



Market potential of electric vehicles: ready for takeoff?

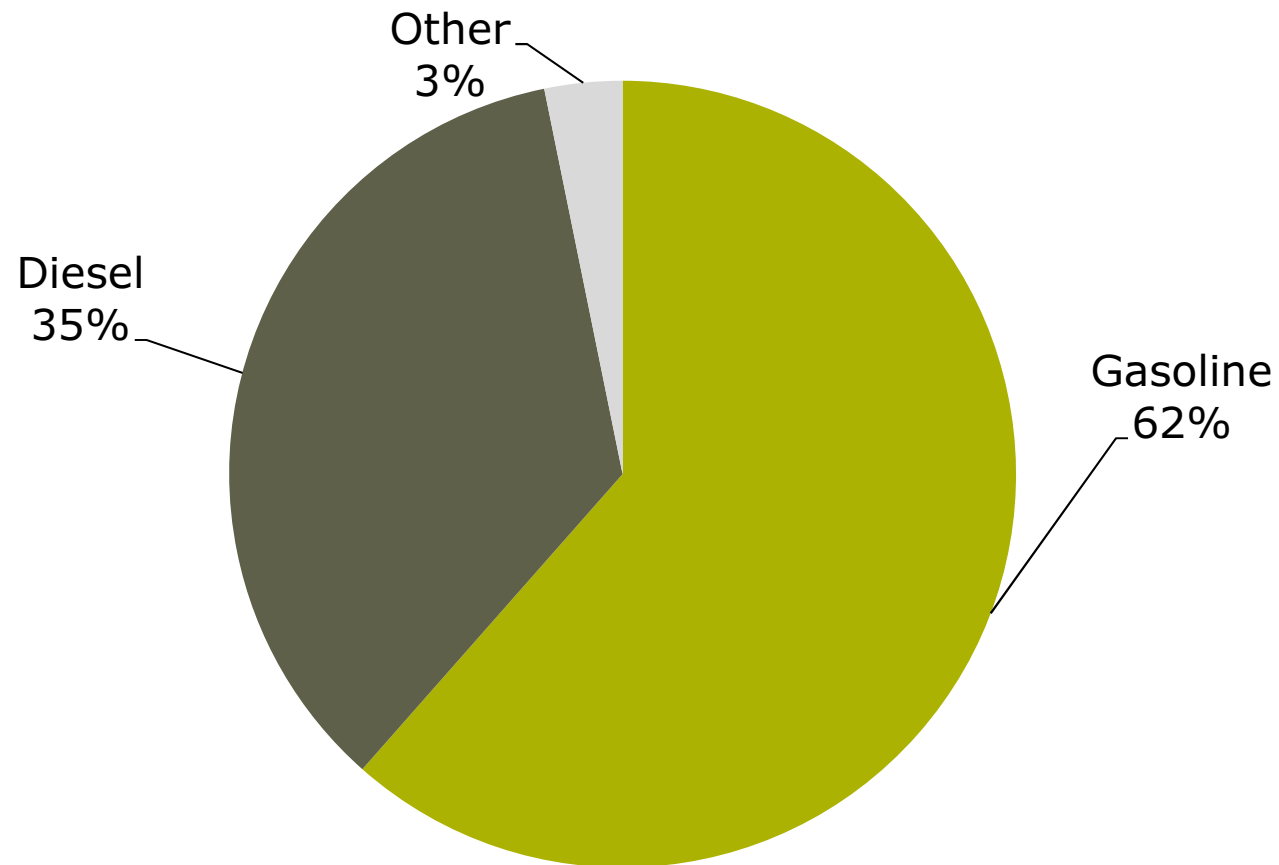
Prof. Dr. Cathy Macharis
MOBI



Vrije Universiteit Brussel



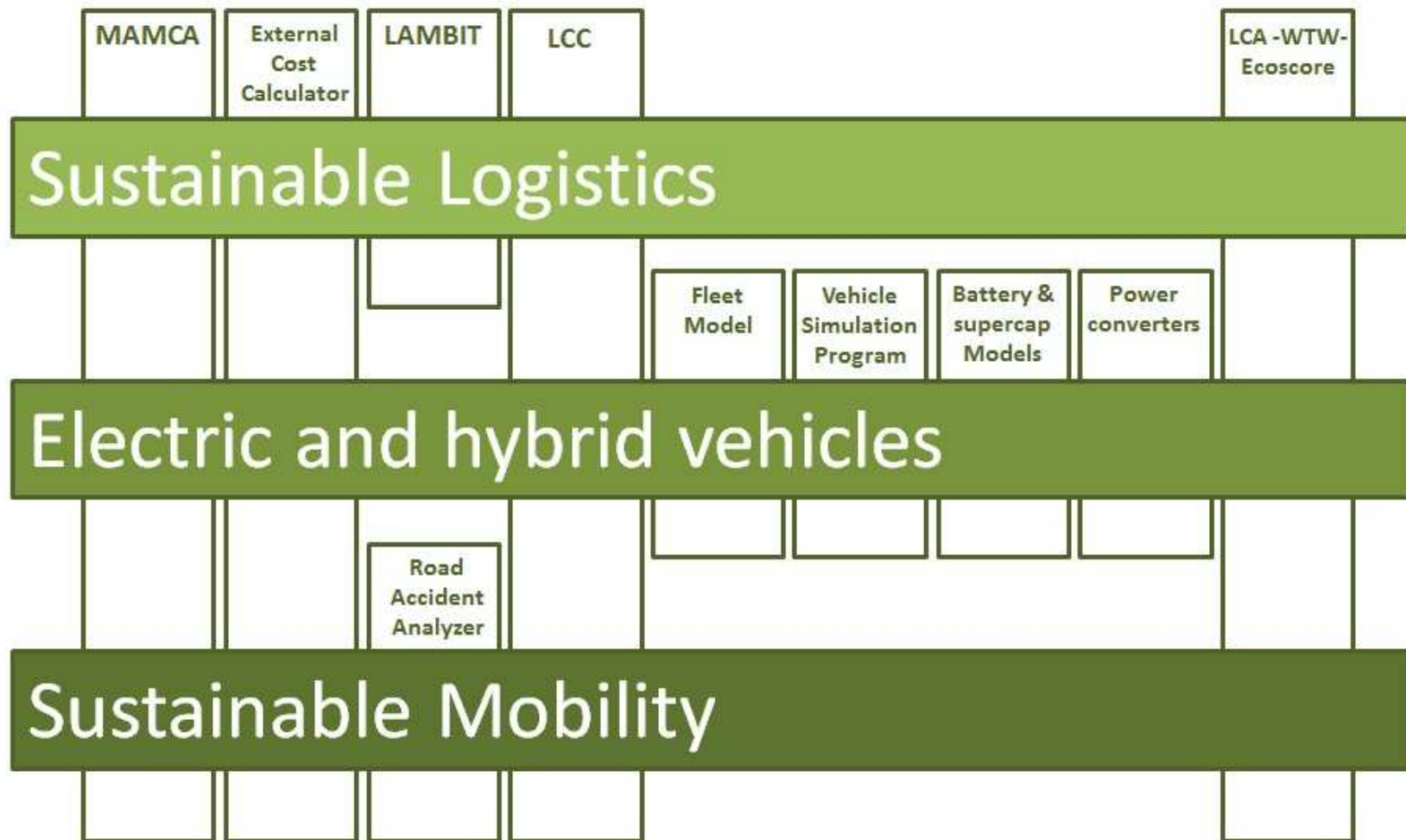
EU car fleet by Fuel type



Source: ACEA, 2012



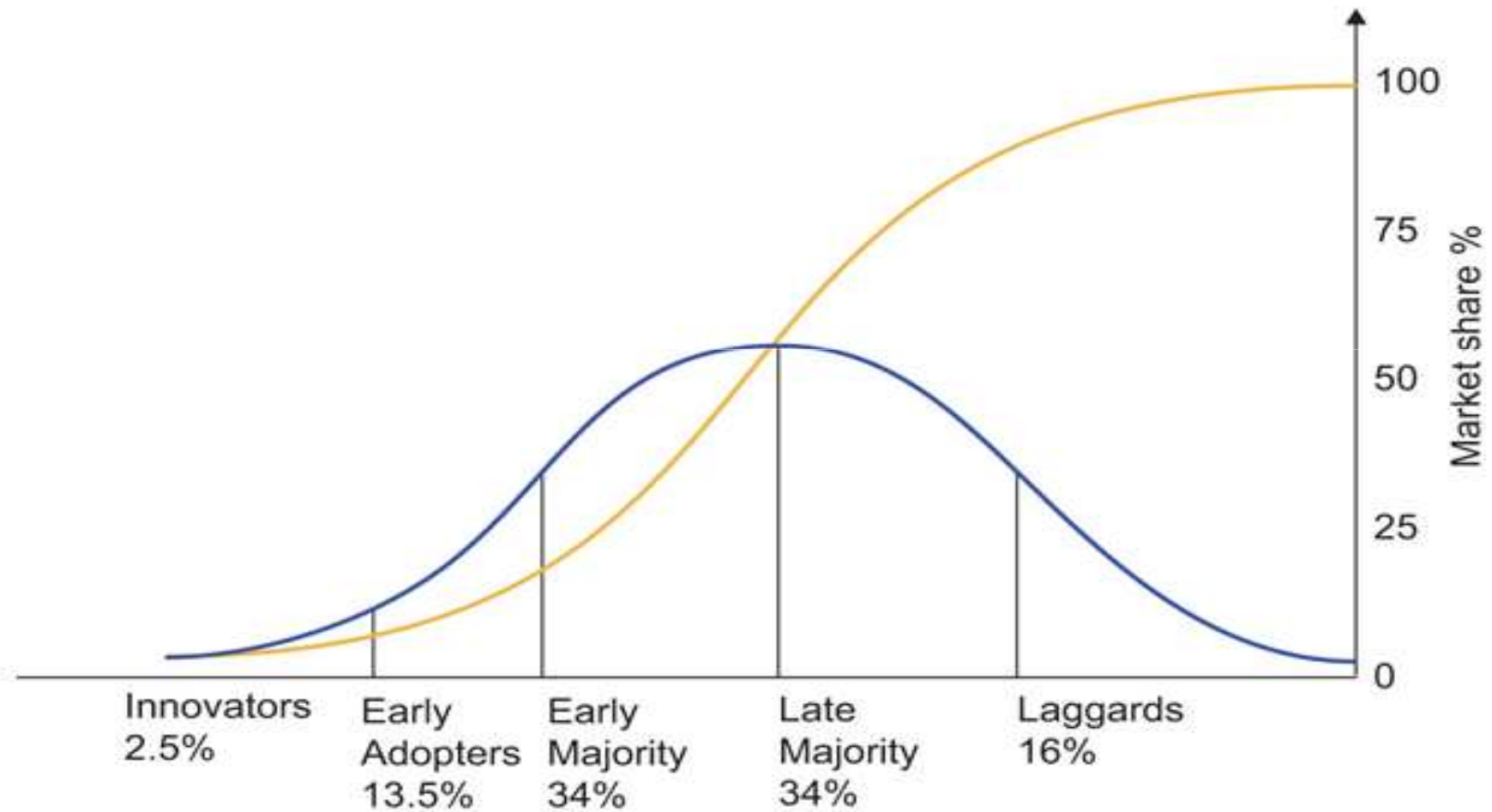
MOBI: themes and tools



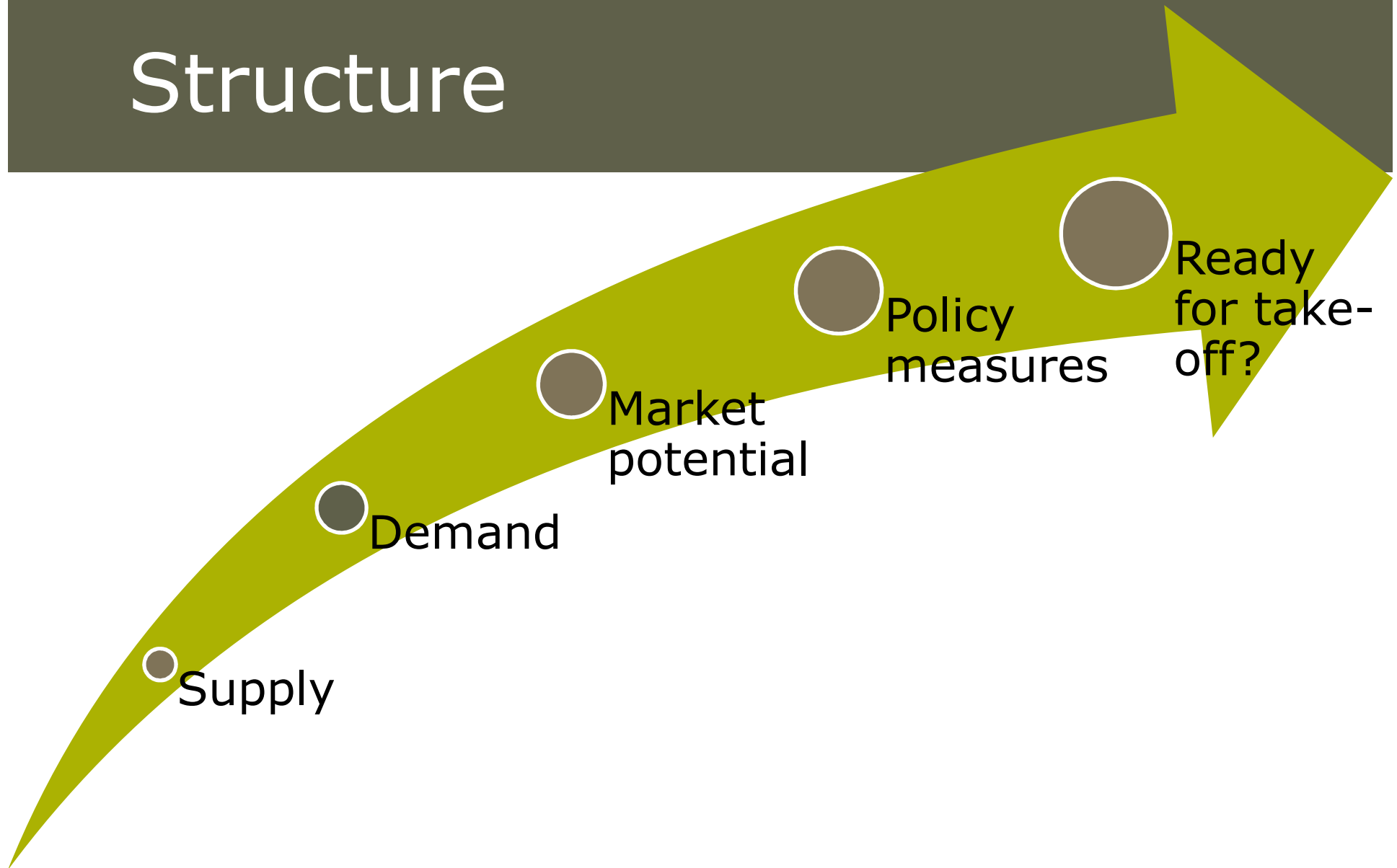
Environmentally friendly vehicles research @ MOBI



The diffusion of innovations curve



Structure



Part I: Why does this matter?



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MOSI – Transport en Logistiek

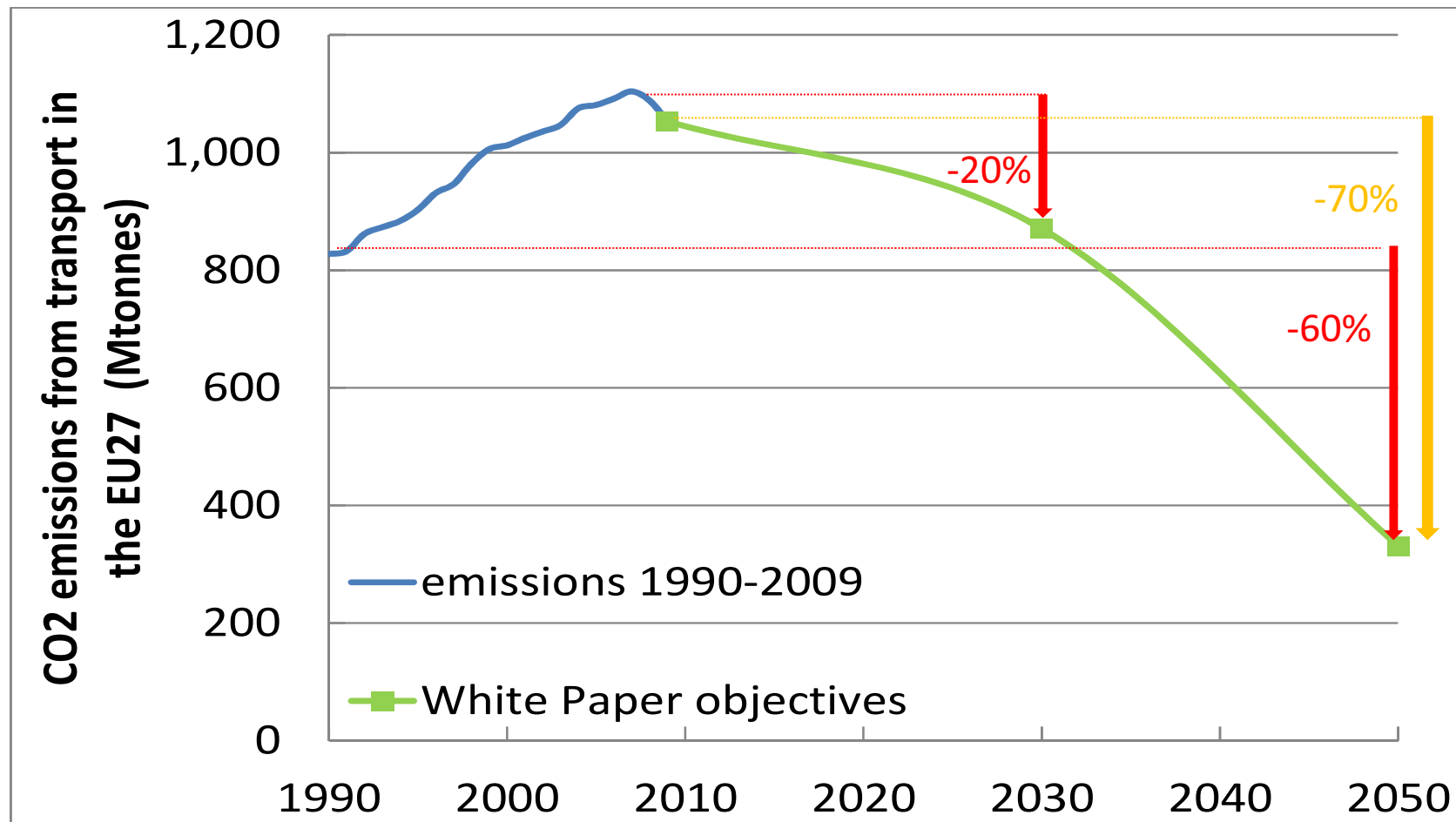
2050 ?



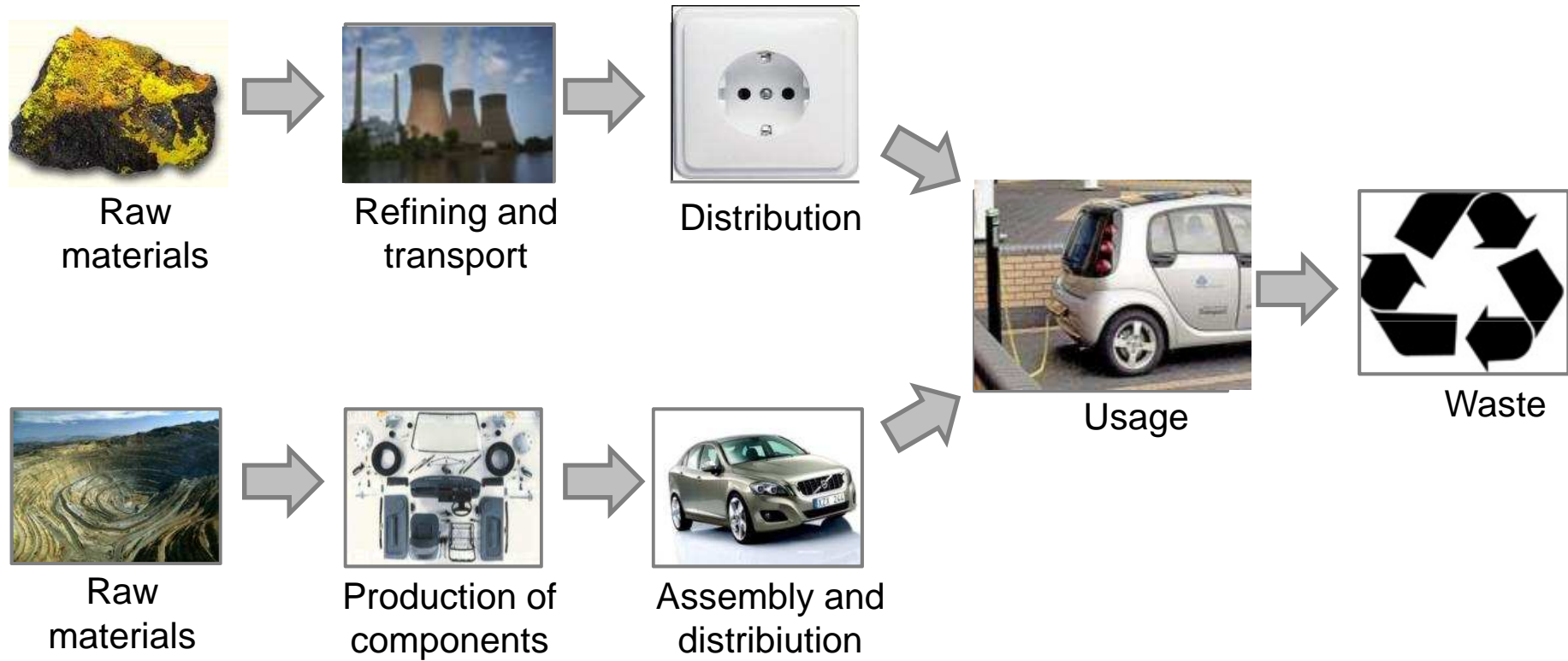


Topik: Arrogansi

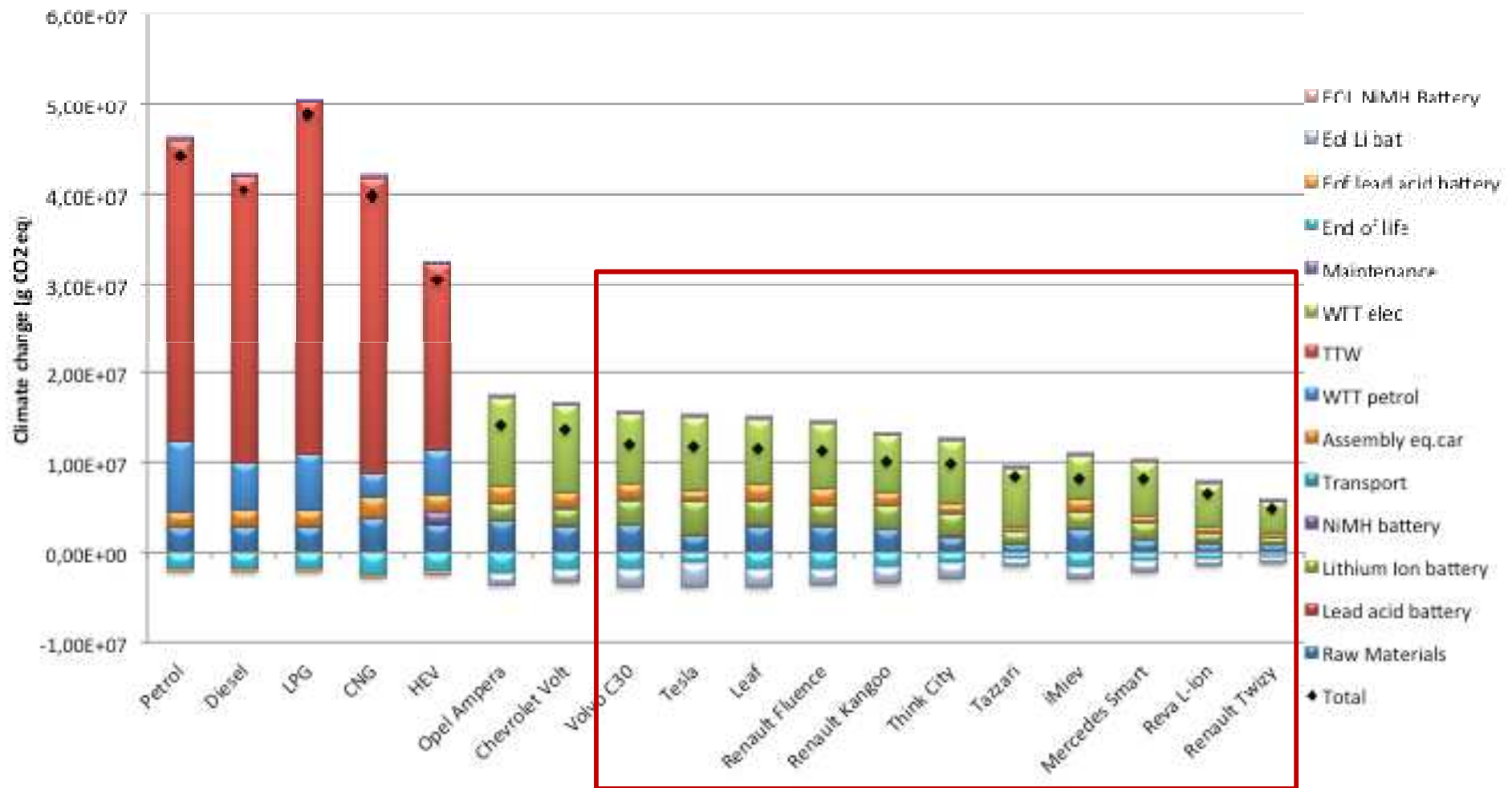
Historic GHG emissions from transport and targets for 2050 (EU27)

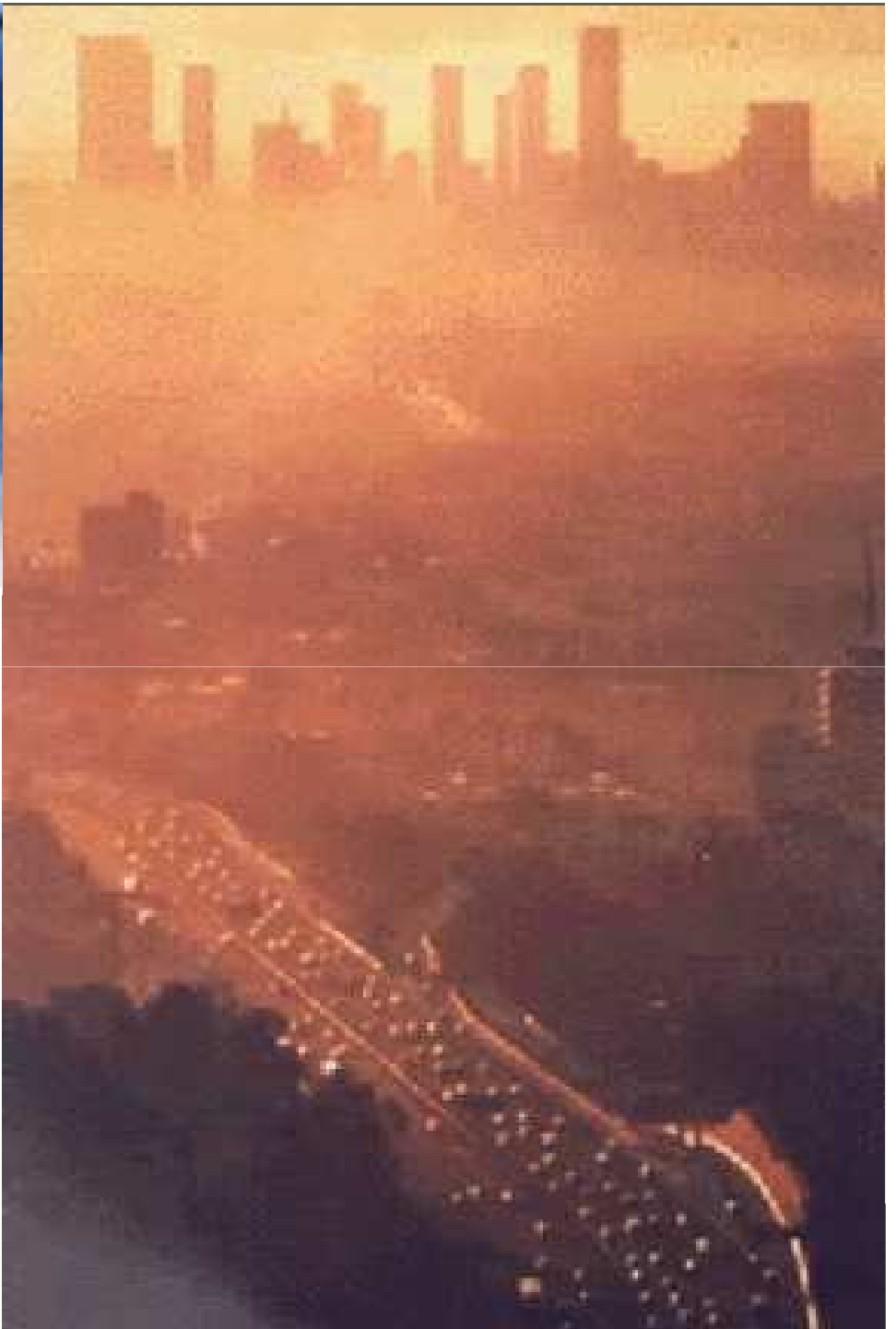


Life Cycle Assessment



Climate change (Life Cycle Assessment in g CO₂ eq)





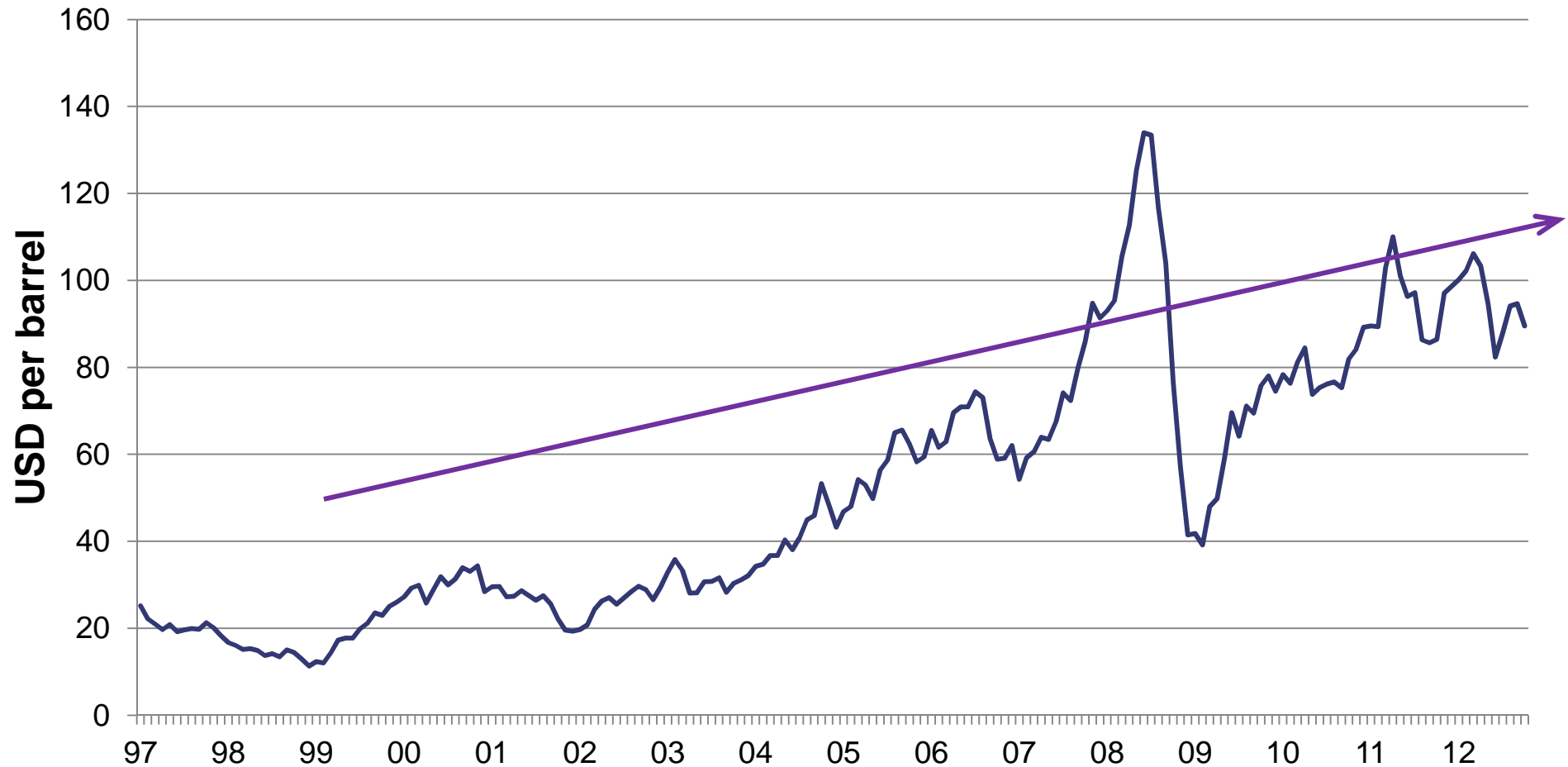
Electric car.
Zero emissions.





Evolution of crude oil price

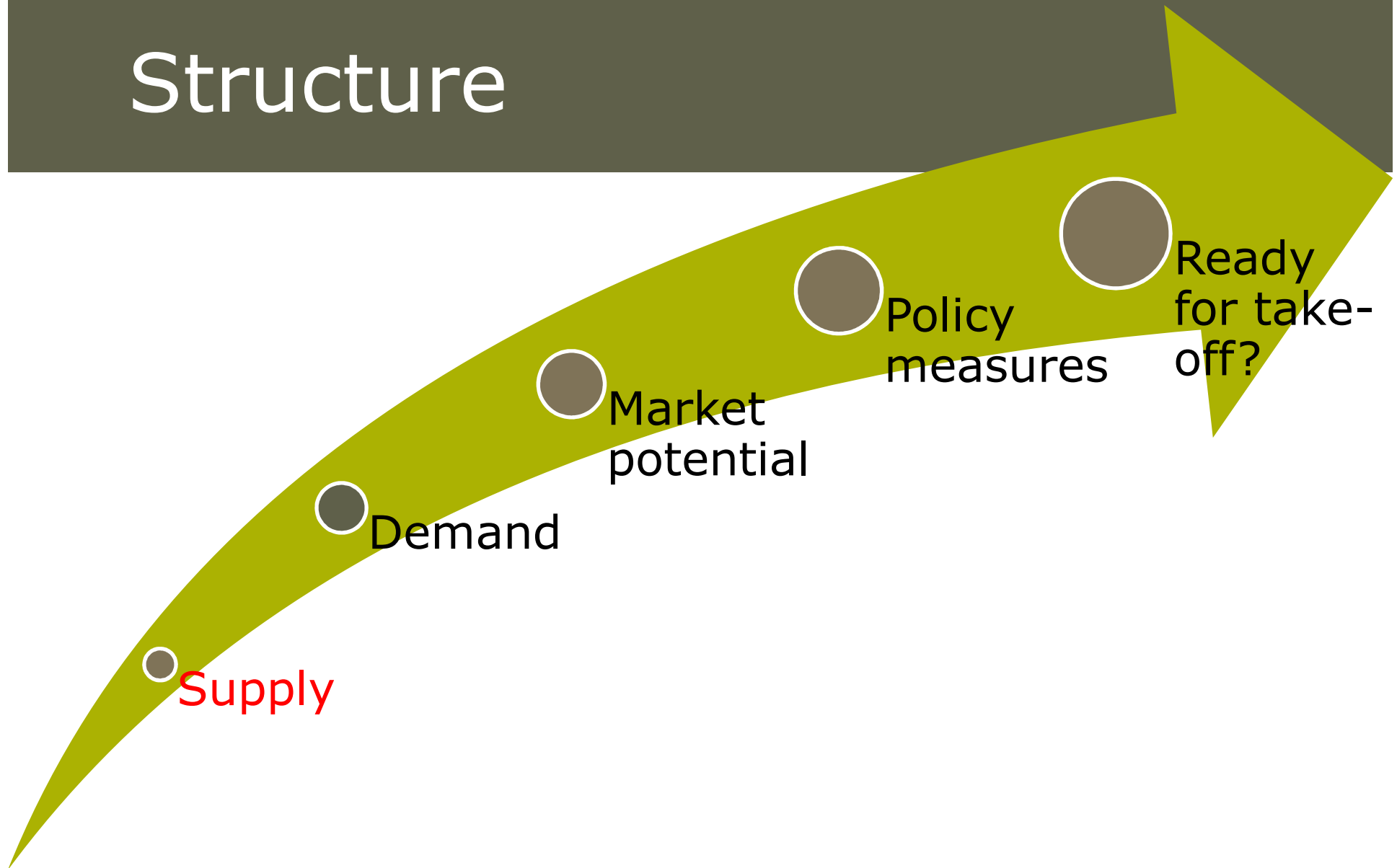
West Texas Intermediate



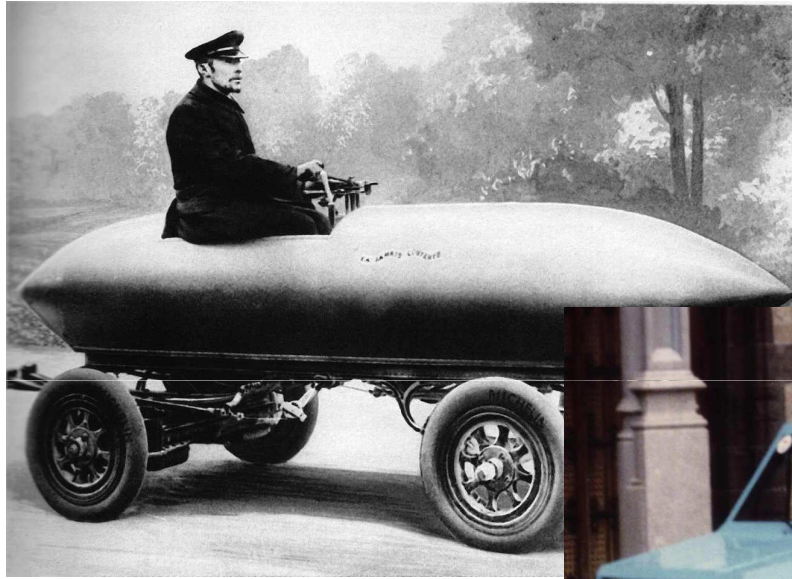


What was that bump?

Structure



History



1899



70ties



Today Tesla Model S



- ❑ 0 – 96 km/h in 4.4s
- ❑ 209 km/h
- ❑ 260-370-480 km range
- ❑ Starts from €43.000

Before 2011...



BEVs and PHEVs in 2012

Battery electric vehicles



Plug-in hybrid electric vehicles



Tomorrow's electric vehicles



EVs in different car segments

Small car



Citroën C-zero



Renault Twizy



Mitsubishi iMiEV

Medium sized car



Renault Fluence



Ford Focus BEV



Nissan Leaf

Sports car



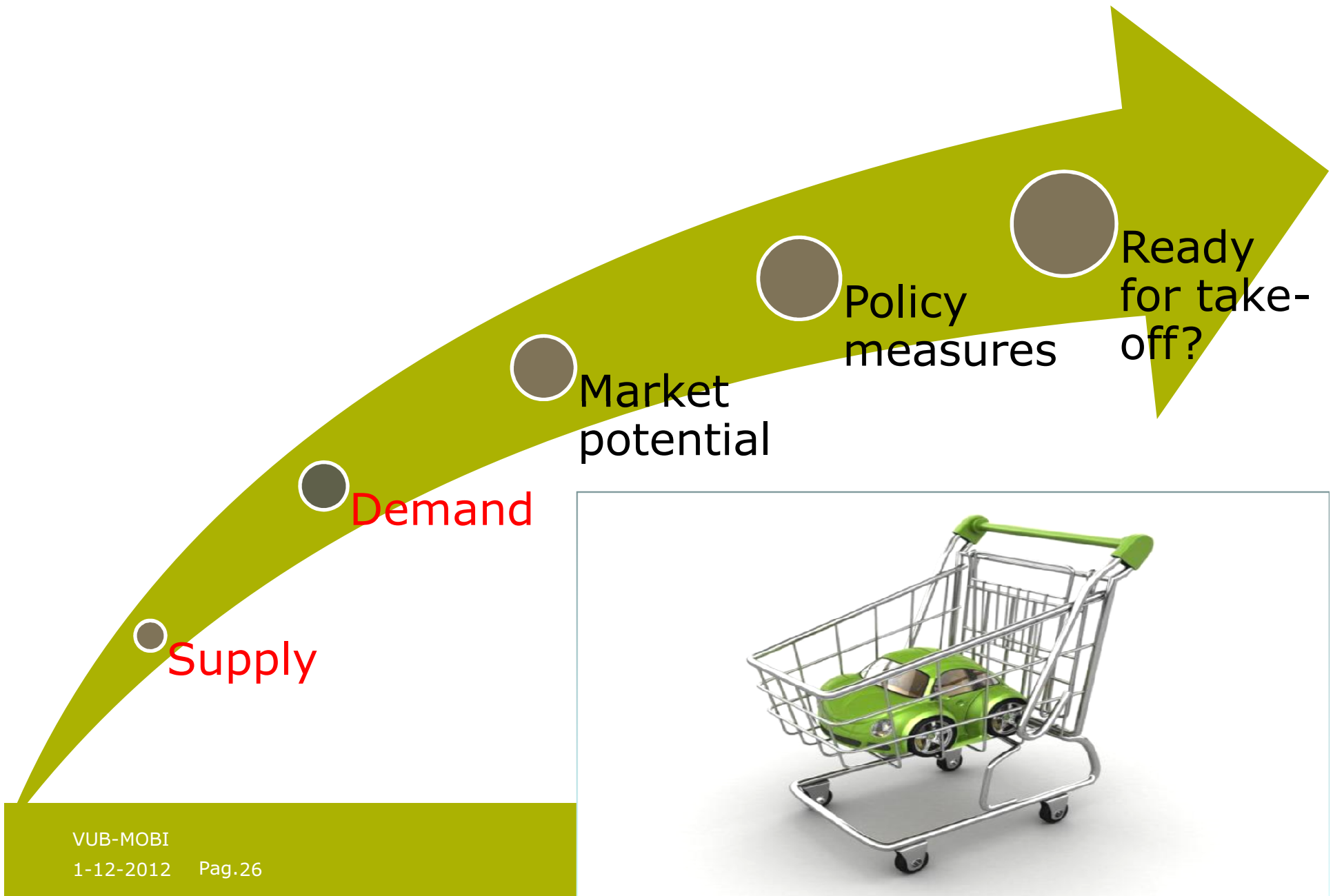
Audi E-tron



Fisker Karma

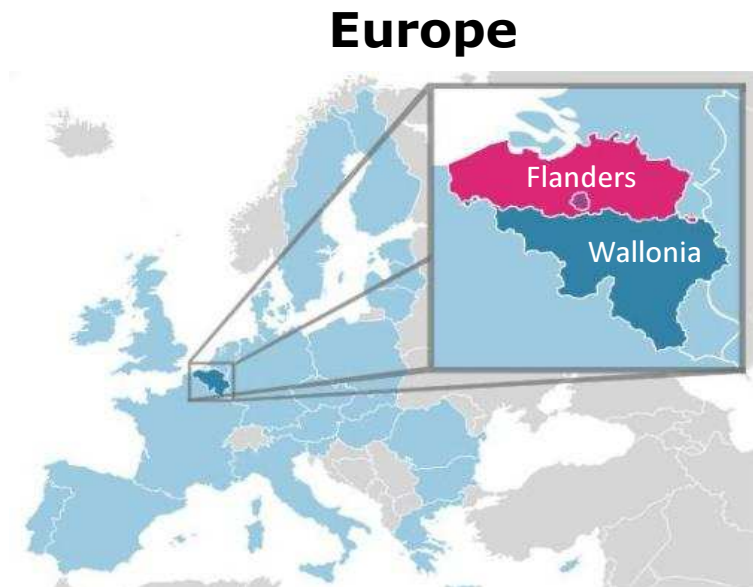


Mercedes SLS AMG

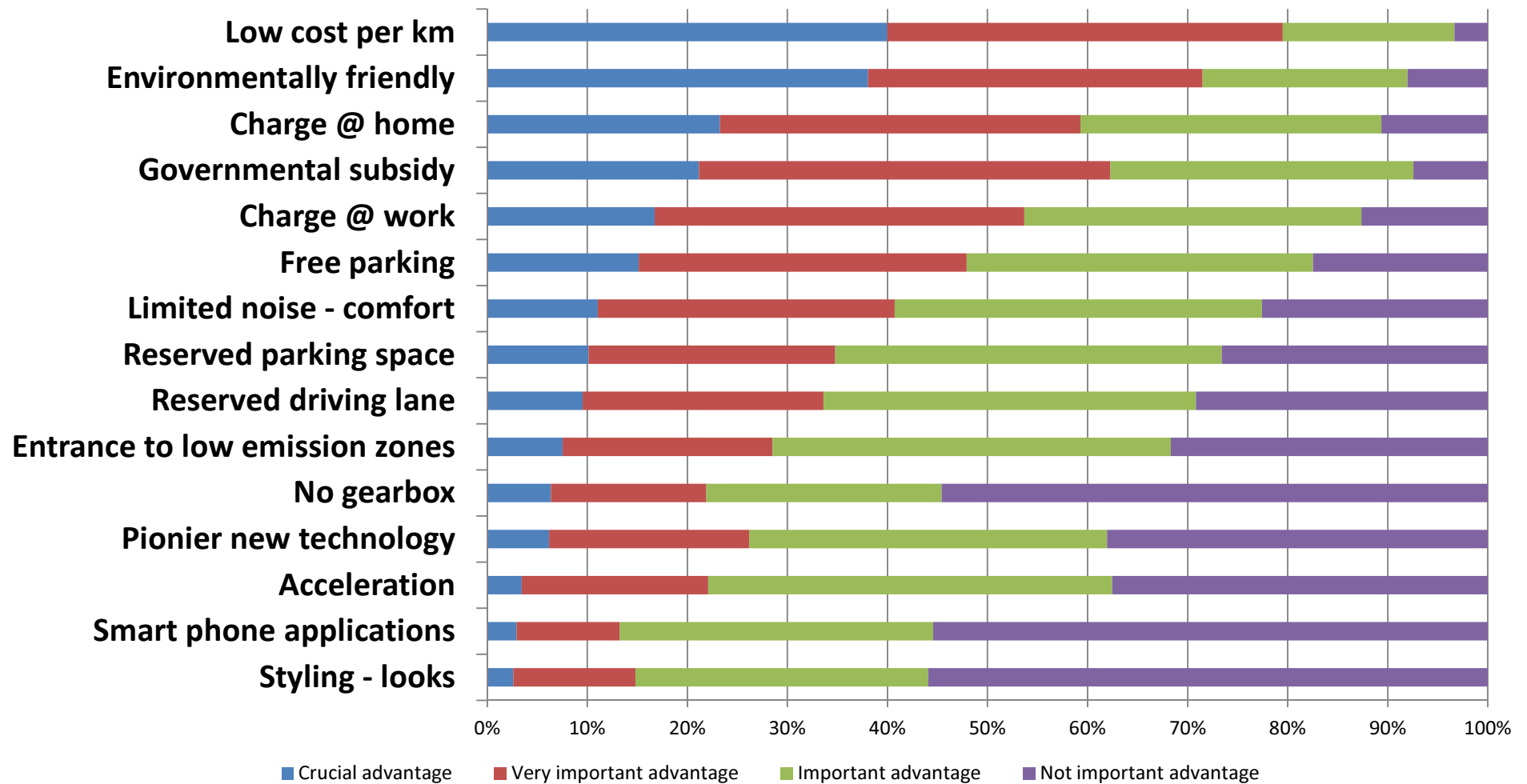


Survey setting

Target group	Flanders, 18+ year
Pilot survey	BMS January 2011
Data collection	11 days (2-13 May 2011)
Quantitative survey	2.037 sent 1.196 received
Average length survey	26 min and 20 sec
Environment	Online



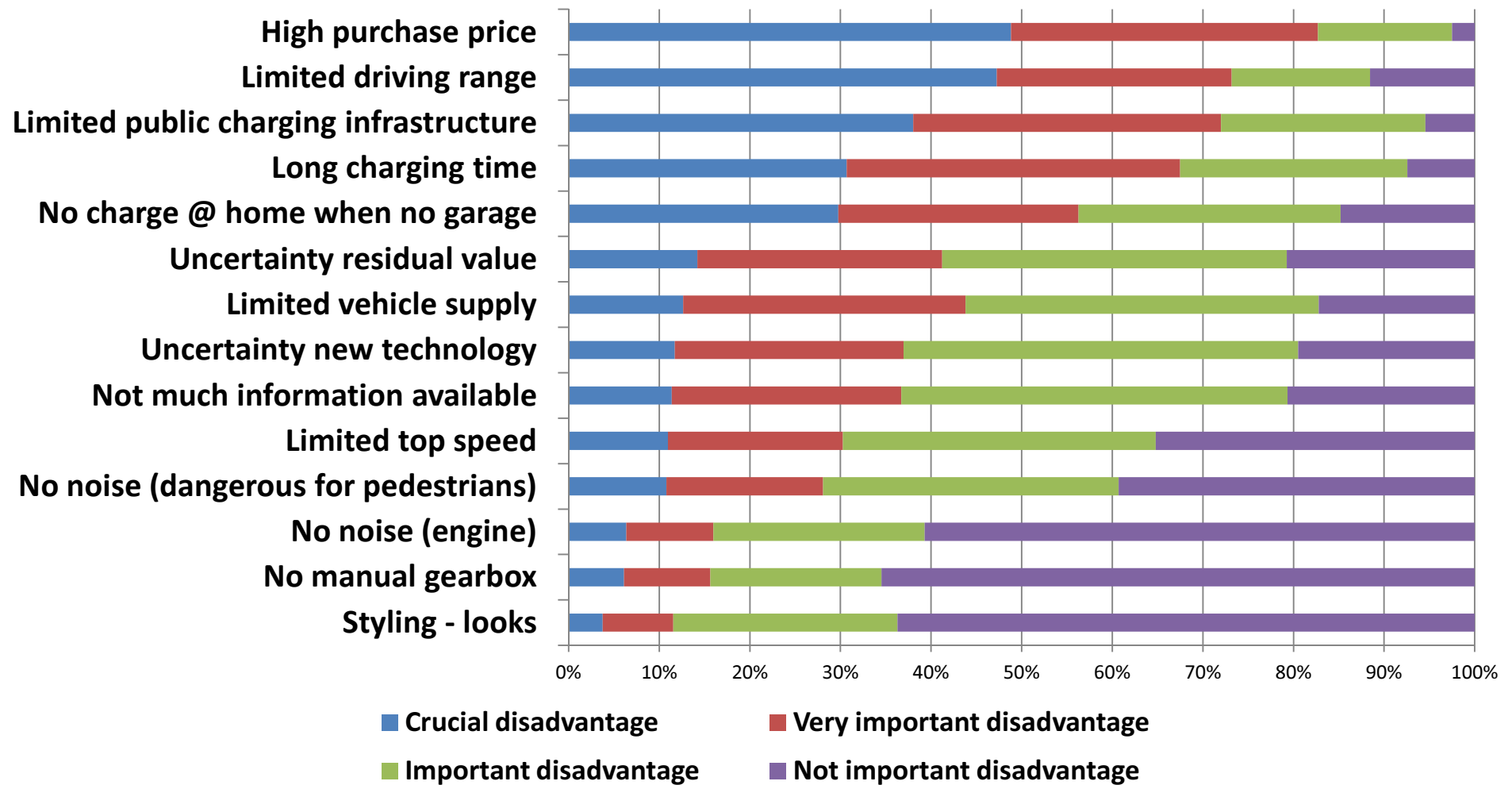
Opportunities for EVs



Top 3

- Low cost per km
- Environmental friendly
- Charge at home

Barriers for EVs



Top 3 : Barriers for EVs



Expensive initial purchase cost



Limited driving range



Limited charging infrastructure

Total Cost of Ownership (TCO)



TCO methodology

TCO Methodology

Financial costs

- ❖ Purchase price
- ❖ Registration tax
- ❖ Governmental supports
- ❖ Opportunity cost
- ❖ Depreciation cost

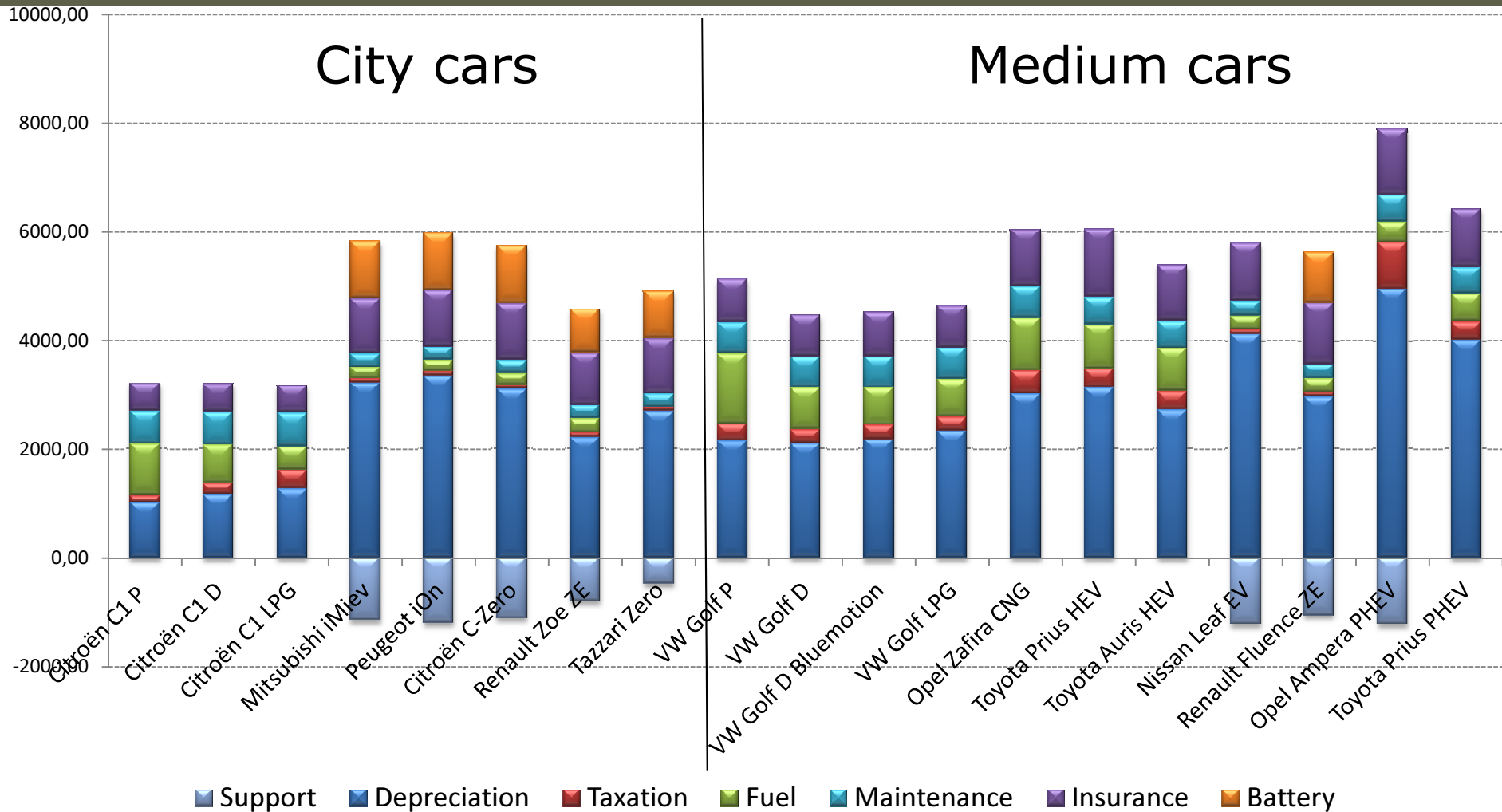
Fuel operating costs

- ❖ Fuel cost (electricity)
- ❖ Taxes on fuel

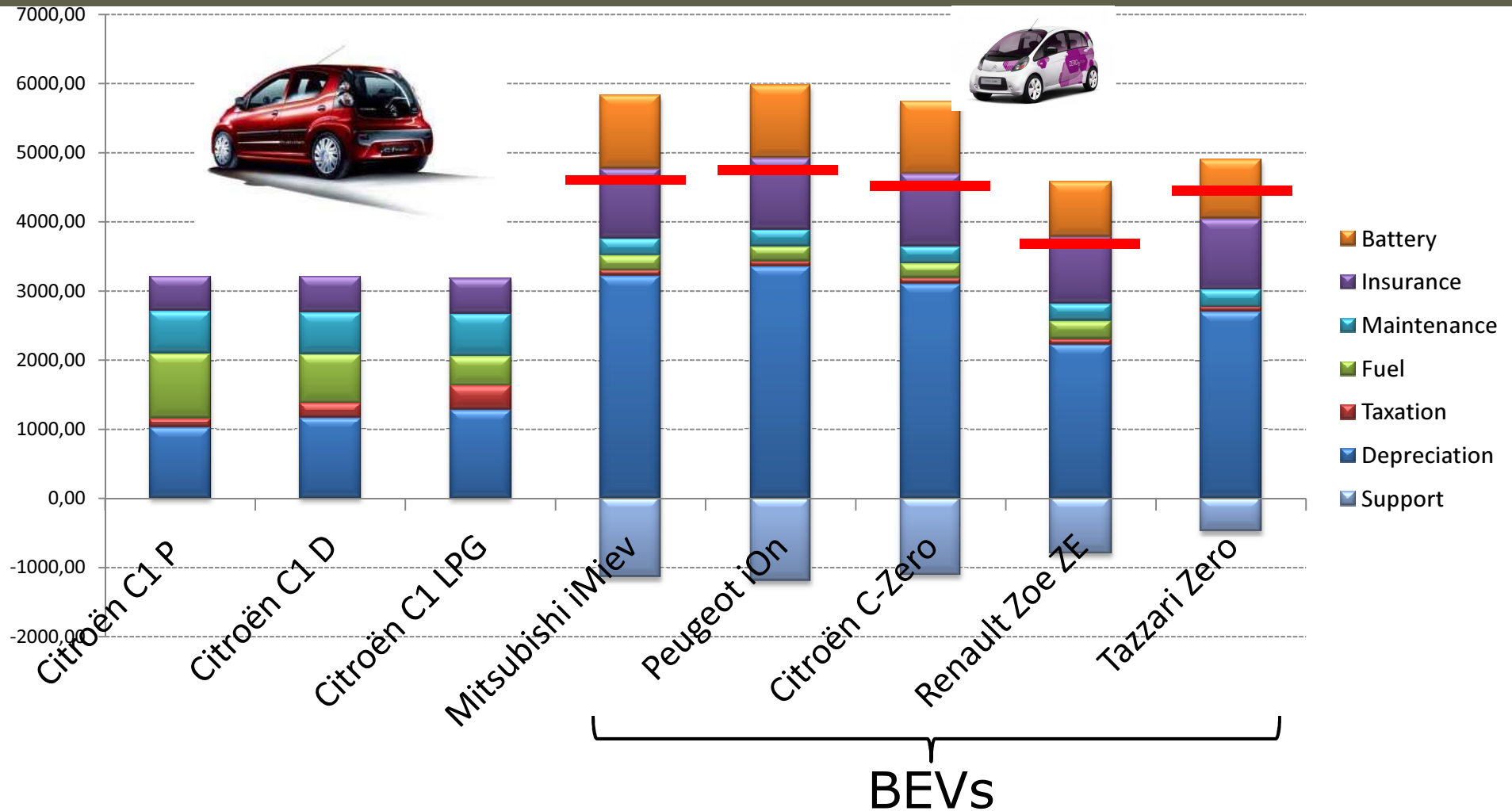
Non-fuel operating costs

- ❖ Taxation
- ❖ Insurance
- ❖ Technical control
- ❖ Tyres
- ❖ Maintenance

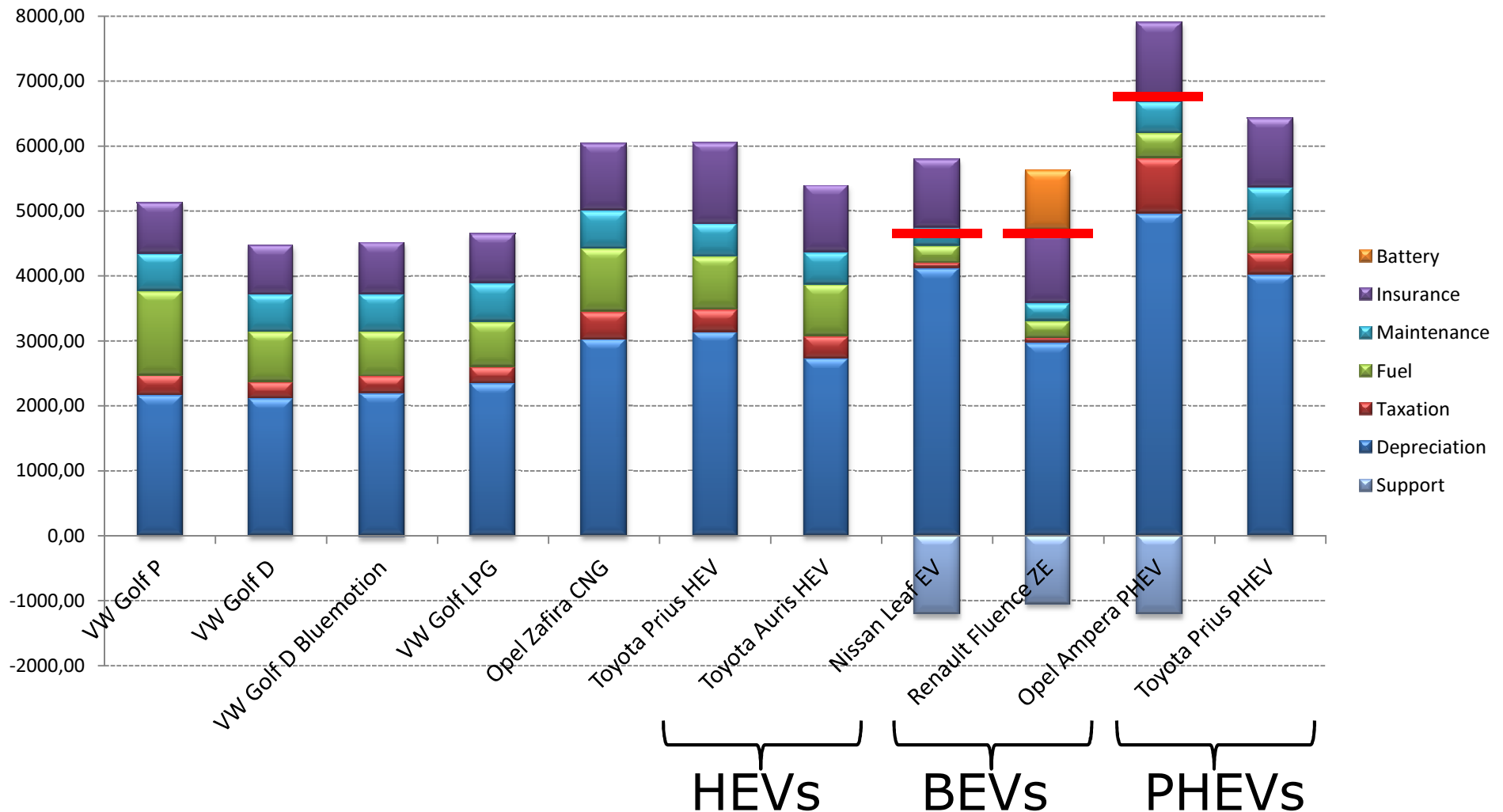
Total cost of ownership



Total cost of ownership: City cars



Total cost of ownership: Medium cars



Battery electric vehicles on the market



IVECO



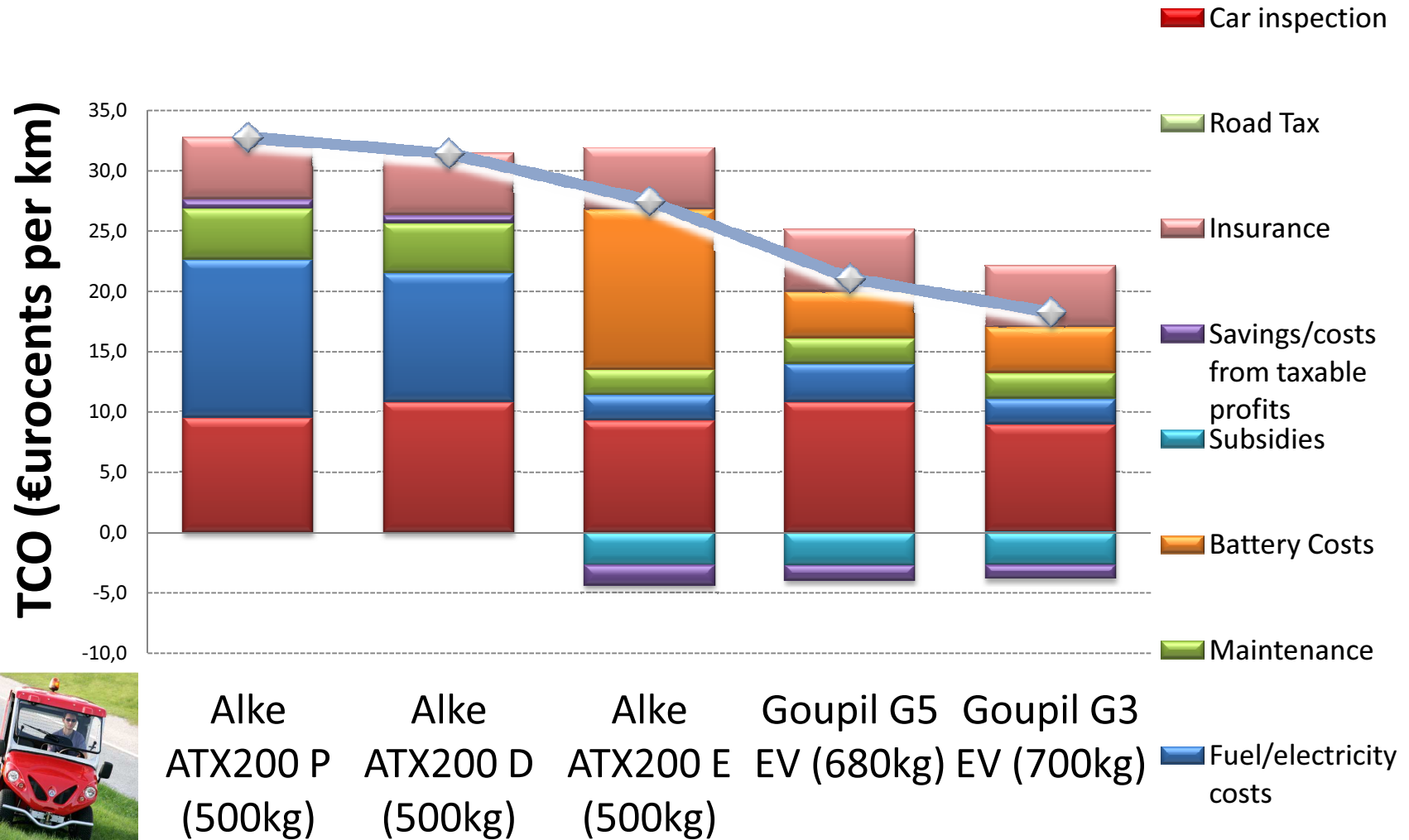
The well known OEM's are coming...



Mercedes-Benz



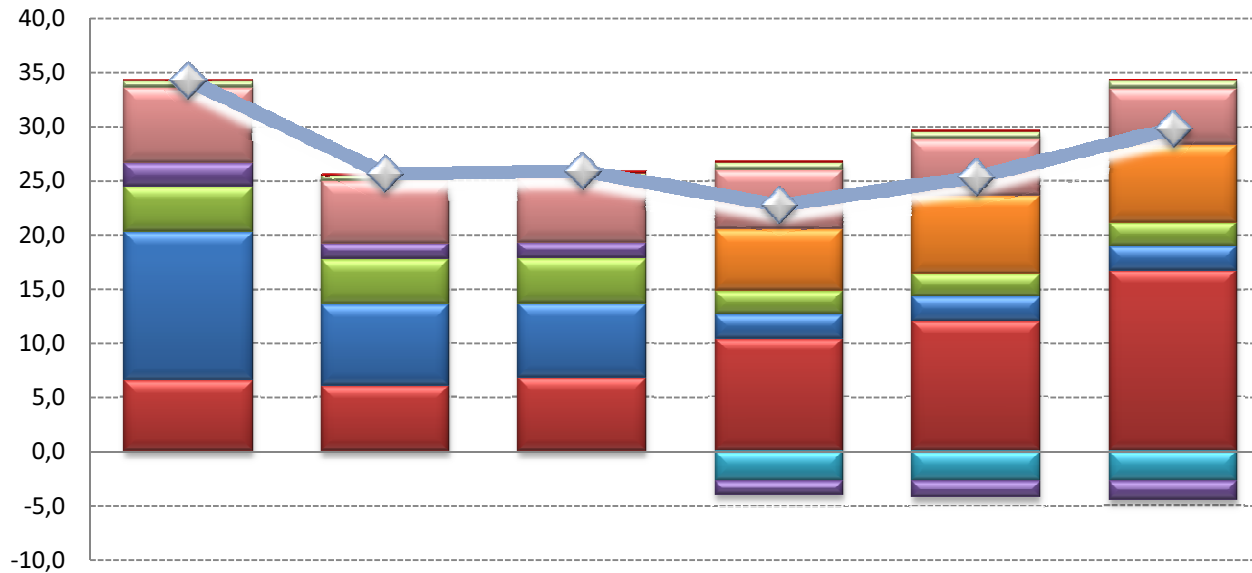
Quadricycles



Vehicles below 1 ton



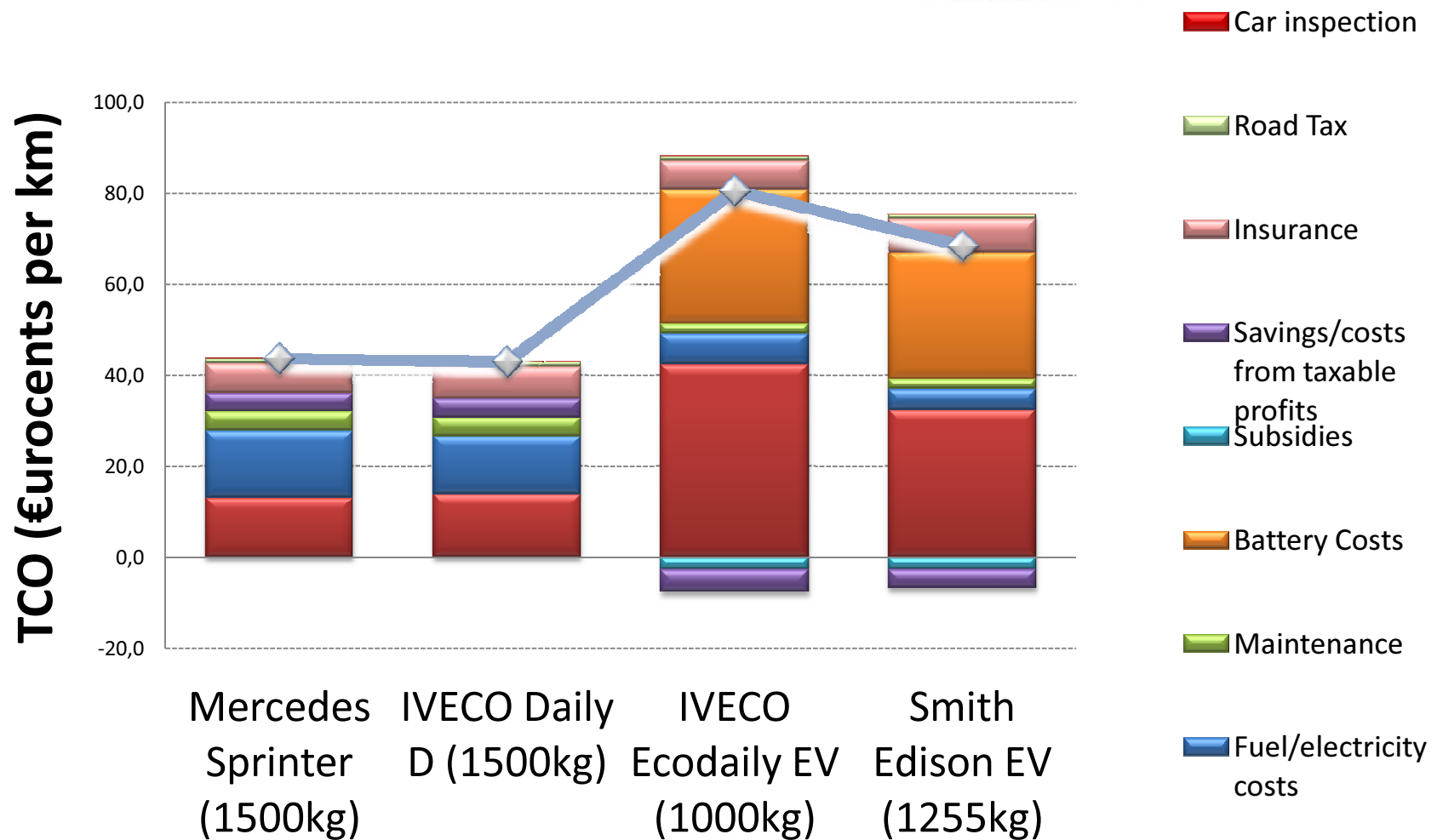
TCO (€urocents per km)



- Car inspection
- Road Tax
- Insurance
- Savings/costs from taxable profits
- Subsidies
- Battery Costs
- Maintenance
- Fuel/electricity costs

Renault Kangoo Express P (650kg)
 Renault Kangoo Compact Diesel (500kg)
 Renault Kangoo Express D (650kg)
 Renault Kangoo ZE (650kg)
 Mooville 2m³ EV (450kg)
 Mooville 4m³ EV (700kg)

Vehicles above 1 ton



Battery cost forecast



2010

A number of industry players have full battery pack at \$550-\$450/KWh already in line of sight.

2020

Note: All figures in 2010 dollars

Source: PRTM Analysis, Industries Interviews

Barriers for EVs



Expensive initial purchase cost

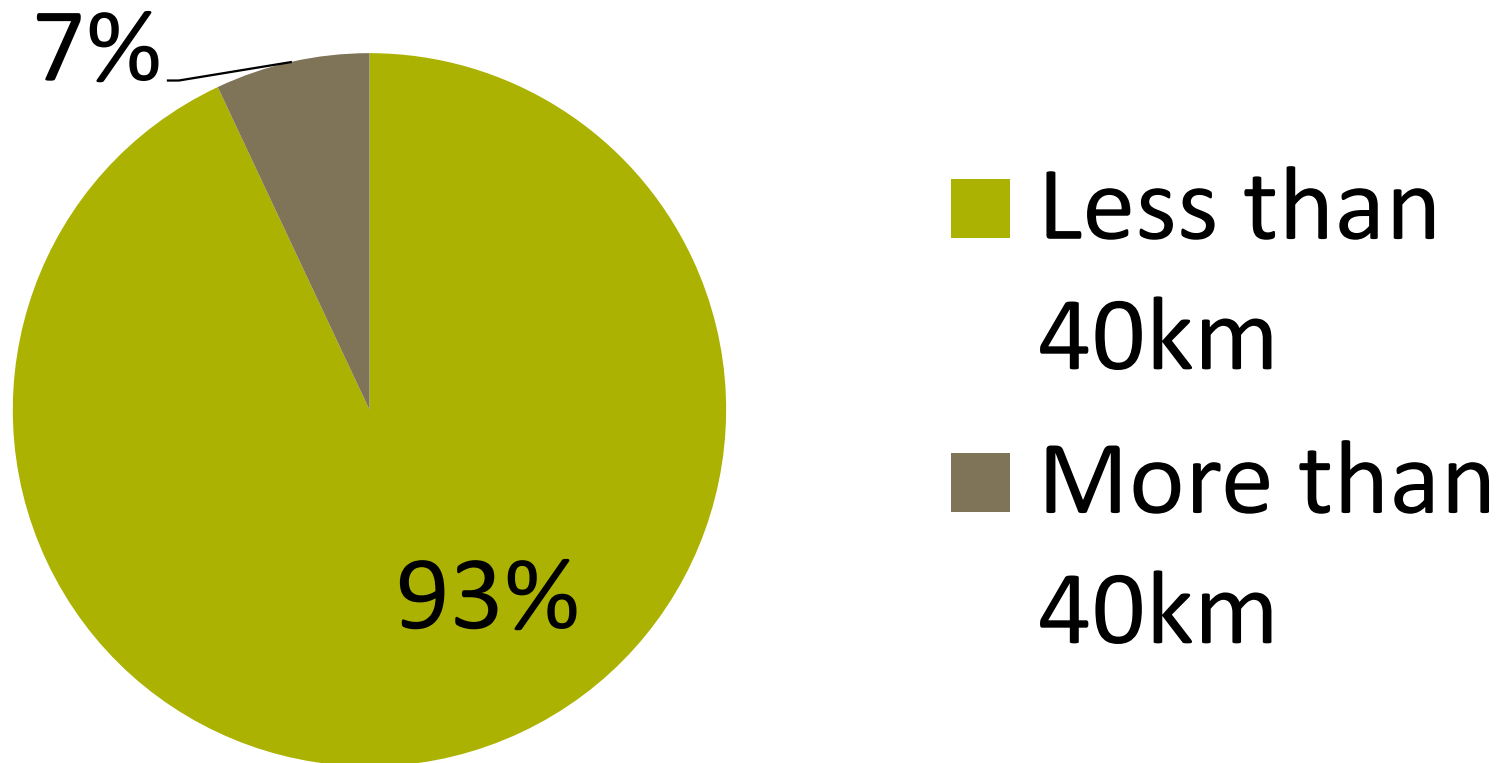


Limited driving range



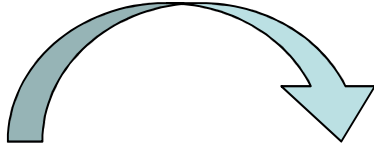



Limited charging infrastructure

Average daily travelled distance



Energy (Wh/kg)

	x2	x2	x2	x2
				
Lead	Nickel	Lithium	2020	2030
30 – 35	50 – 80	80 – 200	400 - 600	800- 1200?



Barriers for EVs



Expensive initial purchase cost



Limited driving range



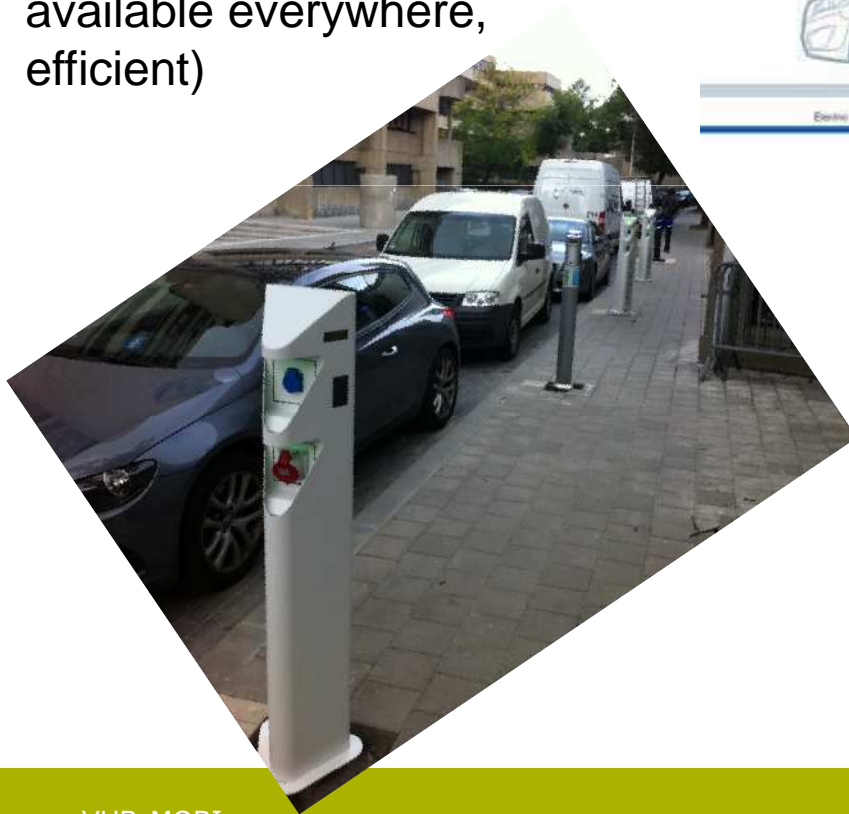
Limited charging infrastructure

Charging infrastructure

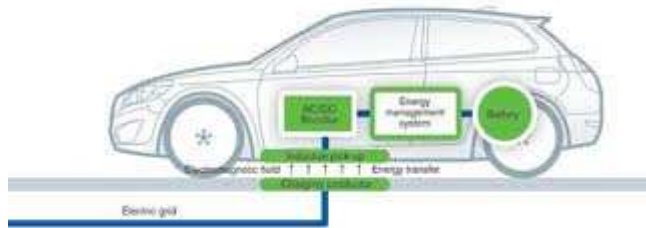
Normal charging

95%

(overnight, cheap, available everywhere, efficient)



Wireless inductive charging



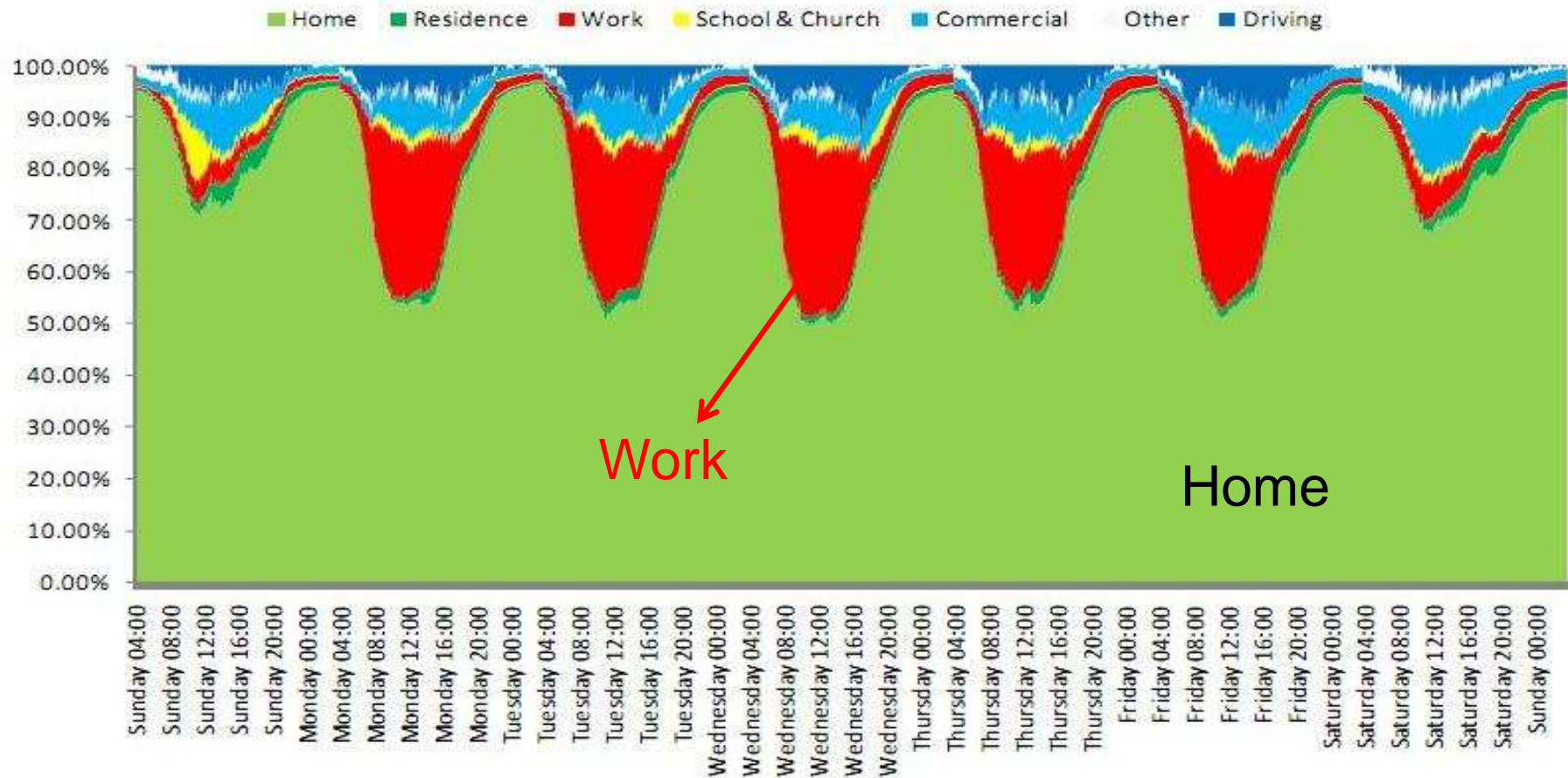
Fast charging (5%)



Battery swap

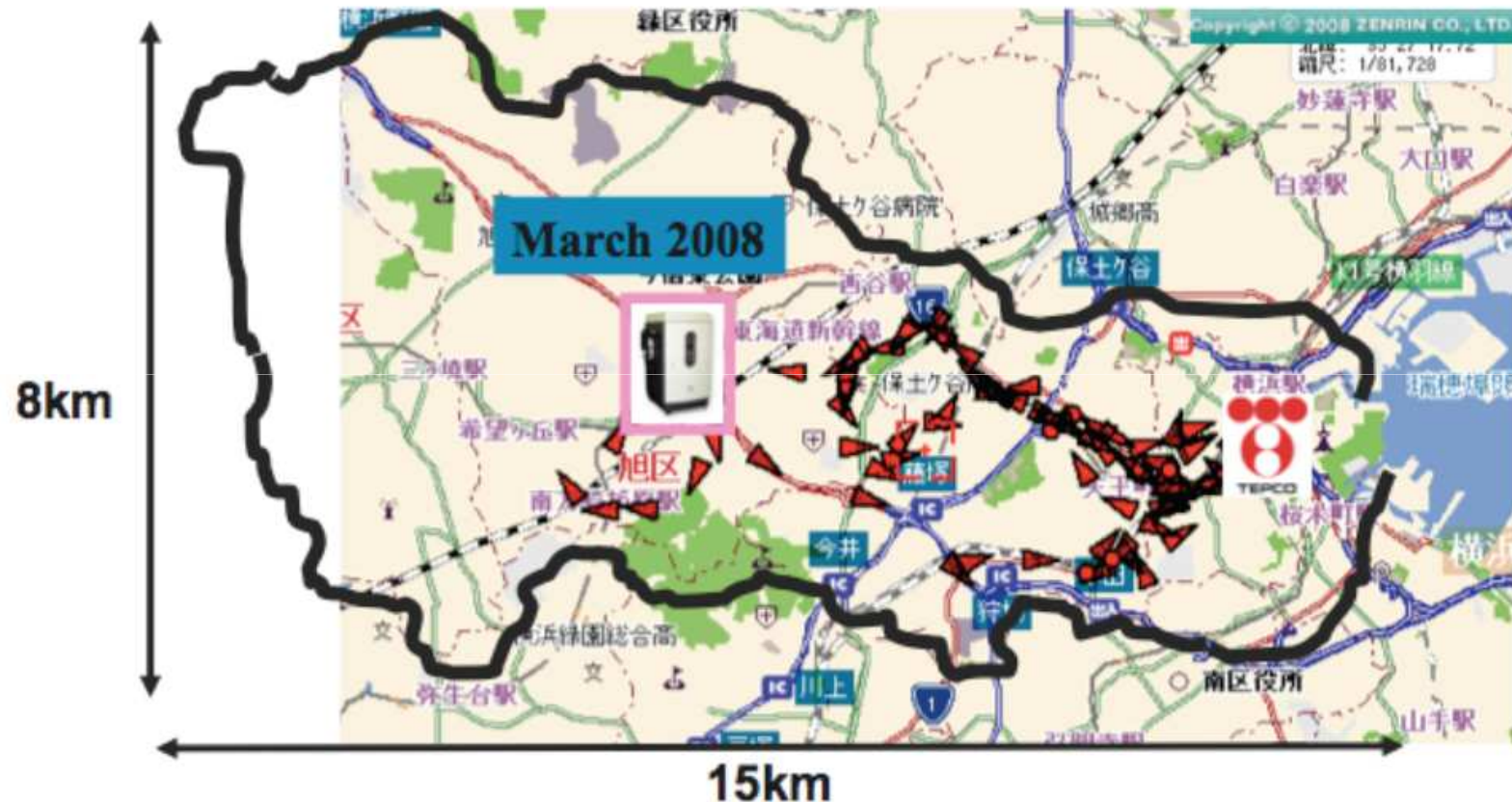


Infrastructure



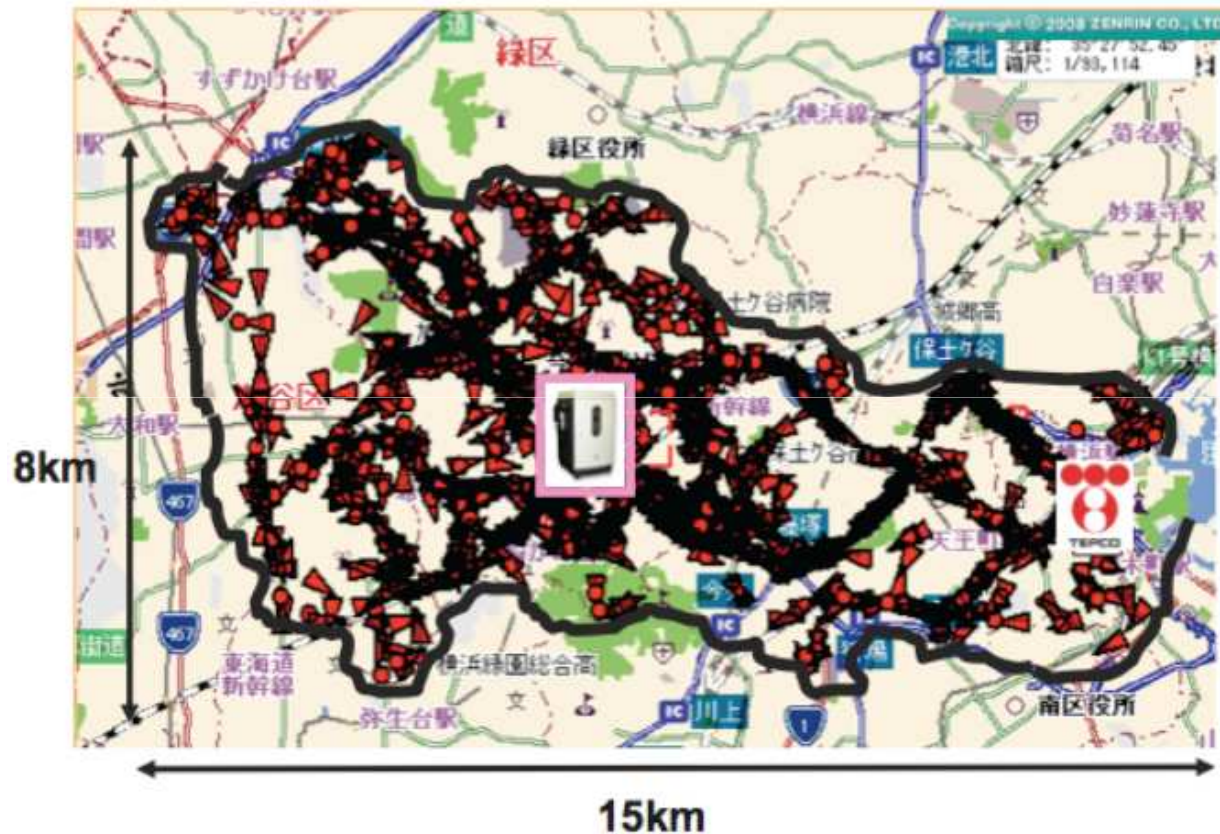
Source of Data - 2001 National Household Travel Survey ;
GM Data Analysis (Tate/Savagian) - SAE paper 2009-01-1311

Impact of charging infrastructure

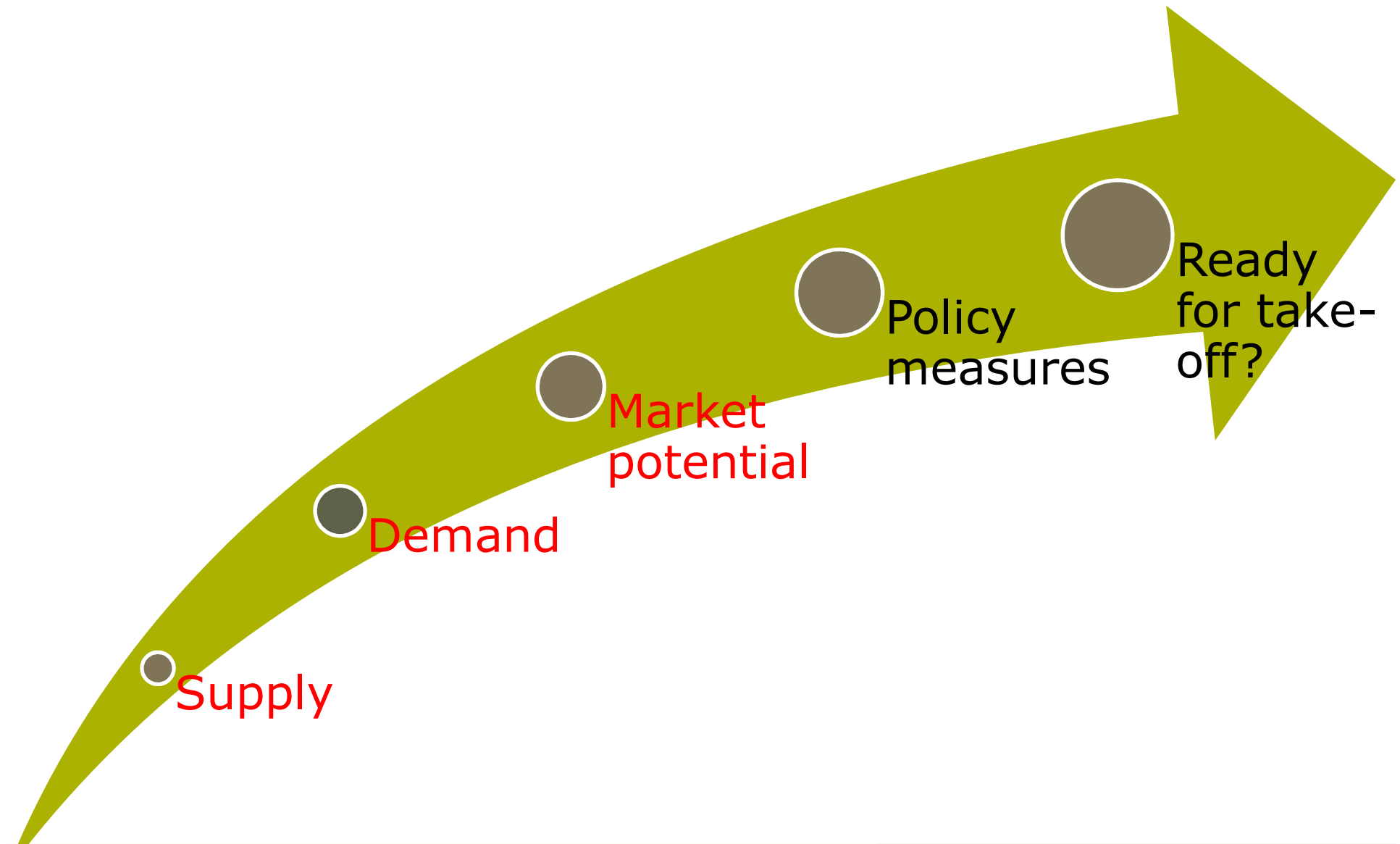


**Drive mileage was 203km before quick charger installation.
Driver understood EV performance but they were reluctant to use it.**

Impact of charging infrastructure



Drive mileage was drastically increase to 1472km after quick charger installation.



Market potential of BEVs and PHEVs

Large scale survey

Choice based conjoint analysis

- Horizon
 - 2012 (ST)
 - 2020 (MLT)
 - 2030 (LT)



Choice-based conjoint (CBC)

	Car A	Car B	Car C
Range	300 km	500 km	400 km
Price	€15.000	€17.500	€12.500
Max speed	100 km/h	140 km/h	120 km/h



Screenshot of CBC

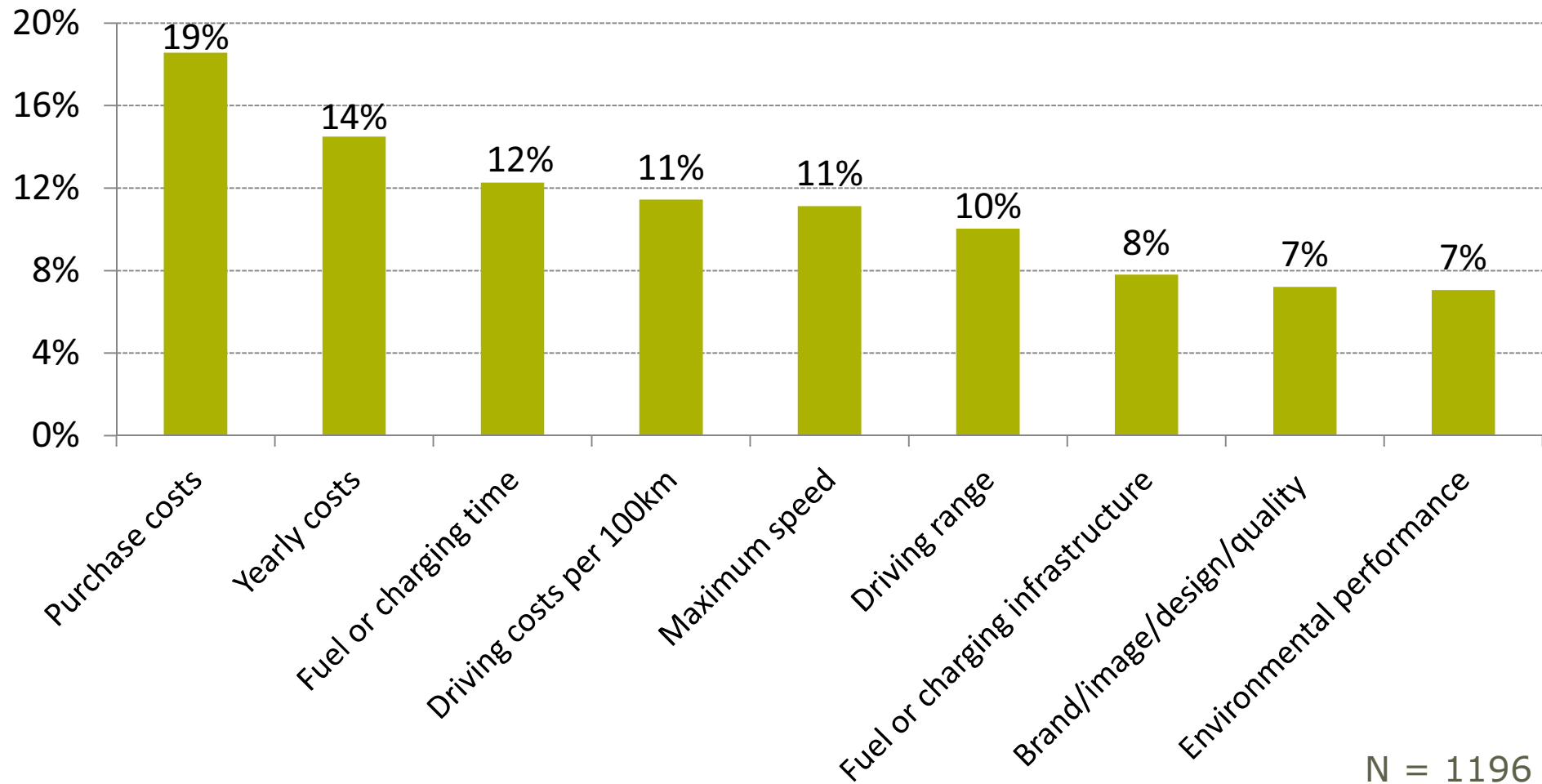
- Driving range
- Refuel or charging infrastructure alongside the road
- Refuel or charging time
- Brand / image / design / quality
- Maximum speed
- Annual costs
- Travel costs per 100km
- Environmental performance
- Purchase costs

300km	750km	1250km
120%	150%	100%
10min (station)	8u (home)	5min (station)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>
140km/h	200km/h	160km/h
500€/year	4500€/year	3500€/year
10€ / 100km	2€ / 100km	15€ / 100km
70	80	95
25.000€	15.000€	35.000€
0	0	0

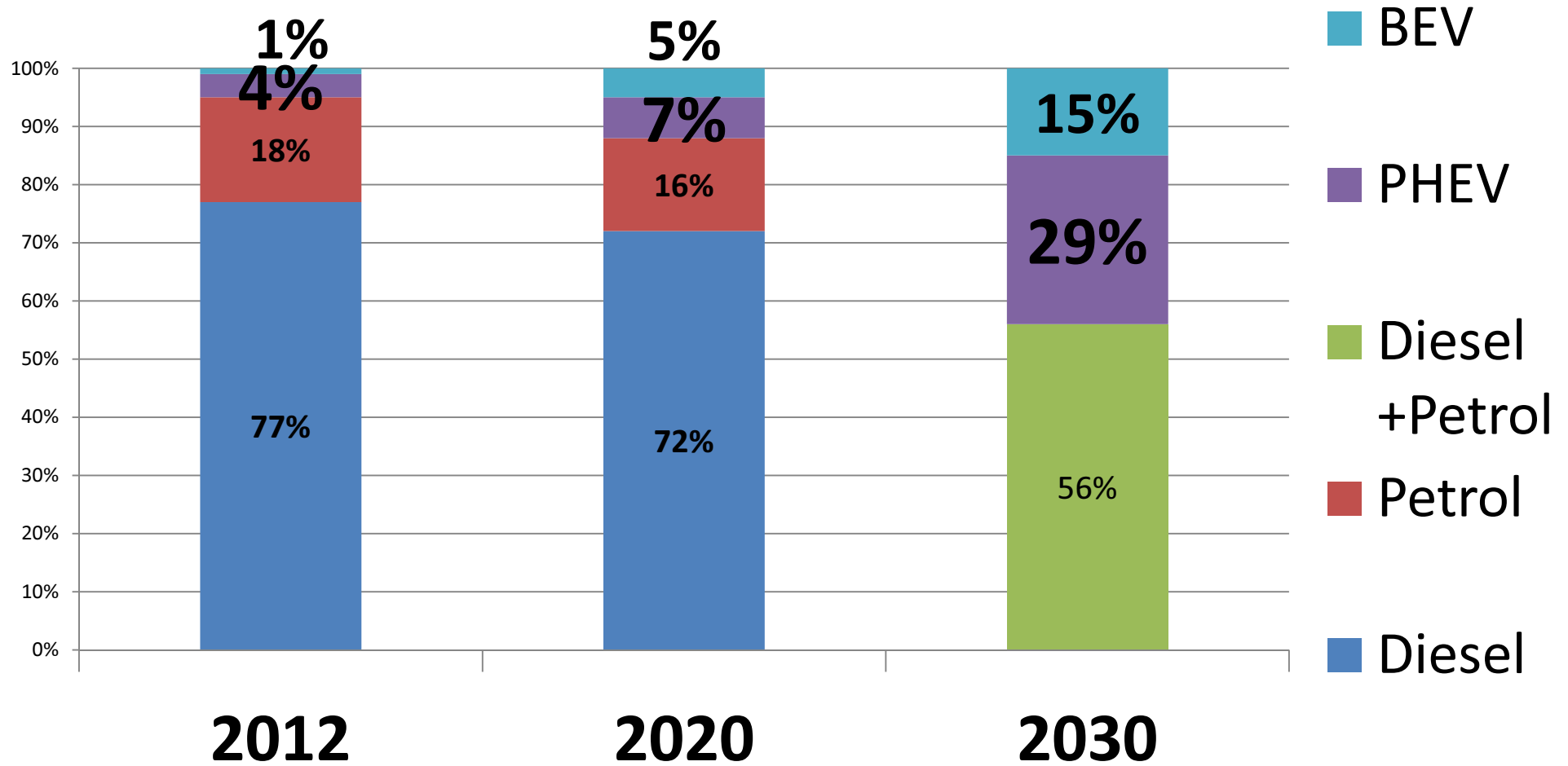
Would you really purchase this vehicle?

- Yes
- No

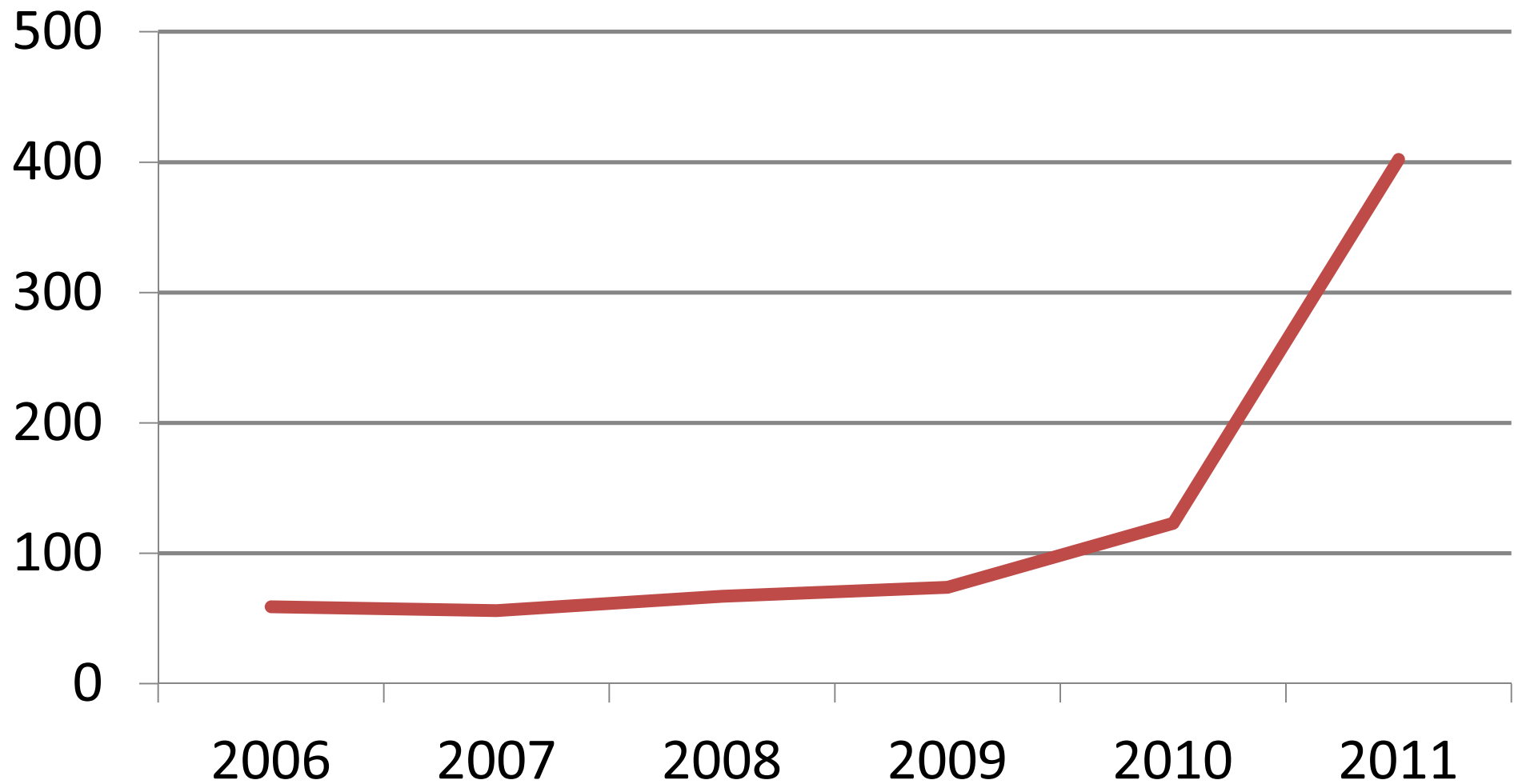
CBC results: weight of attributes

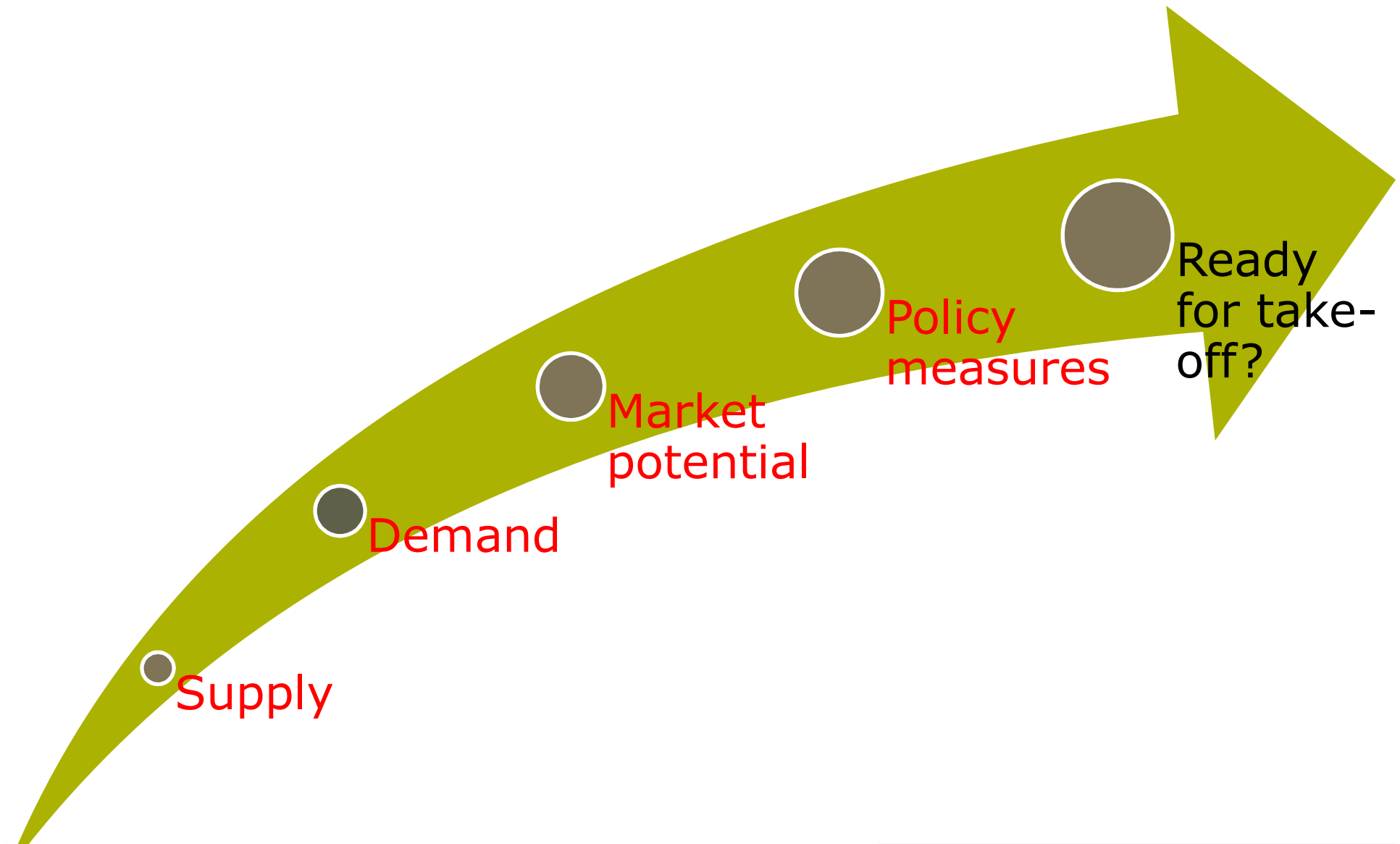


Forecasts



EV fleet in Belgium





EV financial incentives in Europe

Austria

No fuel consumption tax & no monthly vehicle tax

Belgium

30 % tax reduction on purchase price of EV (max € 9,190)
No registration tax in Flanders and lowest circulation tax

Czech Republic

No road tax for EV

Denmark

No registration tax for EVs
(normally between 105% and 180%)

Germany

No annual circulation tax (first 5 years)

Spain

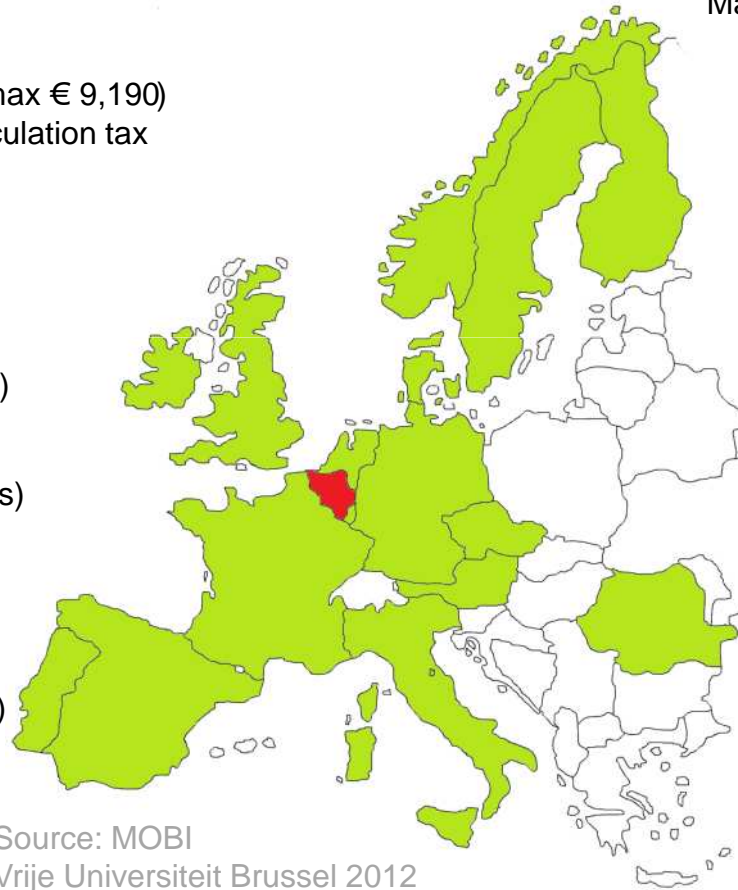
€ 2,000 to € 7,000 for EV

Finland

Minimum rate of registration tax (5%)

France

Max € 5,000 for EV
No company car tax



Source: MOBI
Vrije Universiteit Brussel 2012

Ireland

Max € 5,000 benefit on registration tax

Italy

No circulation tax (first 5 years)

Luxemburg

€ 5,000 for EV (ends in 2013)

The Netherlands

No registration and circulation tax

Norway

No VAT, free parking,
exemption from certain tolls

Portugal

No registration and circulation tax

Romania

No registration tax

Sweden

Max € 1,600 for EV
no circulation tax (first 5 years)

United Kingdom

Max £ 5,000 for EV, no annual
circulation and company car tax

Public incentives and support for infrastructure

Ireland

2.000 home chargers, 1.500 public slow chargers, 30 public fast chargers

United Kingdom

9,3 mio GBP for charging infrastructure
Target: 1.300 public charging stations in 2013 in London

France

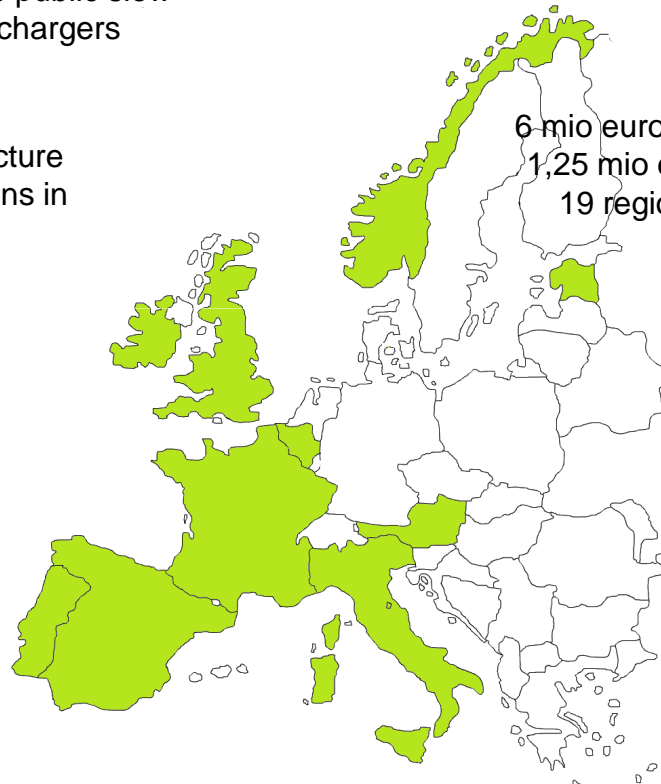
50 mio euro (2011-2015)
for 20 cities (slow/fast)

Spain

40% in MOVELE plan
(Madrid, Barcelona and Sevilla),
around 500 charging stations
Regional supports: 25%

Portugal

MOBI.E network: 1.300 slow chargers
and 50 fast chargers



Source: MOBI
Vrije Universiteit Brussel 2012

Norway

6 mio euro in 2009-2010 for 1.830 normal charging points
1,25 mio euro in 2011-2012 for 48 fast charging stations
19 regions: 1 mio euro yearly for slow/fast chargers

Belgium

40%, (max 250 euro) (ends 2012)
13,5% tax cut of investment for companies
installing fast chargers

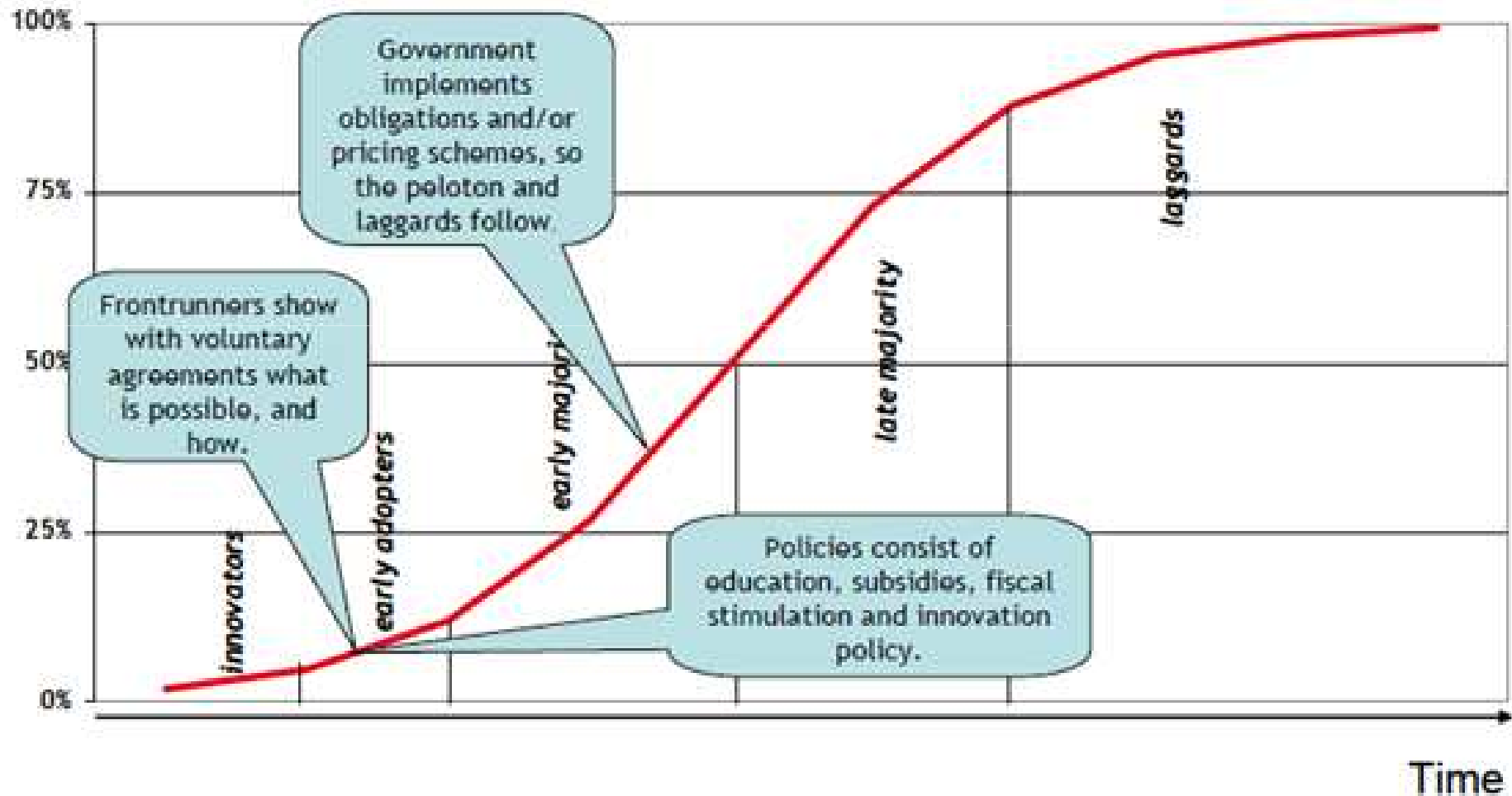
Austria

€1.000 for charging station (2010-2011)
Regional support: 30%

Italy

5 pilot projects, up to 2015,
>1.000 charging stations

Government support



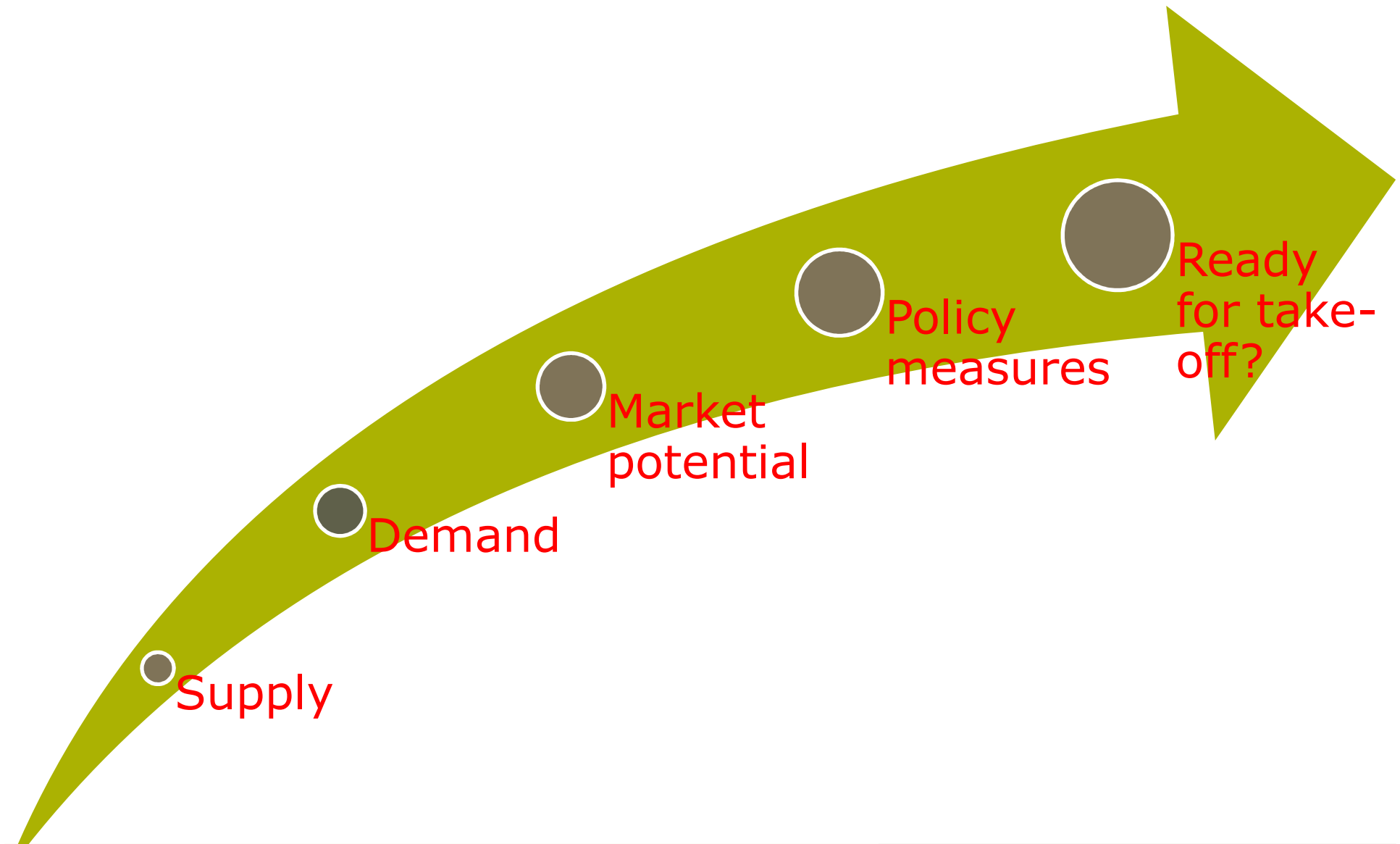
Types of support



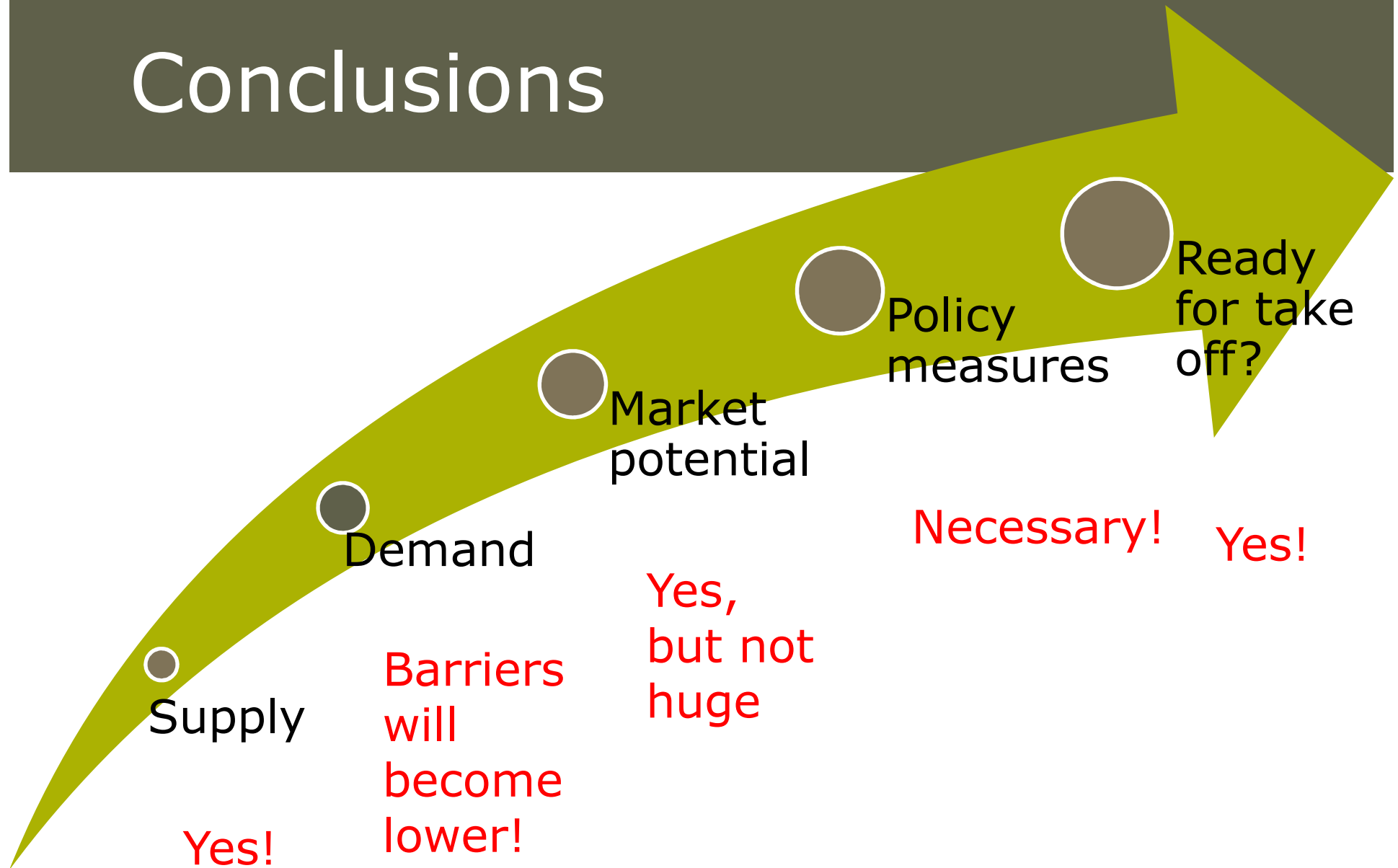
Living Labs for EVs in Flanders

- 2011-2014
- 5 platforms
- 600+ EVs
- 600+ charging points





Conclusions



More info?

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