DTEK GRIDS CONCEPT FOR TECHNICAL DEVELOPMENT AND LONG TERM INVESTMENT PROJECTS

DTEK Energy in action

DTEK GROUP OPERATES AS AN ENERGY INVESTMENT HOLDING

DTEK Group – largest privately owned investor in the Ukrainian energy sector
The holding employs 56,000 employees





DTEK ENERGY

ESTABLISHED IN 2009

Coal mining & thermal power generation

- **13.3 GW** installed capacity (8 thermal power plants*)
- 2022 power output of **18 TWh** (25 TWh in 2021)
- **9 mines** with **420 Mt** reserves of steam coal

Electricity generation

DTEK RENEWABLES UKRAINE

ESTABLISHED IN 2008

Renewable energy development & operation

- Over **1.0 GW** installed capacity (7 wind* and solar plants)
- **500 MW** under construction incl. **114 MW** built amid war
- 2022 power output of **0.9 TWh**

Renewable generation

DTEK OIL&GAS

ESTABLISHED IN 2014

Natural gas, oil and condensate production

- **2.0 bcm** of gas produced in 2022 (**2.1 bcm** in 2021)
- **36 bcm of 2P** reserves (SPE-PRMS classification)
- **12.8 bcm of 2C** resources (SPE-PRMS classification)

Natural gas production

DTEK GRIDS

ESTABLISHED IN 2018

Electricity distribution network operation

- **33 TWh** electricity distributed in 2022 (**50 TWh** in 2021)
- **7** distribution companies
- **5.6 mln** customers
- **43%** market share

Electricity distribution

D.TRADING

ESTABLISHED IN 2019

Coal, power and gas trading

- **30.3 TWh** of electricity, **2.3 Mt** of coal, **1.5 bcm** of gas were supplied to domestic and international clients in 2022

Commodities trading

D.SOLUTIONS

ESTABLISHED IN 2018

Power and gas supply & energy services

- **12.8 TWh** of electricity supplied in 2022 (**16.6 TWh** in 2021)
- **3.5 mln** of households and industrials consumers
- **33 fast DC chargers 50 kW** with public access

Energy supply & services

*as of March 2023, 2 out of 8 thermal power plants and 3 out of 4 wind farms are located at the occupied territories

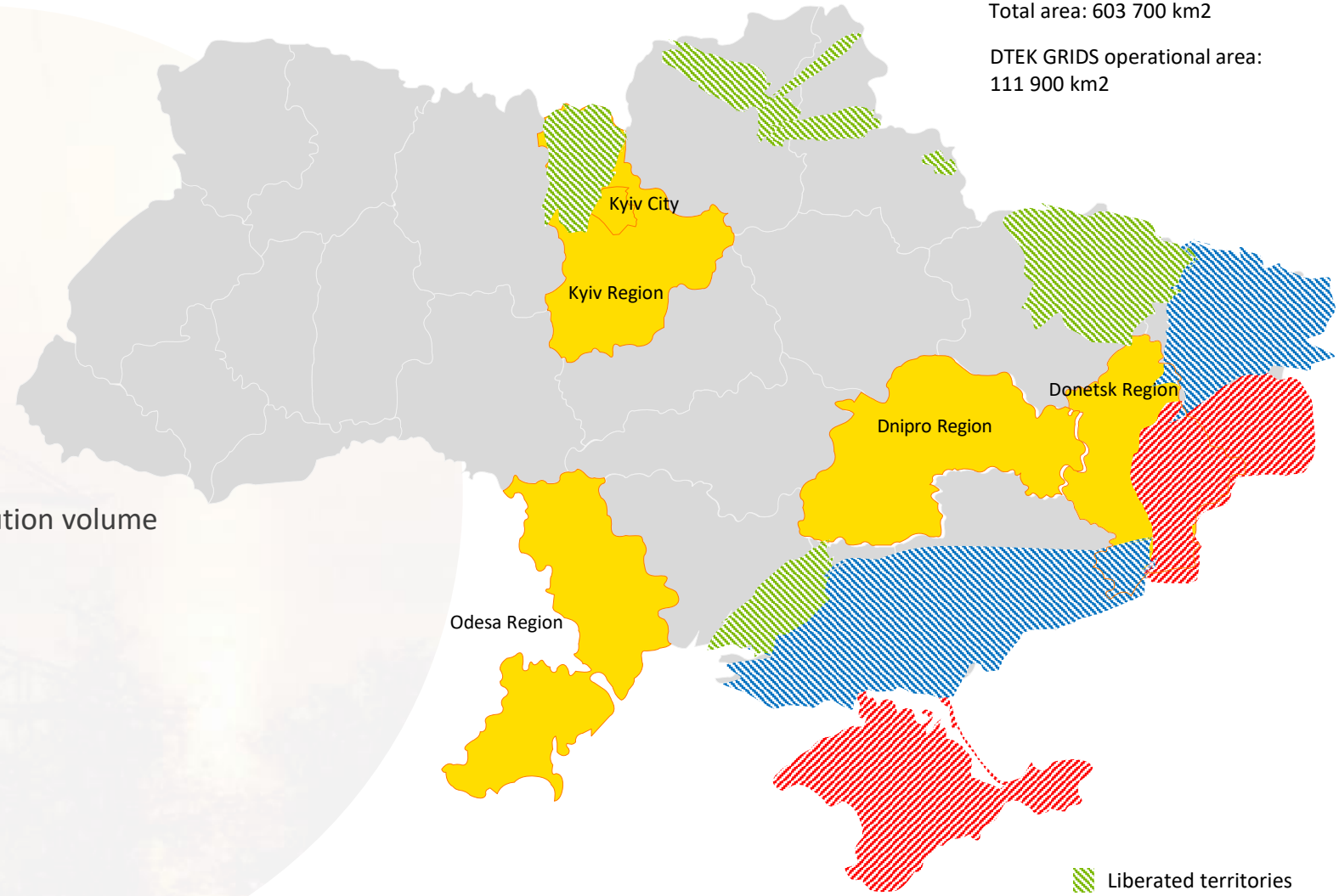
DTEK GRIDS OVERVIEW

- **5 600 000** customers
- **188 000** km of grids
- **14 000** employees
- **50** TWh electricity distribution volume (43% of the market)
- **7** DSOs
- **5** regions of operation

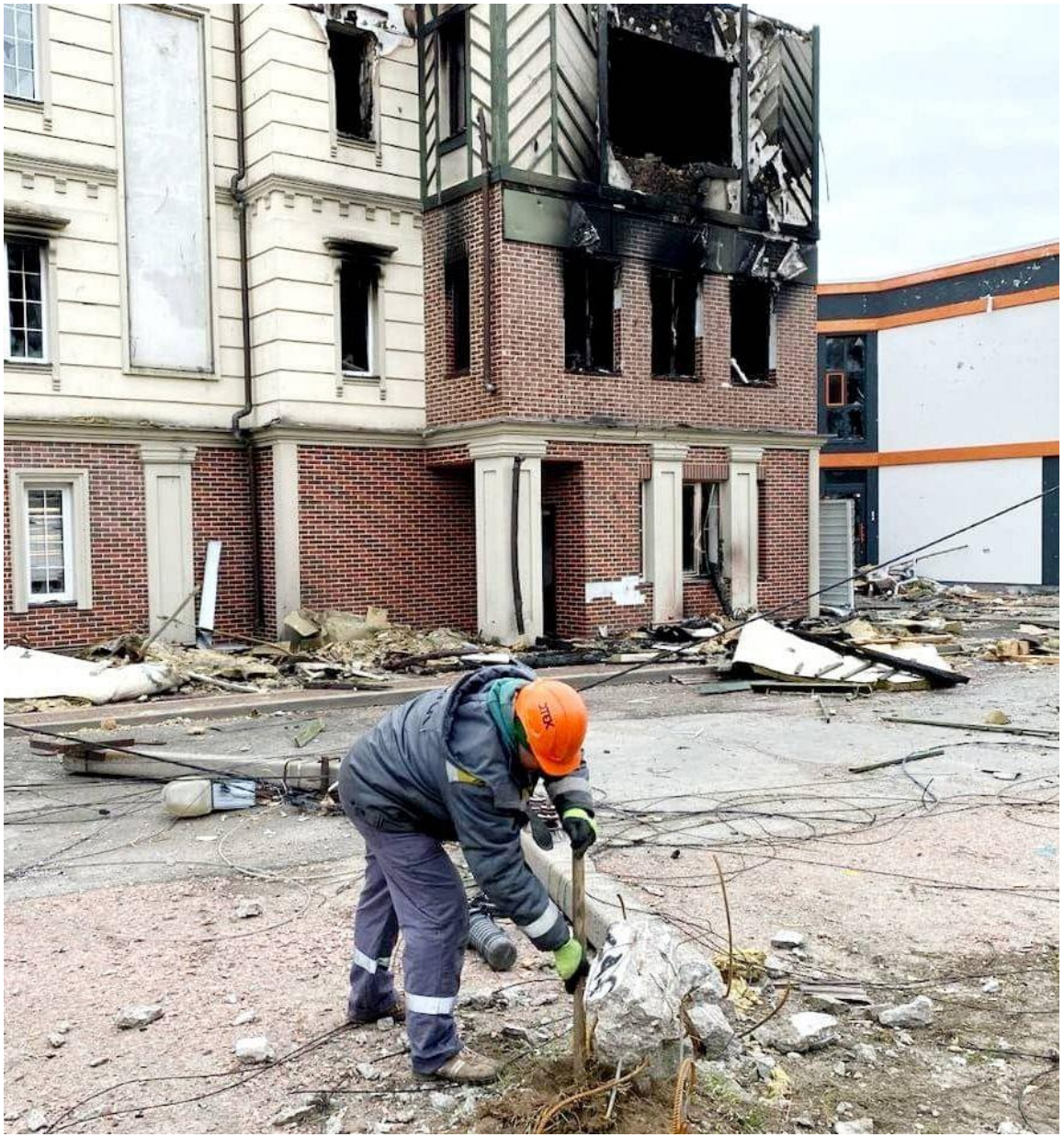
Geography of Operations

Total area: 603 700 km2

DTEK GRIDS operational area: 111 900 km2



Data based on 2021.



DTEK GRIDS POWER DISTRIBUTION NETWORK MODERNIZATION IN UKRAINE

DTEK Energy in action

POWER GRID TO PLAY THE KEY ROLE IN DECARBONIZATIONOF UKRAINE

Grid destruction from russian full-scale invasion requires significant restoration and an opportunity to build back better

Vulnerability of the centralized energy infrastructure has highlighted the need to transform the energy system into a more decentralized one

Building new renewable capacities will become a key factor in the recovery of Ukraine, leveraging high potential in renewable energy

Energy transition-oriented recovery will create demand for energy-efficient customer services (EV-charging, battery storage, etc.)

Integration of Ukraine into the EU energy markets has been expedited with market synchronization and expanding harmonization with EU regulations

Modernization of Ukrainian grids is needed to ensure energy security and connect new capacity by facilitating the decentralization of the system

GRID MODERNIZATION ADDRESSING CURRENT CHALLENGES

Reliability

- Grid visibility, control and automation
- Building a weatherproof grid

Flexibility

- Power quality, capacity reserve and congestion management
- Automatic voltage control and grid optimization systems

Efficiency

- Optimum grid construction standards to minimize losses and costs
- Digitalization of grid planning and equipment monitoring

Energy Transition

- Integration of renewables, EV charging stations, storage systems, and other distributed resources

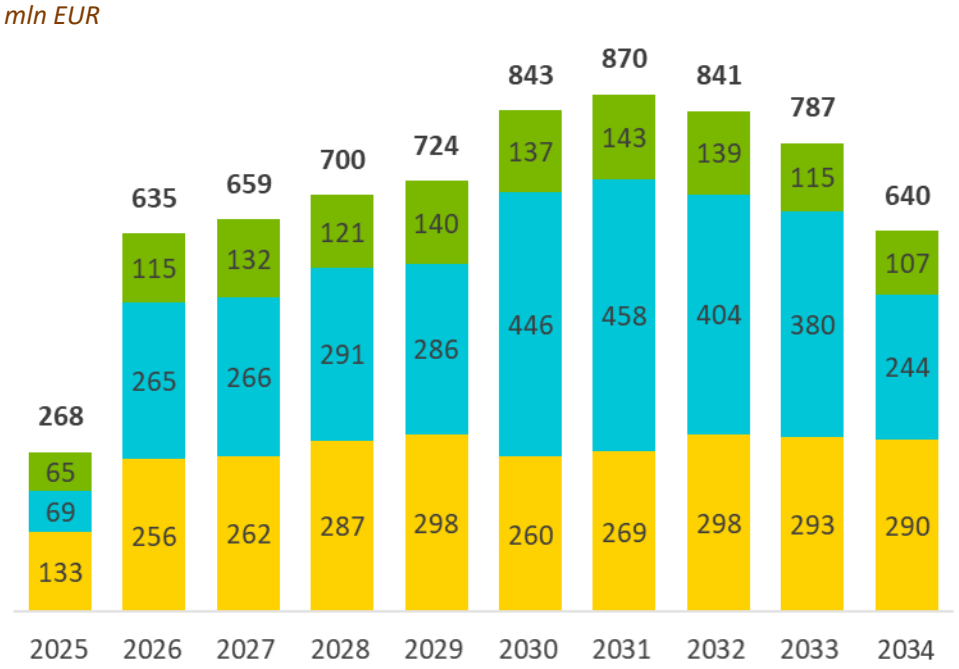
Sustainability

- Environmental friendliness standards of the equipment
- Quality of customer services and operations

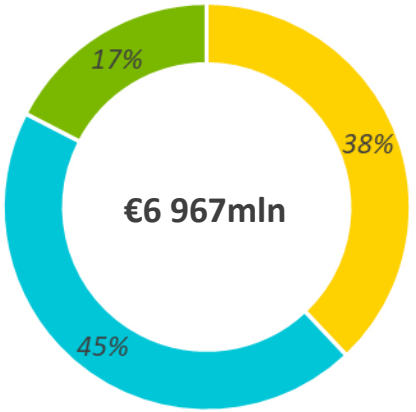
Note: 1. Distribution System Operator

INVESTMENT PROFILE OF DTEK GRIDS MODERNIZATION

10-YEAR INVESTMENT PLAN

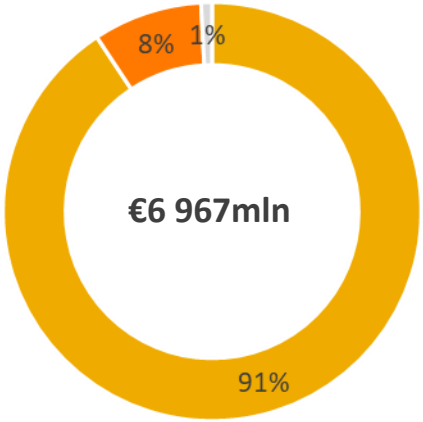


BREAKDOWN BY PURPOSE



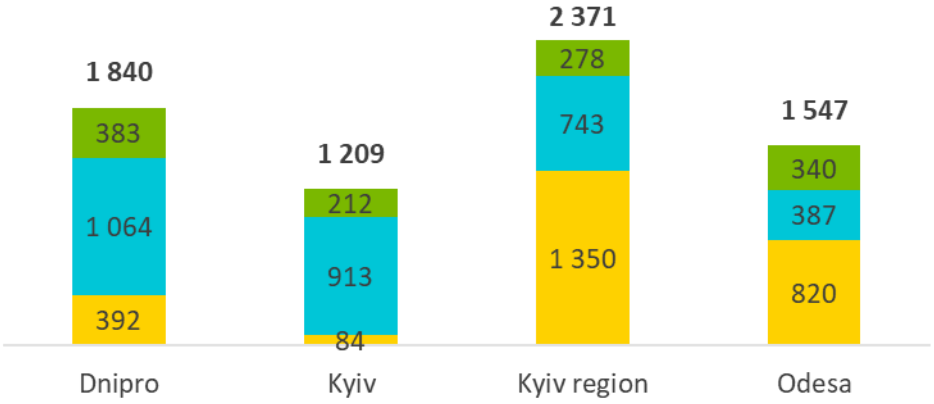
- **Reliability** - €2 645 mln
- **Flexibility** - €3 108 mln
- **Efficiency** - €1 214 mln

BREAKDOWN BY COMPONENT



- **Equipment** - €6 319 mln
- **IT/OT** - €589 mln
- **Communication** - €59 mln

BREAKDOWN BY COMPANIES



Complete transformation of DTEK Grids would require a **~€7 bln investment** with **€145 mln** investment for Irpin pilot project

917 110-150 kV substations	**579** Power transformers HV/MV	**4 234 765** Smart meters	**5 796** Automation primary/distribution/ secondary substations
2 556 Reclosers	**8 976** Power transformers MV/LV	**36 052 km** Overhead lines 0.4-20 kV	**13 957 km** Underground lines 0.4-20 kV

Note: calculations were made in UAH with recalculation for EUR at the NBU exchange rate

DTEK POWER DISTRIBUTION GRID MODERNIZATION
IRPIN REGION OF KYIV REGIONAL GRIDS

DTEK Energy in action

SUMMARY OF THE PROJECT

1 PROJECT SCOPE

Rebuilding and modernizing existing power distribution network into a smart grid in Irpin region of the Kyiv regional grids

2 PROGRESS TO-DATE

Detailed technological grid development concept and plan created to meet the future challenges in the energy sector

3 TIMEFRAME

3-year investment plan to transform the Irpin rigion grids

4 STANDARDS

Technological standards for equipment and grid construction principles were reviewed to synchronized with the EU standards

OVERVIEW OF IRPIN REGION CURRENT PARAMETERS

67.5 tsd customers

6 MV – total number of substations

640 km – total length of the 0.4-10 kV overhead lines

Kyiv Regional Grids | **Grid pilot region - Irpin** | Liberated territories

GRID CHALLENGES

- Reliability
- Flexibility
- Efficiency
- Enabling Energy Transition
- Sustainability

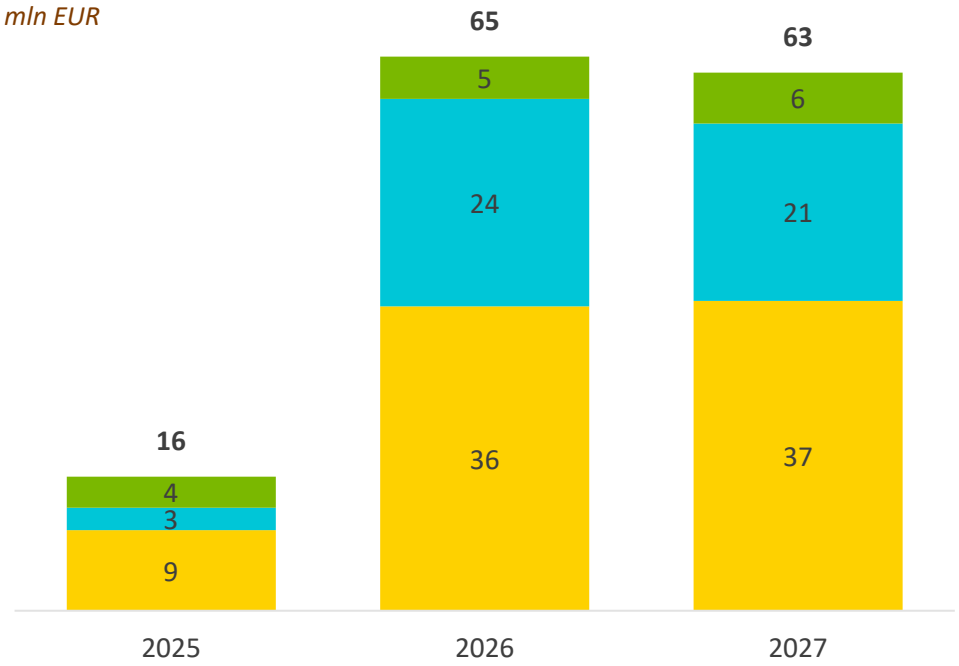
PROJECT KPI

SAIDI reduction	-242 min.	-16%*
OPEX saving	-494 tsd Euro	-20%*
Losses reduction	-18 million kWh	-0,22%*
New reserve capacity creation	+105 MW	+6%*
Smart meters installed	+5%	

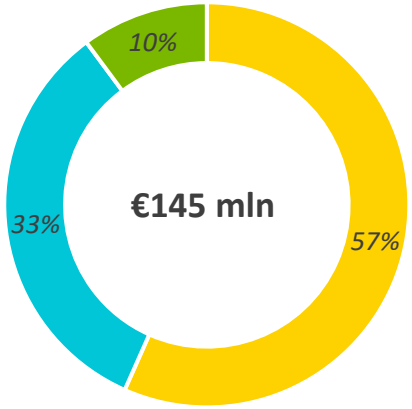
* - percentage improvement of the indicator in comparison with the composite indicator of Kyiv regional grids

INVESTMENT PROFILE OF PROJECT IN IRPIN REGION OF KYIV REGIONAL GRIDS

PROJECT INVESTMENT PLAN

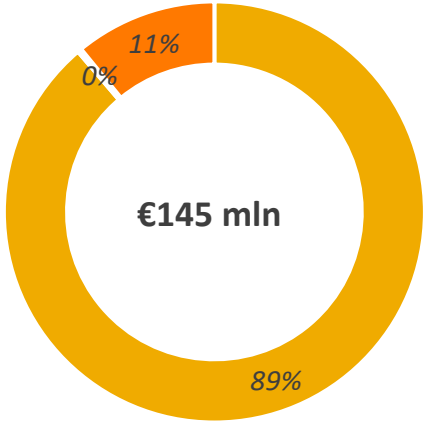


BREAKDOWN BY PURPOSE



- **Reliability** - €82 mln
- **Flexibility** - €48 mln
- **Efficiency** - €15 mln

BREAKDOWN BY COMPONENT



- **Equipment** - €128 mln
- **IT/OT** - €16 mln
- **Communication** - €0.4 mln

COMPLETE TRANSFORMATION OF IRPIN GRIDS WOULD REQUIRE A ~€145 MLN INVESTMENT

6 110-150 kV substations	**6** Power transformers HV/MV	**47 443** Smart meters	**148** Automation primary/distribution/ secondary substations	**1** New HV power substations
33 Reclosers	**387** Power transformers MV/LV	**60 km** Overhead lines 0.4-20 kV	**456 km** Underground lines 0.4-20 kV	**9 km** New HV lines

Note: calculations were made in UAH with recalculation for EUR at the NBU exchange rate as of May 12, 2023 – 39.97 UAH/EUR adjusted for CPI Europe (by DTEK Consensus forecast)

NEXT GENERATION SMART METERING

DTEK Energy in action

NEXT GENERATION SMART METERING IN DTEK GRIDS
SUMMARY OF THE PROJECT

ISSUES / PREREQUISITES

Low level of meters reading (77 %)

High level of actual losses in the DSO grid (9,24 %)

HIGH LEVEL OF OPEX:
- for maintenance of existing metering systems (usage of PLC communication modules only)
- for receiving data from the non-system meters

OBJECTIVES

1
- Create an updated ToR for procurement of the Smart Metering (PLC + RF communication channels).
- Selecting a supplier, implementing pilot project and conducting transition to the Smart Meters of Second Generation.
- Conducting analysis of the existing software solutions for localization of losses in the 0.4 kV grid
- Implementing a system of analysis of losses in the DSO grid.

2
- Implementing a model of comprehensive investment in automaton
- Improving DSO customers automation to 100 %

1 PROJECT SCOPE

It is necessary to implement the Smart Meters for 100% of DSO's customers to reduce commercial losses in the distribution grid and the costs of obtaining data from meters.

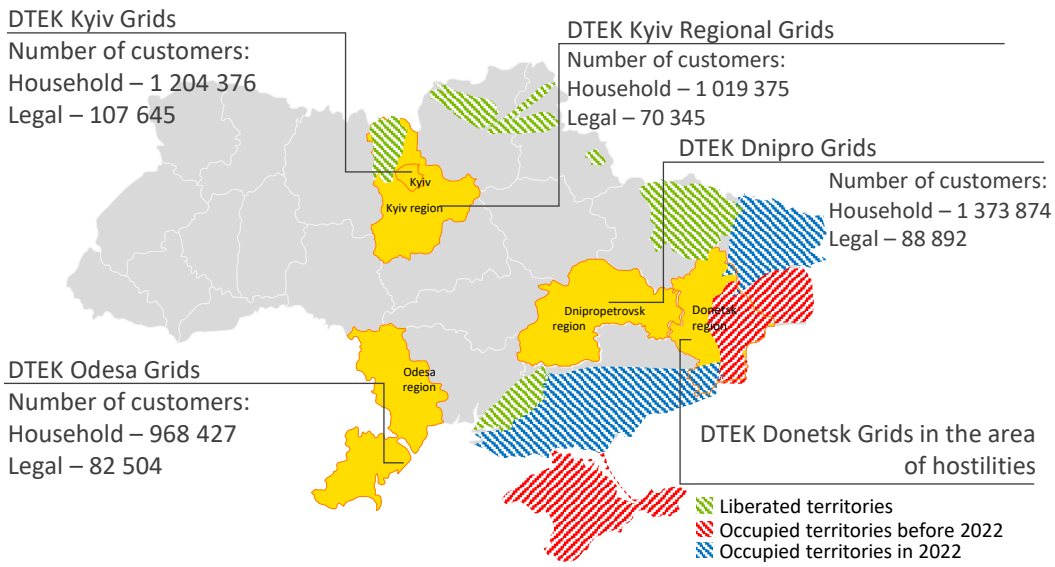
2 PROGRESS TO-DATE

The level of DSO metering automation on the first-generation meters is 15% of the total amount.

3 TIMEFRAME

The project is to be implemented in 10 years.

OVERVIEW OF CURRENT PARAMETERS



PROJECT KPI

	CURRENT		GOAL
Automation of the legal customers metering	27 %	10 years →	100 %
Automation of the household customers metering	23 %	10 years →	100 %
Receiving a signal about emergency shutdown of customers	0 %	10 years →	76 %
Implementing a system of analysis of losses in the grid	20 %	3 years →	100 %
Level of actual losses in the DSO grid	9,24 %	10 years →	6,4 %

INVESTMENT PROFILE
PROJECT IMPLEMENTATION IN DTEK GRIDS

ROADMAP / STAGES OF PROJECT COVERAGE

2025

- **Creating Terms of Reference** for the purchase of Smart Metering of Second Generation
- **Conducting tenders** for the purchase of software equipment and second-generation communication equipment
- **Conducting analysis** of existing software solutions for localization of losses in the grid
- **Installation** of Smart Meters: **42 702** meters

2026

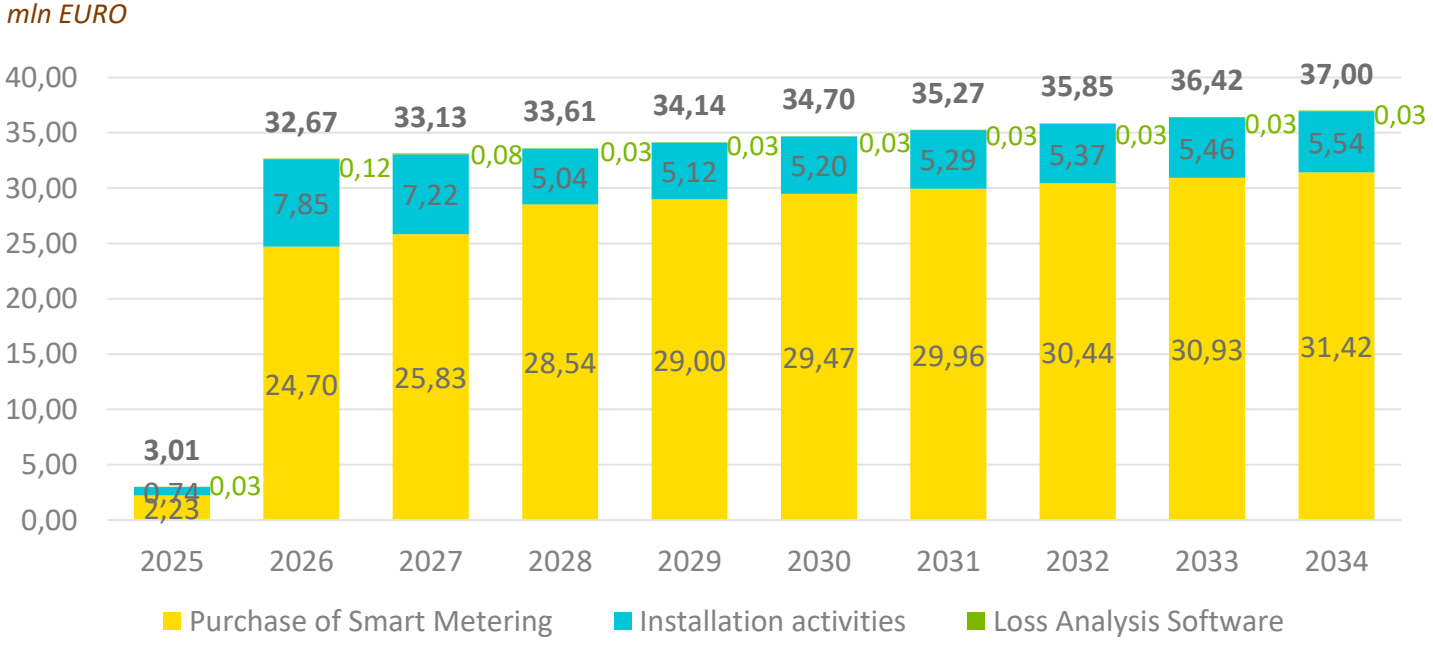
- **Implementing pilot project** and conducting transition to the Smart Meters of Second Generation
- **Selecting the software** for analysis of losses in the 10/6/0,4 kV DSO grid
- **Installation** of Smart Meters: **480 540** meters

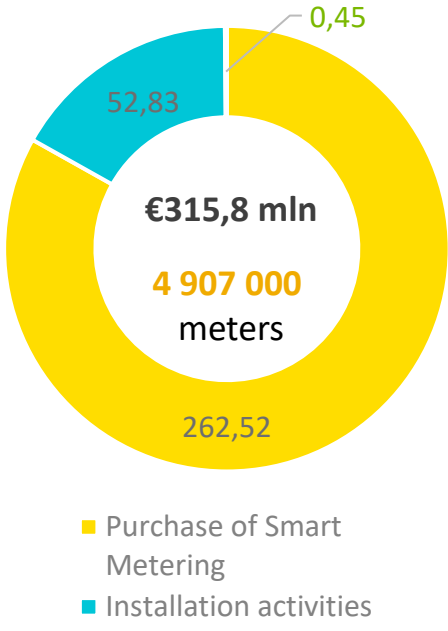
2027-2034

- **mplementIing the software** for analysis of losses in the 10/6/0,4 kV grid
- **Installation of Smart Meters** of Second Generation: **4 383 759** meters

PROJECT INVESTMENT PLAN

mln EURO





10 KV GRID AUTOMATION

DTEK Energy in action

10 KV GRID AUTOMATION SUMMARY OF THE PROJECT

OBJECTIVES

Reducing the duration of interruptions in the power supply of customers during a power outage

Localization of places of damage, increasing the visibility of network parameters

Decreasing search time for damaged network sections

1 PROJECT SCOPE

10 kV grids automation of Kyiv, Odesa, Dnipro regions and the city of Kyiv

2 PROGRESS TO-DATE

Detailed technological grid development concept and plan on 10 kV grids automatization created to meet the future challenges in the energy sector. Standard designs / technical requirements for the installation of reclosers, reconstruction of MV/LV substations have been developed

3 TIMEFRAME

10-year investment plan to automate the regional grid

OVERVIEW OF CURRENT PARAMETERS

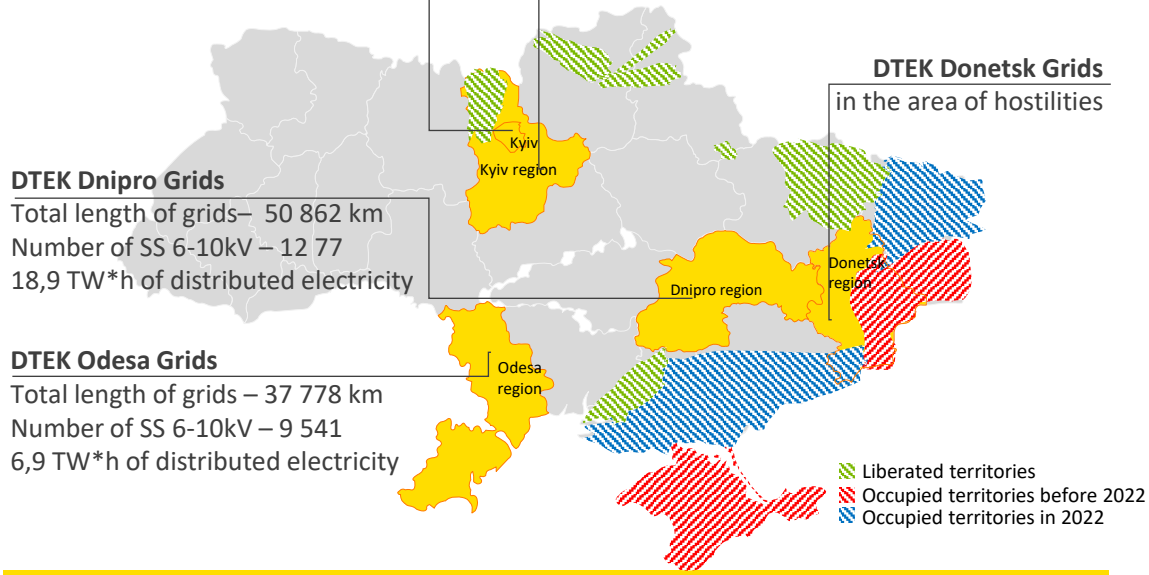
DTEK Kyiv Grids
Total length of grids– 15 102 km
Number of SS 6-10kV – 4 028
10,5 TW*h of distributed electricity

DTEK Kyiv Regional Grids
Total length of grids– 47 355 km
Number of SS 6-10kV – 11 876
8,1 TW*h of distributed electricity

DTEK Donetsk Grids
in the area of hostilities

DTEK Dnipro Grids
Total length of grids– 50 862 km
Number of SS 6-10kV – 12 77
18,9 TW*h of distributed electricity

DTEK Odesa Grids
Total length of grids – 37 778 km
Number of SS 6-10kV – 9 541
6,9 TW*h of distributed electricity

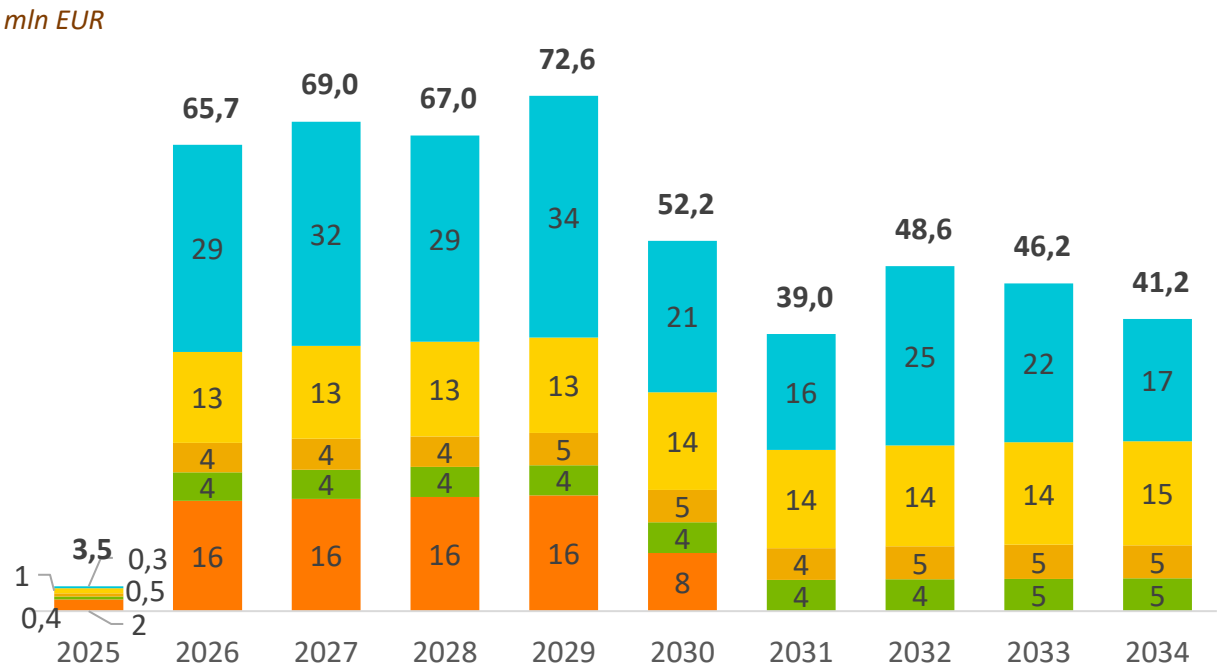


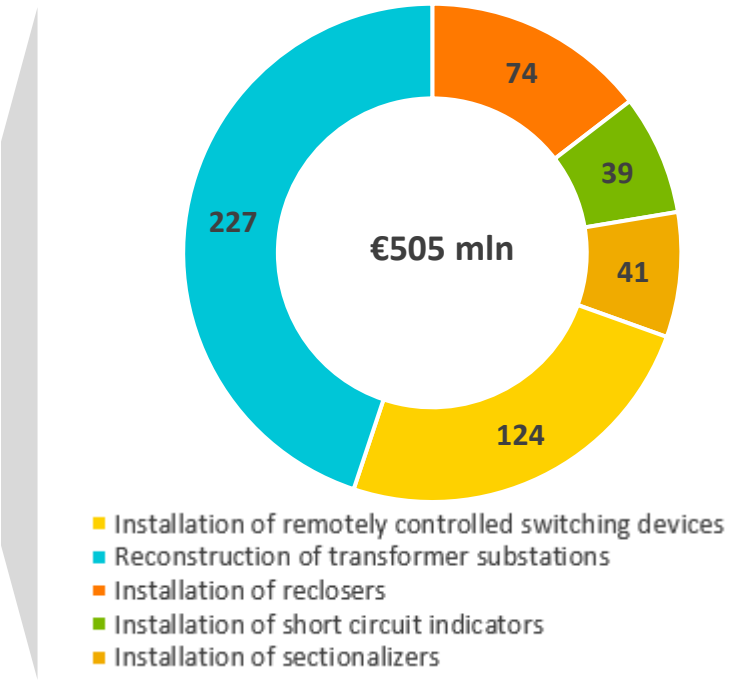
PROJECT KPI

SAIDI reduction	-152 min.	-21%
OPEX saving	-4,157 mln Euro	-4%
Losses reduction	-74 million kWh	-0,1%
New reserve capacity creation	+222 MW	

INVESTMENIMPLEMENTATION T PROFILE PROJECT IN DTEK GRIDS

PROJECT INVESTMENT PLAN





CONCLUSIONS

2,556 Reclosers	**18,878** Short circuit indicators	**5,894** Sectionalizers
7,717 10 kV substations	**4,479** Power transformers MV/LV	**17,694** Remotely controlled switching devices

Implementation period:
Installation of reclosers - 5 years;
Installation of sectionalizers, short circuit indicators - 10 years;
Reconstruction of transformer substations with replacement by MPTS and installation of remotely controlled switching devices - 10 years.
The plan provides for the availability of internal personnel and external contractors, as well as carrying out design and survey work on transformer substations` reconstruction

REPLACEMENT OF OVERLOADED POWER TRANSFORMERS

DTEK Energy in action

REPLACEMENT OF OVERLOADED POWER TRANSFORMERS
SUMMARY OF THE PROJECT

Issues / prerequisites

- **The lack of capacity reserve at substations limits the connection of new capacities, restrains the development of RES and distributed generation**
- **7% of the power transformers on the 35-150 kV substations and 15% of transformers on the 6-10 kV secondary substations are overloaded**

- **High level of actual losses in the DSO grid (9,24 %)**
- **The impact of overloading of power transformers on the grid losses, the quality of electricity and the risk of additional accidents and shortening the service life of power transformers**

Objectives

1 Replacement of overloaded power transformers on the 35-150kV and 6-10kV substations with ones with a higher capacity without the need for reconstruction of the structural part of the substation

2 Implementation of power transformers with eco-design in accordance with the requirements of Ukrainian legislation and European standards

1 PROJECT SCOPE

Replacement of overloaded transformers in the 6(10)-110(150) kV power grids of Kyiv, Odesa, Dnipro regions and the city of Kyiv

2 PROGRESS TO-DATE

A detailed concept of automation and modernization of 6(10)-110(150)kV networks was formed in order to meet future challenges in the energy sector. Typical projects / technical requirements for replacing power transformers on 35-150kV and 6-10kV substations have been developed

3 TIMEFRAME

A 10-year investment plan for the replacement of the power transformers
Annual volumes are based on the availability of internal staff and external contractors

Overview of current parameters

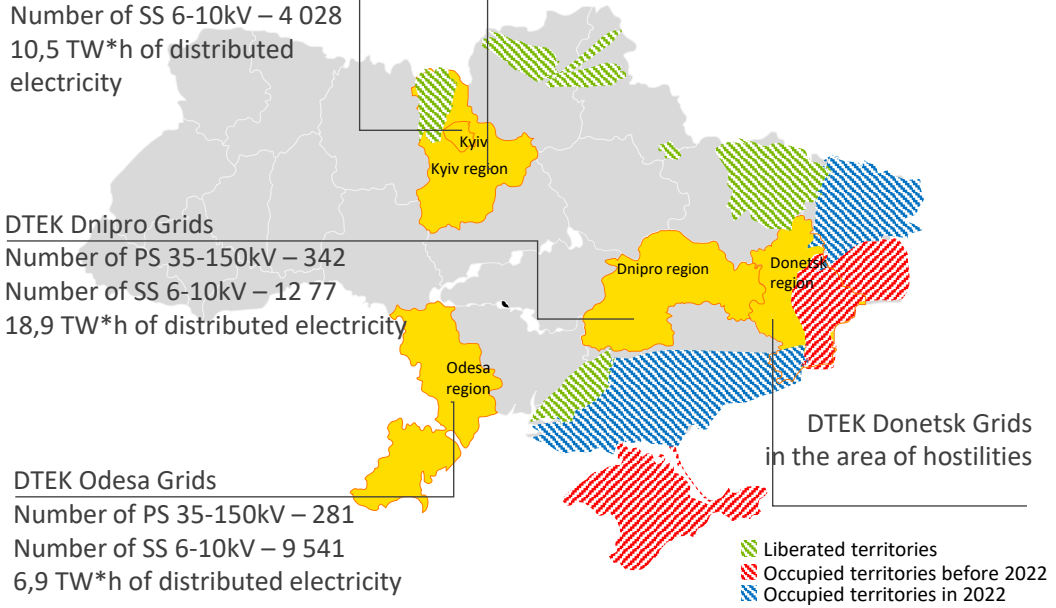
DTEK Kyiv Grids
Number of PS 35-150kV – 67
Number of SS 6-10kV – 4 028
10,5 TW*h of distributed electricity

DTEK Kyiv Regional Grids
Number of PS 35-150kV – 251
Number of SS 6-10kV – 11 876
8,1 TW*h of distributed electricity

DTEK Dnipro Grids
Number of PS 35-150kV – 342
Number of SS 6-10kV – 12 77
18,9 TW*h of distributed electricity

DTEK Odesa Grids
Number of PS 35-150kV – 281
Number of SS 6-10kV – 9 541
6,9 TW*h of distributed electricity

DTEK Donetsk Grids
in the area of hostilities



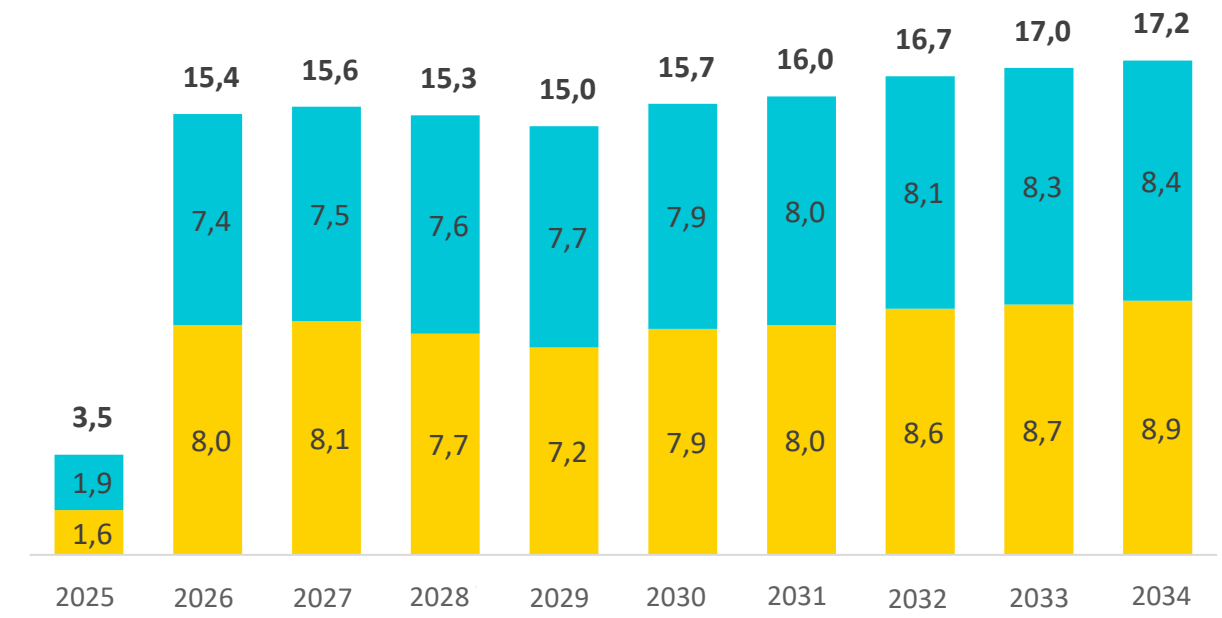
Project KPI

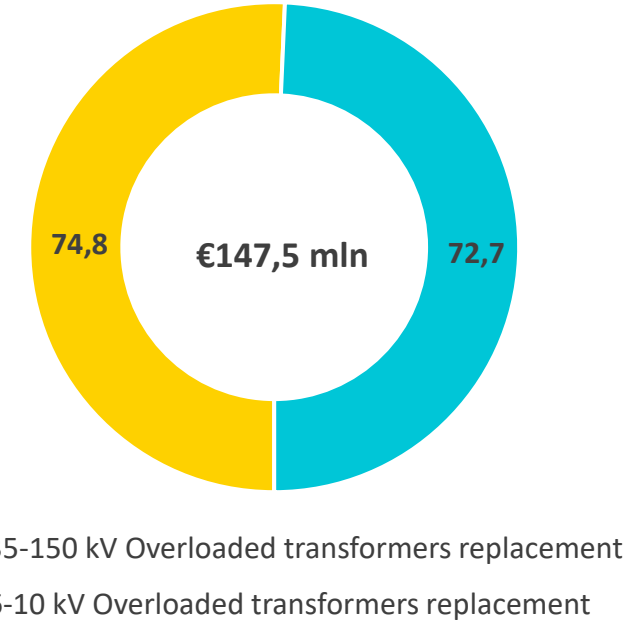
	GOAL
Losses decreasing	**-66 mln kW*h annually**
New capacity creation • **Primary substations 35-150 kV** • **Secondary substations 6-10 kV**	 **+421 MW** **+1 133 MW**
Improvement of ESG rating	CO_2

INVESTMENT PROFILE
PROJECT IMPLEMENTATION IN DTEK GRIDS

Project investment plan

mln EURO





The volumes in terms of capacity ratings of new power transformers

New capacity, MVA	**2,5**	**4**	**6,3**	**10**	**16**	**25**	**40**	**63**	**Total**
Transformers on 35-150 kV Subs.	5	13	19	22	3	24	9	16	**111**
New capacity, MVA	**0,063**	**0,1**	**0,16**	**0,25**	**0,4**	**0,63**	**1**	**1,6**	
Transformers on 6-10 kV Subs.	149	368	970	1633	1356	1155	636	206	**6 473**