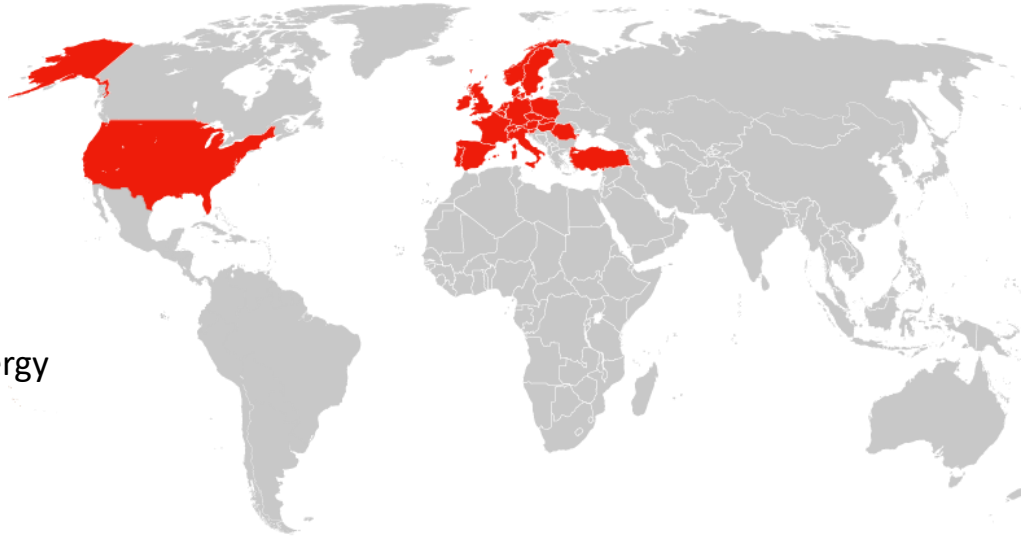
Peter Bjerregaard, market regulation manager

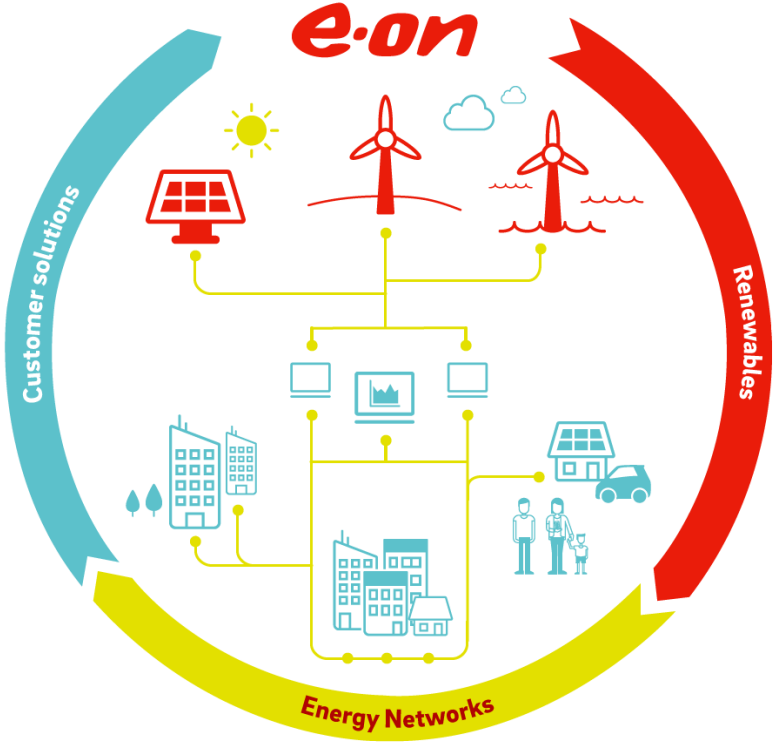
e-vehicles and infrastructure for freight and goods transport

E.ON – one of Europe's largest privately owned energy companies

- Headquarters based in Essen
- 22m customers in Europe and the US
- 43,000 employees
- €38.2bn in turnover (2016)
- Networks, customer solutions and sustainable energy solutions
- Invested more than €12bn in sustainable energy solutions in the last decade
- 2,500 wind turbines on land, at sea and (soon) in the sky
- A pan-European quick charger network



E.ON in the new energy world



eMobility and biogas solutions

eMobility

E.ON is a full-fledged eMobility player with full-range of solutions and services, as well as strong capabilities in grid connection, load and backend solutions

Depot charging solution
for heavy transport and B2B fleets

Biogas

E.ON has demonstrated strong track record of biogas production and supplies in the heavy transport sector, with 20 depot filling stations in operation in Nordics

E.ON is the partner of choice of all of our customer's fossil-free transport needs for heavy transport fleets

Chicken or the egg?

Cities and regions have set ambitious electric fleet targets

Key concerns caused by diesel buses

GHG emission	By using electric buses, cities can reduce 100-160 tons of greenhouse gas emission per year compared to diesel
Air pollution	Increasing evidence shows strong correlation between air pollutants caused by diesel vehicles and serious health issues; 'diesel scandal' in car industry spills over to buses in the public mind
Noise pollution	Increasing awareness that noise pollution impacts human health and wellbeing—road traffic, especially diesel vehicles, identified as the most widespread contributor

Electrification targets set by major cities

Oslo
To have 60% of its bus fleet electrified by 2025

Stockholm
Free of diesel fuel of bus fleet by 2030

Copenhagen
To be the first carbon neutral capital in the world by 2025 and electrify whole bus fleet by 2031

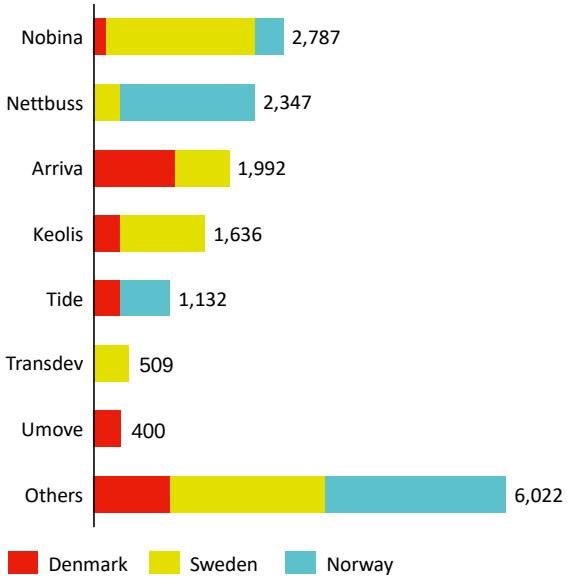
Helsinki
To have one-third of its fleet electrified by 2025

London
100% of electric vehicles by 2040

Paris
All buses in Paris area will have to be electric by 2025

Bus operators: tendering process and operational flexibility are key concerns

# of buses in use by bus operators, 2016



Business model

- Revenue is based on contracts won through tendering – compensation based on # of buses, hours or kilometers, # of passengers and other certain qualitative measurements
- Operational cost depends on the way of fleet management
- Bus schedule is highly regulated with service level requirements
- Prefers leasing model to reduce balance sheet burdens

"We depend on the ability to accurately price contracts and identify risks."

Nobina

Key concerns

- Long and complex tendering process with high risk of loss
- Hard to change bus schedule due to very limited flexibility of PTAs
- High penalties from PTAs and risk of renewal rate bus performance is not satisfactory
- Strict internal return requirements for listed bus operators

"We can't change bus schedules and if the bus failed to perform, we have to pay high penalty."

arriva

The eBus market is expanding, enabled by environmental needs and technology development

Key drivers of eBus adoption

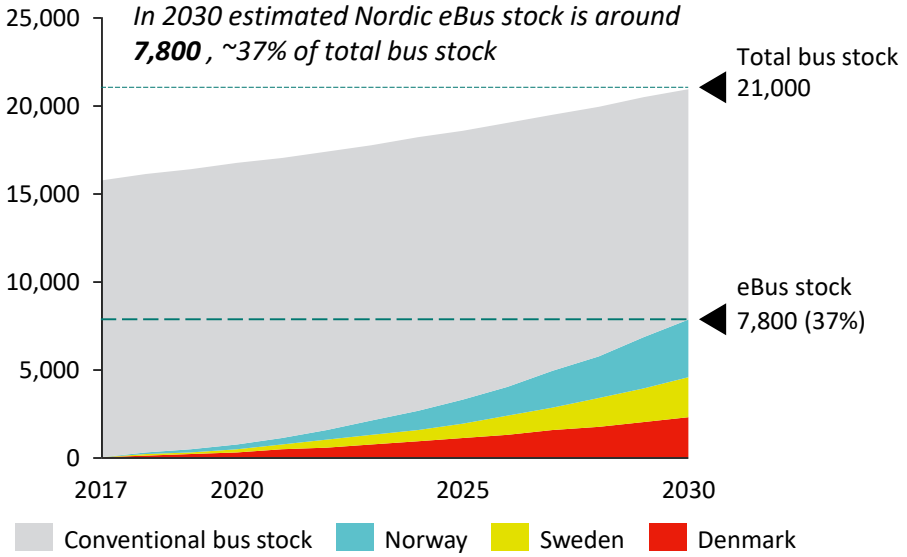
Sustainability needs

- Rising concern from GHG emissions, air and noise pollution push cities to be aggressive on adopting green transportation
- *"100% eBus fleet by 2031" in Copenhagen*

Technology advancement

- Extended battery range and improved fast charging mechanism give cities more flexibility on eBus operation with even lower costs

Estimated city bus stock, 2017-2030



City buses is the first wave of electrification, further potential lies in other heavy transport fleet segments

Large market potential for electromobility

x10-15 more potential than city buses alone

roughly ~1.5-2.2 B€

Major players have entered market with trial project ongoing

SIEMENS Ingenuity for life · TESLA MOTORS · BYD · VDL

Electrification of heavy transport fleets

Overview of Nordic HDV stocks in 2017 *(in #)*

Trucks · Coaches · Constructions · Logistics

- Area: Nordic
- Brand: MAN
- Range: ~200km
- Trial started in 2018

- Area: U.S.
- Brand: BYD and Wayen Garbage Truck
- Battery size: ~176kWh
- Trial started in 2016

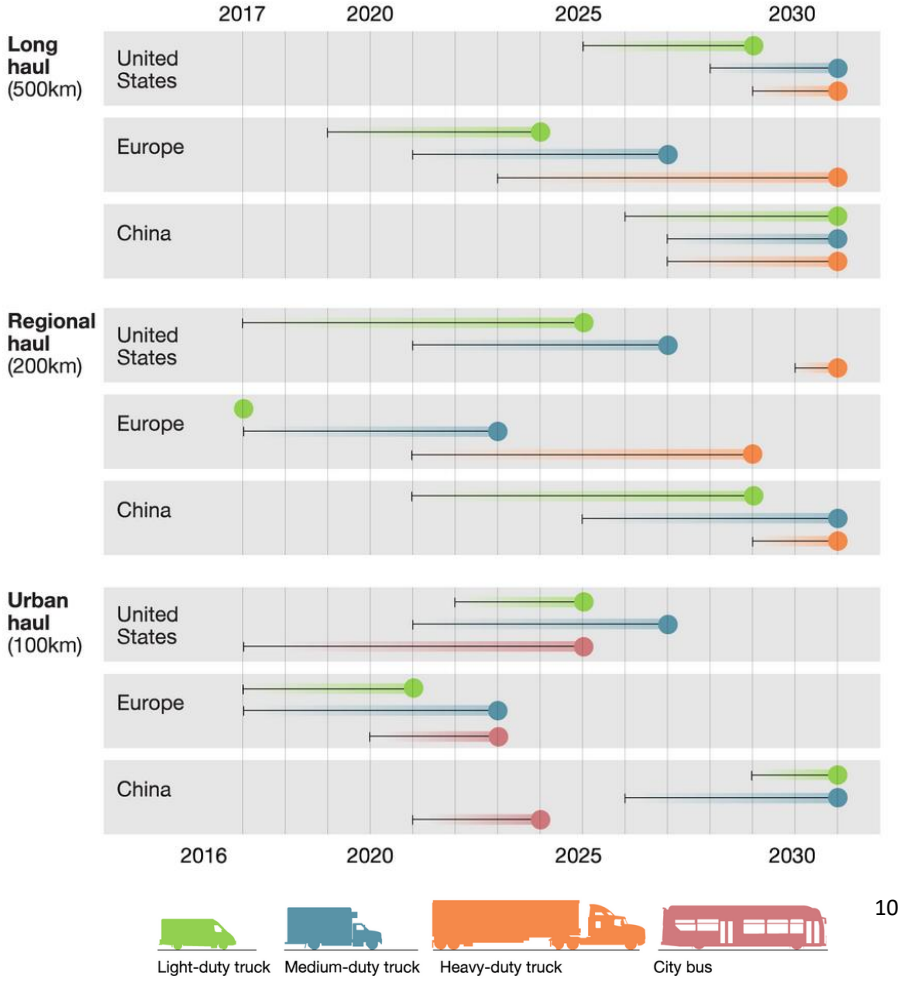
Note: Heavy Duty Vehicle (HDV) here includes city buses with scheduled service; Other buses includes coaches, construction vehicles, city logistics and etc.
Source: EAFO 2017

Three main drivers

Based on total cost of ownership (TCO), e-trucks could be on par with diesels and alternative powertrains in the relative near term.

Robust electric-vehicle (EV) technology and infrastructure is becoming increasingly cost competitive and available.

Adoption is being enabled by the regulatory environment, including country-level emission regulations (for example, potential carbon dioxide fleet targets) and local access policies (for example, emission-free zones).



Investment in grids and chargers

Assumptions

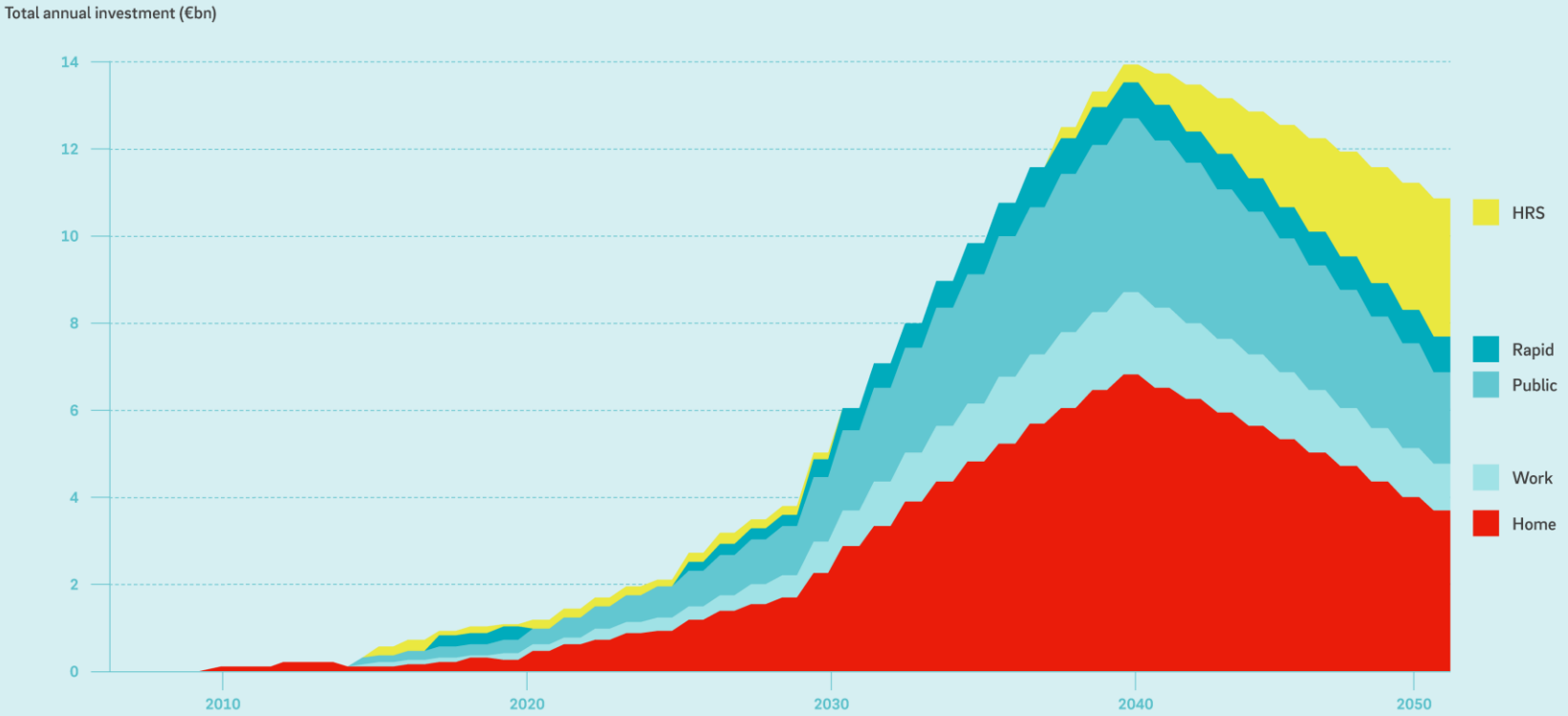
Each EV sold has, on average, either a residential wall box or a workplace charging post installed and roughly two public charging posts in urban areas for every 10 EVs on the road.

There is over 71,000 km of highway in Europe, and to provide rapid charging sites on each side of the highway, with a spacing of 60km on each side of the highway, implies that around 2,400 rapid charging sites are needed. When we also take into account the charging needs on national roads, we determine that around 7,100 rapid charging sites will be needed in total.

After an initial deployment of 14,000 individual rapid charge points before 2025, the number of rapid charge points is in proportion to the number of BEVs in the fleet.

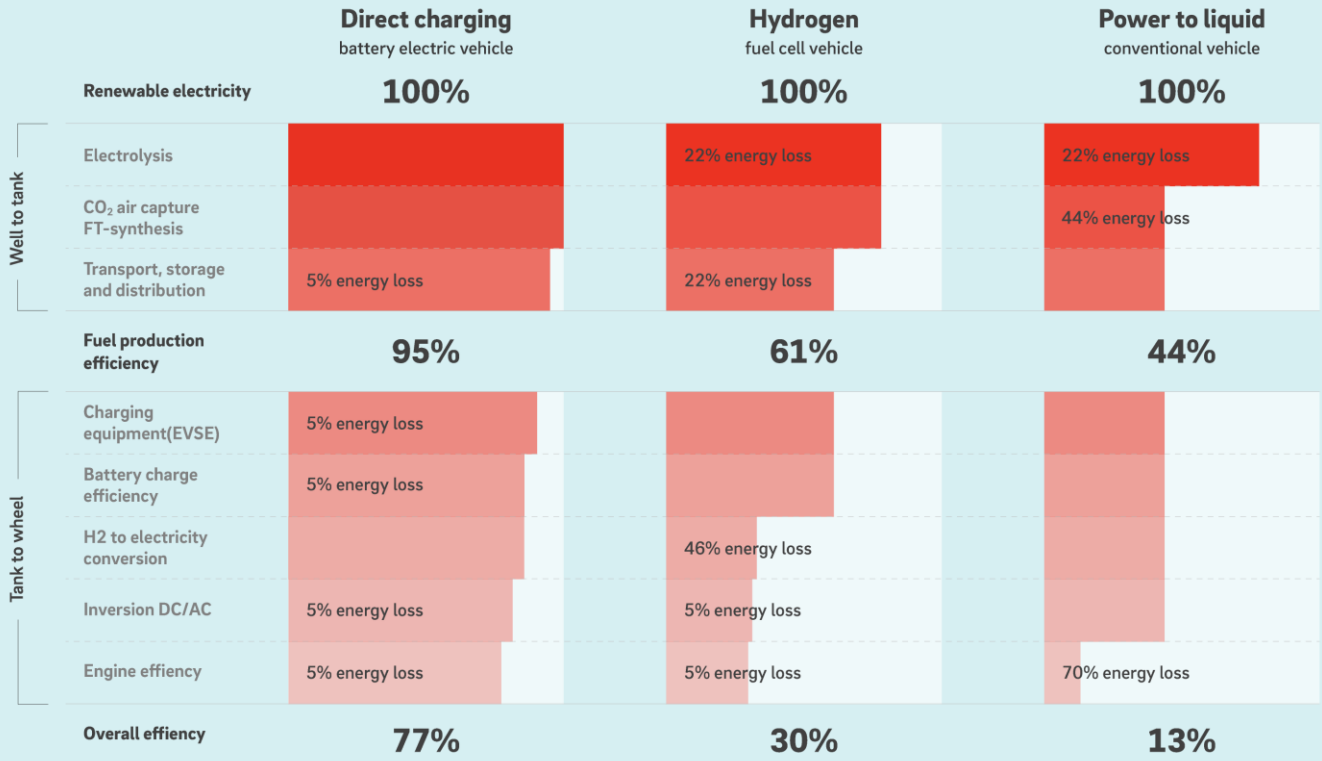
Harrison P, 2018, Fuelling Europe's Future: How the transition from oil strengthens the economy

Investment in grids and chargers



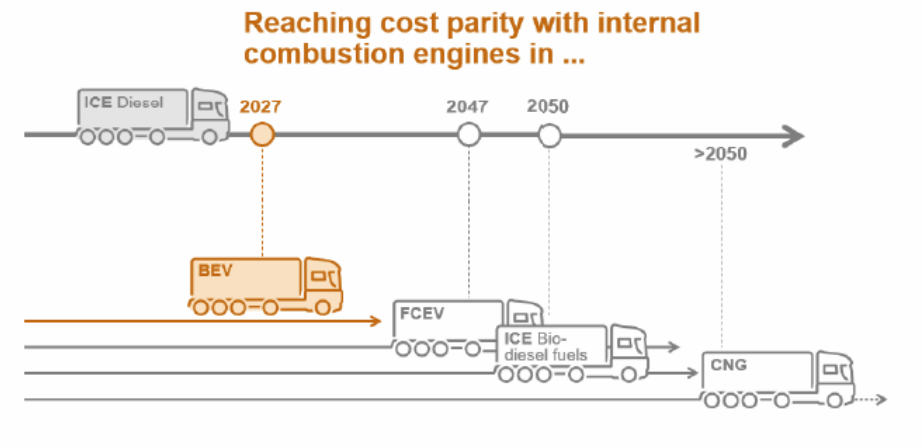
Harrison P, 2018, Fuelling Europe's Future: How the transition from oil strengthens the economy

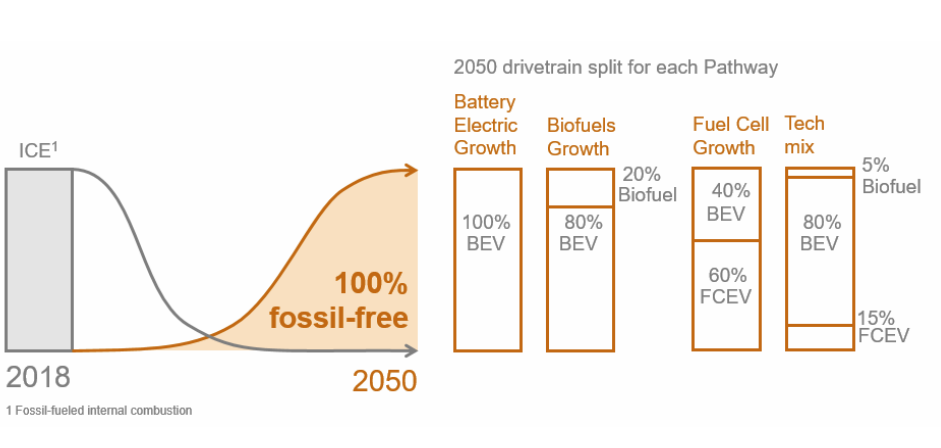
Technology limits



Source: WTT (LBST, IEA, World bank), TTW, (IEA, DOE, Transport & Environment calculations).
Note: values displayed here are on the higher side (optimistic) of the ranges found in the bibliography

Investment in Grids and Chargers

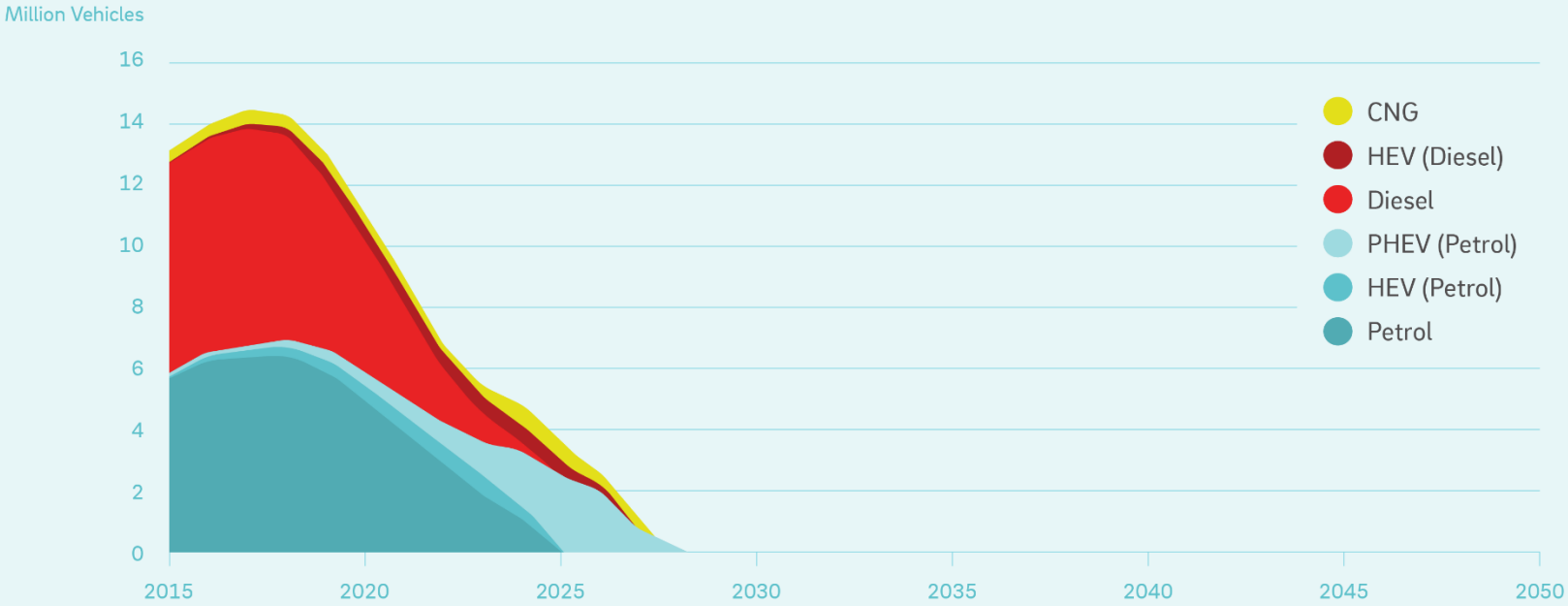




The Pathways Study: Achieving fossil-free commercial transport by 2050

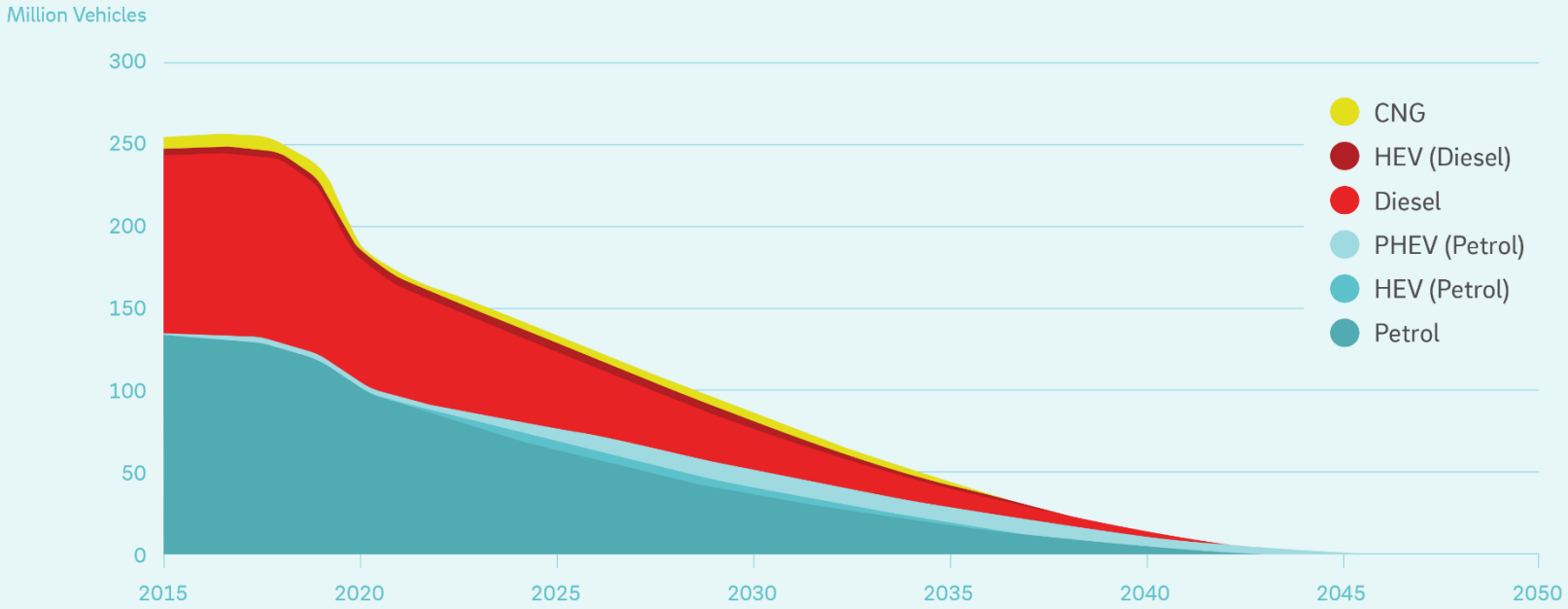
Decarbonising transport well before 2050

Development in Europe's car sales, if the Paris Agreement target of 1.5°C is to be achieved



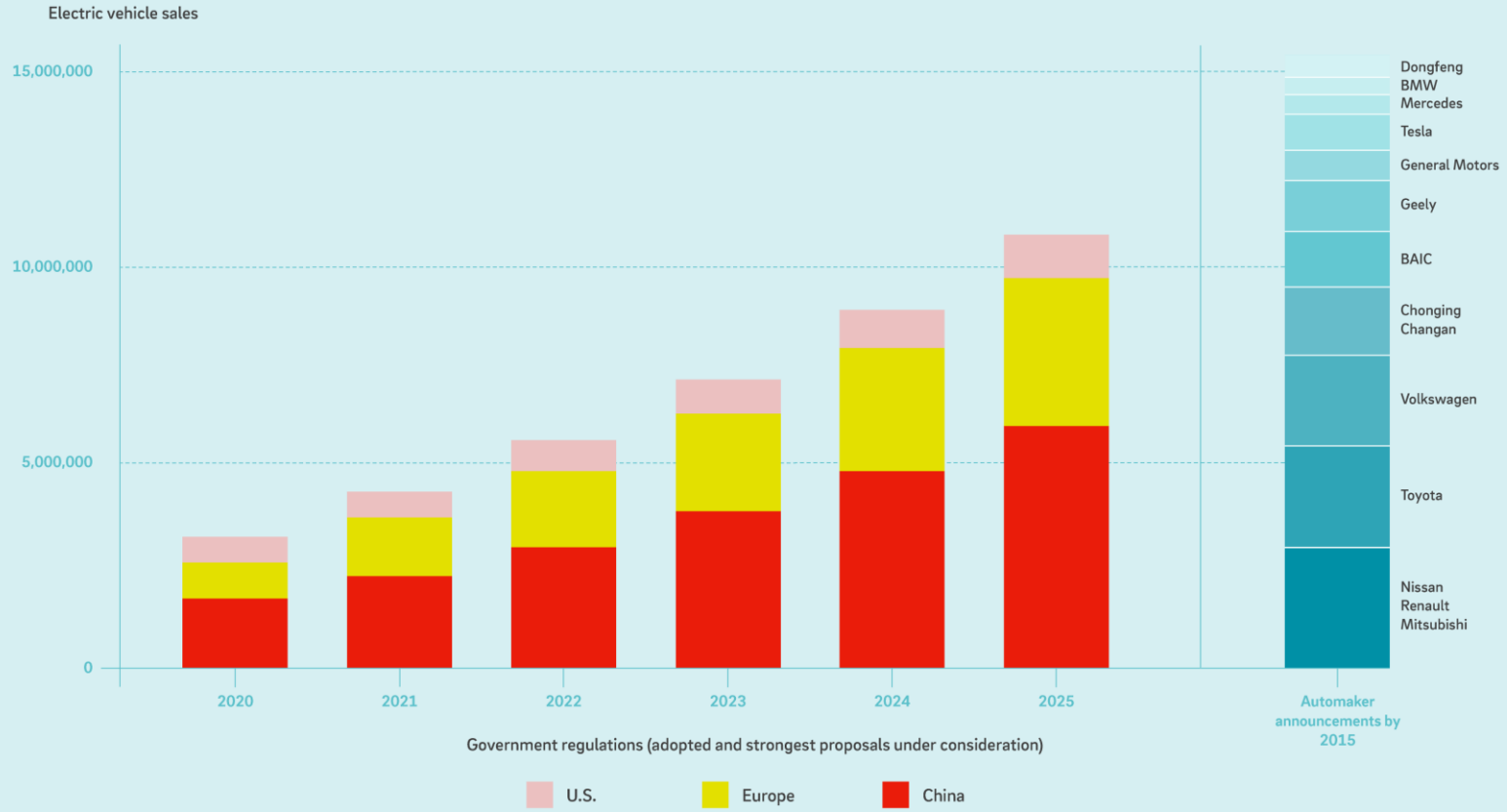
Source: DLR Institute of Vehicle Concepts, Vehicle Systems and Technology Assessment

Development in Europe's car stock, if the Paris Agreement target of 1.5°C is to be achieved

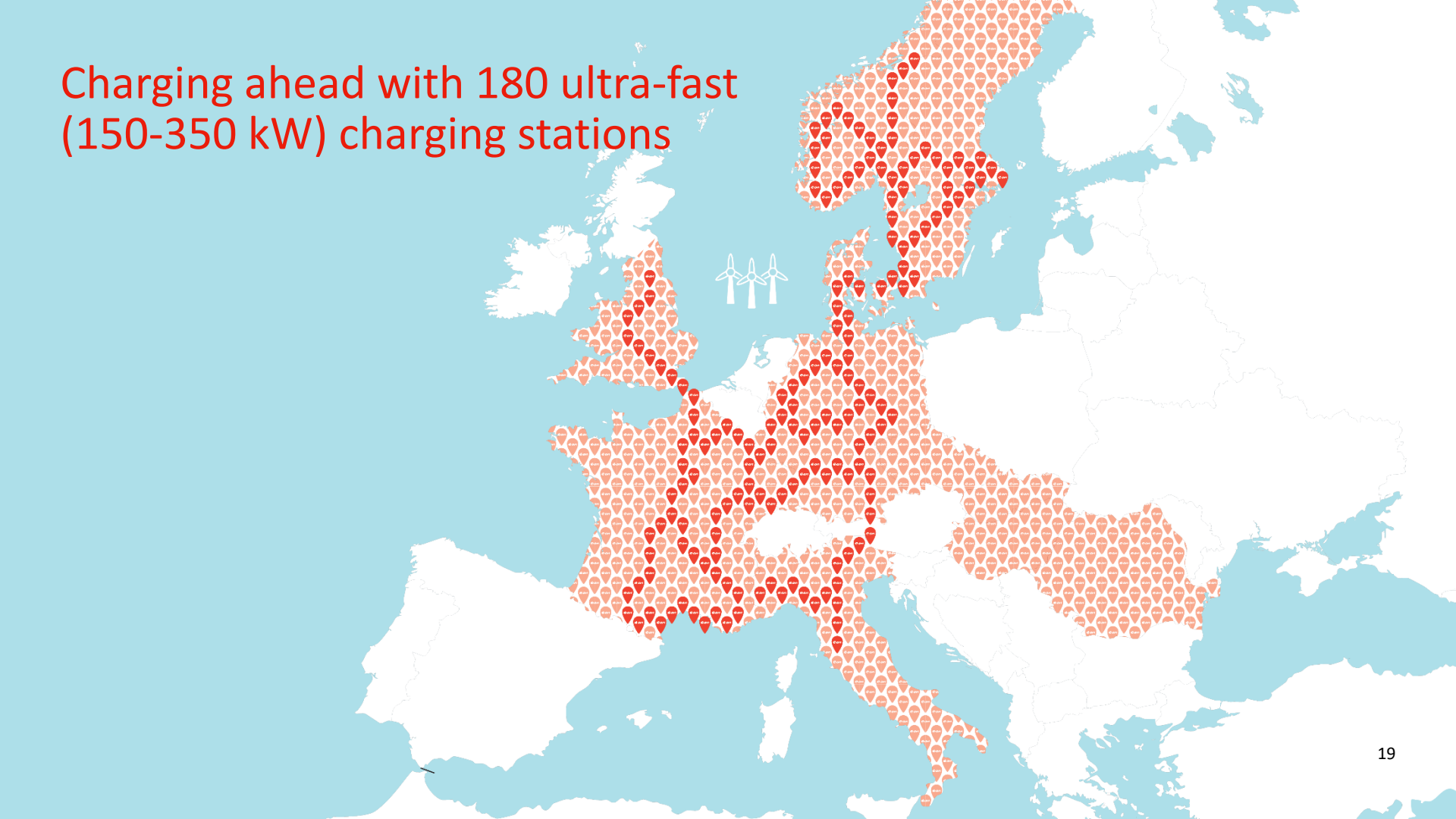


Source: DLR Institute of Vehicle Concepts, Vehicle Systems and Technology Assessment

Government vs company targets



Charging ahead with 180 ultra-fast (150-350 kW) charging stations



Smarter ownership, better usage

Transport as a service

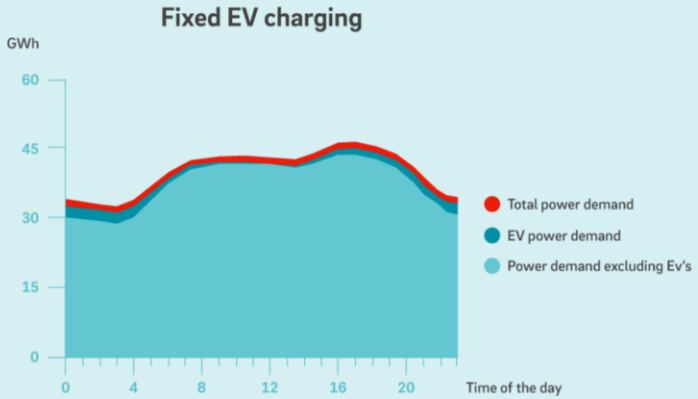
Open source roaming

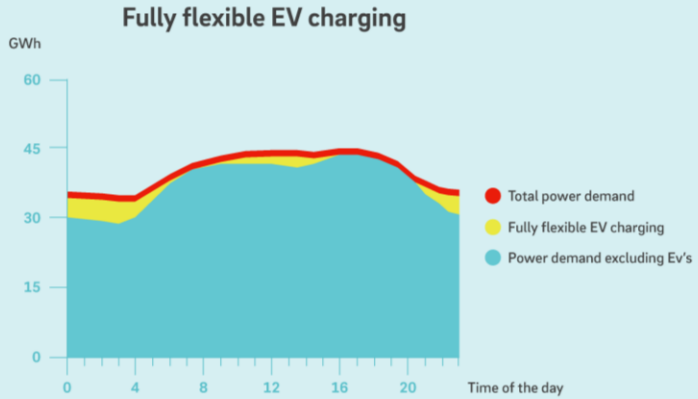
Crowd charging

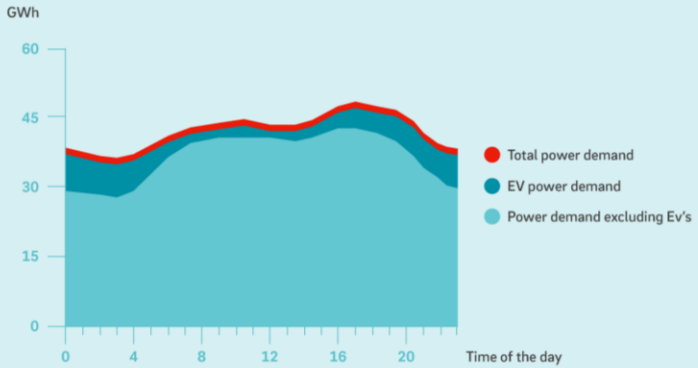
Aggregator-options

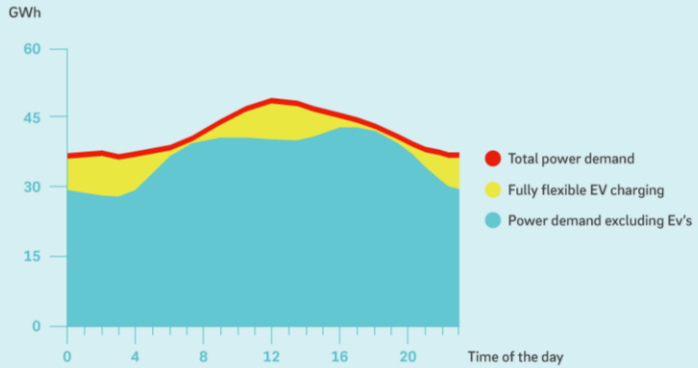
Autonomous cars

Grid services, sector coupling and a solution to the cannibalising problem









Take-aways

Capture supply chain synergies and improve business models

Enforce existing tax regulations and the polluter-pay-principle (incl. life cycle analyses) to support ”the last investment cycle”

Efficiency standards are essential but insufficient to launch a mainstream electric vehicle market

The strongest possible policies under consideration will deliver up to 5% electric share in the United States, 11% in Europe, and 20% in China by 2025

Ensure the transition to electric by 2050 means much bolder efficiency standards or direct electric vehicle requirements are needed

The transition to all zero-emission vehicles by 2050 entails a 12%–14% annual CO_2 improvement in new vehicles from 2020–2040.

A level playingfield?

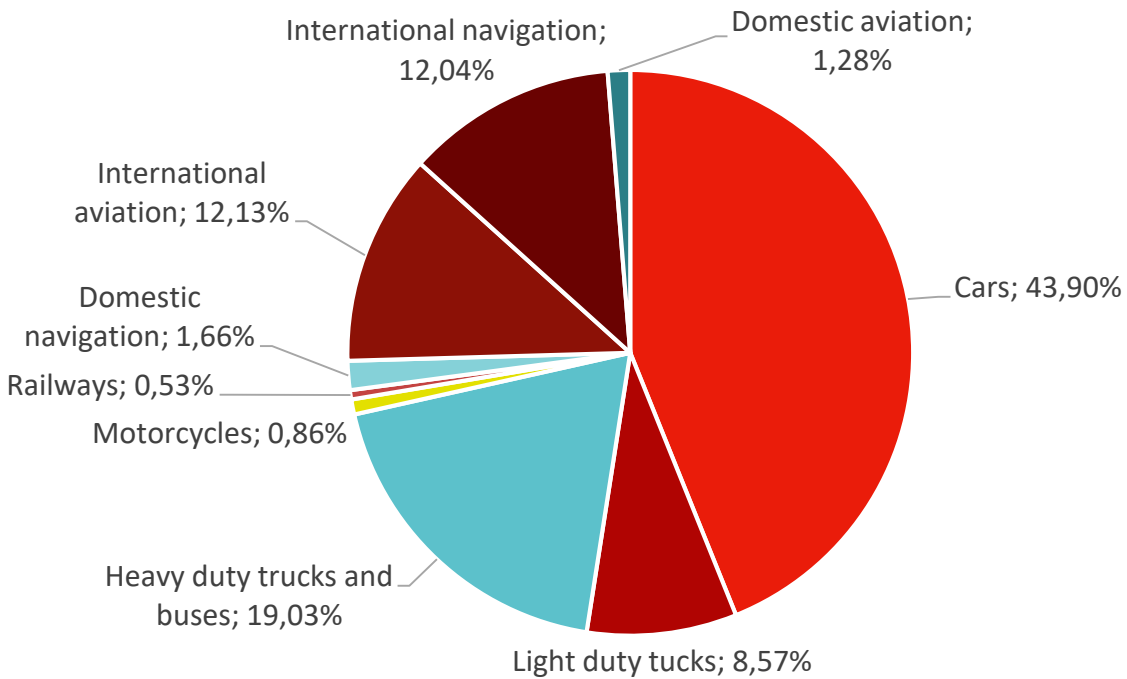
Table 1: Executive Summary — Main statistics and results

	Tax Deficit 2016	Cumulated 2010-2016		Tax Deficit 2016	Cumulated 2010-2016
	in million Euro			in million Euro	
Austria	560	2,527	**Luxembourg**	27	110
Belgium	212	687	**Netherlands**	2,554	11,981
Denmark	831	3,227	**Spain**	>500	2,500—5,000
Finland	273	1,315	**Sweden**	245	814
France	2,599	10,946	**United Kingdom**	2,238	7,977
Germany	1,189	4,090			
			Total	>11,228	<46,174

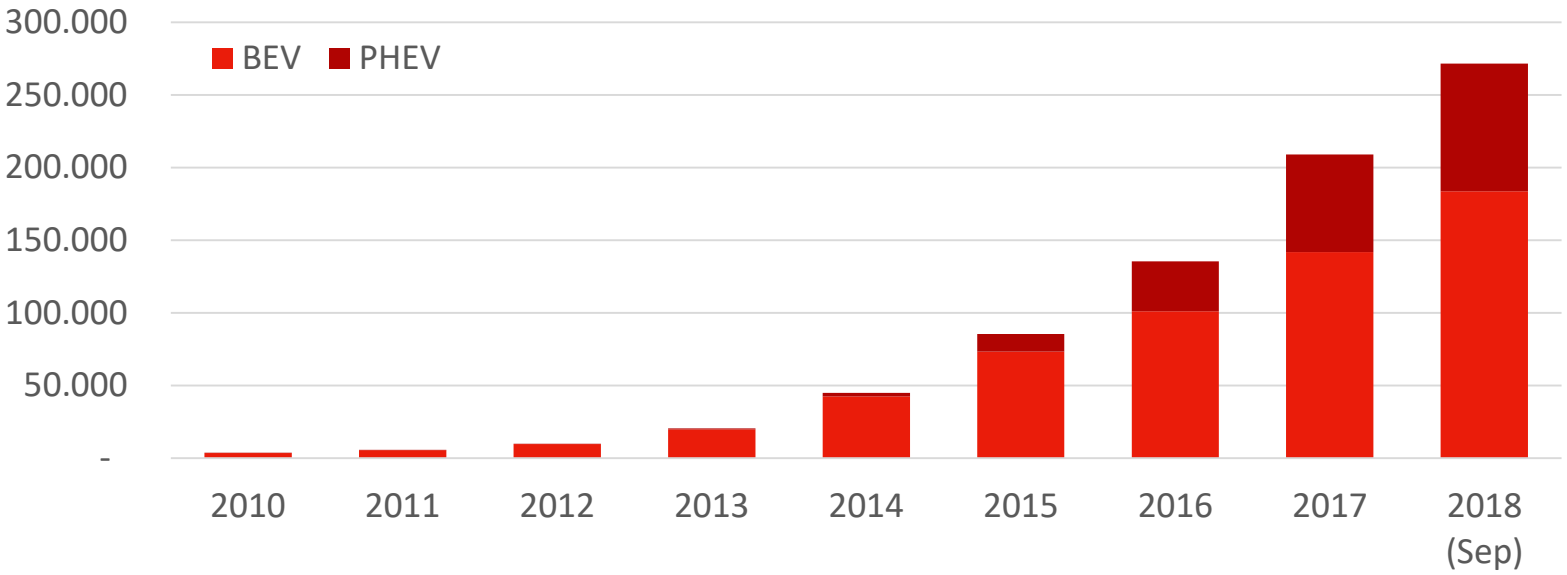
Sources: own calculations based on ACEA (2010, 2012, 2014, 2015, 2016, 2017a), EEA (2017), KBA (2017a), ICCT/TNO (2017)

Green Budget Germany (FÖS/GBG) , 2018, Loss of revenues in passenger car taxation due to incorrect CO2 values in 11 EU states

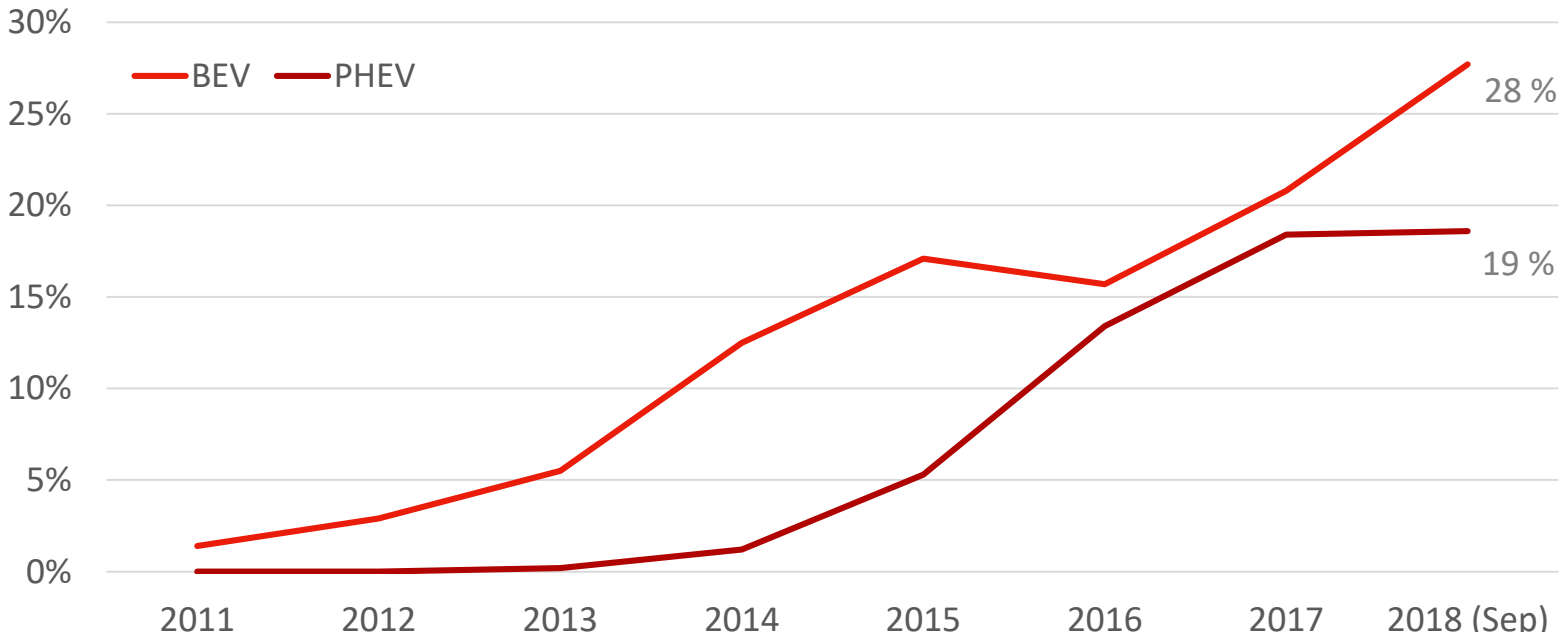
Transport modes and their greenhouse gas emissions in the EU



More than 270,000 EVs in Norway



EV-market shares in Norway



E.ON is the one-stop shop for bus operators

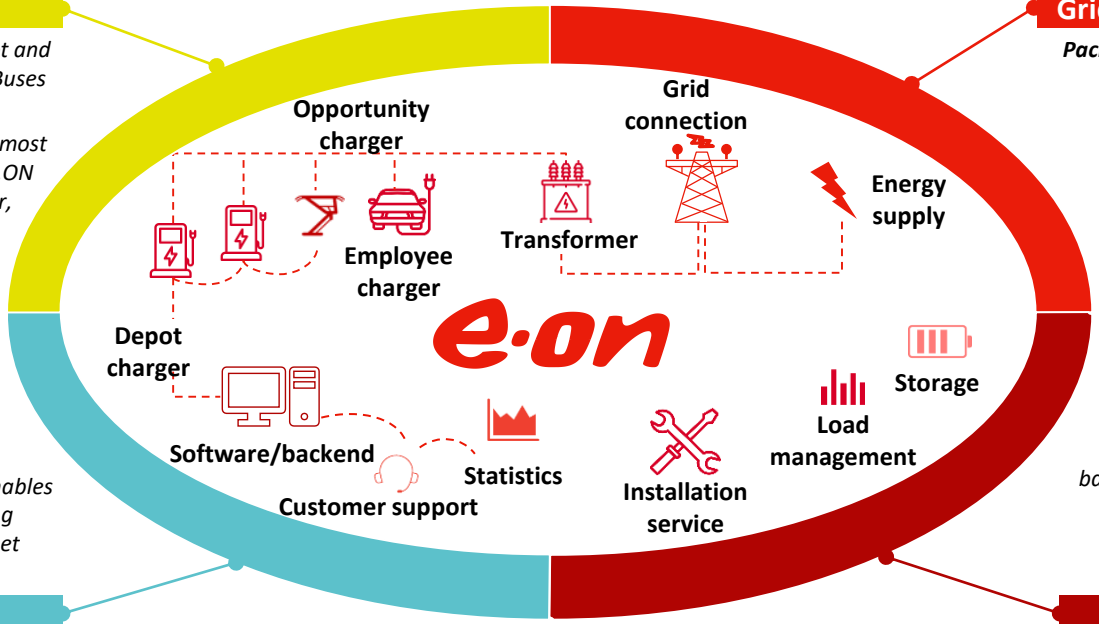
Hardware

Chargers: *E.ON will provide depot and opportunity chargers for both eBuses and employees or public use*

Transformer: *high voltage will almost always require a transformer—E.ON can manage this for the customer, who benefits from lower cost*

Grid connection and supply

Package for initial setup and grid load management expense*: provides integrated connection and load management package that suits customer needs based on depot capacity in cooperation with grid operator*



Charger management system *enables customer to timely check charging status to control and optimize fleet scheduling*

Software/Backend

Installation *of opportunity, depot chargers and transformer*

Maintenance service *provided based on customer's choice of service level agreement*

Further value-added services *possible, see next page*

Installation & Services

A one-stop-shop for opportunity and depot charging solution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