

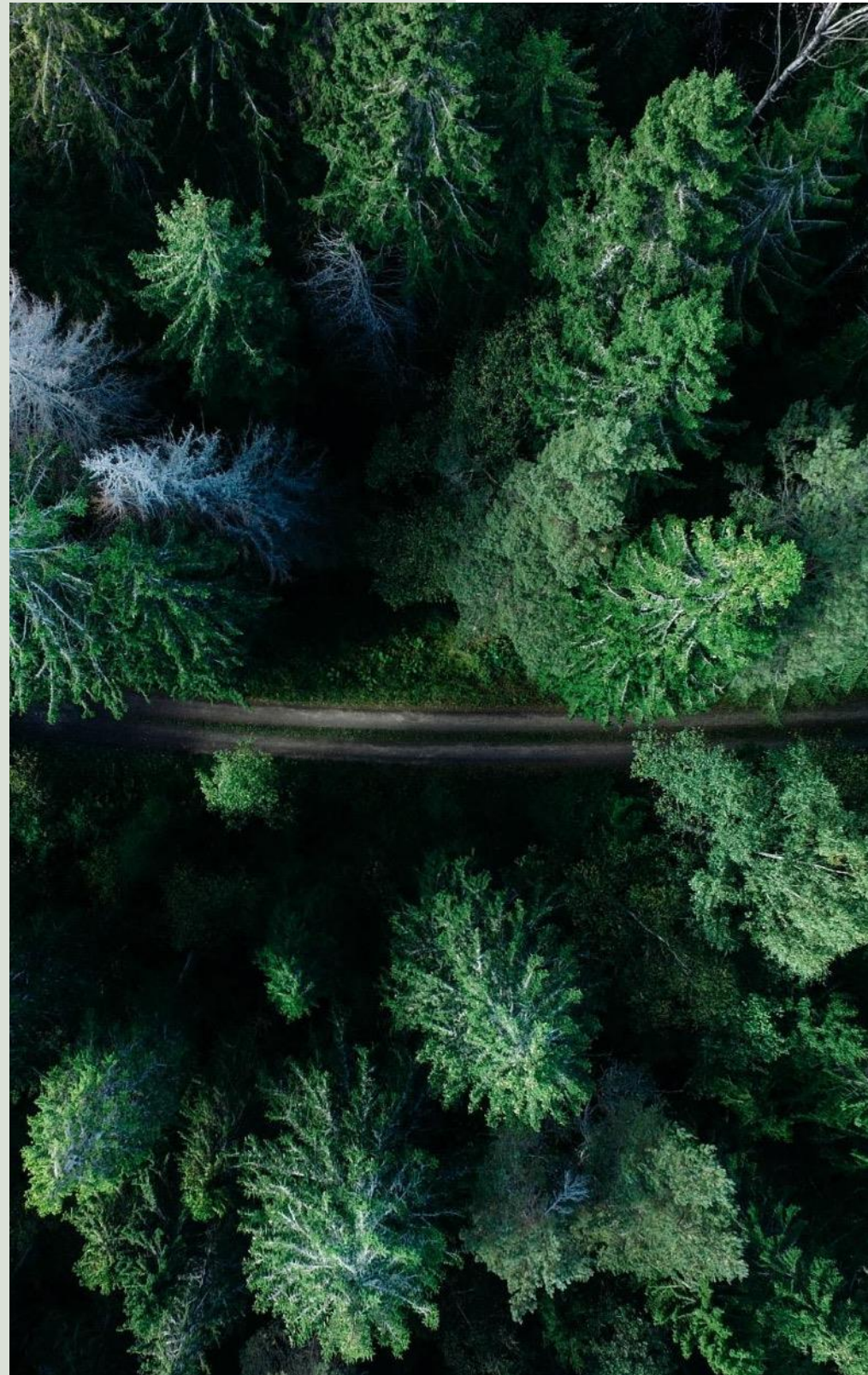
Cost efficient power electronics for renewable energy

Power Electronics Day, May 16, 2024
Saltsjöbaden

Björn Jernström, Founder & CTO, Ferroamp

Topics

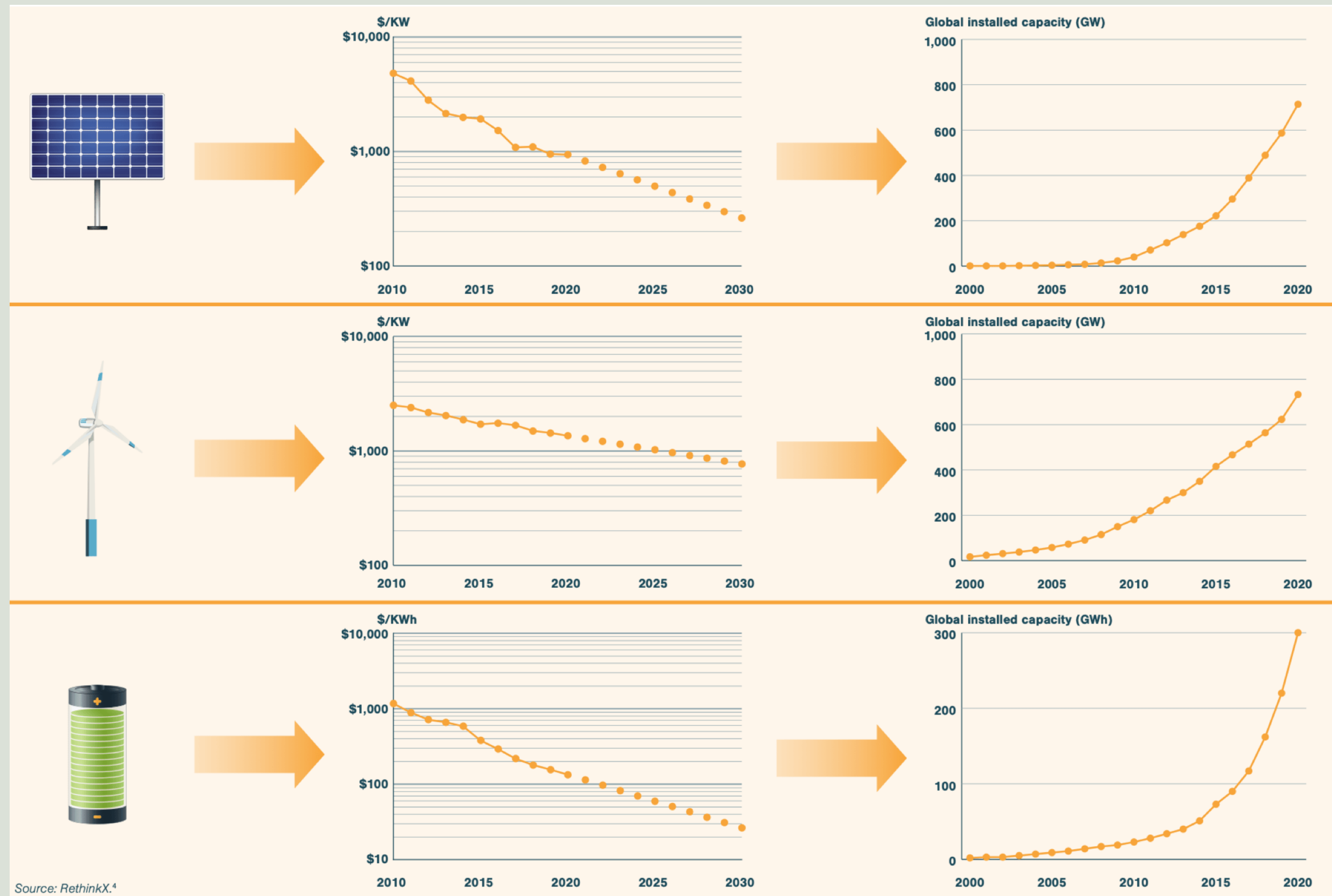
1. Macro trends
2. Edisons rematch
3. Cost drivers
4. Looking ahead



1.

Macro trends

Declining costs for solar, wind and batteries



Efficient use of raw materials

FUTURES & COMMODITIES

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Why a looming copper shortage has big consequences for the green economy

Copper prices have surged in 2021. The base metal remains in high demand, much thanks to its need in green energy projects and electric cars. In May 2021, commodities analysts at Goldman Sachs called copper 'the new oil.' That's because electric cars need several times more copper than their gas-powered counterparts. And power grids getting electricity from wind, solar and hydro sources also need copper—much more than the industry is currently producing. Here's how copper became so important to the world economy, and the green energy revolution.

FRI, JUL 30 2021 • 12:00 PM EDT

CNBC 2021-07-30

Why a Copper Shortage Threatens EVs and Green Transition

EVs require four times as much copper as gas-fueled cars.

By Wall Street Journal

Jun 08, 2023 11:30 am



The push for electrification is fueling a rush for copper. The non-precious metal is critical for electric vehicles, windmills and even the power grid. With a shortage looming, WSJ explains why copper is crucial to the global economy, and how its availability threatens a green-tech transition. Photo Illustration: Ali Larkin

Wall Street Journal 2023-06-08



Copper price 1999-2024 in USD/pound, macrotrends.net

The global copper market is entering an age of extremely large deficits

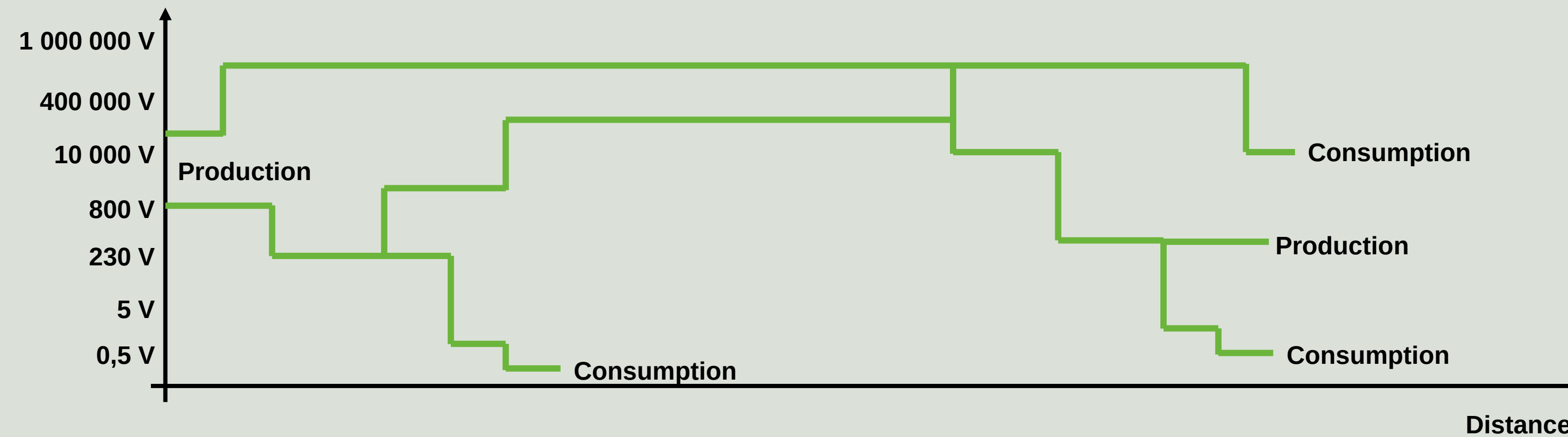
Rick Mills - Ahead of the Herd | July 25, 2023 | 1:40 pm Markets Copper

Mining.com 2023-07-25

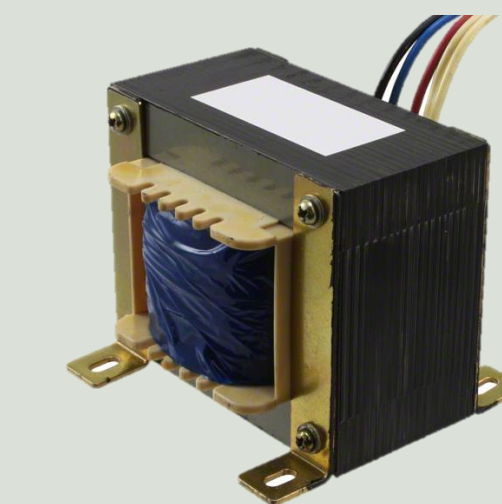
2.

Edisons rematch

Why is DC interesting now?



1900

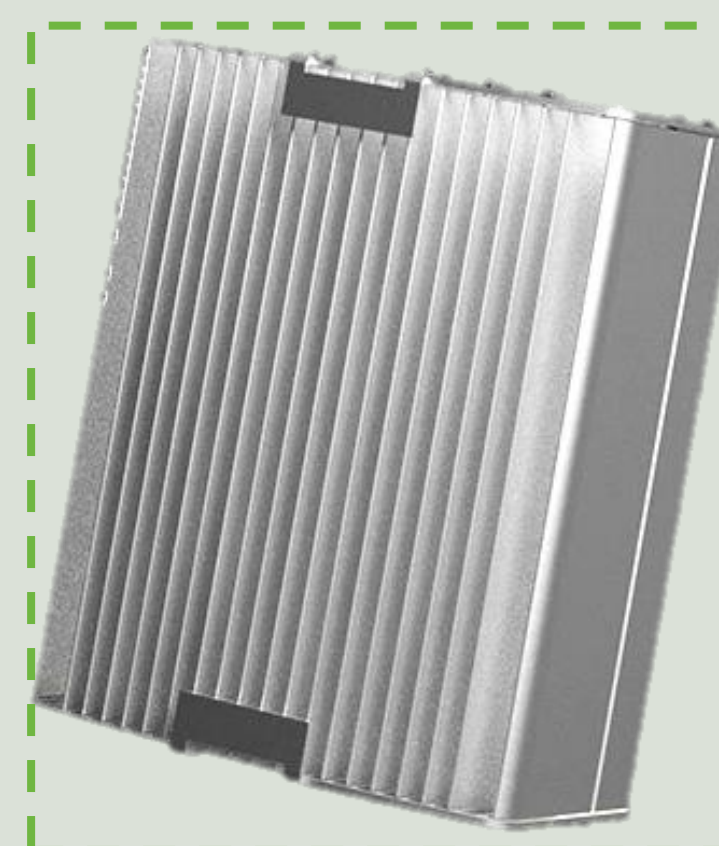


2000



2100

Lower costs with DC



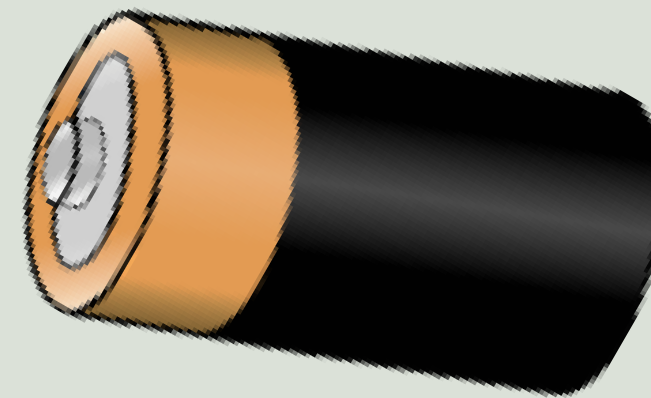
To scale

8 kW DC/DC converter
7 kg



8 kW DC/AC inverter
22 kg

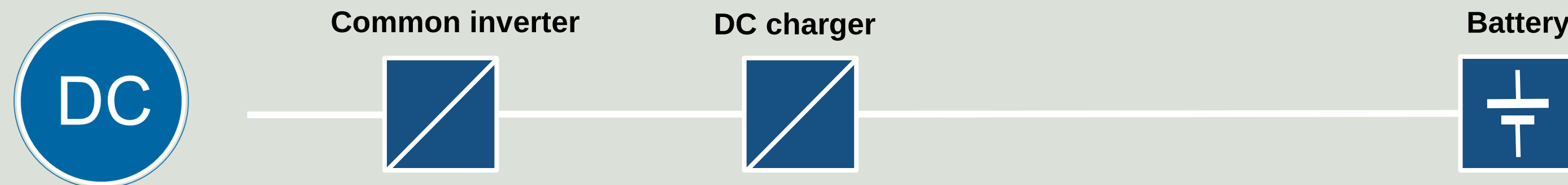
Mega trends are powered by DC



Example – vehicle to grid



- Vehicle needs to implement grid codes
- More expensive and heavy electronics in vehicle
- Difficult to handle asymmetric feed in
- Difficult with fast regulation and for example backup



- No additional cost in vehicle
- A DC/DC converter can be made very cost effective
- Power is not limited by on-board charger
- Easy to handle grid codes and backup power

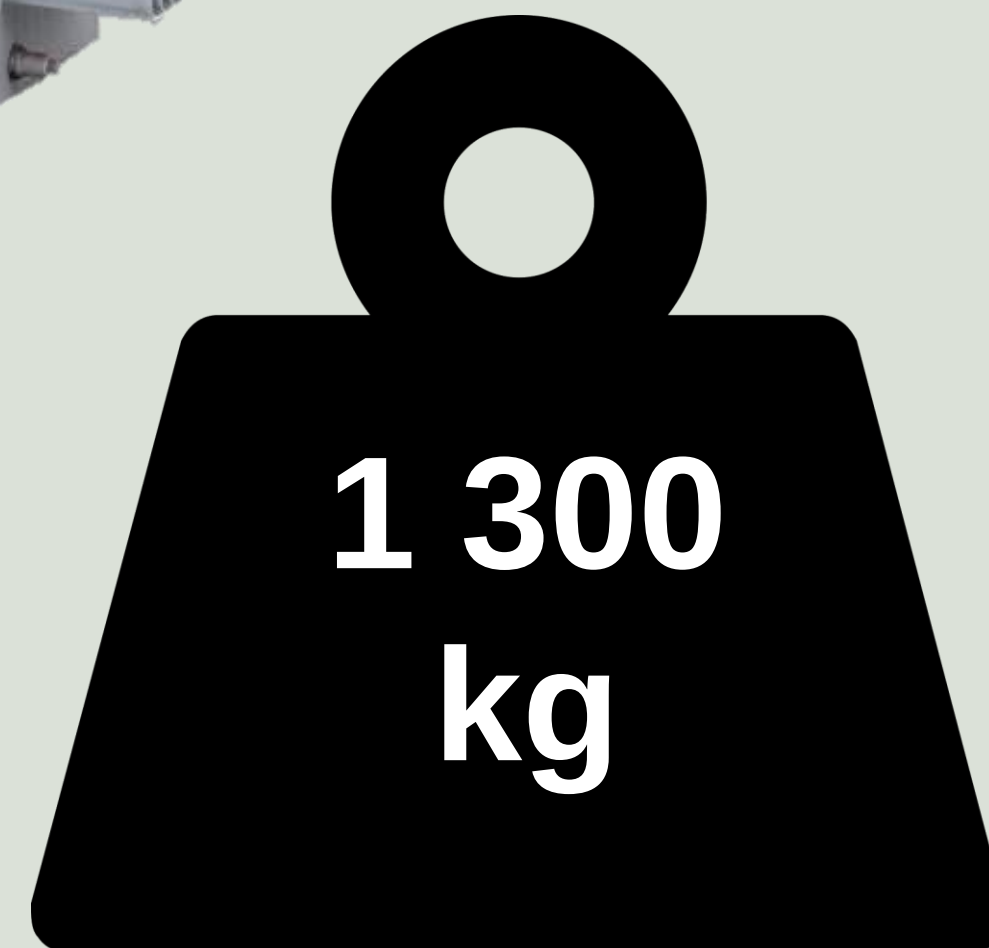
3.

Cost drivers

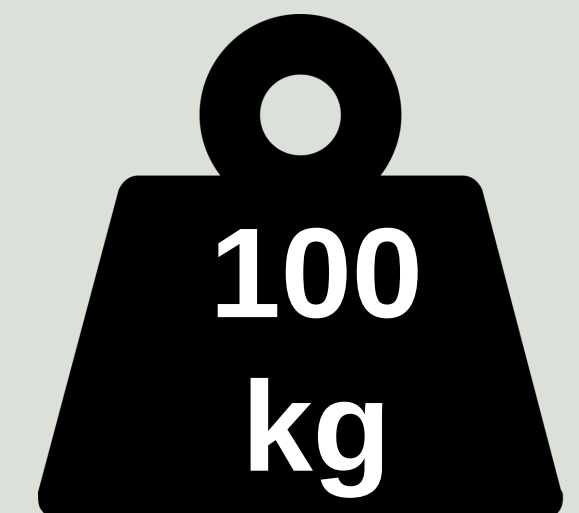
Apples and oranges



250 kVA
60 EUR / kW

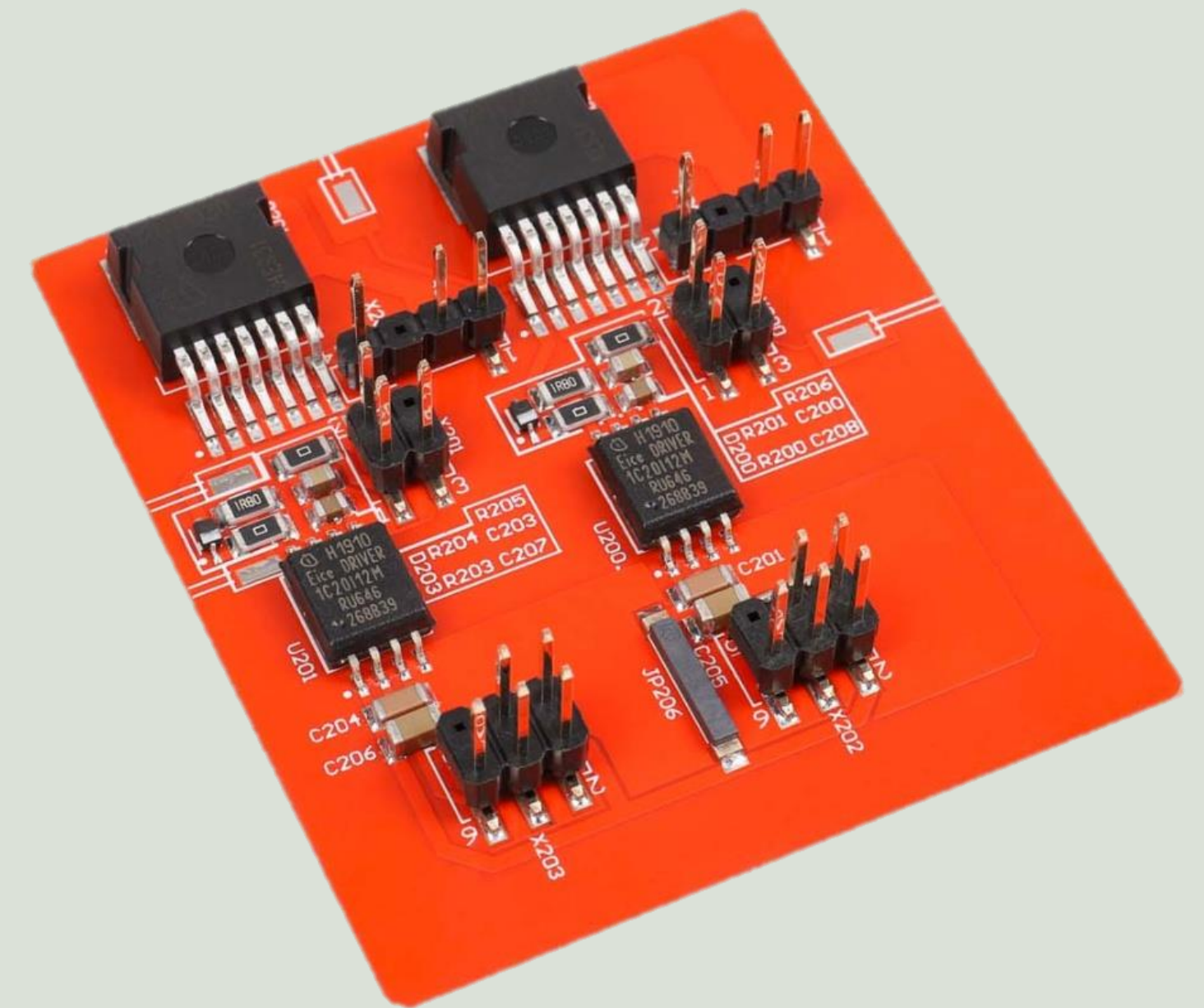


250 kW
40 EUR / kW

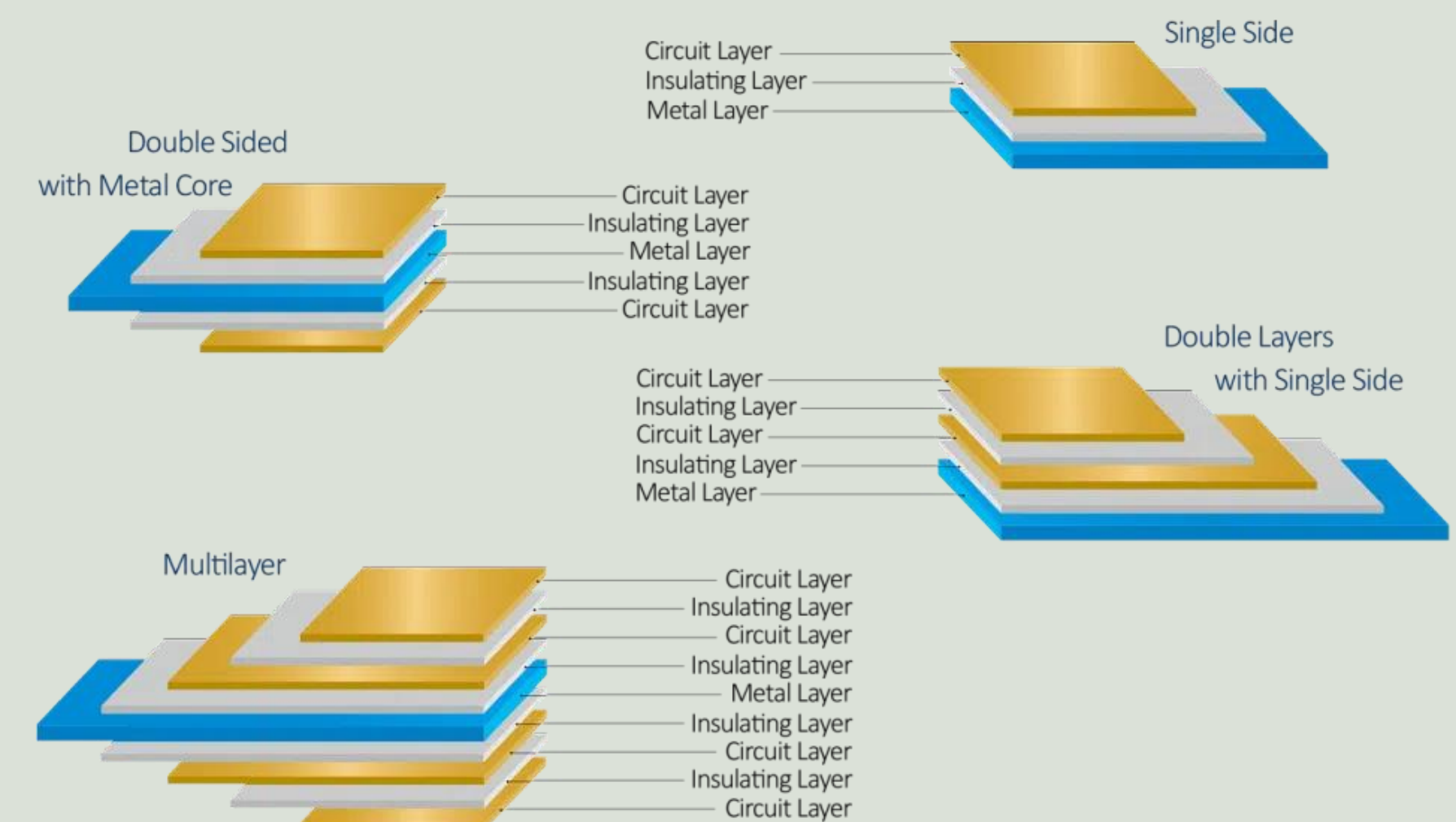


IMS for power electronics

- From LED industry
- Multiple stack up options
- Conventional SMT assembly methods
- Integrate other components close to power devices
- Multiple second source options
- Very good cooling
- Drawback: High capacitance to PE



DIFFERENT STACK UP FOR SINGLE SIDE TO MULTILAYERS



The quest for higher efficiency

Typical efficiencies for modern renewable energy converters:

AC/DC inverters	98%
DC/DC converters	99%

But does it really matter?

Non-isolated converters

- Removing isolation transformer saves cost, weight & increase efficiency
- May need other methods for electrical safety:
 - Insulation monitoring
 - Residual current detection
 - Monitoring of protection systems
 - Single fault tolerant systems
 - Overvoltage protection

Example: PV inverter with redundant & monitored relays, RCD, IMD

4.

Looking ahead

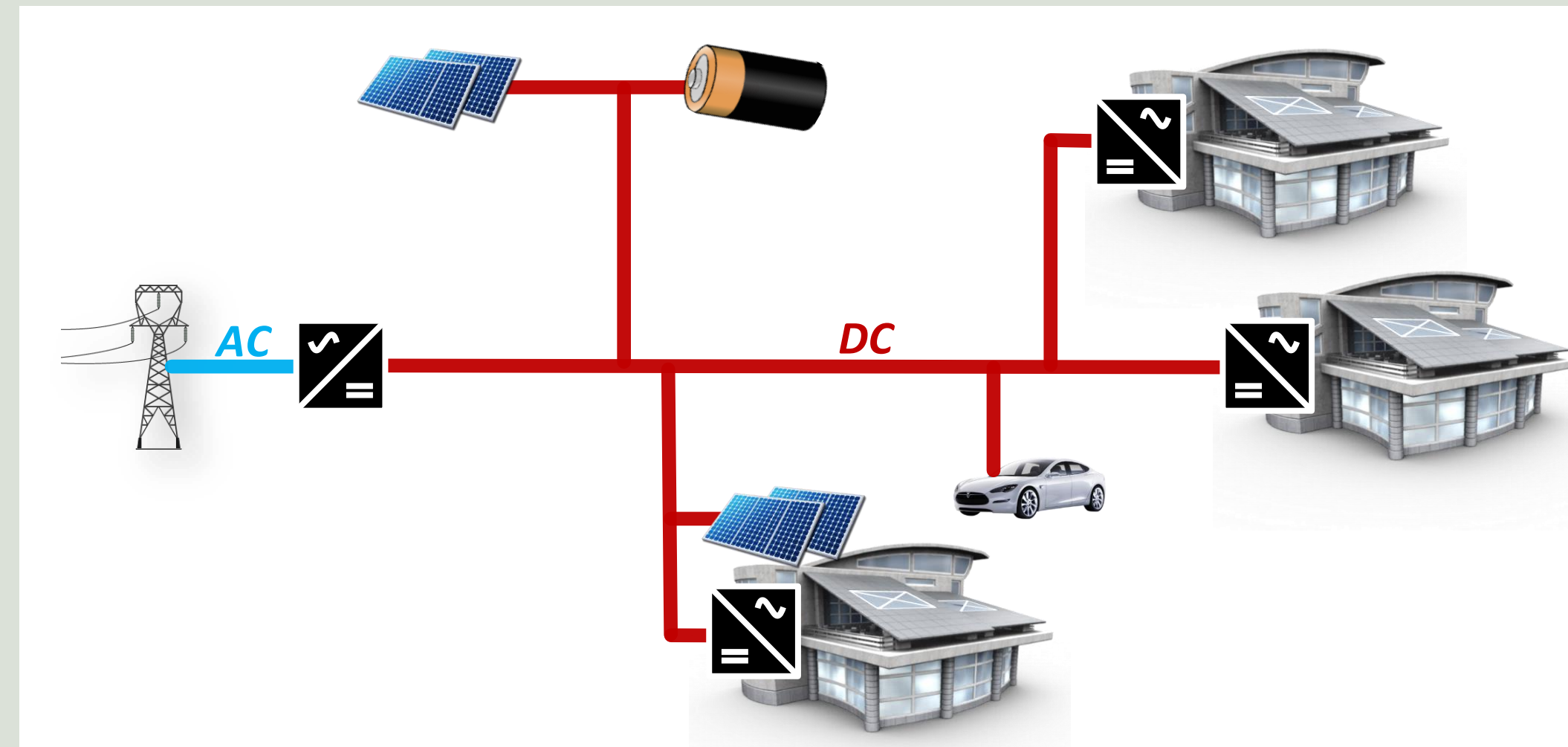
Looking ahead



1. USB-C (240 W)



2. Industrial products

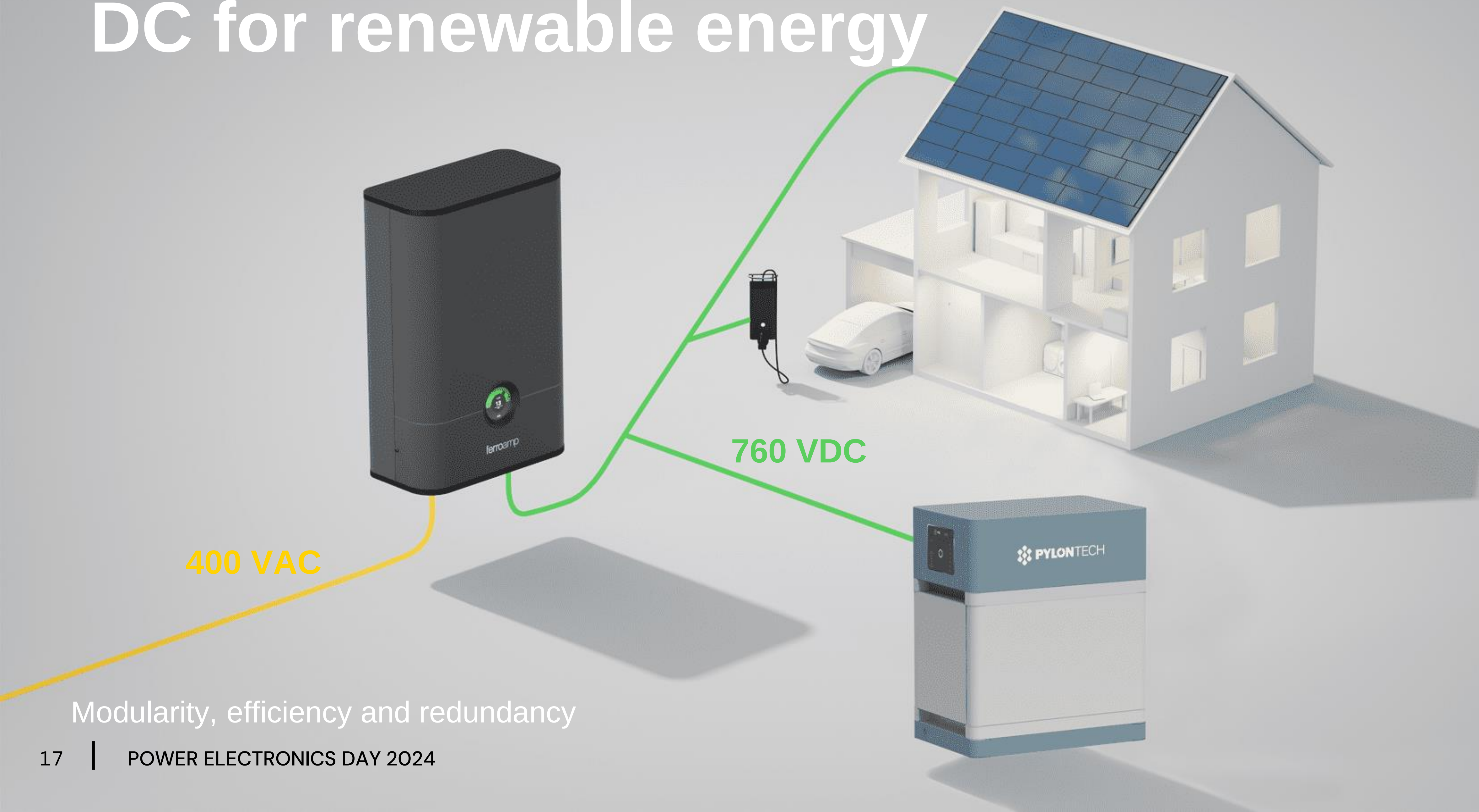


3. DC distribution / Off-grid elektrification



4. Consumer products

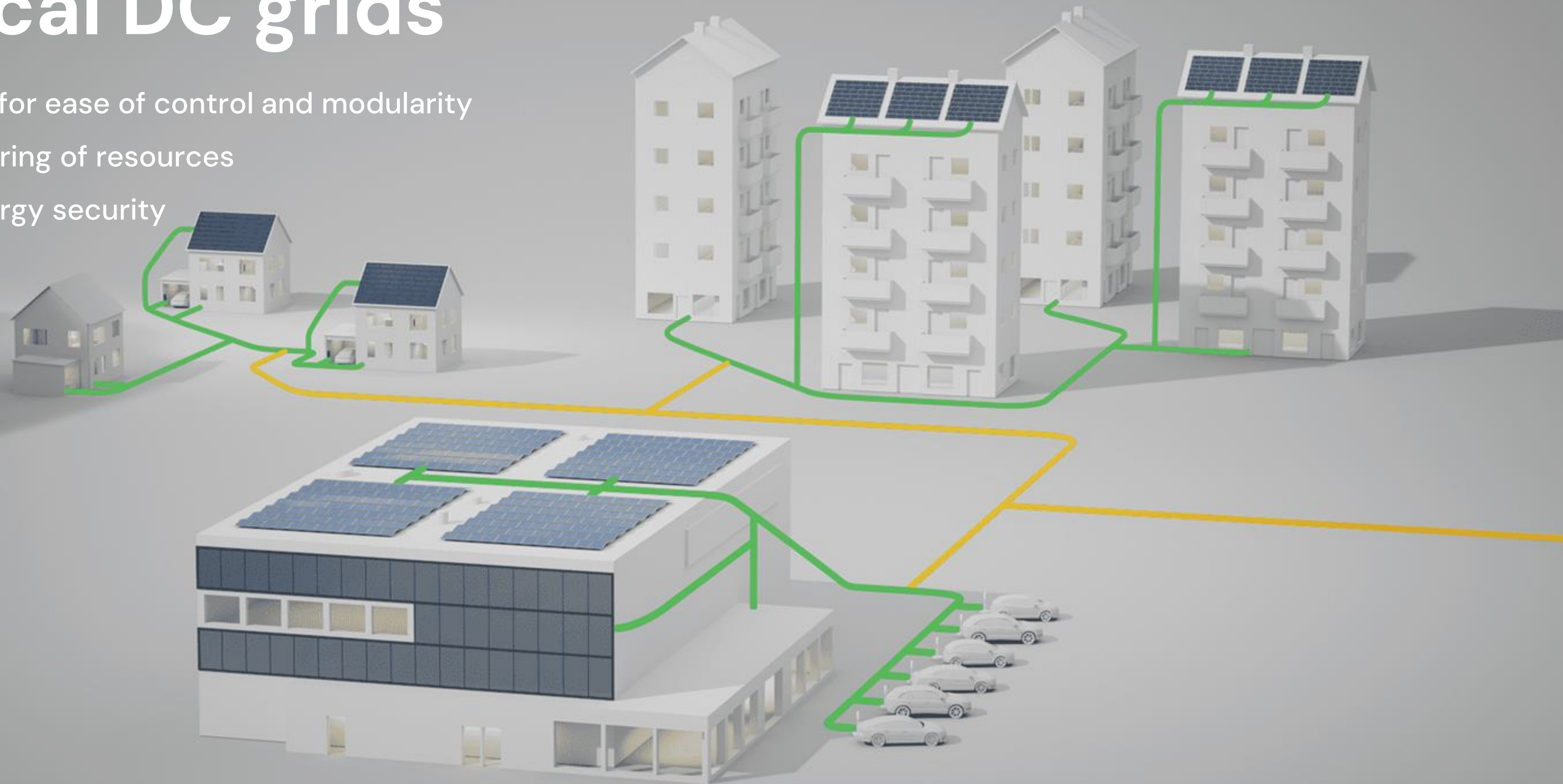
DC for renewable energy



Modularity, efficiency and redundancy

Local DC grids

- 🔌 DC for ease of control and modularity
- 🏠 Sharing of resources
- 🏆 Energy security



A world powered by 100% renewable energy

ferroamp

smart electricity control

