Takeaways

The Ukrainian electricity system is at risk. Doubling of the electricity demand by 2030, outdated thermal production facilities and higher fuel costs make the Ukrainian electricity system vulnerable and substantial investments are required to ensure reliable supply of electricity in the future.

The generation facilities are only utilising 38% of their capacities. This is mainly due to old, inefficient plants and poor transmission lines. Coal and nuclear contribute with more than 80% of the total electricity generation of around 180 TWh (2010). The renewable share is currently at around 7% of the generation.

Renewable energy plants below 10 MW receive some of the highest subsidies in Europe. The implementation of green tariffs in 2008 increased the average price received by renewable energy producers to around 23 EUR cents per kWh. This is around 8 times higher than the non-renewable wholesale price. Producers of solar power receive the largest subsidy at around 47 EUR cents per kWh.

Despite attractive green tariffs, renewables in Ukraine implies high risk for investors. The investment climate is as important as green tariffs for installing new renewable capacity. Corruption, powerful oligarchs and political instability are creating large barriers for investors wanting to do business in Ukraine. This will be analysed more thoroughly in our next report on Ukraine.
What’s at stake?

Although Ukraine is currently a net exporter of electricity, the country is facing a significant energy security risk, due to primarily three factors. First, the electricity production facilities, in particular hydro and thermal plants, are becoming out-dated. 95% of them have reached the end of their normal life span and major investments are now needed to keep up the production capacity.

Second, not only the power plants themselves, but also the inputs to them – the fuel – constitute a considerable risk. A significant share of Ukraine’s aging electricity system are based on thermal inputs such as oil and gas, traditionally imported at a low price from Russia. This discounted supply of energy has seen increasing prices over the past years. In 2009, Ukraine and Russia’s 4-year long dispute over gas prices, and the cost of transit, erupted into a gas crisis, affecting the gas supplies of 18 European countries. Whilst the gas price dispute with Russia was solved in 2009, Ukraine’s dependency on Russia for resources is still high. In 2010, Ukraine imported close to 80% of its natural gas and approximately 85% of its oil from Russia. Crises like these have forced Ukraine to seriously consider its energy security and geopolitical risks.

Finally, the electricity consumption per capita in Ukraine is very high because of inefficiencies both in industry and household consumption, following years of subsidised electricity prices. The annual electricity consumption is also expected to double over the next 20 years, to more than 395 TWh in 2030. Hence, both the supply and demand side are facing severe challenges that make the Ukrainian electricity system vulnerable.

This report provides a brief overview of the Ukrainian electricity system, including the physical facts, the regulatory framework under which the various players are operating as well as the potential for electricity generation based on renewable sources. This will be the context for an upcoming analysis of the green tariff scheme in Ukraine and business opportunities emerging from that scheme.

The Ukrainian electricity system

Ukraine has a population of more than 45 million and is the second largest country in Europe. Since 2000 the Ukrainian economy has experienced an annual average growth of around 6%. Despite this, Ukraine is still poorer than its neighbouring countries. In 2009, 35% of Ukraine’s population was living below the poverty threshold. The average GDP per capita in 2010 was US$ 6,700, ranking Ukraine as number 133 out of 190 countries.

The total installed electricity generation capacity in Ukraine is approximately 52 GW or 1.16 kW per capita [2009], which compares to for instance 2.65 kW/cap and 1.84 kW/cap for Romania and Germany respectively. The installed capacity is dominated by thermal (64%) and nuclear power (27%) capacity (see Table 1). Hydropower generation is the main renewable energy (RE) generation capacity at 9%, while Ukraine’s wind power capacity is modest at less than 0.08 GW (~0.15%).

In 2009, Ukrainian gross electricity production amounted to approximately 173 TWh, with nuclear and coal-based generation adding up to more than 140 TWh, 48% and 35% of total, respectively. Ukraine’s dependency on gas for electricity generation has been reduced significantly over the past years due to high input prices. In 2009, approximately 18 TWh (11%) of electricity was generated using gas. Hydropower contributed with 7% of the total production. In 2010, electricity generation was at 191.5 TWh, a 10% increase from the year before.

In 2009, the average capacity factor – the share of the installed capacity that was actually in operation over the year – was 38%, which is for example 3% lower than Romania and 28% lower than Indonesia. As can be seen from Table 1, nuclear energy has the highest capacity factor (69%), while thermal production is at only 27%. The low capacity factor is a consequence of overcapacity, lack of export possibilities due to poor transmission grid, as well as high costs at thermal plants due to inefficient generation capacity and high cost of inputs. The residual lifetime of Ukraine’s thermal capacities [45% of annual production: World Energy Database [2011]]

Table 1: Low capacity factors
The table shows installed generation capacity and electricity generation by technology for 2009, as well as the estimated capacity factor by technology. Source: Installed capacity: Imepower [2011]. Production: World Energy Database [2011]

<table>
<thead>
<tr>
<th>Installed capacity</th>
<th>Generation</th>
<th>Capacity factor</th>
<th>World average</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW</td>
<td>TWh</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Thermal</td>
<td>33.5</td>
<td>64.3%</td>
<td>45.2%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>13.8</td>
<td>25.6%</td>
<td>47.9%</td>
</tr>
<tr>
<td>Hydro</td>
<td>4.7</td>
<td>9.0%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Wind</td>
<td>0.08</td>
<td>0.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td>52.08</td>
<td>100%</td>
<td>173.2</td>
</tr>
</tbody>
</table>
The Ukrainian electricity system - a brief overview

generation) are limited, some has indicated that typically 2-5 years remain, which means that a significant share of the country’s generation capacity will need to be replaced in the near future. Due to the increasing cost of thermal inputs, most of the capacity expansion is planned to come from nuclear and other non-thermal energy sources.

In 2009, Ukraine’s electricity consumption was approximately 135 TWh, 22% below the production level. The consumption is divided fairly evenly between households and domestic industry, at 43% and 50% respectively. Whilst Ukrainian electricity demand per capita has increased by nearly 15% from 2001 to 2009, total consumption of electricity fell around 3% between 2000 and 2011. The demand growth until 2007 was largely driven by increased economic activity and increased household consumption, whilst the growth of input prices and consequent increase in end-user prices is the main reason for the late fall in electricity consumption.

As seen from Figure 1, Ukraine has been a net exporter of electricity each year except 2007 during this century, and is currently exporting around 4 TWh per year. Ukraine’s main export markets are Slovakia, Poland, Hungary and Romania.

The grid density of Ukraine is reasonably high and the country enjoys an electrification rate of nearly 100%. Ukraine has a history of high transmission losses mainly caused by insufficient upgrading of the transmission grid. From a reasonable level of 7% in 1991, transmission losses peaked in 2002, when they accounted for nearly 20% of generated electricity.

Although transmission losses have been reduced, partially due to the EUR 400 million investments to improve the Ukraine transmission grid by the European Bank for Reconstruction and Development (EBRD), transmission losses are still high. In 2008, Ukrainian transmission losses were still close to 12%, 2-2.5 times higher than average in developed countries. Hence, electricity generation needs to be significantly higher than the consumption if Ukraine is not going to be dependent on import.

Table 2: Large renewable energy potential

<table>
<thead>
<tr>
<th>Economic potential (TWh/yr)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>97</td>
</tr>
<tr>
<td>Wind power</td>
<td>42</td>
</tr>
<tr>
<td>Biogas</td>
<td>28</td>
</tr>
<tr>
<td>Solar PV</td>
<td>16</td>
</tr>
<tr>
<td>Small-scale hydro</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
</tr>
</tbody>
</table>

Figure 1: Net exporters of electricity

The figure shows the annual Ukrainian electricity imports and exports in TWh for the period 2000-2011. Source: CIA World Factbook (2011)
How does renewable energy (RE) fit into this picture? If all of Ukraine’s technical potential for renewable energy sources was exploited it is believed to add up to 650 TWh per year. This situation is unlikely due to both technological and economic constraints. Table 2 outlines the forecasted utilisation of renewable energy sources in Ukraine, which provides a more realistic picture of the exploitable renewable potential.

The largest estimated potential for renewable energy generation is in geothermal generation, whilst the country’s estimated potential in wind and biogas power are also significant. Solar PV and small-scale hydro are assumed to be able to generated around 30 TWh if the economic potentials are fully utilised, or around 7% of the estimated generation in 2030 (see Figure 2). If Ukraine utilised all of its forecasted potential of renewable energy sources, a total of 196 TWh/year of electricity would be generated by renewable energy sources.

Going forward, the Energy Strategy of Ukraine up to 2030, as approved by the Cabinet of Ministers in 2006, outlines forecasts of electricity generation growth. The need for electricity generation is expected to double over the period from 2010 (210.1 TWh) to 2030 (420.1 TWh). The forecast seems to overshoot slightly, as annual generation in 2010 was 191.5 TWh, 18.7 TWh less than forecasted. Similarly, consumption has also proved to be less than this forecast, ending at 148 TWh in 2010, while the forecast was around 200 TWh. The general picture is nevertheless that demand will increase significantly and that substantially more generation capacities are needed.

The Energy Strategy of Ukraine also outlines the Ukrainian government plans for capacity expansion by nuclear power plants, and future utilisation of renewable energy sources for electricity generation. The base case scenario, estimated using the forecasted growth of electricity generation, shows that the share of electricity generated by renewable energy sources (RES) is expected to increase from 22 TWh to 34 TWh between 2010 and 2030, hence around 17% of the estimated economic potential for renewables (see Table 2).

The renewable share of total electricity generation is, however, expected to fall from an estimated 10.7% (2010) to 8.1% in 2030, due to the strong growth in total electricity generation. The largest increase of RES is expected to come from the use of solar energy, while heat pumps are the most promising energy efficiency measure.
The regulatory landscape

In order to understand the Ukrainian electricity system and how it may evolve, the regulatory aspects including the players and the rules that govern them are essential to grasp. Who are the players? What are the rules and laws?

The players

During the mid-1990s Ukraine underwent substantial reforms and became the first amongst the Former Soviet Union (FSU) countries to liberalise the electricity sector. In 1995, the National Electricity Regulation Commission (NERC) was established. NERC has the legal authority to handle all activities in the electricity industry, including the overall responsibility for the wholesale energy market (WEM) that opened in 1997.

The Ukrainian electricity sector consists of 51 generators of electricity, including 13 enterprises producing electricity from renewable sources, the wholesale electric power supplier and market administrator (Energorynok), the state-owned national grid company (Ukrenergo), the distribution companies (Oblenergos) which also function as electricity suppliers for retail customers, as well as the independent suppliers that supply large industrial customers [see Figure 3].

The Ukrainian electricity market is based on a single-buyer model with Energorynok as the only buyer. All licensed power plants with a capacity over 20 MW and annual generation exceeding 100 GWh, and wind power generators regardless of size, are obliged to sell their electricity to Energorynok.

Electricity generators based on large-hydro and nuclear sell at regulated prices [tariffs] to the wholesale market, while thermal power plants sell to a competitive bidding platform where the prices are set on a daily basis. Hence, the prices are dependent on the source of generation and the market is not [yet] completely liberalised. The average wholesale market price in 2009 was 25 kopecks/kWh [2.4 EUR cents/kWh]. Smaller electricity generators may – but are not obliged to – sell to Energorynok.

Energorynok purchases electricity at various wholesale market prices and sells to the 27 oblenergos and independent suppliers at a blended rate. In 2009, the average blended wholesale rate was 28.6 kopecks/kWh [2.8 EUR cents/kWh]. Theoblenergos, which are regional natural monopolies, are responsible for distribution, supply and the provision of electricity services to end-users, as well as sales of electricity to consumers at NERC-regulated end-user tariffs. The average end-user tariff in 2009 was 49 kopecks/kWh [4.7 EUR cents/kWh].

Figure 3: Energorynok - the centre of the Ukrainian electricity sector
The charts shows the major players and segments of the Ukrainian electricity sector, including the flows of electricity and payments between these.
The Ukrainian electricity system - a brief overview

Although the Ukrainian electricity sector was unbundled and re-structured to increase competition in the mid-nineties, a large share of the sector is still in state hands. Following the consolidation of most of the non-nuclear generation and distribution assets into one single state-owned company in 2004, competition in the sector is limited. A new reform of the Ukrainian wholesale market, which would include a full liberalisation process and abandon the single-buyer model, has been discussed since 2008.

The rules
Table 3 outlines the most important laws and regulations that have been implemented over the last years in the Ukrainian electricity sector. The Law of Ukraine «On Electric Power Industry» from 1997 provides the main legislative framework for the electricity sector of Ukraine. The law was amended in 2008 to incorporate the legislative framework of Green Tariffs [The Law on Green Tariffs], the support system providing feed-in tariffs for alternative (renewable) energy sources. During the financial crisis the Ukrainian currency depreciated against the EURO to a level which made the feed-in tariff unfeasible as an instrument for stimulating green electricity generation. This resulted in new amendments to the law in 2009 when the green tariff system was modified to its current form, through the passing of a new Green Tariff Regulation.

The average green tariff for wind energy, biomass, solar energy and small hydropower is currently at 243 kopecks/kWh (23.5 EUR cents/kWh), significantly above the wholesale market price that non-renewable generators get (25 kopecks/kWh). Generators based on solar energy receive by far the highest tariff at just below 500 kopecks/kWh (47 EUR cents/kWh), while small-scale hydro plants get the lowest green tariffs at around 80 kopecks/kWh.

Business opportunities?
Given the fragile Ukrainian electricity system with its outdated production capacities and the expected growing demand on the one hand, and the apparently lucrative green tariffs for renewable energy generation on the other, there should be a space for investors and project developers within renewable energy sector in Ukraine. But how attractive is it really? What are the business opportunities in the renewable energy sector if not only taking into account the green tariffs, but also the entire market situation, the business and investment climate, as well as the political stability in the country? Moreover, there are reasons to believe that the high level of green tariffs currently in Ukraine is not sustainable in the long run. We will discuss this in another upcoming report on Ukraine – “Green tariffs in Ukraine – too good to be true?”.

Table 3: Stimulating green power?
The table provides an overview of laws and regulations concerning producers of electricity generated by RETs

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Year</th>
<th>Key content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law of Ukraine “On Electric Power Industry”</td>
<td>1997</td>
<td>Main legislative act for regulating the power industry</td>
</tr>
<tr>
<td>Law of Ukraine “On Alternative Energy Sources”*</td>
<td>2003</td>
<td>Defines legal, economic, ecological and organizational principles of use of alternative energy sources</td>
</tr>
<tr>
<td>Energy Strategy of Ukraine</td>
<td>2006</td>
<td>Provides government strategy for capacity expansion by nuclear and renewable energy technologies for electricity generation up until 2030</td>
</tr>
<tr>
<td>The Law on Green Tariffs “Amendments to the Law of Ukraine On Electrical Power Industry”</td>
<td>2008</td>
<td>Initial framework for Green Tariffs</td>
</tr>
<tr>
<td>The Energy Act «On Amendments to the Law of Ukraine «On Electrical Power Industry»</td>
<td>2009</td>
<td>Stimulation of alternative energy sources use. Revised framework for Green Tariffs Rate calculations by base and technology multiplier Local content requirements</td>
</tr>
<tr>
<td>Law of Ukraine «On Company’s Profit Tax»</td>
<td>2010</td>
<td>Energy enterprises’ income from sale of electricity generated from renewable energy sources shall be exempted from taxation for a term of 10 years starting from January 1, 2011</td>
</tr>
</tbody>
</table>
About

Differ [www.differgroup.com]
Differ’s business idea is to help scale up small-scale carbon reduction technologies [e.g. renewable energy and energy efficiency] in developing countries through i) providing free in-depth analysis on e.g. market conditions, feed-in-tariffs, financing and business opportunities in selected developing countries, ii) advising project developers, project owners, investors and other decision makers, iii) developing our own concepts and companies and iv) investing in start-ups.

Differ was founded in November 2010 by entrepreneurs that previously have started and developed companies like Renewable Energy Corporation (REC) and Point Carbon.

Differ Analysis series
This analysis is part of the Differ Analysis series, which provides in-depth analysis on market conditions, regulations, financing and business opportunities for carbon reduction technologies in selected developing countries. The reports are available for free on differgroup.com. Any questions or comments are appreciated on analysis@differgroup.com.

Upcoming analyses:
• Ukrainian green tariffs: Too good to be true?
• The Indonesian electricity system – a brief overview
• Is the Indonesian capacity crisis creating business for small-scale RE?
• The Kenyan electricity system – a brief overview

Differ Disclaimer
The content of this analysis is provided with the understanding that Differ is not herein engaged in rendering professional advice and services to you. The content of this analysis is provided “as is” without warranty of any kind. Differ shall have no liability or responsibility for any indirect, incidental, consequential, or punitive damages or for lost revenues or profits regardless of the theory of liability.