ENERGY INDUSTRY

IN UKRAINE

2018

INTRODUCTION

WHY DID WE MAKE THIS GUIDE

Energy sector is the basis of economic development in any country. Stable power system is crucial for the sustainable development and economic security. Its efficiency and operating rules can create new opportunities or, vice versa, act as a constraint.

Today, all energy sectors globally are going through significant changes. Ukraine is not an exception, though the changes required need to be implemented a lot faster. We have made this Guide to demonstrate the opportunities and challenges that Ukraine will be facing in the coming years, and to show what has already been achieved.

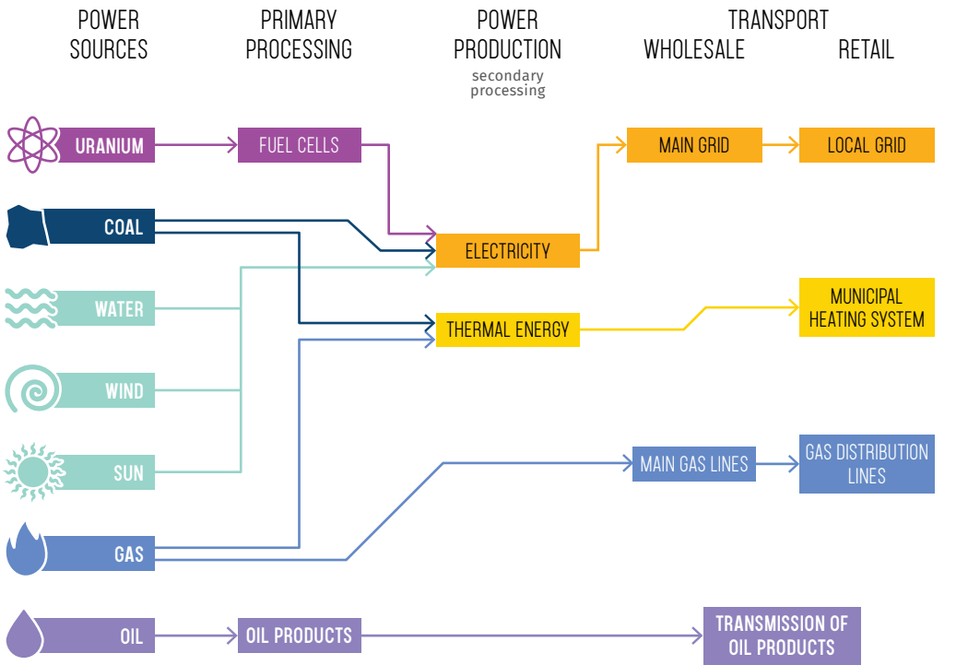
WHAT THIS GUIDE DEMONSTRATES

The Guide covers the key areas where reforms in the energy sector of Ukraine will be implemented. We split the energy sector by industries taking into account the reform areas and key challenges. The focus is made on reforms in relevant sectors and their potential impact on the national economy. We also demonstrate how specific industries were developing in the past, their current status and the challenges that emerge in the development. We have also separately covered the efficiency of the Ukrainian energy sector.

HOW TO READ THE GUIDE

Energy is measured in different ways. This Guide includes all indicators in traditional units. Most sources of energy are measured in physical terms: coal in tonnes, and gas in cubic meters. Energy itself has additional units of measurement: heat — J, electricity — kWh. To compare the data, in the Energy Balance, Strategy and Global Energy Development Section of this Guide we use the indicator of reference fuel (tonnes of oil equivalent, toe).

ENERGY FROM SOURCE TO CONSUMER



ACKNOWLEDGEMENTS

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SOURCES

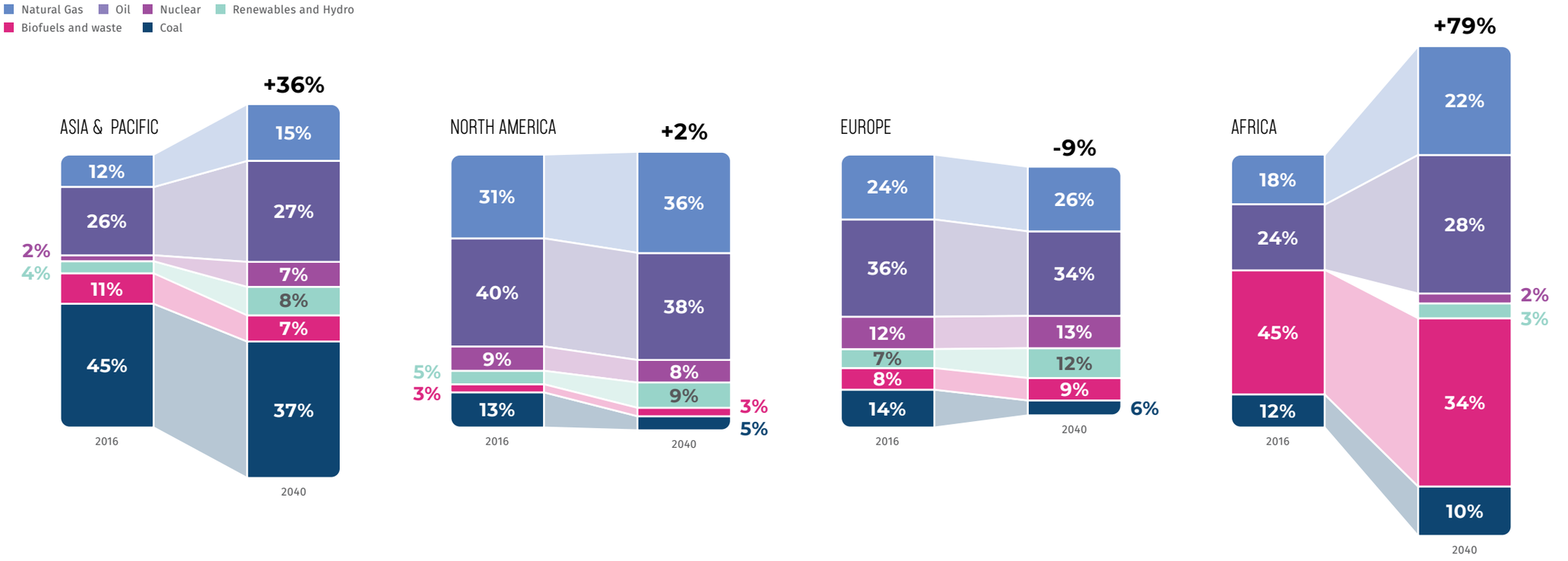
AEQUO Law Firm (AEQUO)
Agencia Estatal Boletín Oficial del Estado (AEBOE)
Arthur D. Little (ADL)
Association of Gas Producers of Ukraine (AGPU)
Bloomberg New Energy Finance (Bloomberg NEF)
British Petroleum (BP)
Business Combinations Ukrmetallurgprom (Ukrmetallurgprom)
China Electricity Council (CEC)
Consulting Group A-95 (A-95 CG)
Council of European Energy Regulators (CEER)
DiXi Group
DTEK
European Commission (EU Commission)
European Network of Transmission System Operators for Electricity (ENTSO-E)
Eurostat
Extractive Industries Transparency Initiative (EITI)
Extractive Industries Transparency Initiative Ukraine (UAEITI)
Exxon Mobil Corporation (ExxonMobil)
Heinrich Boell Foundation (Boell)
International Atomic Energy Agency (IAEA)
International Energy Agency (IEA)
International Finance Corporation (IFC)
International Renewable Energy Agency (IRENA)
Ministry of Energy and Coal Industry of Ukraine (MECIU)
Ministry of Internal Affairs of Ukraine (MIAU)
Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine (Minregion)
NANU Coal Energy Technology Institute (CETI)
National Energy and Utilities Regulatory Commission (NEURC)
NJSC Naftogaz of Ukraine (Naftogaz)
Nuclear Energy Agency (NEA)
PJSC Ukrtransgaz (Ukrtransgaz)
Plugshare.com (PlugShare)
SE Kirovgeologiya (Kirovgeologiya)
SE NNEGC Energoatom (Energoatom)
SE NPC Ukrenergo (Ukrenergo)
State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE)
State Nuclear Regulatory Inspectorate of Ukraine (SNRIU)
State Scientific and Production Enterprise Geoinform Ukraine (Geoinform)
The State Statistics Service of Ukraine (SSSU)
The World Economic Forum (WEF)
The World Steel Association (World Steel)
U.S. Energy Information Administration (EIA)
Ukraine Sustainable Energy Lending Facility (USELF)
Ukrainian Association of Renewable Energy (UARE)
Ukrainian Institute of the Future (UIF)
Ukrainian Wind Energy Association (UWEA)
World Bank Group (WBG)
World Nuclear Industry Status Report (Worldnuclearreport)

STRATEGY

GLOBAL TREND: FOCUS ON RENEWABLE ENERGY

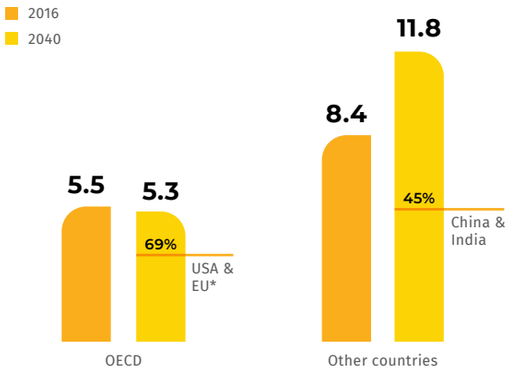
ENERGY DEMAND GROWTH AND STRUCTURE IN MAIN CONSUMPTION REGIONS

2016 and 2040, %



ENERGY DEMAND FORECAST BY REGION

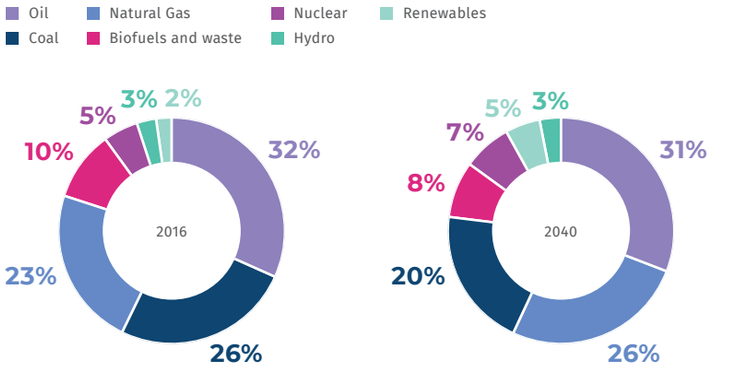
2016 and 2040, bn toe



Most countries are planning to increase the share of renewable energy in their energy portfolio. However, fossil fuel is still playing the leading role, though certain changes will be made in its structure as all regions expect to increase the share of natural gas and reduce the share of coal. The actual structure of energy sources may vary significantly due to the difficulty to forecast technological innovations in the long run.

ENERGY DEMAND STRUCTURE FORECAST BY SOURCE

2016 and 2040, %



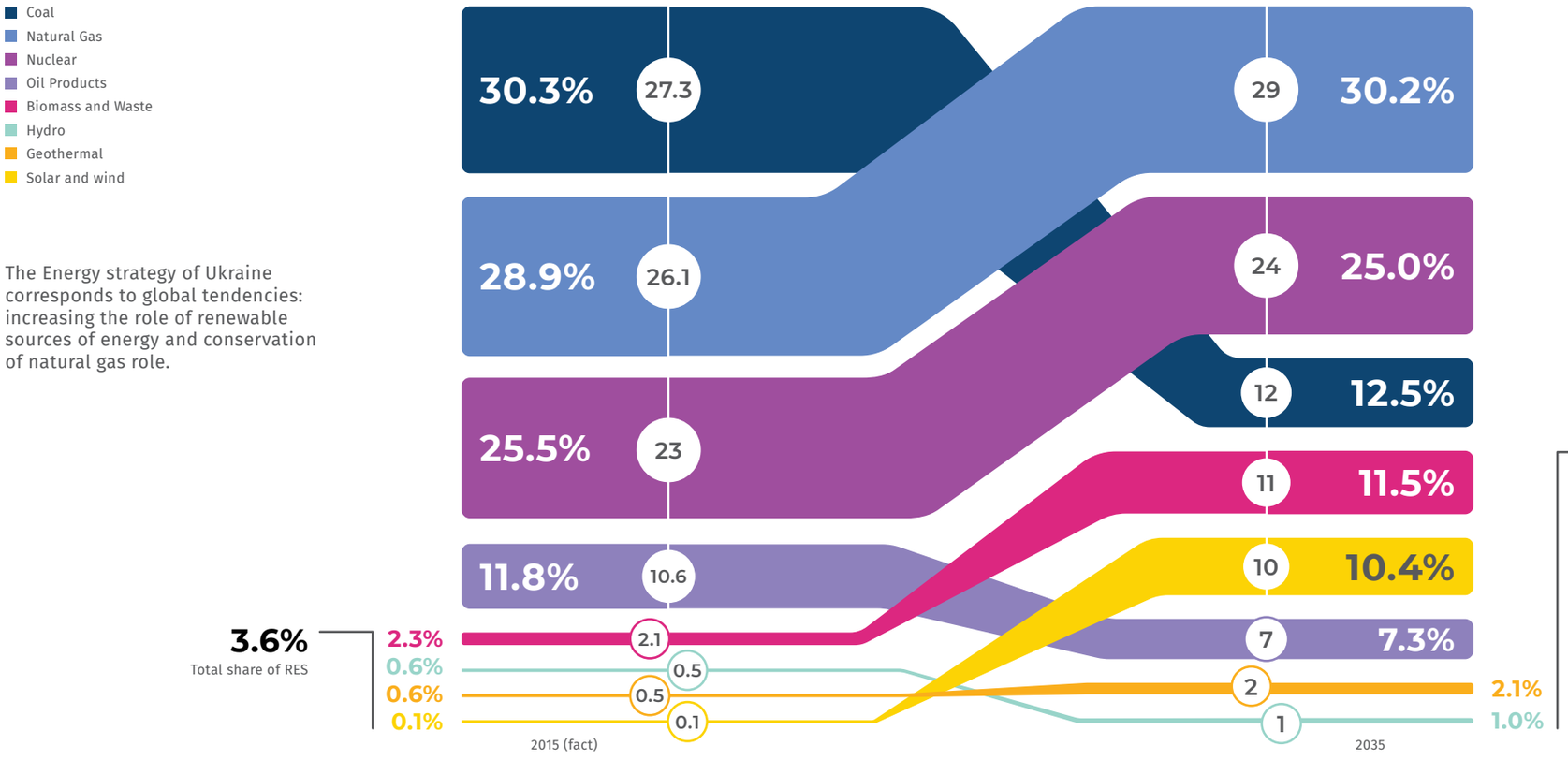
Sourse: ExxonMobil

*Bulgaria, Cyprus, Lithuania, Malta, Romania and Croatia are the EU member states but are not OECD members, however their impact on the share is minor.

ENERGY STRATEGY OF UKRAINE CORRESPONDS TO GLOBAL TRENDS

ENERGY CONSUMPTION STRUCTURE AND VOLUME ACCORDING TO ENERGY STRATEGY OF UKRAINE

2015 and 2035, m toe (%)



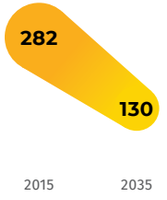
On **18 August 2017,** the Cabinet of Ministers of Ukraine approved energy strategy of Ukraine until 2035 **"Safety, Energy Efficiency and Competitiveness"**.

The Energy strategy of Ukraine corresponds to global tendencies: increasing the role of renewable sources of energy and conservation of natural gas role.

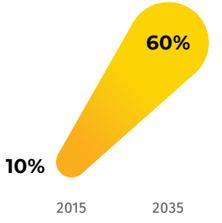
Reforming of gas and electricity markets is the main goal of the Energy strategy at the first stage until the end of 2020.

KEY DIRECTIONS OF ENERGY INDUSTRY REFORMING IN UKRAINE

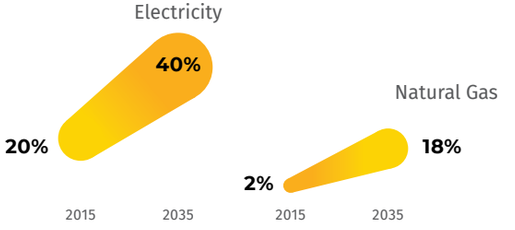
ENERGY INTENSITY OF GDP,
kgoe/1 000 USD GDP (PPP)



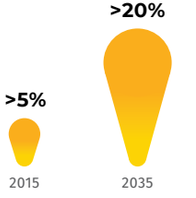
SHARE OF EXCHANGE TRADE IN ENERGY RESOURCES,
% in internal consumption



LEVEL OF INTEGRATION INTO THE EU ENERGY MARKET,
% (cross-border capacity of interconnectors compared to domestic market volume)



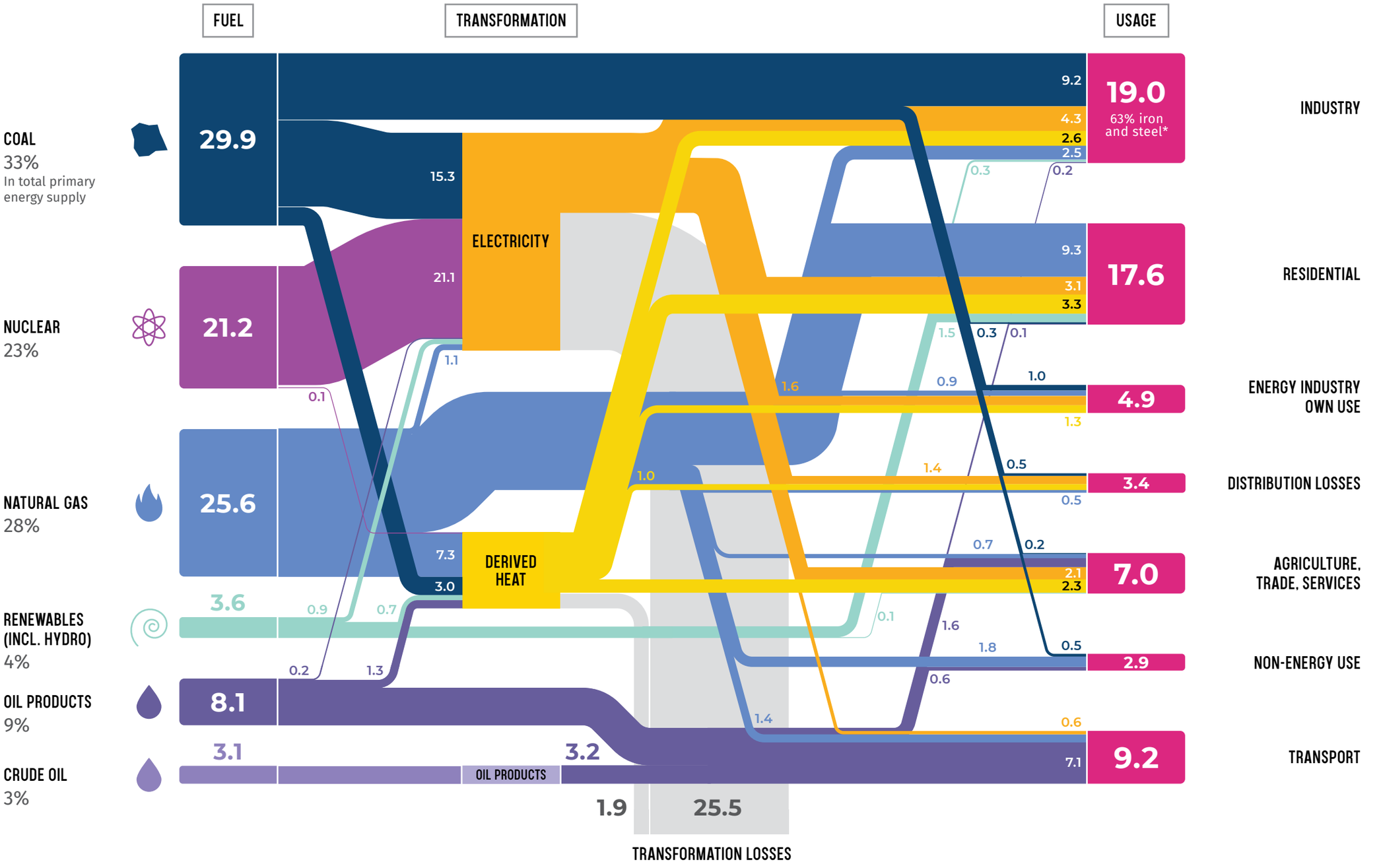
REDUCTION OF EMISSION IN CO2 EQUIVALENT,
final fuel consumption, % of 2010



Source: MECIU

ENERGY BALANCE: INDUSTRY — THE LARGEST CONSUMER

2016, m toe



Source: SSSU

*including coke ovens

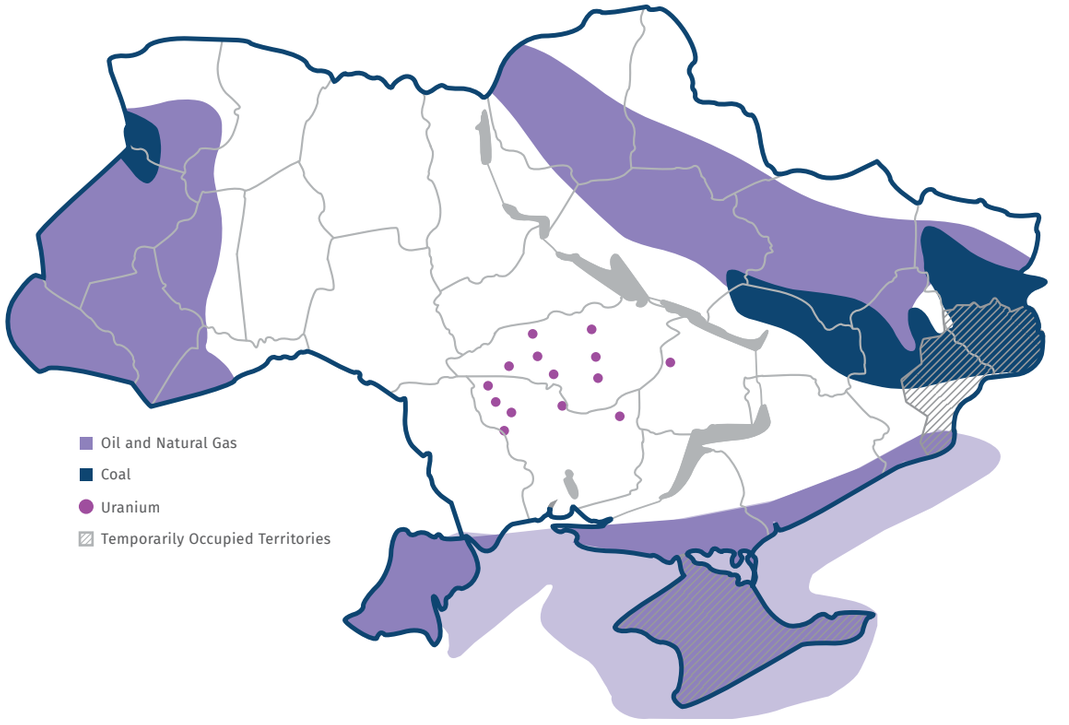
UKRAINE HAS SUFFICIENT RESOURCES TO INCREASE ITS ENERGY PRODUCTION

BALANCE RESERVES OF UKRAINE

as of 01.01.2018

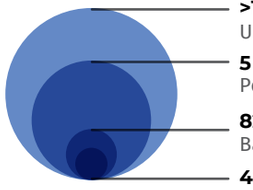
	BALANCE RESERVES	RESERVES BEING EXTRACTED	LEVEL OF EXPLORATION*	RESERVES IN YEARS**
GAS	829 bcm	87%	16%	40
OIL	110 m t	78%	38%	72
GAS CONDENSATE	43 m t	89%	26%	64
COAL	44 bn t	20%	—	1 769
URANIUM***	251 kt	—	39%	259

DEPOSITS OF UKRAINIAN ENERGY RESERVES



Most deposits are classified as small and very small

bcm



>10 000
Unconventional resources

5 143
Potential resources

829
Balance reserves

400
Proved and likely reserves

Extraction costs USD/Uranium kg	0–80	80–130	130–260
Resources kt	68	64	119

Main Uranium resources: albitite rock formation with high underground mining cost.

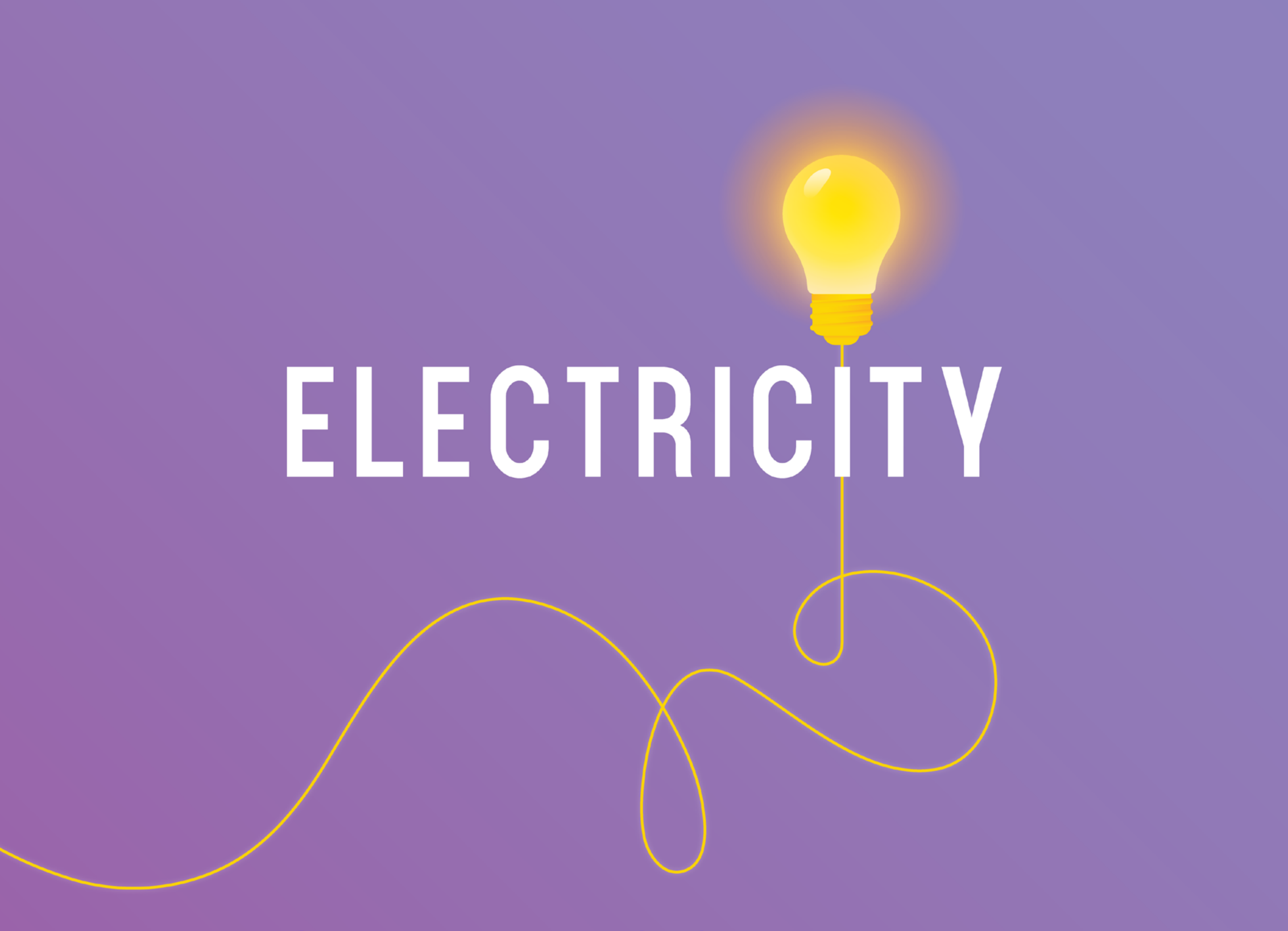
Sources: Geoinform, NEA, AGPU, Kirovgeologiya

*balance vs. potential resources

**at current production level (including extraction losses). Economic feasibility of extraction of all reserves is not included

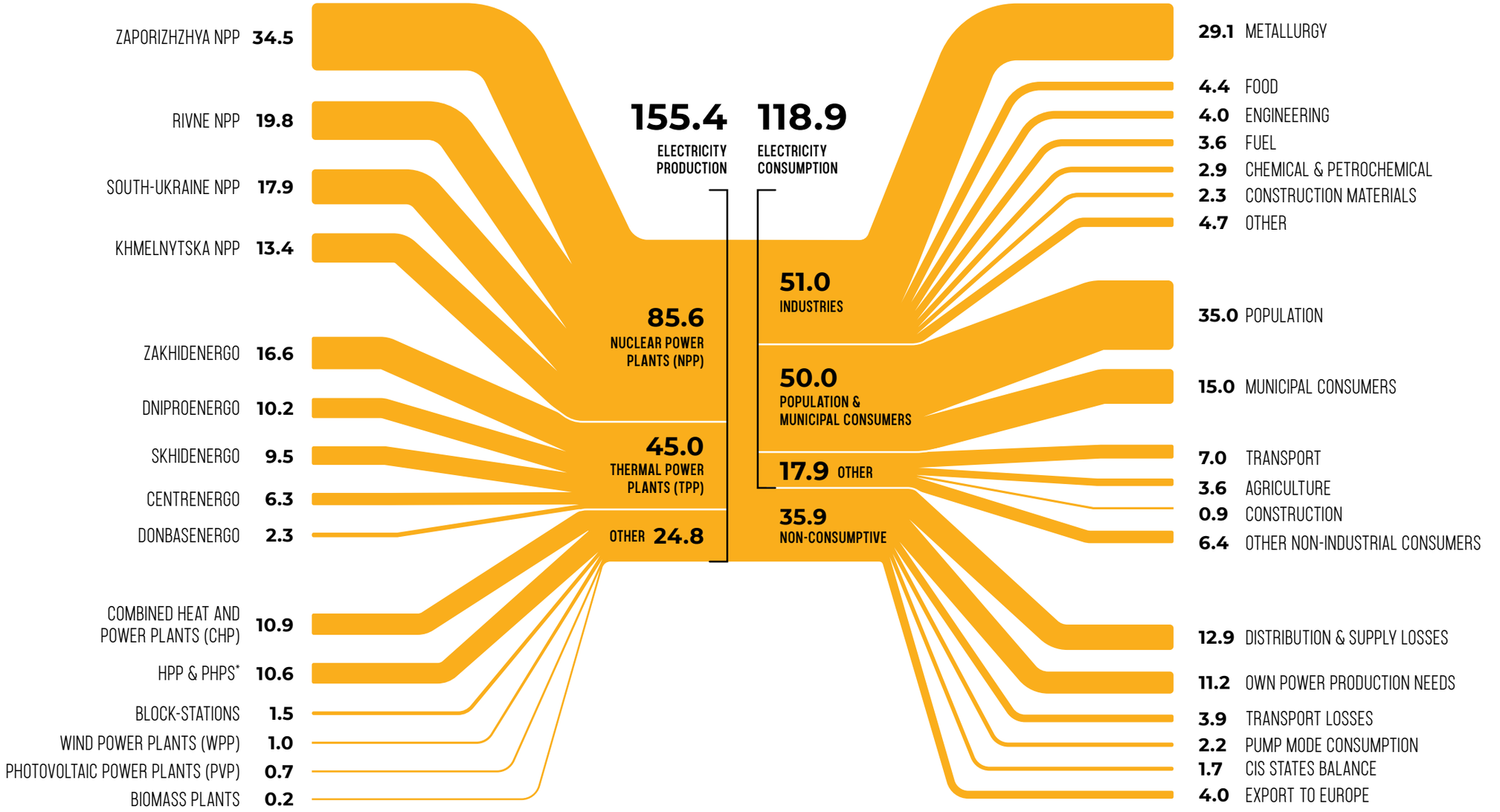
***resources as of 01.01.2015

ELECTRICITY



ELECTRICITY BALANCE

2017, bn kWh



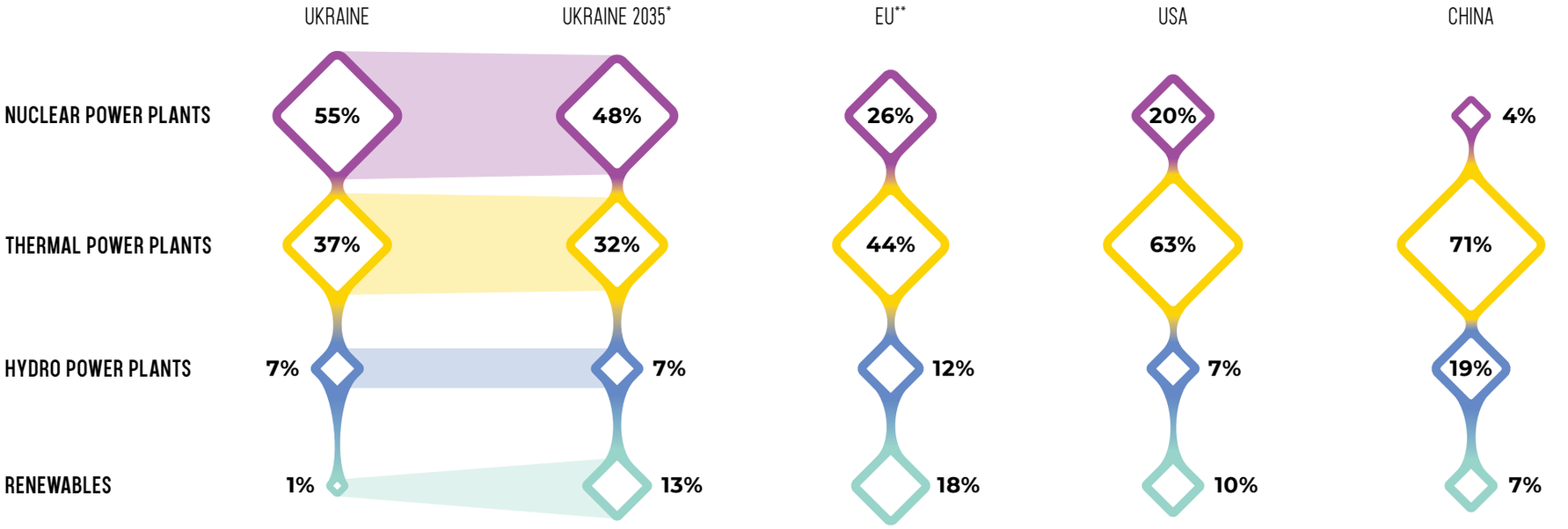
Source: MECIU

*Hydro Power Plant & Pumped Hydro Power Station

UKRAINE PLANS TO REDUCE THE GAP IN THE SHARE OF RENEWABLES

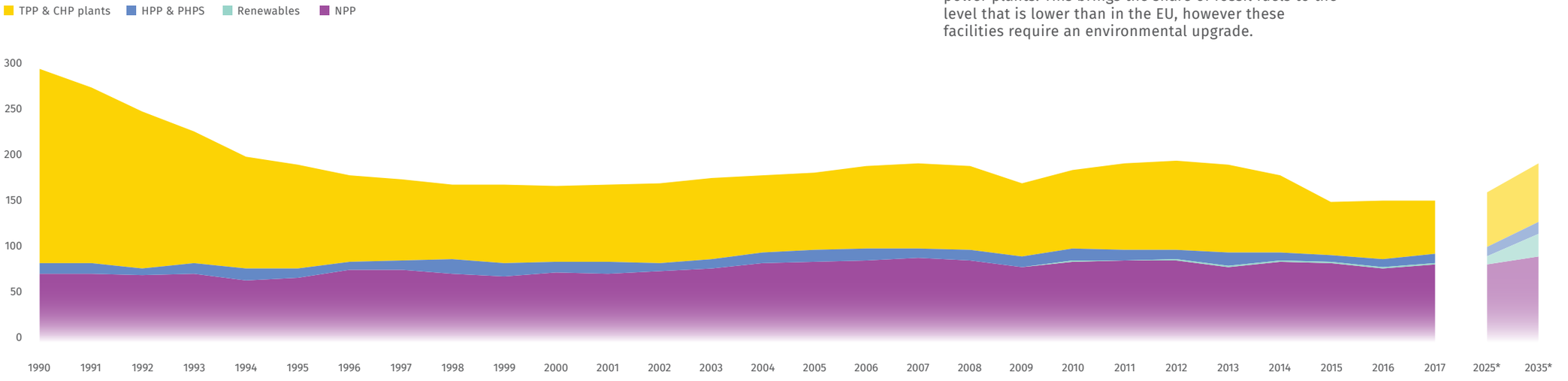
STRUCTURE OF ELECTRICITY GENERATION IN UKRAINE/GLOBALLY

2017, %



ELECTRICITY GENERATION IN UKRAINE

1990–2017 and forecast, bn kWh



The share of renewable energy sources will be increased through reduction of the share of nuclear and thermal power plants. This brings the share of fossil fuels to the level that is lower than in the EU, however these facilities require an environmental upgrade.

Sources: IEA, CEC, EIA, MECIU

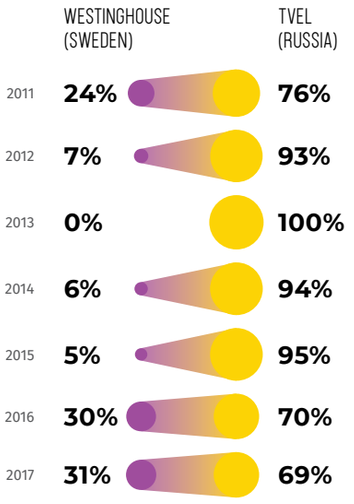
*according to the 2035 energy strategy of Ukraine

**2016

UKRAINE'S STRATEGIC OBJECTIVE IS TO SUBSTITUTE NUCLEAR FACILITIES

STRUCTURE OF FUEL IMPORT FOR NPPS

2011–2017, % of import cost



Ukraine is 100% dependent on the imported nuclear fuel. Efforts to diversify the imports were made as early as in 1996, and cooperation with Westinghouse started in 2008. This helped get away from single-vendor dependence.

The Energy Strategy envisages adopting, by 2020, an action plan to decommission facilities by 2030, and selecting of new reactor technologies to substitute old power units.

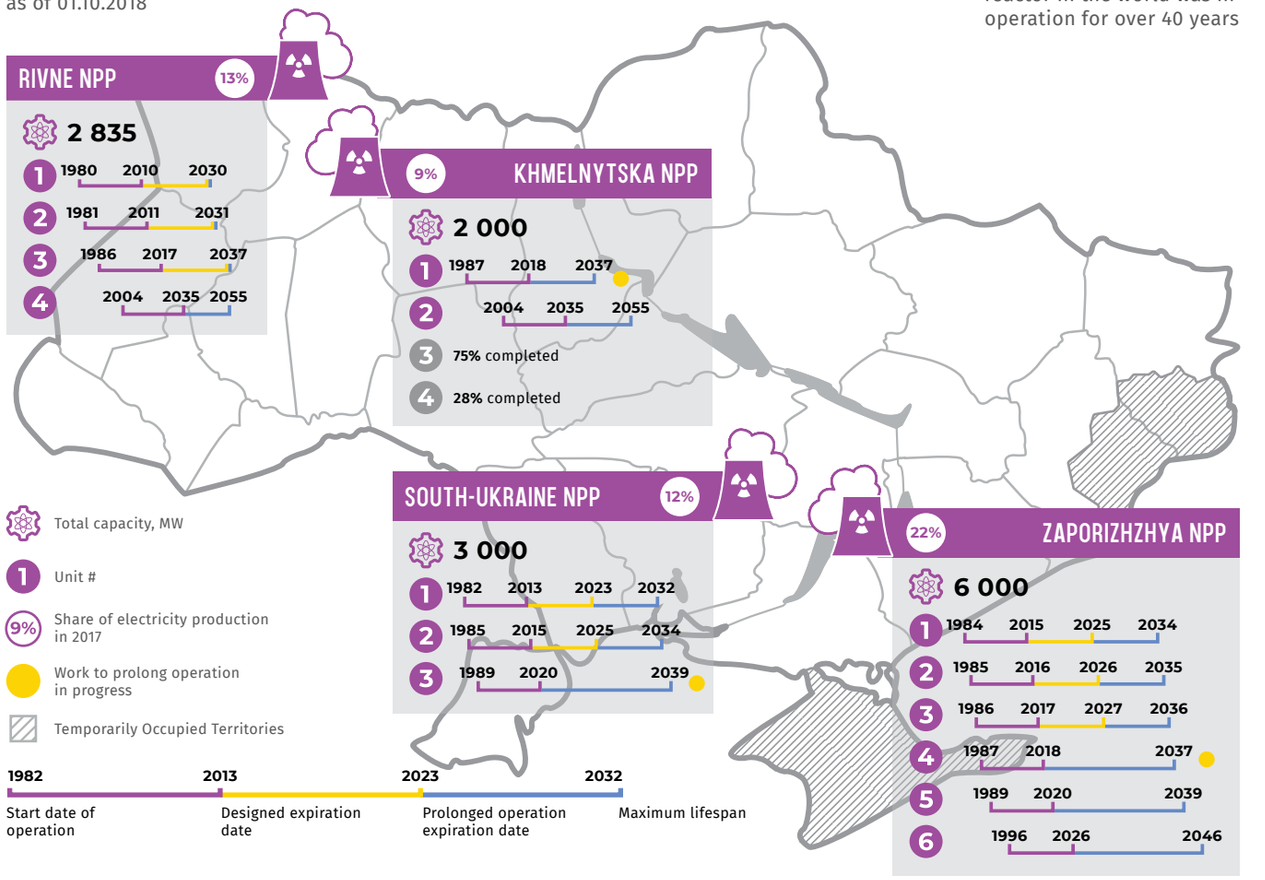
USEFUL LIFE OF UKRAINIAN REACTORS

years

LOCATION AND USEFUL LIFE OF NUCLEAR POWER REACTORS

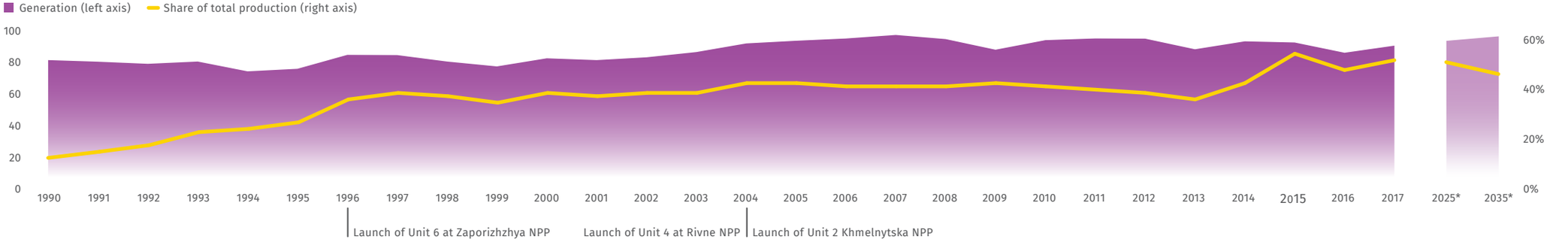
as of 01.10.2018

As of early 2018, every fifth reactor in the world was in operation for over 40 years



NPP ELECTRICITY GENERATION

1990–2017 and forecast*, bn kWh (%)



Sources: Energoatom, SSSU, MECIU, SNRIU

*according to the 2035 energy strategy of Ukraine

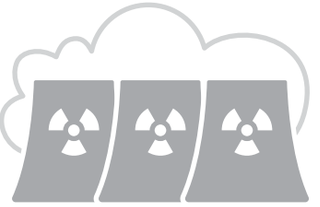
MAINTAINING THE ROLE OF NPPS REQUIRES SIGNIFICANT INNOVATIONS

REACTOR UNITS TO BE DECOMMISSIONED

2030–2040

RIVNE NPP

SOUTH-UKRAINE NPP



KHMELNYTSKA NPP

ZAPORIZHZHYA NPP

COSTS OF SUBSTITUTION OF FACILITIES TO BE DECOMMISSIONED

Unit 1

5 USD bn
(USD 5 000 per kWh)

6–10 years
construction

10–15 years
payback period

DECOMMISSIONING

78%
of facilities
installed
in 2030–2040

10.8
GWh

54.2
bn USD
to install
similar reactors

The following factors make financing complicated:

-9.2 UAH bn — NPP operator's net loss in 2007–2017

75% — of NPP operator's profit goes to the state budget

Practically no funds are earmarked for the purpose of power units decommissioning.

TRENDS IN THE GLOBAL NUCLEAR POWER SECTOR

- Global generation of nuclear power is dropping third year in a row (except China).
- Construction of 86 reactors is planned by the end of 2017. 80% of them are in 4 countries (China, Russia, Japan, USA).
- Low capacity reactors are being designed, with an expected 5 times shorter construction time and payback period.
- Installed capacity of nuclear power plants in the EU will drop down to 33% by 2040*

75 nuclear reactors were connected to the network in 2001-2017:

Every second reactor is located in China, where the share of nuclear power generation is only 4%

Only three reactors are located in Europe, including two in Ukraine

5 years is the average time of construction of a nuclear power unit

After implementation of the energy market reforms, the Ukrainian NPP operator will get new financial opportunities, such as concluding bilateral contracts at the market price.

Taking into account the high cost of NPP construction and given that such projects are being gradually phased out around the world, the economic value for Ukraine should be thoroughly evaluated with regard to significant implementation delay caused by the regulatory and technological complexity of such projects.

16 years from the date when the Ukrainian Nuclear Waste Storage concept was approved to the date when it has been implemented.

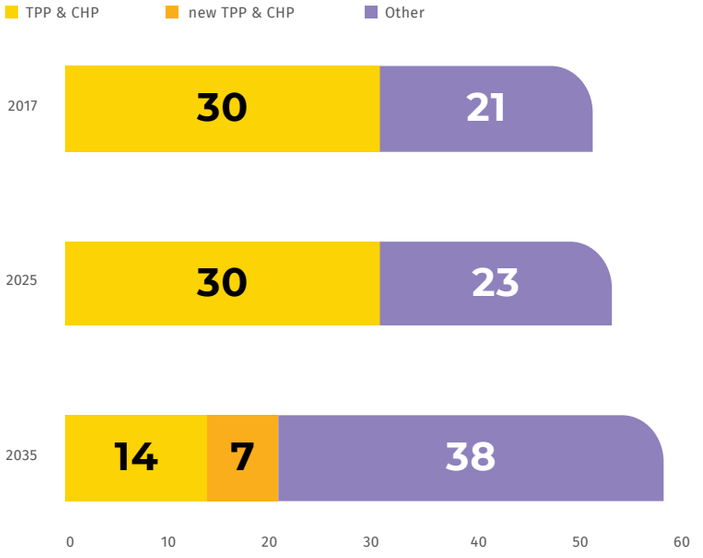
Sources: Energoatom, IAEA, Worldnuclearreport, IEA

*according to IEA forecasts

CLEANER ENVIRONMENT IS THE KEY MISSION OF HEAT GENERATION

FORECAST FOR INSTALLED HEAT GENERATION UNITS

2017–2035, GW*



The share of heat generation in total electricity production will remain at 25–30% by 2030.

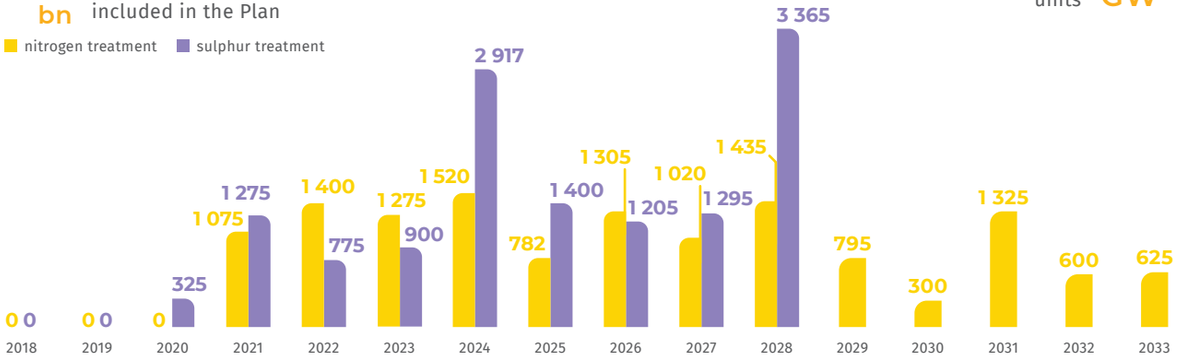
INSTALLATION OF TREATMENT UNITS AT THE EXISTING CAPACITIES

MW

The National Plan for Reduction of Incineration Unit Emissions (approved by the Government in November 2017) requires to reduce dust, sulphur dioxide and nitrogen oxide emissions down to the levels set by Directive 2010/75/EU. The Plan covers the period of 2018–2033.

6.5 EUR bn Total investments in retrofitting and upgrade of units included in the Plan

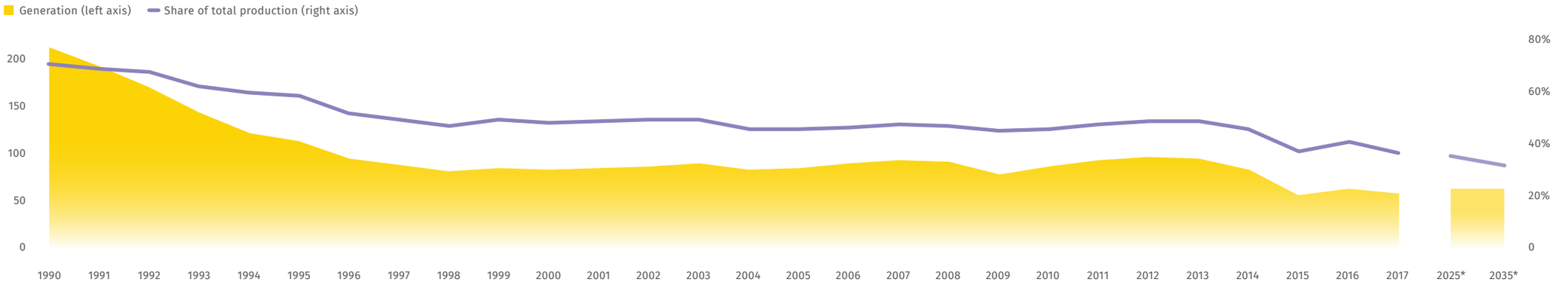
Have sulphur and nitrogen treatment units **13.5 GW**



Funding sources for the actions envisaged in the Plan are not identified, which may endanger its implementation.

GENERATION OF ELECTRICITY AT TPP AND CHP

1990–2017 and forecast*, bn kWh (%)



Sources: IEA, MECIU, CETI

*according to the 2035 Energy Strategy of Ukraine

DEVELOPMENT CAPACITY OF HYDRO POWER PLANTS IS LOW

RATED ELECTRICITY PRICE FOR DIFFERENT HYDRO POWER PLANTS

2010 USD cents/kWh

Min
Max

LOW-CAPACITY HPP

2 — 27

HIGH-CAPACITY HPP

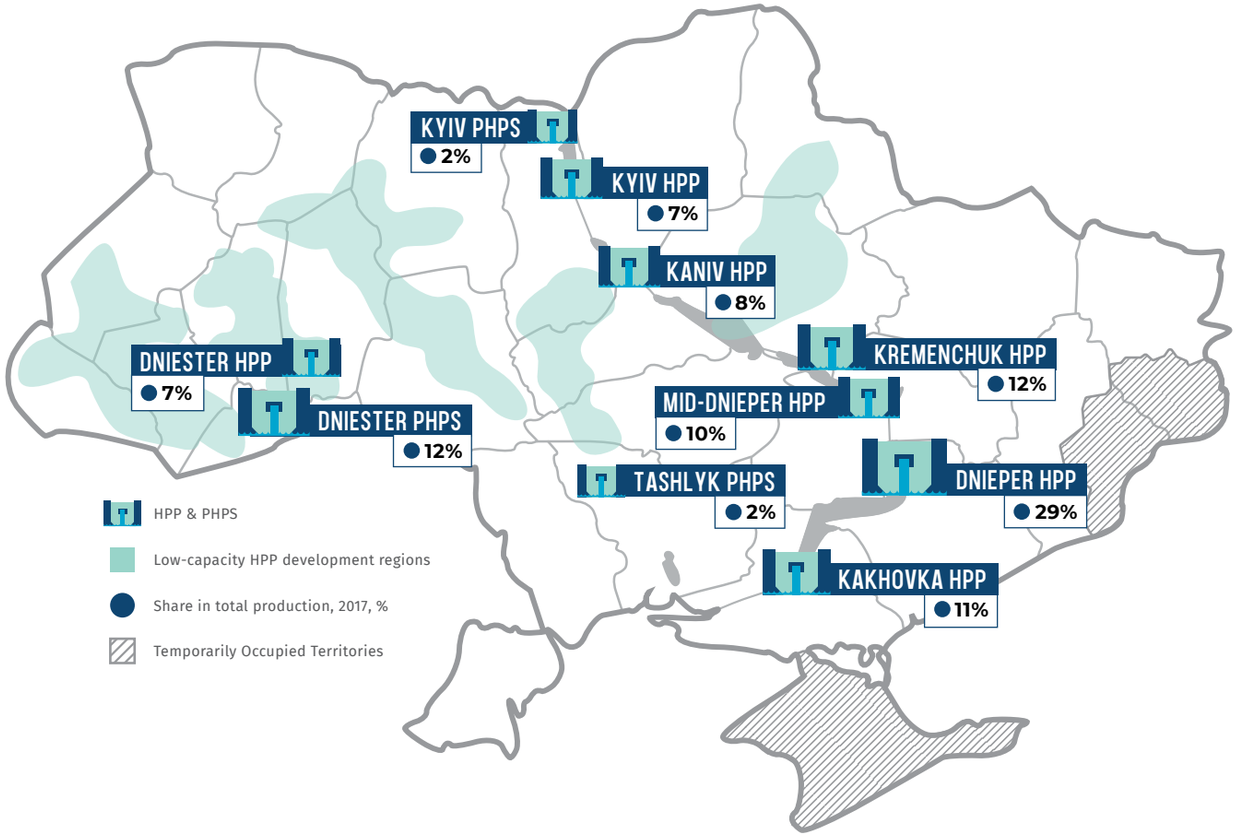
2 — 19

UPGRADING AND MODERNIZATION OF EXISTING FACILITIES

1 — 5

The Energy Strategy of Ukraine envisages reconstruction of existing facilities and construction of new units by 2025.

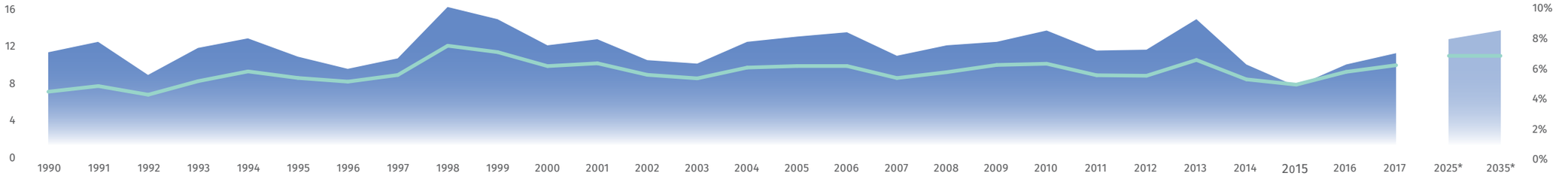
LOCATION OF HIGH-CAPACITY HYDRO POWER PLANTS AND PUMPED HYDRO POWER PLANTS



GENERATION OF ELECTRICITY AT HYDRO POWER PLANTS AND PUMPED HYDRO POWER PLANTS

1990–2017 and forecast*, bn kWh (%)

Development of mini and micro HPP is constrained by environmental conditions. Despite the moderate increase of installed capacity, lower water levels in rivers lead to decline in power generation. As of the end of 2016, capacity factor at low-capacity facilities was 24%.



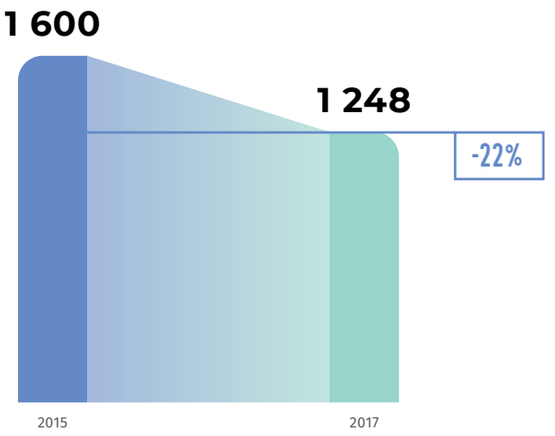
Sources: MECIU, IFC, Minregion

*according to the 2035 Energy Strategy of Ukraine

SIGNIFICANT INCREASE IN WPPS CAPACITIES IS EXPECTED

COST OF WIND POWER PLANTS CONSTRUCTION IN UKRAINE

does not include expenses on projects financing and additional work, euro/kW



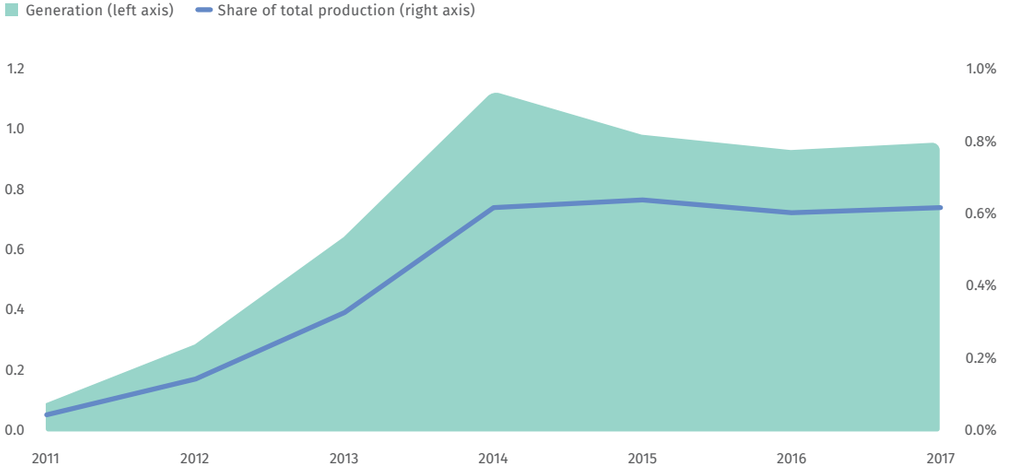
The greatest potential of wind energy is concentrated in the Carpathians. However, technological and legislative difficulties related to this region restrict usage of existing potential.

WPPS CAPACITIES LOCATION IN UKRAINE

2017, MW*

WPPS ELECTRICITY PRODUCTION

2011–2017, bn kWh (%)



CURRENT AND EXPECTED WPPS CAPACITY IN UKRAINE

as of 31.12.2017, MW

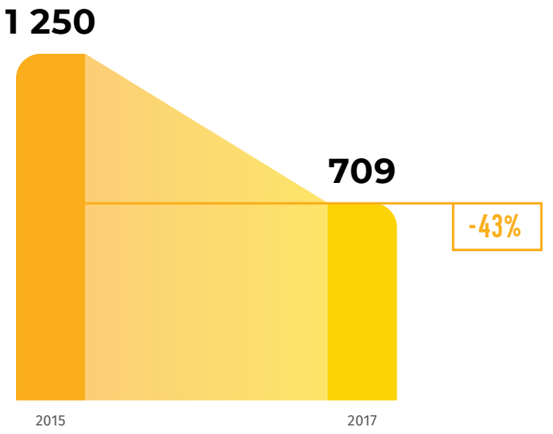
Sources: MECIU, NEURC, USELF, UWEA

*including WPPs located on temporarily occupied territories

SOLAR POWER TECHNOLOGIES BECOME CHEAPER

COST OF PV PLANTS CONSTRUCTION IN UKRAINE

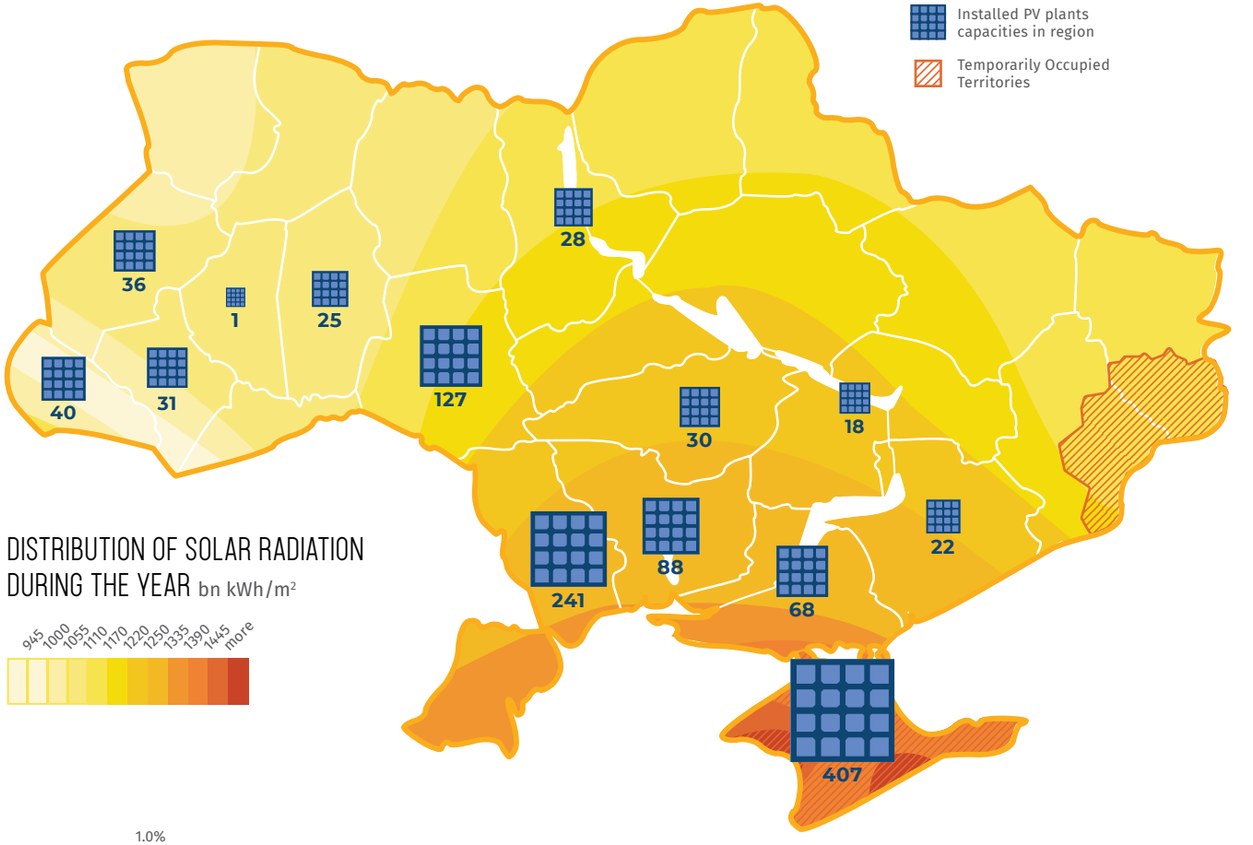
does not include expenses on projects financing and additional work, euro/kW



Solar photovoltaics become cheaper faster than any other renewables technologies.

PV PLANTS CAPACITIES LOCATION IN UKRAINE

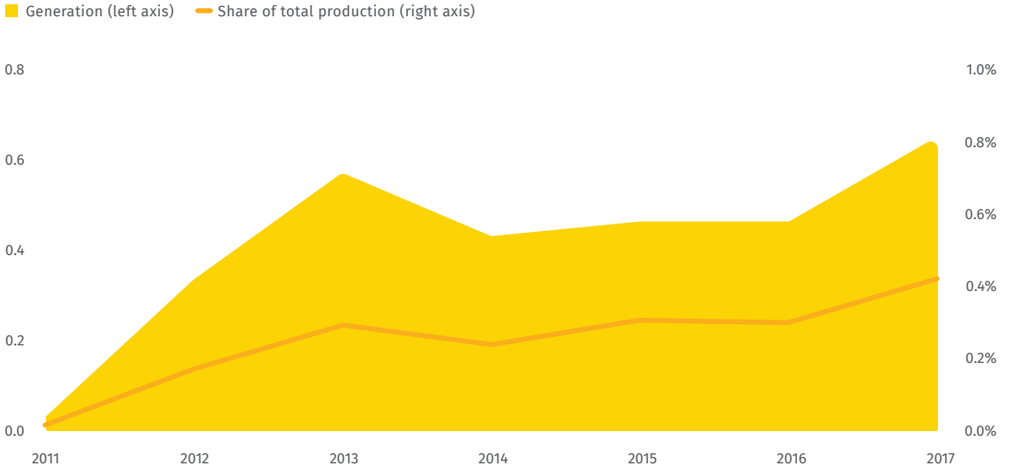
2017, MW*



DISTRIBUTION OF SOLAR RADIATION DURING THE YEAR bn kWh/m²

PV PLANTS ELECTRICITY PRODUCTION

2011–2017, bn kWh (%)

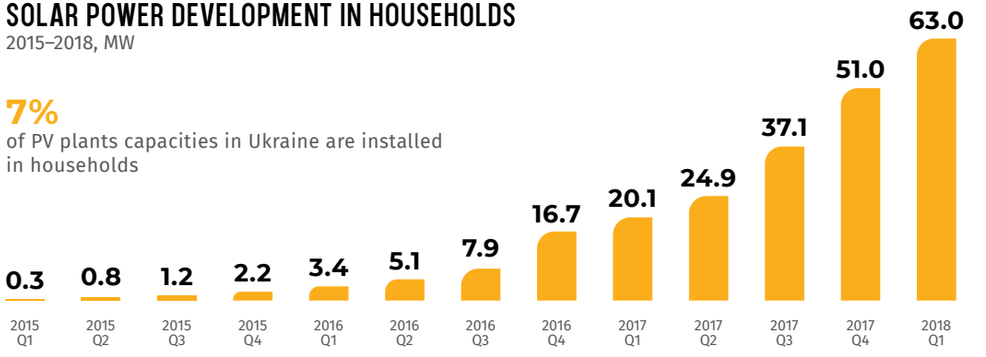


SOLAR POWER DEVELOPMENT IN HOUSEHOLDS

2015–2018, MW

7%

of PV plants capacities in Ukraine are installed in households



Sources: MECIU, NEURC, USELF, IRENA

*including WPPs located on temporarily occupied territories

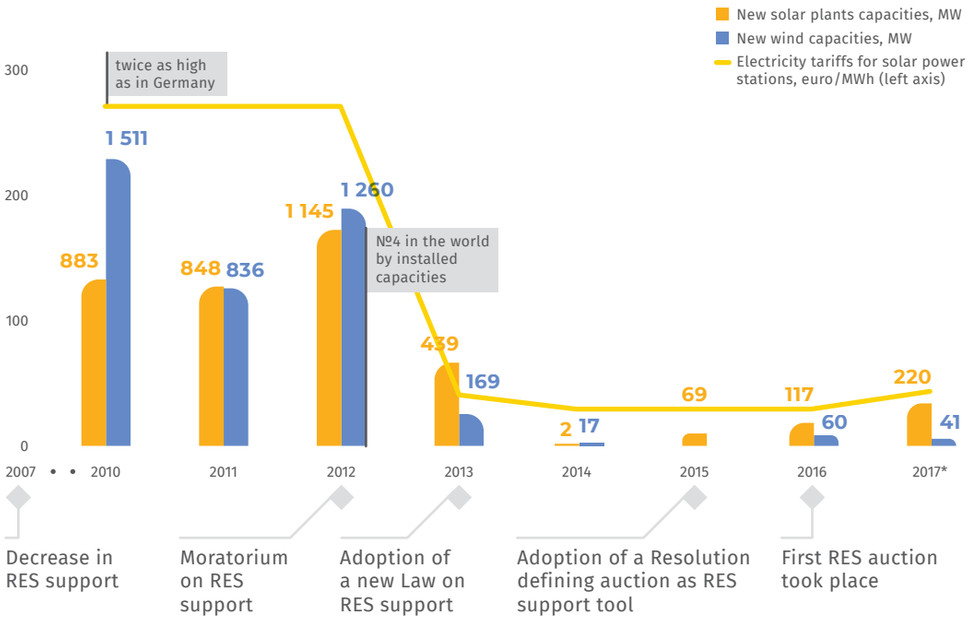
RES SUPPORT MECHANISM SHOULD BE UPDATED GRADUALLY AND ON TIME

NARROW-MINDED DECISIONS CAN CEASE DEVELOPING OF RES

SOLAR POWER PLANTS DEVELOPMENT IN SPAIN

2010–2017

Technologies cost reduction stimulated a sharp increase of solar power stations. Spain became one of the leaders in solar power development rate. Government has decided to retrospectively reduce tariffs, which caused a complete stop of the industry development in 2014-2015. Implementation of auction mechanism for RES support allowed the industry to resume its development.

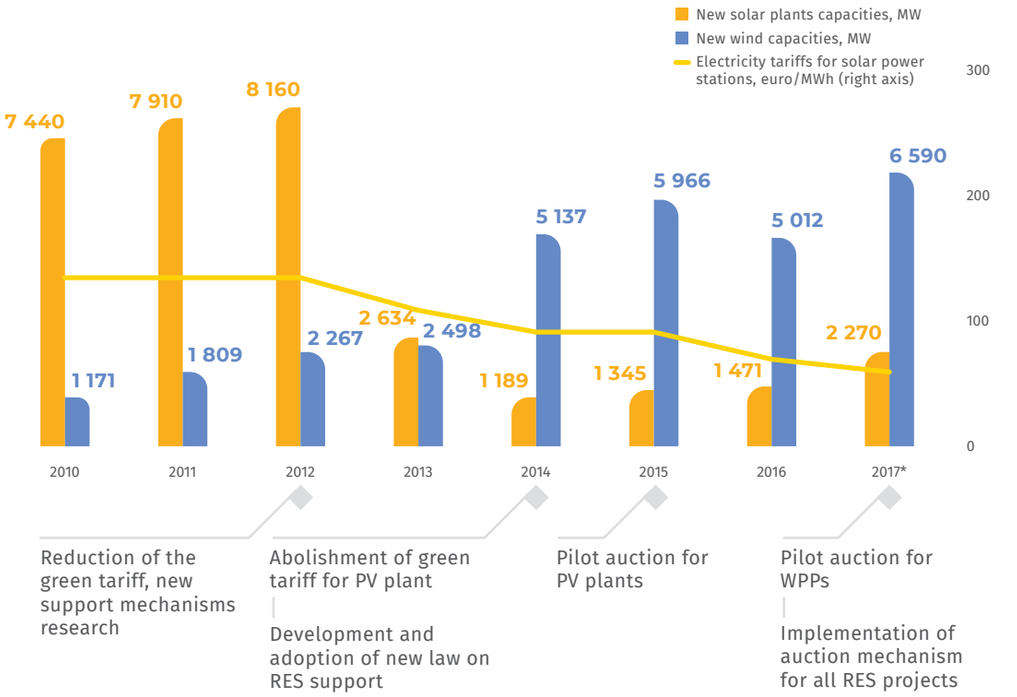


AUCTION SYSTEM ALLOWS TO FIND BALANCE BETWEEN DIFFERENT RES

WPPS AND SOLAR POWER STATIONS DEVELOPMENT IN GERMANY

2010–2017

Implementation of auction mechanism for solar power stations caused rational redistribution of investments and so uniform development of all RES segments.



STEPS NEEDED TO REFORM RES SUPPORT MECHANISM IN UKRAINE

1 Development of auction rules: based on free-access system and limited winner price (no higher than current green tariff)

2 Implementation of auctions in the early 2020

Implementation of a new system ensures investment climate stability and steadiness of RES development in Ukraine

3 Reduction of current green tariffs since 2020 and stable support sceme for existing RES projects

4 Establishment of additional incentives for small RES development.

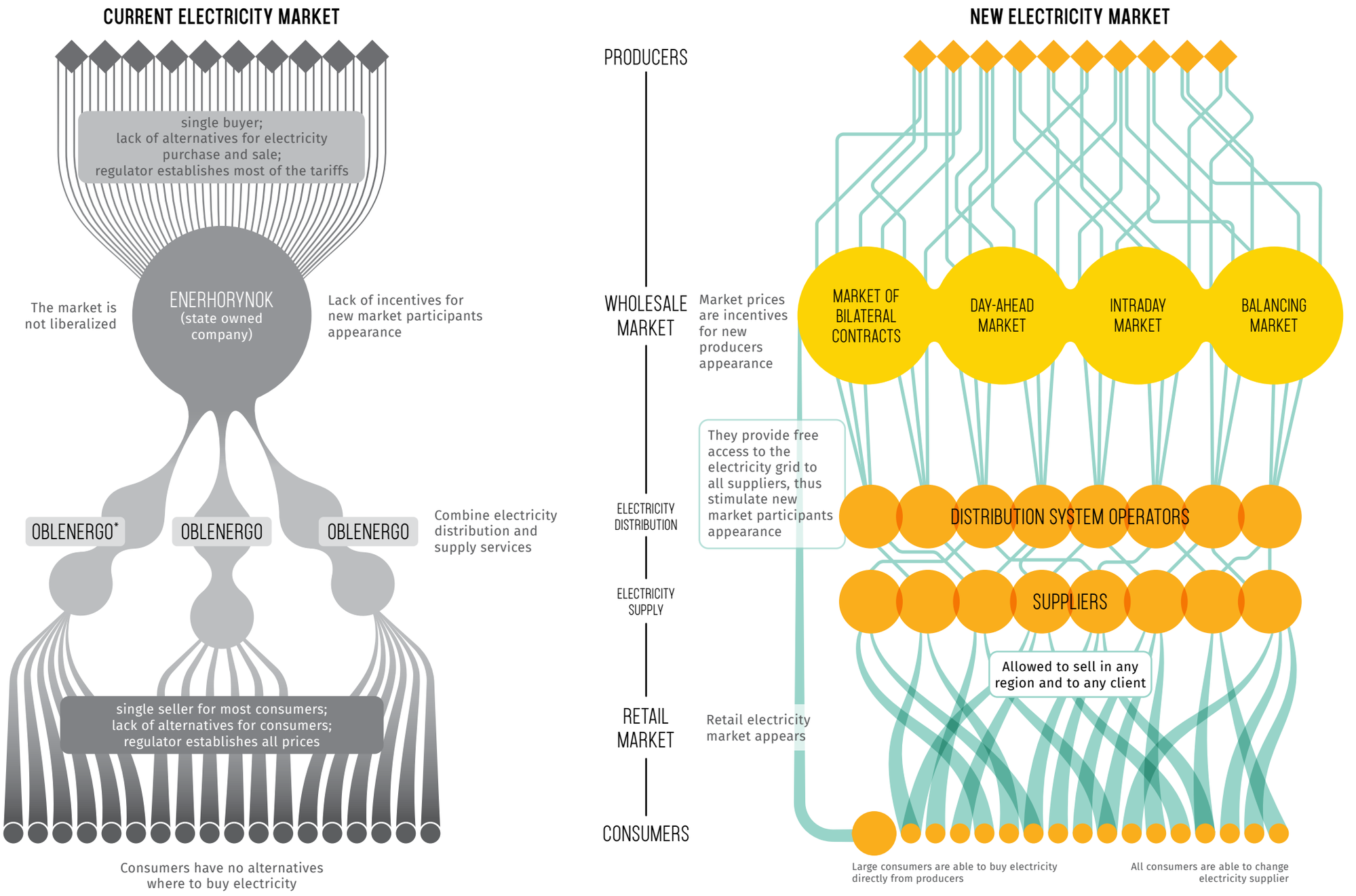
This step leads to gradual implementation of distributed energy generation in Ukraine

Sources: Eurostat, ENTSO-E, EU Commission, AEBOE

*unaudited data

ENERGY REFORM

NEW FREE MARKET IS INCENTIVE TO INVEST IN ENERGY INDUSTRY



Source: the Law of Ukraine No 2019-VIII On the Electricity Market dated 13 April 2017

*distribution and supply companies

IMPLEMENTATION OF NEW ELECTRICITY MARKET REQUIRES ACCELERATION

NEW ELECTRICITY MARKET LAUNCHING TIMELINE*

- completed
- performing with delays
- is not implementing
- deadline has not yet come

Each year of reform delay costs Ukraine, on average, **$7.4** bn USD of GDP and $1.2 bn USD of revenues for the state budget

Law of Ukraine On the Electricity Market entered into force

11.06.2017

11.08.2017

REGULATOR
Approves rules on certification of transmission system operators

11.09.2017

CMU
Approves rules on CHP plants support

CMU
Submits draft law on debt settlement on a current market

11.12.2017

CMU
Establishes guaranteed buyer as structural sub-division of SE Enerhorynok

CMU
Executes corporatization of Ukrenergo

REGULATOR
Drafts regulations necessary for the implementation of auxiliary services

CMU
Submits to the Parliament draft amendments to the legislation (tax and budget codes)

REGULATOR
Approves terms of licenses for market operators, guaranteed buyer, electricity generation, trading, distribution and supply

REGULATOR
Approves regulations necessary for unbundling of electricity distribution and supply

REGULATOR
Approves market rules, day-ahead market rules, retail market rules, commercial metering code, transmission system code, distribution system code (without approval from AMCU)

11.01.2018

VERTICALLY INTEGRATED COMPANIES
Submit information on unbundling to the Regulator

CMU
Ensures submission of a request for certification to Regulator by Transmission System Operator (Ukrenergo)

11.03.2018

REGULATOR
Approves rules on electricity purchase and sell by Guaranteed buyer under PSO for transitional period

CMU
Brings own regulations in the line with Energy market law

REGULATOR
Approves rules on payment for grid connection, congestion management rules and cross-border capacity allocation rules (without approval from AMCU)

11.06.2018

CMU
Approves regulations prescribed by the law: tender procedure on universal service supplier, last resort supplier, reconstruction and new generation capacities construction support rules, rules of supply to protected consumers

01.12.2018

REGULATOR, UKRENERGO
Hold auctions on cross-border capacity allocation

11.12.2018

CMU
Ensures purchase and installation of hardware and software necessary for all market segments functioning by Ukrenergo and Energorynok

SUPPLIERS AND DISTRIBUTION COMPANIES
Unbundling deadline, supply license on regulated tariff revocation

SUPPLIERS, DISTRIBUTION COMPANIES, CONSUMERS
Undertaking a set of actions according to retail market liberalisation: notifying consumers and signing of contracts between consumers, suppliers and distribution companies**

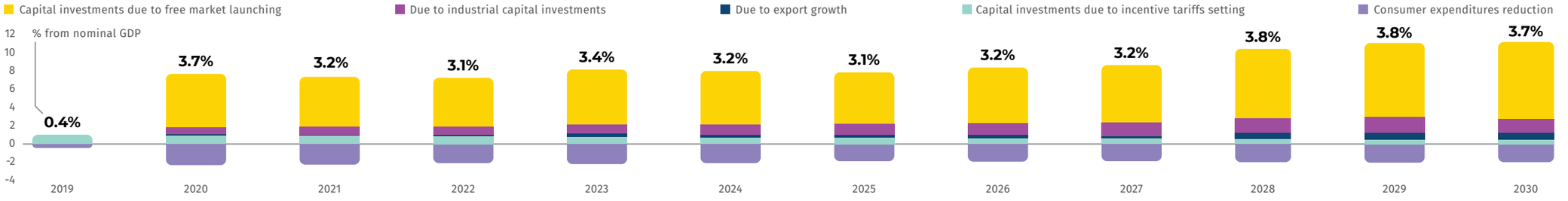
ENERHORYNOK, UKRENERGO
Start of testing electricity sales and purchase operations on relevant segments of the new market

01.07.2019

New electricity market launching

ECONOMIC GROWTH FORECAST DUE TO NEW ELECTRICITY MARKET LAUNCHING

2019–2030, USD bn



Sources: in accordance with the Energy market law implementation plan

*as of October 2018

**except clients of Universal service provider

ENTSO-E INTEGRATION IS THE DEVELOPMENT FRAMEWORK OF INTERNAL MARKET

BENEFITS OF INTEGRATION OF ENERGY SYSTEM OF UKRAINE INTO THE ENERGY SYSTEM OF CONTINENTAL EUROPE (ENTSO-E)

- Increased **reliability** and cohesion of the energy system of Ukraine.
- **Competitive** opportunities on the new energy marker of Ukraine.
- **Investment** appeal of the Ukrainian energy sector due to free energy market.
- 4-times **export** increase — from 5.2 billion kWh to 20 bn kWh (in the first few years after synchronisation). Export growth by more than USD 6 bn in 2019–2030.

UKRAINE'S ENTSO-E INTEGRATION TARGETS

UAH 11,4 bn integration cost

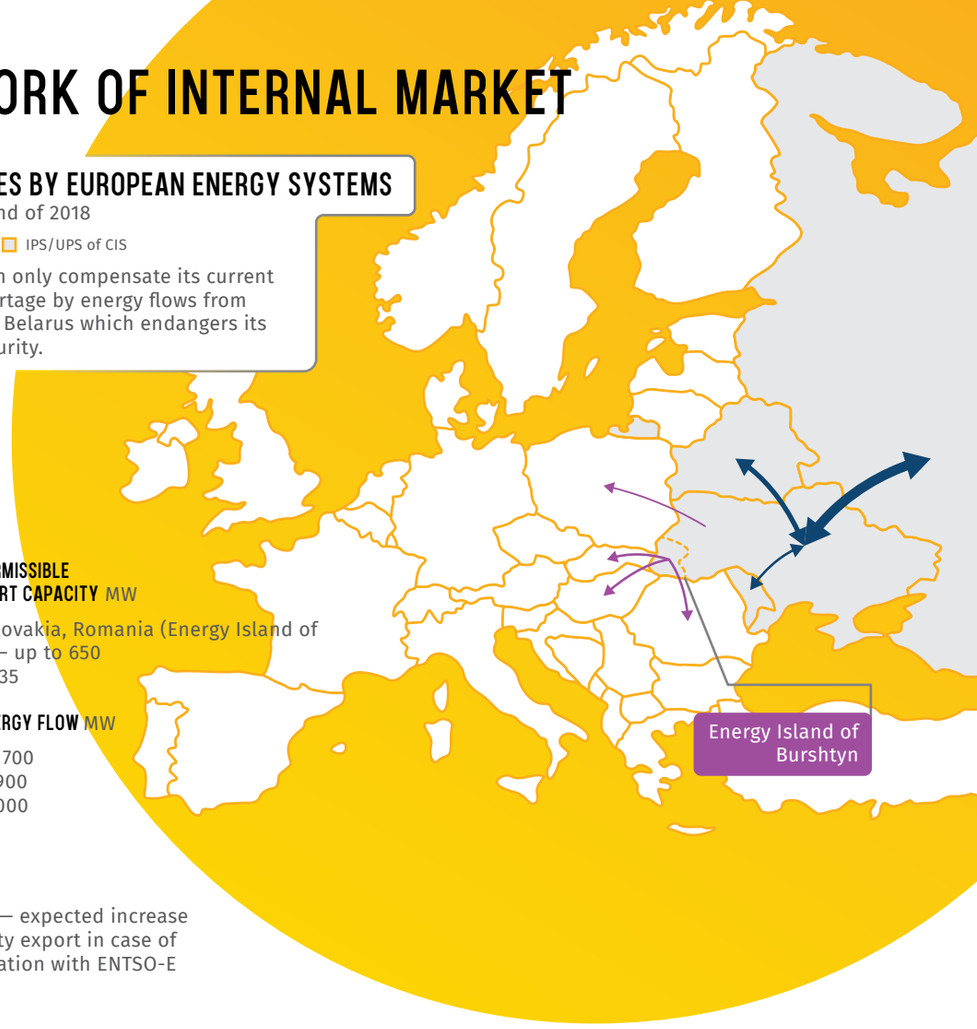
	2017	2018–2019	2022	2027
Technological readiness of the energy system of Ukraine to ENTSO-E integration	15%	50%	99%	100%
Harmonization of the national legislation with the EU legislation	5%	90%	100%	100%
Level of integration of the energy system of Ukraine into ENTSO-E	10%	10%	100%	100%
Technically feasible exchange between the energy system of Ukraine and ENTSO-E, MW	885	885	2 200	4 000

COUNTRIES BY EUROPEAN ENERGY SYSTEMS

as of the end of 2018

ENTSO-E IPS/UPS of CIS

Ukraine can only compensate its current energy shortage by energy flows from Russia and Belarus which endangers its energy security.



MAXIMUM PERMISSIBLE ENERGY EXPORT CAPACITY MW

Hungary, Slovakia, Romania (Energy Island of Burshtyn) — up to 650
Poland — 235

MAXIMUM ENERGY FLOW MW

Moldova — 700
Belarus — 900
Russia — 3000

6 USD bn — expected increase of electricity export in case of synchronisation with ENTSO-E

UKRAINE'S ENTSO-E INTEGRATION CHRONOLOGY

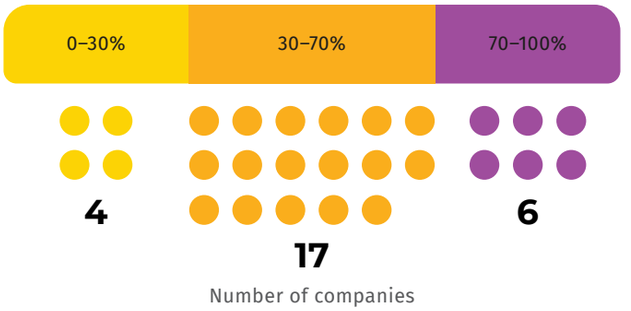
- **2005** — Ukraine declares its intention to integrate into the EU energy market
- **2006** — 4 attempts to sign the Agreement failed due to political situation
- **2007–2012**
- **2013** — Feasibility Study: "Synchronised Integration of the Energy Systems of Ukraine and Moldova into ENTSO-E"
- **2014** — Ukraine-EU Association Agreement includes integration of the United Energy System of Ukraine into ENTSO-E
- **2015–2016**
- **2017** — Terms and conditions for the ENTSO-E integration of the Energy Systems of Ukraine & Moldova signed in Brussels 28 June
- The Agreement comes into force 7 July 2017 (it was signed by 28 system operators members of Continental Europe regional group ENTSO-E)
- **2018–2020** — Fulfilling of Technical Provisions provided in the Terms and conditions
- **2021** — Island mode operation (physically detached from Russia)
- **2022** — Synchronising of the Energy Systems of Ukraine & Moldova with ENTSO-E
- **2023** — Full integration of the United Energy System of Ukraine into Continental Europe ENTSO-E in operating mode

Sources: Ukrenergo, UIF

THE LOWEST QUALITY OF ENERGY SUPPLY IN EUROPE

TEAR AND WEAR OF POWER DISTRIBUTION FACILITIES

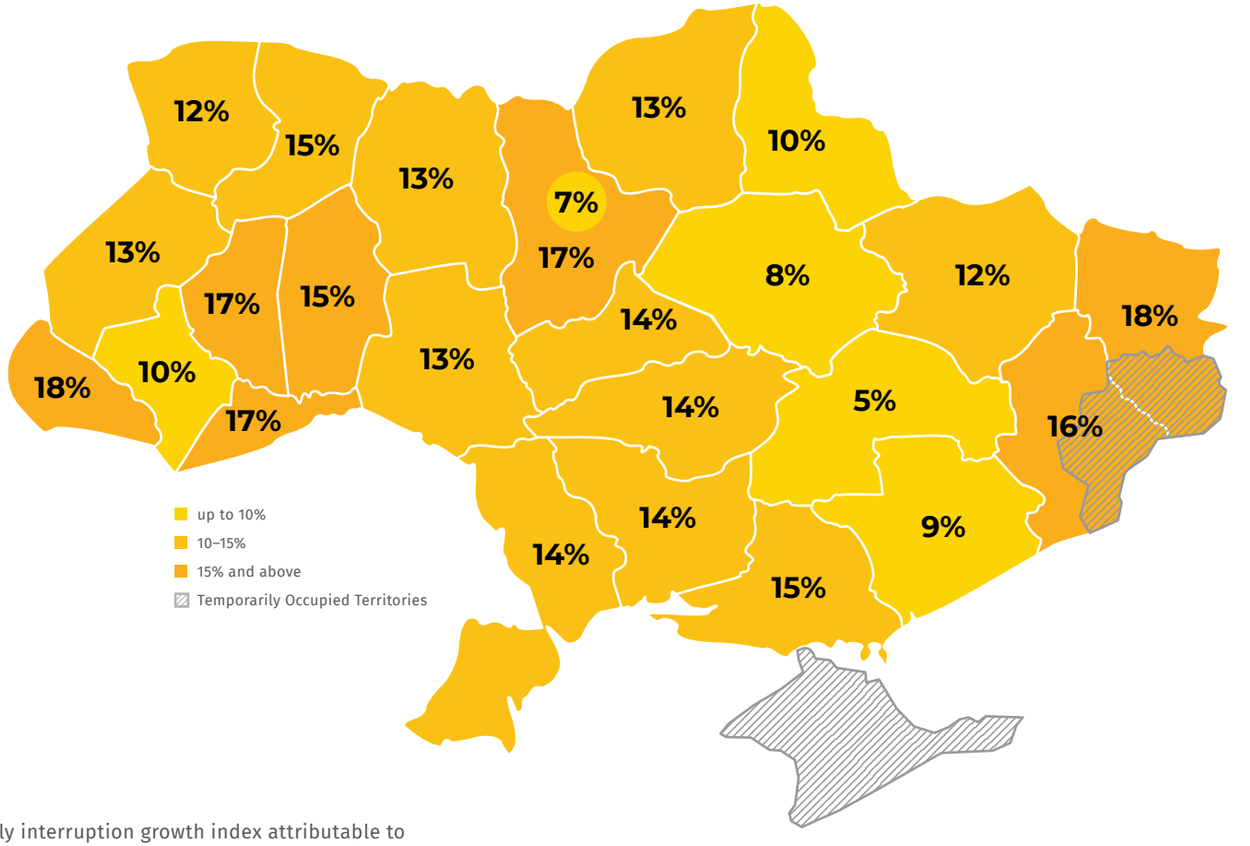
2016, %



Outdated pricing system is the key constraint for development of the power distribution system.

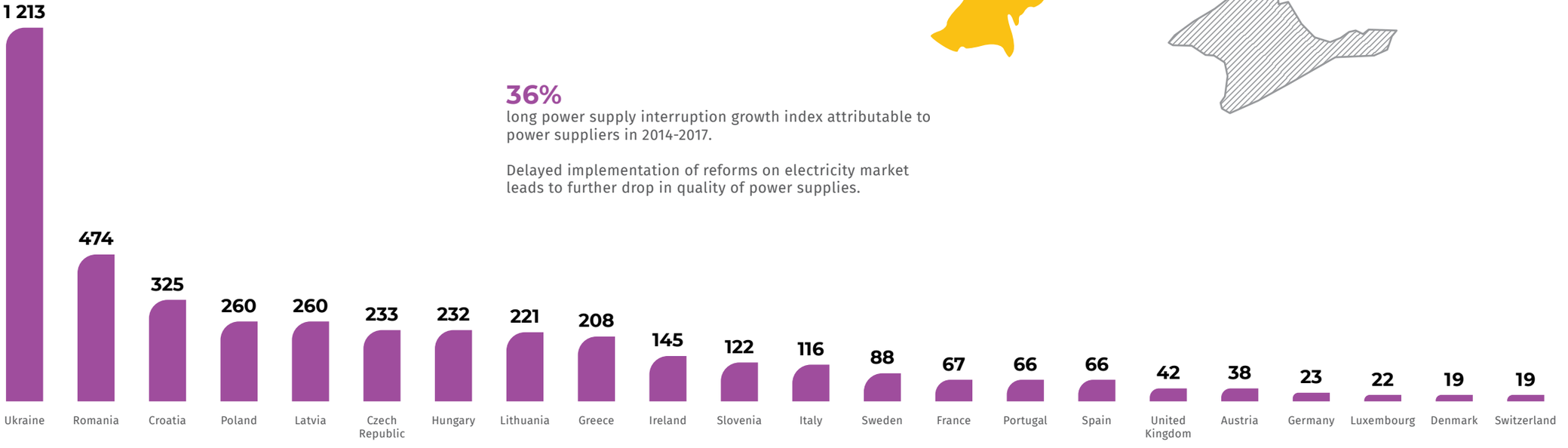
LOSSES IN DISTRIBUTION NETWORKS

2017, % of sales



QUALITY OF ENERGY SUPPLY

long energy supply interruptions, 2016 (Ukraine — 2017), min.*



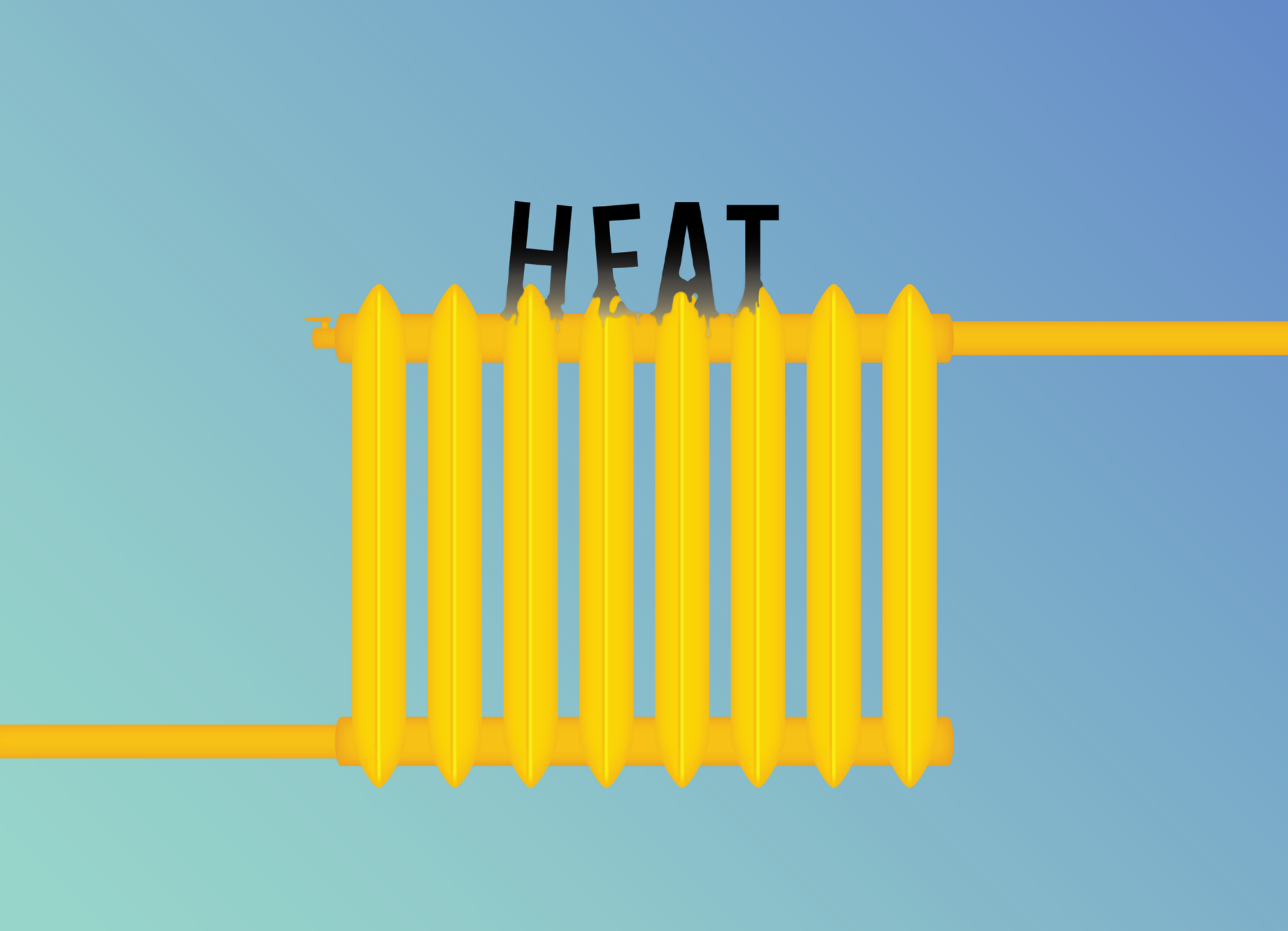
36%

long power supply interruption growth index attributable to power suppliers in 2014-2017.

Delayed implementation of reforms on electricity market leads to further drop in quality of power supplies.

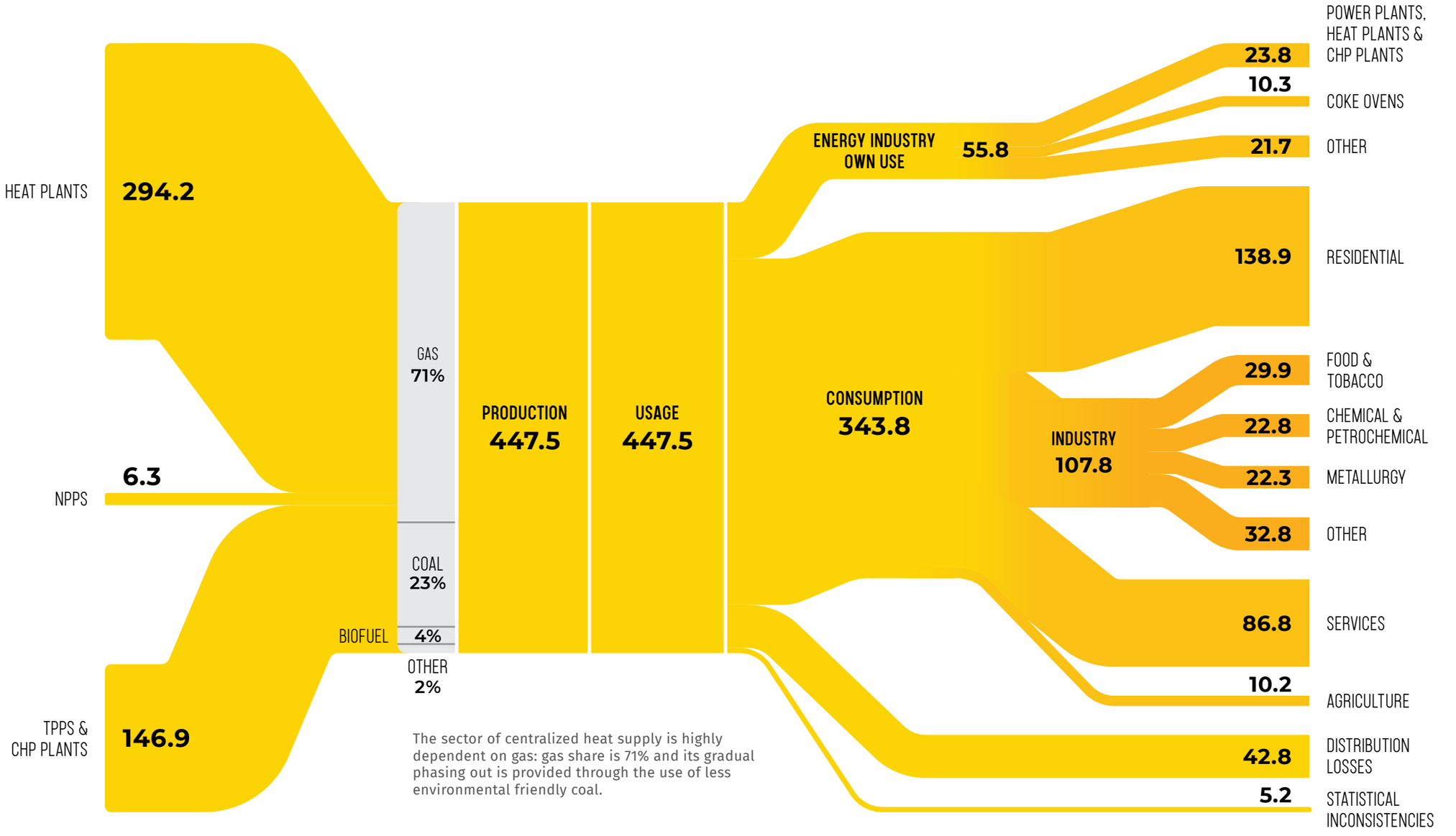
Sources: CEER, NEURC, DiXi Group

*planned and through supplier's fault


HEAT

DERIVED HEAT BALANCE

2016, bn MJ (%*)



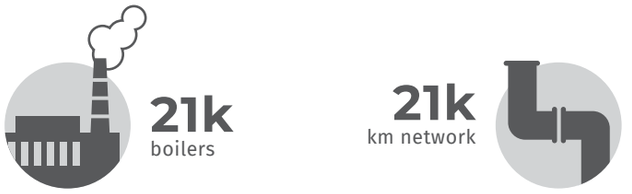
The sector of centralized heat supply is highly dependent on gas: gas share is 71% and its gradual phasing out is provided through the use of less environmental friendly coal.

Sources: Eurostat, Minregion

*sources that generate thermal power are shown as of 2014

ALL CENTRAL HEATING SECTORS REQUIRE REFORMING

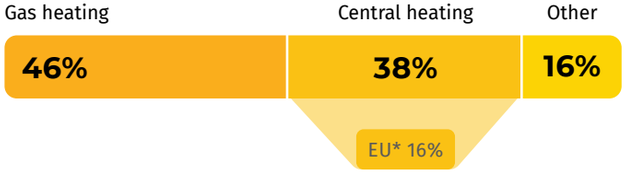
CONDITION OF CENTRAL HEATING SYSTEMS OF UKRAINE AS OF 2017



- **60%** of heating networks are worn down or in damaged condition
- **60%** of boilers completed their useful life
- **20%** higher fuel consumption compared to global average
- **EUR 6 bn** — estimated investment to upgrade the central heating facilities

BREAKDOWN OF HOUSEHOLDS BY HEATING TYPE

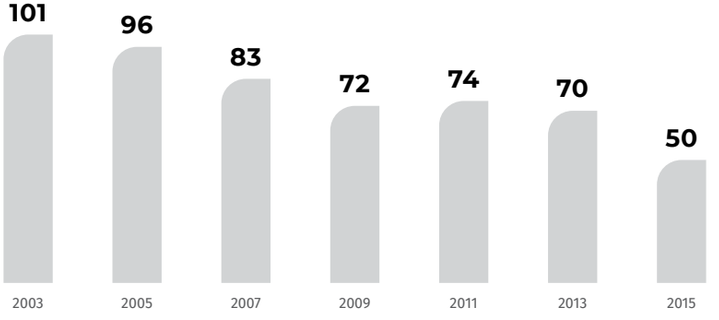
2016, %



The last decade there is a trend towards replacing the central heating system with a decentralised system due to bad quality of the former.

CENTRAL HEATING CONSUMPTION

2003–2015, m Gcal

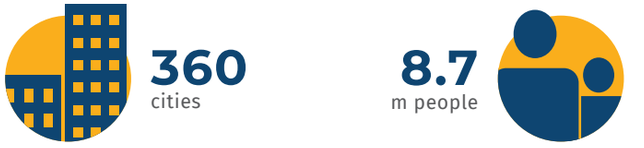


Sources: SSSU, Minregion

*EU-27 — 2014

POTENTIAL FOR DECENTRALISED HEATING IN UKRAINE

Mid- and small-size cities (up to 160k people) are the best targets for the implementation.



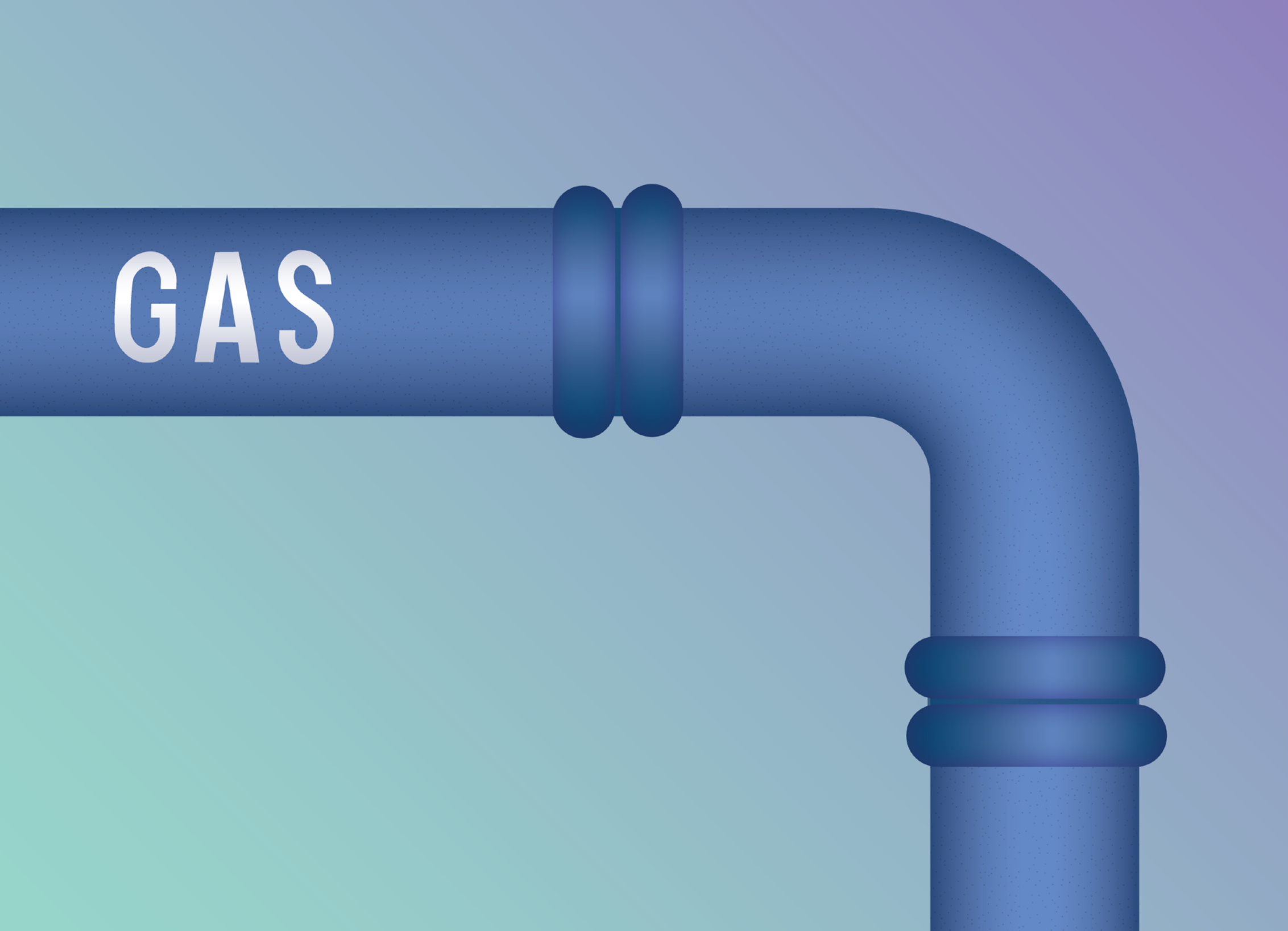
EUR 0.3–1.1 bn
investment needs

20–40%
potential heat savings

Currently the choice of heating system should be focused on the condition of specific districts rather than the city overall.

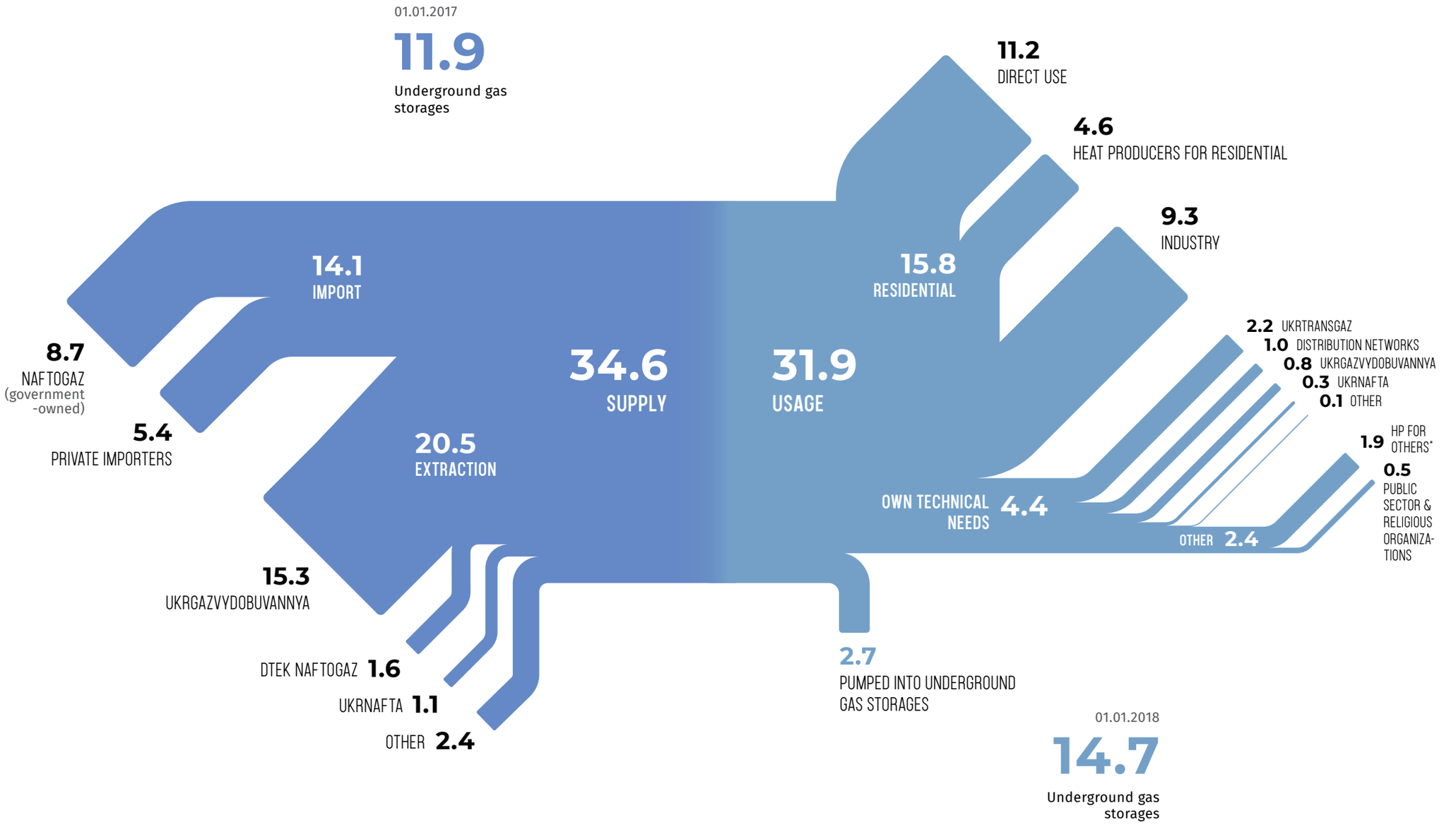
STRENGTH AND WEAKNESSES OF DIFFERENT HEATING SYSTEMS

	CENTRAL	DECENTRALISED
SCALE	scale based savings ✓	higher operational and capital costs
TRANSMISSION	loss of heat during transmission, significant capital costs	less capital costs, minimum heat consumption during transmission ✓
ENERGY SOURCES	big choice (waste, industry) ✓	narrower choice of energy sources
CAPACITY ADJUSTMENT	additional heat distribution stations required to expand capacity	instant adjustment according to needs ✓


GAS

NATURAL GAS BALANCE

2017, bcm



Source: Naftogaz, DTEK

*HP — Heat producers for public sector, religious organizations, industrial consumers

REGULATORY CONSTRAINTS DELAY THE INCREASE OF GAS PRODUCTION

HOW A NEW COMPANY CAN START GAS PRODUCTION IN UKRAINE

◆ Problem areas

GEOLOGICAL INFORMATION PURCHASE
(SSPE Geoinform of Ukraine)

"This information is open around the world to stimulate production development"

- 3 contracts to be signed
- 4 fees to be paid
- The entire procedure will take 1-2 months
- Cost determination is subjective based
- Entities can't dispose of own geological information without regulator's approval

APPLICATION AND SUBMITTING DOCUMENTS TO BID THE LAND

All documents should be submitted to the Derzhgeonadra integrated office

APPROVAL OF DOCUMENTS BY PUBLIC AUTHORITIES

The investors often face difficulties with local authorities who seek benefits. This only acts as a deterrent

BIDDING

Only an extremely small part of lands are subject to bidding, most of them having no potential
No bidding took place in 2017 and first 3 quarters of 2018

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

EIA is a standard European practice for production, while in Ukraine an investor should conduct an assessment to obtain a special permission (before the actual exploration phase)

LAND REGISTRATION

Possible reluctance of land owners or operators to enter into a lease contract
Overcharging

APPROVAL OF DRILLING PROJECT AND COMPLETION OF WELLS

Individually for each Well

Includes up to 10 permissions out of which 6 can be issued for the contractor for a few years

GOVERNMENT ASSESSMENT OF NATURAL RESOURCES

Resource assessment is different from international classification which complicates global integration of the industry

INTEGRATION INTO GAS TRANSMISSION SYSTEM

Challenging pipelining in case of numerous land owners on route

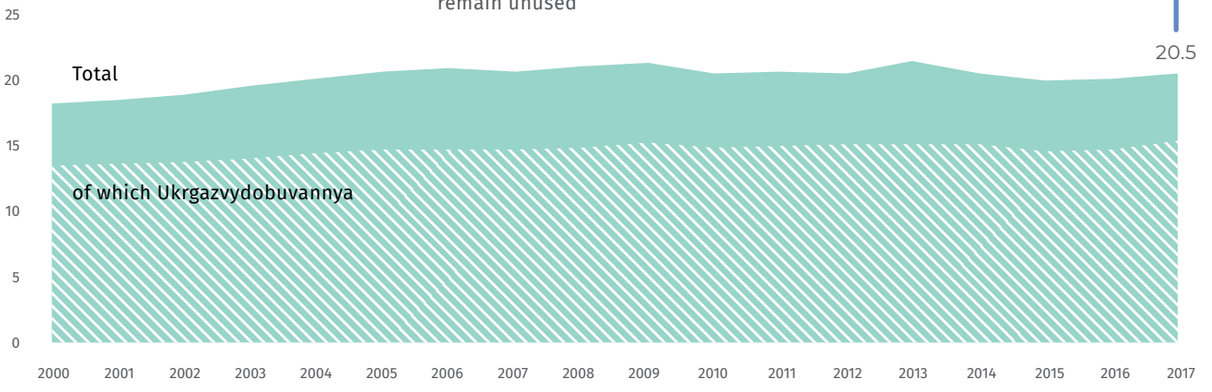
Deregulation of regulatory areas in 2018 allowed to reduce the time of obtaining of permissions from 3.5 to 2 years.

GAS PRODUCTION IN UKRAINE

2000–2017, bcm

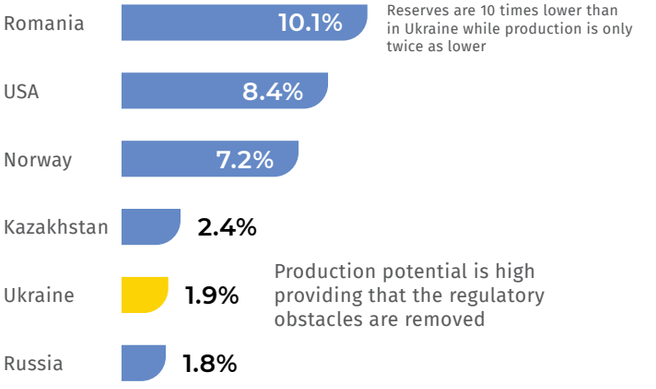
Lack of efficient geological information market and special permissions is the key problem of gas production in Ukraine. According to expert estimations, 30% of issued special permissions remain unused

Required amount to ensure self-sufficiency: 32



GAS PRODUCTION BY COUNTRY

production-to-reserves, 2017, %



Sources: Naftogaz, AGPU, BP

UKRAINE IS PROGRESSIVELY IMPLEMENTING EU LEGAL REQUIREMENTS ON THE GAS MARKET

Being the Contracting Party of the Treaty establishing Energy Community, Ukraine undertakes to implement the EU energy legislation

GAS MARKET OBLIGATIONS INCLUDE THE PROVISIONS OF THE FOLLOWING DOCUMENTS

- EU Directive 2009/73/EC concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC
- Regulation (EC) 715/2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005
- Directive 2004/67/EC concerning measures to safeguard security of natural gas supply

THIRD ENERGY PACKAGE

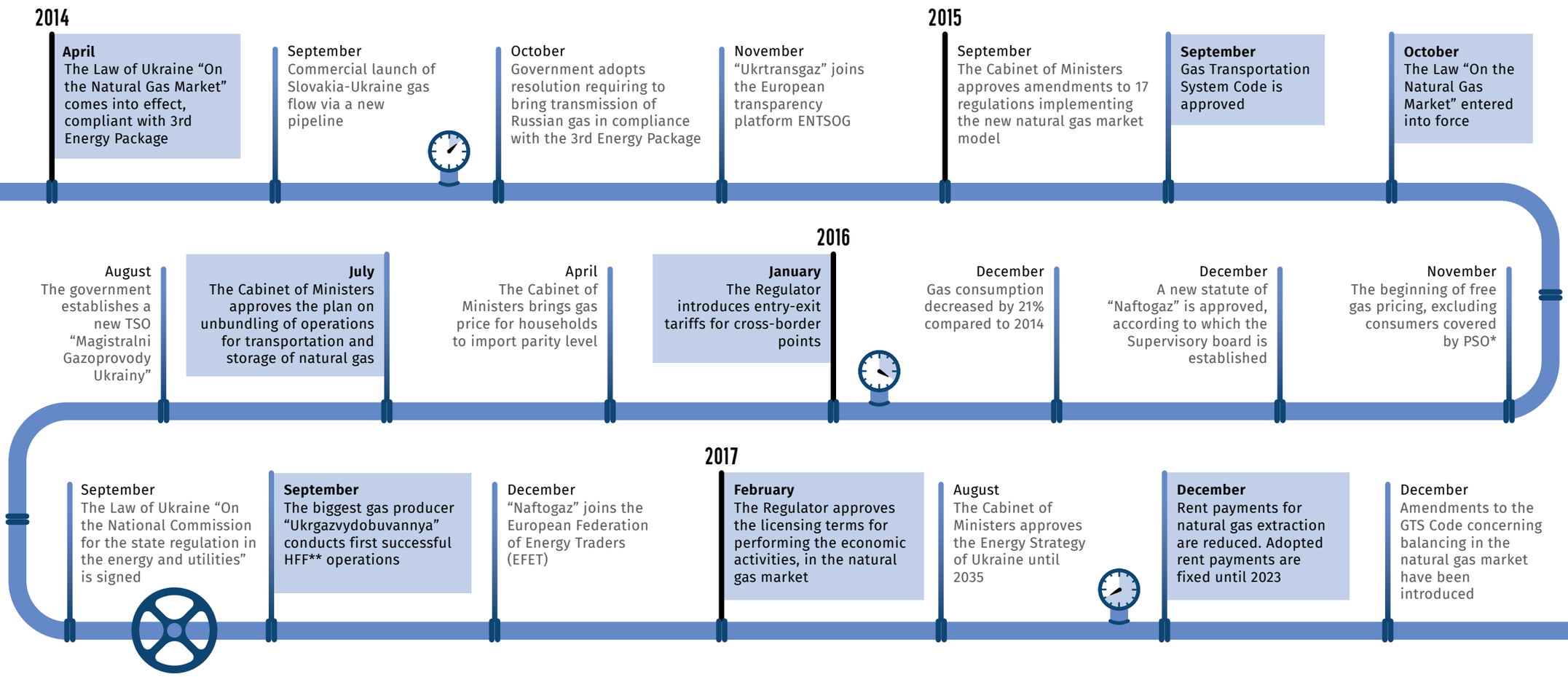
Obligation to unbundle natural gas transmission activities	Obligation to establish independent regulator	Obligation to provide third party access to the gas transmission system	Implementation of a new tariff setting model	Obligation to implement new balancing rules	Obligation to ensure security of gas supplies	Obligation to ensure consumer protection on natural gas market and protection of vulnerable customers	Obligation to enhance regional cooperation to integrate national gas markets
CMU Resolution No. 496 of 7/1/2016 "On Unbundling of Natural Gas Transmission and Storage (Injection, Withdrawal) Activities" CMU Resolution No. 801 of 11/9/2016 "On Establishing Public Joint-Stock Company "Magistralni Gazoprovody Ukrainy" etc. Memorandum of Understanding On Unbundling of Gas Transmission System Operator between the Supervisory Boards of NJSC "Naftogaz of Ukraine" and PJSC "Magistralni Gazoprovody Ukrainy" of 7/24/2018	Law of Ukraine No. 1540-VIII of 9/22/2016 "On National Energy and Utilities Regulatory Commission"	NEURC Resolution No. 2493 of 9/30/2015 "On Approval of the Gas Transmission System Code" NEURC Resolution No. 2494 of 9/30/2015 "On Approval of the Gas Distribution System Code" NEURC Resolution No. 2495 of 9/30/2015 "On approval of the Gas Storage Code and criteria under which negotiated access regime or regulatory access regime is applicable to a specific gas storage"	NEURC Resolution No. 2517 of 9/30/2015 "On Approval of the Methodology for determination and calculation of tariffs for the service of natural gas transmission for entry and exit points based on longterm incentive-based regulation" NEURC Resolutions No. 3158 of 12/29/2015 and No. 348 of 3/28/2017 on setting tariffs for the service of natural gas transmission for entry and exit points (by cross-border pipelines and for Ukrainian consumers)	NEURC Resolution No. 2493 of 9/30/2015 "On Approval of the Gas Transmission System Code"	Ministry of Energy and Coal Industry of Ukraine Order No. 686 of 11/2/2015 "On Approval of the Rules of Secure Gas Supply" CMU Resolution No. 255 of 3/21/2018 "On Approval of the Reserve Stock of Natural Gas"	CMU Resolution No. 867 of 10/19/2018 "On approval of the Regulation on public service obligations of entities operating on the natural gas market to safeguard general public interests in the course of functioning of the natural gas market" Benefit and subsidy programs	NEURC Resolution No. 2493 of 9/30/2015 "On Approval of the Gas Transmission System Code" Signing of Interconnection Agreements between operators of the gas transmission system of Ukraine and the adjacent systems

GENERAL PROVISIONS OF THE ABOVE OBLIGATIONS ARE IMPLEMENTED BY THE LAW OF UKRAINE "ON NATURAL GAS MARKET"

Source: AEQUO

HOUSEHOLD CONSUMERS — THE LAST STATE-CONTROLLED NATURAL GAS MARKET SECTOR

NATURAL GAS SECTOR REFORMING IN UKRAINE



WHAT WAS ACHIEVED

- Free natural gas market pricing (excluding PSO*)
- **More than 500** gas traders on Ukrainian market
- **66** independent natural gas importers as of the end of 2017 (5 in 2014)
- **1000 days** traders are able to store their gas using Ukraine's UGS without customs clearance
- **by 5 times** HFF** cost was decreased because of scale effect
- **More than 40** private gas extraction companies in 2018

Source: Naftogaz

*public service obligations

WHAT ELSE SHOULD BE DONE

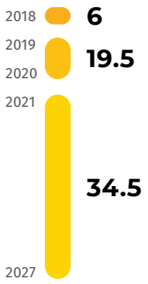
- Fully implement new legislation
- Create the competitive gas supply market for households
- Provide easy and fast process of changing supplier to all types of consumers
- Liberalise circulation of geological data and special permissions
- Finish the process of gas transition unbundling
- Finish corporatization reform
- Reach full integration with European market

**hydraulic fracturing of formation

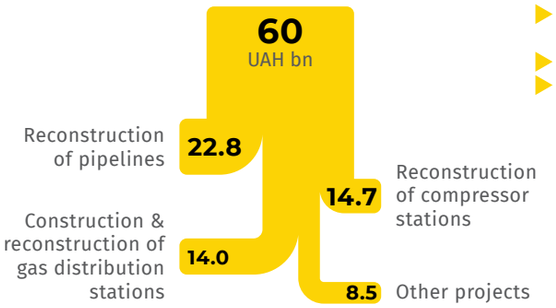
REFORMING UKRAINIAN GAS TRANSMISSION SYSTEM IS KEY FOR ITS EFFICIENT OPERATION

UGTS REFORM PLAN
2018–2027

ALLOCATION OF FUNDS BY PERIOD, UAH bn



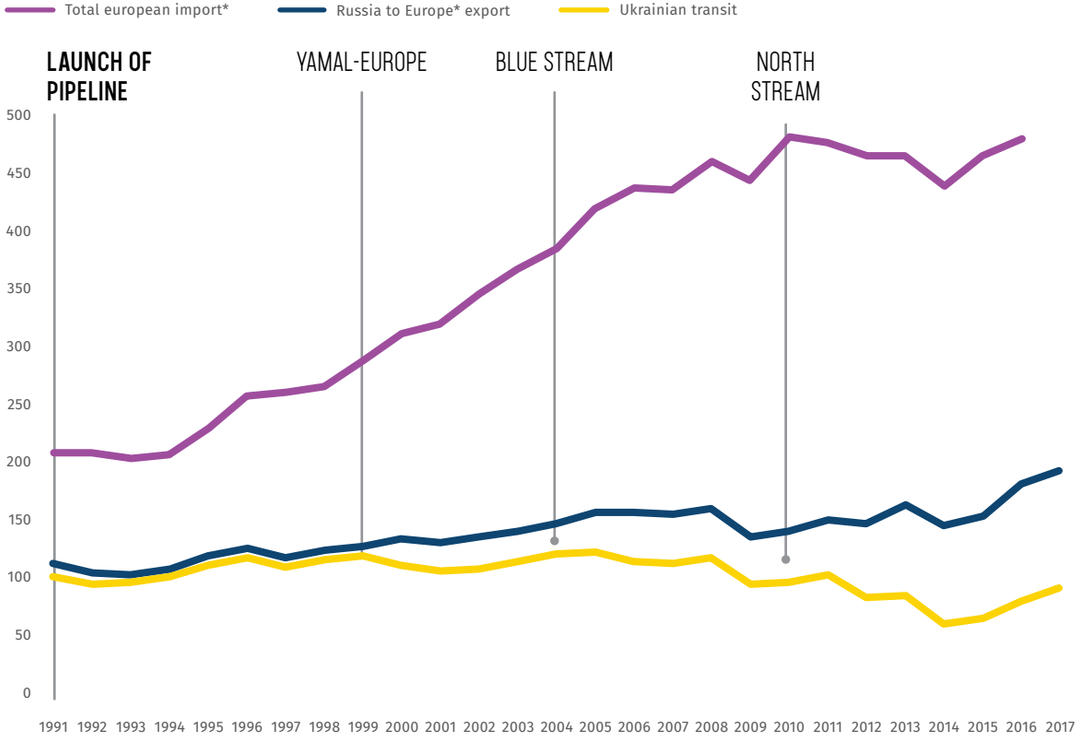
TOTAL PROGRAMME



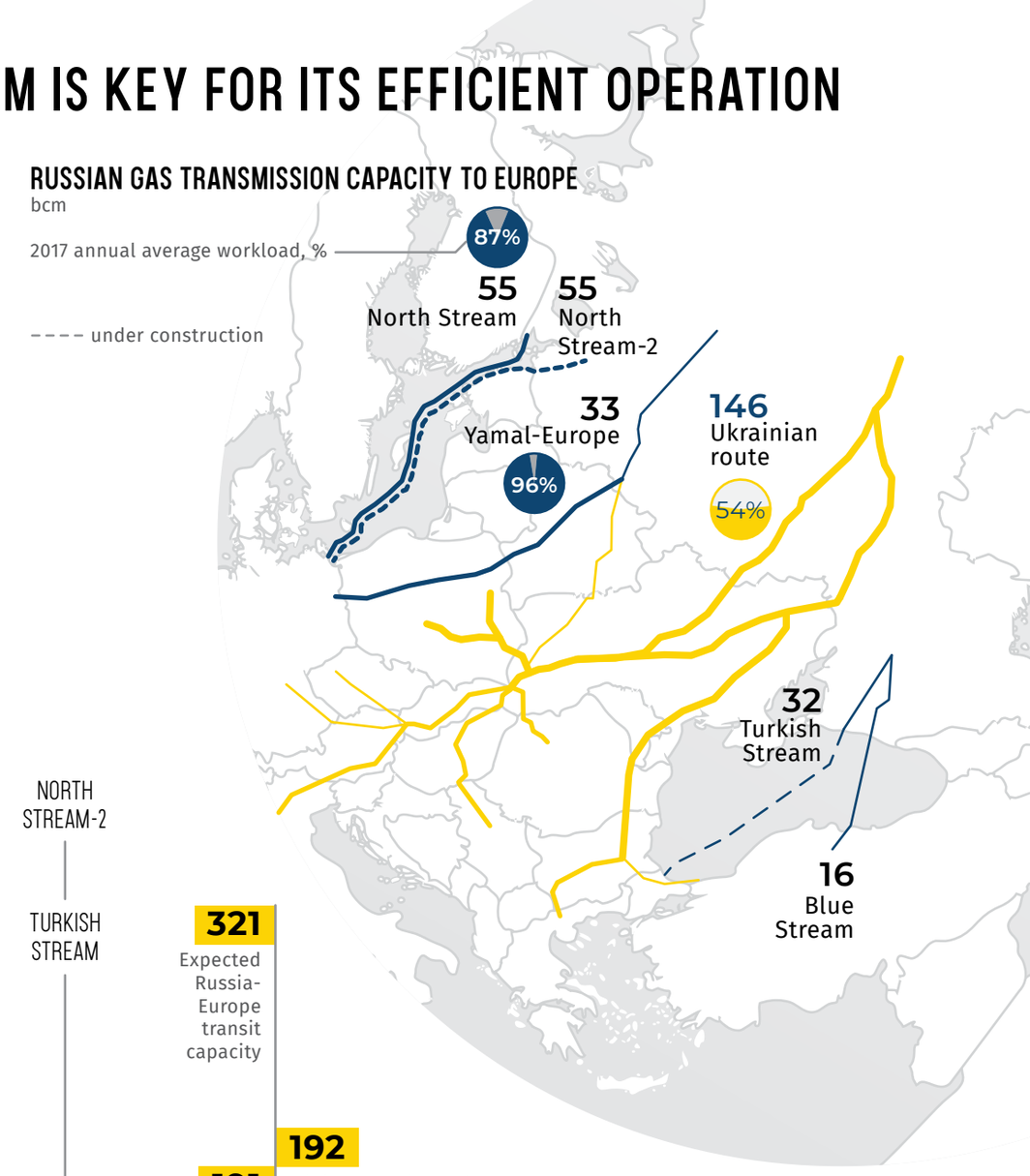
KEY OBJECTIVES OF THE REFORM

- Transition to international operating standards
- Greater operating efficiency
- Better environmental performance

GAS IMPORT TO EUROPE
1991–2017, bcm



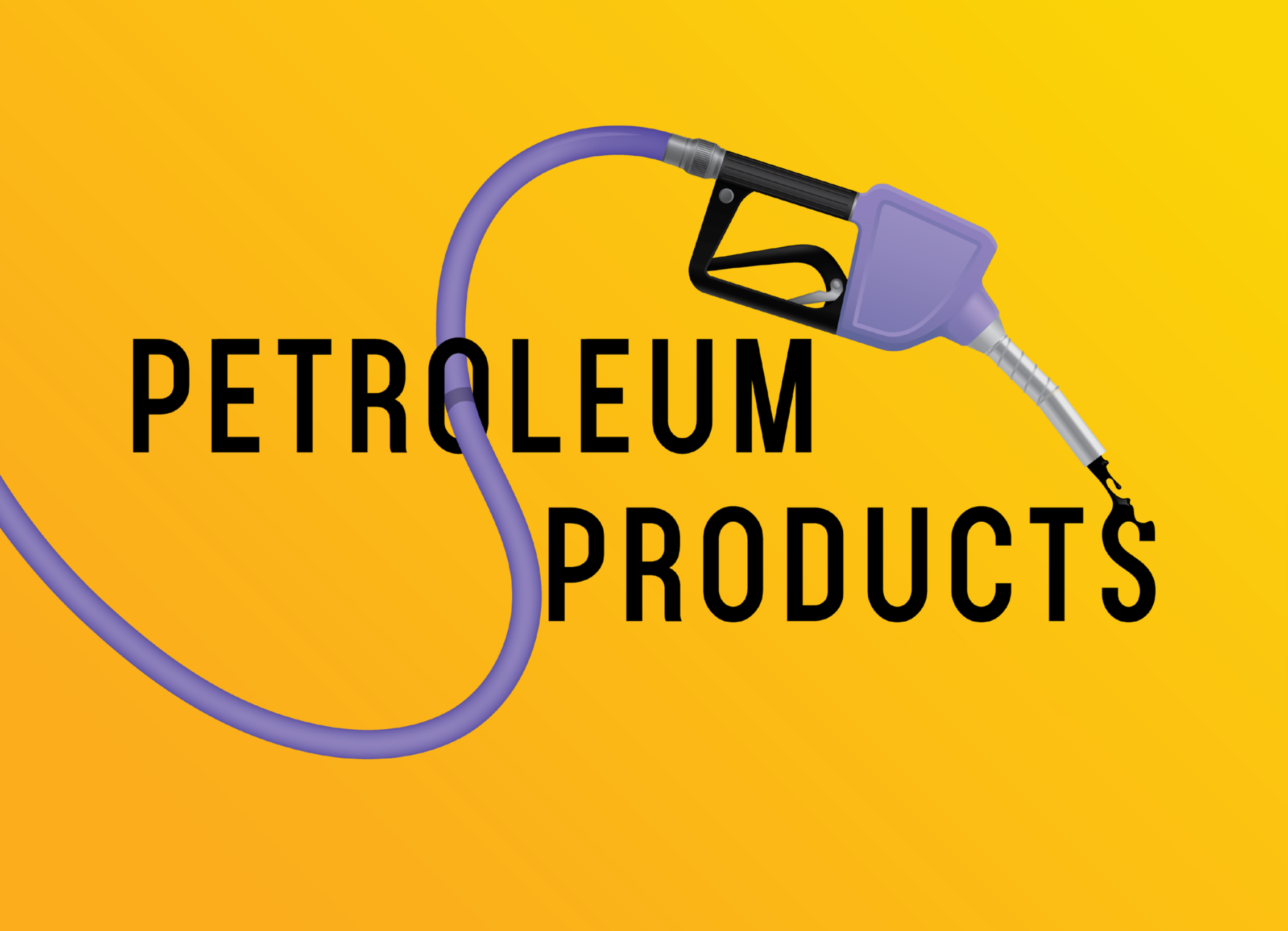
RUSSIAN GAS TRANSMISSION CAPACITY TO EUROPE
bcm



Based on estimation of transit demand, Ukrainian transmission system cannot be eliminated from the Russian gas export scheme. However Ukrainian gas transmission system requires significant economical and legal reforms to ensure its efficient operation.

Sources: Naftogaz, Eurostat, IEA, Ukrtransgaz

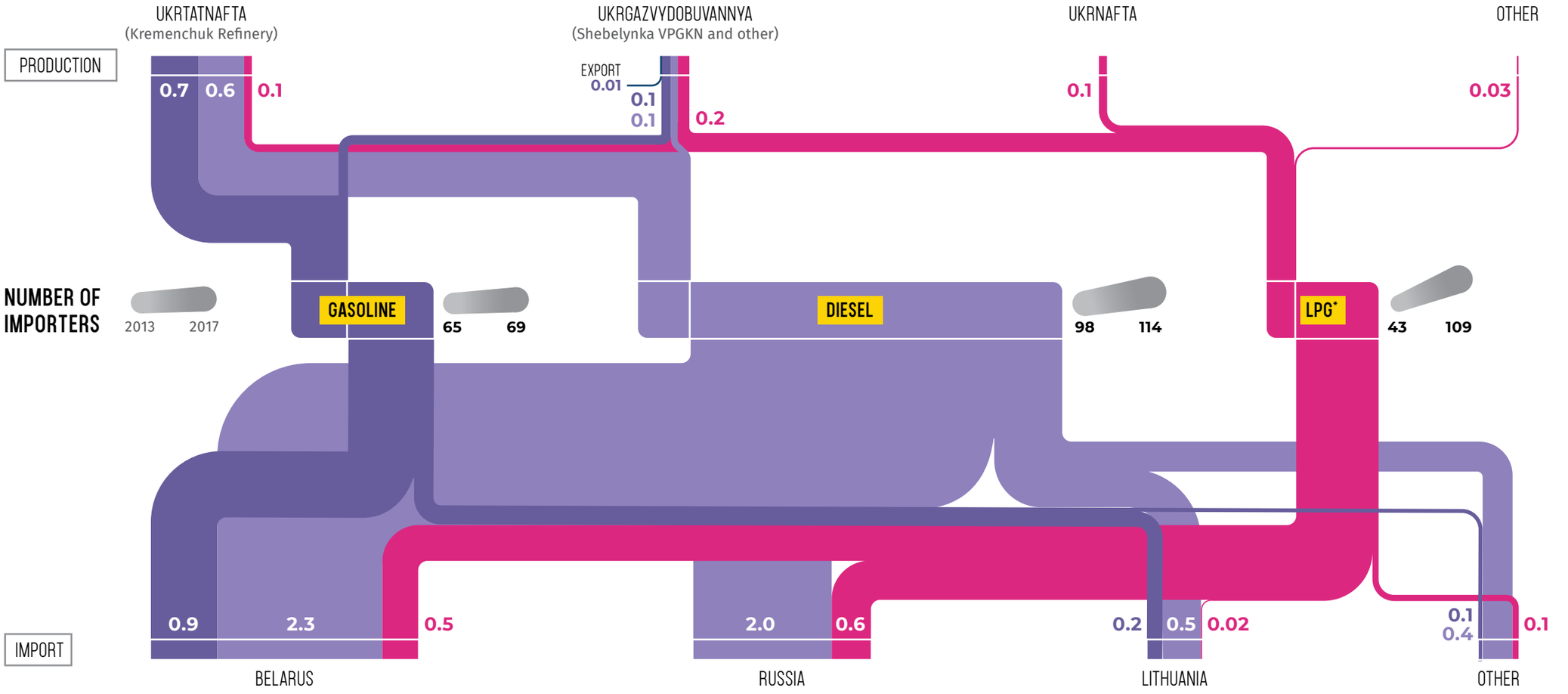
*including EU, Turkey, Bosnia and Herzegovina, Serbia and Macedonia


PETROLEUM
PRODUCTS

THE STRUCTURE OF GAS CONSUMPTION CHANGES

PETROLEUM PRODUCTS SUPPLY STRUCTURE

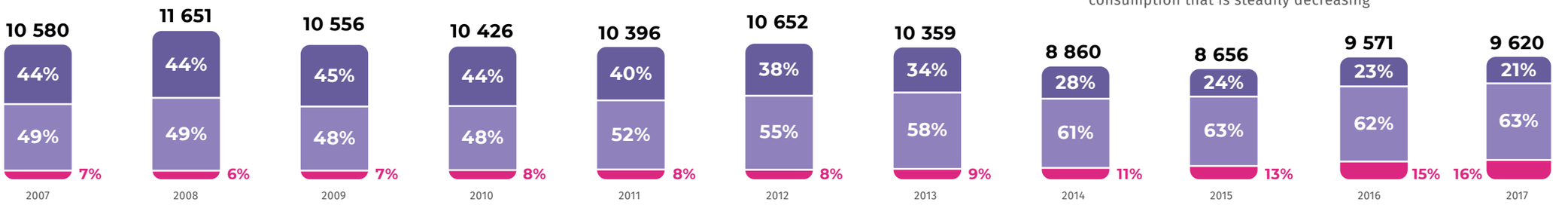
2017, m tonnes



PETROLEUM PRODUCTS CONSUMPTION IN UKRAINE

2007–2017, kt (%)

Gasoline · Diesel · Liquefied Petroleum Gas



Consumption of LPG is rapidly increasing and gradually approaching the volumes of gasoline consumption that is steadily decreasing

Source: A-95 CG

*Liquefied Petroleum Gas

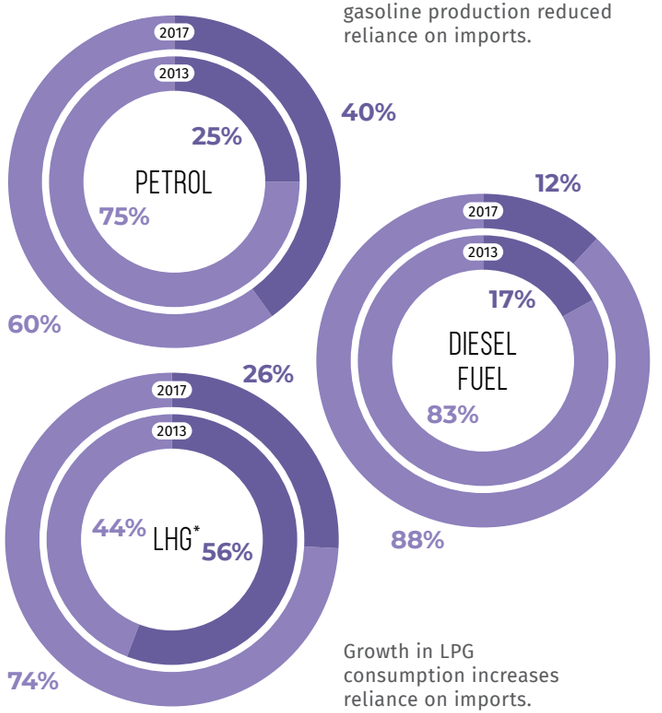
PETROLEUM PRODUCTS: UKRAINE REMAINS DEPENDENT ON IMPORTS

PETROLEUM PRODUCTS: PRODUCTION VS IMPORT

2013 and 2017, %

Import Production

In recent years, the levels of gasoline production reduced reliance on imports.



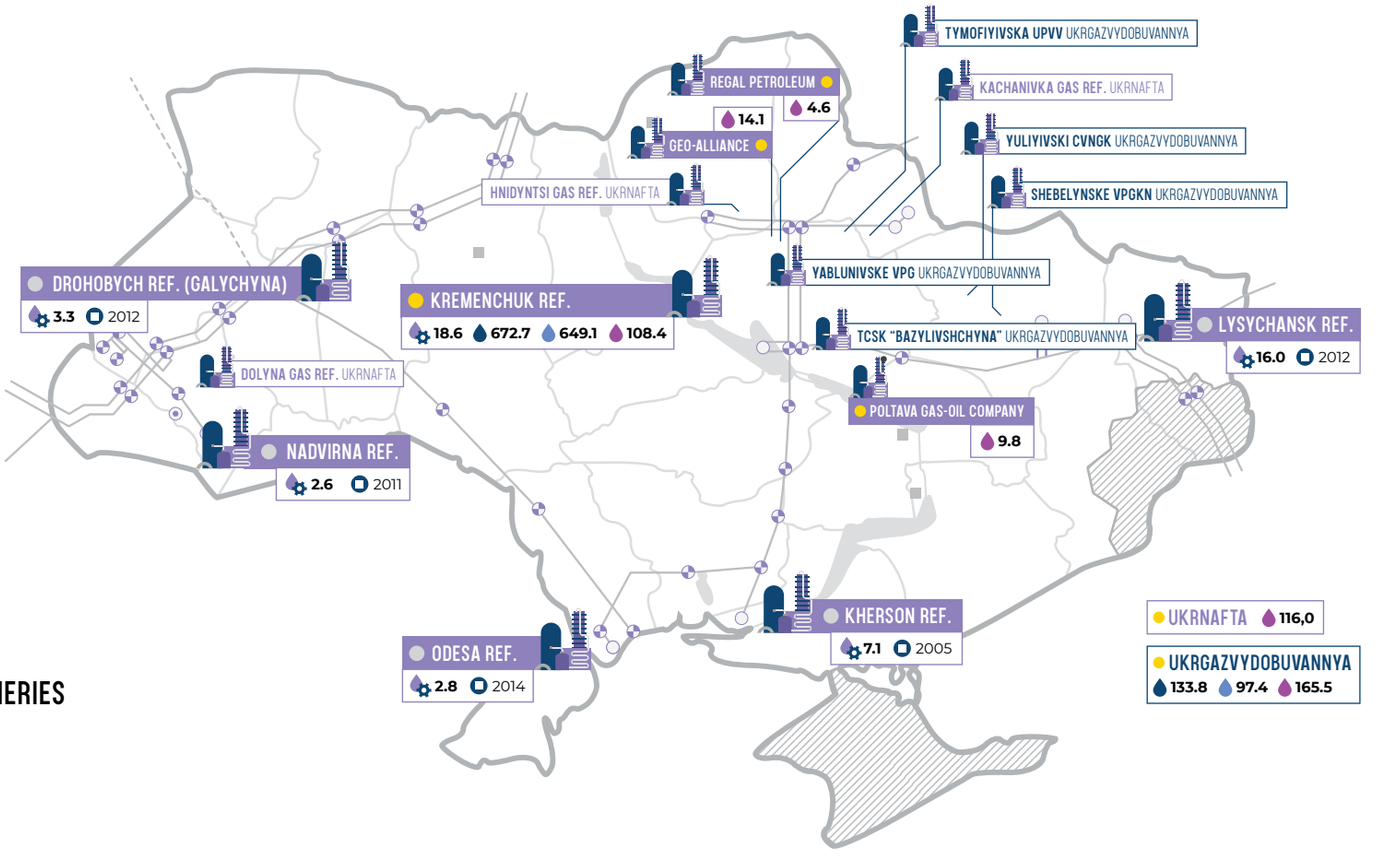
Growth in LPG consumption increases reliance on imports.

PRODUCTION OF PETROLEUM PRODUCTS AND CAPACITY OF THE REFINERIES

2017, kt

Gasoline Diesel LPG* Temporarily Occupied Territories

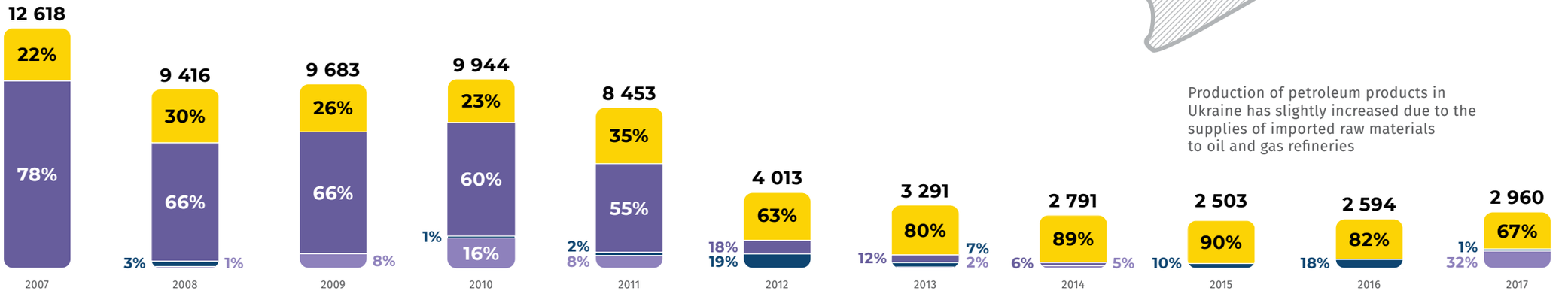
Initial total capacity, m t/year Ceased operation/operates Year ceased



QUANTITIES AND SOURCES OF OIL SUPPLY TO UKRAINIAN REFINERIES

2007–2017, kt (%)

Ukraine Russia Kazakhstan Other



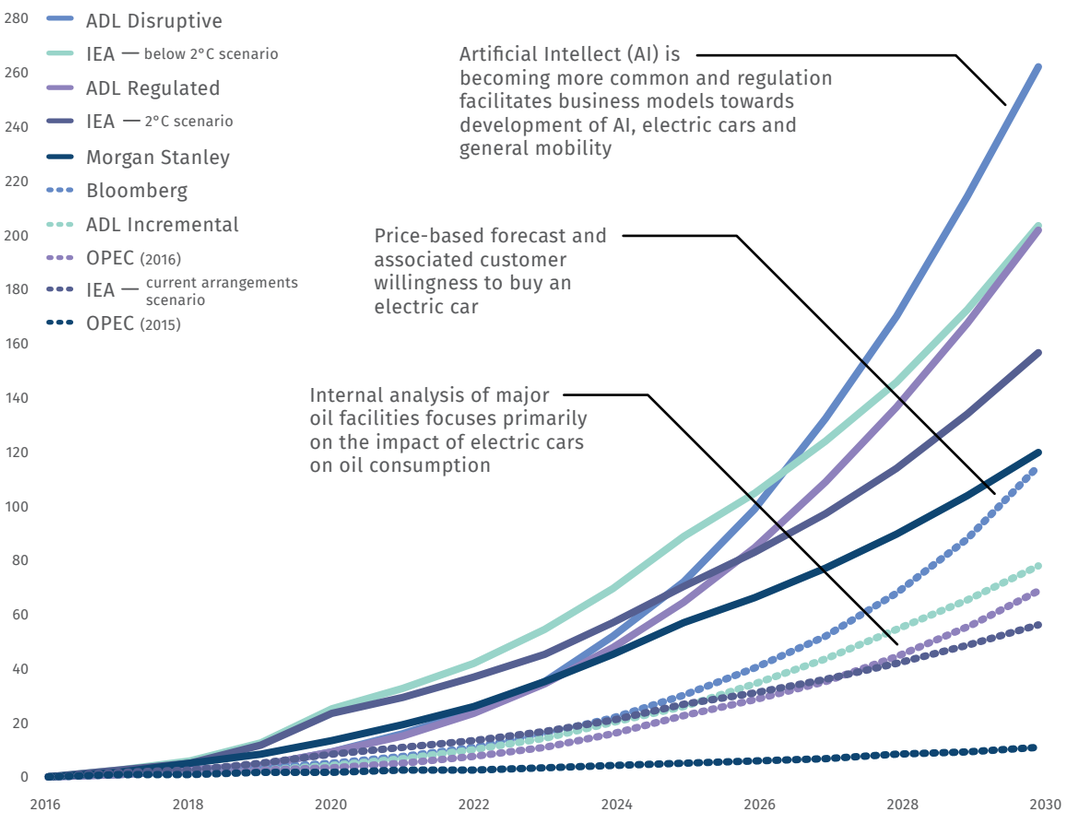
Production of petroleum products in Ukraine has slightly increased due to the supplies of imported raw materials to oil and gas refineries

Source: A-95 CG

*Liquefied Petroleum Gas

ELECTRIC CARS CHALLENGE OIL INDUSTRY

ESTIMATED GLOBAL NUMBER OF ELECTRIC CARS BY 2030



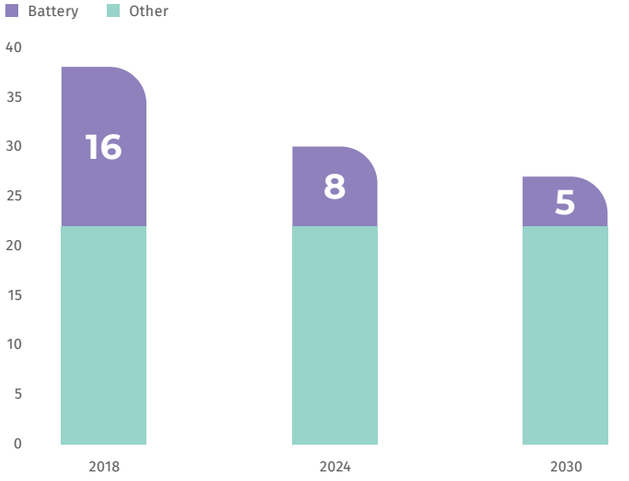
The forecasts vary significantly. The global electric car segment will account for 5-16 % of the overall car market by 2030. The deviations in estimation stem from price uncertainty and governmental incentives.

Battery is the primary price-making component, and it is estimated that the battery price can be three times cheaper by 2030.

2025 Estimated year when price of an electric car is equal to price of a car with internal combustion engine

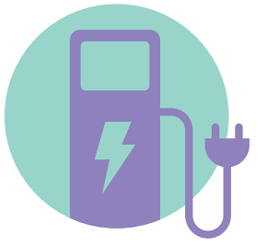
ESTIMATED PRICE OF ELECTRIC CARS IN THE USA BY COMPONENT

2018–2030, 2016 USD ths*



UKRAINIAN ELECTRIC CAR INFRASTRUCTURE

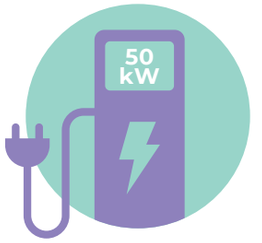
NUMBER OF CHARGING STATIONS



over **1000**

OUT OF THEM QUICK CHARGING STATIONS (50 KW)

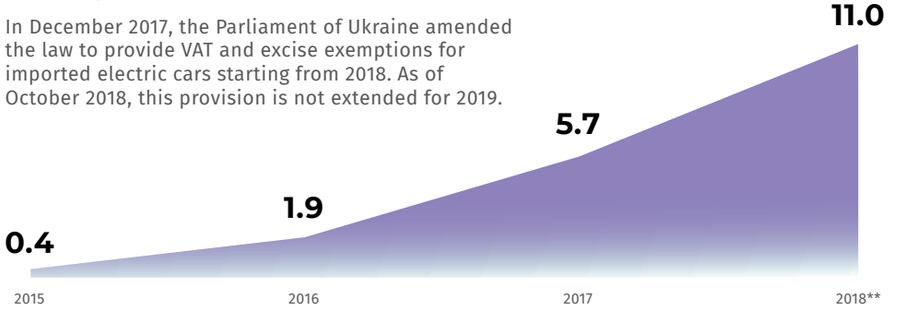
approx. **30**



NUMBER OF ELECTRIC CARS IN UKRAINE

2015–2018, ths

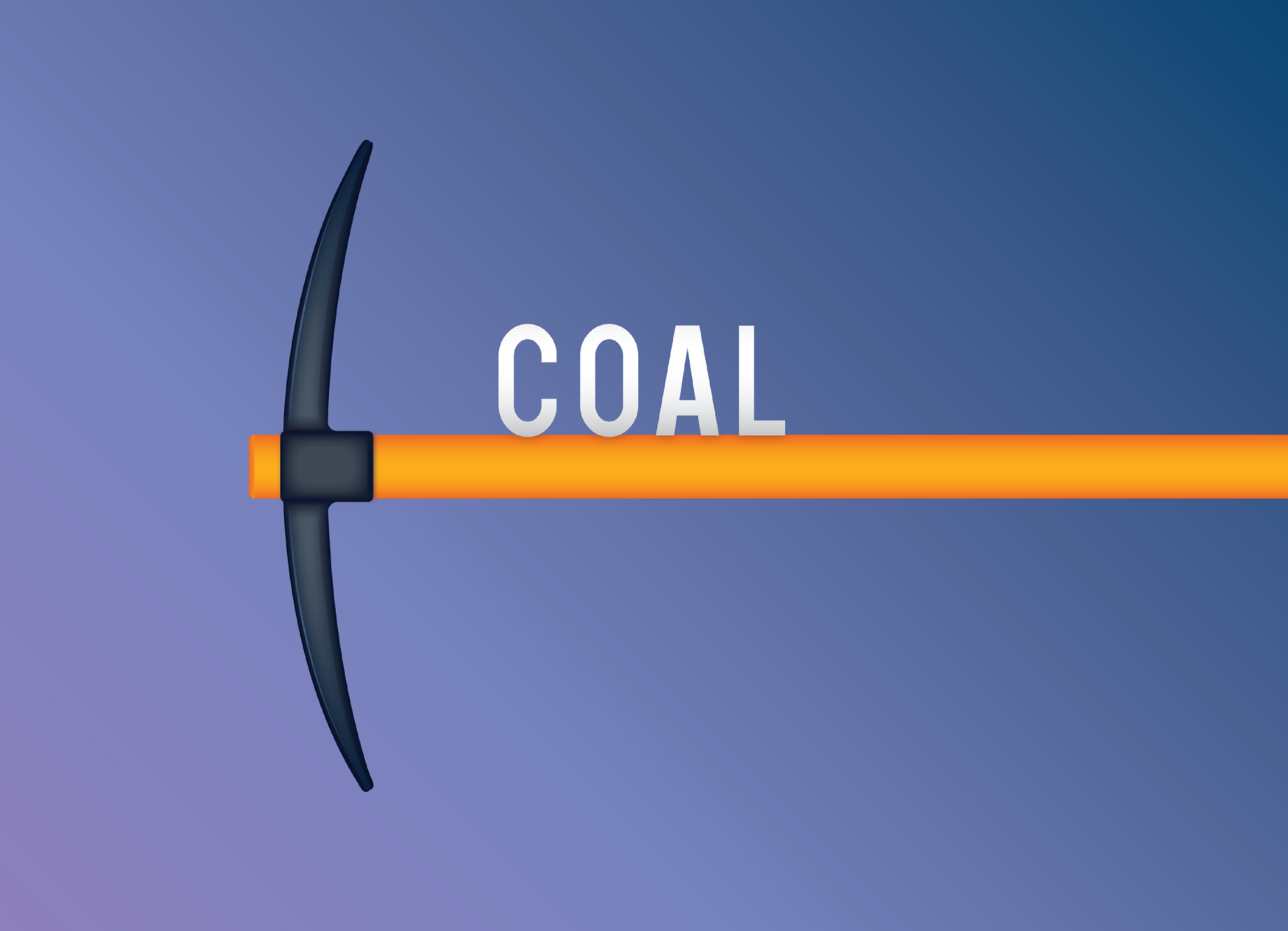
In December 2017, the Parliament of Ukraine amended the law to provide VAT and excise exemptions for imported electric cars starting from 2018. As of October 2018, this provision is not extended for 2019.



Sources: ADL, PlugShare, MIAU, Bloomberg NEF

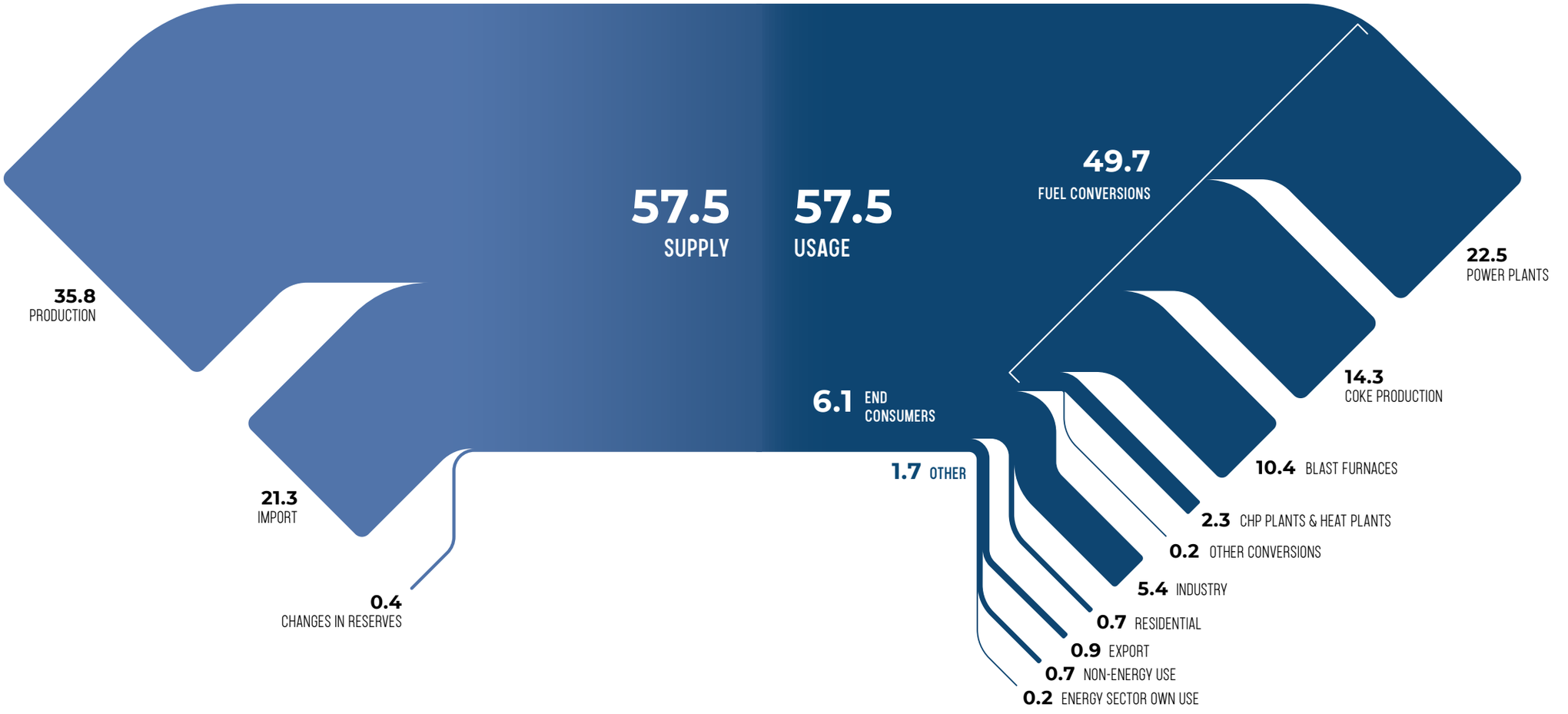
*retail US price before tax

**forecast


COAL

COAL BALANCE

2017, m tonnes



Sources: estimated based on information of MECIU, SSU, DTEK, Ukrmetalurgprom

UKRAINE TO PHASE OUT SCARCE GRADE “A” COAL

EXTRACTION AND CONSUMPTION OF THERMAL COAL

2013–2017, m tonnes

Consumption Extraction

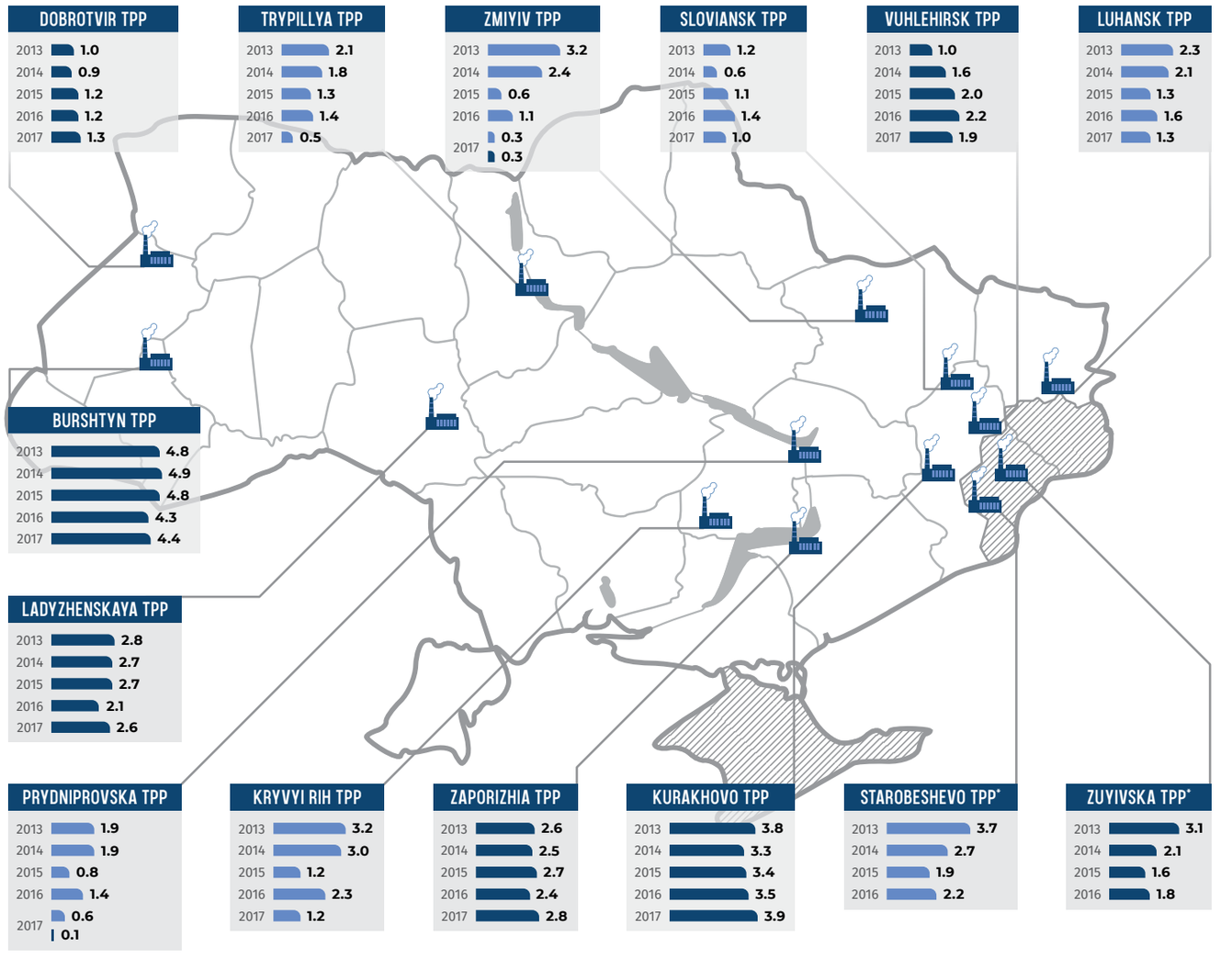
	GAS COALS		ANTHRACITE COALS
2013	29.7	19.1	17.8 / 30.3
2014	28.2	18.0	14.5 / 20.6
2015	28.9	18.3	4.5 / 8.1
2016	26.9	17.4	8.0 / 11.4
2017	27.7	17.5	1.9 / 4.9

Required additional production of Grade G coal is approximately 5 million tonnes to phase out Grade A in 2018

CONSUMPTION OF THERMAL COAL BY UKRAINIAN TPPS

2013–2017, m tonnes

Gas coal Anthracite coal Temporarily Occupied Territories



Sources: MECIU, DTEK

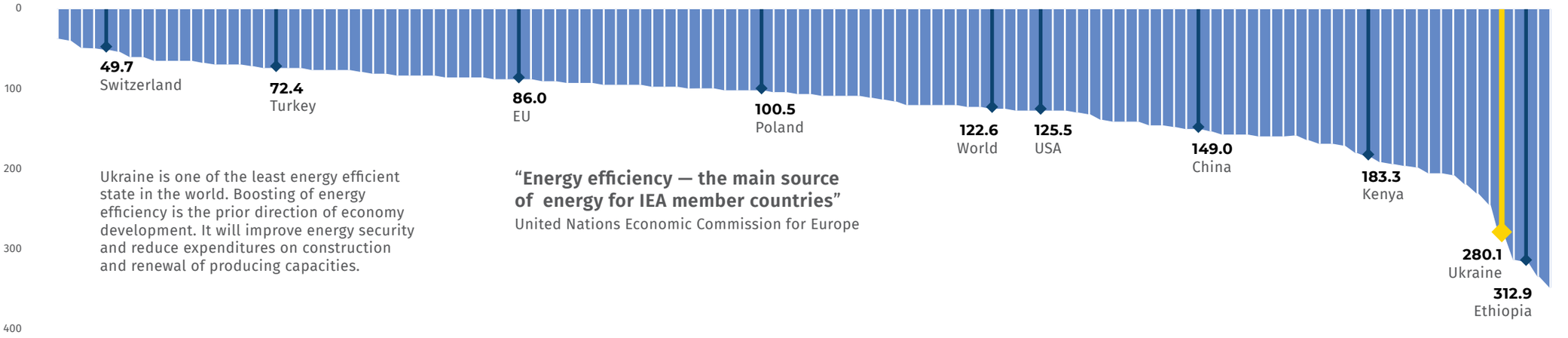
*located in the Temporarily Occupied Territories. Coal supplies stopped in March 2017


EFFICIENCY

ENERGY EFFICIENCY — HIDDEN OPPORTUNITIES OF UKRAINE

ENERGY EFFICIENCY BY COUNTRY

energy use, 2016, kgoe/1 000 USD GDP (constant 2011 PPP)



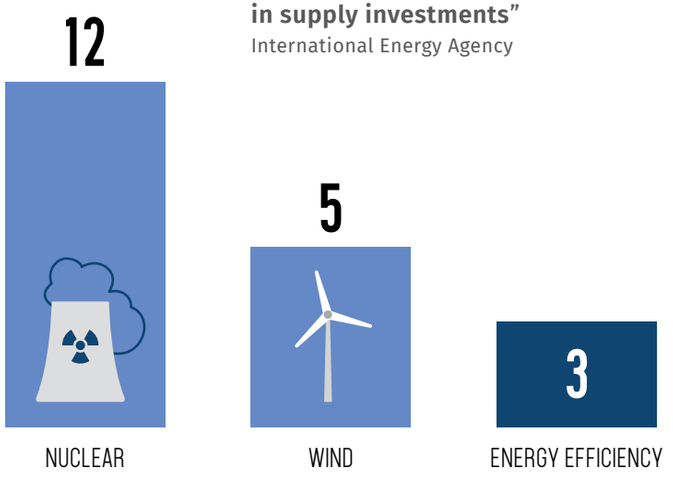
Ukraine is one of the least energy efficient state in the world. Boosting of energy efficiency is the prior direction of economy development. It will improve energy security and reduce expenditures on construction and renewal of producing capacities.

"Energy efficiency — the main source of energy for IEA member countries"

United Nations Economic Commission for Europe

COST OF ENERGY EFFICIENCY

levelized cost of energy by resource, USD cents/kWh

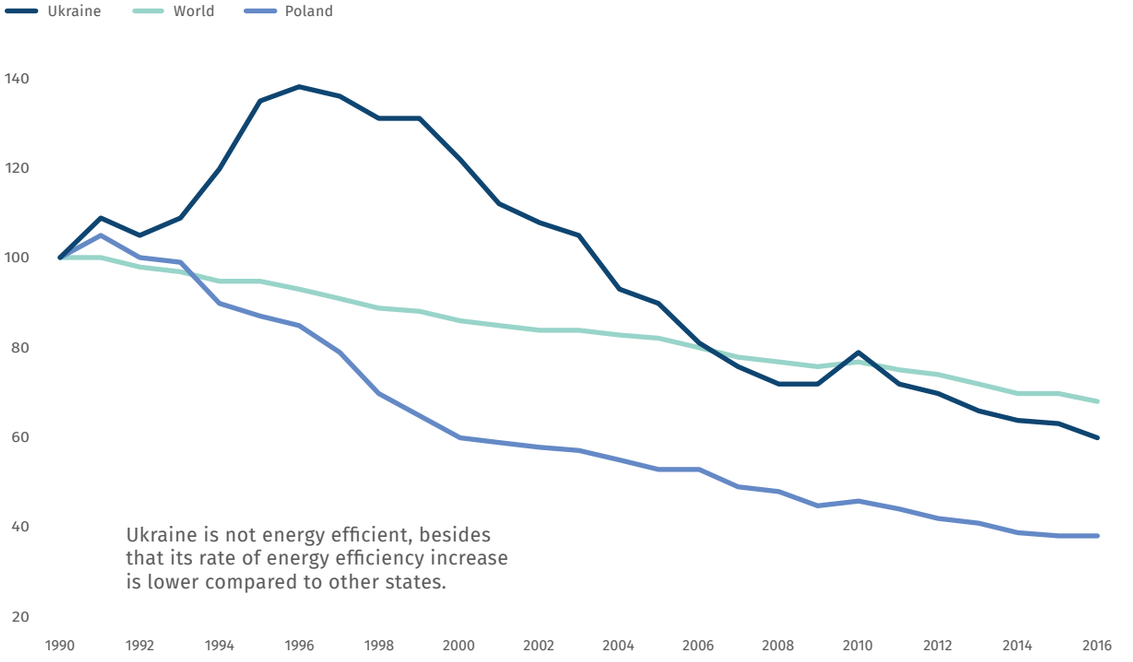


"Every dollar spent on energy efficiency avoids more than $2 in supply investments"

International Energy Agency

ENERGY EFFICIENCY DYNAMICS

energy use (kgoe/1 000 USD GDP (constant 2011 PPP), % relative to 1990



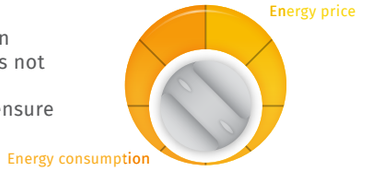
Ukraine is not energy efficient, besides that its rate of energy efficiency increase is lower compared to other states.

Sources: IEA, WBG, WEF

UKRAINE GRADUALLY BOOSTS ENERGY EFFICIENCY OF ECONOMY

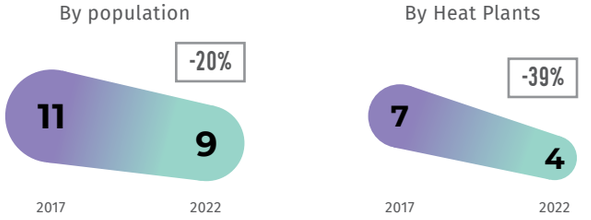
MARKET PRICES — THE MAIN INCENTIVE FOR ENERGY EFFICIENCY

Due to wide, non-targeted subsidising in previous years the energy efficiency was not economically reasonable. Step-by-step implementation of market pricing will ensure demand for energy efficient decisions.



GAS CONSUMPTION FORECAST CONSIDERING MARKET PRICING AND MONETISATION OF SUBSIDIES

2017–2022, bcm

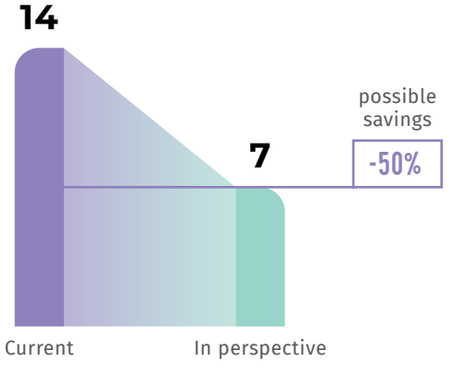


CAPABILITIES OF ENERGY EFFICIENCY INCREASE IN INDUSTRY

(metallurgy industry case)

ENERGY CONSUMPTION PER TONNE OF PRODUCT

GJ



>50%

of total industry energy consumption goes to metallurgy

20%

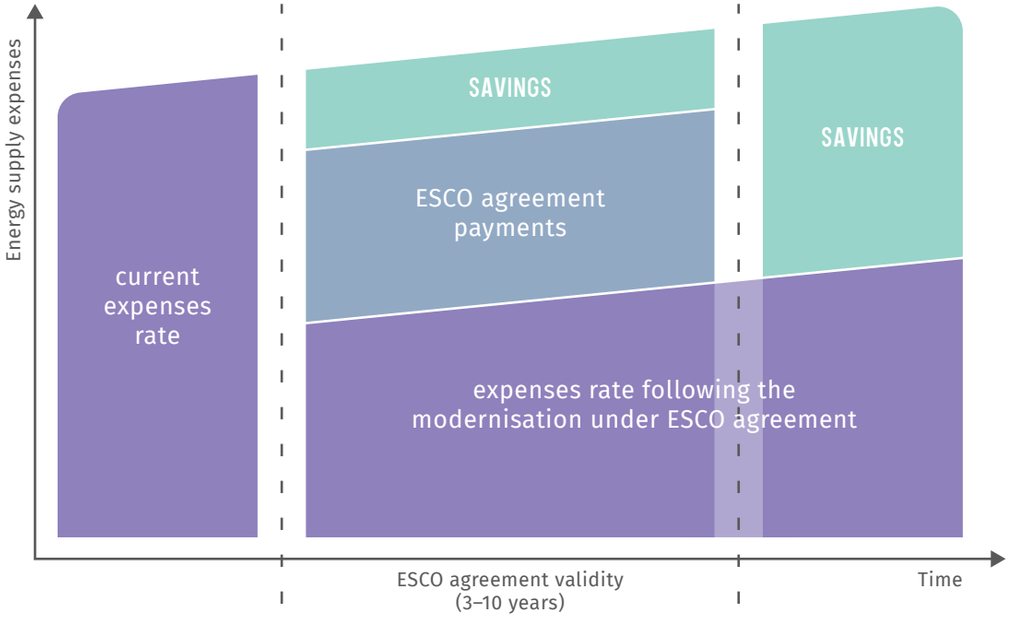
of crude steel is produced in open hearth furnaces. Ukraine and Russia (2%) are the only countries using such type of production

Sources: SAEE, Naftogaz, World Steel, Boell

*as of 02.11.2018

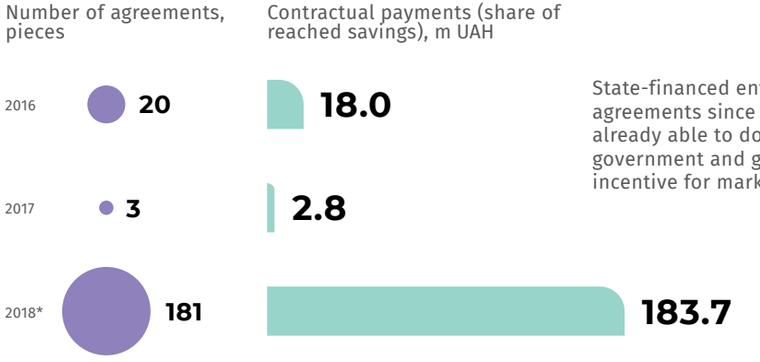
ESCO MECHANISM IN UKRAINE

ESCO mechanism is about setting an agreement between a consumer and ESCO company, which provides solutions for achieving energy cost reductions, in order to receive payments based on the share of further savings.



ESCO AGREEMENTS ON STATE-FINANCED ENTITIES

2016–2018



State-financed entities are able to sign ESCO agreements since 2016. Private entities were already able to do it, however, demand from government and guarantees became an incentive for market development.

INCREASED COMPETITION AND TRANSPARENCY AS KEY GOALS OF THE REFORMS

Implementation year and key reforms

2015

NATURAL GAS

Creation of a new model for the natural gas market, in particular:

- unbundling of transmission of natural gas from production distribution, supply of natural gas, and from activities of wholesalers
- implementation of a new tariff setting model (setting tariffs for the services of natural gas transmission for entry and exit points)
- introduction of a new system of third-party access to the natural gas market, in particular, introduction of capacity allocation system
- introduction of new balancing rules

2016

REGULATOR

Legislative framework for measures to ensure the Regulator's independence:

- appointment of the Regulator's members following an open competition except as otherwise permitted by law to ensure stable activity of the Regulator
- ensuring periodic rotation of the Regulator's members
- financing of the Regulator through fees paid to the Special Fund of the State Budget of Ukraine by entities operating in the energy sector and utilities
- no requirement for the Regulator's decisions to be approved by bodies other than the Antimonopoly Committee of Ukraine as required to ensure competitive business environment

2017

ELECTRICITY

Creation of a new model for the electricity market by the end of 2019:

- segmentation of the electricity market into 6 markets:
  - bilateral contract market
  - day ahead market
  - intra-day market
  - market of auxiliary services
  - balancing market
  - retail market
- unbundling of electricity distribution and transmission activities from other types of activity
- new players entering the electricity market, namely, traders (that purchase electricity solely for the purpose of its resale except for sales to consumers under supply contracts)
- consumer's free choice of electricity supplier

2018

E-AUCTIONS

Introduction of online auction sales of special permits for subsoil use:

- as a pilot project, auction sales of special permits for subsoil use are to be held through e-bidding system from October 24, 2018 to December 1, 2019
- providing an opportunity to monitor auction progress in real time through e-bidding system
- enabling business entities to participate in online auctions regardless of their location
- creation of conditions for forming lot prices competitively and on an arm's length basis
- by September 1, 2019, the State Geology and Subsoil Service of Ukraine shall make recommendations to the Cabinet of Ministers of Ukraine as to whether or not it is reasonable to continue holding auction sales of special permits though e-bidding

2018

GEOLOGICAL DATA

Ensuring transparency of and access to geological information by:

- establishing a clear, transparent and non-discriminatory procedure of acquisition of geological data
- designation of geological data as a subject of civil relations that can be used as a contribution to share capital of legal entities
- imposing a requirement to notify the State Geology and Subsoil Service of Ukraine of transfer of right of ownership or right to use geological data instead of the requirement to obtain relevant approval from the State Geology and Subsoil Service of Ukraine
- introduction of geological data register

BASIC REGULATIONS AND DOCUMENTS

- Law of Ukraine No 329-VIII of April 9, 2015 "On the Natural Gas Market"
- Law of Ukraine No 1540-VIII of September 22, 2016 "On National Energy and Utilities Regulatory Commission"
- Law of Ukraine No 2019-VIII of April 13, 2017 "On the Electricity Market"
- CMU Resolution No 848 of October 17, 2018 "On the implementation of a pilot project introducing auction sales of special permits for subsoil use through e-bidding"
- CMU Resolution No 939 of November 7, 2018 "Administration of geological data"

Source: AEQUO

TRANSPARENCY OF EXTRACTIVE INDUSTRIES IS THE INCENTIVE FOR INVESTMENTS

WHY UKRAINE IMPLEMENTS TRANSPARENCY

- This will facilitate fulfilment of Ukraine's obligations under EU Association Agreement
- Ukraine is the member of Extractive Industry Transparency Initiative (EITI) since 2013 which is the global standard facilitating open management and public awareness of efficient operation of oil, gas and mineral sectors

WHERE DISCLOSURE REQUIREMENTS ARE DEFINED

Law of Ukraine No 2545-VIII "On Ensuring Extractive Industry Transparency" of 18.09.2018

WHO IS SUBJECT TO INFORMATION DISCLOSURE


Economic operators of extractive industries


Parent companies of extractive industries


Payees (public authority, any public or municipal facility)


Ministry of Energy and Coal Industry of Ukraine


Derzhgeonadra

WHAT IS TO BE DISCLOSED — KEY DOCUMENTS:

BUDGETARY PAYMENTS REPORT*

- Total amount received (I); per payment type (II)
- Total subsurface management rent, land rent and environmental tax: (I) per each individual project (II) per each payment type within each individual project
- Funding and support provided by government and local authorities and accountable operators
- Description of extractive activity
- List of individual projects including specifications
- Participation in social projects/programmes and payments related to such activities
- Output per respective project
- Average daily personnel
- Information about beneficial owners (supervisors)
- Reporting period audit report (for operators subject to audits)

PAYMENTS RECEIVED

- Total amount received (I); (II) per payment type; (III) per activity type; (IV) per individual activity
- Payment currency
- Payment reporting period
- Funding and support provided by payee for economic operator of extractive industry

CONSOLIDATED BUDGETARY PAYMENT REPORT (PARENT COMPANIES ONLY)

EITI REPORT (TO BE COMPLETED BY INDEPENDENT ADMINISTRATOR)

Economic operators of extractive industries
Individual: entrepreneur or legal person who carries out subsurface management in exploration purposes, including pilot exploitation of deposits of national importance, excavation of mineral resources of national importance, carrying out work (activity), included in the product distribution agreement related to mineral resources of national importance, transmission of hydrocarbons, including transit purposes.

Independent administrator
Economic operator who analyses and reconciles data provided by economic operators of extractive industries and payees in accordance with technical requirements and makes an EITI Report.

Sources: AEQUO, EITI, UAEITI

*also includes items similar to item 2 and 3 of the Payments Received

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