FNI Report 12/2011

Small hydro in Ukraine: to invest or not to invest?

Liv Arntzen Løchen

FRIDTJOF NANSENS INSTITUTT
FRIDTJOF NANSEN INSTITUTE

Small hydro in Ukraine: to invest or not to invest?

Liv Arntzen Løchen

livchen82@hotmail.com

December 2011

FRIDTJOF NANSENS INSTITUTT
FRIDTJOF NANSEN INSTITUTE

Title

Small hydro in Ukraine: to invest or not to invest?

Publication Type and Number

FNI Report 12/2011

Pages

28

Author

Liv Arntzen Løchen

ISBN

978-82-7613-635-7 (print version)
978-82-7613-636-4 (online version)

ISSN

1504-9744

Abstract

The vast and unexploited renewable energy potential and the introduction of green tariffs in 2009 have made Ukraine an attractive location for investors within the renewable energy sector. The Green Tariff system offers developers and investors the highest feed-in tariffs in Eastern Europe, and thus far covers alternative energy production from biomass, biogas, wind power plants and hydropower plants. Ukraine has a history in both large- and small hydro production. Whereas the potential of the country's big rivers is now to a great extent exploited, this is not the case for the smaller watercourses. Ukraine is well endowed with small rivers, approximately 60,000 of which can be classified as 'very small'. Most of these are located in the western part of the country, near the Carpathian Mountains. However, despite the natural potential foreign investors should be aware of the potential risks and hurdles. The country has a huge problem with corruption, and the process of obtaining licenses is not straight forward. On the whole, it can be worth exploring the possibilities of small hydro production in Ukraine for those who can deal with a high level of risk and uncertainty. If not, one would be better advised to look for investment locations elsewhere.

Key Words

Ukraine, renewable energy, small-hydro, green tariffs

Orders to:

Fridtjof Nansen Institute
Postboks 326
N-1326 Lysaker, Norway.

Tel: (47) 6711 1900
Fax: (47) 6711 1910
Email: post@fni.no
Internet: www.fni.no

Contents

Executive summary

Ukraine remains highly dependent on nuclear energy. However, the renewables potential is vast, and recent political incentives have sought to make Ukraine an attractive place for investors within the renewables sector. On the other hand, it remains to be seen how stable the conditions really are, or if they are all too good to be true.

Ukraine has a history of both hydro and small hydro production. Whereas the potential of the country's big rivers is now to a great extent exploited, this is not the case for the smaller watercourses. Ukraine is well endowed with small rivers, approximately 60,000 of which can be classified as 'very small'. Most of these are located in the western part of the country, near the Carpathian Mountains. Although not suitable for traditional hydro-power plants, such watercourses can effectively be used for small hydro plants (SHPs). In the 1950s there were 956 SHPs in Ukraine. However, interest diminished as new traditional large hydro as well as nuclear power plants were put into operation. In the 1980s fewer than 50 SHPs were still functioning in Ukraine, but interest was rekindled after the turn of the century. As of 2006 there were about 70 SHPs in service (Winkler 2009).

In 2009 a new Green Tariffs Law was passed aimed at making Ukraine more attractive to investors within the renewable energy sector. Thus far, the renewable energies covered by the Green Tariffs are biomass, wind, solar and small hydro plants. The country's natural potential and the introduction of the Green Tariffs clearly make Ukraine an attractive location for small- hydro investors. However, foreign investors should be aware of the potential risks and hurdles. The country has huge problems with corruption, and the process of obtaining licenses is not straight forward. On the whole, it can be worth exploring the possibilities of small hydro production in Ukraine for those who can deal with a high level of risk and uncertainty. If not, one would be better advised to look for investment locations elsewhere.

1 Introduction

Ukraine's 2005/2006 gas crisis with Russia clearly showed Ukraine's dependency on Russian gas. This was one of the contributing factors that spurred Ukrainian politicians to come up with policies aimed at changing this situation. In 2009, the Green Tariff system was introduced, offering developers and investors the highest feed-in tariffs in Eastern Europe. In addition, Ukraine has a vast renewable energy potential waiting to be exploited. These factors combined should make the country attractive to investors within the renewable energy sector. However, Ukraine is not an easy country to do business in, and its natural potential and favourable regulations may not always outweigh the risks associated with investments in Ukraine.

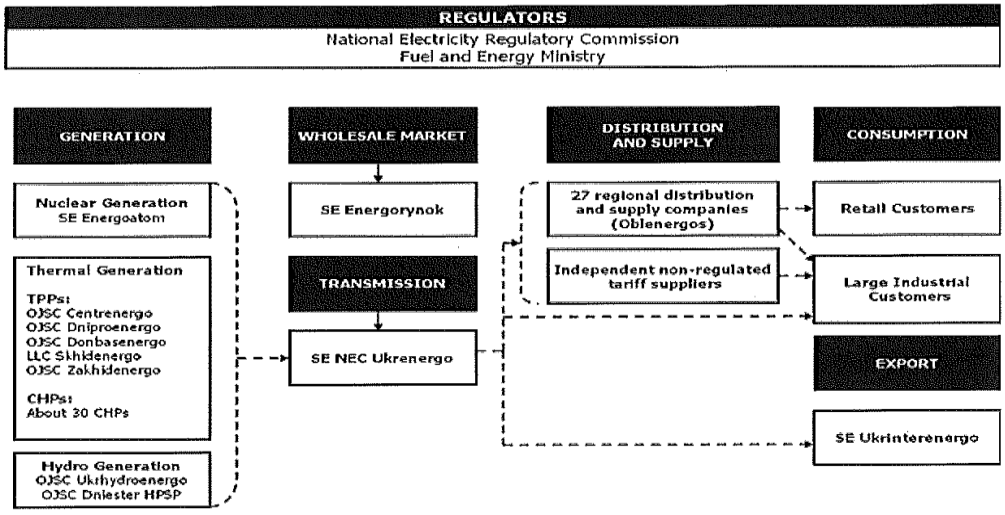
This report is an empirical study focused on mapping the potential for foreign investment within small- scale hydro production. Further, it looks into two central questions: (1) what are the most important indicators that can explain the growth, or lack of growth, of small- scale hydro production in Ukraine? (2) what are the future prospects for such technology in the country?

The report is based on data collected on the power sector in Ukraine in general, and small hydro in particular. Data derive from official reports from the national level, scholarly academic articles, reports and surveys, as well from a series of interviews in Kiev in September 2011. Interviews were conducted with representatives off the legal branch, consultancy firms, NGOs, power companies and state representatives. Interviewees were asked specific questions as well as being allowed to reflect freely on the issues in focus.

2 Ukraine's power sector and its current status

To a considerable extent, the energy markets of Ukraine inherited production technologies and capacities from the Soviet Union. After independence, however, the Ukrainian energy sector underwent several substantial changes in ownership structures as well as organizational aspects (Herasimovich and Tsarenko 2008). In the mid-1990s came a substantial reform, and Ukraine became the first country of the former Soviet Bloc to introduce a competitive electricity market. The president of Ukraine issued in May 1994 a decree requiring liberalization of the power sector as well as the development of a competitive national wholesale electricity market (WEM). The restructuring was carried out in 1995-96, supported by the extensive technical assistance from bilateral and multilateral donors (Herasimovich and Tsarenko 2008). The National Electricity Regulation Commission (NERC) was established in 1995, tasked with commissioning issues and monitoring licenses for electricity generation, high-voltage transmission, low-voltage distribution, wholesale market operations, and tariff and non-tariff supply. As can be seen from Figure 1, the Ukrainian power sector is structured in terms of its major business activities: generation, transmission and distribution of electricity.

Figure 1: Overview of industry structure



Source: IMEPOWER Consulting (2009: 3)

Electricity demand collapsed after the system changed. It has been recovering since, and both production and consumption have been growing since 2000, thanks to the economic recovery. The drop in demand can also to some extent explain the overcapacity characteristic of the Ukrainian system today. Surplus electricity production has further enabled Ukraine to export to neighbouring countries. Ukraine's energy sector is still heavily dominated by thermal and nuclear power, but the share of renewables is increasing (Herasimovich and Tsarenko 2008). Due to recent increases in gas prices, there has come a stronger political focus on increasing the share of alternative/renewable energy sources, in order to reduce the nation's dependence on gas from Russia.

3 Potentials

3.1 Natural potential

Compared to other countries poorly endowed with mineral resources, Ukraine produces renewable energy in negligible amounts (Mosaic Investments 2009). However, there is a large renewable energy potential, and in *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006), the development of renewable and alternative sources of energy is held up as an important factor for enhancing the energy security of the country. According to INFORSE (IMEPOWER 2010), an international NGO network for sustainable energy, Ukraine is capable of generating more than 80 TWh of electricity from renewable sources by 2030, and more than 120 TWh by 2050. Although the Ukrainian government operates with more modest calculations, as seen in Table 1 it nonetheless calls for a renewable share of the electricity production of more than 30% by 2030 (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006).

Table 1: Indicators of Alternative and Renewable Energy Sources (ARES) development by key development areas (Base Case Scenario), million tons of standard fuel/year

ARES Development Areas	ARES Development Level in Years			
	2005	2010	2020	2030
Off-balance energy sources, total	**13.85**	**15.96**	**18.5**	**22.2**
including coalbed methane	0.05	0.96	2.8	5.8
Renewable energy sources, total, including:	**1.661**	**3.842**	**12.054**	**35.53**
Bioenergetics	1.3	2.7	6.3	9.2
Solar Power Engineering	0.003	0.032	0.284	1.1
Minor Hydropower	0.12	0.52	0.85	1.13
Geothermal Energy	0.02	0.08	0.19	0.7
Wind Energy	0.018	0.21	0.53	0.7
Ambient Energy	0.2	0.3	3.9	22.7
Total	**15.51**	**19.83**	**30.55**	**57.73**

Source: *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006: 85).

According to the Energy Strategy of Ukraine for the period until 2030 (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006) the technically feasible alternative and renewable energy sources (ARES) potential of the country when converted to standard fuels represent a total of 79 million tons annually. The economically feasible potential under the base-case scenario is 57.7

million tons of standard fuel. Of that figure, renewable sources make up 35.5 million tons, and alternative (off-balance) 22.2 million tons.

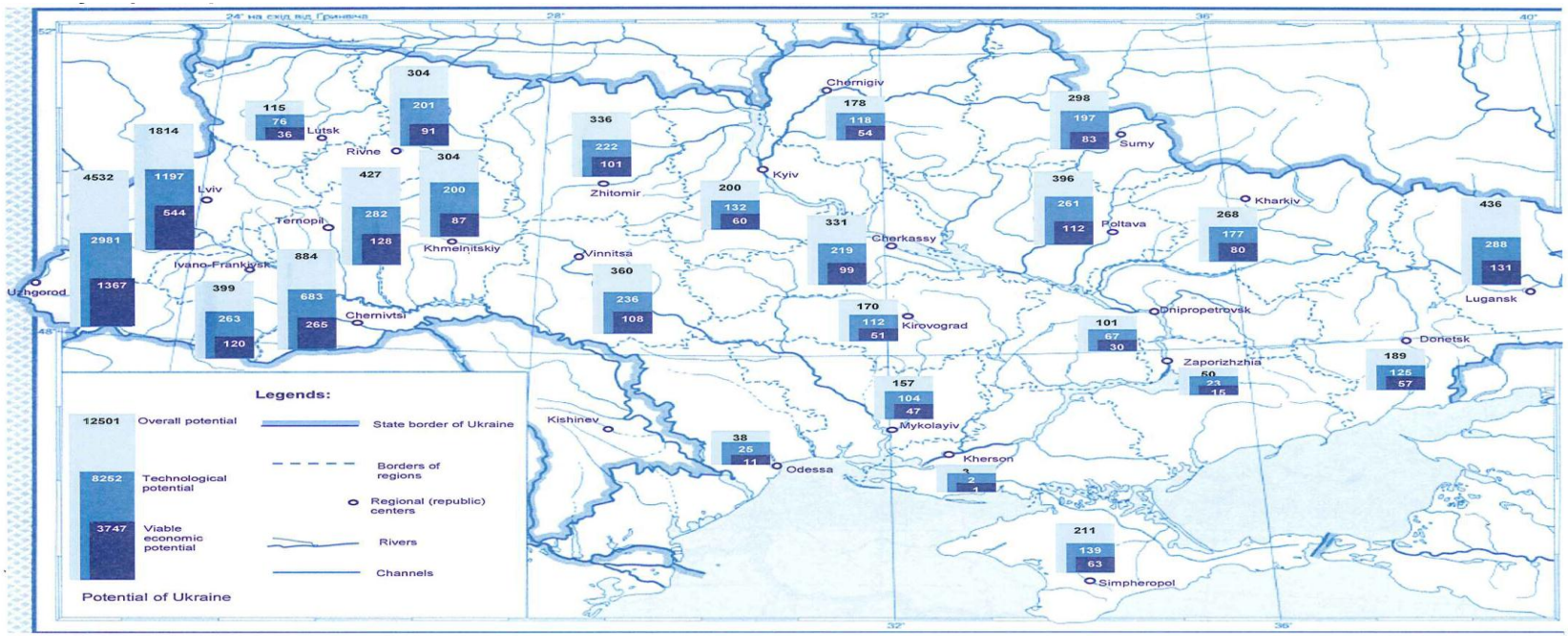
Hydropower constitutes a promising sector for ARES development in Ukraine. The country has a history of hydropower production, and large hydro accounted for 9% of total gross power consumption in 2008. According to Winkler (2009), there are more than 40 operational hydropower plants in Ukraine. Most of these are located on the main rivers: the Dnipro, Dnister, Southern Bug and Tisza. The energy potential of big rivers has to a great extent already been exploited, whereas the potential of small rivers has barely been tapped. There are more than 63,000 small rivers with a total length of 135,800 km in Ukraine, and approximately 60,000 of these fall into the category 'very small' (less than 10 km long). These are not suited for traditional hydropower plants, but are relevant for small hydro- production, as small plants can effectively use the river-flow energy of such watercourses (Kovalenko 2007, Winkler 2009).

Several regions in Ukraine are suitable for small hydro- production. The greatest potential is to be found in the western part of the country, near the Carpathian Mountains. As regards small-scale hydro the energy potential of small rivers has been estimated at 3-4 TWh. A recent study on small hydro in Ukraine[1] recommends that in order to realize the existing small- hydro potential of 3.3TWh, some 1.04 GW of small-hydro capacity should be installed (Winkler 2009, Kubrushko 2010).

The average annual amount of electric power now being generated by small- hydro is 300-400 million kWh. According to Mosaic Investments (2009), the small- hydro potential of Ukraine is equivalent to approximately 1.9% of current gross power consumption. Today there are some 50 small hydropower plants in operation, with the largest in the areas of Tereblya Rika, Gaivoron, Korsun-Shevchenkivsk, Stebliv and Ladyzhyn. Some of these plants are owned by private investors; the others belong to *oblenergos* (regional power distribution companies). Most of the operative plants require refurbishment. Around 100 small hydropower 21.5 MW plants are currently decommissioned and in need of comprehensive modernization. Figure 2 shows the hydropower potential of small rivers of Ukraine in million kWh per year.

[1] Study conducted by the Consortium of Promotion of Small Hydro Power Retrofitting and Implementation in the Caucasus and Carpathian Region, at the request of the EC. Referred to by Mosaic Investments (2009).

Figure 2: Hydropower potential of small rivers of Ukraine, million kWh per year



Source: IMEPower Consulting (unpublished paper)

When the Soviets started the connection of isolated grids in the 1960s and 70s it was not considered worth bothering about connecting the smallest hydro- plants and many of these were therefore abandoned. As a result there are in Ukraine today many old small hydro- plants in need of refurbishment. Figure 3 lists some of the small plants currently in operation, whereas Figure 4 lists the location of some of the decommissioned small hydropower plants as of 2007. In western Ukraine a rush to find good locations for small hydro has begun, and many of the best spots are already taken. However, there are still brownfields and abandoned sights available for potential investors.

Figure 3: Location of Ukrainian small hydropower plants currently in operation (2007)

Region	Number of plants	Design capacity, MW	Average annual output, GWh
Zakarpatye	3	31,55	143,0
Vinnitsa	9	19,04	83,9
Kirovohrad	4	12,25	45,6
Ternopil	6	8,03	27,0
Cherkasy	6	5,66	22,4
Khmelnytsk	7	4,6	15,7
Mykolaiv	3	4,2	17,0
Kharkiv	1	3,14	12,5
Kyiv	2	1,8	7,3
Rivne	3	1,22	6,3
Sumy	3	1,02	4,2
Zhytomyr	2	0,75	1,9
Poltava	2	0,7	2,2

Source: Kovalenko (2007)

Figure 4: Location of decommissioned small hydropower plants (as of 2007)

Region	Number of plants	Design capacity, MW	Average annual output, GWh
Vinnitsa	19	3,79	17,8
Zhytomyr	23	3,62	14,5
Cherkasy	11	3,41	11,1
Poltava	7	2,53	11,3
Ternopil	11	2,51	8,7
Khmelnytsk	8	1,82	7,0
Lviv	6	1,44	4,9
Chernivtsi	5	1,25	4,4
Kiev	3	0,82	4,5
Ivano-Frankivsk	1	0,8	2,5
Kirovohrad	6	0,74	3,0
Zakarpatya	4	0,56	2,0
Odesa	1	0,5	2,0
Sumy	1	0,25	1,0
Chernihiv	1	0,24	0,9

Source: Kovalenko (2007)

3.2 Electrification ratio and access

The countries of the Commonwealth of Independent States (CIS), including Ukraine, inherited from the Soviet era a rather well- developed electricity network as well as some excess generating capacity. Compared with other middle- income countries in the world, Ukraine scores relatively high on access to utility services. Indeed, this is a distinguishing characteristic of most post-Soviet states, and stands in sharp contrast to the situation in developing countries. As Table 2 shows, access to electric power is high throughout Ukraine, with almost 100% connection rate in most regions (Fankhauser et al. 2008).

Table 2: Connection rates to different utilities by region in 2004

Region		Access to the utility, per cent (weighted)						
		Centralised gas supply	Electricity	Sewerage or indoor toilet	Cold water	Hot water	Central heating	Gas/electrical stove
C	Cherkasskaya	36.9	100.0	28.0	38.9	30.3	27.0	93.7
C	Chernigovskaya	64.5	96.2	25.1	75.1	22.1	32.4	59.1
CE	Dnepropetrovskaya	87.7	99.4	52.4	78.6	38.6	78.9	92.8
C	Kiev city	**98.4**	**100.0**	**99.7**	**100.0**	**98.3**	**99.6**	**99.4**
C	Kievskaya	94.4	100.0	56.3	73.3	39.7	80.9	98.9
C	Kirovogradskaya	28.1	100.0	21.5	39.1	6.0	34.8	93.0
C	Vinnickaya	39.2	98.7	35.4	42.6	12.7	42.5	95.5
CE	Zaporozhskaya	56.5	99.7	58.1	87.2	55.9	56.3	97.2
CW	Zhitomirskaya	58.1	89.5	52.9	50.5	54.5	55.3	69.8
E	Doneckaya	48.7	98.7	43.5	80.3	22.0	43.9	64.8
E	Harkovskaya	77.8	99.7	56.8	66.8	41.6	80.4	91.6
E	Luganskaya	43.9	99.3	47.6	71.4	11.1	34.4	79.1
E	Poltavskaya	86.3	100.0	37.4	47.7	20.8	68.2	66.0
E	Sumskaya	59.8	100.0	22.7	34.1	15.7	22.0	42.0
S	Crimea	65.9	100.0	58.1	87.3	19.6	36.9	98.1
S	Hersonskaya	68.7	99.2	59.4	82.5	37.3	55.5	93.7
S	Nikolaevskaya	98.5	100.0	90.9	100.0	55.7	98.5	100.0
S	Odesskaya	56.8	98.4	51.3	80.6	31.1	45.1	86.4
W	Chernovickaya	82.1	96.2	33.0	25.8	0.0	72.1	86.4
W	Hmelnickaya	73.6	100.0	50.4	62.3	34.8	66.2	63.4
W	Ivano-frankovskaya	86.8	100.0	23.6	28.7	20.6	29.7	95.9
W	Lvovskaya	99.9	100.0	57.8	64.1	28.6	59.8	93.5
W	Rovenskaya	72.2	100.0	67.6	71.2	68.2	70.5	99.7
W	Ternopolskaya	88.7	98.7	43.3	75.4	39.3	77.9	96.0
W	Volynskaya	47.8	100.0	51.7	59.3	40.1	64.1	97.7
W	Zakarpatskaya	49.6	90.6	17.0	30.9	7.1	29.0	50.9
	Mean	67.5	98.9	49.8	68.0	33.6	55.8	84.8
	Std. dev.	20.9	2.7	19.9	22.0	21.6	22.3	17.0

Source: Fankhauser et al. (2008: 4170)

3.3 Demography/economic development/demand growth

The transition from central planning to a market economy necessitates deep structural changes in the organization of economies and societies. Such drastic structural changes can have undesirable side-effects, and the social costs have often been high. This has also been the case for Ukraine. According to Fankhauser et al. (2008) many people are finding it difficult to pay for such basic services as water, heat and electricity.

In terms of area, Ukraine is the second largest country in Europe, and has a population of more than 45 million. It also has one of the lowest birth rates in Europe, and indeed in the world in general (UNDP 2010). Moreover, of all the former Soviet republics, Ukraine has suffered the longest and deepest declines in economic activity (see Figure 5). Its transition recession lasted a full 11 years, from 1989 till 2000. However, the Ukrainian economy has grown rapidly since the turn of the century,

and from 2000 to 2007 the country enjoyed strong economic growth – 7.3 percent annually (Crane and Larrabee 2007: 9). This favorable trend experienced a drop with the financial crisis in 2008/2009, but in 2010 promising recovery signs appeared. Figure 6 presents GDP growth rates as forecast in the 2006 Energy Strategy.

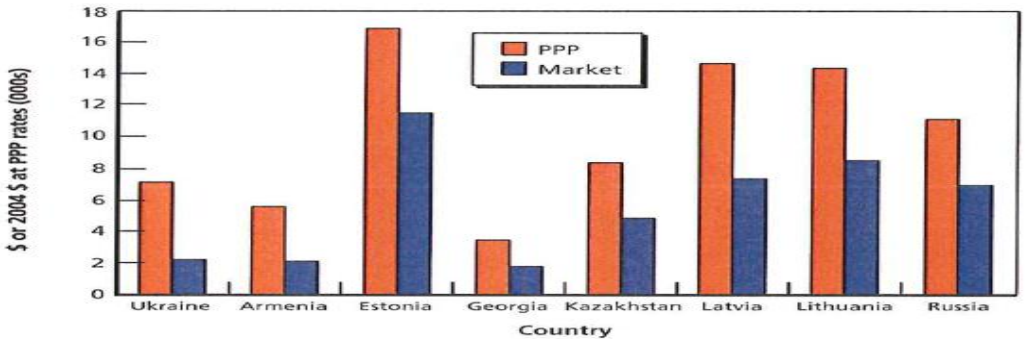
Figure 5: Main macro indicators of Ukraine

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Real sector									
Real GDP, %, YoY	5.2	9.4	12.1	2.7	7.3	7.9	2.1	-15.0	4.2
Nominal GDP, млрд USD	42.4	50.1	64.9	86.1	107.8	142.7	180.4	117.2	137.9
GDP per capita, USD	879	1 049	1 367	1 829	2 303	3 069	3 916	2 571	3 025
Real Industrial Output, % YoY	7.0	15.8	12.5	3.1	6.2	10.2	-3.1	-21.9	11.2
Real Agricultural Output, % YoY	1.2	-11.0	19.7	0.1	2.5	-6.5	17.1	0.1	-1.0
Retail turnover, bln UAH	39.7	50.0	67.6	94.3	130.0	178.2	246.9	231.0	274.6
Retail turnover, %, YoY	15.0	20.5	21.9	23.4	26.4	29.5	17.3	-20.9	7.8
Real wages, %, YoY	18.2	15.2	23.8	20.3	18.3	12.5	6.3	-9.2	10.2
Prices									
Consumer Price Index, YoY, %	0.8	5.2	9.0	13.5	9.1	12.8	25.2	12.3	9.1
Production Price Index, YoY, %	5.7	11.1	24.1	9.5	14.1	23.3	23.0	14.3	18.7
External Sector									
Trade balance, bln USD	1.9	1.3	5.0	0.7	-3.1	-8.2	-14.4	-2.7	-2.9
Financial account, bln USD	-1.1	0.3	-4.2	8.0	3.7	15.1	9.6	-11.8	7.9
FDI, bln USD	0.9	1.3	2.3	7.8	4.7	7.9	6.1	4.4	4.7
Balance of payments, bln USD	3.2	2.9	6.8	10.7	2.4	9.4	-3.2	-13.7	5.0
Government finance									
Budget surplus, bln UAH	1.6	-0.5	-9.9	-7.5	-3.5	-6.1	-11.4	-18.7	-46.5
Budget surplus, % to GDP	0.7	-0.2	-2.9	-1.7	-0.6	-0.8	-1.2	-2.1	-4.3
External Public Debt, bln USD	10.2	10.2	12.1	11.7	12.7	15.1	16.7	24.0	32.5
Gross External Debt, bln USD	21.6	23.8	30.6	39.6	54.5	80.0	101.7	111.6	117.3
External Public Debt, %of GDP	24.1	20.3	18.6	13.6	11.8	10.6	9.3	20.6	17.5
Gross External Debt, % of GDP	51.1	47.5	47.2	46.0	50.6	56.0	56.4	89.1	75.7
Gross F/X Reserves, bln USD	4.5	6.9	9.7	19.4	22.4	32.5	31.5	26.5	34.6
Monetary Indicators & Exchange Rate									
Discount Rate of NBU, %	7.00	7.00	9.00	9.50	8.50	8.40	12.00	10.25	7.75
USDUAH (NBU),average	5.33	5.33	5.32	5.12	5.05	5.05	5.27	7.79	7.94

Source: NIKO (2011: 1)

Having privatized its land and assets as well as joining the World Trade Organization (WTO), Ukraine is now considered a fully functioning market economy. Despite the economic growth, however, it remains poorer than the neighbouring countries. As shown in Figure 6, per capita GDP is far lower in Ukraine than in, for examples Russia or the Baltic republics. As noted in a report by UNDP and the Ukrainian Ministry of Economy (2005: 3), widespread poverty is regarded as one of the most severe socio-economic problems of Ukraine. Official data from the Ministry of Economy of Ukraine indicates that in 27.1% of the Ukrainian population was below the poverty line in 2005 (when using the official definition of poverty line as 75% of median daily expenditures per adult).

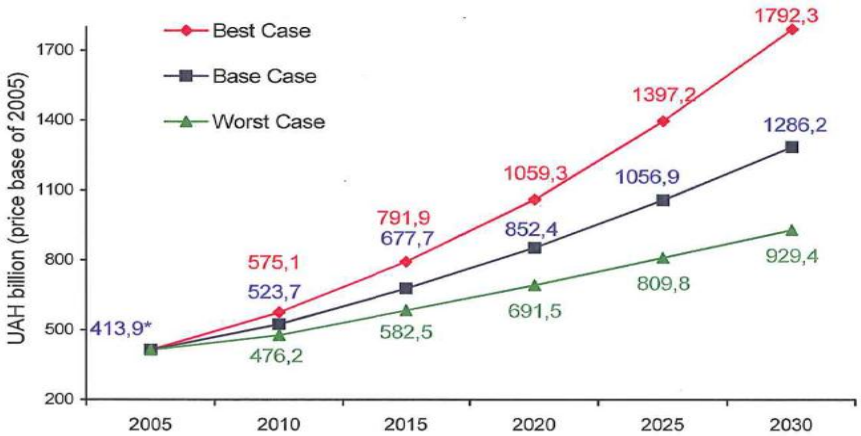
Figure 6: GDP per capita (2006) for Ukraine compared to other former Soviet Republics



Source: Crane and Larrabee (2007: 12)

The Energy Strategy of Ukraine until 2030 (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006), and as seen in Figure 7, presented a forecast of the GDP growth rate with steady growth in the economy until 2030[2]. However, and as seen in Figure 4 above, a drastic economic downturn came in 2008 when the global economic crisis hit Ukraine harder than most other East European countries. This economic downturn was due largely to aggressive foreign borrowing, as well as to the drop in steel prices. In 2009, the economy contracted more than 15% – which was among the worst economic performances in the world. Recent statistics, however, show signs of economic recovery in the Ukrainian economy; and, buoyed by exports, growth resumed in 2010 (CIA Factbook 2011).

Figure 7: Forecast of GDP Growth Rates, UAH billion (price base of 2005)



Source: The Energy Strategy of Ukraine for the period until 2030 (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006: 18).

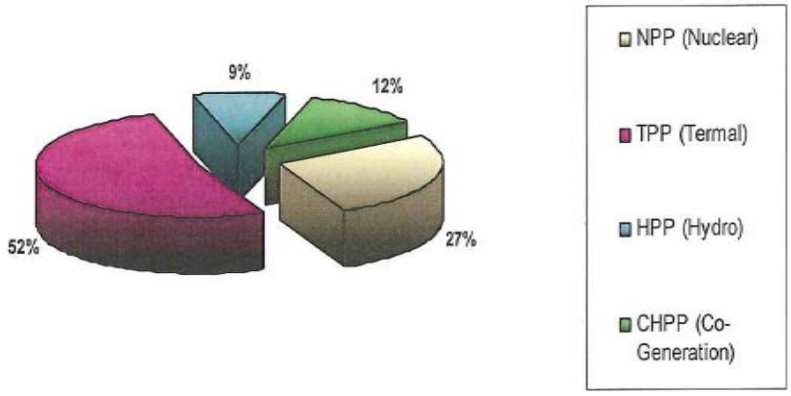
[2] It should be noted that this forecast was made prior to the 2008 global economic crisis.

4 Electricity system

4.1 Supply mix

Ukraine depends on three types of generation facilities: thermal power plants, hydroelectric plants and nuclear power plants. The importance of hydro and wind power, has been increasing gradually. Figure 8 shows installed capacity among the different types.

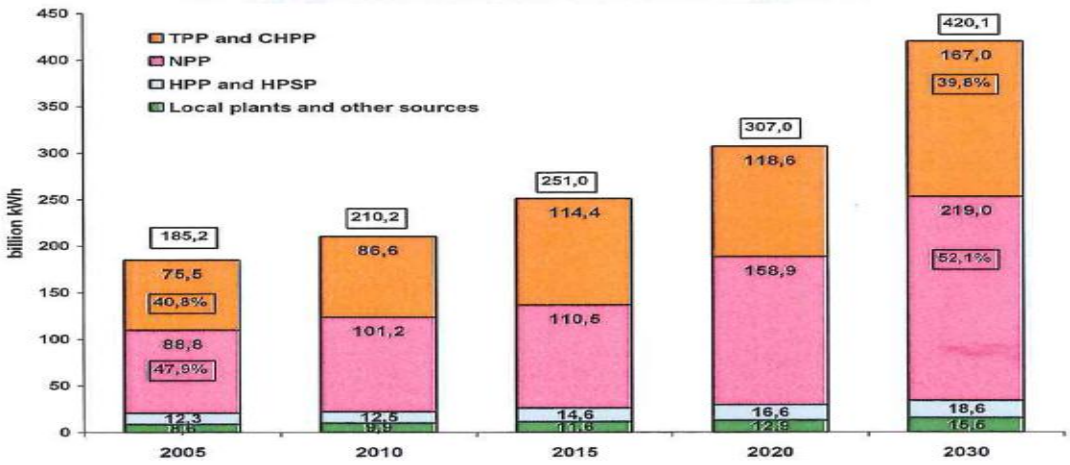
Figure 8: Installed capacity of power plants (2006).



Source: Herasimovich and Tsarenko (2008: 5)

According to *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006), and as seen in Figure 9, the volumes of electric power generated from nuclear power are set to increase, due to the commissioning of new plants as well as the rehabilitation of existing ones. Nine of the currently operating plants (out of which seven have extended service life) are expected to be in operation also in 2030. Output of electricity generated from hydropower is set to increase, and likewise for electricity from thermal sources. As for electricity generation from plants using renewable or alternative energy resources (power generated from small hydro and bio-fuel power plants are not included in these figures) this is predicted to reach 1 500 kWh by 2020 and 2 100 kWh by 2030 (ibid).

Figure 9: Forecast of the development of the electric power generation (billion kWh)



Source: *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006: 32).

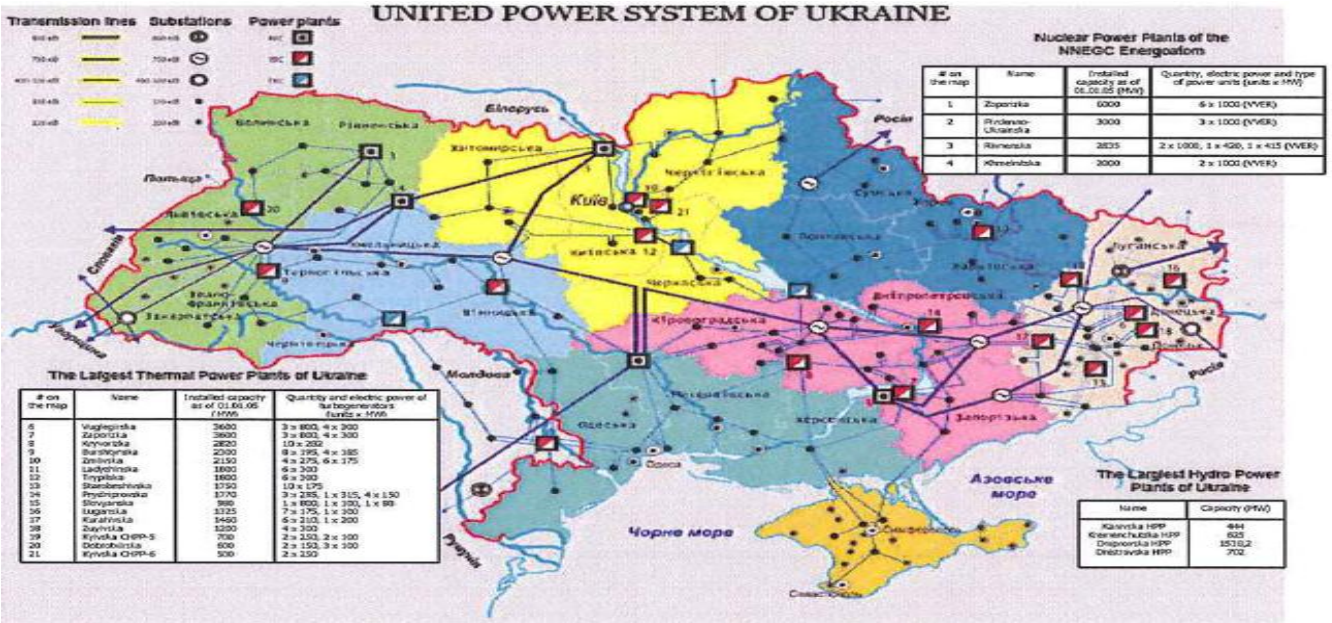
4.2 Distribution grids

In the 1950s, the Soviet Union started electrification of the rural parts of Ukraine. At first this involved various isolated grids, but in the 1960s and 70s the work began on connecting these scattered grids. Today network density is close to 100 %, and the distribution and transmission system covers the entire country (Dobonov et al. 2003).

The low-voltage networks are operated by the distribution companies known as '*oblenergos*'. The National Energy Company Ukrenergo is the system and network operator; it owns the high- voltage transmission network as well as the cross-border lines of Ukraine. Ukrenergo is administered by the Ministry of Fuel and Energy of Ukraine, and acts as a guarantor of unity and reliable operation of the Unified Energy System (hereinafter the UES) of Ukraine. The total length of transmission lines makes up more than 22,000 km (IMEPOWER 2009, Arzinger 2011).

The UES is the basis of the power industry in Ukraine. It provides centralized electricity supply for consumers, as well as interacting with the energy systems of neighbouring countries. It also provides for electricity export, import and transit. The UEA combines the powergenerating facilities and distribution networks in the country, which are interconnected by system power transmission lines (Arzinger 2011). Figure 10 shows the main power stations and transmission lines in Ukraine.

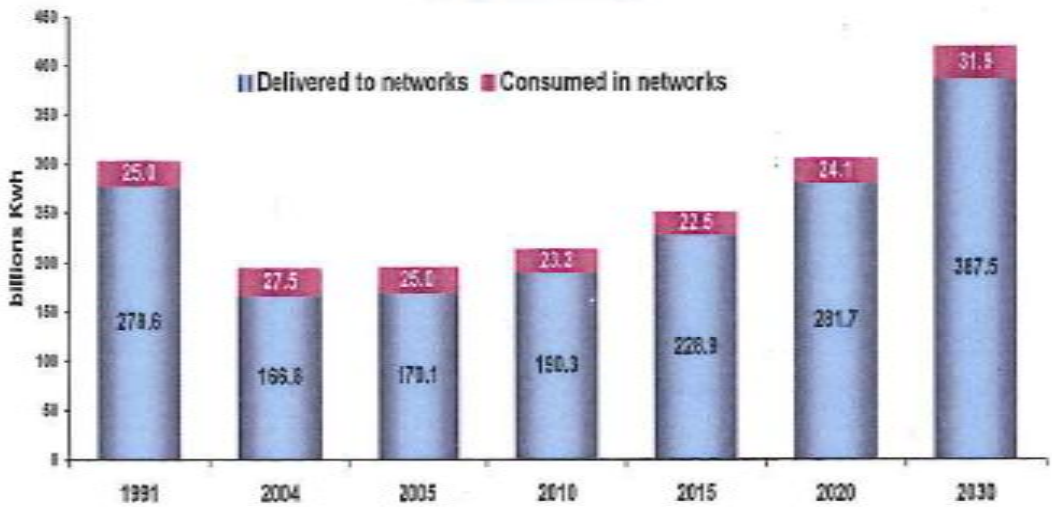
Figure 10: Transmissions lines Ukraine



Source: *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006: 29)

The growing demand for electricity constitutes a challenge for the old transmission and distribution networks (Herasimovich and Tsarenko 2008). Ukraine has a history of problems with technological losses in its electricity production. Between 2000 and 2004, average annual power losses (commercial and technical) for transmission by power transmission networks amounted to 31.5 billion kW/hour – equivalent to 19.9% of total power input to the network. As of 2008, the level of technological losses was 'down' to 12.5% of the electricity produced – still 2-2.5 times higher than in developed countries. Reducing these losses will require investment and modernization of the transmission and distribution networks (ibid, Energy Strategy (2006)).

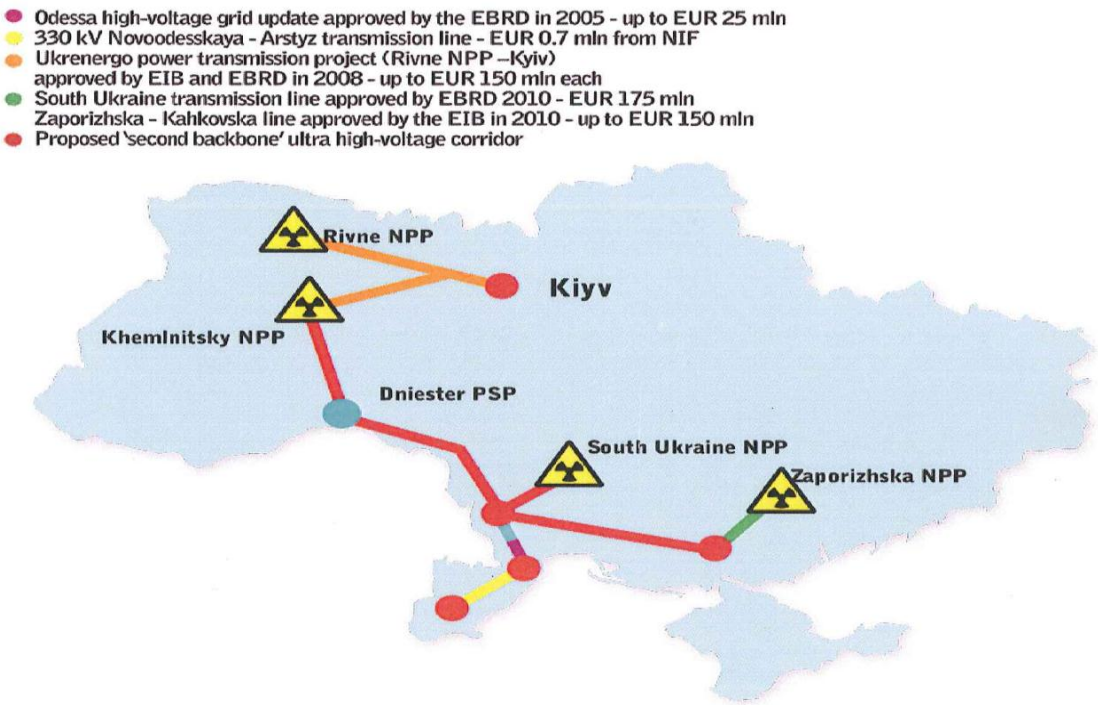
Figure 11: Electric power produced and Losses in its transmission by Power Networks of Ukraine (billion kW/hour)



Source: *The Energy Strategy of Ukraine for the period until 2030* (Ministry of Fuel and Energy of Ukraine & National Academy of sciences of Ukraine, 2006: 30).

The European Bank for Reconstruction and Development (EBRD) has since 2005 invested roughly EUR 400 million in high voltage transmission line projects across Ukraine, sponsored by the Ukrainian state owned company Ukrenergo. Figure 12 shows transmission line projects already funded or planned to be funded with EU financing(Bankwatch 2011).

Figure 12: Ukrainian transmission line projects already funded or planned to be funded with EU public finances.



Source: Bankwatch (2011)

When starting up small hydro production, an important element is connection to the grid. According to Ukrainian regulations the distribution companies, the *Oblenergos*, are obliged to pay for the connection. In practice, the investor usually has to pay for the construction. This money shall later, according to the law, be reimbursed by the *oblenergos*. Here it should be mentioned that there exist serious doubts as to whether this system works in practice and whether investors will in fact get their money back (interviews Kiev, September 2011).

4.3 Energy subsidies: Feed-in tariffs for renewable energy

As noted, Ukraine has a huge renewables potential (wind, bio-, solar and hydro). As yet, the country has produced renewable energy only in negligible amounts. Moreover, it remains a heavy consumer of gas, with Russian gas accounting for the majority of total consumption. Ukrainians (at least household consumers) had long been able to enjoy cheap and subsidized gas. However, the gas dispute with Russia in 2006 marked the start of a market relationship without the same favours as before. The steep increase in the price of gas has therefore made energy generation from renewable/alternative sources a hot topic in Ukraine today.

One of the incentives set forth by the Ukrainian government to increase the share of renewable energy was the introduction of green tariffs. The legislation was debated for years before it was agreed in 2008. Several drafts went through the first reading (two readings are required), which means an initial vote in the Ukrainian parliament. The second reading

was postponed for requested amendments, but in 2008 the first Green Tariff Law passed the second reading and could be signed by the president. However, during the financial crisis in 2008, the local currency depreciated against the Euroand USD to level that made the Green Tariff Law no longer a feasible feed- in tariff. As a result on 22 April 2009 the president approved a 'revised' Green Tariff rate calculation methodology.

This new law offers developers and investors the highest feed-in tariffs in Eastern Europe. The Green Tariff is pegged to the Euro, which entails a fixed tariff valid until 1 January 2030 and a guaranteed electricity off-take by the wholesale electricity market operator. The tariffs apply to new construction as well as existing renewable energy producing facilities put in operation prior to 2014. The Green Tariff is revised on a monthly basis to follow changes in the UAH/EUR currency exchange rate, with a guaranteed 'minimum floor' in Euros. It includes a guarantee against local devaluation, and has resulted in higher prices for alternative energy producers (IMEPOWER Consulting 2010).

The Green Tariff is set by NERC, and covers alternative energy production such as biomass, biogas, wind- power plants and hydropower plants. So far the only capacity cap on Ukraine's Green Tariff is on hydropower plants, where eligible facilities may not exceed 10 MW in capacity. The tariffs for small hydro are fairly high, but nothing compared to the solar tariffs, as can be seen in Table 3.

Table 3: Green Tariffs in Ukraine, €/MWh (net of VAT)

Types of RES / Alternative Energy Sources	Green Tariff in Ukraine	Methodology of Green Tariff Calculation			
		Formula for Green Tariff Calcula-tion	Retail Electricity Tariff Applicable for the 2nd Voltage Class Consumers[1]	Green Coefficient [2]	Peak Period Coefficient [3]
			A	B	C
Wind plants with installed capacity of less than 0.6 MW	64.6	A x B	53.85	1.2	Not applied
Wind plants with installed capacity of more than 0.6 MW but less than 2 MW	75.4	A x B	53.85	1.4	Not applied
Wind plants with installed capacity of more than 2 MW	113.1	A x B	53.85	2.1	Not applied
Biomass plants	123.9	A x B	53.85	2.3	Not applied
Solar plants located on land	465.3	A x B x C	53.85	4.8	1.8
Solar plants installed on the roofs of buildings with capacity of more than 0.1 MW	445.9	A x B x C	53.85	4.6	1.8
Solar plants installed on the roofs of buildings with capacity of less than 0.1 MW and for solar plants installed on the front of buildings irrespective of their capacity	426.5	A x B x C	53.85	4.4	1.8
Small hydro plants	77.5	A x B x C	53.85	0.8	1.8

Source: IMEPOWER Consulting
[1] Set by the NERC as of January 2009 and calculated at 10.86 UAH/EUR official exchange rate set as of January 1, 2009
[2] Set in the Green Tariff Law
[3] Set by the NERC as of July 2005

Source: IMEPOWER Consulting (20010: 2)

The development and introduction of the Green Tariffs did not come about solely because of the wish to beless energy-dependent on Russia. The role of the oligarchs should also be mentioned. During President Leonid Kuchma's decade in office, Ukraine's oligarchs made their greatest capital accumulation through the re-sale of Russian energy – particularly during the 1990s when Russian energy was imported at below 'market' prices. According to Kuzio (2008), corruption from the energy sector through the newly established Naftohaz Ukrainy and the role of the Ukrainian oligarchs provided Kuchma with resources crucial for winning the 1999 elections. In that sense, the oligarchs played the same role as their Russian counterparts had in ensuring Boris Yeltsin's re-election in 1996. Interviewees (in Kiev, September 2011) have further confirmed that the oligarchs were active in the development of Ukraine's Green Tariff scheme. Such tariffs were. It is argued, seen by certain individuals as a way to make money. This was certainly the case with the solar industry, which emerged as the technology with the best Green Tariff conditions (see Table 2).

4.4 Tariff structure and payment systems

It is the National Electricity Regulation Commission of Ukraine (NERC) which regulates electricity and gas tariffs. District heating, on the other hand, is subject to the approval of the local authorities according to the Law on Heat Supply (Park 2011).

Electricity consumers in Ukraine are categorized as either regulated tariff consumers or non-regulated tariff consumers. The first group includes households, settlements (lighting, group consumer) and other consumers. The non-regulated group includes big companies with special permits (Park 2011). As mentioned, Ukraine has almost universal access to electricity. The challenge, however, is to ensure that this remains affordable to the people.

A problematic factor in the operation of the electricity market is the high level of cross-subsidization by industrial actors with regard to the cost of electricity supplied to certain consumer categories at reduced tariffs (Arzinger 2011). Electricity tariffs generally involve the price of generation, transmission, distribution and supply. During Soviet times, tariffs were set by the state. They did not cover the actual costs, as electricity supply was seen as a public good or even a human right. Industrial customers paid much higher tariffs in order to subsidize these low prices for households and other end-customers. Ukraine continued with the practice of subsidized energy also long after independence from the Soviet Union in 1991; even today, it has to a large extent retained the low energy- price policy which originated in the Soviet era (Dodonov et al. 2003).

Energy prices in Ukraine – especially for electricity, gas and district heating – are low compared to other OECD countries. As a result, the revenues from sales do not cover the costs. This in turn has led to a situation where several Ukrainian energy providers have not even been able to finance necessary investments for capacity replacement and maintenance. Energy prices generally cover only actual operating costs,

without taking the long-term costs of energy supply into account. According to NERC, in 2006 electricity tariffs covered only 60 % of the total production costs (Tsarenko 2007).

Low prices for households have been possible due to subsidization and cross-subsidization from industrial consumers to households. The low household tariffs are still, after years of economic reforms, a sensitive issue in Ukraine. 'Although tariffs have been increasing several times in Ukraine since 1991, they still remain far below cost covering levels, and cross subsidization of private households and agrarian customers by industry still takes place' (Dodonov et al. 2003: 855). Ukraine lags behind other transition countries in re-balancing electricity tariffs between households and industry. As can be seen from Table 4, industrial consumers in Ukraine pay substantially higher energy prices than do households (Park 2011). The present system of subsidies is not sustainable; according to Fankhauser et al. (2008: 4168) 'tariffs will have to go up substantially to make the underfunded networks financially viable again and finance the extensive rehabilitation needs'.

Table 4: Electricity tariffs for Industrial and Household consumers

Tariff period	House-Holds	First Group	Second Group	Big Com-panies
Jan 2008 – Dec 2008	24.4	39.8	53.4	24.8
	(4.6)	(7.6)	(10.2)	(4.8)
Jan 2009 – Sept 2009	24.4	52.3	70.2	27.5
	(3.2)	(6.8)	(9.1)	(3.5)

Source: Taken from Park (2011: 16).

Notes: First group (o.4-10 kW); second group (35-110 kW); big companies (92 with special permits).

Also relevant is the history of non-payment in Ukraine. According to Dodonov et al. (2003) it has been common to manipulate electricity meters; the same author also claim that official estimates showed that Ukrainian households were at times paying for only 70 –80% of the electricity they consumed. Non-payment has traditionally had no consequences such as disconnection from the energy supply, and no Ukrainian governments or politicians have been willing to enact laws and regulations to enforce payment by private households, as by power disconnection.[3] This is slowly beginning to change. With the ricing prices

[3] Disconnecting individual users from the energy supply also faces some technical problems, at least with multi-storey buildings (Dodonov et al. 2003). However, various ways of solving these technical issues are now being tested out (interviews Kiev, September 2011).

for gas and electricity it is becoming obvious also for Ukrainian politicians that such a system cannot remain sustainable much longer. Non-payment for electricity consumed has led to serious cash shortages in the sector, in turn resulting in fuel- supply shortages and frequent interruptions of the electricity supply. Tariff policy has an important role to play in modernizing the sector as well as in improving the reliability of electricity supply (Dodonov et al. 2003).

A further element is the debt situation. Table 5 shows the debt dynamics of the power sector of Ukraine in the period 2000 – 2006. According to Herasimovich and Tsarenko (2008) the main reason for the accumulation of debt was the non-payment crisis of the late 1990s. At its worst in 1998, only 7 – 10% of electricity bills were paid in cash; 77% were settled through barter arrangements, and the remainder was not paid at all. In 2000, Energorynok was created with the aim of eliminating barter settlements and clearing up cash flows for electricity. Energorynok is currently the largest debtor in the electricity market. A system of 'special accounts' has also been introduced to prevent misuse of energy funds. As can be seen in Table 5, the amount of debt decreased in 2006 after many years of continuing increase of the accrued amount of non-payment.

Table 5. Debt dynamics in the power sector of Ukraine in the period 2000-2006

Date		1	2000	2001	2002	2003	2004	2005	2006
Consumer debt to distribution companies, mln UAH		**2**	**6,711**	**8,431**	**9,559**	**10,108**	**10,417**	**10,496**	**9,590**
Increase/ decrease	mln UAH	3	n/d	1,720	1,128	550	309	79	-906
	%	4	n/d	25.6	13.4	5.7	3.1	0.8	-8.6
Gross debt of distribution companies to Energorynok, mln UAH		**5**	**9,006**	**12,264**	**14,027**	**15,138**	**15,730**	**15,962**	**15,279**
Increase/ decrease	mln UAH	6	2,312	3,258	1,763	1,111	592	233	-682
	%	7	34.5	36.2	14.4	7.9	3.9	1.5	-4.3
Net debt of distribution companies to Energorynok, mln UAH (5-2)		**8**	**2,295**	**3,833**	**4,468**	**4,829**	**5,312**	**5,465**	**5,689**
Gross debt of Energorynok to creditors, mln UAH		**9**	**11,301**	**14,651**	**16,180**	**17,293**	**18,106**	**18,323**	**17,587**
Increase/ decrease	mln UAH	10	2,588	3,350	1,529	1,113	813	217	-736
	%	11	29.7	29.6	10.4	6.9	4.7	1.2	-4.0
Net debt of Energorynok to creditors, mln UAH (9-5)		**12**	**2,295**	**2,387**	**2,153**	**2,155**	**2,377**	**2,361**	**2,308**

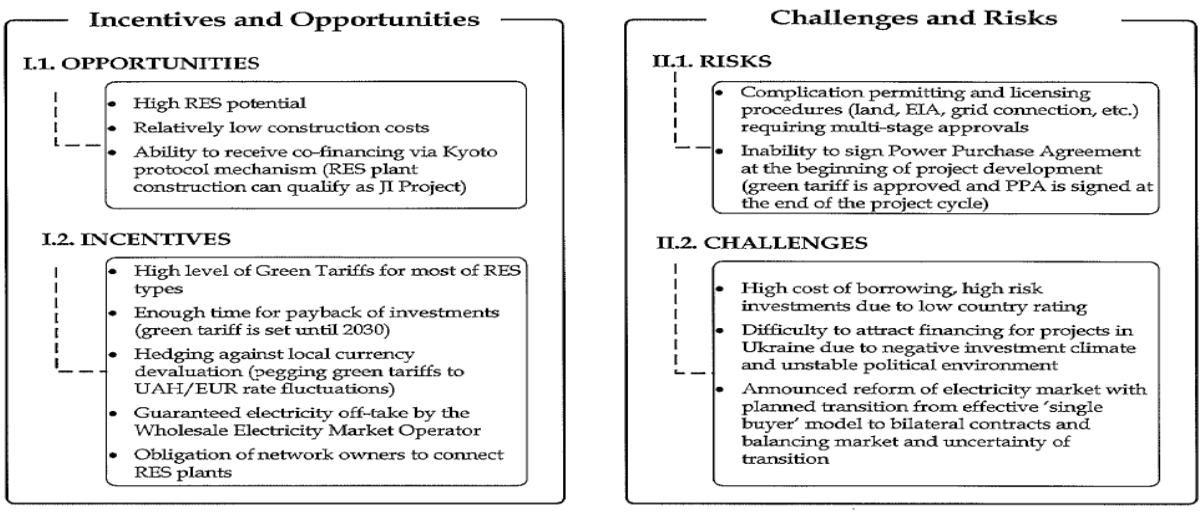
Source: Herasimovich and Tsarenko (2008: 15)

5 Business environment

5.1 Investment climate

Ukraine has since independence in 1991 tried to shift from a centrally-planned economy to a business environment driven by market forces. However, despite the country's natural resources, extensive human capital as well as industrial potential, there are several challenges and risks to be considered before starting up business in Ukraine (PWC 2011). For some investors these might even outweigh the natural potential (see Figure 13 for opportunities and challenges connected to investment in renewables in particular).

Figure 13: RES Project Development in Ukraine

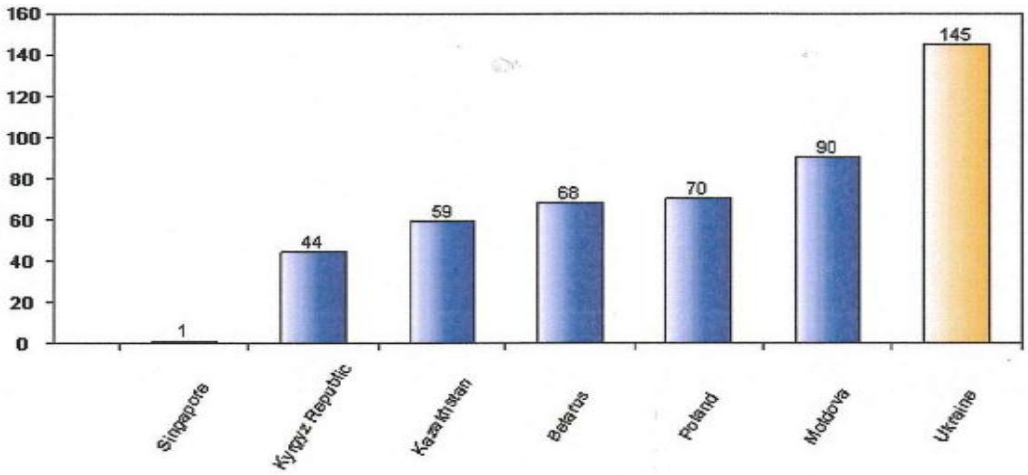


Source: IMEPOWER Consulting (2011: 5)

A noted by the World Bank and the International Finance Corporation in 'Doing Business 2011[4]' Ukraine can be a challenging country to do business in. Their report ranks it as 145 out of 183 economies (see Figure 14). For example the procedures for securing permits and getting necessary approvals are complicated, the project development process both costly and lengthy (Kubrushko 2010). However, reforms have been implemented which have improved investor protection in the country, and it is deemed likely that ratings will improve in the future (PWC 2011).

[4] "A set of regulations affecting 9 stages of a business's life are measured: starting a business, dealing with construction permits, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business" (IFC 2011:1).

Figure 14: Ease of doing business in Ukraine compared to a selection of other countries.



Source: IFC (2011: 2)

5.2 Financing and banking sector

Ukraine has a two-tier banking system, with the National Bank of Ukraine (NBU) as the central bank, and the other commercial banks operating under NBU supervision and authorization. The recent economic crisis has hit the Ukrainian banking sector hard, triggering a substantial slowdown in the credit market. Thus, the crisis continues to be a significant risk for the banking sector (PWC 2011).

Investments in the energy sector often entail the need for hefty loans or external funding. Especially after the financial crisis, however, loans from local banks are generally not available for such capital- intensive projects. Potential investors might be better advised to turn to international financial institutions like the EBRD and the IFC (IMEPOWER Consulting 2010).

5.3 Property rights, corruption and theft:

When a site for operation has been acquired, the important question of property rights arises. Heritage Foundation and *The Wall Street Journal* have developed a property rights index as a subcomponent of the Index of Economic Freedom. According to the Index of Economic Freedom, Ukraine's overall economic score is 45.8, which ranks it as only the 164th freest economy out of the 179 countries listed in 2011. The score is 0.6 points lower than the previous year, due mainly to the decline in government spending and in freedom from corruption. The same index also ranks Ukraine last of the 43 countries in the European region. Protection of property rights is weak in Ukraine. It is further noted that the judiciary is subject to the executive branch as well as to criminal pressure. Moreover, contracts are not well enforced, and there is the risk of expropriation.

According to Crane & Larrabee (2007) the Ukrainian regulatory and legal hurdles are designed to elicit bribes. They further argue that government employees in Ukraine, as like in other countries afflicted by corruption, deliberately design registration and licensing procedures to be so complex that they may credibly threaten to halt or slow trade or a foreign investment. All in all the time and expense involved in obtaining the requisite permits and licenses in order to trade, and set up a business adds substantially to the costs, as well as reducing both trade and investment.

Corruption in Ukraine is perceived as widespread: indeed, Crane & Larrabee (2007) see corruption as the greatest barrier to expanding investment and trade in Ukraine. Complying with the many bureaucratic demands, which are not always mutually consistent, makes it more time-consuming and more expensive to start a business in Ukraine. Thus, again according to Crane and Larrabee (2007), the advantages the country can offer in terms of low labour and operating costs are often not enough to compensate for the extra trouble and costs of trying to figure out the government bureaucracy.

Since the Orange Revolution of 2005, fighting corruption has been high on the political agenda in Ukraine. However, in Transparency International's Corruption Perceptions Index for 2009, the country ranks as 146th out of 180 countries –a sharp drop for the second year in a row (Transparency International 2011). Further Transparency International's (TI) has recently published a National Integrity System[5] assessment (NIS) which shows that Ukraine has made little progress in halting the tide of corruption. According to the 2010 Corruption Perception Index, Ukraine scored 2.4, which indicates widespread perception of corruption. The NIS of Ukraine indicates that corruption is a systemic problem found across the board at all levels of public administration; moreover, that both grand and petty corruption is flourishing. Political parties, the legislature, public officials, the police and the judiciary are all institutions perceived by the public to be highly corrupt. Further, according to the NIS, Ukrainian society to a certain degree can be characterised as having a high tolerance for corrupt practices (Crane & Larrabee 2007, Transparency International 2011).

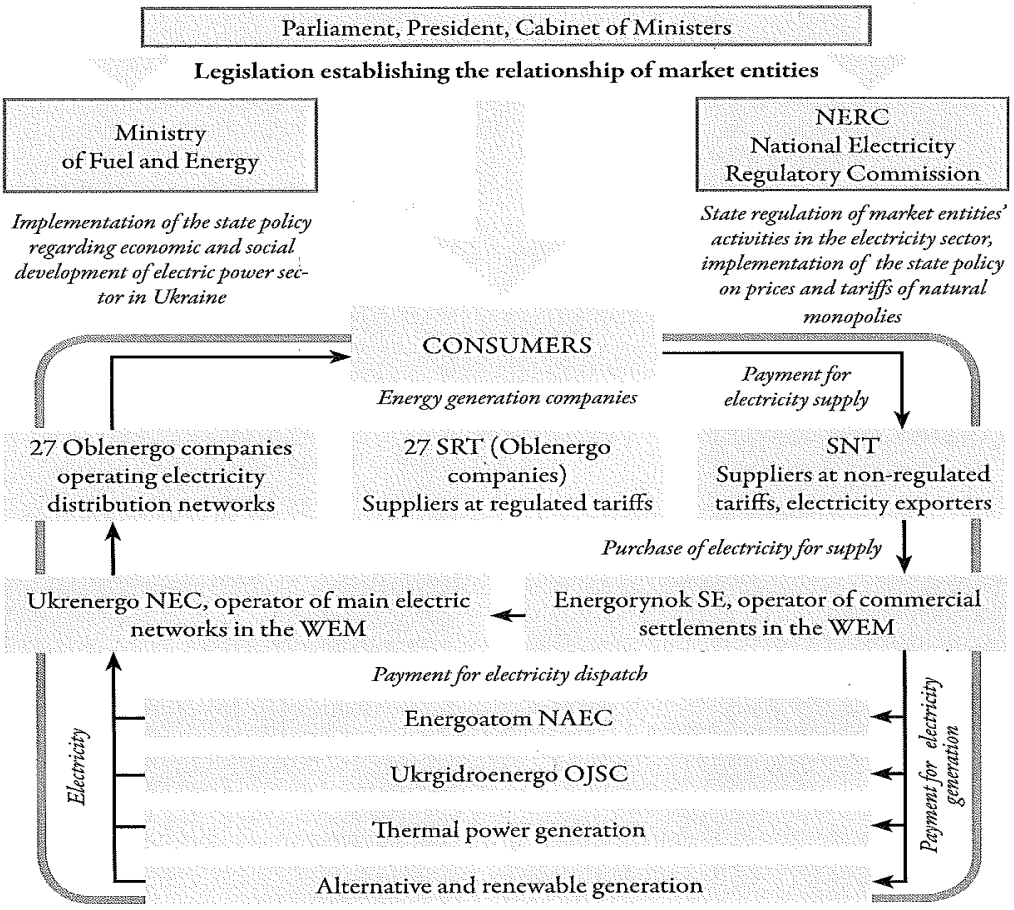
[5] The National Integrity System (NIS) assessment approach provides a framework which anti-corruption organizations can use to analyse the extent and causes of corruption in a spesific country as well as the effectiveness of national anti-corruption efforts (http://www.transparency.org/policy_research/nis).

6 International and national

6.1 Investors, owners and operators

Ukraine started the process of re-organizing its power sector in line with the British Pool model in 1994. Generation, transmission and distribution are the responsibility of separate companies. Among the countries of the former Soviet Bloc, Ukraine became the first to introduce a competitive electricity market (Dodonov et al. 2004, Herasimovich and Tsarenko 2008).

Figure 15: Current Energy Market Structure in Ukraine



Source: Arzinger (2011: 80)

After the Cabinet of Ministers adopted a decree in February 1996, the energy market started operation on 10 April the same year. Ukraine's wholesale electricity market (hereafter WEM) is a market set by business entities for the purchase and sale of electric energy under contract. Today it operates on the basis of the law 'On Electric Power Industry' as amended on 22 June 2000 (Arzinger 2011). WEM is made up of the following entities: electricity producers, suppliers of electricity at both regulated and non-regulated tariffs, the wholesale electric power supplier Energorynok SE (which provides centralized management of the United Energy System of Ukraine), as well as the grid operator National Energy

Company Ukrenergo. Ukraine's WEM operates according to the Single Buyer Model, as shown in Figure 15.

All these entities are to be licensed by National Electricity Regulatory Commission (NERC) in order to carry out their activities. According to the law 'On Electric Power Industry', the authority for state regulation of activities in the electricity industry is to be handled by NERC (Arzinger 2011).

The state company Energorynok acts as operator within the WEM. All electricityproduced is to be sold to Energorynok, which in turn sells the energy to the 27 distribution companies (*oblenergos*) and to the independent suppliers. Energy suppliers are of two kinds: suppliers operating with regulated (fixed) rates and those operating with at non-regulated (free) tariffs. Tariffs for electricity supplies with regulated tariffs are set by NERC, whereas tariffs for electricity supplies operating with non-regulated tariffs are set in agreement between suppliers and consumers. The so-called *oblenergos* are represented in the WEM according to the number of regions (25 regional and two municipal). The *oblenergos* in turn sell the electricity to the end- consumers according to regulated tariffs (Herasimovich and Tsarenko 2008). As explained by Arzinger (2011: 81) 'Physically, the electricity produced by generating companies gets to the consumer through the main and distribution electric networks based on agreements on the transfer of electricity between the relevant WEM entities'.

With the introduction of Green Tariff system, interest in developing renewable energy projects in Ukraine has increased. More and more actors – both Ukrainian and foreign investors – are looking around for good locations.

6.2 Technology suppliers

Ukraine has the experience and technology for large hydro, but not for small-scale hydro production. An investor starting up with small hydro production is advised to import the necessary equipment, as it might prove more expensive to get Ukrainian's large- hydro technology suppliers to produce single items for small hydro than to obtain it from abroad (interviews Kiev, September 2011).

An additional barrier is that it is required that from 2012, 30% of the specific weight of raw and other materials, key assets, works and services must be of Ukrainian origin. From 2013 this will increased to 50%. Precisely because Ukraine lacks experience in producing the equipment needed for small hydro, the recuirement for such a high percentage of domestic equipment can become problematic and was by several interviewees seen as a potential barrier to foreign investment. Others, however, said that since this included manual labour and services, reaching these targets should be possible (interviews Kiev, September 2011).

7 Future prospects

Production capacities in the electricity sector in Ukraine are outdated, and as much as 95 % of existing power plants have reached the end of their normal life cycle (Herasimovich and Tsarenko 2008). Such a situation poses a challenge for future electricity supplies, but also clearly shows the need for new investment. A country with such vast renewables potential as Ukraine, and where more than 60 % of communal and housing services receive energy in the form of gas, offers great opportunities for investors in the field of renewable energy (IMEPOWER Consulting 2010).

According to Winkler (2009), the renewed interest in small hydro in Ukraine can be explained by the spreading energy shortage as well as the ricing prices of energy production and transport. Since power production from small hydro plants can take place close to settlements or industrial installations, it may prove more profitable than power production from larger plants with longer distribution lines. Further, small hydro plants cost less for construction and maintenance than do large- scale plants. According to Winkler (2009) investment in a small hydro plant can be repaid within 5- to 8 years. This type of energy production will not require extensive prior investigation and can be operable in a short time.

The introduction of the Green Tariffs system made Ukraine overnight a far more attractive and lucrative place for investors in the renewable energy sector. However, with regard to this tariff system, the important question is predictability and stability. Can this policy be expected to remain stable for 10–15 years –or will new tariffs be discontinued once influential actors have managed to secure the tariffs for their investments? On the one hand interviewees argued that it is written in the law that the system will continue until 2030, so that stability and predictability was ensured. It was further noted that the Green Tariff system is not a one man show, but is grounded in a larger consensus within the Ukrainian political system. Others, however, argued that in the case of Ukraine anything is possible, and that changes of government can entail changes in rules and regulations.

Interviewees noted that one way to get around potential problems, or at least reduce the obstacles, is to get a trusted local partner. Good local connection can speed up the process as well as handling practical issues that can be difficult for foreign investors. Moreover, this can mean doing business with an influential local partner who can sort out corruption-related problems and speed up the process, but who can also take over the assets.

8 Recommendation for national policies

With the great incentives and opportunities within the renewable sector in general, and within small hydro in particular, Ukrainian politicians should focus on minimizing the challenges and obstacles facing foreign investors seeking to do business in Ukraine. One way to attract foreign businesses and foreign direct investment is to improve the country's reputation and ratings with regard to the business climate. The Orange Revolution was by many seen as the beginning of a new transformation in the social, economic and political life of Ukraine. During such times of major upheaval and change, corruption and lack of transparency and integrity can to some extent be tolerated and even nurtured in order to get necessary things accomplished quickly under such uncertain conditions. However, this makes it even more important to counteract quickly the distortions to the social, economic and political fabric of the country to avert permanent damage and a deceleration of development objectives. The Yushchenko government announced its willingness to fight corruption and its pledge to work toward European Union accession. These are positive signals for potential investors, signals that need to be translated into policies that can yield visible results (Blue Ribbon Analytical and Advisory Centre 2009).

President Viktor Yanukovich has confirmed his predecessor Viktor Yushchenko's wish to establish a closer relationship with the EU. However, with Yanukovich, relations with Russia have again become stronger. How the Ukrainian president manages this balancing act will be important with regard to Ukraine's relationship to the EU (PWC 2011). The accusations of a politically motivated trial against Julia Tymoshenko and a corrupt court system have shown that Ukraine still has a long way to go before it can be perceived as a stable and predictable country to do business in, and have added fuel to the fire of Ukraine sceptics within the EU.

As for the current situation with the good economic incentives for investors within the renewable energy sector, Ukrainian politicians will need to concentrate on establishing a transparent and well-functioning business environment. That means getting rid of the widespread corruption practices and creating a more stable and predictable working environment for international investors. It is important to show that the new tariffs are stable and predictable, and not subject to change due to political fluctuations.

To invest or not in small hydro in Ukraine? Potential investors are confronted with great opportunities as well as risks and obstacles. The country's natural small- hydro potential makes Ukraine undoubtedly attractive; moreover, there still are several brownfields and unexplored areas remaining. On the other hand, investors must be aware of the severe risks and challenges. If an investor can cope with a high level of risk and can manage to find a good trusted local partner, investing in small hydro in Ukraine may prove a lucrative proposition worth exploring. If not, it might be better to considering making the investments elsewhere.

Bibiliography

Arzinger (2009). 'Public–Private Partnership in Ukraine'. Available at http://arzinger.ua/file_collection/en/PPP_Book_2nd_edition_ENG.pdf

Arzinger (2011). 'Energy Law Guide'. 2nd edition. Available at http://arzinger.ua/file_collection/de/book_Energy_engl_2011.pdf.

Bankwatch (2011). 'Ukrainian transmission lines — a vehicle for dirty electricity to the EU'. Available at http://bankwatch.org/sites/default/files/briefing_EBRD_UAtransmissionlines-May2011.pdf.

Blue Ribbon Analytical and Advisory Centre (2009). 'Policy recommendations on economic and institutional reforms 2009'. Available at http://www.undp.org.ua/files/en_96333PolRec_Eng.pdf.

Blue Ribbon Analytical and Advisory Centre (2010). 'Demographic and financial preconditions of the pension reform in Ukraine: forecast – 2050'. Available at: http://www.undp.org.ua/files-/en_60467Demography_Pension_ENG.pdf

CIA Factbook (2011). 'The world factbook'. Available at https://www.cia.gov/library/publications/the-world-factbook/geos/up.html.

Crane, Keith & F. Stephen Larrabee (2007). *Encouraging Trade and Foreign Direct Investment in Ukraine*. Available at http://www.rand.org/pubs/monographs/2007/RAND_MG673.pdf.

Dodonov, Boris, Petra Opitz and Wolfgang Pfaffenberger (2004). 'How much do electricity tariff increases in Ukraine hurt the poor?', *Energy Policy*, Vol. 32, 855–863.

Fankhauser, Samuel, Yulia Rodionova and Elisabetta Falcetti (2008). 'Utility payments in Ukraine: Affordability, subsidies and arrears', *Energy Policy*, Vol. 36, 4168–4177.

Herasimovich, Viachaslau and Anna Tsarenko (2008). 'Overview of electricity market in Ukraine'. CASE updated report available at http://www.case-ukraine.com.ua/u/publications-/86c8a11a843e990d76330e55b66b712a.pdf.

Heritage Foundation and Wall Street Journal (2011). '2011 index of economic freedom'. Available at http://www.heritage.org/index/

Imepower Consulting (2009). 'Power sector overview'. Available at http://www.imepower.com/index.php?lang_id=3&menu_id=17&parentmenu_id=2.

Imepower Consulting (2010). 'Ukraine sets out on green path'. Available at http://www.imepower.com/files/5/article_eiee_oct2010.pdf.

Imepower Consulting (2011). *General Overview of Renewable Energy in Ukraine*. Kiev, Ukraine.

Kovalenko , Elena (2007). 'Overview of Ukrainian SHP'. Unpublished paper.

Kuzio, Taras (2008). 'Ukrainian politics, energy and corruption under Kuchma and Yushchenko'. Available at http://www.taraskuzio.net-/conferences2_files/Ukrainian_Politics_Energy.pdf.

Ministry of Fuel and Energy of Ukraine & National Academy of Sciences of Ukraine (2006). *The Energy Strategy of Ukraine for the Period till 2030*. Kiev.

Mosaic Investment (2009). 'Renewable energy in Ukraine: a new legislation is coming'. Available at http://www.mosaic.kiev.ua-/ru/files/RenewEnergy_legal_issues_210413.pdf.

NIKO (2011). 'Macroeconomics. Foreign Direct Investment in Ukraine'. Available at http://www.kua.niko.ua/wp-content/uploads/2010/07-/Sector_Review_Macro-q-FDI_2011_full-v_ENG.pdf.

Park, Hi-chun (2011). 'Towards cost-reflective energy pricing in Ukraine', *International Association for Energy Economics*, first quarter, 15–18.

PWC (2011). 'Doing business and investing in Ukraine'. Available at http://www.pwc.com/ua/en/survey/assets/Doing_Business_in_Ukraine_2011.pdf.

Raslavičius, Laurencas, Anna Grzybek and Valeriy Dubrovin (2011). 'Bioenergy in Ukraine – Possibilities of rural development and opportunities for local communities', *Energy Policy*, Vol. 39, 3370–3379.

Transparency International (2011). 'Corruption perception Index 2009'. Available at http://www.transparency.org/policy_research-/surveys_indices/cpi/2009/cpi_2009_table.

Tsarenko, Anna (2007). 'Overview of electricity market in Ukraine'. CASE report available at: http://www.case-ukraine.com.ua/u-/db/f6e3285141e96796656164c1b279de3c.pdf.

UNDP and Ukrainian Ministry of Economy (2005). 'Ukraine. Poverty alleviation'. Available at: http://www.undp.org.ua/files-/en_24267mdgp.pdf.

Winkler, Igor (2009). 'Small hydropower resources and prospects of small hydropower electric plants in the near-border regions of Ukraine', *Energy and Environmental Challenges to Security*. NATO Science for Peace and Security Series C: Environmental Security, Part 6, 371–378.

World Bank and the International Finance Corporation (2011). *Doing Business 2011. Ukraine. Making a difference for entrepreneurs*. Washington DC: The International Bank for Reconstruction and Development / The World Bank.

List of figures and tables

The Fridtjof Nansen Institute is a non-profit, independent research institute focusing on international environmental, energy, and resource management. The institute has a multi-disciplinary approach, with main emphasis on political science, economics, and international law. It collaborates extensively with other research institutions in Norway and abroad.

FRIDTJOF NANSENS INSTITUTT
FRIDTJOF NANSEN INSTITUTE

Fridtjof Nansens vei 17, P.O. Box 326, NO-1326 Lysaker, Norway
Phone: (47) 67 11 19 00 – Fax: (47) 67 11 19 10 – E-mail: post@fni.no
Website: www.fni.no