Power electronics and systems applied to automotive: what can the energy sector learn from the automotive application?

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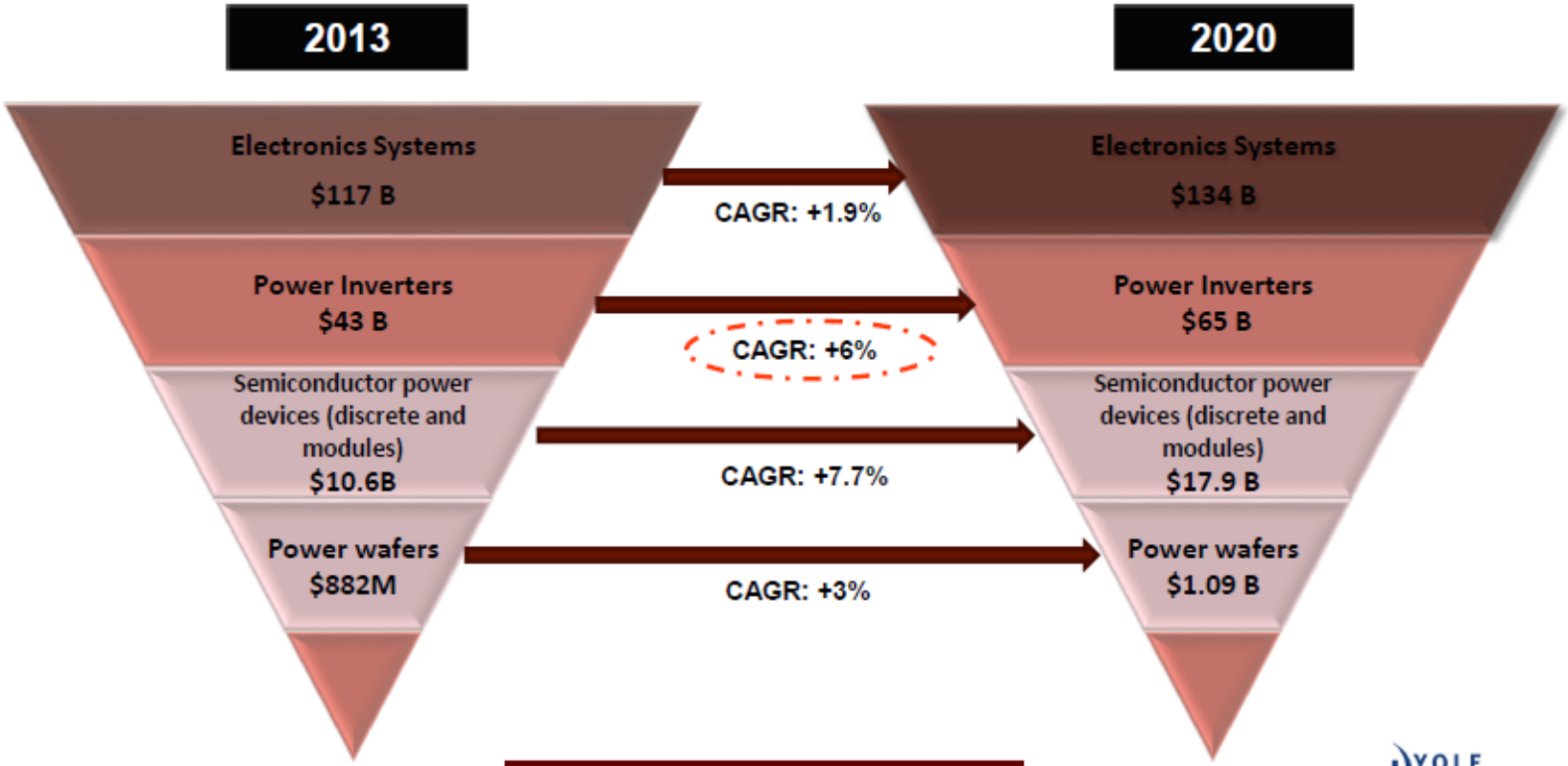
DG-ENERGY
Round Table
Brussels
September 4th, 2017

Power Electronics Market 2014-2020

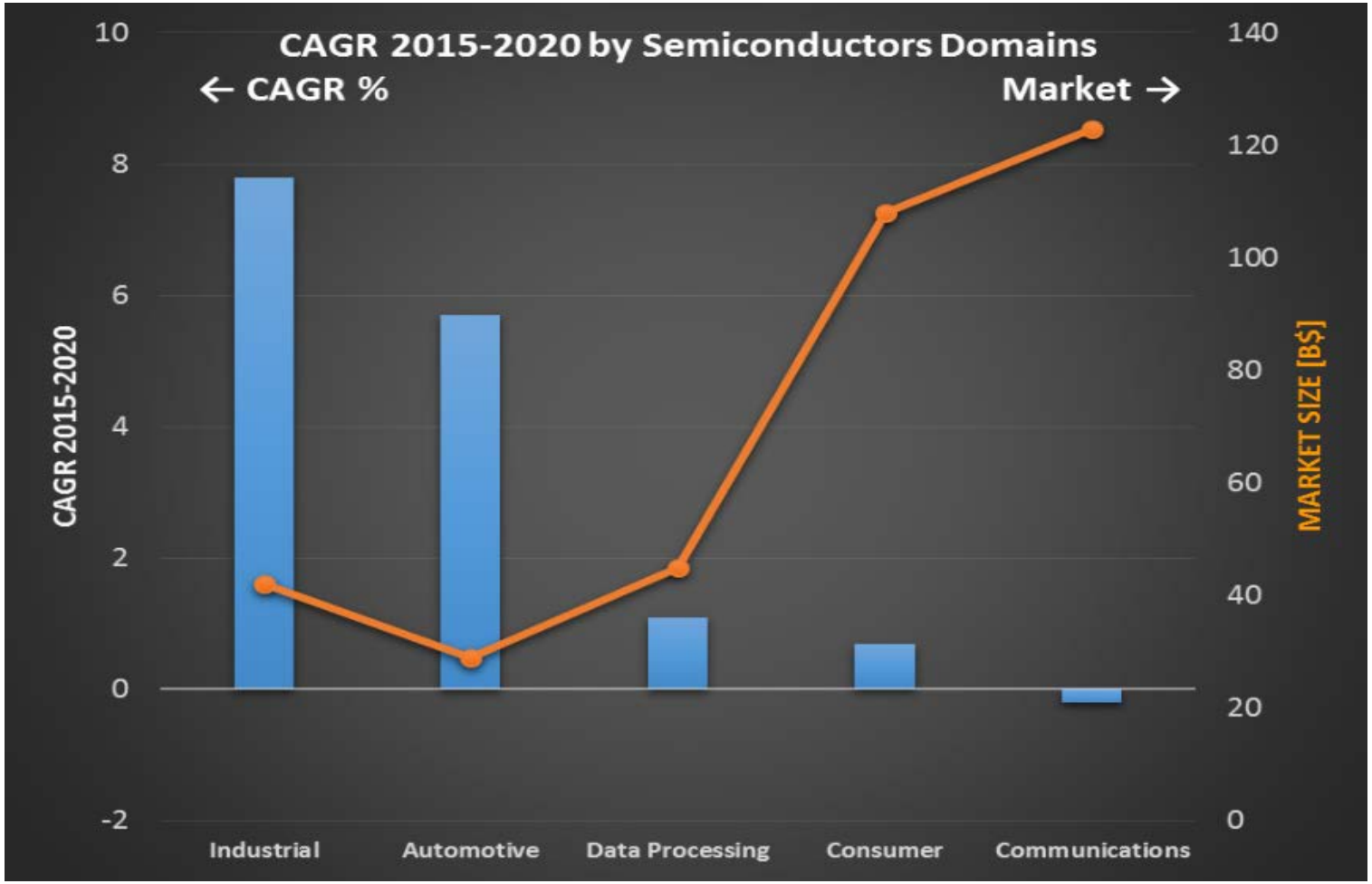
Overall Power Electronics markets

2013 – 2020 value chain analysis: wafer, device, system

The overall inverter market size of applications considered in this report will reach about **$65 billion in 2020**.



Power Semi shows the highest innovation potential for Industrial and Automotive



[source: WSTS 2016-2020]

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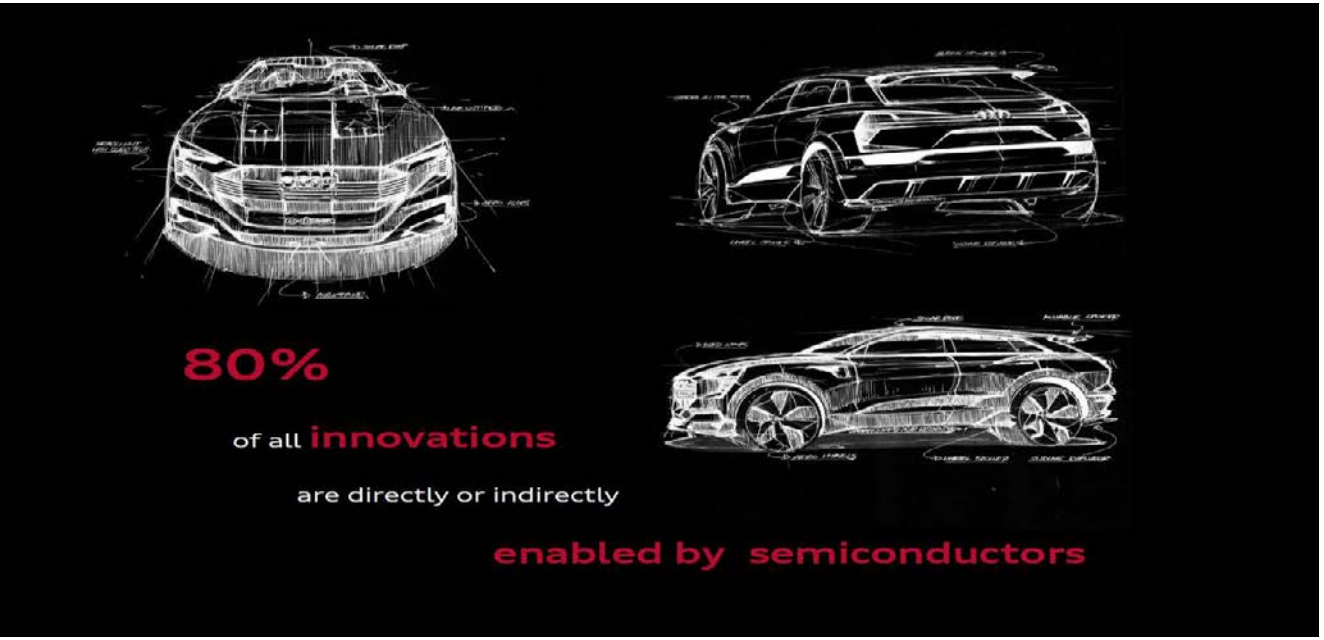
Semiconductor's Leading the new Mobility Transformation



Courtesy of Audi

2016- 2021

Semiconductor Market CAGR +3.3%

Automotive Semiconductors +5.9%

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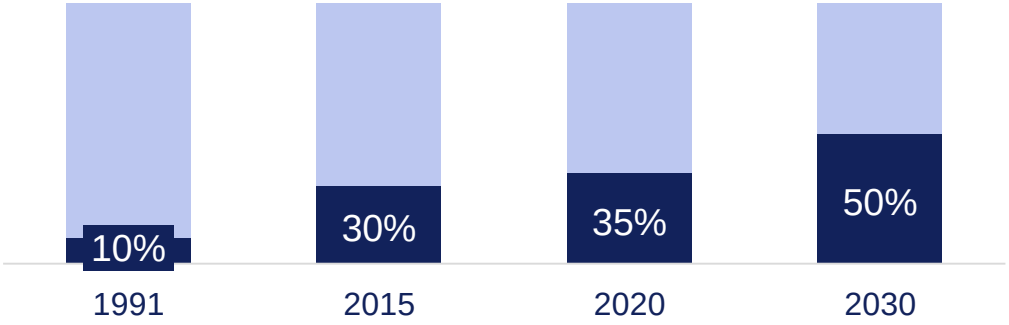
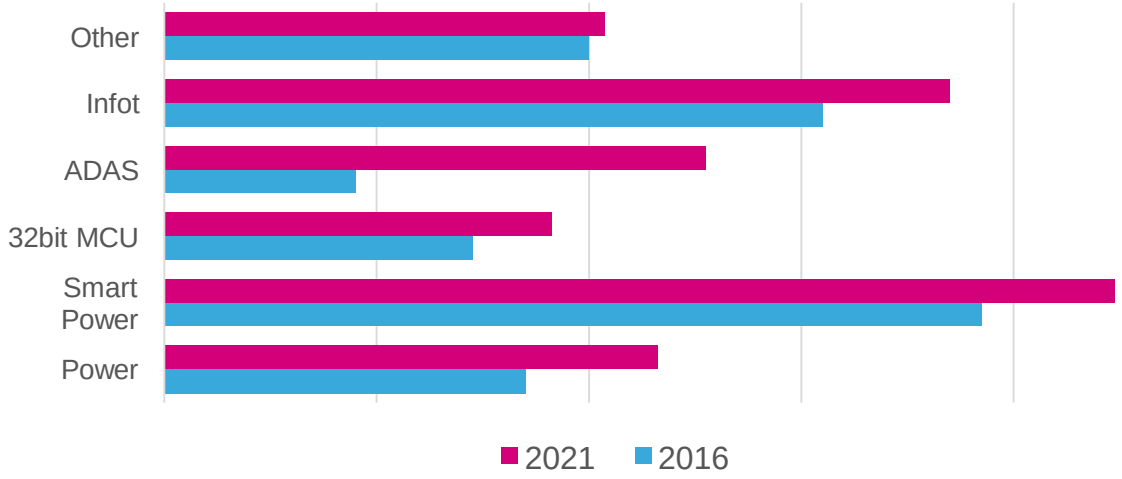
Electronic Component as % of Vehicle Cost (*)

(*) Data source: www.pwc.de



2016 to 2021 Automotive Semiconductor market



Automotive Semi demand 2015-2020 is expected to grow +5.9% CAGR

- In absolute numbers, the global automotive semiconductor market value is expected to be in the range 38-41 B$ by 2020, and reach 44.8B$ by 2023 (including semiconductor-based sensors).

  Worldwide every year we have 17 trillion vehicle*km traveled (1.7 Light Year) and more than 600 billion hours (68 million years) spent by humans in cars every calendar year.

- The emissions scandal at VW, now spread to most of the DE large car manufacturers, has re-focused the industry's attention on EV.

- This strategy's under pressure now: **significant commitment of OEM to increasing the mix of hybrid, partial-hybrid and battery EV vehicles hitting the roads over the next few years. This matches with the launch of the next generation EV vehicles aimed at mass market** (i.e. <30 KEUR price and >300 Km range per recharge, like *TESLA Model-3*).

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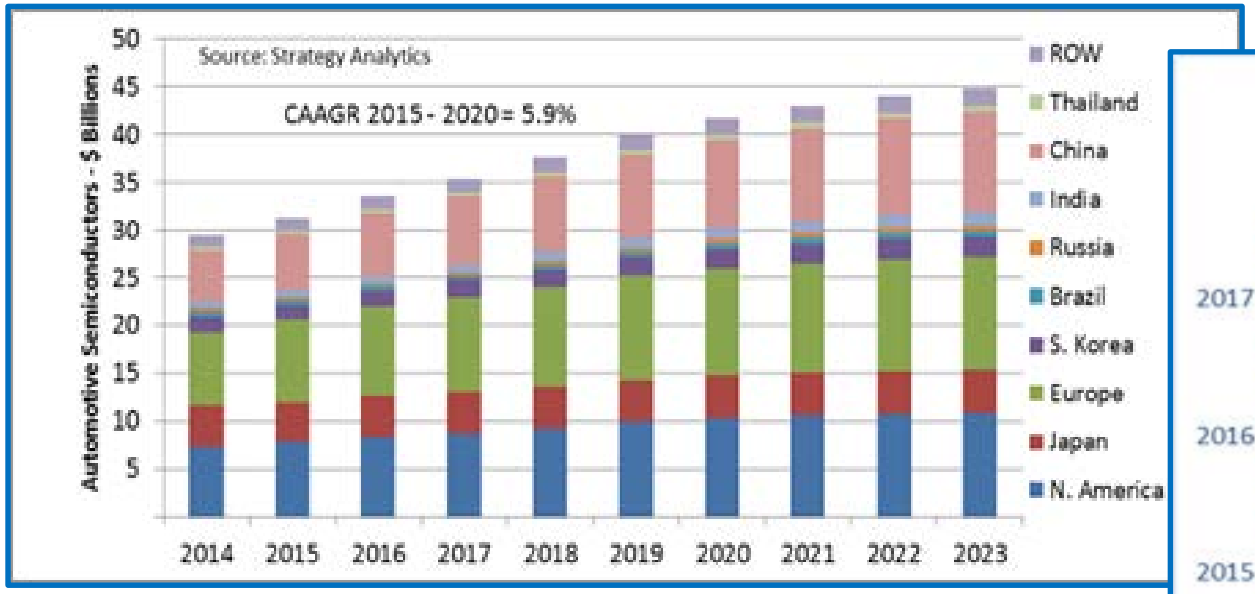
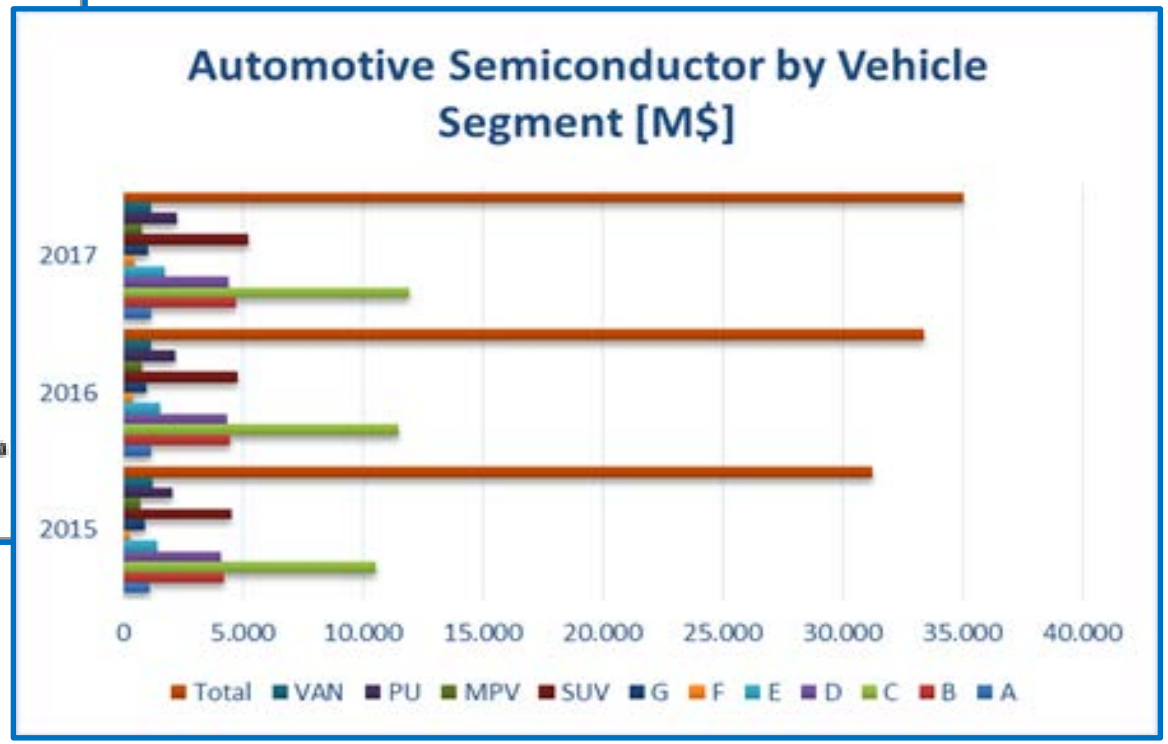
[source: WSTS 2016-2020]

Automotive Semi demand 2015-2020 is expected to grow +5.9% CAGR

- Electric powertrain could generate 540 M€ of semiconductor revenues in 2018 and almost 800 M€ by 2020 with ST extremely well positioned to take a significant portion of this.



Auto supply chain inventories remain healthy. China and Europe drive growth.



Semiconductor content per different car segments [US$]

[source: Strategy Analytics, 2016]

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Power Semi is projected to grow x5 on hybrid vehicles

- It is also worth highlighting the strong opportunity that HEV/FEV charging infrastructures represent for MOSFETs (High and Low Voltage), which are forecasted to be largely adopted by 2020 in charging stations.

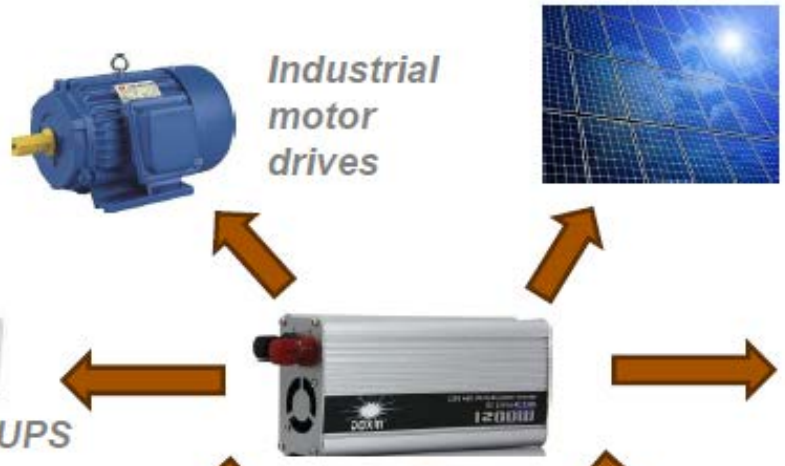
- For instance, **China just launched in 2016 an initiative to develop a charging station network (one every 50 Km)**, limited to major highways so far. This translates into more than 4.5 million charging units of ~100 KW each, i.e. more than 100 MOSFETs per unit, leading to a total semiconductor content per charging point of 200 to 300$. This Chinese initiative alone would represent an opportunity of 1.13 B$.

Efficient Generation and Use of Energy

Applications of inverters

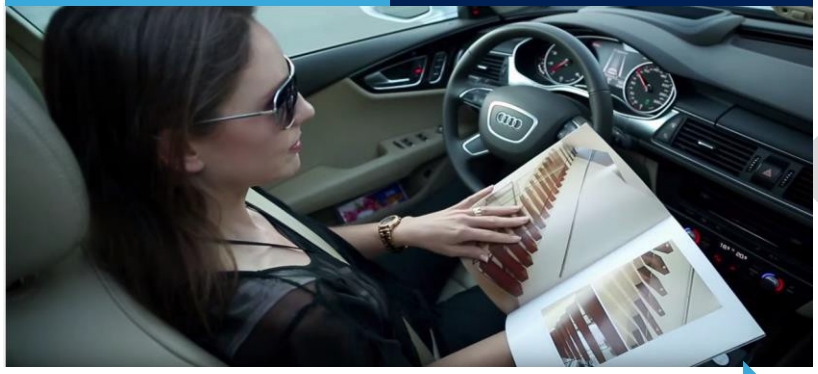
Inverters are in the center of all present and future evolutions of many applications. The development of power electronics becomes "inverter-centric".

- The applications described in this report are the followings:



ST is about Smart Driving

Safer | More Connected



Car Digitalization

- Sensor fusion processors
- 77GHz/24GHz RADAR processors
- Machine vision processors
- 32-bit MCUs specific for automotive
- Infotainment processors
- Telematics processors
- Positioning, Wi-Fi, tuners
- V2X connectivity

Silicon technologies
Application knowledge
Key partners
Customer portfolio
Proprietary IP
Security Expertise

Greener

Analog and Power Technologies

- Smart Power ASIC's
- Smart Power ASSP
- Image and MEMS sensors
- Battery management IC's
- Motor controllers/drivers
- HV MOS, IGBT power drivers
- Silicon Carbide diodes and MOSFETs

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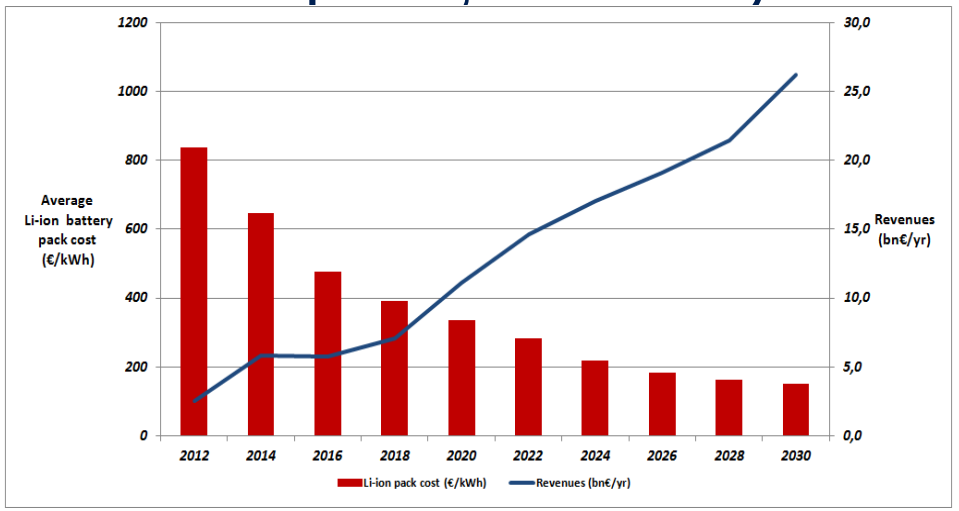
The Discrete Charm of Electrification

- Electric car sales reached 750,000 vehicles worldwide in 2016.
  China alone over 300,000 vehicles.
  40-70 million Electric Vehicles forecasted by 2025.

- The electrification is increasing at an incredible pace, driven by:

  1. Cheaper battery technology and
     acceptable mileage range (i.e. >150 Km)

Battery cost vs. sales trend →



  2. Drive performance allowed by latest generation Power electronics
  3. Ecologic awareness, i.e.: CO2 & NOx & PM10 reduction, Energy saving, etc.

[Source: www.iea.org]

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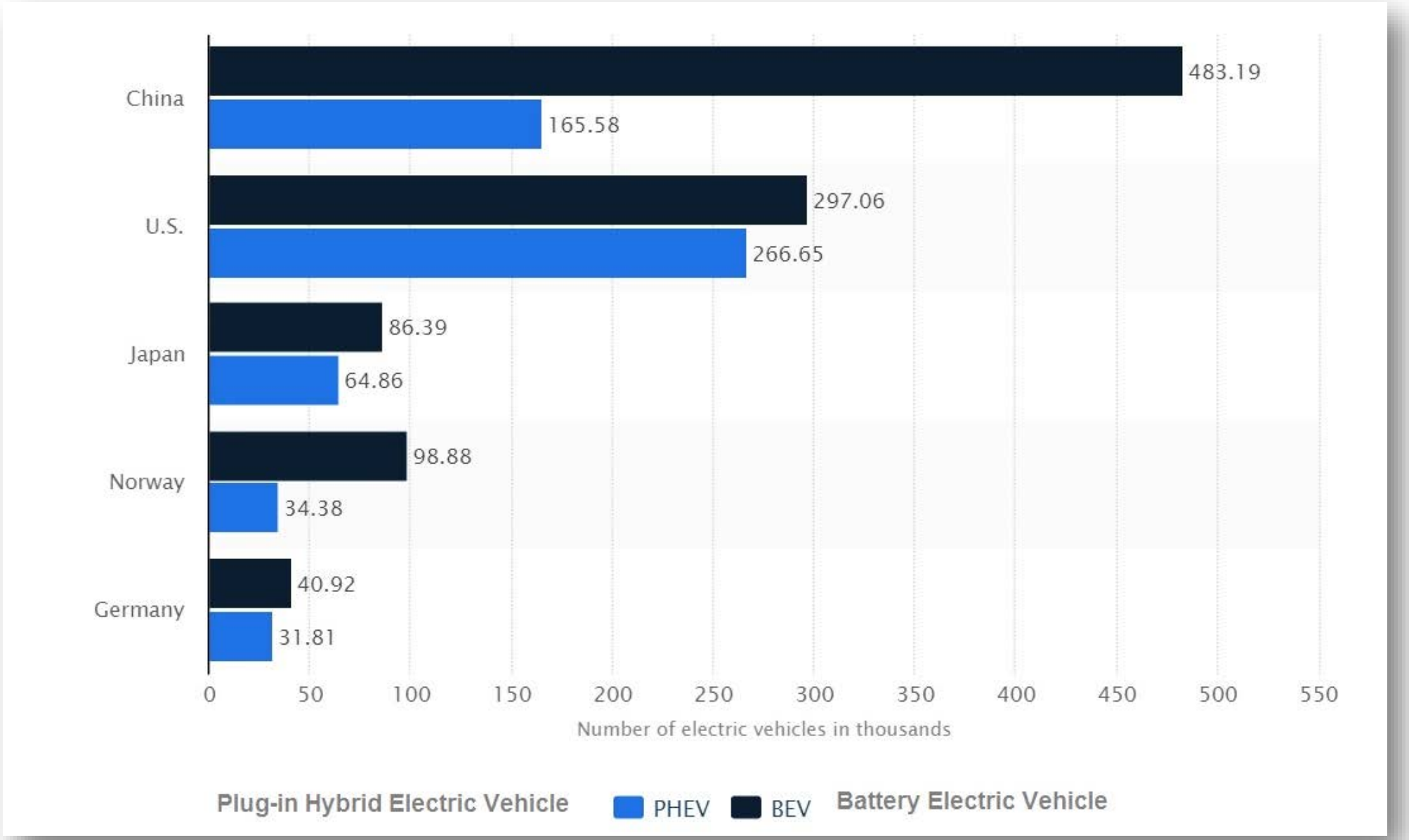
Electric vehicles in use in selected countries (2016)



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Electromobility is growing Bottom-up!

While most of the attention is on electric conventionally sized vehicles (i.e. Cars) the developments are mostly growing bottom-up

- Most of worldwide market is made by e-bikes: >50 Munits/Y with a CAGR of 5-7% for the next 5 years.

- The highest growth is led by low-speed 4-wheel vehicles:
  - China: 1.2-1.5Mu LSEVs produced in 2016 mostly by newcomers

  - Japan: kei e-cars 80% to 100% CAGR.

Ueyama mobility project in Japan →

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3 main areas in electric vehicles (both FEV and HEV) where Power Semi will fit

1. **The on-board-charger**

   The onboard charger or OBC is integrated into the car. It converts energy coming from the grid (110VAC or 220-240VAC) to a DC voltage required internally to charge the battery. The DC voltage is typically 400V DC, but 800V DC is also used to provide faster charge times.

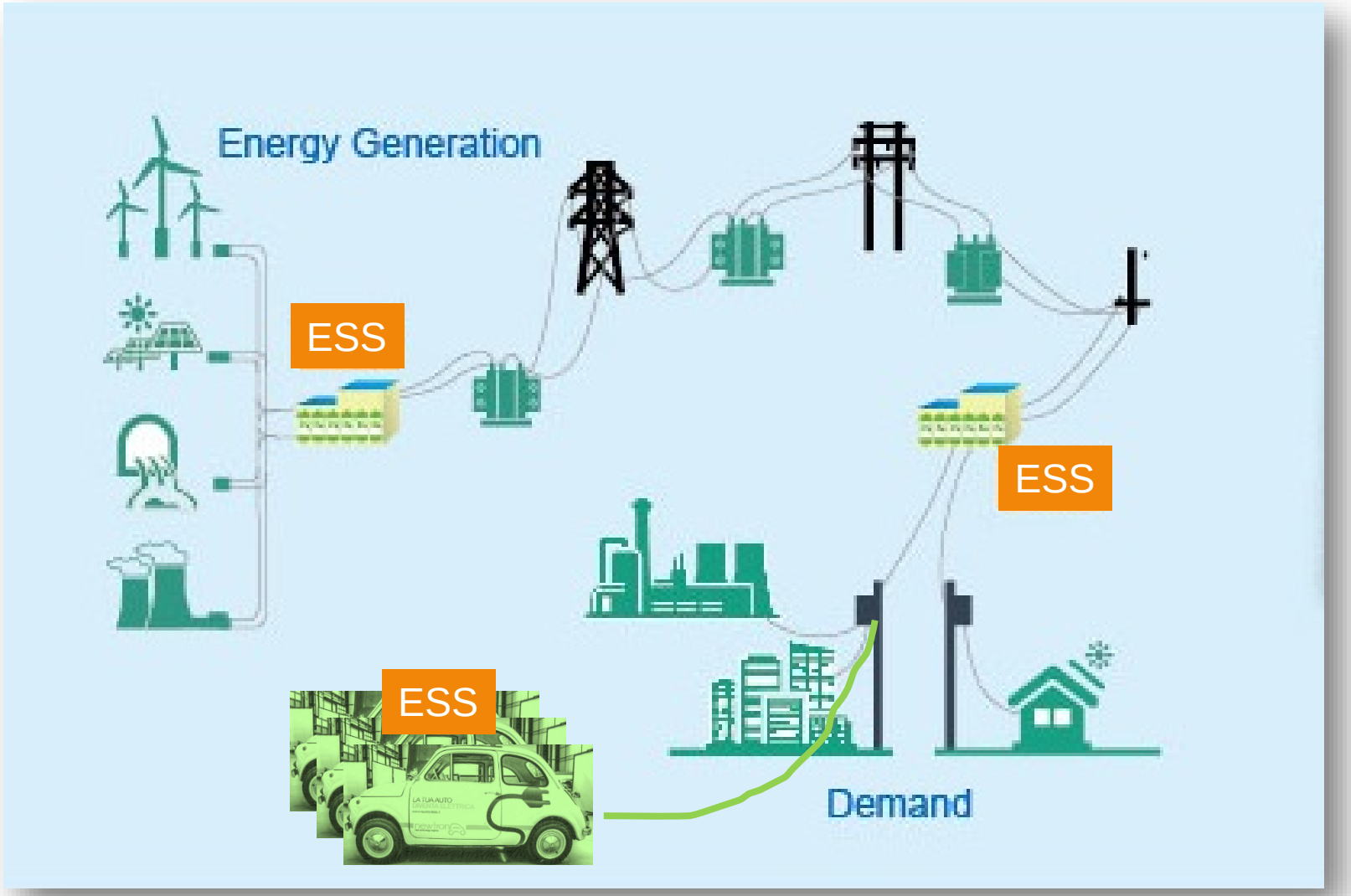
2. **the DC/DC converter**

   It converts the battery's 400V (or even 800V) to 48V, 48V to 12V and other in-vehicle's appliances.

3. **the Traction inverter**

   provides power to the main electric motor(s). This is then used to drive the wheels and control the speed of the vehicle. In a typical configuration, the electric motor requires 3 phase AC voltage. This is why the traction inverter is sometimes called a "DC-AC converter". The output power can commonly reach up to 85-100 kW.

FEV's will feature massive energy storage spread across the Grid!



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ST is making Driving Greener

Energy Efficient

What Greener Driving Means

- Improving power and fuel efficiency in car electronics and helping people drive (or be driven) to minimize fuel consumption, emissions and wear and tear on their cars
- Moving towards hybrid and electric vehicles

Greener Driving Technologies

Processors (EMU, ECU), Low Power MCUs, GNSS, V2X, Power Electronics, Wide Band Gap technologies (SiC GaN), Sensors

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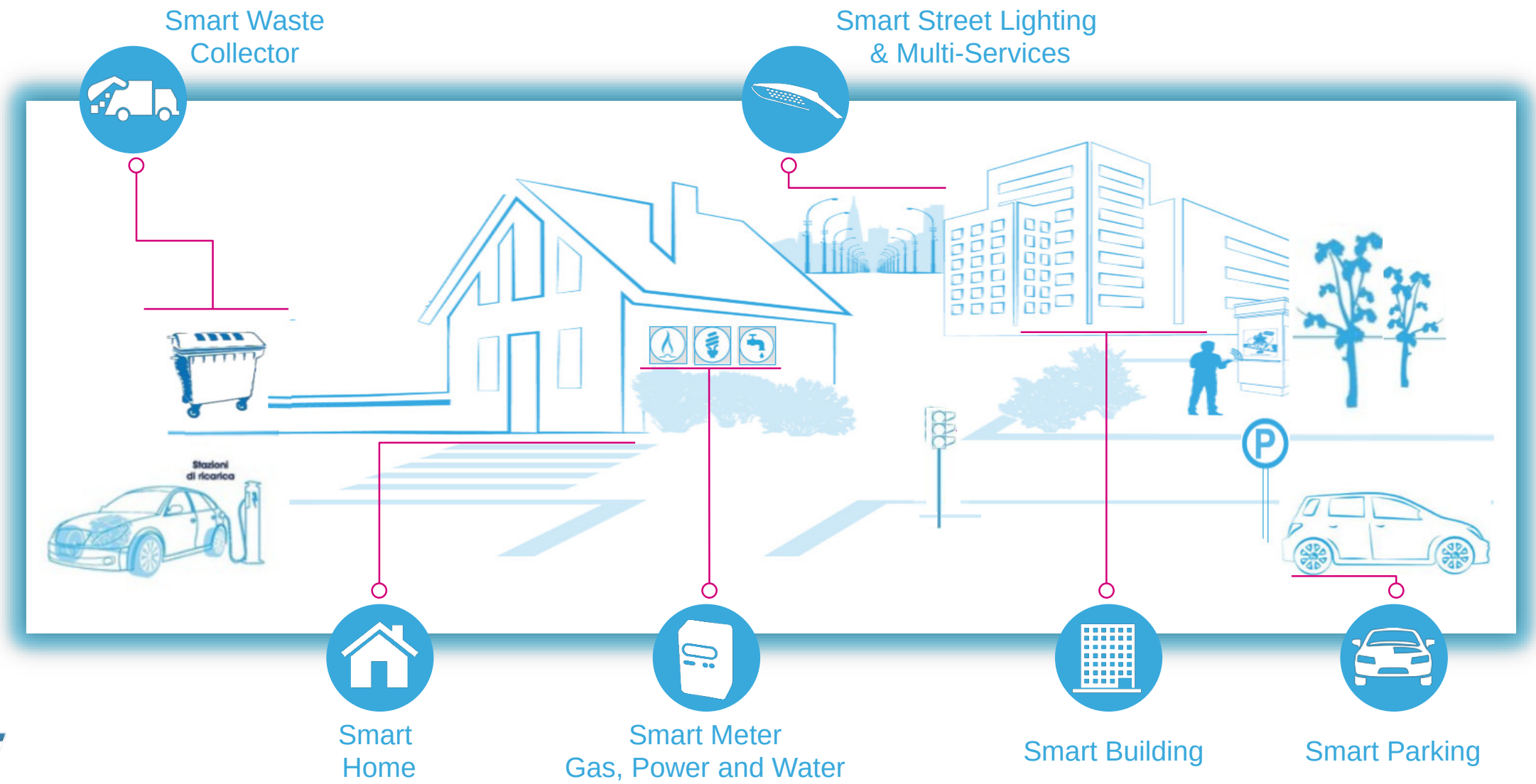
Examples of multi-mode integrated Mobility



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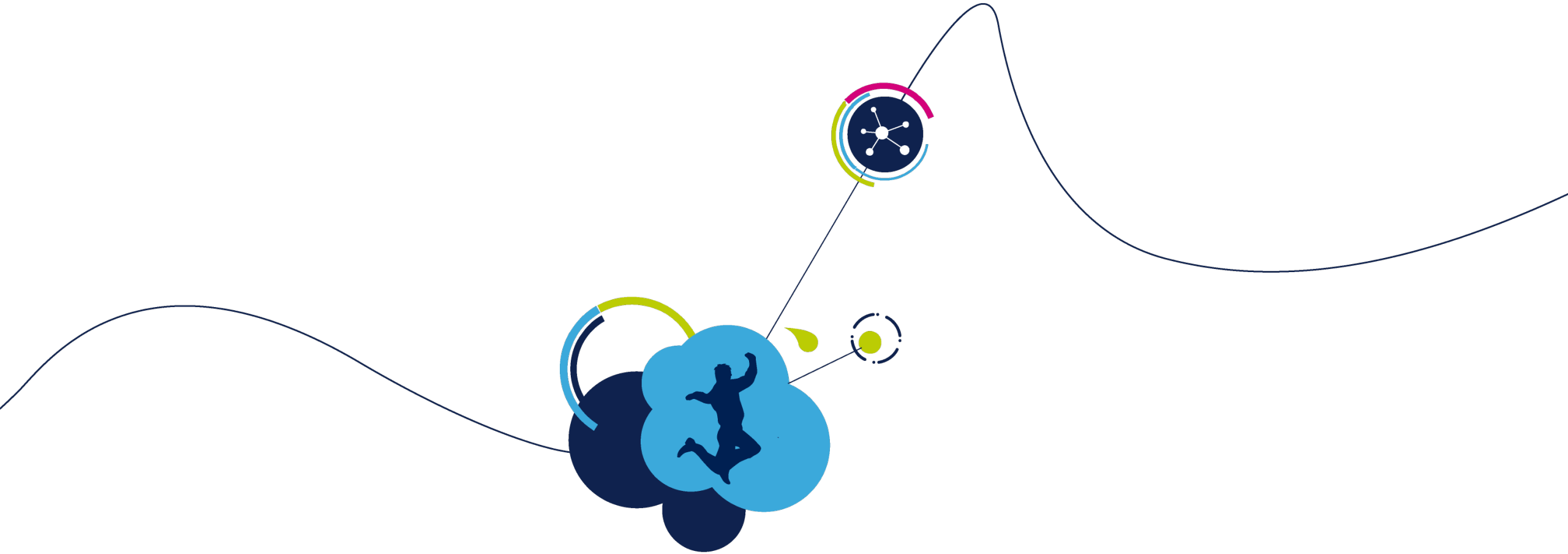

Thank You

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