



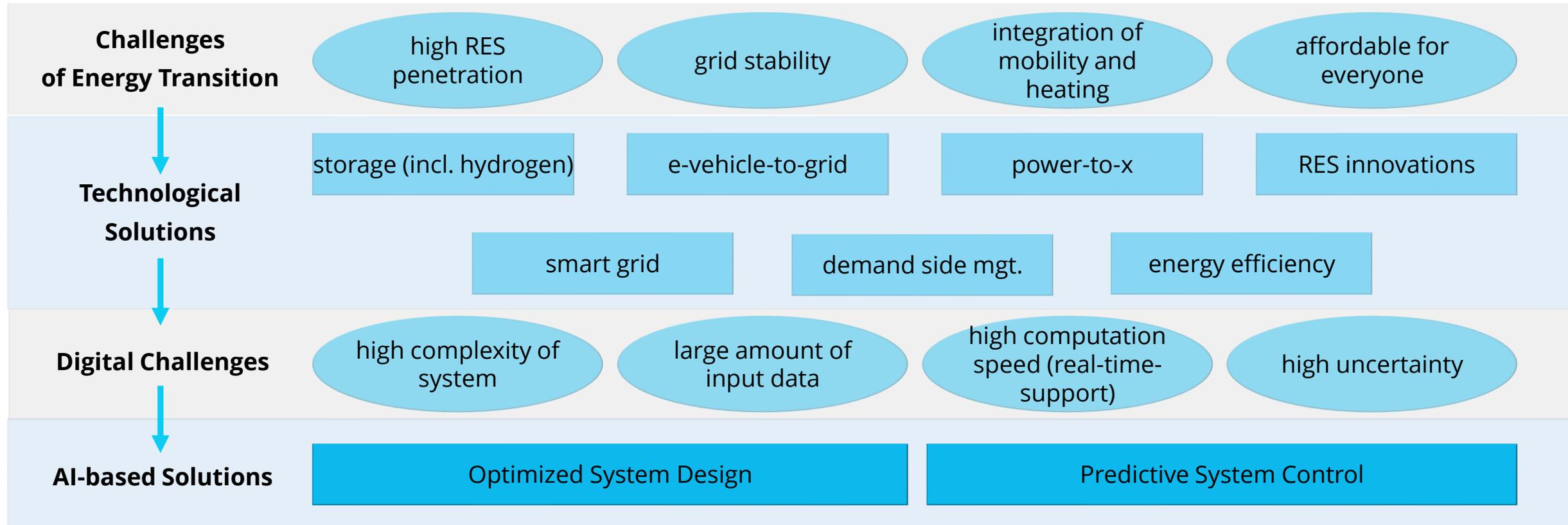
## Artificial Intelligence as an Enabler for the Energy Transition

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## Hardware and software solutions need to be combined to cope with the challenges of integrating large amounts of renewable energy sources (RES)



With Q-System we provide a solution for optimized system design and predictive control of energy systems

Enabling technological solutions for the energy transition with AI-based tools and control algorithms

**Q-System**

Optimized System Design

Predictive System Control

# Our Software “Q-System” simulates energy systems and optimizes design as well as operation based on an AI-Algorithm (Deep Reinforcement Learning)

## Configure Options

The screenshot shows the 'Configure Options' interface. At the top, there are navigation tabs: 'Q-SYSTEM', 'Projects', 'Components', 'Quick create', and 'Import'. Below this, a search bar contains 'Wind turbines'. A table lists three turbine options:

SELECT	NAME	CURRENCY	MIN	MAX	BASE
<input type="checkbox"/>	wind turbine example	EUR	0	1	1
<input checked="" type="checkbox"/>	Enroncon E-08 EP4	EUR	0	10	0
<input type="checkbox"/>	mighty breeze	EUR	0	1	1

Below the table, there are two diagrams: 'Efficiency' showing a flow from 'Wind turbine' to 'Generator & Converter' to 'Battery' and 'Inverter' to 'Grid'; and 'Energy Consumed' showing a flow from 'Grid' to 'Inverter' to 'Battery'.

- Configure options for generation and storage
- Site-specific restrictions

## Simulate Systems

The screenshot shows the 'Simulate Systems' interface. It features two line charts. The top chart is titled 'Electricity generation (line chart)' and shows 'Electricity generation [kW]' on the y-axis (ranging from -1000 to 4000) against time on the x-axis (from Feb 25 2020 to Feb 29). It includes a legend for 'Main battery', 'Diesel engine 18V 28/325', 'Enroncon E-08 EP4', and 'PV Inverter'. The bottom chart is titled 'Electricity generation (cumulative chart)' and shows 'Electricity generation [kWh]' on the y-axis (ranging from -5000 to 5000) against time on the x-axis. It includes a legend for 'Diesel engine 18V 28/325', 'Enroncon E-08 EP4', 'PV Inverter', and 'Battery'.

- Digital Twin of the system architecture allows for in-depth technical and economical analysis

## Optimize Performance

The screenshot shows the 'Optimize Performance' interface. At the top, there is a table with columns 'COMPONENT', 'TYPE', and 'QUANTITY':

COMPONENT	TYPE	QUANTITY
Diesel engine 18V 28/325	Diesel genset	2
Enroncon E-08 EP4	Wind turbine	0
MAN Battery	Battery	41
PV Inverter	Photovoltaic	10

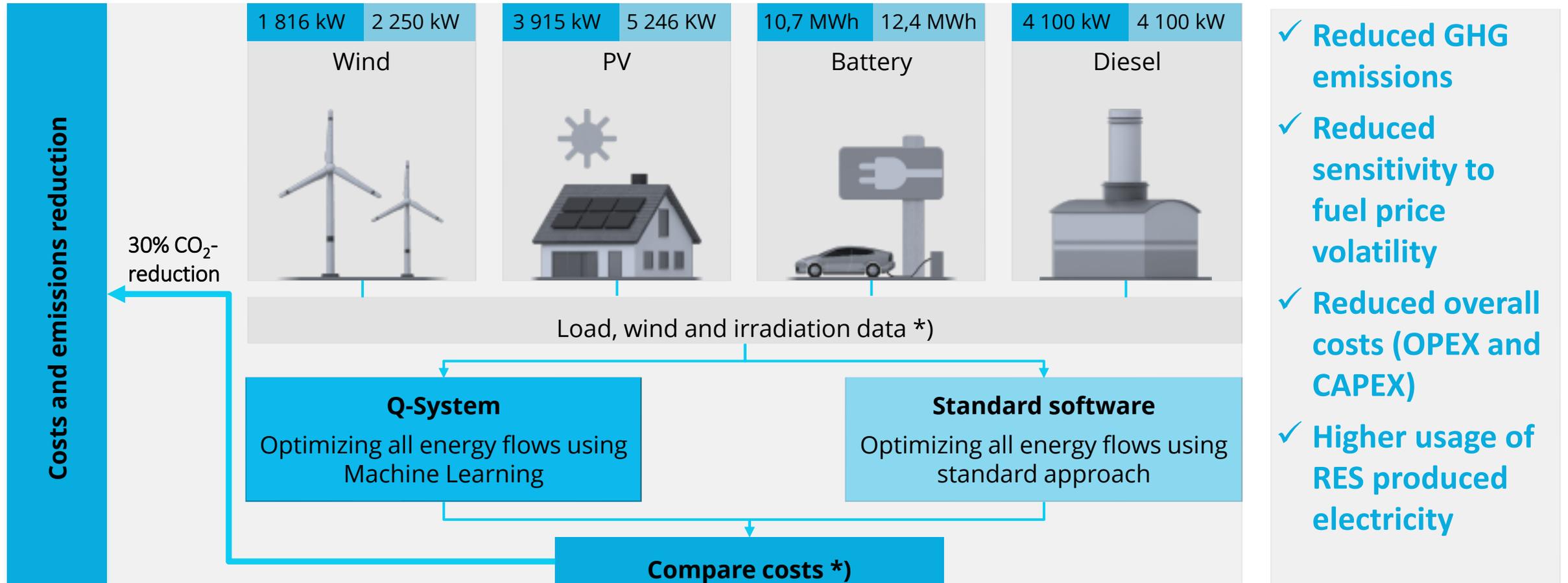
Below the table, there is a section titled 'Economic performance' with a sub-section 'Initial investment' containing a pie chart. The pie chart shows the following data:

Component	Value (EUR)
Diesel engine 18V 28/325	8,484,016
MAN Battery	1,500,000
PV Inverter	1,500,000
Enroncon E-08 EP4	0

Below the pie chart, there is a section titled 'Costs overview'.

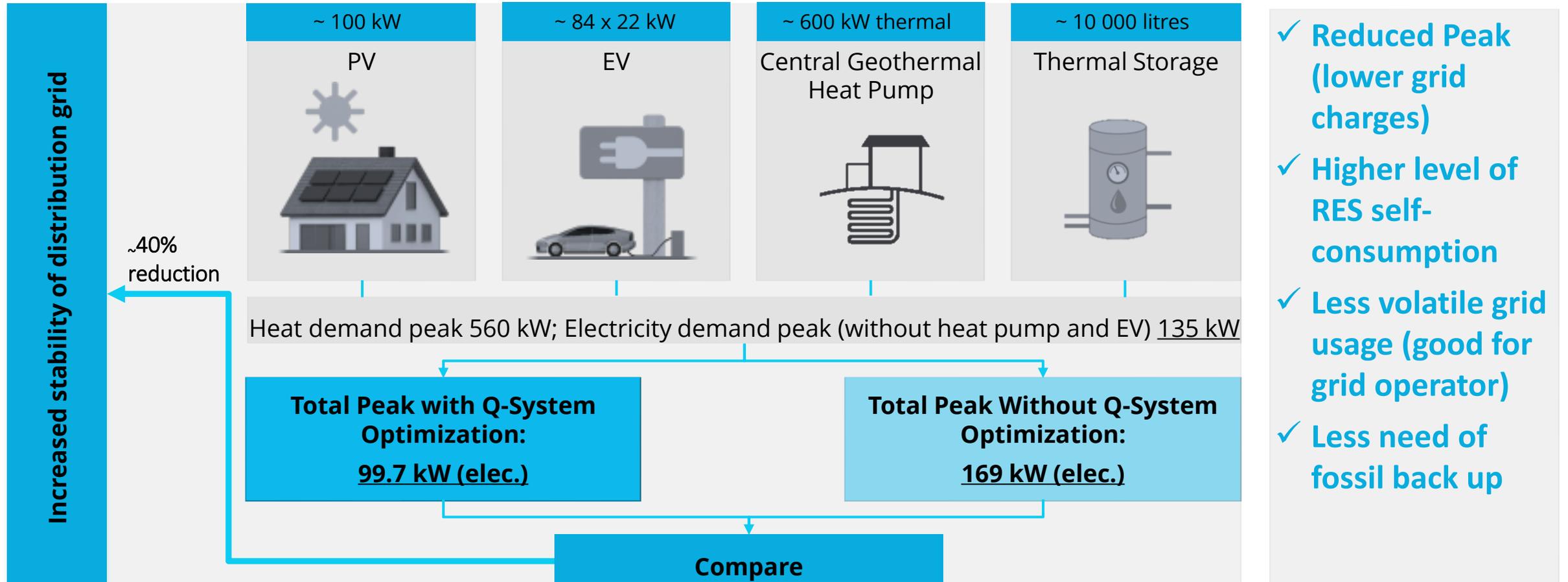
- Optimal system configuration
- Optimal operation/dispatch

## Although less renewables are installed the use of Machine Learning lowers emissions



\*) To avoid any effects from over-optimization i.e. perfect foresight Q-System has been trained on different time-series, whereas the validation has been done on the same set of data for Q-System and standard software

## AI based predictive system control can increase grid stability



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