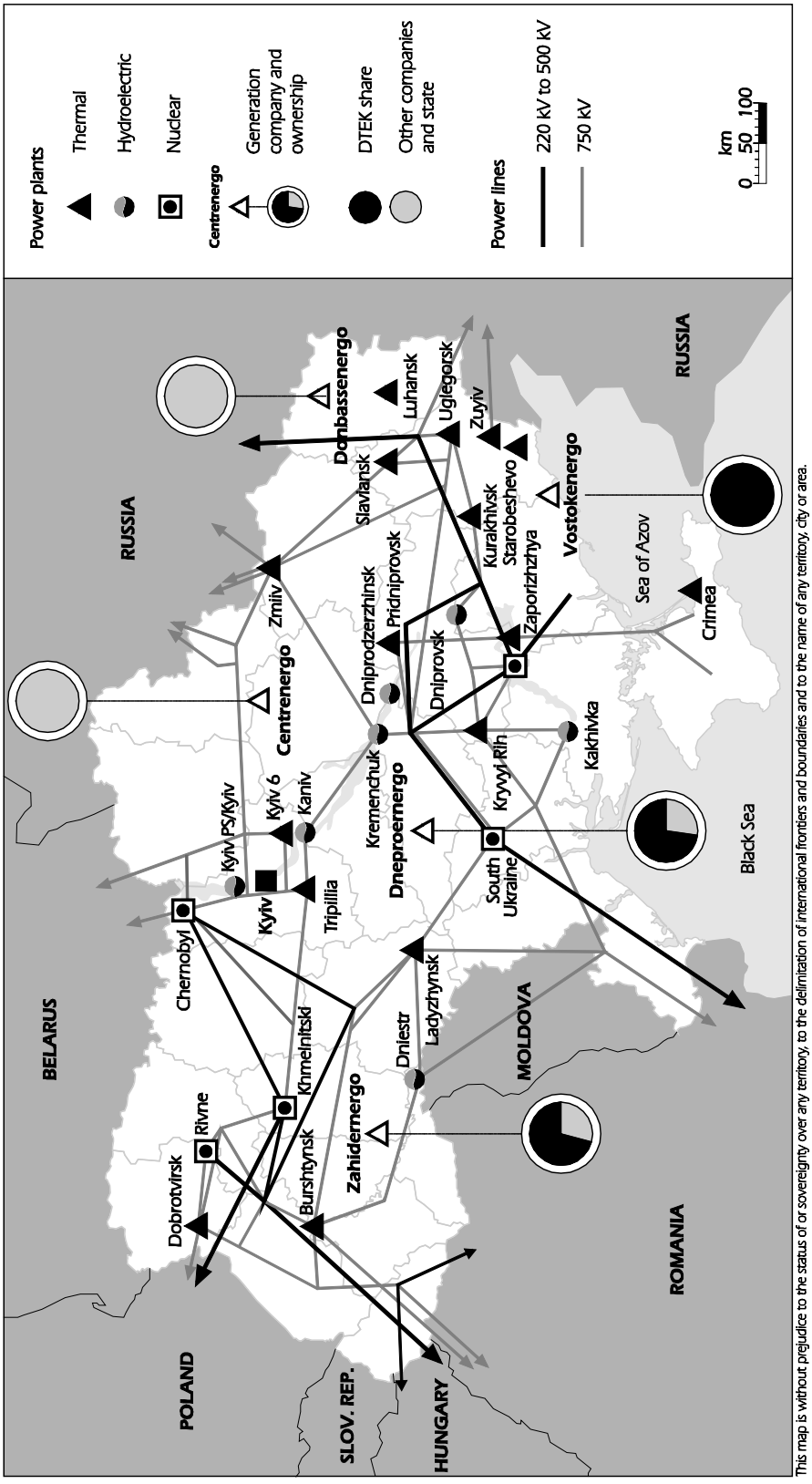
DISTRIBUTION NETWORKS

In 1995 regional distribution and retail companies (oblenergos) were created, one for each administrative region. Since then there have been a few waves of privatisation and today several oblenergos are privately owned, some by foreign investors (with guaranteed rate of return of 15%).[21] The *Programme of Economic Reforms for 2010-2014* entails privatisation of many state-owned enterprises. It lists state shares in eleven oblenergos to be sold in 2012.

20. Fichtner, (2008), *Ukrainian Power Sector Property Reform Study*, IMEPower, EMG.

21. *www.expert.ua/articles/16/0/5086/* (accessed 7 July 2012).

Figure 10.8 **Power lines, thermal generation company location and ownership**



Source: reports by electricity generation companies.

MARKET DESIGN, COMPETITION AND REGULATION

REGULATORY FRAMEWORK

Electricity sector reform began in the mid-1990s when the system was unbundled and a wholesale market was created. For several years after the reform there was not much pressure to take further steps as demand was declining, major fuels for nuclear, natural gas and coal plants were relatively cheap, and capital stock was only starting to suffer from underinvestment. There was also a serious issue of non-payment by wholesale market participants which persists to a lesser extent today (97% of billed sums paid for in 2011; the largest non-paying customer in 2011 was Regionalni elektrychni merezhi, a state-owned company which distributed electricity to coal mines).[22] As demand and fuel prices increased in the 2000s along with aging generation and grid assets, the reform intensified, facilitated by political consolidation in the last few years.

The energy and electricity sectors feature prominently in the *Programme of Economic Reforms for 2010-2014*. It lists clear deliverables with specific deadlines and is updated annually with national action plans for the year.

The main body regulating the sector is the National Commission for State Energy Regulation (NERC) which sets tariffs and calculates prices paid to parties in the wholesale market. The Anti-Monopoly Committee monitors levels of competitiveness and is supposed to prevent excessive concentration of market power.

WHOLESALE MARKET

The wholesale market was created in 1996 and is operated by Energorynok, a state-owned company. Energorynok acts as a single buyer of electricity from all generators and settles payments. Prices and tariffs are calculated and set by NKRE.

In order to attract much needed investment to modernise generation and resolve the chronic non-payment issue, transition to a new market model was initiated by a Cabinet of Ministers decree in 2002.[23] The decree outlined a new market design, which emphasised bilateral contracts as the main means of increasing competitiveness. Moving to the new model required changes in legislation, but it was not until 2009 that the Cabinet submitted a proposal to the parliament, which was returned for further development.[24] In line with the National Action Plan for 2012, a proposal for a new law governing the wholesale market was submitted to the parliament in June 2012.

The current wholesale price formation mechanism is based on the weighted-average price of generation calculated from the competitive marginal price of thermal plants and feed-in tariffs of the other technologies (Figure 10.7). Prices for industrial consumers have reached the level at which they can undermine industry competitiveness while there is room to increase residential tariffs.

The main source of sub-optimal economic efficiency in Ukraine's electricity sector appears to be very old and inefficient capital stock rather than monopolistic behaviour of

22. Energorynok (2011), Annual Report.

23. Decree No. 1789, 2002.

24. Decree proposal No. 5292.

utilities driving prices up. This is in contrast with the situation prior to electricity market restructuring in some IEA member countries where the sector was dominated by vertically integrated monopolies and introducing competition was the main tool for reducing end-user prices. Consequently, recognising the diversity of electricity market designs around the world, Ukrainian policy makers should select approaches and policies tailored to deliver objectives most relevant for Ukraine. A possible approach is to evaluate market design options by allocating points to each based on relevant criteria.[25] Some designs can incentivise quicker investments (although in Russia, the regulator had to resort to contractual investment obligations during privatisation) while sufficiently competitive markets can keep prices down. Lack of investment from private capacity owners has been experienced in a few countries so this possible consequence should be considered by Ukrainian policy makers.

The proposed market design emphasises bilateral contracts in the wholesale market, which are implied to be long term judging from the expected security of demand they would provide, and thus would facilitate investments in generation capacity. Bilateral contracts are a common practice in European electricity markets, but they can be viewed as a tool for "stable revenues" only if they set prices over a long-term period. This important distinction should be carefully considered in discussions about the new wholesale market design in Ukraine. Since it is moving towards integration with European electricity markets, Ukraine needs to take into consideration the trend in EU legislation towards phasing out long-term contracts.[26] An illustrative example is long-term contracts between Hungary's MVM and power suppliers which were ruled illegal by the European Commission.[27] Another important consideration for Ukraine's market design is that often bilateral contracts are indexed to spot and forward prices and this does not guarantee stable revenues.

NETWORK REGULATION

Adopted in 2006, the current methodology for setting tariffs for transmission and distribution networks is cost plus, which includes investment and cost of capital components. NERC is moving to incentive-based regulation which will be facilitated by amendments to the law on natural monopolies. The changes have been approved by the parliament in 2012 and include efficiency indicators, regulated rate of return and quality indicators.

At the retail level, customers officially have a choice of supplier. There are examples of large enterprises switching providers. There are also instances of oblenergos hampering third-party access to the networks.[28]

TRADE

A portion of Ukraine's electricity system is synchronised with eastern European countries, which dates back to when electricity trade was arranged via the "Council of Mutual Economic Assistance". Exports to Poland are carried via a direct line from the

25. Poyry (2010), *Southeast Europe Wholesale Market Opening*.

26. Hauteclocque, A. (2009), *Long-term Supply Contracts in European Decentralized Electricity Markets: An Antitrust Perspective*, Ph.D. thesis, University of Manchester.

27. IEA (2011)*, Energy Policies of IEA Countries – Hungary*, OECD/IEA, Paris.

28. *www.expert.ua/articles/16/0/5086/(accessed on 12 July 2012).*

Dobrotvorskaya thermal power plant. Also, there are plans to refurbish and restart another line from the Khmelnitskaya nuclear power plant. The Burshtynskaya thermal power plant supplies electricity to Slovakia, Hungary and Romania (total connection capacity about 500 MW), as well as for local power customers, but is not connected to the rest of Ukraine. Both the Dobrotvorskaya and Burshtynskaya power stations, the only plants that can export electricity, belong to Zahidenergo where DTEK is a majority shareholder. As part of the Energy Community framework, there is a plan for the whole of Ukraine to be synchronised with the European Network of Transmission System Operators for Electricity (ENTSO-E) within the next seven years. This is a positive development since enlarging markets improves security of supply and can open up more business opportunities for Ukraine given the spare capacity it has.

Ukraine's electricity system is well connected to Russia, Belarus and Moldova. Total exports were 6.4 TWh in 2011 with the largest amount, 2.5 TWh, going to Belarus. Exports to Russia are negligible, but the connectivity is useful for emergencies such as in February 2012, when the power line connecting Ukraine's Zaporozhskaya nuclear power plant failed during a period of extreme peak demand.

Export of electricity is an area of increasing business activity and revenues are significant. After DTEK, the major utility, acquired the majority stake in Zahidenergo, a regional thermal generating company, it announced a large investment programme into generation assets and signed a contracts for deliveries with European power companies.[29] Access to export power lines is distributed via auctions and DTEK has won all of them and became the only exporter of electricity; the company has also received a waiver from paying the cross-subsidy (dotatsionny sertifikat) on electricity bought for export.

CRITIQUE

Ukraine has made good progress in unbundling the electricity sector and stabilising the situation with non-payments. Experience in IEA member countries shows that liberalisation can be followed by consolidation of assets which can undermine competitiveness of the market. Merger and acquisition activity can intensify. Recent privatisations of the thermal plants resulted in one company controlling three large generating companies with total capacity amounting to 46% of the competitive segment of the market, which raises concerns about possible market power concentration and questions about the role of the Anti-Monopoly Committee. It is critical that the regulator and the Anti-Monopoly Committee are fully independent and stay vigilant. A variety of tools are available to ensure higher levels of competition in the market (divestment, virtual plants).

The IEA commends the on-going projects to refurbish hydropower plants as it increases energy independence and hydropower's low variable costs make its long-term economics favourable. Pumped storage hydro is also very flexible and can help meet peak demand, but the generators do not currently have incentives to provide such flexibility because of the fixed tariff system. Introducing balancing and auxiliary markets with full participation of hydro plants can incentivise them to fully utilise the much needed flexibility pumped hydro generation.

29. DTEK, Press Release, 28 December 2011.

Enlarging interconnected areas can increase security of supply. So the project to synchronise the whole of Ukraine (rather than just the current "island" in the western part of country) is a positive development.

The wholesale market reform has been in the pipeline for a long time and its pace is now accelerating. The proposed market design is more complex than the existing model and evidence suggests that the lead time and administrative costs of such changes are significant, so long-term objectives (including meeting Energy Community obligations) should be taken fully into account when deciding on the detailed elements of design. For example, the much emphasised bilateral contracts in the new design, which are implied to be long term, are supposed to bring long-term stability of revenues to facilitate investments; however this could become an issue with EU competition laws in the near future if Ukraine continues integration with European energy markets. Generally, studies show that different countries have adopted very different approaches to liberalisation of the electricity sector, so Ukraine should weigh all the factors carefully (including setting clear strategic goals for the electricity sector) and not rely on one prescribed solution. Strategic goals for the electricity sector depend on broader economic goals and can vary from reducing end user prices to rapidly bringing online a lot of new capacity.

Ukraine's policy makers should examine the experience of a broader number of countries with liberalised power markets in order to devise a wholesale market design suitable for Ukraine. For instance, it can be instructive to study the ongoing reform in the United Kingdom where "contracts for difference" are to be introduced to secure investment; a number of IEA countries are also introducing capacity markets which are supposed to cover investments costs; Russia's electricity sector reformers used another mechanism, so called DPM, obliging owners of privatised assets to invest in construction of new capacity.

The *Programme of Economic Reforms for 2010-2014* addresses all areas of the electricity system from generation to retail. As Ukraine's power system already is unbundled, changes in individual components could proceed at different paces. For example, effects of increased competition in the wholesale market might not be felt by end-users if retail tariffs are fixed; or if generation assets are privatised but the regulator in charge of market monitoring and concentration is still weak. Thus Ukraine's policy makers are advised to take a structured approach to conducting electricity sector reform and ensure that changes in different activities of the electricity system are co-ordinated so that their effect can be passed on through the value chain.

Residential tariffs are quite low and are heavily subsidised by the industry sector. Energy poverty is a legitimate concern given the wide income disparities in Ukraine. There are tested approaches that can facilitate a transition to cost-reflective levels for electricity prices without undermining the welfare of low income groups. However, maintaining prices at level below marginal cost is not sustainable and does not attract the investment needed to modernise and replace the aging fleet of power plants. At the same time, electricity tariffs for industry have already reached a level close to western European countries while the power system needs investment, which will thus bring even higher tariffs.

Seeing that the current prices for industrial users already negatively affect their profitability, network tariffs cannot be increased significantly. Thus, now that a large privatisation of the remainder of state-owned distribution companies is progressing, it is becoming of utmost importance to streamline network regulations in order to both facilitate investment and minimise price increases, which is more challenging with older

methodologies. Ukraine should benefit from the latest developments in regulation methods which aim to both incentivise cost reductions and pass on the benefits to end-users. Two examples are particularly worth considering for Ukraine's policy makers and regulators: a recently introduced RIIO methodology in the United Kingdom; and statistical methods used for benchmarking network cost efficiency in Germany.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Take strong steps to safeguard and preserve the independence of the relevant regulatory agencies and make sure they are adequately resourced.*
- ☐ *Further develop hydropower potential, which would improve energy independence and increase much needed flexible generation capacity.*
- ☐ *Ensure the timely implementation of the feasibility study on the synchronous interconnection of the Ukrainian and Moldovan power system to the ENTSO-E Continental Europe power system.*
- ☐ *Eliminate cross-subsidies in end-user electricity tariffs and adjust residential electricity tariffs to cost-reflective levels. These increases should be balanced with targeted social protection measures.*
- ☐ *Develop and implement a wholesale market model appropriate for achieving the strategic goals of the power sector and the economy as a whole.*
- ☐ *Implement the electricity system reforms in a comprehensive manner that respects the interdependencies in the sector.*
- ☐ *Take the necessary measures to enable NERC to introduce incentive-based tariff methodology for distribution and transmission networks, which can deliver required investments in modernisation and cost reductions.*
- ☐ *Evaluate the required initiatives and necessary funding for implementing the electricity system provisions of the Energy Community; identify possible sources of financing (market-based, subsidies or external); and set realistic targets for delivery.*

11. NUCLEAR ENERGY

Key data (2011)

Share of electricity supply: 47%

Number of plants and units: 4 nuclear plants and 15 reactor units (all Russian pressurised water reactors)

Net nuclear capacity: 13.1 GW, 28% of installed electrical capacity

Domestic uranium production: meets 30% of uranium requirements

OVERVIEW

Nuclear energy plays a major role in energy policy and power generation in Ukraine. It provides about half of the country's electricity production (47% in 2010) and additional capacity is planned to maintain that share until 2030. Ukraine's current reactors are all Russian pressurised water reactors (VVER) with a design life of thirty years. The two oldest ones have recently received a licence to operate for an additional twenty years.

The key elements of Ukraine's nuclear energy programme are to: implement safety upgrades to ensure operation in compliance with the highest international safety standards, taking into account the lessons learned from the Fukushima Daiichi nuclear accident in Japan; provide for long-term operation of existing reactors beyond their original design life; and construct new capacity to address anticipated electricity needs. Other important elements of the country's nuclear programme include: the construction of a new dry storage facility for spent fuel; decommissioning of Units 1, 2 and 3 of the Chernobyl Nuclear Power Plant (all RBMK reactors which are Russian designed graphite-moderated light water-cooled reactors); and construction of the New Safe Confinement (NSC) to replace the existing sarcophagus over the partially destroyed Chernobyl Unit 4.

LEGAL AND INSTITUTIONAL FRAMEWORK

Legislation covering the use of nuclear energy and application of international treaties is fairly comprehensive in Ukraine. Established in 1995, the basic law, Nuclear Energy Use and Radiation Safety, is complemented with laws related to:

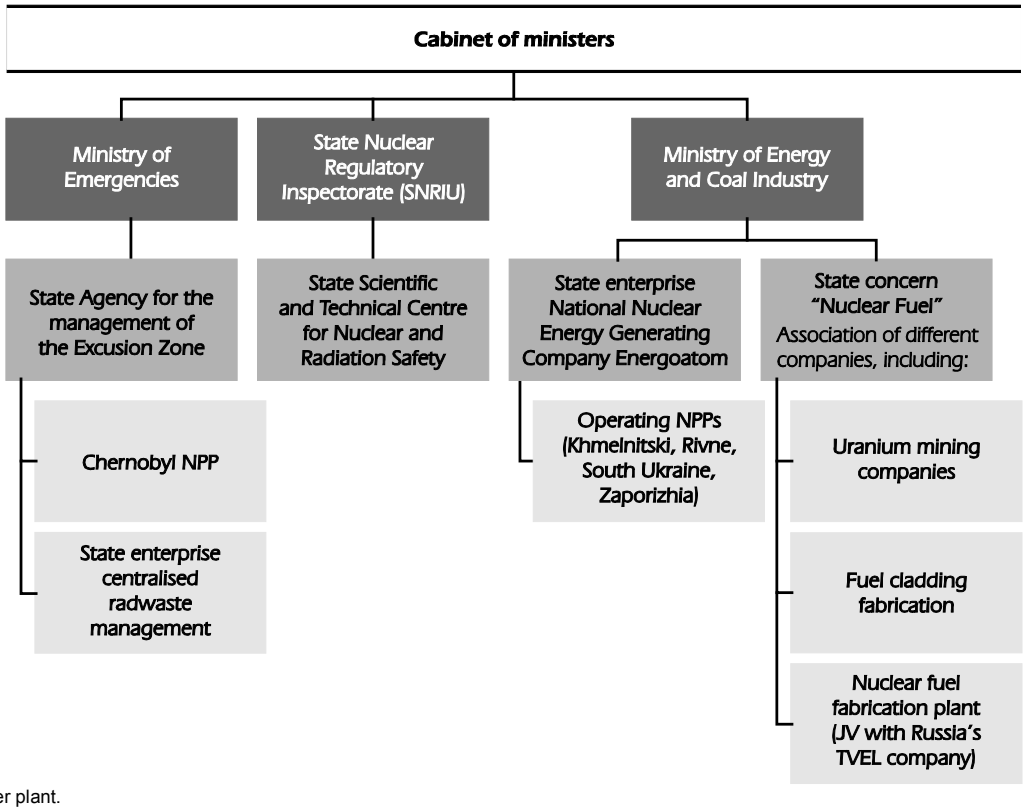
- radioactive waste management;
- regulation of nuclear safety (the corresponding law also established a decommissioning fund);
- permitting (including licensing);
- nuclear energy use and radiation safety;
- the procedure for siting, design and construction decisions for nuclear installations and radioactive waste management facilities;

- the national target environmental programme for radioactive waste management;
- the physical protection of the population from exposure to ionising radiation;
- the physical protection of nuclear facilities and nuclear materials, radioactive waste and other source of ionising radiation; and
- the establishment of a State Fund for Radioactive Waste Management.

The international treaties to which Ukraine is party include:

- Treaty on the Non-proliferation of Nuclear Weapons;
- the Vienna Convention on Civil Liability for Nuclear Damage;
- the Convention on Early Notification of a Nuclear Accident;
- the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
- the Convention on Nuclear Safety;
- the Joint Convention on the Safety of Spent Fuel Management and Safety of Radioactive Waste Management;
- the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (known as the Aarhus Convention); and
- the Convention on Environmental Impact Assessment in a Transboundary Context (known as the Espoo Convention).

Figure 11.1 **Nuclear energy governance structure**



Note: NPP = nuclear power plant.
Source: IEA.

The State Nuclear Regulatory Committee (SNRC) of Ukraine was established in 2000 as an independent government regulatory authority. It was renamed the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) in 2010. This body has regulatory responsibility for: the operation of nuclear power plants and two research reactors; decommissioning of the Chernobyl Nuclear Power Plant (Units 1 to 3) and the construction of the New Safe Confinement over Unit 4; two spent fuel storage facilities and one under construction at Chernobyl; radioactive waste storage facilities; uranium mining enterprises; radioactive material transportation; and production and use of ionising radiation sources. The SNRIU is also addressing the need to inform the public about the safety of the country's nuclear installations through information disseminated on its website and public consultation meetings.

Figure 11.1 illustrates the institutions with management and regulatory oversight of nuclear energy activities. Energoatom, the state-owned utility that operates the country's VVER reactors, is controlled by the Ministry of Energy and Coal Industry as are the nuclear fuel and uranium mining companies which are associated within the State Concern "Nuclear Fuel". Decommissioning of the RBMK reactors, management of the confinement of Unit 4 at Chernobyl and nuclear waste activities are under the responsibility of the State agency for the management of the Chernobyl Exclusion Zone. The regulator, SNRIU, reports directly to the Cabinet of Ministers and to the president. Its head is appointed by the President.

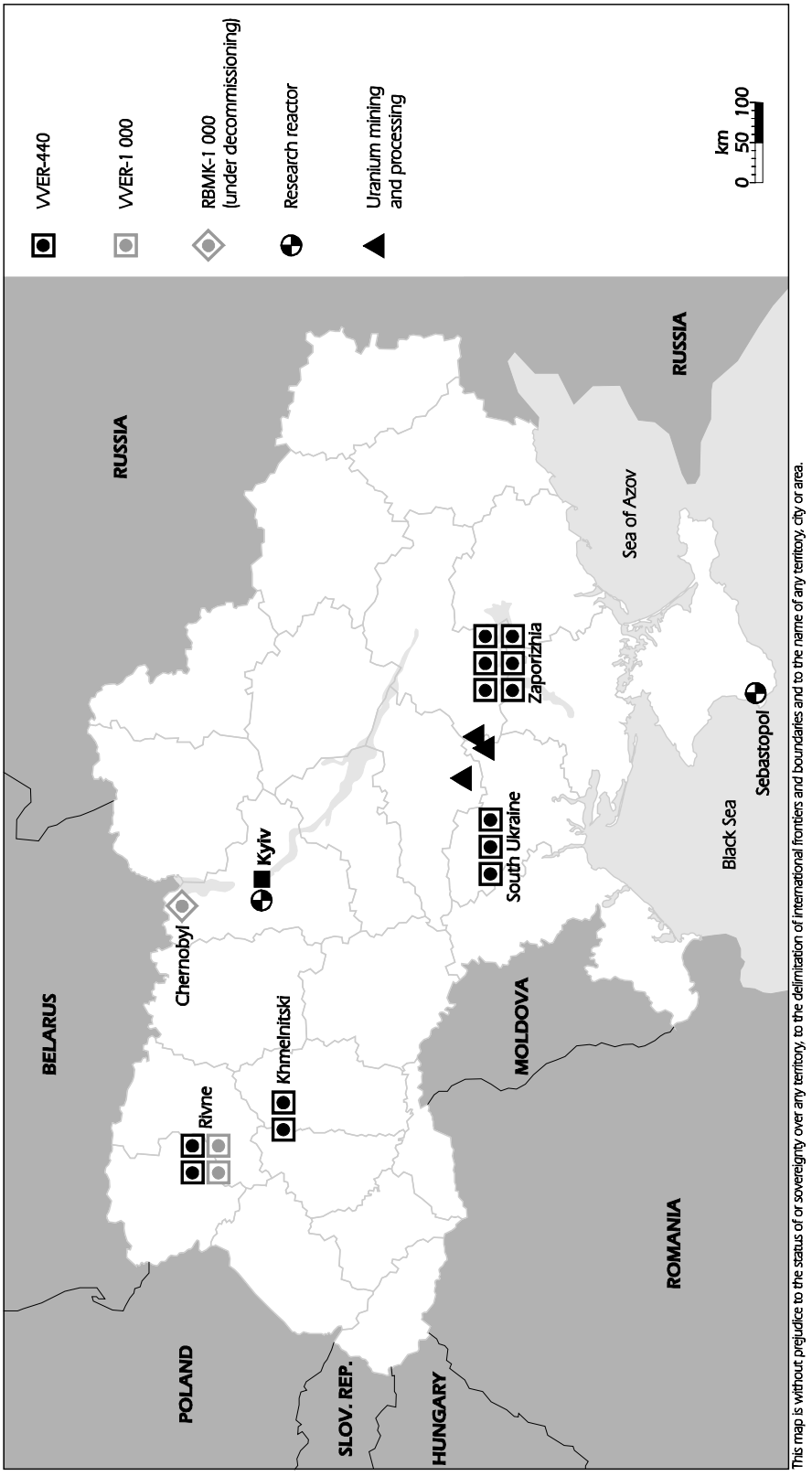
URANIUM PRODUCTION AND FUEL CYCLE

In 2009, Ukraine produced 30% of its uranium requirements. It plans to increase domestic production to cover 100% of its needs by 2020. Uranium reserves are believed to be sufficient to fuel the country's nuclear power sector for about 100 years.

VostGOK, a state enterprise, is the only domestic producer of uranium ore concentrates. Ukraine does not carry out uranium conversion or enrichment (which are performed in Russia), nor does it fabricate fuel for its reactors. It currently receives most of its nuclear fuel services from Russia's TVEL Company, at an annual cost of about USD 300 million. Ukraine has taken a 10% share of the International Uranium Enrichment Centre (which is controlled by the Russian Federation State Corporation Rosatom). This share gives Ukraine a quota on uranium enrichment activities.

In 2010, an agreement was signed to set up a joint venture between Russia's TVEL Company and Ukraine's "Nuclear Fuel" Concern (State business association) to establish a fuel fabrication facility. This agreement foresees a loan from Russia to cover 60% of project costs, technology transfer to Ukraine by 2020 and majority control by Ukraine. The objective is for Ukraine to produce the all of the fuel for the VVER-1 000 reactor fleet by 2021. The construction of the fuel fabrication facility is scheduled to start in 2012. The cost of the construction is estimated at around USD 300 million.

Figure 11.2 **Nuclear installations in Ukraine**



Source: Ukraine State Nuclear Regulatory Inspectorate, 2010.

NUCLEAR CAPACITY

EXISTING REACTORS

Today, nuclear energy provides about 47% of Ukraine's electricity production. Nuclear power figures significantly in the government's draft *Updated Energy Strategy of Ukraine to 2030* (2012) which assumes that the share of nuclear electricity will be maintained between 45% and 48% in all of the economic development scenarios considered.[1] The rationale for this policy is increased energy security and the availability of domestic uranium resources.

Net nuclear capacity today is 13.1 gigawatts (GW) (13.8 GW gross capacity), 28% of Ukraine's installed electrical capacity. There are fifteen Russian designed VVER reactors in four nuclear power plants: two 440 megawatt (MW) V-213 models; thirteen 1 000 MW units of which eleven are V-320 models and two are older models V-302 and V-338 (Figure 11.2 and Table 11.1). Zaporizhia is Europe's largest nuclear power plant with a net capacity of 5.7 GW (6 GW gross). All of Ukraine's operating nuclear plants are owned and operated by Energoatom, which also operates small hydro and pumped-storage power plants used for load following. Ukraine's power system is characterised by a lack of load balancing capabilities: base load coal power plants are used for load balancing. There is also insufficient transmission capacity which limits the output of some of the plants. Long-term operation of the existing reactors is a cornerstone of the nuclear energy programme. Most reactors will have reached their original design life by 2020. Rivne Units 1 and 2 have already received a licence to operate for an additional twenty years with a mandatory safety reassessment after ten years.

PLANNED NUCLEAR CAPACITY

In June 2010, Ukraine and Russia signed a bilateral agreement to complete the construction of two additional units of 1 000 MW capacity each, Khmelnitski 3 and 4, which were started in 1985 and 1986. The cost is estimated at UAH 42 billion (USD 5.2 billion). Financing will be a loan from Russia for 85% of project costs and 15% from Ukraine, though final agreement has not yet been reached. Bids were invited from a variety of international companies in 2008. Only Russian and Korean companies submitted offers. Russia's Atomstroyexport was chosen. These units are expected to be connected to the grid in 2018 and 2020 (Table 11.1).

Beyond the capacity represented by these two reactors currently under construction, between 3 GW and 5 GW of new capacity, built at new sites, are foreseen depending on the evolution of electricity demand. Investment costs range between UAH 96 billion and UAH 160 billion (between USD 12 billion and USD 20 billion).

Contrary to the 2006 version of the energy strategy that emphasised the potential to increase electricity exports to neighbouring countries, the 2012 update states that the planned electricity generation expansion mainly addresses domestic needs, in particular for the industry and service sectors. The decision to build new nuclear units will be made between 2015 and 2018. The search for new sites is underway and a preliminary list of more than 30 potential sites has been established. Energoatom has indicated that it

1. Government of Ukraine (2012), draft *Updated Energy Strategy of Ukraine for the Period till 2030*, June 2012, Kiev.

would select a standard Generation III/III+ design from a competitive tender among international vendors. A high share of the supply chain is expected to be allocated to Ukrainian industry.

Table 11.1 **Nuclear reactors: operational and under construction**

Unit	Current status	Model	Net capacity (MW)	Gross capacity (MW)	Start of construction	Grid connection (licence until)
Khmelnitski-1	Operational	VVER-1 000	950	1 000	1981	1987 (2017)
Khmelnitski-2	Operational	VVER-1 000	950	1 000	1985	2004 (2034)
Rivne-1	Operational	VVER-440	381	420	1973	1980 (2010)*
Rivne-2	Operational	VVER-440	376	415	1973	1981 (2011)*
Rivne-3	Operational	VVER-1 000	950	1 000	1980	1986 (2016)
Rivne-4	Operational	VVER-1 000	950	1 000	1986	2004 (2034)
South Ukraine-1	Operational	VVER-1 000	950	1 000	1977	1982 (2012)
South Ukraine-2	Operational	VVER-1 000	950	1 000	1979	1985 (2015)
South Ukraine-3	Operational	VVER-1 000	950	1 000	1985	1989 (2019)
Zaporizhia-1	Operational	VVER-1 000	950	1 000	1980	1984 (2014)
Zaporizhia-2	Operational	VVER-1 000	950	1 000	1981	1985 (2015)
Zaporizhia-3	Operational	VVER-1 000	950	1 000	1982	1986 (2016)
Zaporizhia-4	Operational	VVER-1 000	950	1 000	1983	1987 (2017)
Zaporizhia-5	Operational	VVER-1 000	950	1 000	1985	1989 (2019)
Zaporizhia-6	Operational	VVER-1 000	950	1 000	1986	1995 (2025)
Capacity in operation			13 107	13 835		
Khmelnitski-3	Under construction	VVER-1 000	950	1 000	1986	2018 (planned)
Khmelnitski-4	Under construction	VVER-1 000	950	1 000	1987	2020 (planned)
Capacity under construction			1 900	2 000		

Note: VVER = Vodo-Vodyanoi Energetichesky Reactor – Russian designed pressurised water reactor.

* Licence to operate until 2030 issued in December 2010.

Source: International Atomic Energy Agency Power Reactor Information System (PRIS) data.

MODERNISATION OF THE NUCLEAR SECTOR: POST CHERNOBYL

On 26 April 1986, an accident occurred at Unit 4 at the Chernobyl nuclear power station (at that time in the former USSR). The accident, caused by a sudden surge of power, destroyed the reactor and released massive amounts of radioactive material into the environment.

In 1990, the Ukrainian Parliament established a moratorium on construction of new nuclear power plants. This halted construction of three VVER-1 000 reactors (Khmelnitski-2, Rivne-4

and Zaporizhia-6 started in 1985-86) until the moratorium was lifted in 1993. Zaporizhia-6 was connected to the grid in 1995 becoming the 13th VVER in operation in Ukraine.

In 1995, a Memorandum of Understanding was signed between the Group of Seven (G7) countries, the European Commission (EC) and the government of Ukraine that required closure of the three remaining RBMK units at Chernobyl. The last unit was shut in December 2000. International financial aid was agreed to support the decommissioning of the Chernobyl reactors, completion of the Khmelnitski-2 and Rivne-4 reactors, power sector restructuring and thermal and hydro plant rehabilitations. Loans of USD 215 million from the European Bank of Reconstruction and Development (EBRD) and USD 515 million from the European Union (EU) were approved for Energoatom to complete the Khmelnitski-2 and Rivne-4 units to western standards. Conditions on the EBRD loan included safety enhancement of all thirteen VVER reactors, independence of the nuclear regulatory authority and electricity market reform, which included doubling the wholesale price of power. The Ukrainian government rejected these conditions, and in the end, Energoatom proceeded with work on the two reactors with local finance and a bond issue. In July 2004, prior to the start-up of the two units, the EBRD approved a loan of USD 42 million, matched by a USD 83 million loan from the EC, to cover a post start-up safety and modernisation programme based on recommendations by International Atomic Energy Agency (IAEA). Conditions on the loan required augmentation of nuclear electricity tariffs to fund the upgrading of the other thirteen VVER reactors, establishment of a decommissioning fund and an internationally agreed level of nuclear liability insurance. The modernisation programme for Khmelnitski-2 and Rivne-4 units was completed in November 2010.

SAFETY UPGRADE PACKAGE AND POST FUKUSHIMA STRESS TESTS

Based on a 2005 Memorandum of Understanding on Energy Co-operation between the European Union and Ukraine, a joint EC/IAEA/Ukraine safety evaluation of nuclear power plants was carried out. This audit, covering design and operational safety, radioactive waste management, decommissioning and regulatory issues, was completed at the end of 2009 and the final report agreed in February 2010. The evaluation found full compliance with most of the IAEA's Safety Standard requirements. Partial compliance was found in areas related to equipment qualification, consideration of severe accidents and seismic design margin. As a consequence of this evaluation, further safety upgrades for Ukraine's reactors have been planned for the 2011-17 period under the "Safety Upgrade Package". The cost has been estimated by Energoatom to be on the order of Ukrainian hrynia (UAH) 15 billion (USD 1.8 billion, EUR 1.4 billion) and it has applied for Euratom and EBRD loans (for about EUR 300 million each). Good progress in preparing the technical studies for these loans had been made and due diligence procedures had been almost completed by September 2012. Euratom and EBRD may agree to issue loans of about half of the total safety upgrade costs. Energoatom has undertaken a number of measures using its own resources, reportedly spending EUR 28 million in 2010 and an estimated EUR 142 million in 2011.[2]

As part of the joint EC/IAEA/Ukraine safety evaluation, an international team of experts visited the State Nuclear Regulatory Committee of Ukraine in 2008 to conduct an Integrated Regulatory Review Service (IRRS) mission: a review against IAEA safety

2. Sixth Joint EU/Ukraine Report on Implementation of the EU/Ukraine Memorandum of Understanding on Energy Co-operation during 2011, March 2012, *www.ua-energy.org/upload/files/2012_03_22_mou_progress_report6.pdf* (accessed 18 April 2012).

standards of the Ukraine national government and regulatory structure for nuclear and radiation safety. A follow-up mission was organised by the IAEA in 2010 at the request of the Ukrainian government. As identified during the 2008 IRRS mission, the team confirmed SNRIU's strengths as effectively regulating nuclear and radiation safety, as a *de facto* independent regulatory body and having taken effective action towards achieving transparency and communication with the public and parliament. New recommendations to the Ukrainian government were to ensure that the independence of the regulator and adequate financial resources to support it are maintained during the major reorganisation of the administration that was announced by Ukraine's president in December 2010.[3]

After the accident at the Fukushima Daiichi nuclear plant in Japan in March 2011, regulators across the world ordered "stress tests" to assess the resistance of operating reactors to major earthquakes and floods. In Ukraine, evaluations were conducted under the authority of the State Nuclear Regulatory Inspectorate. Conclusions of the stress tests reaffirmed the necessity to urgently conduct the "Safety Package" work identified by the EC/IAEA/Ukraine evaluation, in particular with respect to seismic reinforcements of safety equipment. As well, severe accident mitigation measures, in particular dealing with emergency cooling and power systems, and hydrogen risk issues, are being addressed.[4] As a neighbouring country, Ukraine co-operates with the European Nuclear Safety Regulators Group and submitted its stress tests report for peer review on 31 December 2011.[5] To address the need to inform the public, the SNRIU has published information related to the outcome of the stress tests on its website and has also organised public consultation meetings.

EXTENSION OF NUCLEAR PLANT OPERATION

The VVER units were originally designed for a thirty-year lifetime. The three oldest reactors started operation in 1981 and 1982 (Rivne 1 and 2) and 1983 (South Ukraine 1). Extension of the existing licence was very important to Energoatom, which has spent more than USD 300 million for the modernisation of units 1 and 2 of the Rivne NPP since 2004. Checking for embrittlement and demonstrating the integrity of the pressure vessel (which unlike other equipment cannot be replaced) is one of the most costly and difficult operations when considering long-term operation of a nuclear reactor. It requires detailed inspections, and a high level of expertise in material and corrosion sciences, as well as access to experimental facilities including "hot cells" where irradiated material samples can be analysed.

In December 2010, a twenty-year extension of the operating licences of Rivne 1 and 2 (with a mandatory safety reassessment after ten years) was granted by the State Nuclear Regulatory Inspectorate. Energoatom plans to submit requests for long-term operation (for at least an additional ten years) for the other reactors, but this will be costly. Energoatom estimates the cost at around UAH 2 400/kW (USD 300/kW) installed capacity, so the overall cost of extending the lifetime of the eleven reactors whose

3. IAEA NS IRRS (2010), Integrated Regulatory Review Service Follow-up to Ukraine, IAEA NS IRRS, November 2010, *www.snrc.gov.ua/nuclear/en/doccatalog/list?currDir=112215* (accessed 18 April 2012).

4. Zinchenko, Y. (2012), *Safety Improvements of Ukrainian Nuclear Power Plants in Light of the Fukushima Daiichi Accident*, Presentation at International Experts' Meeting on Reactor and Spent Fuel Safety in Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, IAEA, Vienna, 19-22 March 2012.

5. National Report of Ukraine (2011), Stress Test Results, State Nuclear Regulatory Inspectorate of Ukraine, *www.snrc.gov.ua/nuclear/en/doccatalog/list* (accessed 18 April 2012).

licence expires before 2030 would amount to about USD 3.7 billion. This investment comes in addition to that required by the upgrades requested by the EC/IAEA/Ukraine safety evaluations and by the regulator as a result of the post-Fukushima stress tests.

DECOMMISSIONING AND NUCLEAR WASTE

Decommissioning of the Chernobyl RBMK reactors Units 1 to 4 is on-going. Unit 4, which was destroyed in the 1986 accident, is enclosed in a concrete sarcophagus. A more durable structure called the "New Safe Confinement" (NSC) is planned, with funding from international donors under the "Chernobyl Shelter Fund", which is administered by EBRD. The contract for the NSC design and construction was signed in 2007 with the Novarka consortium, formed by the construction companies Bouygues and Vinci. The detailed design, which covers the step-by-step development and implementation of the NSC, is subject to six licensing packages, the structure and contents of which are individually to be agreed with the regulator SNRIU. In 2011, the Joint Venture Novarka completed the first part of the development of the NSC detailed design, related to the basic structure and the system taps (Licensing Package 5). The detailed design covers the construction of the foundations, the installation of bearing elements made of steel structures and cladding of the main building. In November 2011, SNRIU issued the authorisation to perform work within Licensing Package 5, with some restrictions concerning the system of cranes to be used.

An international conference marking the 25th anniversary of the accident took place in Kiev in April 2011 to raise funds for the Chernobyl Shelter Fund and resulted in pledges to cover the required EUR 740 million. Donors pledged EUR 550 million (including EUR 122 million from the European Union and USD 41 million from Ukraine) and the EBRD agreed to complement it with a EUR 190 million contribution.[6] Construction of the NSC was officially launched by the Ukrainian president on 26 April 2012, the 26th anniversary of the accident. Ukrainian authorities are confident that the new confinement structure will be commissioned in 2015.

Chernobyl Units 1, 2 and 3 were closed in 1996, 1991 and 2000 respectively. Their decommissioning will follow conventional methodologies. Ownership of the reactors was transferred from Energoatom to a new state-owned company called "Chernobyl NPP" a few months before the shutdown of Unit 3. Before decommissioning of these three units can begin, long-term storage options for the spent fuel need to be finalised. An interim spent fuel storage facility, ISF-2, will be constructed by 2015, to replace the existing wet storage facility, which does not meet current standards. A contract to design this storage facility was signed in 2007 with HOLTEC, a US company. Regulatory approval was granted in 2010 and the construction contract for ISF-2 was signed in 2011. The project is supported by a special fund provided by the G7 countries and administered by the EBRD.

The cost of decommissioning of the VVER reactors is covered by a special fund set up under the 2004 law on nuclear safety. Energoatom, as the operator of the nuclear reactors, has been contributing to this fund every year since 2005. If operating licences are extended for all the VVER reactors, decommissioning would be expected to start after 2030, but 25 years is not a long period to accumulate funds, so yearly contributions

6. Sixth Joint EU/Ukraine Report on Implementation of the EU/Ukraine Memorandum of Understanding on Energy Co-operation during 2011, March 2012, *www.ua-energy.org/upload/files/2012_03_22_mou_progress_report6.pdf* (accessed 18 April 2012).

may need to be increased to ensure the fund is sufficiently large to address the country's decommissioning needs. In its strategy document, the government estimates that UAH 18 billion need to be transferred to this fund by 2030.

In addition to decommissioning of nuclear reactors, Ukraine also faces the challenge of decommissioning uranium mining and processing enterprises, such as the Prydnieprovsky chemical plant, for which a decommissioning programme has been funded since 2005 by the state budget to cover decontamination of polluted soils and equipment, as well as environmental monitoring.[7] The cost of the programme has been assessed at USD 360 million.

Today, spent fuel is either stored on-site (in the case of the Zaporizhia NPP which has its own on-site spent fuel dry storage facility) or sent to Russia for storage and processing (for all other NPPs), at a cost for Ukraine. Products from this processing are sent back to Ukraine. In 2005, Energoatom signed a contract with HOLTEC to implement a dry storage facility for Ukraine's VVER reactors called the "Central Spent Fuel Storage Project", which will store spent fuel for up to 100 years. The project did not progress until October 2011 when the parliament voted a bill that provides for the construction of this facility within the Chernobyl exclusion area. Ultimately, after long-term storage of the spent fuel (50 to 100 years), two options remain: final disposal, *i.e.* deep geological repository, or reprocessing of the spent fuel.

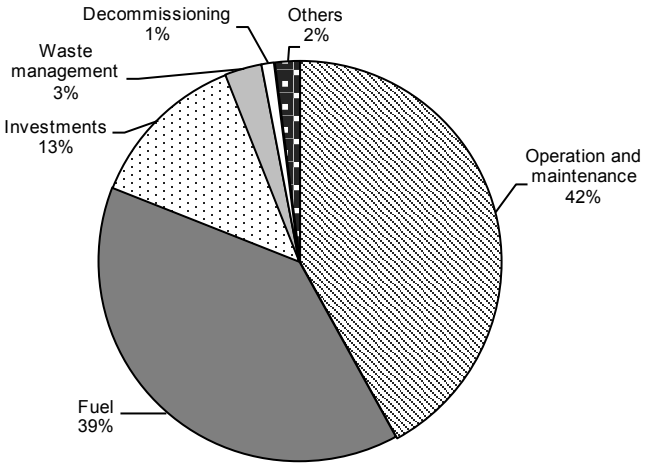
NUCLEAR ELECTRICITY TARIFFS

Electricity production from nuclear plants is part of the regulated generation market, just as is power from hydro, wind, and combined heat and power sources. The price paid to the producer is set by the National Commission for State Energy Regulation (NERC), based on a breakdown of costs proposed by Energoatom and approved by the Ministry of Energy and Coal Industry. The cost structure includes elements related to operational costs (including fuel costs, personnel, waste management and decommissioning), capital costs and investment programmes (Figure 11.3).

The government recognises that at their present level, the tariff set for electricity produced by Energoatom's nuclear plants is not sufficient to cover the investments required for the safety upgrade and lifetime extension programmes. Electricity price increases will be necessary to ensure that full marginal costs including the necessary investment costs are accounted for.

7. Riazantsev, V., O. Voitsehovich and A. Skalsky (2008), *Safety Assessment of Former Uranium Milling Facilities in Ukraine and Restoration Strategy Conception*, IAEA Technical Meeting on Uranium Exploration & Mining Methods, 17-20 November 2008, Amman, Jordan, *www.iaea.org/OurWork/ST/NE/NEFW/documents/RawMaterials/TM%20JOR/36%20Jordan2008_Ukr_Part1* (accessed 18 April 2012).
Mykolaychuk, O. (2010) *The Challenge Faced by Ukraine to Implement Decommissioning and Environment Remediation Projects: How Networking Can Help*, Side-event – IAEA General Conference, 22 September 2010, *www.iaea.org/OurWork/ST/NE/NEFW/documents/Olena%20Mykolaychuk%20-%20Presentation_EnviroNET_GC_2010n.pdf* (accessed 18 April 2012).

Figure 11.3 **Cost structure of nuclear electricity generation**



Sources: Energoatom; Ministry of Energy and Coal Industry of Ukraine.

RESEARCH AND DEVELOPMENT, EDUCATION AND TRAINING

Given the size of its nuclear energy sector, it is important that Ukraine maintain a high level of research and development, and ensures the education and training of professionals required by the sector. This includes companies and institutions that are involved in operation activities (mining, fuel fabrication, reactor operation and maintenance, spent fuel management, decommissioning) and regulatory and inspection aspects.

Ukraine needs to maintain a high level of R&D activity in the areas of nuclear safety, material and fuel science, and simulation tools, among others. This is particularly important for its safety upgrade programmes and extension plans for existing nuclear reactors. R&D requires the use of costly experimental facilities such as research reactors, irradiation facilities and hot cells. International collaboration is one of the recommended means to optimise the financial effort, offer multi-national access to experimental faculties and to share expertise. The European Commission has considerable experience of fostering such activities under the Euratom framework programme among EU and non-EU countries on the basis of co-funded research. Ukraine is also participating in the IAEA's International Project on Innovative Nuclear Reactors and Fuel Cycle (INPRO).

As in other countries that have a long history of nuclear energy development and use, the need to educate and train skilled workers for employment in the nuclear sector is significant as aging engineers, scientists and technicians retire. Ukraine has a large number of academic institutions, universities and nuclear research institutions. The Kiev Polytechnic Institute, the Sevastopol National University of Nuclear Energy and Industry, and the Odessa National Polytechnic University annually produce about 140 master students and experts in the field of nuclear energy. However, that may not be enough as newly qualified engineers and technicians may prefer to work in other economic sectors or relocate to countries that can offer higher salaries. Worth noting is the establishment of a National Training Centre for Energoatom personnel, which is partially funded by the European Union (EUR 14 million, representing one-third of the cost of the project). The Centre, which should open in late 2012, will provide training in nuclear maintenance, management and safety.

CRITIQUE

Nuclear energy is a key pillar of Ukraine's draft *Updated Energy Strategy of Ukraine to 2030*. The government has important responsibilities to ensure the safe and secure use of nuclear energy throughout the life-cycle of its components. These include obligations with respect to safety, decommissioning and radioactive waste management, legal and regulatory frameworks, R&D, education and training. In the next decade, the Ukrainian nuclear power sector needs to further modernise. Financing the necessary investments is a major challenge. International co-operation is one of the keys to the success of these efforts.

All the companies operating in Ukraine's nuclear energy sector (utility, uranium mining, waste management and decommissioning) are state-owned enterprises. While the government strategy indicates that corporatisation of some of these entities may be carried out to raise capital for future investment and attract investors, the government would in each case retain a controlling stake.

The State Nuclear Regulatory Inspectorate is a central executive body specially authorised by the Cabinet of Ministers to regulate all aspects of nuclear energy and radiation safety. The IEA commends the government for requesting the highest levels of safety for operation of the complete nuclear fuel cycle and for ordering stress tests of all its nuclear power plants following the Fukushima accident. Sharing of the outcome of these tests with other European regulators and international peer review contributes to the improvement of public acceptability of nuclear energy. The IEA also commends the government for establishing a policy for nuclear waste management, with the establishment of a special radwaste fund and the decision to construct a new long-term storage facility for VVER spent fuel. The government should ensure that the State Nuclear Regulatory Inspectorate is provided with sufficient human resources in order to monitor the implementation of the "Safety Upgrade Package", to undertake periodic safety reviews required over the next decade for assessing the conditions for the long-term operation of all reactor units, to licence and supervise planned new nuclear units and to further develop and supervise waste management and decommissioning activities.

Ukraine's draft *Updated Energy Strategy of Ukraine to 2030* foresees the extended operation of the country's existing reactors complemented by new capacity additions in order to maintain the present share of nuclear electricity generation. To be successful, this strategy requires that reactors operate with the highest levels of safety and in a cost effective way. Significant financial investments are critical to address equipment, training and safety upgrades for the existing nuclear power plants, as called for in the 2008 and 2010 EC/IAEA/Ukraine safety evaluations and the 2011 post-Fukushima stress tests. Large investments are also needed to address the challenges of long-term operation. It is essential to ensure that these investments are made in a timely manner to guarantee the safe operation of Ukraine's nuclear power plants.

New nuclear plant developments outlined in the draft *Updated Energy Strategy of Ukraine to 2030* will require large investments and the ability for the plant operator to pay back loans from revenue. A successful deployment of new nuclear power plants, especially in securing long-term public trust and support, also requires that decommissioning of the existing reactors at the end of their lifetime as well as the management of spent fuel is appropriately managed and funded. The fund to cover the cost of future decommissioning of nuclear plants was only set up in 2004. Clearly, this fund has not had a long period to generate the required financing for future decommissioning. A special radwaste fund was also established. Energoatom, as operator of Ukraine's nuclear power plants, contributes to both these funds.

If the government wants to attract foreign investment for the large financial requirements in the nuclear sector in order to set up joint ventures with Ukrainian entities, it needs to provide a stable and transparent investment framework. Ukraine should also continue to invite international technology suppliers to bid for new build projects, as Energoatom did in the case of the Khmelnitski 3 and 4 units. This can help to foster access to the best nuclear technology at a competitive price. Investments in the uranium mining sector are also required if Ukraine's plans to produce 100% of future needs are to be met.

Nuclear electricity tariffs must cover the cost of capital investments including safety upgrades, long-term marginal costs of power production including provisions for spent fuel management and decommissioning. In the current framework of regulated tariffs, it is the responsibility of the Ministry of Energy and Coal to ensure that this is the case in order to guarantee safe and sustainable operation of the nuclear industry.

Human resource development is an important priority in Ukraine as it is in all countries that have a nuclear power sector. Governments need to create educational incentives and to foster viable career paths for skilled professionals in the nuclear field, not only engineers, scientist and technicians but also those who have safety, environmental and regulatory responsibilities. Young talent needs to be trained to face the challenge of replacing retiring personnel. Ukraine has several academic institutions that offer a high level of education and training. Rewarding careers need to be offered to this new generation to ensure that trained professionals are available and attracted to jobs in the Ukrainian nuclear energy sector. It is the responsibility of the government to ensure that this sector attracts the needed skills.

Ukraine needs to maintain a high level of R&D activity and a commensurate level of R&D expenditure. Since Ukrainian nuclear operators and regulatory bodies usually do not have in-house research capabilities, skilled research centres and experimental facilities need to be available, and therefore, need to be adequately funded through public funding and possibly commercial contracts. International collaboration with other research organisations, including multi-national access to special facilities, is a way to improve the cost effectiveness of research as well as to promote the sharing of expertise.

Ensuring success of the government policy requires public acceptance of nuclear energy. It requires continued open dialogue and information exchange between all the interested stakeholders at national and local levels to build trust and understanding. At an international level, the participation of Ukraine in the European Stress Tests initiative, sharing of best practices and publication of information on the website of the regulatory authority contribute to build trust. Public acceptance should improve with a successful completion of the new confinement structure at Chernobyl Unit 4, which is due to be commissioned in 2015.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Require that nuclear power prices cover their full costs. Ensure that in setting electricity tariffs the regulator adequately accounts for the inclusion of full long-term marginal costs of nuclear power production and investment requirements. These needs include funding for safety upgrades for existing plants, operating life extensions, spent fuel management, new reactor capacity build and decommissioning.*

- *Ensure that work related to the "Safety Upgrade Package" and recommendations from the post-Fukushima "stress tests" are implemented in a timely manner.*
- *Ensure that investments related to licence extensions are planned and funded to allow for secure and reliable operation of the nuclear power plants beyond their original design life, taking full advantage of international experience of long-term operation of light-water reactors, including VVERs.*
- *Make progress on nuclear waste management by increasing R&D efforts and international collaboration, and proceed with the design and the construction of the Central Spent Fuel Storage facility.*
- *Take the necessary steps to decommission the Chernobyl nuclear power plant and to construct the New Safe Confinement at Unit 4 without further delay.*
- *Ensure that the uranium mining sector adheres to best international standards and practices, including for decommissioning activities.*
- *Ensure that the operator of nuclear power plants, the regulatory authority and the waste management and decommissioning organisations have access to sufficient highly-qualified human resources and adequate research facilities. Encourage international collaboration to improve cost-effectiveness.*
- *Maintain the attractiveness of the nuclear sector as a place to work for the next generation of technicians, engineers and scientists that are needed to realise the objectives for nuclear power in Ukraine's energy mix.*

12. RENEWABLE ENERGY

Key data (2010)

Share in TPES: 2%

Installed capacity: 400 MW

Share in electricity generation: 7.5%

OVERVIEW

Ukraine has made significant progress in the area of renewable energy over the last several years. The development of renewable energy sources is one of the declared priorities of the Ukrainian government because of their potential to reduce dependence on natural gas and to enhance energy security. Recently adopted legislation has introduced very attractive guaranteed feed-in tariffs, known as green tariffs, as well as other fiscal incentives for electricity produced from renewable energy sources.

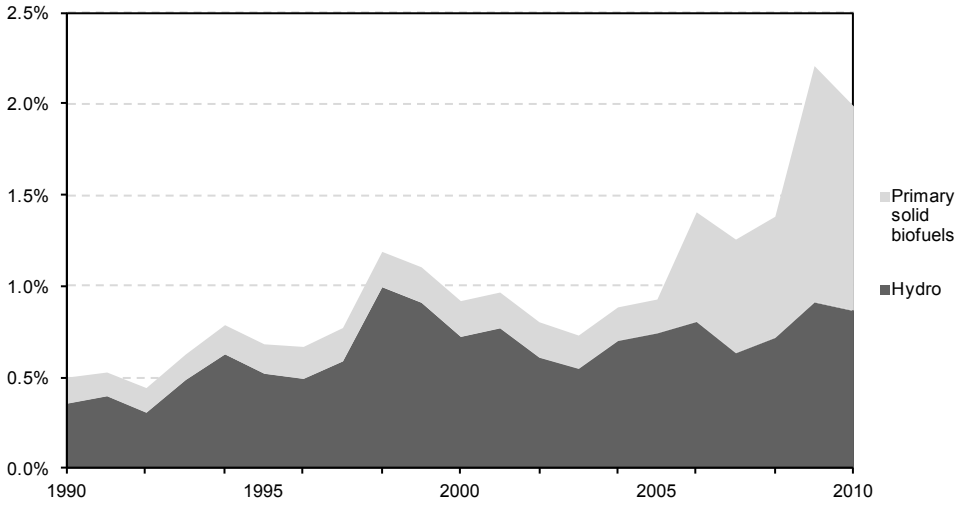
These policy developments have started to attract private investment. In 2011, several major renewable energy projects were implemented, including large wind and solar power plants, bringing the total renewable-based installed generation capacity to more than 400 megawatts (MW). Much more wind and solar capacity is expected to come online in the period 2013-16. Despite these achievements, the share of renewable energy in total primary energy supply and in electricity generation remains relatively low in Ukraine compared to the IEA average.

PRIMARY ENERGY SUPPLY

The share of renewable energy in total primary energy supply (TPES) has grown over the last twenty years from 0.5% in 1990 to about 2% in 2010 (Figure 12.1). Hydropower accounted for 80% to 85% of the renewable energy supply in the period 1990-2005, followed by biomass. The share of solid biomass has significantly increased since 2006 and accounted for nearly 45% of renewables in TPES in 2010. Wind power and solar energy have seen rapid growth in the last few years.

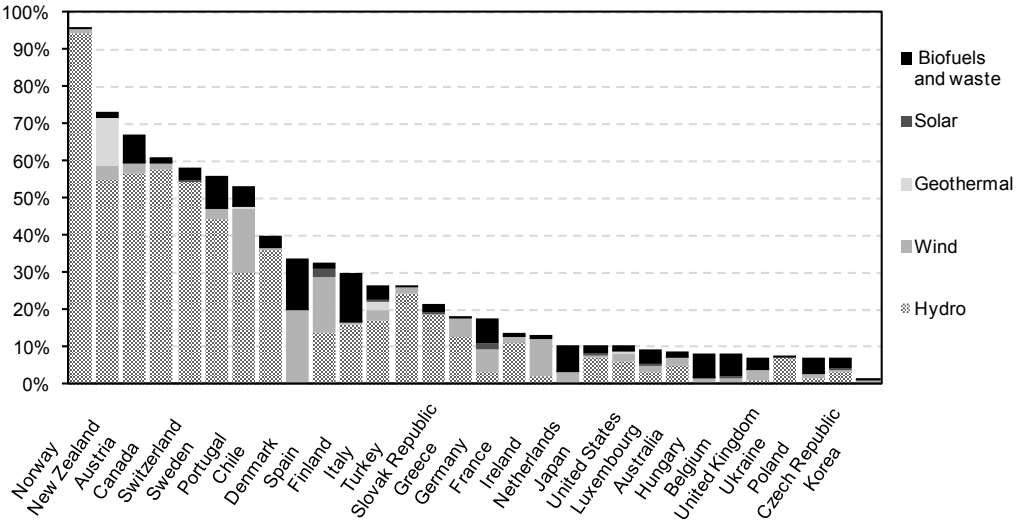
Despite its four-fold increase between 1990 and 2010, the 2% share of renewable energy in TPES in Ukraine is very low compared with the IEA average of 8% (Figure 12.2). Among IEA member countries, only Korea ranks lower than Ukraine in terms of renewable energy's share in TPES. By comparison, the share is close to 8% in Poland and Slovakia, Ukraine's neighbours.

Figure 12.1 **Renewable energy in total primary energy supply, 1990-2010**



Source: IEA databases.

Figure 12.2 **Renewable energy in TPES in Ukraine and IEA countries, 2010**



Source: IEA databases.

ELECTRICITY

The 7.15% share of renewable energy in electricity generation in Ukraine was slightly higher of that of Poland, United Kingdom, Czech Republic and Korea in 2010 (Figure 12.3). While official statistics for 2011 are not yet available, the State Agency on Energy Efficiency and Energy Saving (SAEE) indicates that additional renewables came on line in 2011 and generation was over 332 gigawatt-hours (GWh) excluding large hydropower (Table 12.1).

Table 12.1 **Renewable energy installed capacity and generation, 2011**

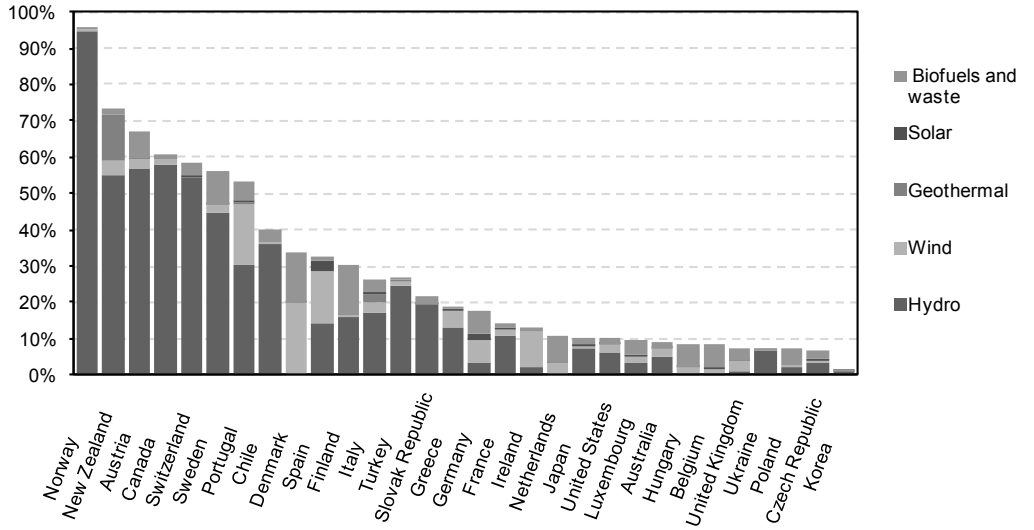
Renewable energy source	Number of generating facilities	Installed capacity (MW)		Electricity generation (million kWh/year)
		Total	Introduced in 2011	
Wind	11	146.42*	69.84	88.98
Solar	18	188.22	185.69	30.04
Small hydro	73	70.82**	2.26	203.46
Bioenergy	2	4.20	0.65	9.602
Total	104	409.66	257.79	332.08

* Installed wind power capacity was 151.1 MW including 85.6 MW of state-owned capacity and 65.5 MW of private capacity in 2011, according to the Ministry of Energy and Coal.

** Installed small hydro capacity is estimated to be 112 MW to 120 MW.

Sources: SAEE; NERC.

Figure 12.3 **Renewable energy in electricity generation in Ukraine and IEA countries, 2010**



Source: IEA databases.

HEAT AND BIOFUELS

Renewable energy, primarily biomass and waste, is used for heat production in private households and public buildings in rural areas, as well as for heating and processes in the wood products industry. Reliable data on heat production from renewables is difficult to collect and it is possible that official statistics significantly underestimate real consumption of biomass products.[1] Estimates are that the total heat production from renewable energy sources does not exceed 1 million gigacalories (Gcal). According to the Ministry

1. Recent studies undertaken for the Energy Community come to significantly higher estimates of biomass consumption, proceedings of the Energy Community RES Task Force, *www.energy-community.org/portal/page/portal/ENC_HOME/INST_AND_MEETINGS?event_reg.category=E12480* (accessed August 2012).

of Agriculture, boilers for the combustion of straw and other types of biomass are installed in 19 villages in the Vinnytsia, Kyiv, Sumy, Rivne, Volyn and Cherkasy regions. Ukraine also has geothermal resources that are used for heat supply in some places.

Ukraine produces wood products such as sawdust briquettes, pellets, fuel wood chips, charcoal and firewood. An estimated 60% of these products are exported.

Ukraine also produces liquid biofuels with about 100 000 tonnes per year (t/year) of biodiesel at small installations. Bioethanol is produced at six small plants at about 50 000 t/year, and one large plant produces 120 000 t/year to 150 000 t/year of bioethanol.

RENEWABLE ENERGY POTENTIAL

Ukraine has significant technical potential for further development of renewable energy sources. Their economic development potential depends on various factors including fossil fuel prices, available technologies and the level of the public support. The estimates of technical and economic renewable energy potential in this chapter come from various sources and may be based on different methodologies; thus they should be considered with caution.

Box 12.1 **Renewable energy definitions**

All graphics and figures in this chapter are based on International Energy Agency (IEA) statistics, unless otherwise noted. Ukraine's State Statistics Committee (Derzhkomstat) provides official data to the IEA through its annual questionnaires.

The IEA category for statistical publications of "renewable energy" includes: hydropower, solar photovoltaic, solar thermal, wind, geothermal, tide, wave, ocean, solid biomass, biogas, liquid biomass and renewable municipal waste. No distinction is made between "small" and "large" hydro in IEA statistical reporting. The renewables category does not include industrial waste, non-renewable municipal waste, waste heat, net heat generated by heat pumps or electricity generated with hydro pumped storage.

Ukraine's Law on Alternative Energy Sources defines renewable energy sources as: hydropower, solar, wind, geothermal, tide, wave, biomass, gas from organic waste and sewage treatment plants and biogas. Renewable energy is part of the category "alternative" energy which also includes secondary energy sources: coke gas and gas from blast furnaces, methane from coal mines and transformation of waste heat from processing.

A price premium scheme for renewables, feed-in tariff, in the hydropower category only applies to small hydro – defined as hydro plants with a capacity at or below 10 megawatts. Often only small hydro is included in the aggregate "renewable energy" statistics published in Ukrainian sources.

Sources: IEA (2011), *Renewables Information*, IEA/OECD, Paris; Law of Ukraine on Alternative Energy Sources (No. 555-IV, 2003).

Overall, the total potential of renewable energy sources in Ukraine is estimated to be about 25 terawatt-hours (TWh) of electricity and 2 million tonnes (Mt) of biofuels. This is the potential set out in the government's draft *Updated Energy Strategy of Ukraine to 2030* which is under public consultation in the third quarter of 2012. The potential for small hydro plants is estimated to be around 2.3 GW.[2]

2. Kovalenko, V. (2011) *Renewable Energy Recap: Ukraine*, Ernst and Young, *www.renewableenergyworld.com/rea/news/article/2011/12/renewable-energy-recap-ukraine* (accessed 14 June 2012).

Wind power potential is estimated at 10 gigawatts (GW) to 15 GW in the draft *Updated Energy Strategy of Ukraine to 2030*, although other estimates put it as high as 19 GW to 24 GW. The most promising areas for wind development are located in the south and southeast of the country, where the average wind speed exceeds 5 metres per second (m/s). The average wind speed at good open sites is around 6.5 m/s, potentially reaching 8 m/s.

Solar energy potential is significant in the south of Ukraine, where solar irradiation reaches 1 450 kilowatt hour per square metre per year (kWh/m²/year), compared with around 800 kWh/m²/year in the north. The technical potential of solar energy is 28.8 TWh/year, based on estimates from the Institute of Renewable Energy of the National Academy of Sciences of Ukraine.

A 2011 comprehensive study of the energy potential of biomass found that the technical potential of forest biomass was 89.08 petajoules (PJ) (2.1 million tonnes of oil equivalent [Mtoe]) and that of agricultural waste was 501.43 PJ (12 Mtoe) based on 2008 data.[3] Agricultural biomass is concentrated in the central, south eastern and southern regions, while the potential for forest biomass is in the northern and western parts of the country.

Ukraine's agriculture sector generates significant agricultural waste. The Biomass Centre estimates that it could be used to produce enough biogas to replace 2.6 billion cubic metres (bcm) of natural gas per year. With agricultural expansion, biogas potential could grow to the equivalent of 7.7 bcm of natural gas. It is estimated that organic matter from livestock could support 4 000 biogas installations.

TARGETS AND PROJECTIONS

The draft *Updated Energy Strategy of Ukraine to 2030* sets a renewable energy target of 10% of installed electricity generating capacity. The outlook is for 5 GW to 7 GW without hydropower (10 GW to 12 GW including large hydro), and production output of about 11 TWh to 16 TWh without hydropower (23 TWh to 28 TWh including large hydro) (Table 12.2).

According to the strategy, the development of renewables-based generating capacity, other than large hydro, to meet the target will require investment of UAH 130 billion (USD 16.5 billion or EUR 12.4 billion) over the period 2011-30 (in 2010 prices). The bulk of this investment will be needed in 2020-30. An additional UAH 55 billion (USD 7 billion or EUR 5.2 billion) will be required for the construction of hydropower plants, mainly in the period 2011-20, and UAH 5 billion for the modernisation of existing hydro plants in 2011-15. Therefore, the estimated total investment requirements for renewables including large hydro are UAH 190 billion (USD 24 billion or EUR 18 billion), or more than 26% of the total investment needs in the energy sector for the period 2011-30, which does not include the required investment for power grids.

In addition to the energy strategy, which is the energy sector's general guiding policy document, Ukraine has more specific sectoral programmes. The *National Targeted Economic Programme on Energy Efficiency and Renewable and Unconventional Energy for the period 2010-2015* was adopted by the Cabinet of Ministers (Decree No. 243,

3. Lakyda P., Geletukha G., Vasylyshyn R. *et al*. (2011), ed. Lakyda P., *Energy Potential of Biomass in Ukraine*, Institute of Forestry and Landscape Park Management of the National University of Life and Environmental Sciences of Ukraine, Publishing Center of NUBiP of Ukraine, Kiev.

March 2010). It sets a target to increase the share of renewable and alternative energy in primary energy supply to 10% by 2015. This will result in the replacement of the 14 Mtoe of traditional fuels.

Table 12.2 **Projected electricity generation from renewable and unconventional energy sources**

Renewable and unconventional energy sources (TWh)	2010	2015	2020	2025	2030
Wind	0.1	0.6	1.9	3.8	7.4
Solar energy	< 0.1	0.3	0.8	1.4	2.6
Small hydro	0.2	0.4	0.7	1.3	2.1
Bioenergy	< 0.1	< 0.1	0.2	0.2	0.3
Other nonconventional and renewable sources	< 0.1	< 0.1	< 0.1	0.1	0.2
Total	**0.4**	**< 0.4**	**3.6**	**6.8**	**12.6**

Source: reference scenario in draft *Updated Energy Strategy of Ukraine to 2030*, 2012.

The draft *Updated Energy Strategy of Ukraine to 2030* projects that between 11 TWh and 16 TWh of electricity will be produced from renewable and unconventional energy sources by 2030. Adding generation for large hydropower brings the renewables projection to 23 TWh to 28 TWh by 2030. It foresees a nearly twenty-fold increase in biofuel production between 2010 and 2030 (Table 12.3).

Table 12.3 **Projected biofuels production (million tonnes)**

	2010	2015	2020	2025	2030
Bioethanol	< 0.1	0.3	0.6	0.8	1.1
Biodiesel	0	0	< 0.1	0.3	0.8
Total biofuels	< 0.1	0.3	0.6	1.1	1.9

Source: reference scenario in draft *Updated Energy Strategy of Ukraine to 2030*, 2012.

LEGAL AND INSTITUTIONAL FRAMEWORK

Ukraine's legislative framework relative to renewable energy consists of ten laws including those on alternative energy sources, power industry and energy savings.[4]

The Ministry of Energy and Coal is responsible for overall energy policy, including renewable energy. The Ministry of Agriculture plays an important role in the development and implementation of policy related to bioenergy. The National Commission for State Energy Regulation (NERC), among other activities, issues licences for electricity generation and

4. The laws include: Energy Savings (No. 74/94-BP) 1994; Power Industry (No.575/97-BP) 1997; Alternative Fuels No.1391-XIV) 2000, amended (No.1391-VI) 2009; Wind Energy Promotion (No.1812-III) 2000; Alternative Energy Sources (No. 555-IV) 2003; Combined Heat and Power Production and Use of Waste Energy Potential (No.2509-IV) 2005; Heat Supply (No.2633-IV) 2005; Energy Saving Promotion (No.760-V) 2007; Green Tariff (No. 601-VI) 2009; Power Industry Promotion of Alternative Energy Use (No.1220-VI) 2009; Promotion of Biological Fuels Production and Use (No.1391-VI) 2009.

sets feed-in tariffs for qualified generators that use alternative and renewable sources of energy. It also develops and approves procedures for connecting cogeneration facilities to electricity networks.

The State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) is the central government body responsible for energy efficiency and renewable energy policy. Approximately half of SAEE's staff work on renewable energy. SAEE also serves as a co-ordinating body for international relations in the renewable energy sector, including representation to the Energy Community and co-operation with the European Union (EU) agencies. Prior to an administrative reform in 2011, SAEE's predecessor agency was one of the key government bodies for proposing legal initiatives concerning renewable energy sources and directly submitted draft laws to the Cabinet of Ministers. Now, SAEE's legal initiatives are subject to approval by relevant ministries beforehand.

Ukraine, as part of its accession to the Energy Community Treaty, is expected to develop, on a voluntary basis, plans to implement EU directives on the promotion of electricity from renewable energy sources (2001/77/EC) and biofuels or other renewable fuels for transport (2003/30/EC) In August 2011, the Cabinet of Ministers signed a resolution on the planned measures to meet Ukraine's obligations regarding the Energy Community Treaty and tasked SAEE with development of proposed measures to comply with the directives. The draft proposal was under consideration by the Ministry of Justice in mid-2012. SAEE plans to develop a National Renewable Energy Action Plan in accordance with the Energy Community's template by the end of 2012. Moreover, discussions on the adoption of Directive 2009/28/EC on the promotion of renewable energy, including the setting of mandatory targets for all Contracting Parties are on-going and expected to be finalised by the end of 2012.

FISCAL MEASURES

Ukraine has a number of fiscal incentives for renewable energy sources. Most are tax-related:

- exemption from corporate profit tax until 2020 on income from:
  - production of electricity and/or heat from biofuels;
  - sale of electricity generated from renewable energy sources;
  - sale of biofuels; and
  - production and reconstruction of power plants, vehicles and agricultural machinery that use biofuels.
- tax reduction of 75% for land used for renewable energy facilities;
- exemption from the surcharge on electricity and heat tariffs for electricity generated from renewable sources;
- exemption from excise duties and VAT until 2019 for the import of equipment for generating electricity from renewable energy provided that similar goods are not manufactured in Ukraine; and
- reduction of 80% in the corporate profit tax for five years for the sale of equipment that operates on renewable energy sources and/or that is used for producing alternative fuels.

The list of goods that can benefit from the 80% reduction in the corporate profit tax and the exemption from excise duty and VAT is proposed by the Ministry of Economic Development and Trade and approved by the Cabinet of Ministers.

ELECTRICITY SECTOR

Promotion of renewables for electricity generation has been on the government agenda since the 1990s. Based on a presidential decree, the Complex Programme for Wind Farm Construction was launched in 1997 with an objective to install 1 990 MW of wind capacity by 2010 and under which the commercial production of wind turbines was established in Ukraine.[5] The programme was not successful and did not meet its targets. Several factors contributed, including inconsistency of the turbine model with actual wind conditions; lack of maintenance and repair services; low efficiency of the turbines; and mistakes made during preparation of the financial module of the programme.

Green tariffs[6]

Ukraine's Power Industry Law sets a feed-in tariff, known as the "green tariff", for electricity produced using renewable energy sources, excluding hydropower plants with capacity over 10 MW and biogas plants.[7] The procedures for setting the feed-in tariff were established in 2009 and by mid-2012, 45 companies had been authorised.[8]

NERC approves feed-in tariff rates on a case-by-case basis. Green tariffs can only be obtained upon the completion of a power plant. The Power Industry Law sets minimum feed-in tariff rates that are applicable until 1 January 2030 (Table 12.4). They are calculated on the basis of electricity prices for retail consumers[9] in January 2009 multiplied by an established co-efficient.[10] The premium tariff for solar and hydropower has an additional multiplier – a peak time co-efficient.

The approved renewable-based generators are shielded from EUR/UAH exchange rate fluctuations because the fixed minimal green tariff rates are converted to Euros at a fixed exchange rate of 10.86 (based on the 1 January 2009 rate). NERC can apply the exchange rate that is effective on the date of establishing the green tariffs only if it is higher than 10.86.

Minimum green tariffs for renewables-based electricity generation are established for solar, wind, small hydro and some biomass resources. Electricity production from animal waste, biogas and landfill gas is not eligible for feed-in tariffs. For biomass, only electricity generated at power plants 100% fuelled by biomass are eligible. NERC does not authorise green tariffs for co-firing of biomass or organic waste with other fuels. There have been attempts to extend green tariffs to biogas, but presently biogas plants are not eligible (Box 12.2).

5. Presidential Decree №.159, Construction of Wind Power Plants, 1996.

6. The Green tariffs section uses, among other sources, the findings of an unpublished study commissioned by the International Finance Corporation (IFC) in 2012.

7. Law on Power Industry (No. 575/97-BP) 1997.

8. Resolution of the National Energy Regulatory Commission on Approval of Procedures for Setting, Re-Setting and Repealing of Green Tariff for Business Entities (No. 32), 2009.

9. Consumers connected to distribution grids with the voltage below 35 kV.

10. Article 17-1 of Power Industry Law.

Table 12.4 **Minimum tariffs green rates**

Renewable source	Power plant capacity	Retail price (EUR/kWh)	Co-efficient	Peak time co-efficient	Minimum rate (EUR/kWh)
Wind	Less than 600 kW	0.05385	1.2	N/A	0.0646
	Range: 600 kW to 2 000 kW		1.4	N/A	0.0754
	More than 2 000 kW		2.1	N/A	0.1131
Solar	Land-based		4.8	1.8	0.4653
	Roof-top with capacity exceeding 100 kW		4.6	1.8	0.4459
	Roof-top with power capacity of up to 100 kW		4.4	1.8	0.4265
Biomass	Fuelled by biomass of vegetable origin		2.3	N/A	0.1239
Small hydropower plants	Less than 10 MW		0.8	1.8	0.0775

Sources: Ukraine Country Submission to IEA; SAEE; Study commissioned by IFC; press reports.

The Ukrainian state guarantees that the green tariff support scheme will apply to power plants which are fully commissioned within the period to 2030. The feed-in tariff rates progressively decline by 10% after 2014, 20% after 2020, and 30% after 2024 for new plants or those significantly upgraded.

Box 12.2 **Green tariffs for biogas**

Many stakeholders in Ukraine advocate the introduction of preferential tariffs for electricity produced from biogas. There have been several attempts to introduce legal amendments to this effect. A proposal in February 2011 would have extended the eligibility for green tariffs to wood products and residues, biogas from animals, landfills and sewage plants and to mixed generation as long as 50% or more of the fuel was renewable energy. The law was rejected on second legislative hearing. Later in 2011, legislators proposed again to amend the electricity law to include biogas. The parliament adopted it in October 2011, but it was vetoed by the president the next month.

On 4 July 2012, the parliament passed draft law (No. 10183), which proposes to introduce a feed-in tariff for electricity generated from biogas and solid household waste from 1 January 2013. Under the draft, the feed-in tariff coefficient for electricity generated from biogas will be 2.7 and that for solid household waste will be 3.

Source: press reports.

In July 2012, the parliament adopted on the first reading of the draft Law (No.10183) on Amendments to the Law on Electric Power Industry. The draft law envisages extending green tariffs to biogas and municipal waste (Box 12.2). It also stipulates a significant decrease in the coefficients for the solar energy installations: 3.5 to 3.7 from the current 4.4 to 4.8 (differentiated by size and type). The draft law also introduces differentiated coefficients for electricity produced at small hydro power stations in accordance with their installed capacity. The amendments in coefficients are not to be applied to the generating facilities, construction of which had begun before the draft law came into effect. In addition, according to the draft law, biomass of both plant and animal origin would be eligible for green tariffs.

LOCAL CONTENT REQUIREMENTS

The law provides that as from 2012, renewable energy generating plants must comply with local content requirements in order to become eligible for green tariffs (Table 12.5). By 2014, the share of Ukrainian materials, equipment, services and works cannot be less than 50% of total construction costs.

Table 12.5 **Local content requirements to qualify for green tariffs**

Type	Year	Local content requirement (%)
All types of alternative energy sources for materials, equipment, services and works	2012	15
	2013	30
	2014	50
Solar energy for the value of Ukrainian materials in the production of solar modules	2013	30
	2014	50

Source: SAEE.

The local content requirements are established in the law; however, the exact procedures to actually determine and control these shares had not been approved as of mid-2012. An initial draft of the procedure was prepared by the Ministry of Economy, but not adopted. According to that draft, it was up to the producer to determine the Ukrainian share based on financial documents. The Cabinet of Ministers has tasked NERC to elaborate a more specific procedure.

There are some manufacturers of components for renewable energy generating facilities in Ukraine, but it is reported to be insufficient to meet existing requirements. The application of the local content requirement was postponed in 2012 because of the missing methodologies and the inability to secure sufficient local supply. The draft law (No. 10183) adopted in July 2012 stipulates some amendments to the local content requirements.

OBLIGATION TO PURCHASE

All electricity produced by eligible renewable energy power plants and not sold under direct contracts must be purchased at green tariff rates on the Wholesale Electricity Market of Ukraine (WEM). (In practice, direct contract purchases do not happen because there are no economic or administrative incentives for consumers to purchase electricity at higher green tariff rates; and no secondary legislation governing such contracts.) The state enterprise, Energorynok, as a wholesale supplier is obliged to purchase electricity produced from certified renewable energy sources. With reform of the Ukrainian electricity market, it is expected that the WEM will be replaced by a market of bilateral contracts. If Energorynok is liquidated, there is no clarity on what the replacement would be as the purchaser of electricity at green tariffs. To provide more certainty to investors and project developers, the Power Industry Law stipulates that the state's obligation to purchase renewable energy at green tariff rates will survive the reform.[11] A draft law on the functioning of the electricity market of Ukraine that is under

11. Amendments to Article 17-1 of Power Industry Law (No. 3486-VI) effective June 2011.

consideration stipulates that the generators of electricity at nuclear and large hydro power plants will have an obligation to purchase at green tariffs electricity produced from renewable energy sources and not sold at negotiated prices directly to consumers and power suppliers.

According to the Power Industry Law, all renewable-based electricity supplied to the grid must be paid in full. However, renewable energy power producers – like any other generators – must follow the commands of the system operator, which has no obligation to provide priority dispatch for generation from renewable sources.

GRID CONNECTION

Electricity network companies are obliged to connect power produced from renewable energy to existing networks.[12] There are a number of regulatory documents that govern the relations between the grid operators and generating companies, but these rules apply to all generators without specific provisions for installations based on renewable energy sources. In addition, a regulation was adopted in 2009 concerning connection of wind power plants to the grid, but it only covers wind installations in specific locations. There is no official standardised grid connection procedure for all renewable-based generating units. The law (No. 5021-IV, June 2012) on amendments to certain legislative acts regarding connection fees to the networks of natural monopolies, which comes into force on 1 January 2013 regulates the issue of connection to the networks of power generation facilities that produce electricity from alternative energy sources.

Project developers finance the construction of the connection from a plant to the grid, while the grid companies must finance the investments in substations and related equipment to accommodate the renewable generation. In practice, however, investors usually finance all the expenses related to the grid connection and then transfer some of the assets to the grid company (oblenergos or Ukrenergo). There are no standard procedures for reimbursing the developer's costs of such grid investments or including these costs in the budgetary process of the grid operators.

REGULATORY PROCEDURES

Procedures for getting all the necessary licences, permits and approvals for obtaining the green tariff are quite complex and bureaucratic. A detailed schematic for project developers outlining the necessary steps was developed by the International Finance Corporation (IFC).[13] IFC describes the key requirements and possible bottlenecks at each of the following steps:

1. Feasibility analysis.

2. Incorporation of a legal entity, obtaining certificate of title to land.

3. Preparation of the project documentation.

4. Agreement for grid connection.

5. Connection to the grid.

12. Law on Power Industry and Decree of the Cabinet of Ministers Decree No. 126, 2009.

13. International Finance Corporation (IFC) (2011), *How to Obtain Feed-in Tariff*, IFC Europe and Central Asia Advisory Programme, *www.ifc.org/ifcext/uspp.nsf/AttachmentsByTitle/GTMap_Eng/$FILE/ENG_green-tariff-final.pdf* (accessed 24 June 2012).

6. Certificate from the Ukraine State Architecture and Building Control Commission (GASK) or Registered Declaration on Readiness for Exploitation (RDRE).

7. Obtaining licence.

8. Awarding feed-in tariff.

9. Gaining membership in the wholesale electricity market.

10. Signing agreement on sale of power at feed-in tariff.

It can take more than two years to progress through all ten steps. The procedures for obtaining land access are reported to be among the largest barriers to successful implementation of renewables projects. Furthermore, "the procedure of awarding the feed-in tariff has a number of gaps which may increase the term of tariff approval and aggravate project risks."[14]

HEAT SECTOR

The draft *Updated Energy Strategy of Ukraine to 2030* mentions the possibility of using renewables to replace the use of natural gas to produce heat, namely biomass combustion from wood and agricultural waste, geothermal, solar and heat pumps. It highlights today's relatively high cost of these technologies which impedes their market penetration. It foresees that technology developments will drive cost down such that the use of renewables for heat production will become more cost effective in the future. The draft strategy does not include any measures to support the use of renewables in the heating sector.

TRANSPORT

In 2005, Ukraine's Cabinet of Ministers approved the Concept of Biodiesel Production Development Programme for the Period to 2010. Subsequently a resolution was adopted in 2006 for the Diesel Biofuel Production Development Programme. Its objective was to stimulate the domestic biofuel industry and build at least twenty biodiesel production plants with annual capacity from 5 000 tonnes to 100 000 tonnes and total capacity of at least 623 000 t/year. A proposed law related to production and consumption of biofuels currently is under consideration in the parliament.[15] Its focus is the creation of the necessary conditions for and regulation of the production and consumption of biofuels.

In 2009, a number of support measures for biofuels were introduced.[16] They include:

- Customs duty exemption for imported machinery and equipment for construction of new biofuel production plants and refurbishment of existing plants, and modification of vehicles to use biofuel, based on an approved list for the period 2010-19. Custom duty and VAT exemption for imports of bioenergy equipment.
- Exemption from corporate profit tax on income from sale of biofuels, combined heat and power production from biofuels, production of bioenergy equipment (2010-19). Excise tax exemption for motor biofuels production (2010-14).
- Preferential depreciation rates for bioenergy equipment (2010-19).

14. IFC (2011).

15. Legislative proposal, (registration No.7524).

16. Amendments to Certain Laws of Ukraine as to Support of Production and Use of Biofuels.

- Allowance for bioethanol to be produced by state and private companies provided the licence is available.

The draft *Updated Energy Strategy of Ukraine to 2030* projects gradual growth in demand for biofuels. In its reference scenario, the mix of bioethanol in total gasoline consumption will reach 10% by 2020 and 15% by 2030. This will require investment of UAH 6 billion to UAH 8 billion (USD 750 million to USD 1 billion or EUR 540 million to EUR 720 million at 2011 average exchange rate). The share of biodiesel in total diesel demand is projected to be 7% by 2030. The reference scenario projects demand for bioethanol to reach 1.1 Mt and for biodiesel at 0.8 Mt by 2030. In the strategy's optimistic scenario, the share of bioethanol reaches 10% by 2020 and 20% by 2030; and the share of biodiesel is 7% in 2020 and 15% in 2030. In this outlook, demand for bioethanol increases to 1.3 Mt and biodiesel to 2.1 Mt by 2030.

The strategy highlights that it is important to stimulate the use of biofuels through the whole value chain from generation to sale. It calls for the development of a comprehensive biofuels development programme within six months after its adoption. It is to include the following measures to stimulate demand for biofuels:

- introduce differentiated excise duties for biofuels and traditional oil products;
- establish obligatory requirements for minimum shares of biofuels in gasoline and diesel, in line with EU practices, and brought in gradually;
- provide economic incentives for consumers to buy or convert vehicles that can use blends with higher shares of biofuels;
- ensure strict control over the quality of biofuels produced and sold; and
- support a domestic biofuel industry at the initial stage of its development through fiscal measures such as tax holidays, accelerated depreciation and exemptions from excise duties for imported equipment.

CRITIQUE

The development of renewable energy sources is one of the declared priorities of the Ukrainian government because of their potential to reduce the dependence on natural gas and to enhance energy security. Ukraine has made significant progress in the area of renewable energy since the 2006 IEA in-depth review of Ukraine. Recently adopted legislation has introduced very attractive guaranteed feed-in tariffs, known as green tariffs, for electricity produced from renewable energy sources. This law also stipulates guaranteed connection of renewable-based generating facilities to electricity networks and obliges purchase of all electricity produced from certified generation from renewables. In addition, Ukraine has adopted a number of fiscal incentives for renewable-based electricity.

These policy developments have started to attract private investment: several solar photovoltaic and wind projects have been initiated. Despite these significant achievements, however, the Ukrainian renewable energy policy needs further strengthening and reform.

Ukraine lacks a clear strategic direction for the development of its renewable energy sector. This should be addressed by agreeing to an ambitious mandatory target for renewable energy in the context of the integration of Directive 2009/28/EU in the Energy Community *acquis* and developing a national action plan to achieve this target. The draft *Updated Energy Strategy of Ukraine to 2030*, currently under review, should

take this into account and must include a strategic vision for the use of various renewable energy sources in different sectors – electricity, heat and transport – with clear targets, milestones and an action plan for meeting these targets.

In developing its renewable energy policies, the government should carry out cost-benefit analyses of the support schemes taking into consideration all renewable energy resources, and the current and projected costs of different technologies. The main support mechanism – feed-in tariffs – does not prioritise the most cost-effective options for reaching the country's objective of energy security. The green tariff rates for solar photovoltaic and wind are set at levels higher than those in many European countries, while more cost-efficient technologies such as biogas and waste are not eligible for support. The cost of generous support for wind and solar installations is passed on to consumers. Overly generous support bears the danger of triggering growth at an uncontrolled rate, which might in turn lead to a significant increase of the end-user prices. Such a situation can contradict another objective of the Ukrainian government-namely the protection of final consumers.

Ukraine has considerable biomass resources, especially in the agriculture sector, and there is significant potential for the use of biogas and municipal waste for electricity generation. Nevertheless, the current legislation provides support only to some types of biomass and excludes biogas and waste from the list of technologies that can benefit from the green tariffs. These gaps significantly narrow the cost-effective opportunities for Ukraine to diversify its energy mix, reduce dependence on natural gas, boost local economic development and job creation, and reduce environmental impacts. Therefore the government should extend the green tariffs to biogas, different types of biomass and waste in order to stimulate investment in these technologies.

Another cost-effective opportunity is co-firing of biomass at coal power plants. If Ukraine introduces incentives for electricity generating companies to use biomass together with coal, this will stimulate an internal market for the biomass products that are currently produced in Ukraine for export. In designing such support, the government should be aware of the technical limitations of the coal plants. If the requirement for the minimum share of biomass in the total fuel input is too high, *e.g.* 50%, this can be achieved only with major reconstruction of coal plants, which the generating companies will not necessarily carry out.

Another factor that can drive overall costs up is that the projects that benefit from the green tariffs are not always situated in most favourable locations. To minimise the impact on consumer prices, the government should make available detailed maps of renewable energy potential together with the analysis of suitable connection points to the transmission and distribution grids, taking into account the balance of supply and demand in different parts of Ukraine. The government, together with the transmission system operator, should develop a clear policy for connecting renewable generation to the network and ensure a fair balance of costs between the project developer and the consumer. Then it should put in place clear procedures to ensure that the projects at the most favourable sites are developed first.

The existing policy stimulates the use of renewable energy only in the electricity sector, apart from some fiscal incentives that can apply to equipment for renewables used for heat. Yet, Ukraine has huge opportunities for the use of renewable energy in the heating sector. A very large share of the total energy consumption in the country goes for heating needs and the current heat supply system is very inefficient. In carrying out the

much needed reforms of the heating sector, the government should introduce incentives for the use of renewable energy in combined heat and power plants and boilers.

While the introduction of the green tariffs has been a major step towards attracting investment into the sector, more can be done to improve the investment climate. From an investor's point of view, the key problem with the existing system is that the green tariff can be obtained only after the plant is constructed, which represents significant risks for the project. In addition, several regulatory gaps remain which complicate project approval. Secondary legislation needs to be developed to clarify the provisions for connecting renewable energy generating facilities to the grid and for financing the costs of the connection and the necessary grid upgrades. Similarly, clear methodologies must be adopted for calculating and monitoring the share of local content in the total costs of the renewable energy projects in order to meet the established requirements. In addition, the procedures for getting licences and permits to build and operate renewable energy facilities are complex and time consuming. There is no one-stop-shop for getting all the necessary documentation and assistance.

RECOMMENDATIONS

The government of Ukraine should:

- ☐ *Enhance the cost-efficiency of its policy in order to increase renewable energy development while minimising the financial burden on consumers and the state budget.*
- ☐ *Establish a clear definition of what constitutes renewable energy based on internationally accepted definitions, for example, those used in EU directives.*
- ☐ *Focus on technologies that have a competitive advantage such as biomass and biogas, in order to promote economic growth and job creation.*
- ☐ *Determine clear criteria for approving projects benefitting from the green tariffs and prioritise the projects in best locations in terms of the resource and distance from the electricity network.*
- ☐ *Develop an incentive framework for using renewable energy and waste in the heating sector and combined heat and power production, including provisions for co-firing of biomass and coal.*
- ☐ *Continue developing the needed secondary legislation to attract investment, including clear rules and methodologies for connecting generating facilities to the grid.*
- ☐ *Ensure clear, transparent and non-discriminatory procedures for getting licences and permits to build and operate renewable energy facilities.*

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The Shared Goals are presented in Annex B.

REVIEW TEAM

The *2012 In-Depth Energy Policy Review of Ukraine* was undertaken by a team of energy specialists from the International Energy Agency and IEA member countries.

The team visited Kyiv from 5 to 12 December 2012 to hold discussions with government officials, energy companies, non-governmental organisations and other stakeholders. The IEA Secretariat drafted this report based on those discussions and subsequent meetings during a follow-up visit in early March 2012 as well as on the official response of the government of Ukraine to the IEA policy questionnaire and other information provided by the government. When information from official Ukrainian sources was not available, the team relied on alternative sources. The team wishes to express its sincere appreciation to the staff of the Ministry of Energy and Coal Industry of Ukraine, especially to Ms Natalya Boytsun and Ms. Oksana Poplavskaya for their helpfulness throughout the review process. The team also wished to express its gratitude to the Delegation of the European Union to Ukraine that financed this review and offered continuous support to its preparation, as well as to the many stakeholders met that offered their time and shared their expertise for this review.

This report is primarily based on information available as of July 2012.

The members of the team were:

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Vida Rozite drafted the chapter on energy efficiency. Thea Khitarishvili drafted the upstream oil and gas chapter. The chapter on electricity was drafted by Alexander Antonyuk. Henri Paillere drafted the chapter on nuclear energy and Ellina Levina on climate change and environment. The chapter on coal was drafted by Carlos Fernández-Alvares. Chapters on the gas and oil markets were drafted by Marc-Antoine Eyl-Mazzega. The district heating chapter was co-drafted by Vida Rozite and Marc-Antoine Eyl-Mazzega. The renewable energy chapter was written by Elena Merle-Beral. The review was coordinated by Thea Khitarishvili, Kieran McNamara and Marc-Antoine Eyl-Mazzega, under the supervision of Ulrich Benterbusch. It has benefited from support from other colleagues from the IEA, as Laszlo Varro, Michael Cohen, Pierre Boileau, Raphaël Vial. Bertrand Sadin prepared the maps. Angela Gosmann, and Muriel Custodio supervised and handled the production.

ORGANISATIONS MET:

The Ministry of Energy and Coal Industry

The Ministry of Ecology and Natural Resources

State Environmental Investment Agency of Ukraine

The Ministry of Economy and Trade Development

The Ministry of Regional Development, Housing and Building Services of Ukraine

The National Commission for State Energy Regulation (NERC)

The Anti-Monopoly Committee

The State Nuclear Regulatory Inspectorate

State Agency for Investment and National Projects of Ukraine

National Agency for Energy Efficiency and Renewables

Naftogaz

Energy Company of Ukraine

Energoatom

Ukrenergo

Kyivenergo

Energorynok

World Bank

European Bank for Reconstruction and Development

European Union Delegation to Ukraine

International Monetary Fund

UNDP

DTEK

Beten International

Shell

TNK-BP

AES

Ostchem

Scientific Engineering Centre "Biomass" Ltd.

Ukrainian Wind Energy Association

European-Ukrainian Energy Agency

Renewable Energy Centre

Kiev Polytechnic Institute

Committee for Energy Security of Ukraine

National Academy of Science of Ukraine

Institute for Economic Research and Policy Consulting

Fund of Energy Efficiency Investments

Global Carbon

Q-Club

NOMOS

Dixi Group

TORO

Razumkov Center

International Center for Policy Studies

ANNEX B: INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have the ability to respond promptly and flexibly to energy emergencies. In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued research, development and market deployment of new and improved energy technologies make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

*Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

ANNEX C: GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations and acronyms are substituted for a number of terms used by the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for many of the abbreviations used.

AAUs	assigned amount units
b/d	barrels per day
bcm	billion cubic metres
CCGT	combined-cycle gas turbine
CDM	clean development mechanism (under the Kyoto Protocol)
CCS	carbon capture and storage
CHP	combined production of heat and power
CO_2	carbon dioxide
DSO	distribution system operator
EEA	European Economic Area
EC	European commission
EIA	environmental impact assessment
ECSO	energy services company
ERUs	emission reduction units
EU	European Union
EUR	Euro
Gcal	gigacalorie
GDP	gross domestic product
GHG	greenhouse gas
Gt	gigatonnes
GTS	gas transmission system
GWh	gigawatt-hour
IEA	International Energy Agency
IMF	International Monetary Fund
mb	million barrels
mcm	million cubic meters

Mt	Million tonnes
Mtoe	million tonnes of oil equivalent
MW	megawatt
PPP	purchasing power parity
PSA	production sharing agreement
PV	photovoltaic
SAEE	State Agency of Ukraine for Energy Efficiency and Energy Conservation
tcm	thousand cubic metres
Tcm	Trillion cubic metres
TPES	total primary energy supply
UAH	Ukrainian hryvnia
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar

ANNEX D: CURRENCY CONVERSION TABLE

Average year currency conversion rate, Ukrainian hryvnia (UAH) to US dollar (USD) and Euro (EUR), 2005-11

	2005	2006	2007	2008	2009	2010	2011
1 UAH/USD	5.1	5.1	5.1	5.3	7.8	7.9	8
1 UAH/EUR	6.4	6.3	6.9	7.7	10.9	10.5	11.1

Source: National Bank of Ukraine.

IEA Publications
9, rue de la Fédération, 75739 Paris cedex 15

Printed in France by Sorégraph, October 2012
Cover design: IEA.

(612012061P1) ISBN: 9789264171510

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