UKRAINE ELECTRICITY MARKET, trends and opportunities

- Electricity market of ukraine
- Nuclear power sector
- Wind and solar
- Thermal generation
## ENERGY SECTOR OF UKRAINE AT GLANCE

### Balance 2017

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Generation (heat&amp;electricity)</strong></td>
</tr>
<tr>
<td><strong>Consumption (mtoe)</strong></td>
</tr>
<tr>
<td><strong>Coal</strong></td>
</tr>
<tr>
<td><strong>Nuclear</strong></td>
</tr>
<tr>
<td><strong>Natural gas</strong></td>
</tr>
<tr>
<td><strong>Hydro&amp;RES</strong></td>
</tr>
<tr>
<td><strong>Oil products</strong></td>
</tr>
<tr>
<td><strong>Oil</strong></td>
</tr>
<tr>
<td><strong>Transportation and distribution losses</strong></td>
</tr>
<tr>
<td><strong>Industries</strong></td>
</tr>
<tr>
<td><strong>Housing sector</strong></td>
</tr>
<tr>
<td><strong>Energy sector</strong></td>
</tr>
<tr>
<td><strong>Agriculture, trade, services</strong></td>
</tr>
<tr>
<td><strong>Non-energy use</strong></td>
</tr>
<tr>
<td><strong>Transport</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

**Transformation losses**

- **Electricity**
- **Heat energy**
- **Oil products**
- **Oil**
- **Coal**
- **Nuclear**
- **Natural gas**
- **Hydro&RES**
Electricity generation vs. consumption (2017, bln kWh)

** generation

- Nuclear: 85.6
- Thermal: 45.0
- Hydro: 10.6
- CHPP: 10.9
- Wind: 1.0
- Solar: 0.7
- Biomass: 0.2

** consumption

- Industries: 51.0
- Households: 50.0
- Other consumers: 17.9
- Export, energy system consumption, electricity transportation and distribution, pumped-storage HPP: 35.9

** Totals

- Total: 155.4

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*AS FOR 2017, UKRAINE IS NEAR TO NEW YORK STATE IN TERMS OF ELECTRICITY GENERATION*

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**Key Trends:**

- Free competitive electricity market (2019)
- More RES: 1% (2017) → 13% (2035)
- Digitalization and IT solutions
- Major modernization of NPP (new technologies) and TPP (less pollution)
- Comprehensive energy efficiency modernization (households, transport)

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### Nuclear Power Sector

**Capacities – 13 880 MW**

- **4 NPP**
- **15 Reactors**
  - (13 VVER 1000 and 2 VVER440)
- **2 Reactors Under Construction**
  - (temporary frozen)

**Energy Strategy of Ukraine 2035 – NPP Capacities up to 18 000 MW, around 50% of total electricity generation**

<table>
<thead>
<tr>
<th>NPP</th>
<th>Reactors Completed</th>
<th>Date of Commissioning</th>
<th>Lifetime Expiry</th>
<th>Maximum Lifetime</th>
<th>Share in Total Electricity Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivenska NPP</td>
<td>13%</td>
<td>1980 2010 2030</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1981 2011 2031</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1986 2017 2037</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2004 2035 2055</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khmelnitska NPP</td>
<td>9%</td>
<td>1987 2018 2037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004 2035 2055</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>completed by 75%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>completed by 28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pivdennoukrainska NPP</td>
<td>12%</td>
<td>1982 2013 2032</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985 2035 2055</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1989 2039</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zaporizka NPP</td>
<td>22%</td>
<td>1984 2025 2034</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985 2026 2035</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>1986 2027 2036</td>
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<td></td>
<td>1987 2037</td>
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<td></td>
<td></td>
<td>1989 2039</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>1996 2046</td>
<td></td>
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</tbody>
</table>

**NUCLEAR POWER SECTOR**

**NUCLEAR FUEL SUPPLIERS**

- Westinghouse share in fuel supply up to 55% by 2025

**Key challenges:** NPP lifetime extension; nuclear fuel diversification; nuclear fuel utilization; NPP closure

**Key opportunities:** Fuel supply; technical services; trainings sessions; new NPP technologies
**THERMAL GENERATION**

**Forecast of installed capacity of thermal generation (2017-2035)**

2017: 30 units, 21 units
2025: 30 units, 23 units
2035*: 14 units, 7 units, 38 units

* The share of thermal generation in total production will remain at the level of 25-30%

**Technical condition of thermal power units by operation resource as of 01.01.2018**

- Park term*
- Maximum term
- Project term

**Maximum volumes of emissions for all large combustion units included in the National Plan of Emissions Reduction (tons per year)**

<table>
<thead>
<tr>
<th>Date</th>
<th>SO₂</th>
<th>NOₓ</th>
<th>Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.12.2018</td>
<td>1017034.5</td>
<td>191300.5</td>
<td>205878.2</td>
</tr>
<tr>
<td>31.12.2022</td>
<td>630622.5</td>
<td>154631.1</td>
<td>125595.7</td>
</tr>
<tr>
<td>31.12.2027</td>
<td>147607.4</td>
<td>108794.9</td>
<td>25242.6</td>
</tr>
<tr>
<td>31.12.2033</td>
<td>51004.4</td>
<td>53791.3</td>
<td>5172.0</td>
</tr>
</tbody>
</table>

**Key challenges:** Financing and of outdated equipment, reconstruction for lower pollution, coal dependence

**Key opportunities:** Balancing and reserve capacities for RES, strategic reserve for emergency cases, strong demand for new environmental programs and technologies

WIND AND SOLAR

Production
974 million kWh

Capacities
512.2 MW

The cost of building wind power plants in Ukraine:

The cost of building solar power plants in Ukraine:

Key challenges: Legal uncertainty (green auctions vs fixed feed in tariff), high bank interest rates, integration into the grid

Key opportunities: attractive climate conditions, political support according to energy strategy 2035, qualified personnel, convenient logistic via sea ports

Key challenges:

- The Ukrainian biomass-to-energy market is quite fragmented
- There is a lack of established links in the market among players
- The share of biomass in total electricity generation only about 0.2%
- The lack of biomass market

Key opportunities:

- Demand is represented by biomass-to-energy facilities:
- Heat suppliers use biomass boilers to sell heat to schools, hospitals and small industrial plants
- Electricity producers implement projects to process biomass into biogas and sell electricity to the grid
- An extremely low level of biomass generation

Capacities: 43, 8 MW

Electricity power production:
- 2017: 101 million kWh

Sustainable potential of wood biomass:
- 16,282 GWh/yr

Green Tariff (2018):
- 12.4 euro cent /kWh

Production of solid:
- 6,360 GWh/yr

The area under energy crops in 2020 is estimated to be over 118,000 (ha)
Only about 7% of the used materials was recycled in 2017.

Almost 10 million tons of waste ends up in landfills. 94% of solid waste is disposed of in landfills, the total area of which has already reached 12,000 ha.

There is only one plant in the country located in Kyiv.

While processing 10 million tons of waste = equivalent to 1 billion cubic meters of gas per year.

**Key challenges:**
- High bank interest rates
- Undeveloped regulatory framework
- Low experience of cooperation between local authorities and business

**Key opportunities:**
- Low level of waste recycling gives the opportunities to enter the market.
Ukraine is ranked 7th in the world in terms of coal reserves.

102 mines, but only 33 mines are on the controlled territory, 4 of which work profitably.

17 coal mines belong to private owner DTEK Energo.

According to the Energy Strategy of Ukraine until 2035, the coal production will drop from 34 mln tons (2017) to 12 mln tons (2035).

Key challenges:
- Technological backwardness of coal mines

Key opportunities:
- Business re-engineering of closed state owned coal mines (RES, tourism, exhibition center)
US-UKRAINE COOPERATION TRENDS

SUPPORT OF REFORMS
(judicial, electoral, free media, modern police, competitive market economy, effective and transparent energy sector, energy efficient housing sector)

SECURITY SECTOR
(non-lethal and lethal weapons, training of armed forces, navy ships, aircraft reconnaissance)

EDUCATION AND TRAINING OF UKRAINIAN PERSONNEL
(SABIT - Special American Business Internship Training Program)

AIR AND SPACE PEACEFUL DEVELOPMENT
(Antares – rocket engines)

RECOVERY AND PEACEBUILDING IN DONBASS
(Eastern Ukraine)
State/USAID Assistance since 2014 – over $2 billion

2018 received and registered as technical assistance in Ukraine

<table>
<thead>
<tr>
<th>Area</th>
<th>Assistance Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy security</td>
<td>$ 84 mln</td>
</tr>
<tr>
<td>Electricity market</td>
<td>$ 5 mln</td>
</tr>
<tr>
<td>Media market</td>
<td>$ 35 mln</td>
</tr>
<tr>
<td>Reform of healthcare sector</td>
<td>$ 23 mln</td>
</tr>
<tr>
<td>Support to the Eastern Ukraine</td>
<td>$ 62 mln</td>
</tr>
<tr>
<td>Competitive economy of Ukraine</td>
<td>$ 42 mln</td>
</tr>
<tr>
<td>National Police of Ukraine</td>
<td>$ 10 mln</td>
</tr>
</tbody>
</table>

**ASSISTANCE BY ACCOUNT**

<table>
<thead>
<tr>
<th></th>
<th>FY 2016</th>
<th>FY 2017</th>
<th>FY 2018 Enacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>377,140</td>
<td>454,315</td>
<td>420,700*</td>
</tr>
</tbody>
</table>

*Until September 2019

Source: [https://www.state.gov/p/eur/rls/fs/2018/284748.htm](https://www.state.gov/p/eur/rls/fs/2018/284748.htm)

US companies involved into USAID programs:

- Deloitte Consulting LLP
- Chemonics International Inc.
- The Solidarity Center
- The Peace Corps
- Tetra Tech, Inc.
- Western NIS Enterprise Fund
- Federal Trade Commission (FTC)
- Johns Hopkins University

Johns Hopkins University
The U.S. business in Ukraine key achievements 2016 - 2018

- **210.4 mln $**
  - Coal supply

- **401.27 mln $**
  - Nuclear fuel supply, maintenance and upgrading, trainings

- **Around 400 mln $**
  - 2 VVER-440 power units of the Rivne NPP with SMR-160 modular reactors; equipment and systems for Central Spent Fuel Storage Facility (CSFSF)

- **Around 1 bln $**
  - Locomotives TE33AC Trident

### Bilateral USA-Ukraine trade:

- **2014**: 3.8 bln $
- **2015**: 3.12 bln $
- **2016**: 3.52 bln $
- **2017**: 3.35 bln $
- **2018 (8 months)**: 3.9 bln $

Legend:
- Blue bar: Trade volume, bln $
The new Electricity Market Law of Ukraine was adopted on April 14, 2017 and came into force on June 11, 2017.

This law will introduce the rules of the EU Third Energy Package:

- **Directive 2009/72/EC** concerning common rules for the internal market in electricity,
- **Directive 2005/89/EC** concerning measures to safeguard security of electricity supply and infrastructure investment,

The law implies the following:

- Introduction on the following market segments: Day Ahead market, Intraday market, Balancing market and Ancillary Services market,
- Launch of the Ukrainian Electricity Market – July 1, 2019.

Key opportunities for US business:

- Free trading
- Free market pricing
- Deregulation of prices (no regulatory interference – prices will be set by market participants on its different segments)
- New opportunities for investments in generation.
GRID DEVELOPMENT

The full modernization of Ukrenergo has started
It provides for

ALL SUBSTATIONS AUTOMATION (104)
2018-2027

• To increase the reliability of power transmission for energy-supplying company and consumers.
• To implement automated process control over substations
• To reduce operating and capital maintenance costs of substations
(30 € mln/year)

Total amount of automation program
1 bln €

IT INFRASTRUCTURE ENHANCEMENT
2018-2024

Creation of an inclusive telecom network for the company through implementing Optical Fibre Ground Wire Cable (OPGW) programme

Total length of the OPGW cable – 6960 km

The budget of the project
95,5 mln €

RE-ENGINEERING OF SYSTEM OPERATION FUNCTION

New SCADA/EMS system development through implementing several projects with IFIs

Key opportunities for US business:
▪ A possibility of participating of US companies in tenders

Total amount of automation program
1 bln €
NEW OPPORTUNITIES IN DSO BUSINESS

The decision to implement Regulatory Asset Base (RAB) regulation has been adopted.

Efficiency equals to (=) modernization

RAB will encourage DSO to be more efficient.

The approximate cost of DSO modernization amounts to USD 3 billion for the next 10 years.

Key opportunities for US business:

- A possibility of participating of US companies in tenders.
Level of digitalization in electricity is 15%.

International trend: generation management is moving towards demand management.

New markets - Day Ahead, Intraday, Balancing and Ancillary Services - require new IT solutions.

Cybersecurity.

Data collection, data storage, data(hub).

Approximate value of this market is up to USD 2 billion for the next 10 years.

**Key opportunities for US business:**
- Participation of US companies in tenders
- New cooperation`s for development the best solutions for new markets
AGREEMENT WITH ENTSO-E

On June 28, 2017 in Brussels
Agreement on the Conditions for Future Interconnection of Power System of Ukraine with Power System of Continental Europe was signed

The Agreement came into force
On July 7, 2017

BENEFITS OF THE INTEGRATION INTO ENTSO-E:

- Reduction in the active members’ primary reserve shares due to synergy (by ± 140-160 MW)
- Easier control over the energy system in peak loads (due to non-coincidence of the Ukrainian and European peak hours)
- Increased stability of the power system (due to addition in the Ukrainian power system inertia)
- Increased stability of the power system (due to addition in the Ukrainian power system inertia)

Key opportunities for US business:
- Trading
- Investments in electricity generation
Key measures and initiatives to combat corruption

- Anti corruption program
- Assessment of corruption risks
- Assessment of conflicts of interest
- Verification of business partners
- Transparency and simplification of connection to Ukrenergo grids

Corruption risks were identified in the following areas

- Public procurement
- External activity of the enterprise, in its relations with other enterprises, institutions, organizations or state bodies
- External corruption risks in activities of business partners

Compliance
Ukrenergo has formed a regulatory platform GOR the compliance office operation

Procurement
a) Ukrenergo was one of the first in the country to join the system of electronic procurement ProZorro
b) Money saving
- attracting cheap loans
- integrated approach to reconstructions
- centralization and consolidation of purchases
- Price monitoring and marketing research to prevent price overstatement

Thanks for your attention!