How to innovate and prepare for the energy system of the future – Siemens Future Grid & N47

Smart Energy Network, Oslo 21st May 2019

Moritz Ingerfeld, Nils Klippenberg


10 billion
people by 2050


70% in cities

Clear purpose

Decarbonization

Renewables provide sufficient energy to fuel the energy demand

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Increased renewable power generation – Germany as an example

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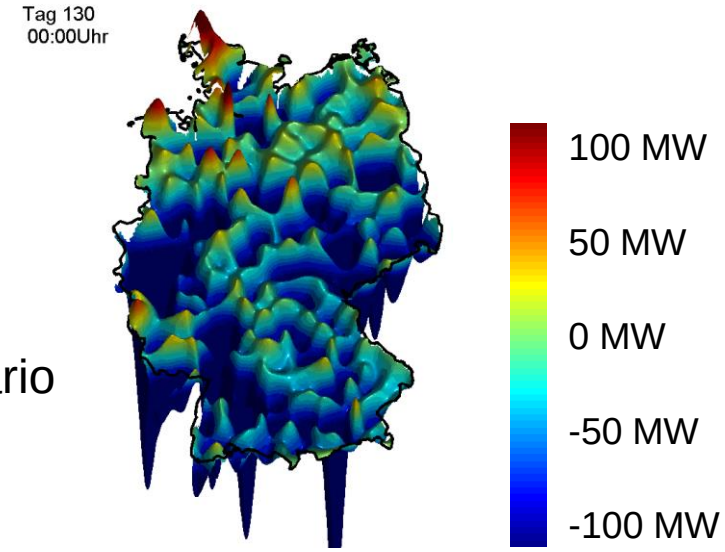
40% share of renewables

Most likely scenario for 2024



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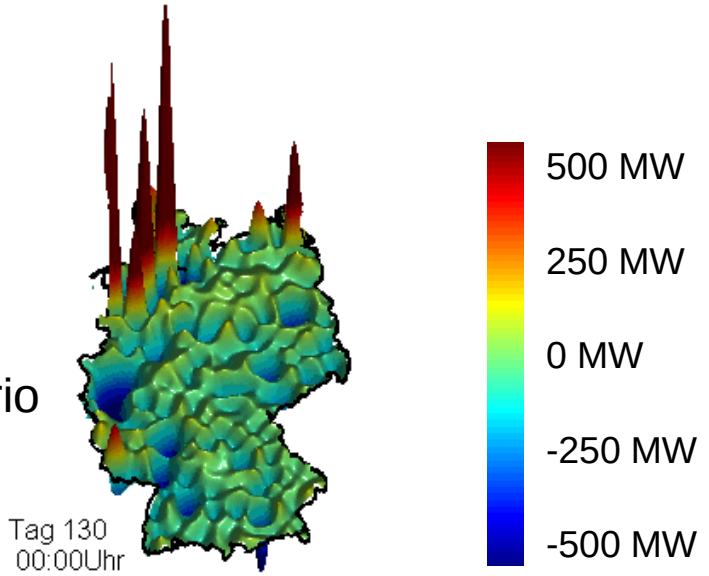
80% share of renewables

Most likely scenario for 2035+



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Past
Generation follows consumption

Today
Generation and consumption: gap

In the future
Generation and consumption decoupled

Source: German Power Network Development Plan

Germany renewable generation – more capacity than peak load demand

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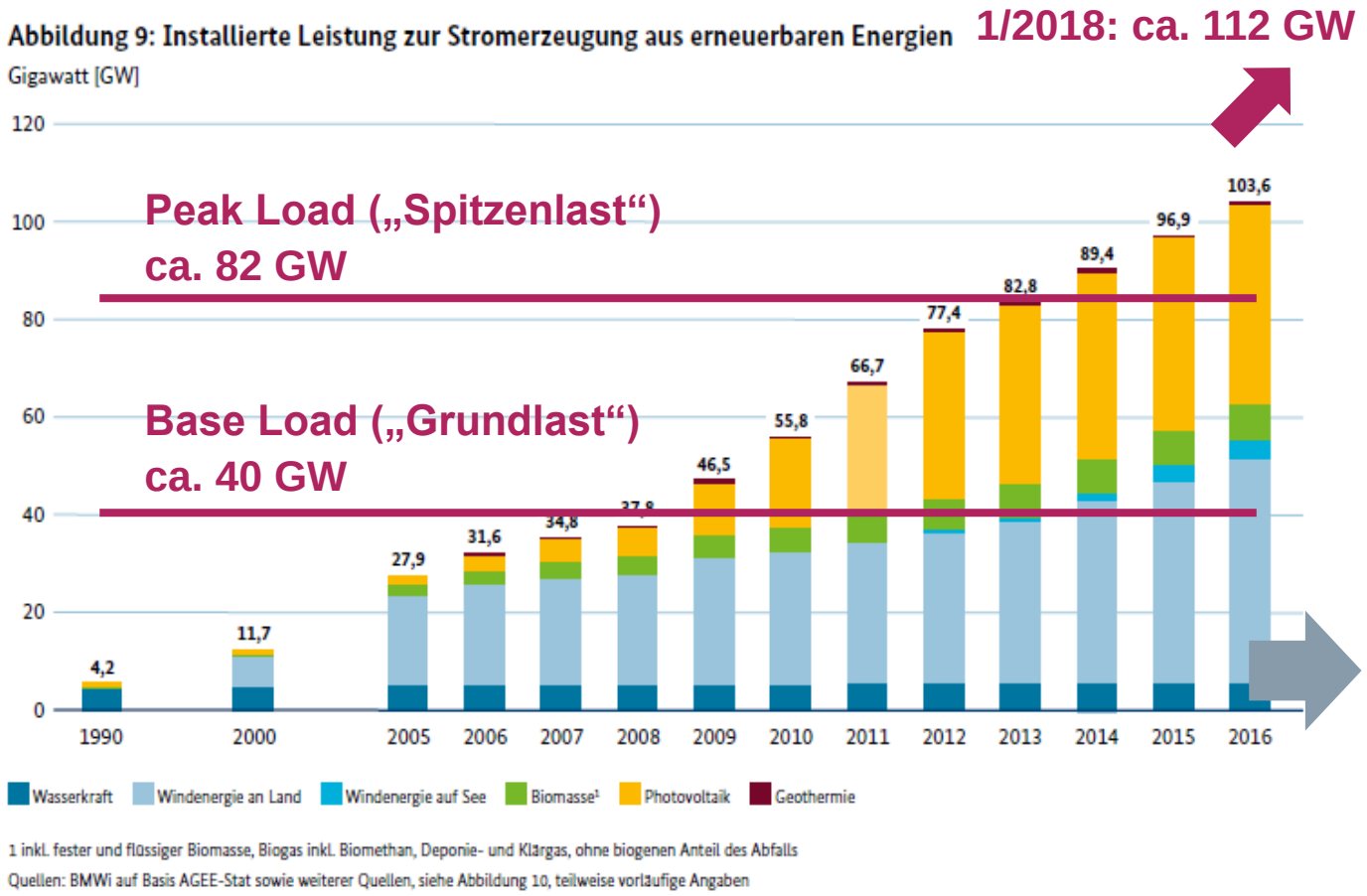

More installed Wind- and PV-capacity than Peak Load demand

>65 GW of Wind and PV-Power Plants connected to LV- and MV-systems

Resulting Challenges for grid operators:

- Changing system dynamics
- Frequency and Voltage Stability
- Short Circuit Power
- …

Source: https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/erneuerbare-energien-in-zahlen-2016.pdf?__blob=publicationFile&v=8

Huge potential and challenge to decarbonize further the final energy consumption

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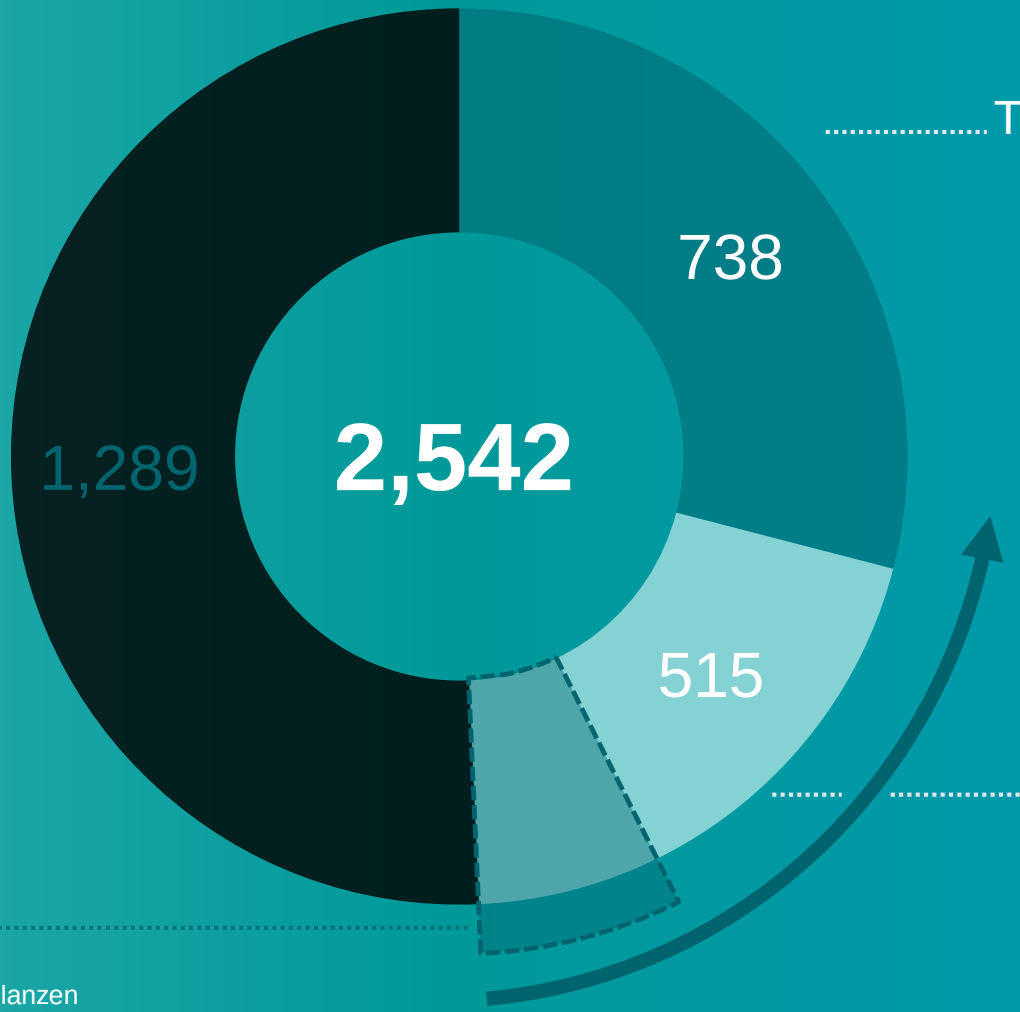
Final energy consumption in
Germany 2016
(in TWh)



Transport **29%**

Other (heating) **51%**

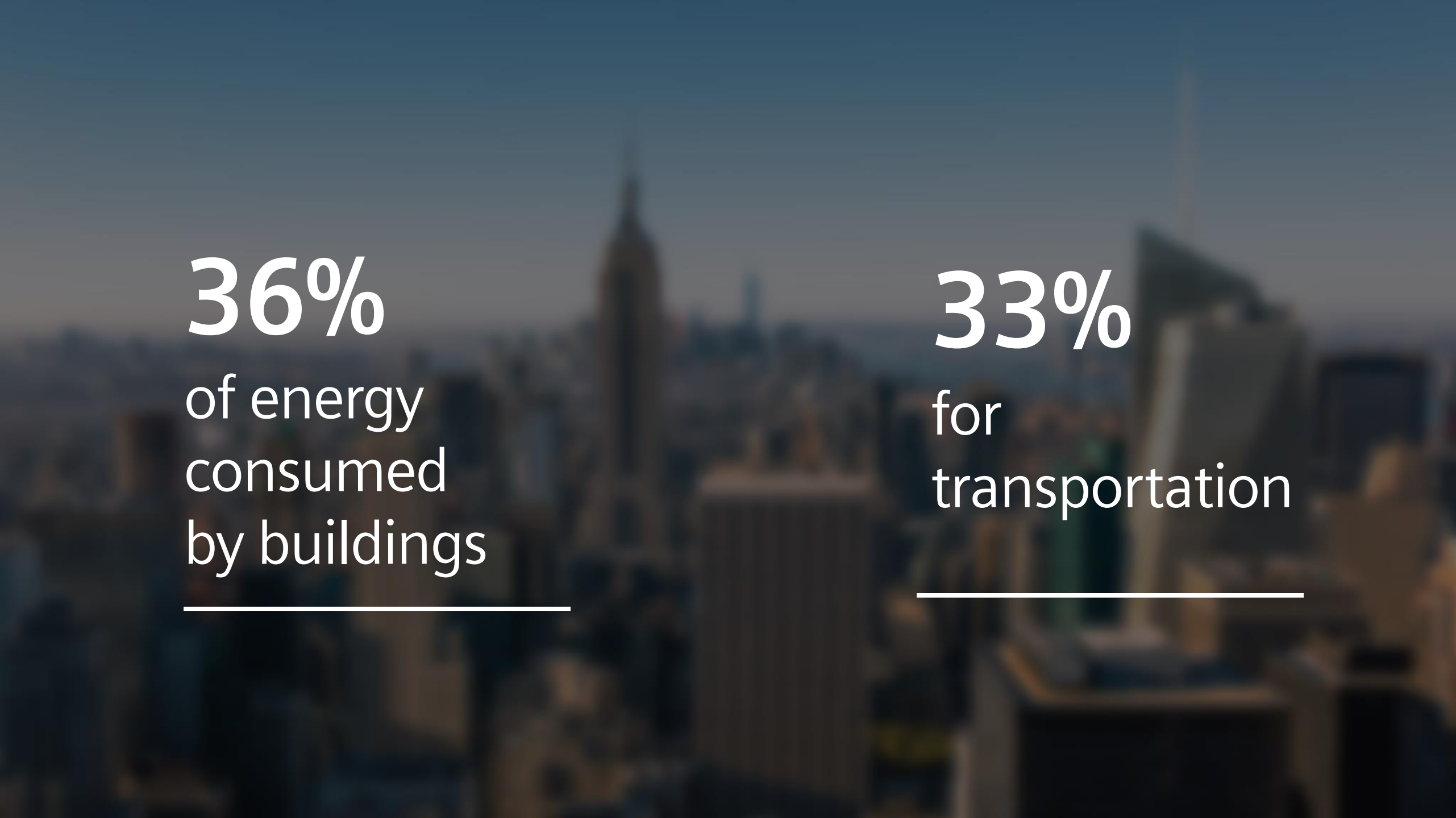
Power **20%**

E-mobility,
E-highways

Electrical
heating/cooling,
heat pumps, etc.

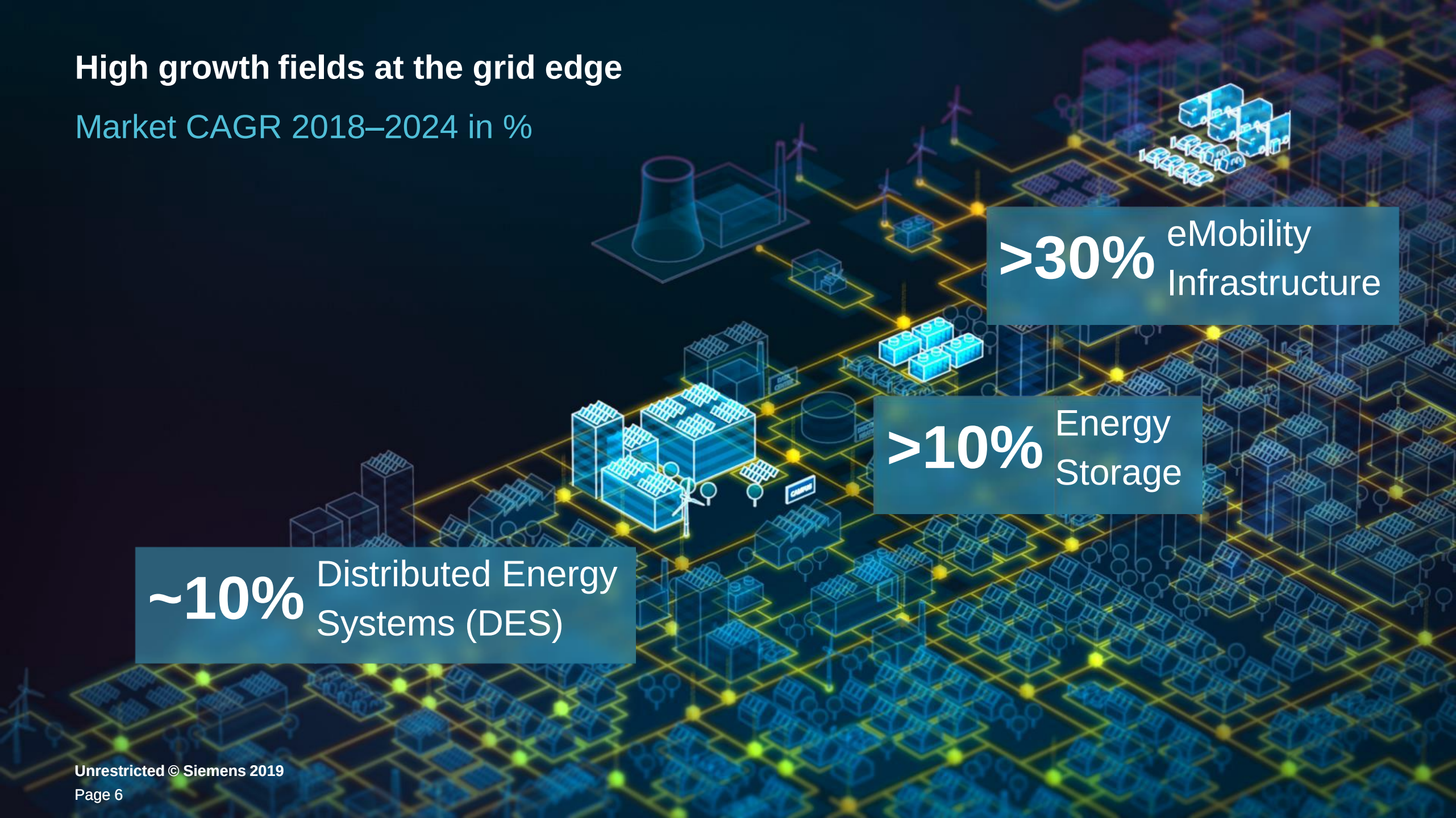
Share of renewables
~32%

Source: Umweltbundesamt.de/Arbeitsgemeinschaft Energiebilanzen


36%
of energy
consumed
by buildings
33%
for
transportation

High growth fields at the grid edge

Market CAGR 2018–2024 in %



>30% eMobility Infrastructure

>10% Energy Storage

~10% Distributed Energy Systems (DES)

Siemens Future Grid – addressing the demand at the grid edge

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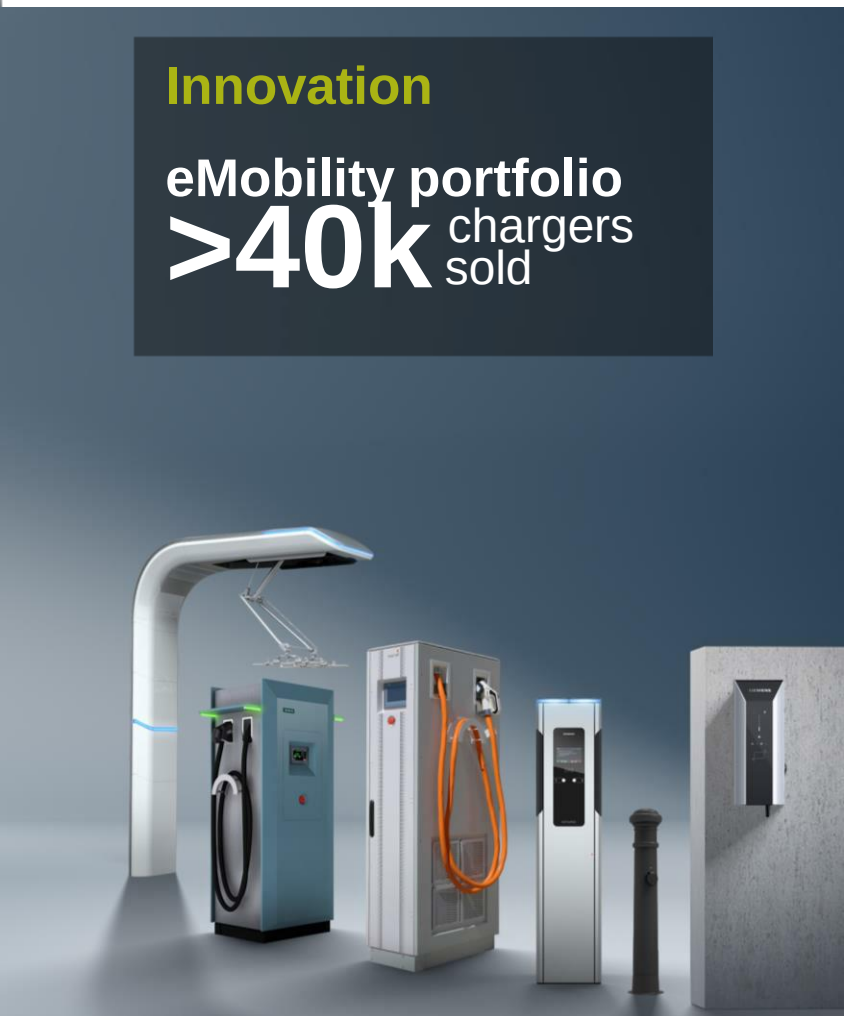
Innovation

eMobility portfolio

>40k chargers sold



Acquisition

Power electronics

10GW installed capacity

KACO

Partnering

Energy storage JV

#1 in energy storage

FLUENCE
A Siemens and AES Company

FAST COMPANY 2019 MOST INNOVATIVE COMPANIES

Beginning of the eMobility transition

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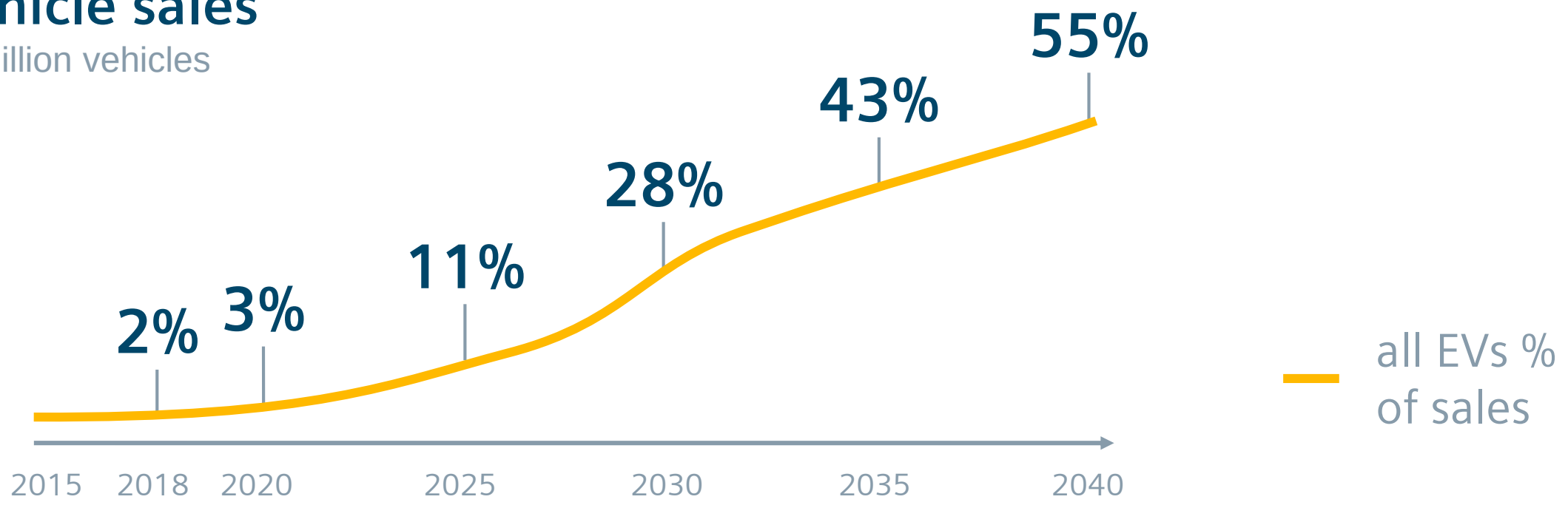
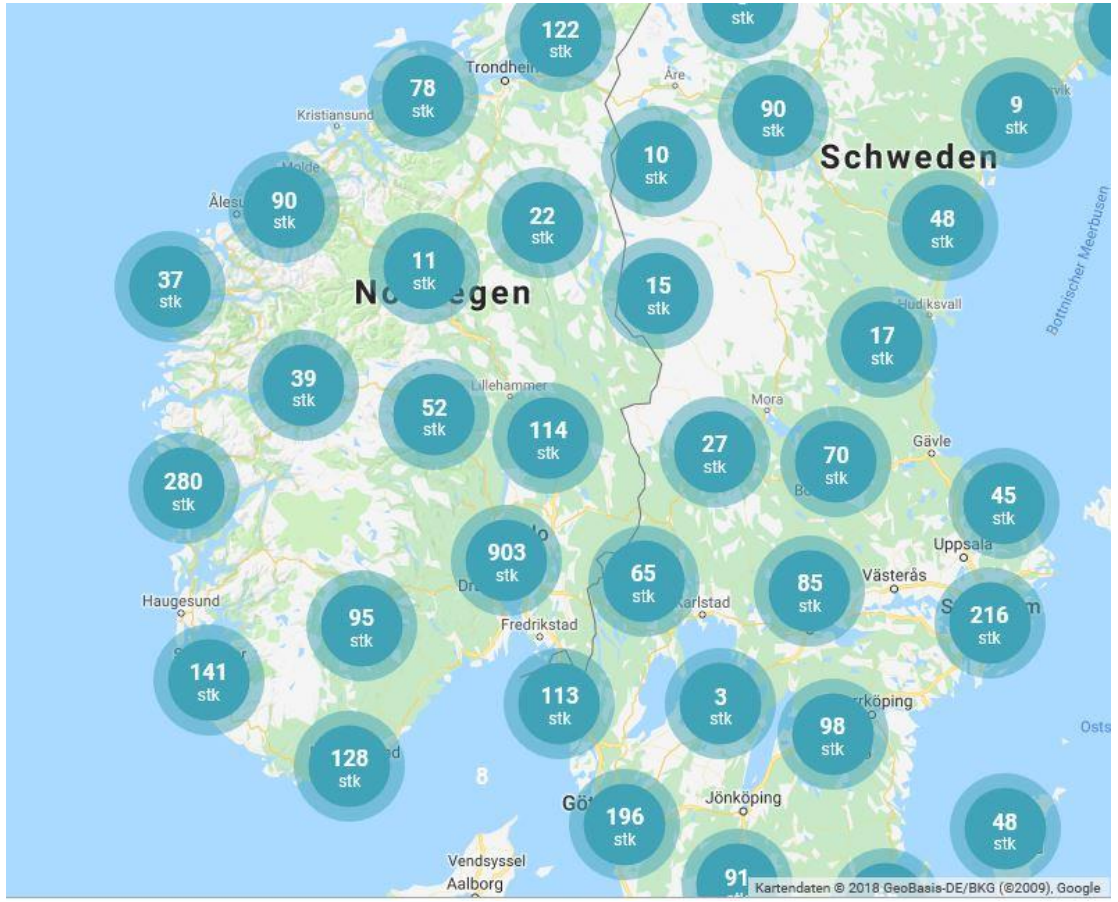
Annual global light duty vehicle sales

in million vehicles



Source: Bloomberg New Energy Finance

Norway becomes the frontrunner in electromobility penetration – at least for private passenger vehicles



Source: https://www.ladestasjoner.no

Source: https://electrek.co


#ELECTRIC
ubitricity

Heavy duty vehicles represents a substantial emmision part – how can electrification help here?

- In Germany 60% of Truck emissions generated on 2% of the roads
- Leading transport experts expects a substantial growth in heavy transport on roads, with limited offset by rail or sea/water roads
- According to the national plan for transportation (NTP 2018-2029), all new heavy trucks, 75% of long distance buses and 50% of new lorries should be zero emission vehicles in 2030.

China at the forefront

Shenzen 16,000 buses full electric...

Benchmark of “zero emission” transportation strategies

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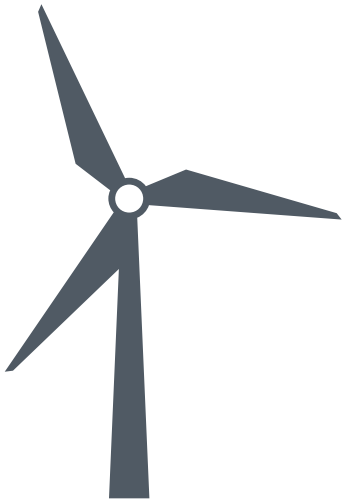

„Zero emission“ alternatives	Range Cost per km	
eHighway e⁻ → Grid (incl. catenary) → e⁻ → eTruck (Catenary-Hybrid) 96 kWh, 12 ct/kWh; 1,6 kWh/km	**60 km** 19 ct/km	
Batteries / charging e⁻ → Grid → e⁻ → eTruck (Battery) 96 kWh, 10 ct/kWh; 2 kWh/km	**48 km** 20 ct/km	
Hydrogen e⁻ → Electro-lysis η = 70% → H_2 → H_2-network[1)] → H_2 → CH_2- fuel station → CH_2 → Fuel cell truck 2 kWh; 5 kWh 93 kWh; 65 kWh, 15 ct/kWh; 65 kWh, 18 ct/kWh; 65 kWh, 20 ct/kWh; 2.7 kWh/km	**24 km** 55 ct/km	
Power-to-Gas e⁻ → Electro-lysis η = 70% → H_2 → Methanation η = 80% → CH_4 → NG-network[1)] → NG → CNG-fuel station → CNG → Gas-truck 2 kWh 98 kWh; 69 kWh, 15 ct/kWh; 55 kWh, 19 ct/kWh; 55 kWh, 20 ct/kWh; 55 kWh, 22 ct/kWh; 3.2 kWh/km	**17 km** 70 ct/km	

Source: The German ministry of environment
1) Including storage

Considering the electrification of the transport system requires a customer made “system architecture”

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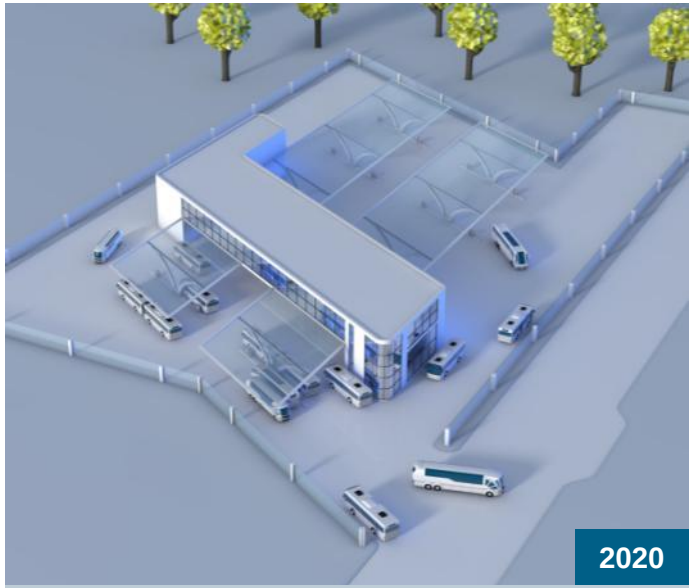
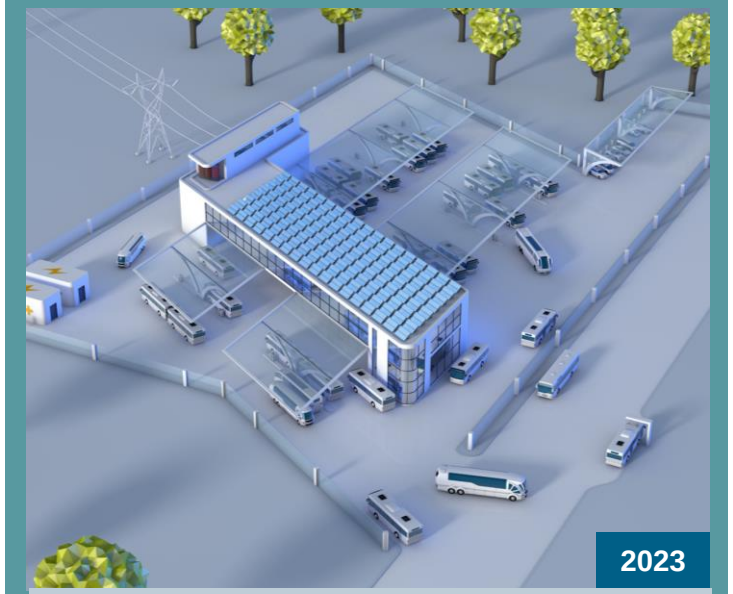


Basic Infrastructure

- Charger & local power distribution
- Control system & software integration
- Data analytics & process optimization



Expansion

- Grid access design & power generation
- Battery storage & 2nd life bus battery
- DC energy distribution & consumption optimization

Multi City Deployment

- Connected sites
- Demand response & energy trading
- Charging offering to for 3rd party (IaaS)

Depot charging concepts – more than a charging pole, part of electrification of transportation

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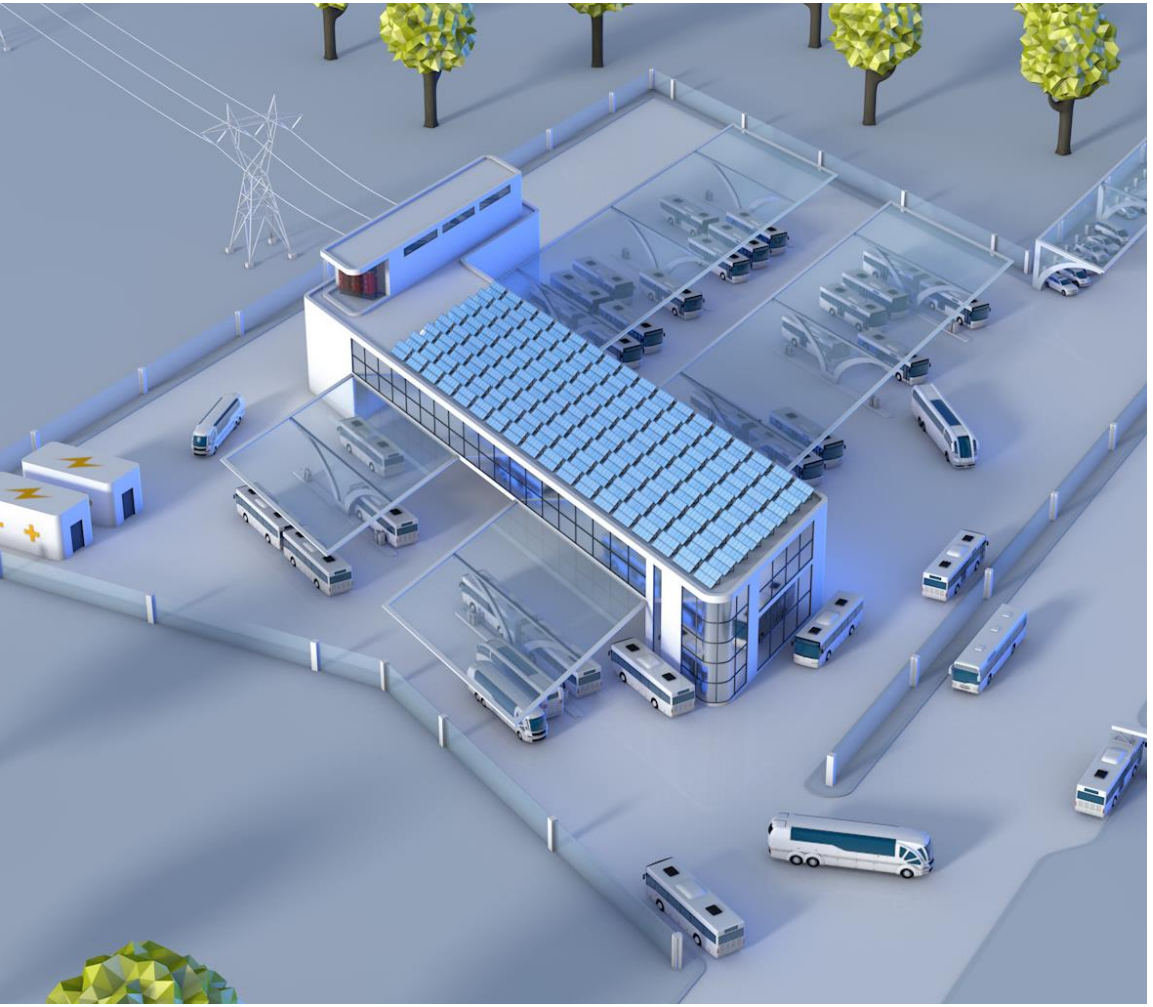
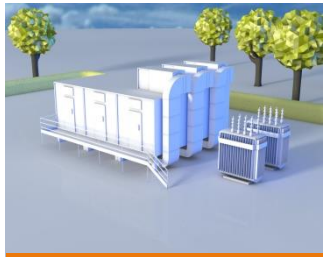


Power distribution	 Flexible and modular grid access	 Space optimized roof top or underground installed	 MV & LV distribution on site “clean-air”	 Busbar trunking system
Charging infrastrcture	 Charging poles – Plug-in or roof-mounted	 Indoor pantograph	 Fast charging stations outside	 Integration of e-cars service fleet
Distributed Energy Systems and services	 Renewable integration & micro-grid	 Modular storage & second life	 Monitoring & control SW	 Consulting, operations & managed services

Siemens eMobility Charging Ecosystem

End to end charging solutions for multiple customer applications

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- **Highway transit charging**
- **Gas stations & truck stops**
- **E-Bus depot incl. opportunity charging**
- **Logistics depot charging (fleets)**
- **Enterprises & retailers (dealerships)**
- **Parking & real-estate**
- **Single-home & multi-home (private customers)**
- **City & town street parking**

eMobility Charging Ecosystem

- E-vehicle charging incl. product, systems' software, integration & operation
- Distributed energy systems: Storage and micro grid
- Grid connection and integration in existing power supply architecture
- Energy Management System

- eMobility infrastructure consulting & financing
- Planning & simulation, engineering
- Project management, installation & commissioning
- Operation & managed services

The energy market is changing – different innovaion culture is required

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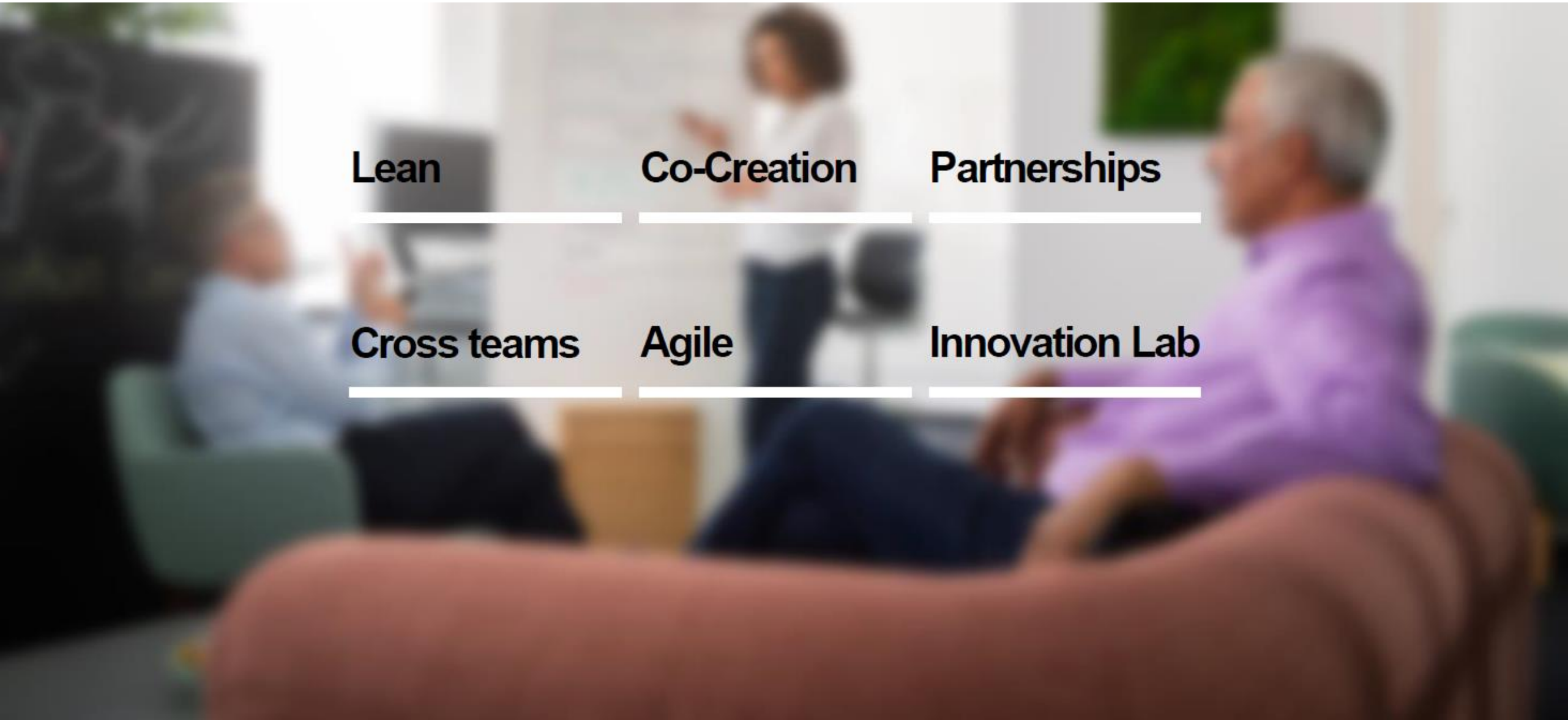

Ideas alone have little value. An innovation’s importance lies in its practical implementation.

Werner von Siemens

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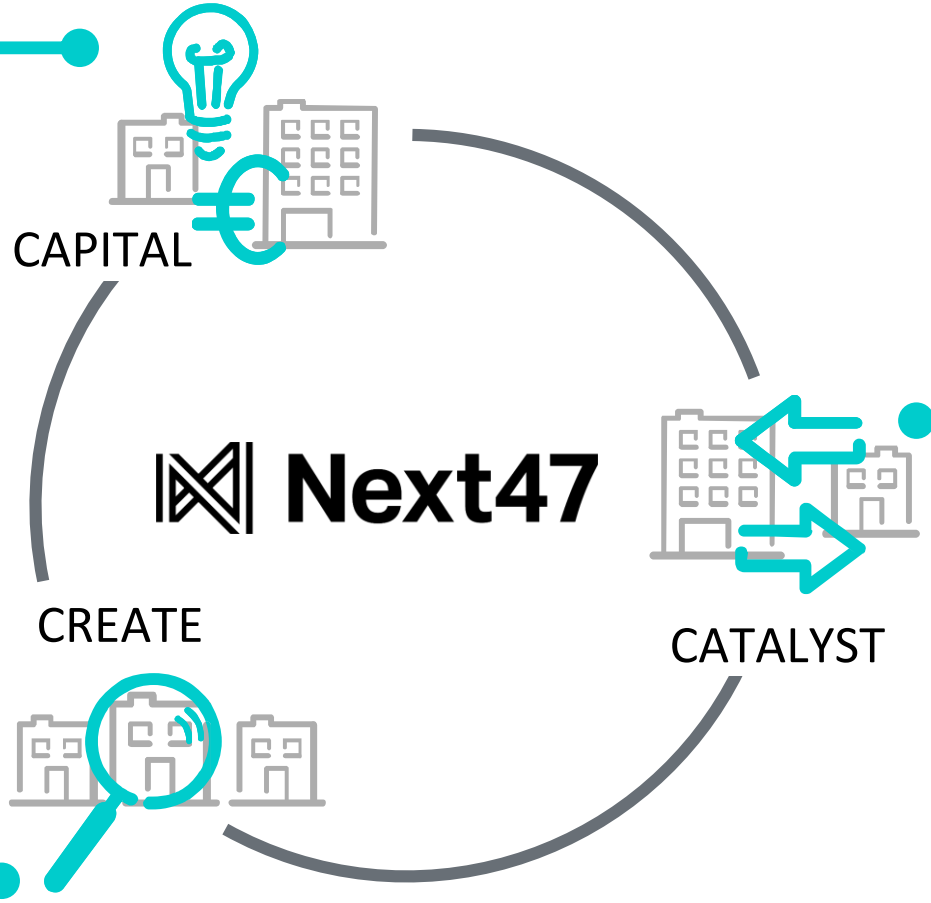
How we work

Invest in best start-ups in areas of strategic interest to Siemens



Foster deep collaboration with Siemens and Siemens customers to grow start-ups and source expertise.

Selectively create new businesses through accelerators

Global presence

Lak Ananth
Managing Partner & CEO

Matthew Cowan
Partner

Robert Hardt
Partner

Eva Riesenhuber
Partner & CFO

T.J. Rylander
Partner

Chris Barchak
Venture Partner

Examples of our portfolio

Autonomous	rideOS, AEVA, DEEPSCALE, AVIDBOTS
Advanced Manufacturing	VARQ, Markforged, SEURAT
Cyber	IDENTIFY 3D, CLAROTY
Internet of Things	VERKADA
Decentralized Energy	SILA NANOTECHNOLOGIES, EcoG, chargepoint
Shared Economy	fair
Digital Building Blocks	COHESITY, Yellowbrick
SCM / Logistics	BRINGG, TURVO

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Ultimately, we need to protect the next generation

Let’s shape together

the world of smart energy and eMobility.

Thank you