

# Electricity in transport

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# Content of this presentation

- Why electricity can be the alternative fuel for the transportation sector in the future
  - Analysis on alternative fuels
  - Several stakeholders – utilities, car Manufacturer and battery vendors
  - Country analysis
  - Enablers and barriers
- Fortum's project

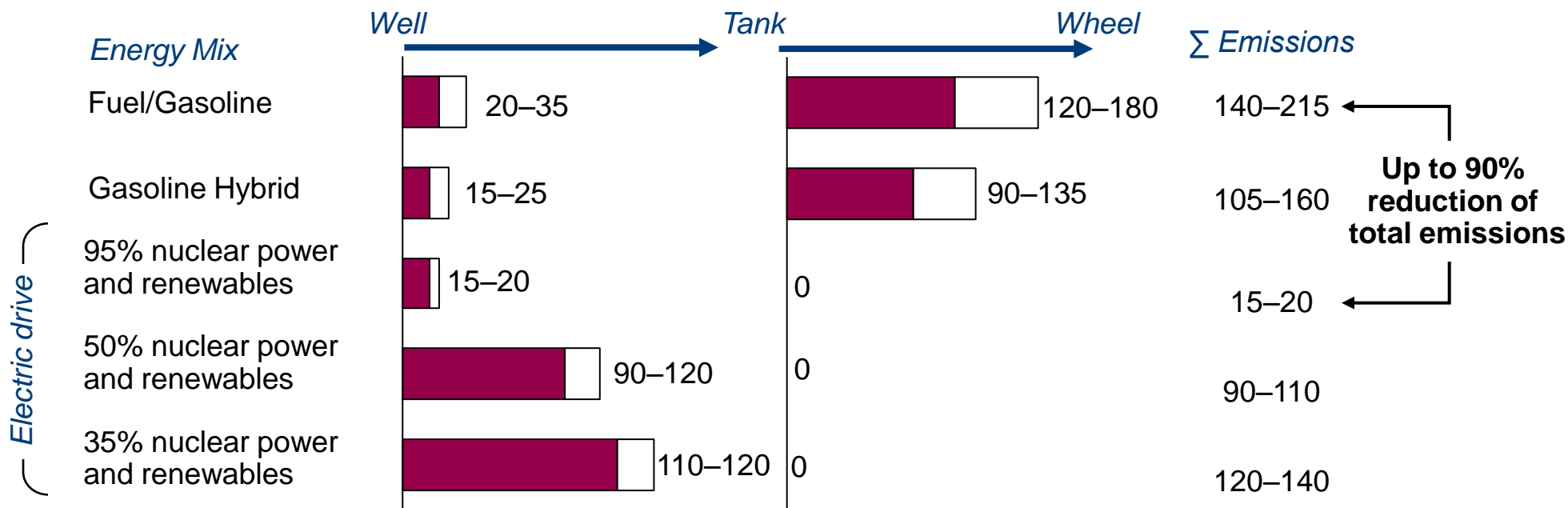
# Plug-in vehicles use electricity as their main power source

	Plug-in vehicles		
	Hybrid electric vehicle (HEV)	Plug-in hybrid electric vehicle (PHEV)	Pure electric vehicle (EV)
<b>Powertrain</b>	<ul style="list-style-type: none"> <li>Internal combustion engine (ICE)</li> <li>Supporting electric engine</li> </ul>	<ul style="list-style-type: none"> <li>Electric engine</li> <li>Supporting ICE</li> </ul>	<ul style="list-style-type: none"> <li>Electric engine</li> </ul>
<b>Fuel</b>	<ul style="list-style-type: none"> <li>Primarily gasoline</li> <li>Battery charged when braking, coasting or idling</li> </ul>	<ul style="list-style-type: none"> <li>Primarily electricity, battery charged through power grid</li> <li>Gasoline for long-range driving</li> </ul>	<ul style="list-style-type: none"> <li>Electricity only, battery charged through power grid</li> </ul>
<b>Range</b>	<ul style="list-style-type: none"> <li>+1,000 km</li> <li>Electric drive used to improve fuel economy</li> </ul>	<ul style="list-style-type: none"> <li>25-150 km (electric)</li> <li>600-1,000 km (ICE support)</li> </ul>	<ul style="list-style-type: none"> <li>60-300 km</li> </ul>
<b>Availability</b>	<ul style="list-style-type: none"> <li>Several models available on the market, e.g. Toyota Prius</li> </ul>	<ul style="list-style-type: none"> <li>Not currently available</li> <li>Start of production scheduled 2009-10</li> </ul>	<ul style="list-style-type: none"> <li>First mass-market products available, e.g. Th!nk City</li> <li>Renault Megane to be launched in 2009</li> </ul>
<b>Cost</b>	<ul style="list-style-type: none"> <li>10-25% price premium compared to conventional car</li> </ul>	<ul style="list-style-type: none"> <li>Not determined, but expected higher than HEVs</li> </ul>	<ul style="list-style-type: none"> <li>~€20,000 (mini-EVs)</li> <li>~€30,000 (normal size EVs)</li> </ul>
	Electrically assisted driving	Electricity main power source	Electricity only power source

# Plug-ins enable major reductions in fuel consumption and CO<sub>2</sub> emissions, helping countries to realize their CO<sub>2</sub> targets

**CO<sub>2</sub> emissions – well to wheel balance for an average car**  
(CO<sub>2</sub> g/km)

**Example France:  
Regular fuel vs.  
HEV & EV**



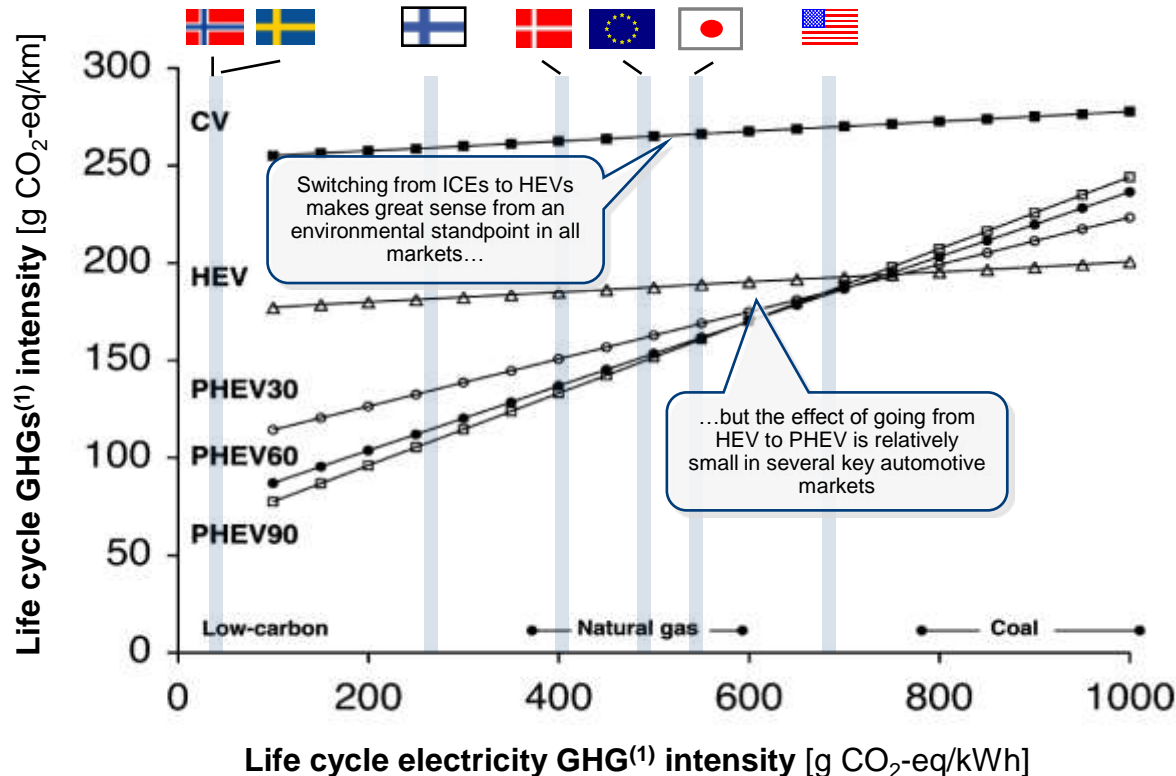
**Full-scale adoption of PHEV vehicles can cut car CO<sub>2</sub> emissions by at least 50%, helping Sweden achieve 75% of the EU 2020 requirements**

Notes: Gasoline hybrid assumed to have 25% lower fuel consumption in combined city and highway driving  
Source: EDF; A.T. Kearney research and analysis

# The Nordics are among the countries that have the most to gain from moving to plug-ins

## Impact of energy mix on EV CO<sub>2</sub>-emissions (indicative average GHG lifecycle energy mix)

Indicative



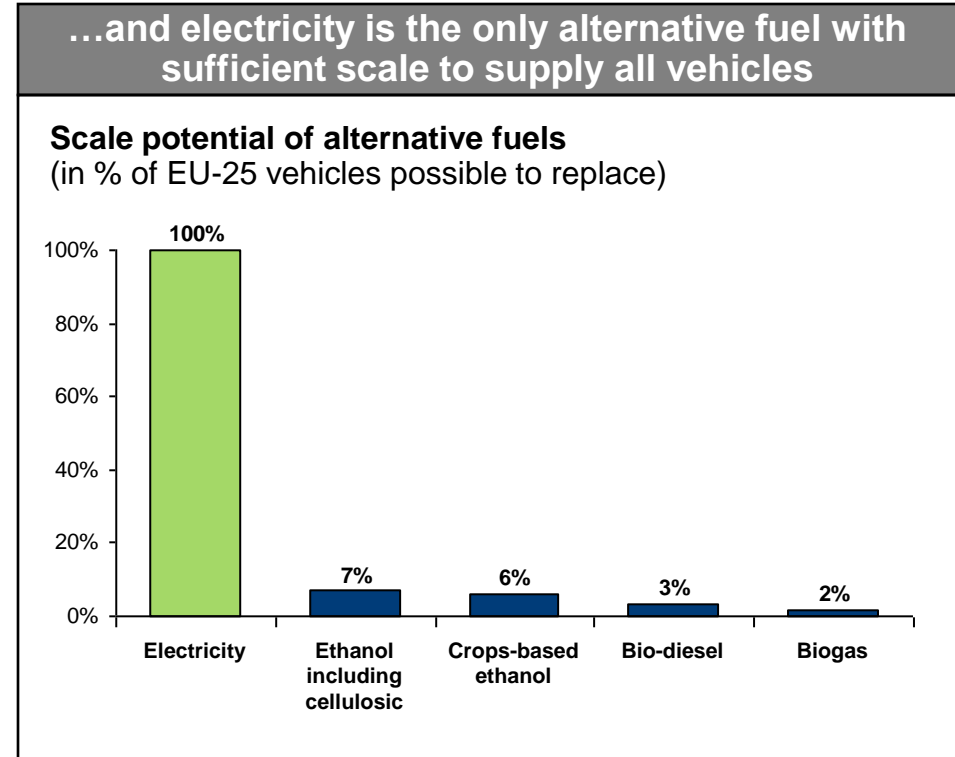
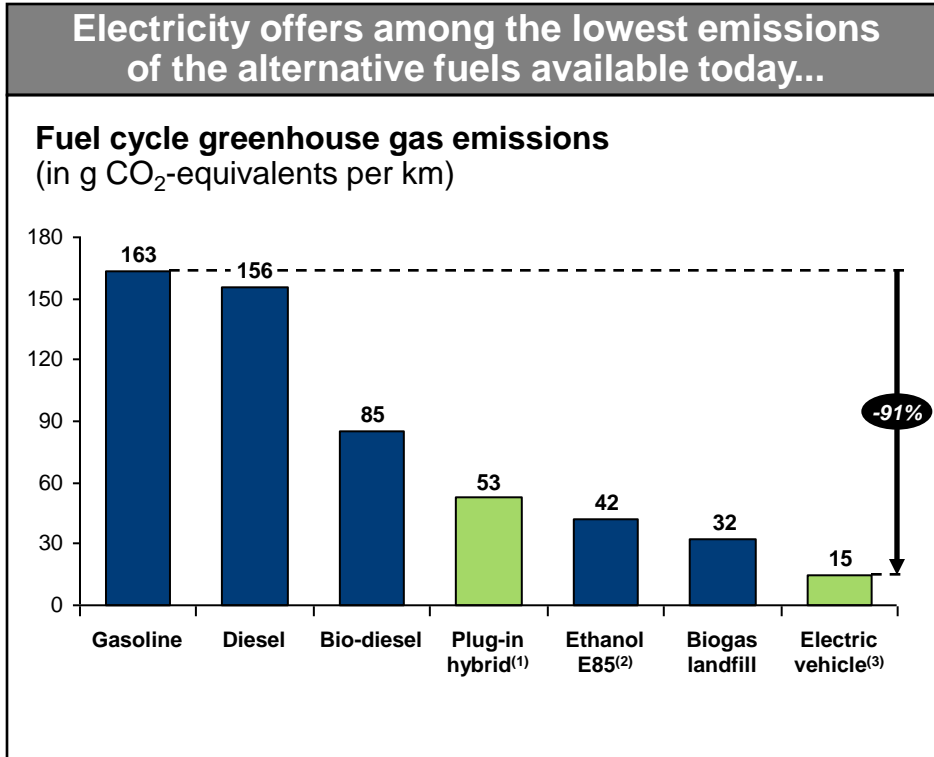
### Observations

- Countries with a high share of renewable energy, such as Sweden, have the most to gain from moving to PHEVs
- In these countries, a greenhouse gas emissions argument would be strong towards policy-makers to promote incentives for PHEVs
- The big three markets for automobiles – US, Japan and EU – would not see a significant reduction in emissions between HEVs and PHEVs, and could potentially block introduction of PHEVs by auto OEMs

Notes: (1) Green House Gasses

Source: Life Cycle Assessment of Greenhouse Gas Emissions from Plug-in Hybrid Vehicles; Fortum PHEV project team

# The alternative fuel of tomorrow must provide both lower emissions and sufficient scale – electricity offers both today



Notes: (1) Assumes electrical range of 30 km with EV operation 70% of the time; Nordic electricity mix used to charge vehicle (90 g CO<sub>2</sub>-eq./kWh)  
 (2) Ethanol produced from sugar cane from Brazil (90% of ethanol used in Sweden) and blended with 15% regular gasoline  
 (3) Assumes EV charged with Nordic electricity mix as for (2)

Source: Joint Research Council/EUCAR/concawe Well-To-Wheel analysis; Center for Transportation Research, Argonne Labs; Environmental Systems Analysis of Biogas Systems; Energimyndigheten; Nordel; A.T. Kearney analysis

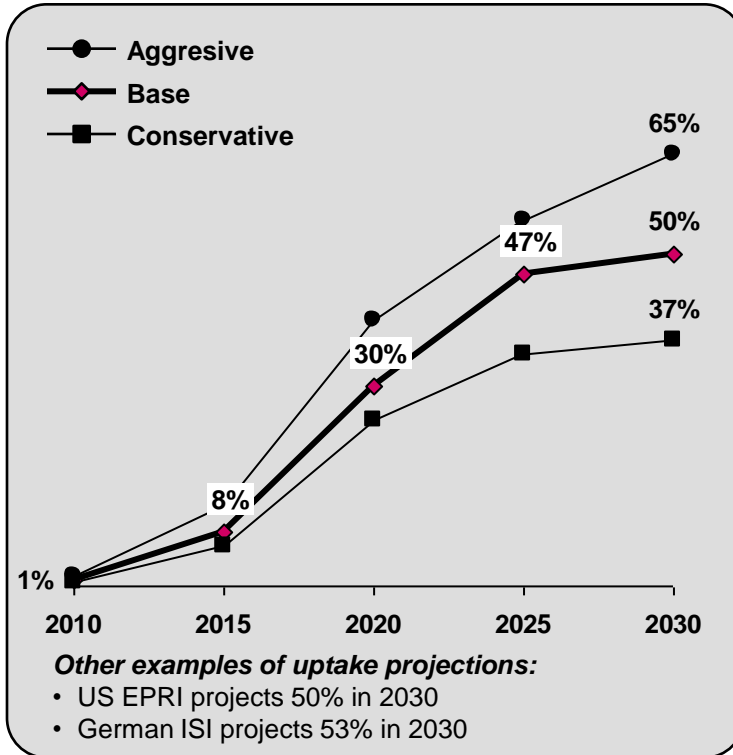
# Automobile manufacturers are bringing numerous plug-in vehicles to the market in 2009 and 2010...

## Examples

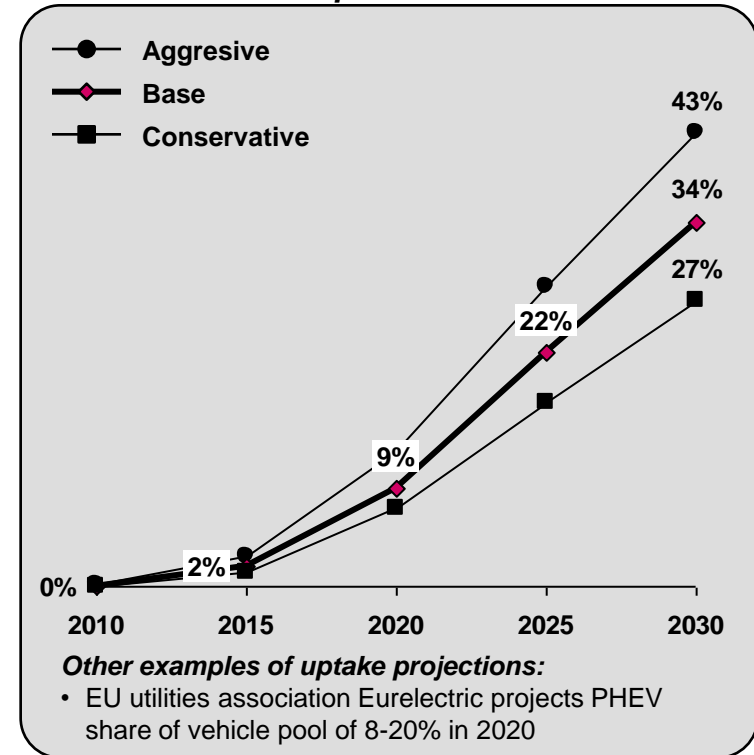
Manufacturer	Model name	Country	Type	Powertrain	Launch year	Battery type	EV Range
	Doblo		Passenger van	EV	2008	NiMH	110 km
	Better Place		Sedan	EV	2008	Lithium-ion	161 km
	City		Sedan	EV	2008	Zebra/Li-ion	200 km
	F6DM		Sedan	PHEV	2009	Lithium-ion	100 km
	F6E		Sedan	EV	2009	Lithium-ion	161 km
	smart ed		Sedan	EV	2009	Lithium-ion	241 km
	Karma		Sports car	PHEV	2009	Lithium-ion	80 km
	Roadster		Sports car	EV	2009	Lithium-ion	350 km
	Prius		Station wagon	PHEV	2009	Lithium-ion	25 km
	F3DM		Sedan	PHEV	2010	Lithium-ion	161 km
	Nissan		Sedan	EV	2010	Lithium-ion	160 km
	Indica Vista		Sedan	EV	2010	Lithium-ion	180 km
	Model S		Sedan	EV	2010	Lithium-ion	385 km
	Volt		Sedan	PHEV	2011	Lithium-ion	64 km
	Twin Drive		Sedan	PHEV	2011	Lithium-ion	50 km
	Escape		SUV	PHEV	2013	Lithium-ion	48 km
	ReCharge		Coupe	PHEV	2015	Not available	Not available
	Sprinter		Commercial van	PHEV	N/A	Lithium-ion	32 km

# The penetration of PHEVs and EVs in the nordic region is difficult to predict but a substantial growth is likely next coming years

**Projected plug-in vehicles share of new vehicle sales**



**Projected plug-in vehicles share of total Nordic car pool**



**High uncertainty around development of several customer buying criteria; especially crude oil price, taxation and subsidies**

Fortums project

# Pilot installations and vehicles are in place along with broad partnership initiatives

Project vision

*Fortum is a forerunner for sustainable and energy-efficient road transport solutions*

Key achievements

## Cars



**Toyota Prius**  
(plug-in hybrid)



**Think City**  
(electrical)



**Fiat Doblo**  
(electrical)



**VW Passat**  
(electrical)

## Infrastructure



**Elektromotive (UK)**  
(slow charging)



**Ensto (FI)**  
(fast/slow charging)



**Garo (SE)**  
(slow charging)



**Cale (SE)**  
(payment)

## Key partners

- Stockholm City
- Espoo City
- Pudasjärvi City
- Karlstad City
- Stockholm Parking
- SAY (automotive org. Finland)

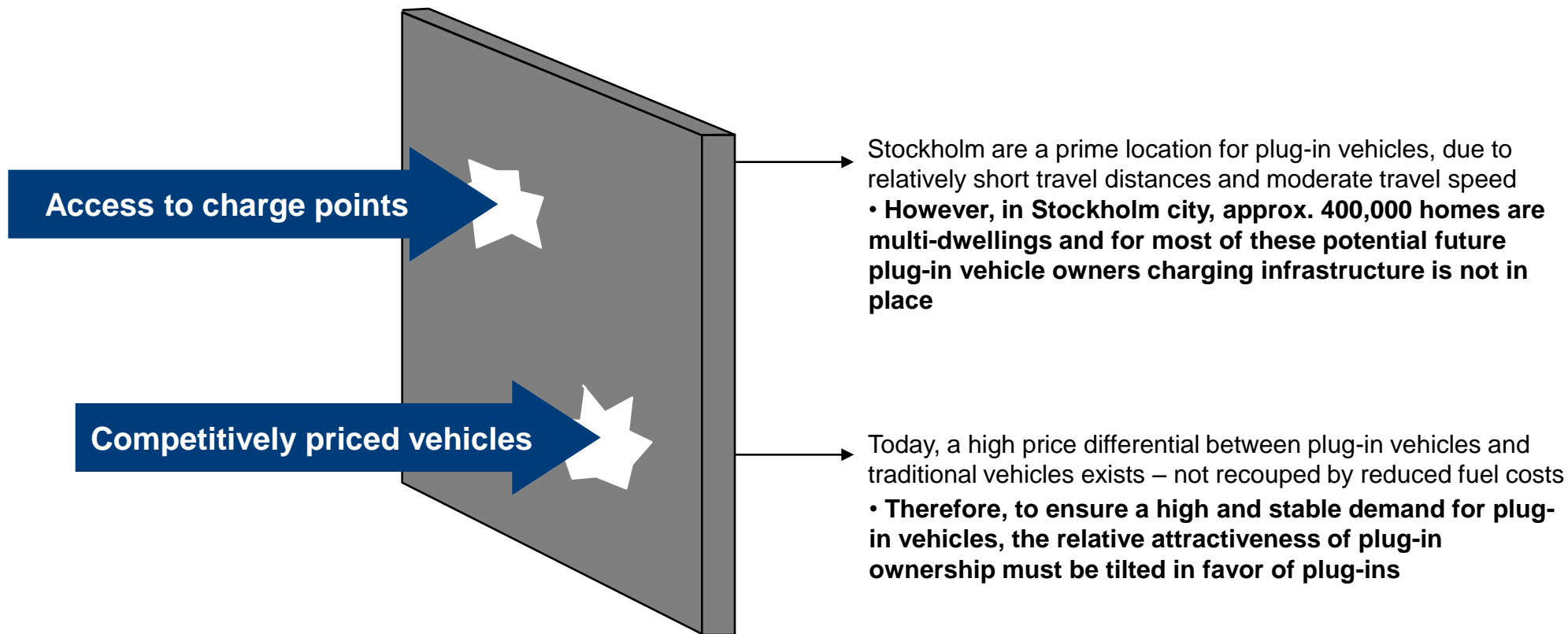
*Testing ongoing with 4 types (PHEV & EV)*

*Pilot rollouts in Stockholm, Espoo and Pudasjärvi*

*Numerous partners in place*

Enablers and barriers

# Stockholm city is a prime location for plug-in vehicles, however two key blockers need to be overcome



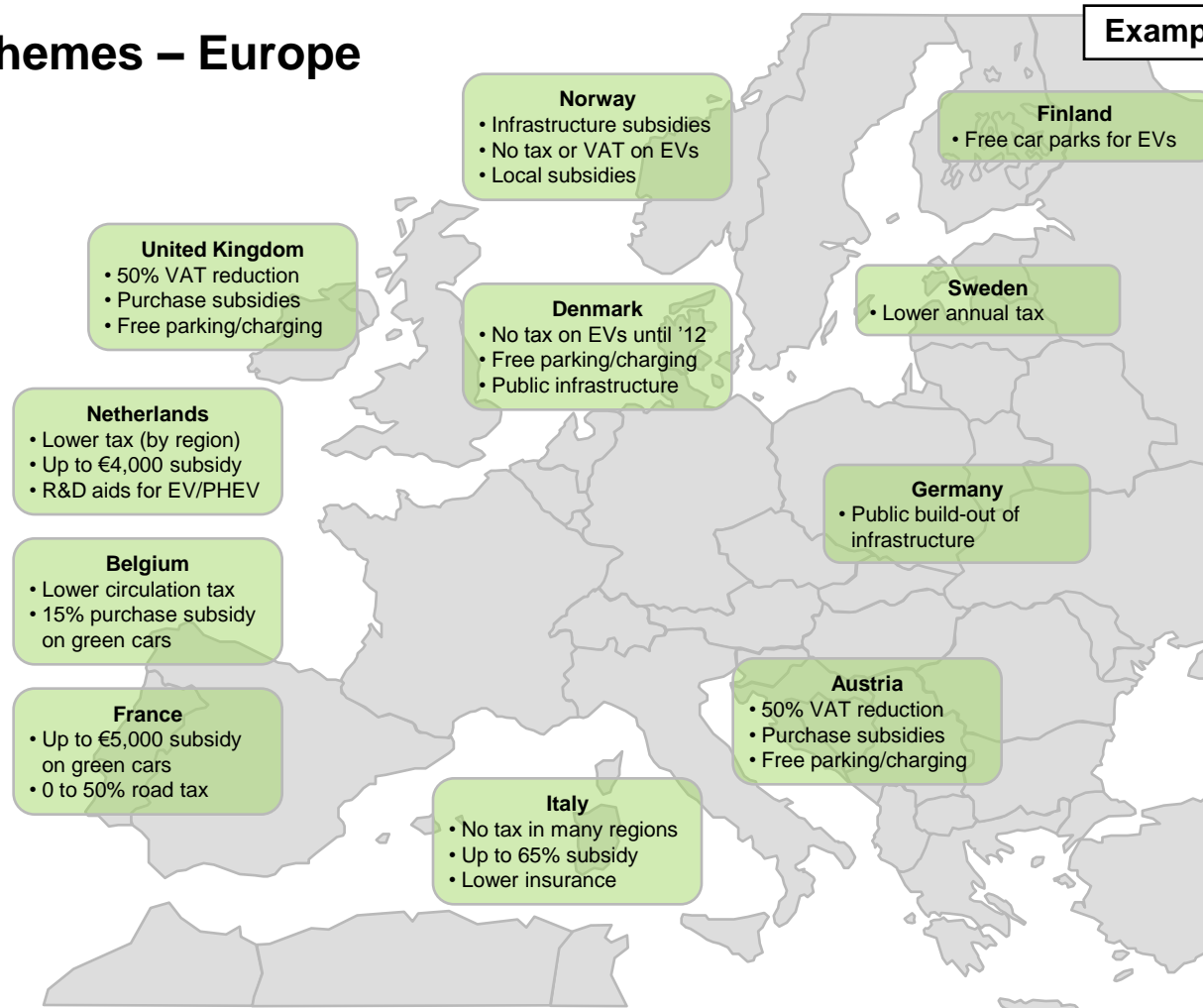
Numerous ways and means to address key blockers exists, however requires partnership and cooperation between stakeholders

# ...and several countries have already taken initiatives to ensure uptake of plug-ins

## Plug-in vehicles incentive schemes – Europe

### Incentives in use today

- Reduced vehicle taxation
- Vehicle acquisition support
- Parking, congestion, and charging fees
- Other consumer incentives and initiatives
- Subsidies on charging infrastructure





**The future for PHEVs and PEVs is already here...  
you have one by yearend?**