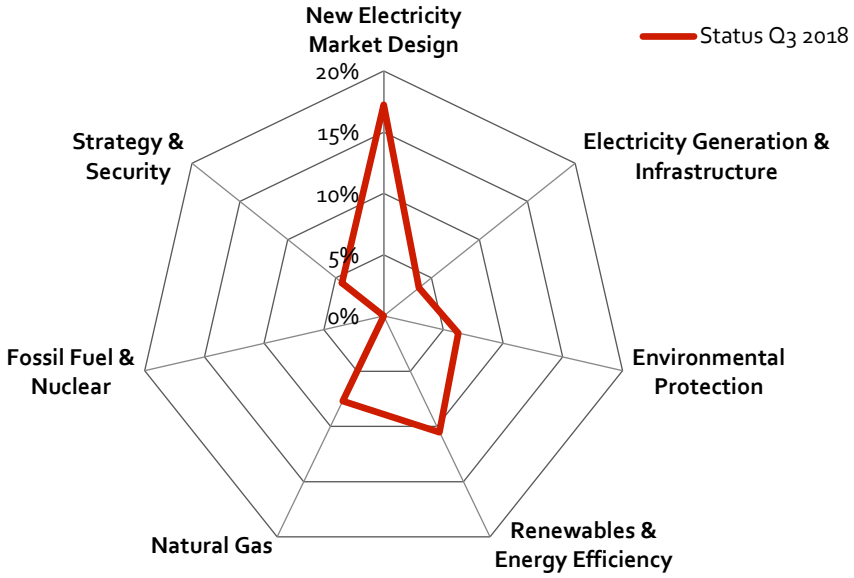
Quarterly Monitoring Report on the Implementation of Ukraine's Energy Action Plan

November 2018



Executive Summary

Most progress was made in the fields of New Electricity Market Design and Renewables & Energy Efficiency. Several activities, however, are already overdue and threaten a timely implementation of the first stage of the Energy Strategy 2035. In our view, most attention should be paid on overhauling the system of balancing on the gas market. By switching from a monthly to a daily mode of balancing, Ukraine wants to enhance financial liquidity and competition. Delays in this process were due to disputes between the transmission system operator, the distribution system operators as well as the regulatory authority. Speedy implementation of daily balancing is crucial to set the basis for a functioning gas market.

Moreover, we think that the implementation of a well-designed Renewable Energy Auctioning Law is particularly important. The law proposed by the Parliament aims at replacing the excessively high feed-in tariffs that are currently in place. Without changes to the current feed-in tariff system, even the modest goals of 2020-2025 will not be achievable. Yet, neither the basic law nor other alternative drafts submitted by parliamentary groups propose solutions for problems of the current system such as the restriction of its duration until 2030. It is hence important that the necessary urgent fixes of the tariff levels do not prevent the establishment of a well thought through system that enables a cost-effective deployment of RES in line with the Energy Strategy.

A recent study by Low Carbon Ukraine (see summary on pp. 5-6) provides a promising outlook on the expansion of renewable energies in Ukraine. Contrary to previous assumptions, a simple electricity system model shows that the existing system could successfully balance increasing shares of fluctuating renewable energy sources up to an installed capacity of 15 GW.

Low Carbon Ukraine
Policy advice on low-carbon policies for Ukraine

Supported by:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
based on a decision of the German Bundestag

Assessment by Sector

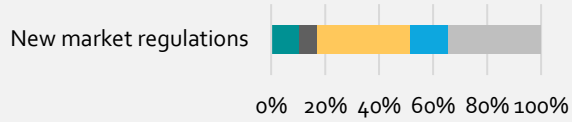
About the Assessment

IN this quarterly monitoring report, we assess Ukraine's progress on implementing the Action Plan measures for the Energy Strategy of Ukraine until 2035 (ESU). We grouped 206 actions into **seven sectors** and rated their status of implementation: completed, in political process (e.g., being discussed or provisionally adopted), overdue, or scheduled for a later date. Completed actions are classified as serving or not serving the purpose, i.e., whether or not they contribute to achieving the goals laid out in the Energy Strategy of Ukraine until 2035. Underlying data, additional material and references will be made available online at *www.LowCarbonUkraine.com*.

Legend

- Completed and serving the purpose of the ESU
- Completed but not serving the ESU's purpose
- In the political process
- Overdue
- Scheduled for later

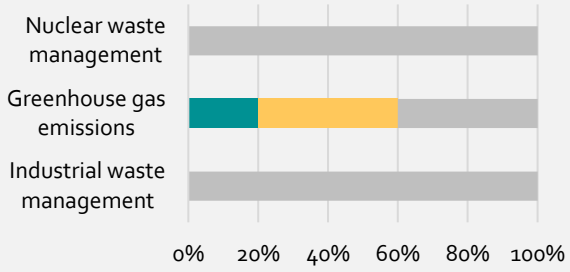
New Electricity Market Design



Implementation progress **17%**

The **corporatisation of NEC Ukrenergo** is overdue, with a supervisory board approved only in October 2018. The **settlement of indebtedness** of SE Energorynok is stalled since spring 2018 and the draft law requires significant revision. The draft law "On **Energy Ombudsman**" is stuck in Parliament with an unclear outlook. The National Energy and Utilities Regulatory Commission (NEURC) continues to pursue deadlines for the implementation of the **new market**, but the first phase scheduled for December 2018 is at risk of delay. A new methodology for the allocation of **cross-border capacity for electricity** was adopted, along with rules for information disclosure on import-export of electricity. Yet, **incentive-based tariffs** for electricity distribution system operators (DSOs) are overdue and likely to be postponed until 2020. Also, **unbundling** of some state-owned DSOs is delayed, and there is a risk of delay for obtaining new DSO licenses.

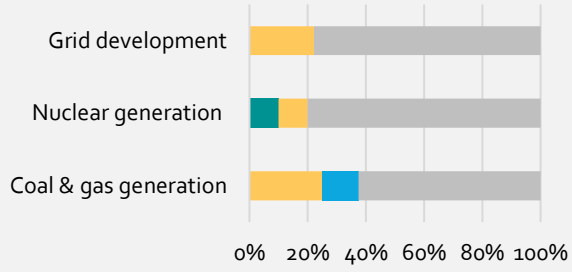
Environmental Protection



Implementation progress **6%**

The **Low Carbon Development Strategy 2050** was supported and approved by the Cabinet of Ministers (CoM) in July 2018. It was sent to the UN Secretariat for approval. A plan of measures for 2018 and subsequent years on the implementation of the National Emission Reductions Plan for large combustion plants was adopted in June 2018, yet its actions are vague and it does not include clear performance indicators. The draft law on principles for **monitoring, reporting and verification of greenhouse gas emissions** is in political process and supposed to be approved by the CoM by the end of 2018.

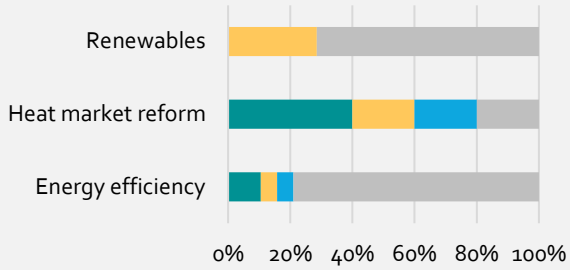
Electricity Generation & Infrastructure



Implementation progress **4%**

The approval of safety rules for electric power supply and safety monitoring of electricity supply is overdue. While the procedure for temporary **state support for combined heat and power plants** (CHP) was adopted on time, the methodology for calculating tariffs has been delayed. Centrenergo is expected to be privatised before the end of 2018 but privatisation of all other big companies is delayed until 2019. In **nuclear**, the feasibility of two new blocks for the Khmelnitsky nuclear power plant (NPP) was approved by the CoM, but the submission of a draft law to allow for its construction is likely to be delayed beyond 2018. In infrastructure, a **development concept for smart grids** is being developed, with first suggestions presented by consultants to the Ministry of Energy and Coal Industry in July 2018.

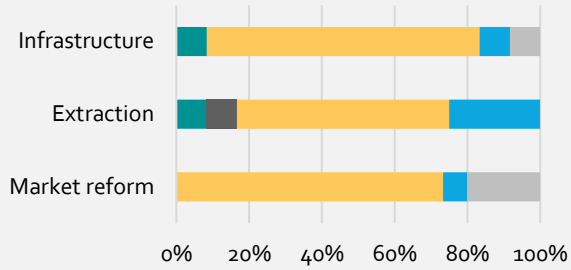
Renewables & Energy Efficiency



Implementation progress **11%**

The parliament registered the draft law on state support for electricity from **renewable energy** sources introducing **auctions**, yet the Ministry of Energy scheduled it only for 2019. Along with the basic law, seven alternative drafts were presented which all require significant revision as they do not introduce solutions for the problems brought up by the feed-in tariff. Multi-stakeholder working groups have been introduced to gather feedback but for now, the process is stalled and untransparent. The draft law on **energy efficiency** was presented in 2017 without further progress. It is likely to be delayed beyond the deadline of 2018. Meanwhile, most regulatory acts required for the Energy Efficiency fund to start working are already in place, and its start is scheduled for Q1 2019. In addition to some preliminary activity on monetisation of housing subsidies from 2019 on, a comprehensive roll-out plan is needed. This would be of high importance given the recent changes in gas prices and in the subsidy system.

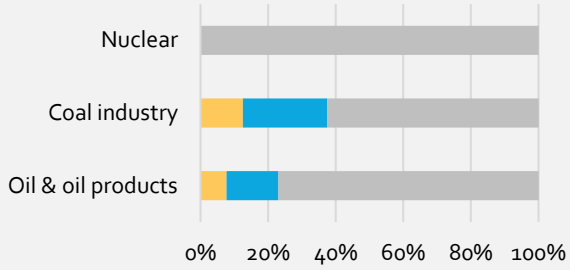
Natural Gas



Implementation progress **8%**

The introduction of **daily balancing** is pending, due to a lack of both transmission (TSO) and distribution system operators (DSO) to establish a functioning platform that provides full information on gas consumption. The Naftogaz **unbundling** model amendment, following the Stockholm arbitration decisions, has to be fixed in a CoM decision, as it currently exists only as an agreement and a "roadmap" between the supervisory boards of Ukrtransgaz (UTG) and Magistralni Gazoprovody Ukrainy (MGU). Clarity is needed on the competition for the **TSO operating partner**. Drafted updates to the National Action Plan and Security of Supply Rules still require approval. Actions to ramp up domestic gas production seem to be stalled, despite progress in the approval of electronic sale of upstream licenses.

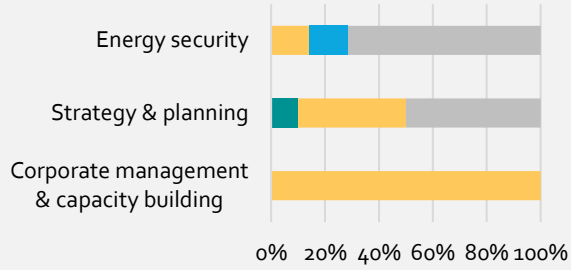
Fossil Fuels & Nuclear



Implementation progress **0%**

Amendments to technical regulations for motor petroleum, diesel, marine and boiler fuels developed in early 2018 require approval. Still pending are the model and the draft law for **minimum reserves of oil and oil products**, with poor progress recorded also by the Energy Community. In the **coal sector**, the state enterprise "National Coal Company" was created, yet with no supervisory board elected to start restructuring of state-owned assets in the industry.

Security, Strategy & Governance



Implementation progress **4%**

The **corporate governance reform** has stalled as the draft law 6428 was not adopted, and so far, supervisory boards of Naftogaz and MGU are the only successful cases of functioning independent bodies. Next quick wins could be the transposition of Regulation (EU) 347/2013 on projects of common interest, with a technical assistance project started, and the draft law "On Critical Infrastructure and its Protection".

Key Developments in Ukraine's Energy Sector

The draft law on renewable auctions

ON June 7, 2018, Members of Parliament Oleksandr Dombrovsky and Lev Pidlysetskii submitted a draft law "On Amendments to the Laws of Ukraine on Ensuring Competitive Conditions for the Production of Electricity from Alternative Energy Sources" (No. 8449). During the following two weeks seven alternative bills authored by various parliamentary groups were submitted, which mostly propose the introduction of state support for renewable energy sources (RES) on the basis of auctions.

This legislative initiative is aimed to reduce the upward pressure from renewables cost on the wholesale electricity price in Ukraine – as of 2017, RES generated only 1.5 % of electricity but made up 7.5 % of the wholesale electricity price. The main concern voiced by members of Parliament regards the relatively high feed-in tariffs (FIT). Thus, changes to the renewable energy support scheme in Ukraine are essential to the sustainable development of the industry and to achieving the goals of the Energy Strategy 2035. While the Energy Strategy stated conservative goals for the years 2020-2025, even those moderate goals will not be achievable without changes to the current FIT system.

The draft law proposed technology-specific auctions to be held twice a year for larger solar (>10 MW) and wind (>20 MW) projects. The proposed auction mechanism and other details will still require some modification in order to be workable. Moreover, much-needed changes to the FIT scheme remain unaddressed as current drafts only focus on tariff reduction. The main issue at stake is that tariffs expire in 2030. This bears risks for projects below the auction threshold that will find it difficult to secure financing.

In sum, it is highly recommendable that Ukraine addresses the urgent need to reform the RES support, which risked becoming financially unsustainable. It is important, however, that the necessary urgent fixes do not prevent the establishment of a well thought through system that enables a cost-effective deployment of RES in line with the Energy Strategy.

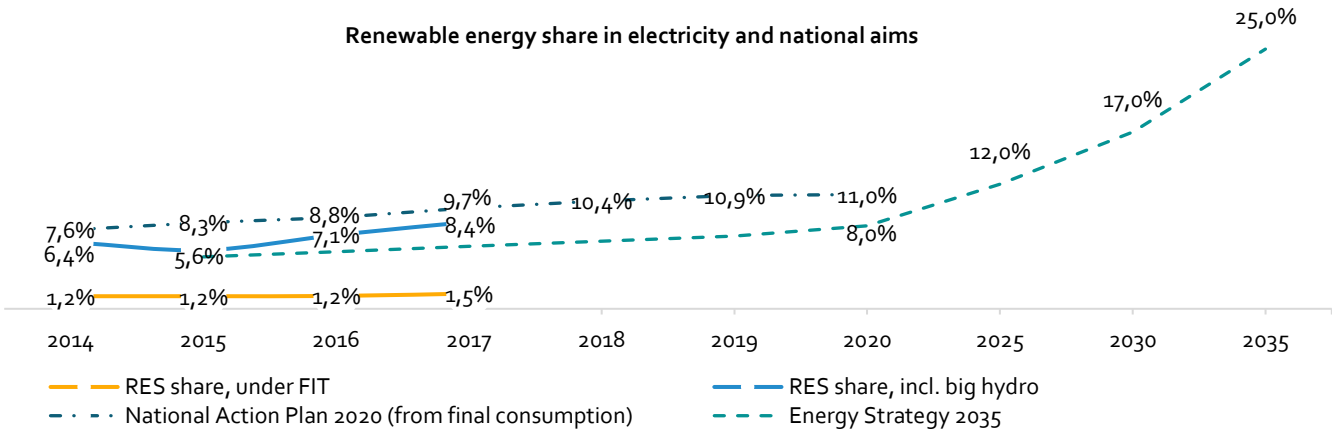
Daily balancing on the gas market

THE introduction of daily balancing in the gas market is an important step towards higher market liquidity and competition. Daily balancing implies that, for each day, all market participants make sure that they do not withdraw more gas from the system than they inject. According to the amendments to the Gas Transmission System (GTS) Code made in December 2017, daily balancing should have been introduced on August 1, 2018.

However, the regulator had to postpone it – first to October 1, later to December 1, 2018. NEURC claimed that the TSO Ukrtransgaz blocked the process and was responsible for the delay. In July, the regulator conducted an inspection of Ukrtransgaz, detecting a number of violations and imposing a 850,000 UAH fine. Ukrtransgaz itself has a number of claims to the GTS Code and accuses the NEURC of ignoring its position. Claims were taken to the mediation by the Energy Community Secretariat, with first results achieved: The regulator approved amendments to the GTS Code improving provisions on financial guarantees, trade notification and transmission contract termination.

As of September, Ukrtransgaz held several tests of the daily balancing platform and a number of presentations for market players. However, it also claimed that consumer-relevant data (e.g., EIC codes) received from most DSOs is incorrect, making it impossible to form a consumer database. Also, Ukrtransgaz addressed the NEURC with a complaint on 24 DSOs which signed new contracts on gas transmission with reconciliation protocol – which is not foreseen by the regulations. In its latest decision NEURC ordered Ukrtransgaz to finalise comprehensive testing and completion of the platform, and DSOs to ensure provision of necessary data. The new deadline could be missed again due to conflicts between Ukrtransgaz and the DSOs, in particular on formats of consumer data and protocols of interaction within the platform.

Renewable energy share in electricity and national aims



Sources: National Action Plan 2020, Energy Strategy 2035, Energorynok

Balancing Needs in the Ukrainian Power Sector due to Increasing Integration of Renewable Power Sources

THANKS to an attractive green tariff scheme, falling technology cost, improvements in the overall business environment, and the significant technical and economic potential, the installation of renewable energy sources (RES) accelerated recently in Ukraine. From January 2017 to June 2018, wind capacities grew by about 18 % and Photovoltaic-solar (PV) capacities by about 78 %. Increasing penetration of variable renewable energy resources – mainly wind and PV – brings new challenges for the development and operation of the electricity system.

Challenge 1: Excessive fluctuations

One main challenge from an increasing integration of wind and PV into a power system are short-term fluctuations. The system might, for example, have to accommodate abrupt increases in PV generation in the morning, or abrupt decreases in wind generation when the wind stops blowing. These jumps (in terms of MW) are amplified by the amount of RES installed.

Solution 1.1 Optimise the wind-PV mix

Wind and PV differ in their generation profile. A system that is solely based on wind produces no power when the wind is not blowing; but a lot when the wind does. And a system that is solely based on PV produces no power when the sun is not shining. A system that has a mix of both technologies will see much less fluctuations.

Solution 1.2 Optimise the location of wind and PV

In the same hour, there might be a lot of wind in one region of Ukraine, while there is none in another. The same is true for clouds that reduce solar irradiation. Hence, the more widely wind and solar installations are spread over the country, the less variable will their total generation get (this phenomenon is called "geographic averaging").

While all investors might prefer to put their wind turbines where there is the most wind (see scenario "concentration" in the below table) it might be better for reducing fluctuations to spread installations over the entire country (see scenario "even distribution"). For Ukraine, the latter might be characterized by a 10 % lower total generation, but it would reduce the hourly generation jumps by 40 % and the number of hours with very low generation by 75 %.

Solution 1.3 Variable use of conventional and biogas capacities

Our modelling results illustrate that at high shares of wind and PV generation other types of power plants will have to play a more active role in balancing the variable renewables. We find that even in a scenario with very high shares of renewables (e.g. ~14,5 GW) the Ukrainian system can still be managed. In this scenario, nuclear power and thermal plants more often use their flexibility (which we observed in 2017) more extensively.

Wind scenario results

Power plant distribution	Unit	Concentration	Even distribution
Annual power generation	TWh	23	21
Maximal hour-to-hour load change	GW	3.1	1.8
Number hours load < 530 MW	hours	1,241	282

Additionally, Ukraine might in the future also incentivise biogas plants to run more flexibly. Currently the plants run 90% of the time but in a scenario with high renewables these plants might essentially be stopped when the wind is blowing.

Challenge 2: Excess renewables generation

When the wind is blowing, the sun is shining and electricity demand is low, we might see situations where generation exceeds demand. Typically, the system operator would call on thermal plants to reduce generation in such situations. But as nuclear power plants and some thermal plants must run for system stability, the risk of overloading the system increases with higher shares of renewables in the system.

Solution 2.1: Curtailment of renewable power

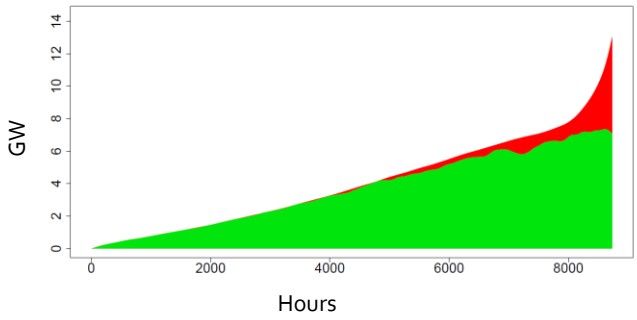
To avoid overloading the system, generation from wind turbines and PV panels can be shut down – an action which is referred to as 'curtailment'. Thereby, the infeed of renewable electricity into the power grid is reduced so that electricity supply equals the current demand.

Curtailment is a relatively cheap option for system operators. However, it reduces the income of the plant operator – which do not earn income if they do not produce. To allow for high flexibility and incentivise the development of RES, a compensation for lost profits can be introduced.

Furthermore, curtailment essentially "throws away" energy. To reduce curtailment losses in a power system, the flexibility of the system can be increased by other means such as: development of storage capacities, demand side management, or increased flexibility of conventional capacities. To increase the economic efficiency of the power system a cost-minimal combination of flexibility options should be developed.

Scaling the current structure of RES to a scenario where Ukraine deploys around 15 GW of RES capacities would imply that around 10 % of the renewable electricity has to be curtailed (see red area in the figure below).

Curtailment of renewable power – 31 TWh (ordered for increasing power load per hour)



So even at a significantly higher capacity than today, curtailment losses are in a tolerable range. Furthermore, the deployment of additional flexibility options can decrease curtailment further.

Solution 2.2: Export of excess power

Theoretically, Ukraine can also export excess power to other countries. In practice, however, cross-border electricity trading for Ukraine is still limited. The differences between the Ukrainian and the European electricity system reduce the possibilities for cross-border electricity flows.

With the integration of Ukraine in the European system, cross-border electricity trade will be an additional flexibility option in the long term. With respect to costs, electricity trade seems to be one of the cheapest flexibility options.

Challenge 3: Lack of electricity

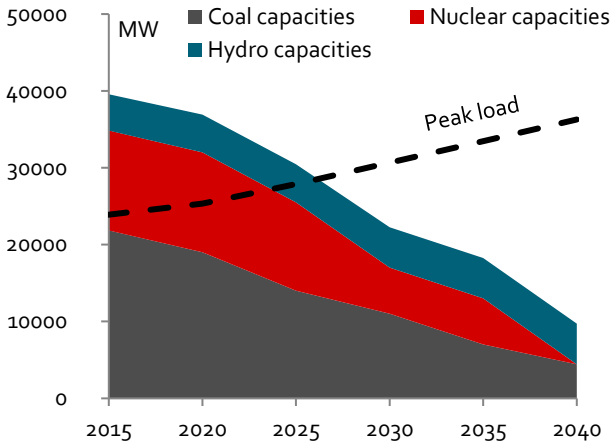
If renewables replace conventional generation capacities, a new issue might arise. If the wind is not blowing, the sun is not shining and demand is very high, available generation might not be sufficient to meet demand.

A lack of electricity is unlikely in the short term. The existing conventional capacities (nuclear and thermal power plants) exceed the maximal observed load in 2017 by more than 30 % (see figure below). Hence, existing capacities are appropriate for covering the peak loads in the short term.

However, during the next decade, many conventional power plants might have to leave the system. This is due to the age structure of the conventional power plant park. Today, the average age of conventional capacities is almost 50 years.

Aging capacities increase the costs of maintenance, and the need for repair. Furthermore, an increasing age of power plants increases the risk for unexpected shutdowns, which for their part increases the risk for lack of power. In addition, the electricity demand of the Ukraine is assumed to increase in the future. If the conventional capacities that leave the system are solely replaced by wind turbines and PV panels, and no other measures are taken, critical situations might arise.

Forecasted nameplate capacity for Ukraine



Solution 3.1: Back-up by conventional power plants

To overcome these problems, two options for the conventional power plant park are available. First, the lifetime of existing plants can be extended by additional investments and maintenance measures. This option might be a solution in the short to medium term. In the long term it faces economic and technical limits. Second, additional generation capacities can be built to back-up the system. Especially flexible gas power plants are suitable for this task. However, constructing additional power plants to back-up the system is costly, takes a long time and does not reduce the problem of import dependency.

Solution 3.2: Demand response

Another way to reduce the risk of electricity shortages is to increase the flexibility of the demand side. That is, the demand is adjusted to the supply of electricity. Large electricity consumers such as industrial companies decrease their demand in times of low electricity supply. These companies are attracted to offer additional flexibility by monetary incentives. Compared to lifetime extensions and the construction of additional power plants, demand side measures are often a cheaper way to increase the flexibility of the system and reduce the risk of undersupply of electricity due to a high share of RES.

Conclusion

The Ukrainian electricity system is capable to balance the fluctuation of significant amounts of RES. The available flexibility options are sufficient to cope with RES capacities of 15 GW. An optimal mix of different RES as well as a high geographical distribution of RES allow to reduce the flexibility needs of the overall electricity system.

In the short term, excess and lack of electricity does not pose a risk to the Ukrainian electricity system. However, Ukraine has to prepare for the further development from mid of the next decade on resulting from increasing demand, structural changes in demand, an aging power plant stock and further needs for decarbonisation of the power generation.

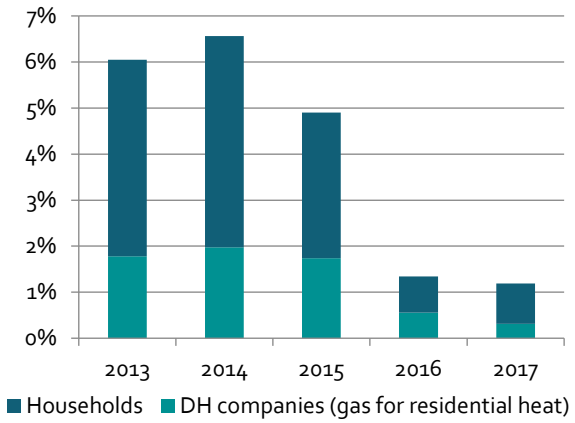
Introducing the *Low Carbon Ukraine* Project

THE Low Carbon Ukraine (LCU) project is part of the International Climate Initiative (IKI) and supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It aims at supporting the government of Ukraine in pursuing an active and effective climate policy, therefore enabling Ukraine to follow a low-emissions pathway. In the framework of the project, the Ukrainian government will be continuously supported with analyses and policy proposals it requested. In particular, the project aims at supporting the Vice Prime Minister responsible for coordinating the implementation of the Energy Strategy 2035 in his efforts.

Current challenges for Ukraine

Ukraine's energy sector is important for the country's economy as it accounts for about 13 % of its GDP (Antonenko et al. 2018). Yet, Ukraine is among the least energy efficient countries in Europe, which drags down economic growth and has left it vulnerable to political pressure from energy suppliers. Moreover, Ukraine's energy sector currently faces a number of other – often intertwined – challenges such as a longstanding investment backlog, loss-making state-owned companies, and increasing energy cost for households.

Phasing out subsidies: Natural gas price subsidies 2013-2017, % of GDP



Source: IEA for EU4 Energy 2018

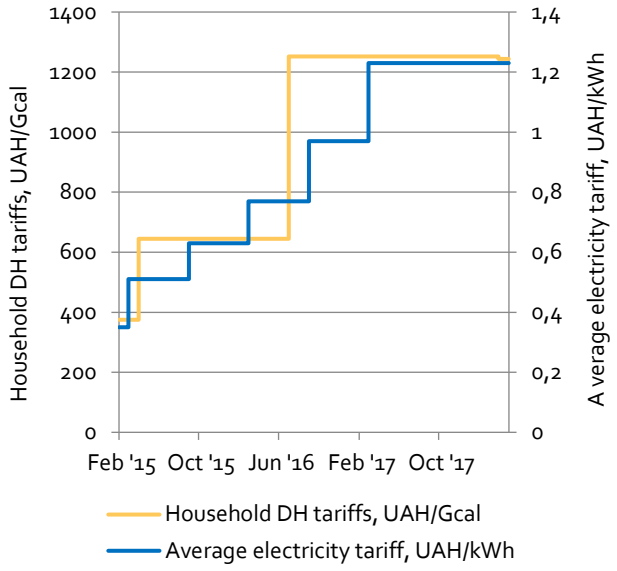
Supply and transit of natural gas have for the last decades dominated public debate on Ukraine's energy sector, both on the national and international level. Natural gas represented about 30 % of the country's primary energy consumption in 2016 and is particularly important for heat generation (BP 2018).

Yet, repeated disputes with the historic main supplier Russia over the terms of gas supply and transit highlighted the risks associated with a dependency on gas imports from the East.

The country's electricity sector has been significantly affected by the conflict in eastern Ukraine as the occupation of coal mines in those regions has restricted supply with high-quality coal, thus forcing the country's thermal power plans to increasingly rely on imports. The dependency on coal imports – mainly from Russia – is widely viewed as a significant threat to national energy security. Ukraine's nuclear power industry also heavily relies on Russian imports, as the bulk of nuclear fuel is imported from Russia and used in all of the country's 15 reactors. Since Ukraine's nuclear plants generate more than half of the country's electricity, they are critical to national energy security (Ministry of Coal and Energy 2018).

Furthermore, aging power generation and electricity network assets highlight the need for attracting investments to ensure supply security.

Energy costs on the rise: Average electricity tariffs and district heating (DH) tariffs



Source: IEA for EU4 Energy 2018

Ukraine's international obligations

Ukraine has entered into a number of obligations in order to achieve its long-term goal of becoming a full member of the EU internal energy market. In 2011, Ukraine joined the Energy Community, a group of southeast and east European countries that agreed to adopt the EU's internal energy market legislation. It has thereby obliged itself to establish real markets for electricity and gas and to integrate these markets with the EU. Ukraine also promised to unbundle transportation of electricity and natural gas from production and distribution in order to open up both pipelines and grid to third parties.

By signing the Ukraine–European Union Association Agreement in 2014 and the treaty of the Energy Union in 2015, Ukraine further committed to aligning its energy and climate policy to EU standards. The obligations of the Association Agreement included, among others, the development of a non-discriminatory and competitive energy market, the support of renewable energy, and the encouragement of energy efficiency and energy security. In June 2017, the state-owned operator of the Ukrainian power grid, Ukrenergo, signed the agreement on Ukraine's accession to the EU grid ENTSO-E, which had already been an obligation under the Ukraine-EU Association Agreement.

Increasing import dependency: Coal exports vs. imports, ktoe

Source: IEA 2018

By ratifying the Paris Agreement in 2016, Ukraine signalled the political will to contribute to global efforts to tackle climate change and to reduce the shares of gas, coal and oil in the country's energy mix. Ukraine's future emissions will depend on energy system choices and investments in the coming years. Yet, the current debate in Ukraine is driven by incumbent interests that prefer a high-energy-consumption, high-fossil-fuel-share pathway. This scenario is inconsistent with Ukraine's energy policy goals. The LCU project therefore aims at supporting the government of Ukraine in their efforts by developing sector strategies and policy measures that are in line with the country's international obligations and long-term energy policy goals.

The Energy Strategy of Ukraine: a window of opportunity

In September 2017, the Energy Strategy of Ukraine (ESU) was approved by the Cabinet of Ministers of Ukraine. The ESU's main goals are the liberalisation of energy markets and the establishment of effective regulation, which should in turn attract investors to the country's energy sector. It encompasses the whole range of the country's energy goals until 2035 and defines the necessary steps to achieve them.

Vice Prime Minister Volodymyr Kistion, who coordinates the Cabinet's measures on energy policy, is responsible for its implementation. Successful implementation of the ESU would ensure the much-needed coordination among the different ministries and state agencies regarding strategic decisions on energy and climate policy. The adoption of the ESU hence provides a window of opportunity for the Vice Prime Minister to improve coordination of Ukraine's energy and climate policy.

The objective of the LCU project

The objective of the project is to continuously support the work of the Ukrainian government with demand-driven policy analysis and proposals.

The project will be implemented by BE Berlin Economics GmbH, a Berlin-based economics consultancy with extensive experience both in energy and climate policy and in working with the Ukrainian government. Berlin Economics will implement the project in cooperation with DiXi Group and IFRI. DiXi Group is a renowned Ukrainian think tank involved in research and consultation in the area of energy, while IFRI is a leading international think tank in the fields of economics, energy, and environment.

The LCU project is designed to work in a demand-driven, results-oriented, and open manner. Instead of offering ready-made solutions, the idea of the LCU project is to identify the relevant questions together with Ukrainian decision-makers and to tackle these questions in co-creation with Ukrainian experts. This implies that project outputs shall if possible be co-authored by Ukrainian experts, which ensures the political relevance of the treated topics, optimally utilises local knowledge, and enhances political ownership. Moreover, co-creation helps to strengthen analytical capacities in Ukrainian authorities and civil society on a long-term and sustainable basis.

By developing an energy model for Ukraine the LCU project team will explore major trade-offs, interdependencies, drivers and uncertainties in long-term planning. The rigidities of a modelling framework will thereby help to ensure consistency of the arguments and hence allow a fruitful discussion.

Regular bilateral meetings with the most important stakeholders will identify the relevant topics for policy making in Ukraine, thus ensuring that the project always works in a results-oriented way. Moreover, all publications are made accessible for the public.

This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag.

All results of the project are available online at www.LowCarbonUkraine.ua.

We are grateful for feedback on this monitoring report, in particular comments how to make it even more useful for supporting the implementation of the energy strategy and contributing to a low-carbon development for Ukraine. Please get in touch via monitoring@LowCarbonUkraine.ua.

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