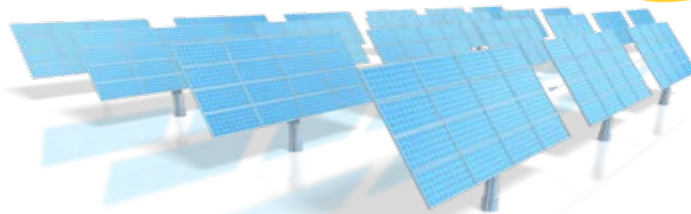


Internet of Energy

for Electric Mobility



IoE
Internet of Energy



Dr. Ovidiu Vermesan, Chief Scientist, SINTEF

24 November 2011, Munich, Germany

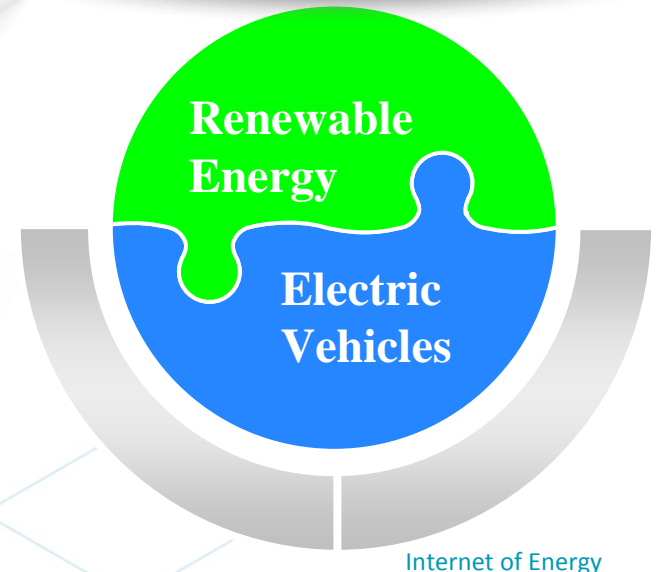
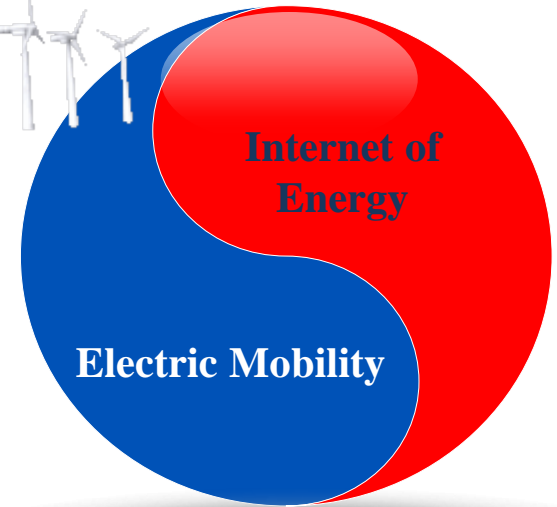


Advanced Research & Technology for Embedded Intelligence and Systems

Presentation Outline



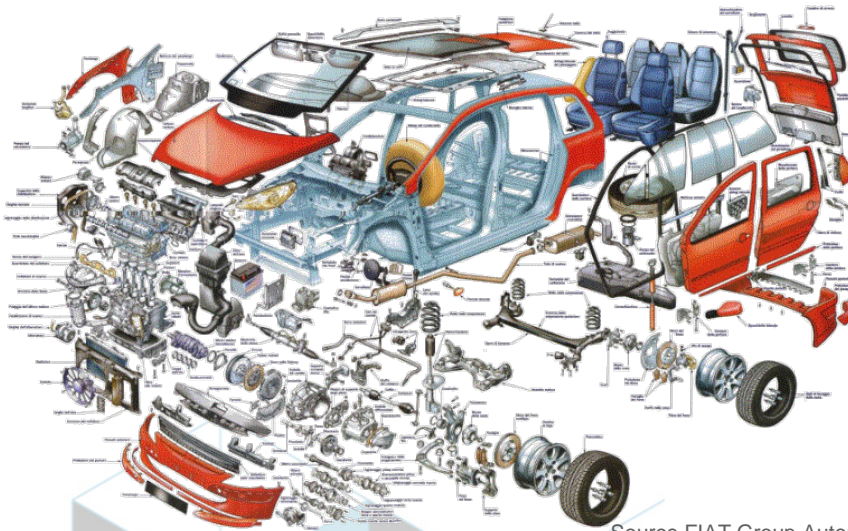
- ▶ Introduction
- ▶ Objectives
- ▶ Technological Challenges
- ▶ Partners
- ▶ Summary



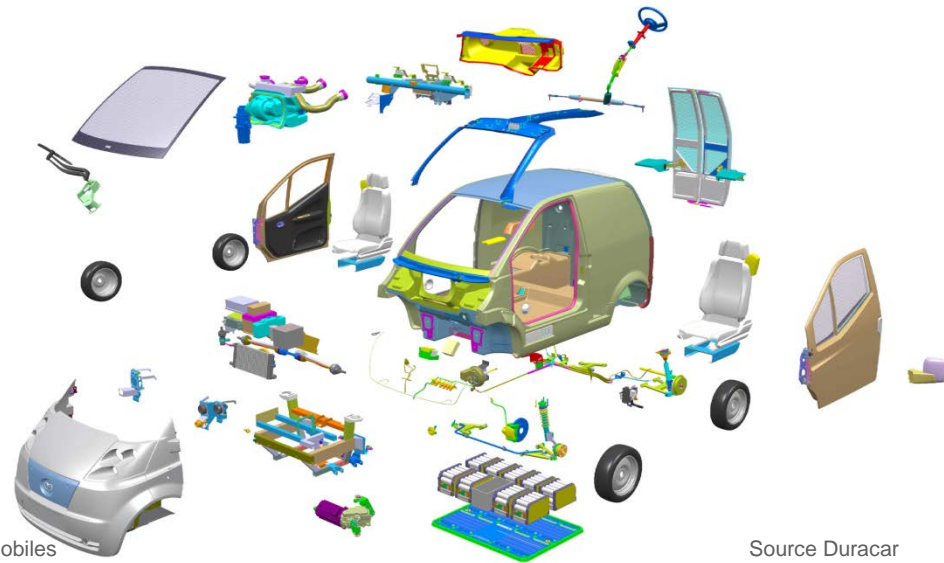
Future Vehicle



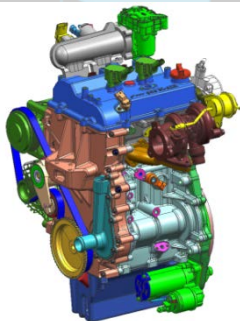
► From mechanics to mechatronics



Source FIAT Group Automobiles



Source Duracar



Mechanical
Craft

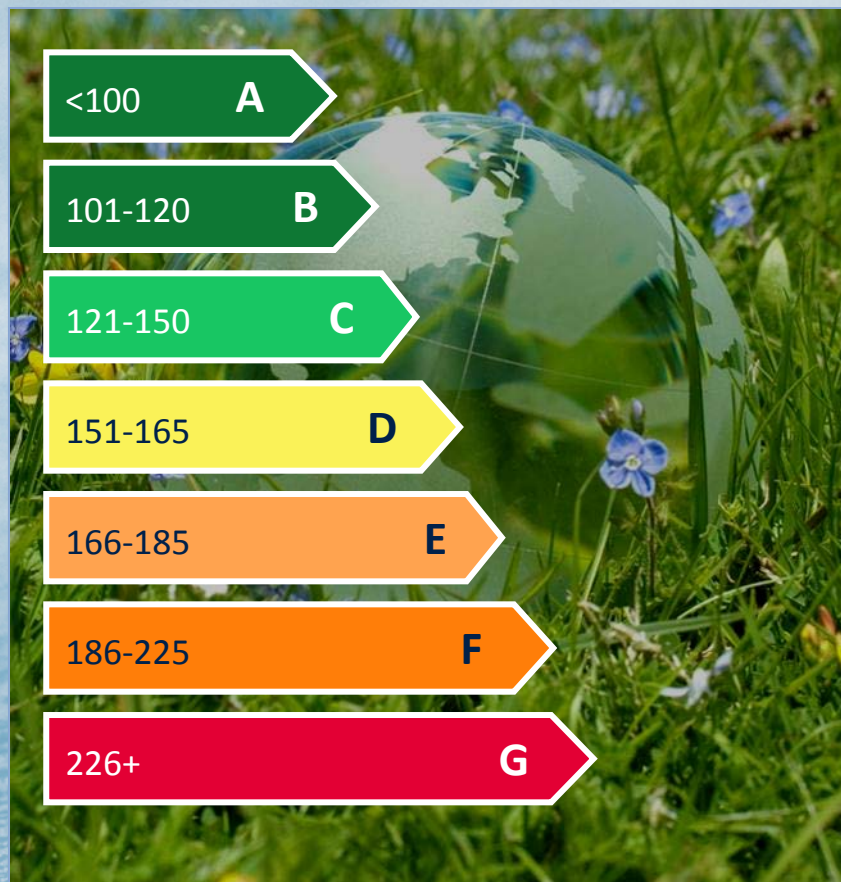


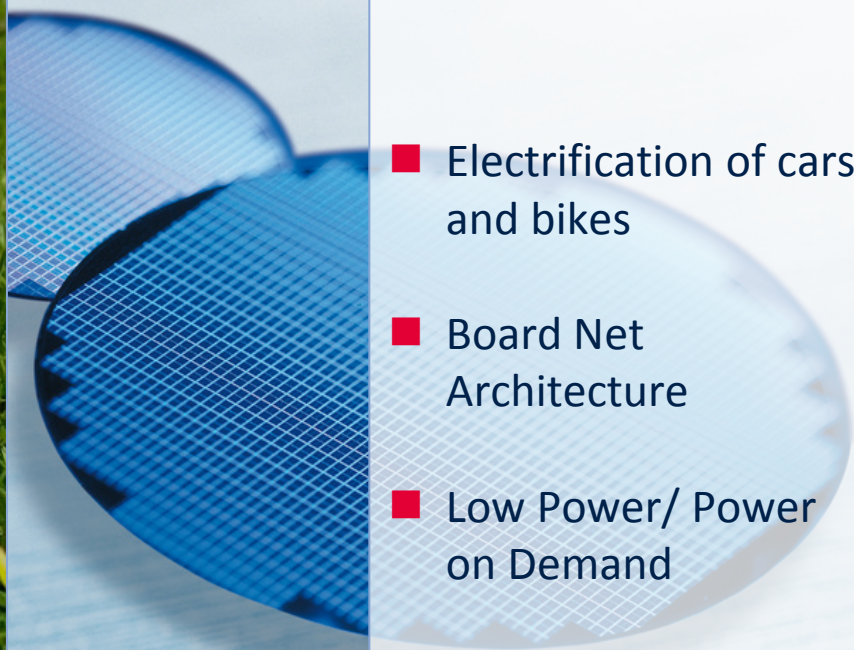
Computer on
Wheels



Internet of Energy

Emission of CO₂ g/km



- 
- Electrification of cars and bikes
 - Board Net Architecture
 - Low Power/ Power on Demand

Source: Infineon

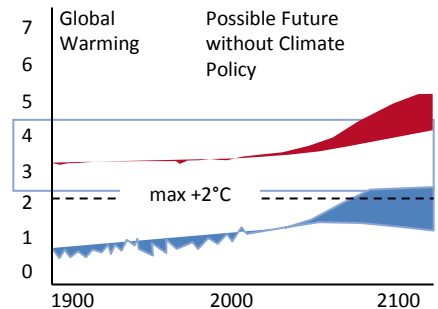
Expectations: Society and citizens



Green house effect and diminishing fossil energy resources demand

- Deployment of energy efficient technology
- Increase of share of energy from renewable “green” resources
- While maintaining best resilience and permanent availability
- Without loss of comfort and increase of cost for consumers

The Internet of Energy
is the technology to
achieve these goals



Source: Infineon

Energy and Propulsion Alternatives



Energy Resources

Oil

Coal

Natural Gas

Biomass

Other Renewable Energy
Hydro, Solar, Wind

Energy Carriers

Liquid
Fuels

Gas
Fuels

Electricity

Hydrogen

Propulsion Systems

Conventional ICE
Gasoline / Diesel

Gas ICE

ICE Hybrid

Plug-In Hybrid ICE

Electric Vehicle

Fuel-Cell Electric

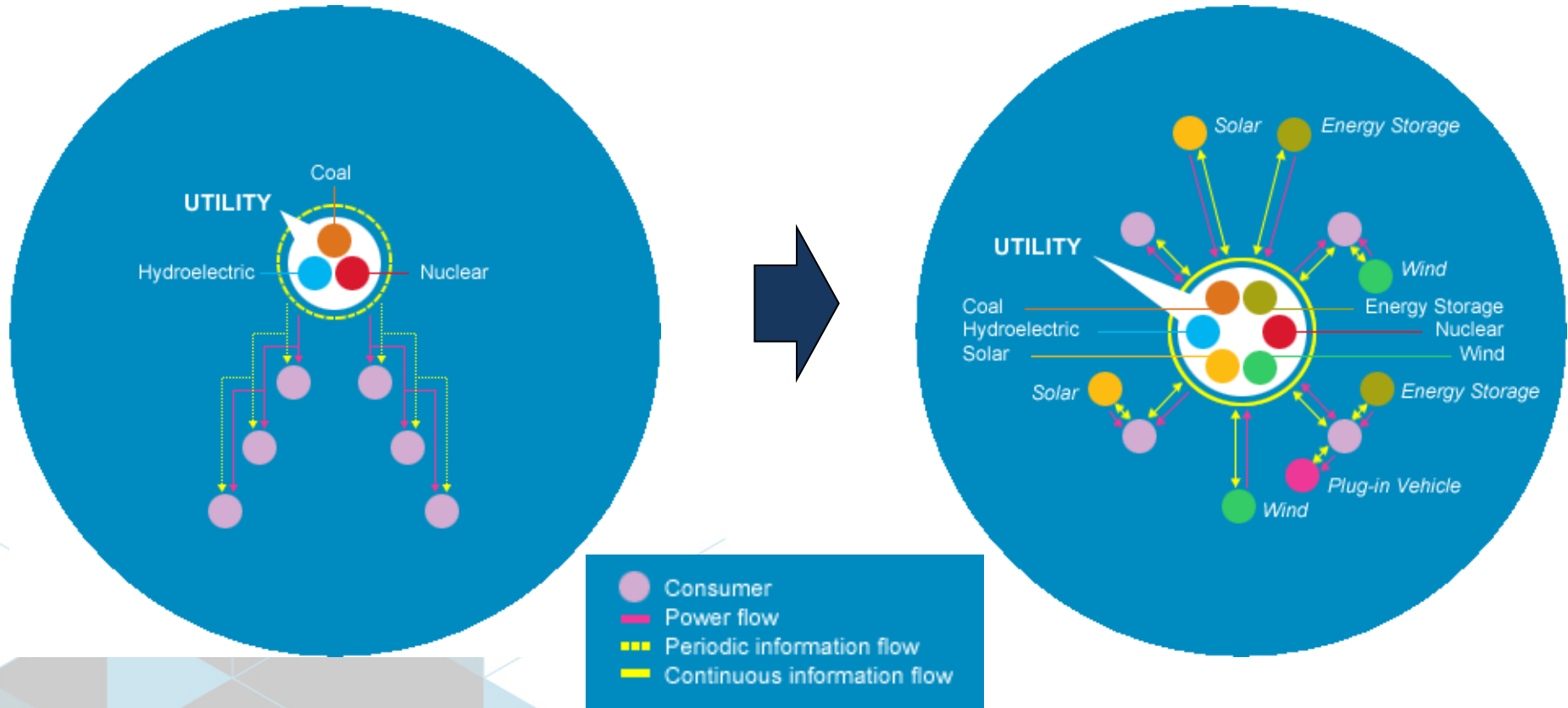
Battery

Electrification

Future Smart Grid



► From centralised to distributed



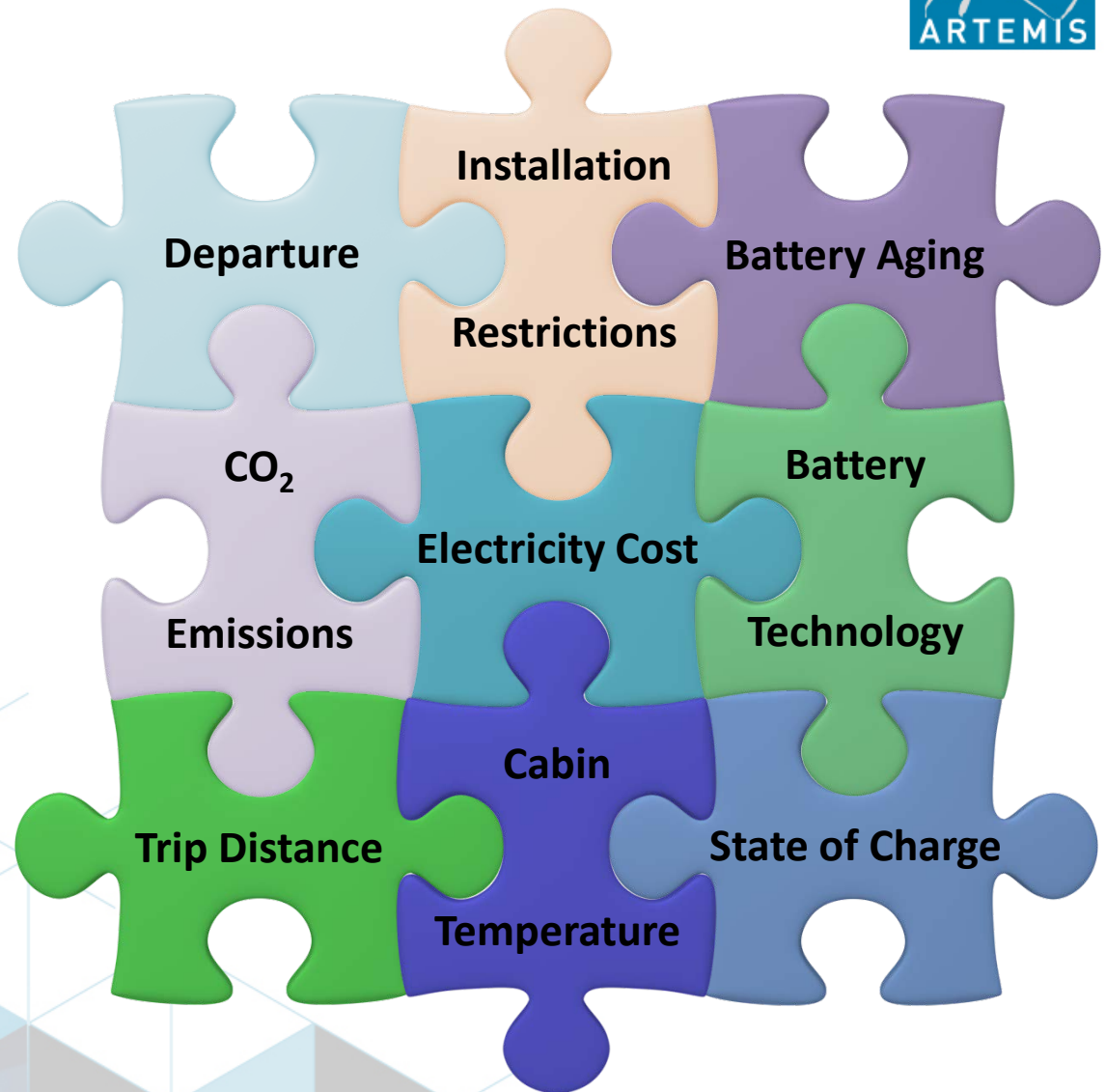
Source: IBM

Factors influencing charging profile

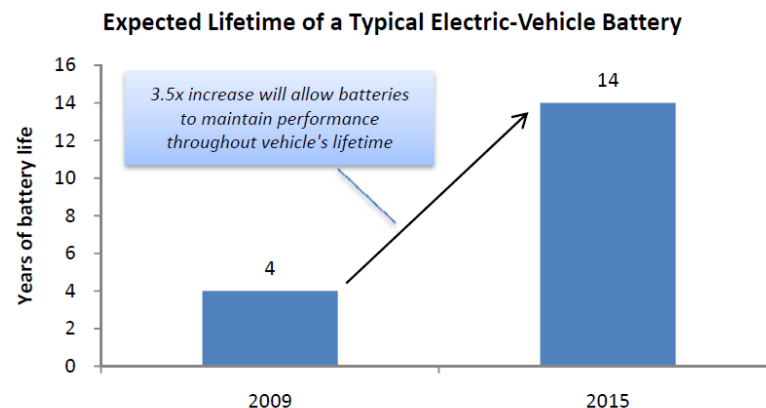
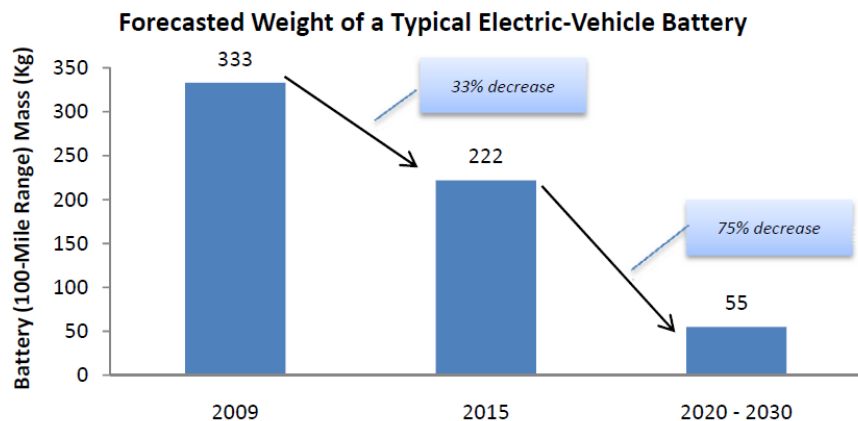
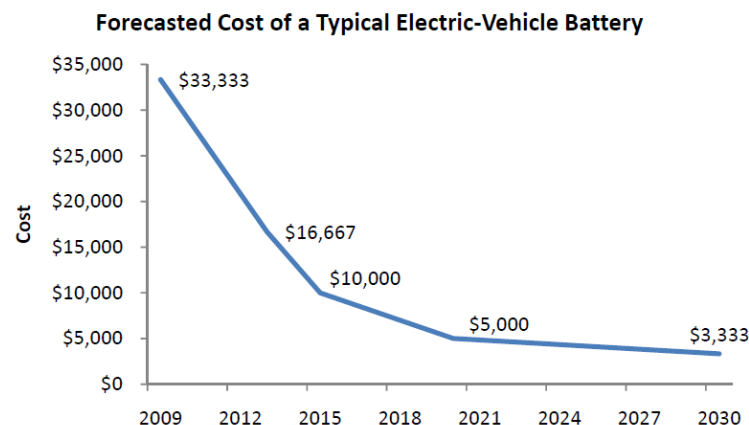
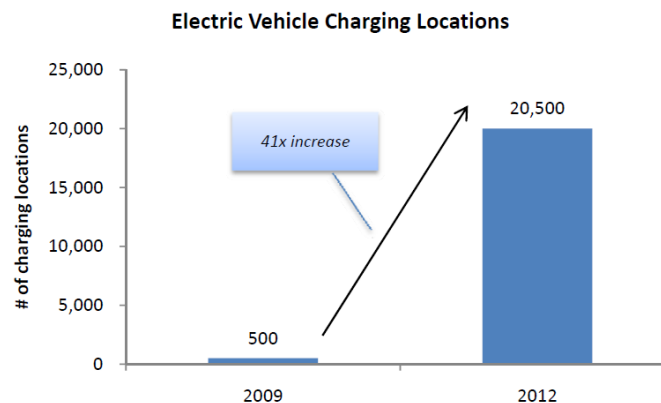
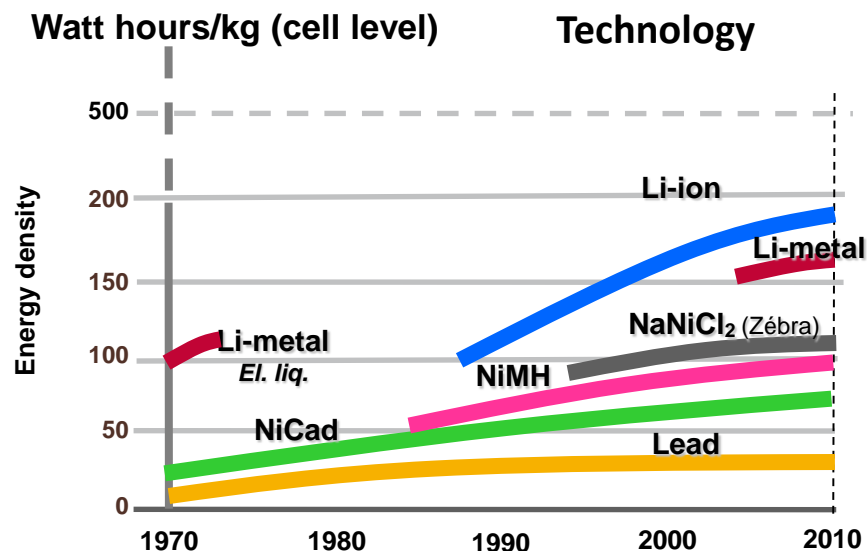


EVs Charging Puzzle

The decision how to charge optimally is taken within the vehicle.



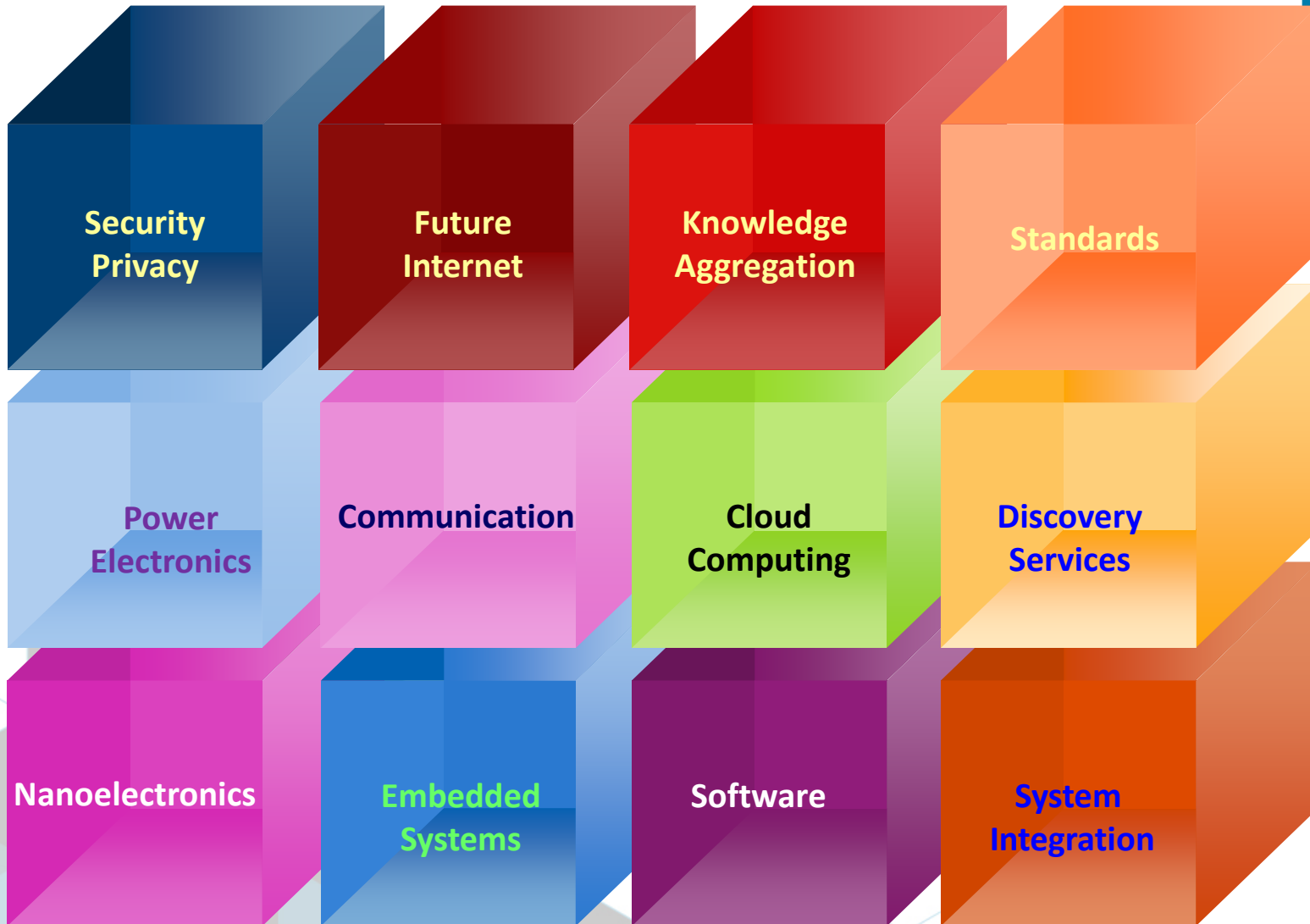
Future Batteries



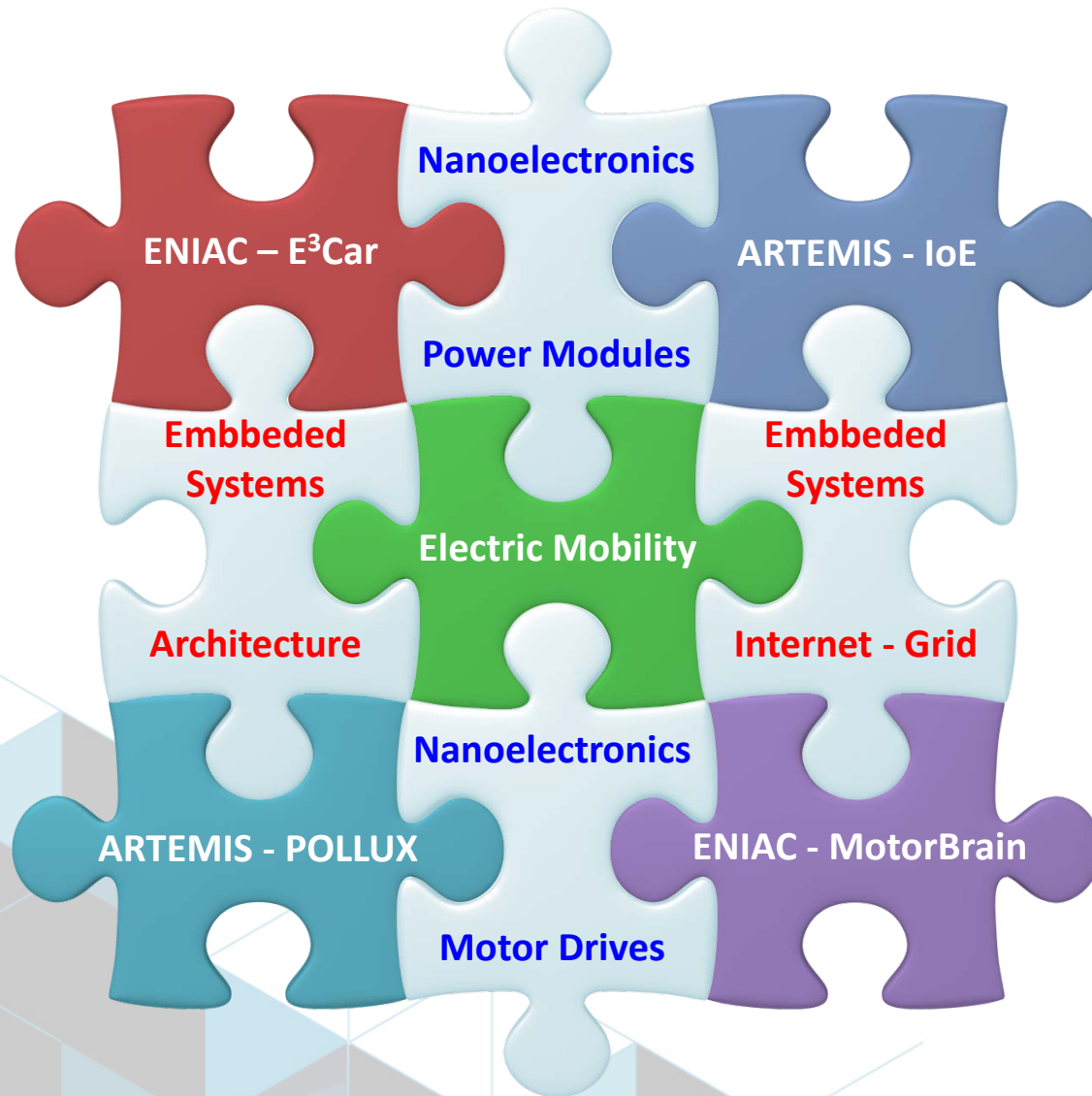
Source: DoE

► Increasing expected lifetime, decreasing cost and weight

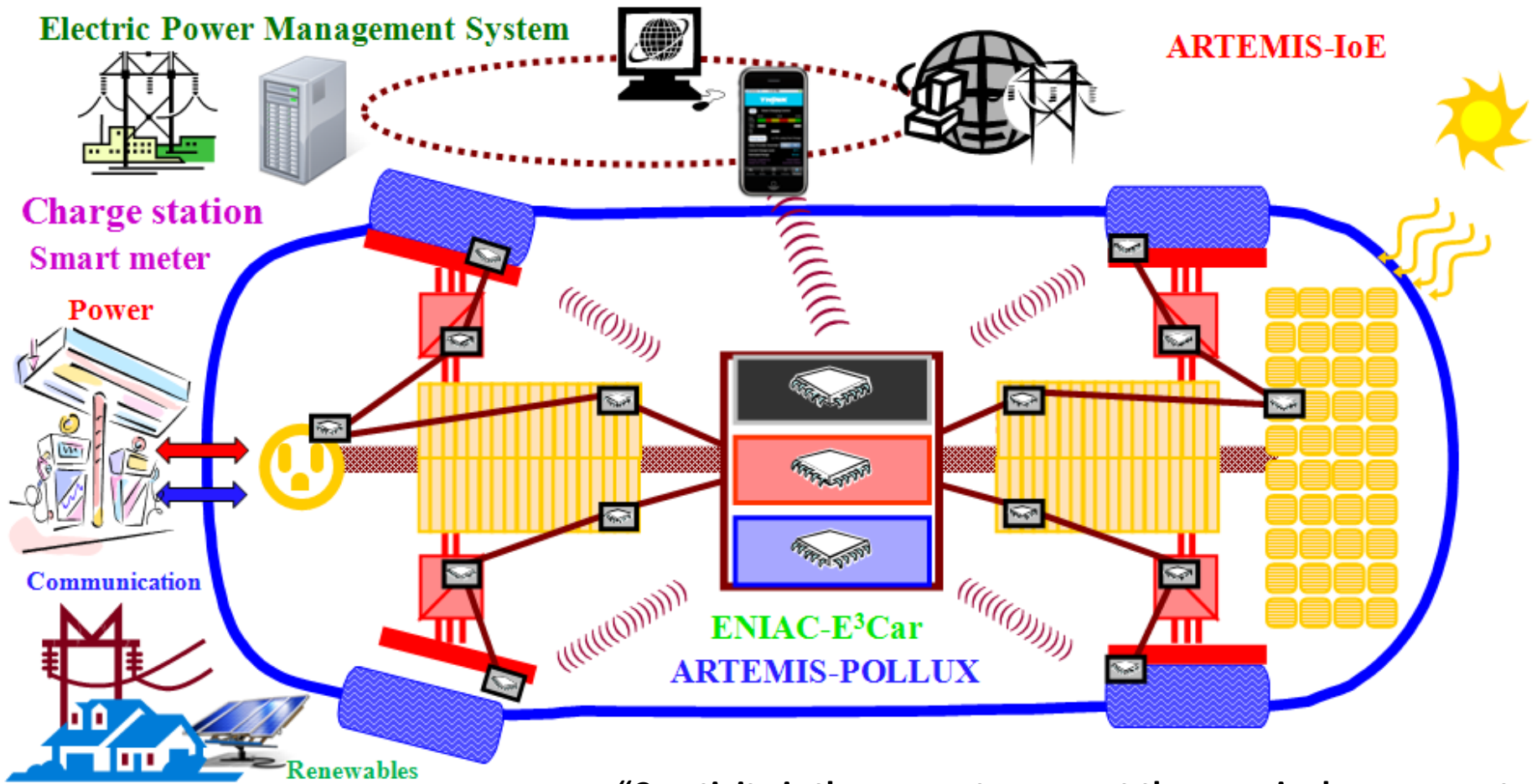
Enabling Technologies



Synergies among European Programs



IoE - ENIAC E³Car - ARTEMIS POLLUX



“Creativity is the power to connect the seemingly unconnected.”

William Plomer (African born English Writer, 1903-1973)

Internet

of

Energy



Internet

Develop hardware, software and middleware for seamless, secure connectivity and interoperability.

Connecting the Internet with the energy grids with application in the area of Electric Mobility.

of

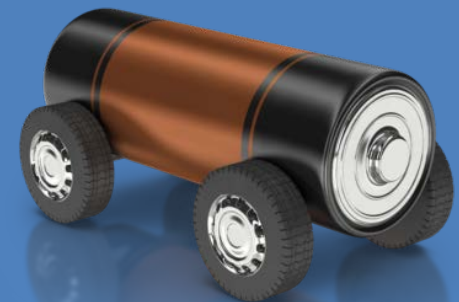
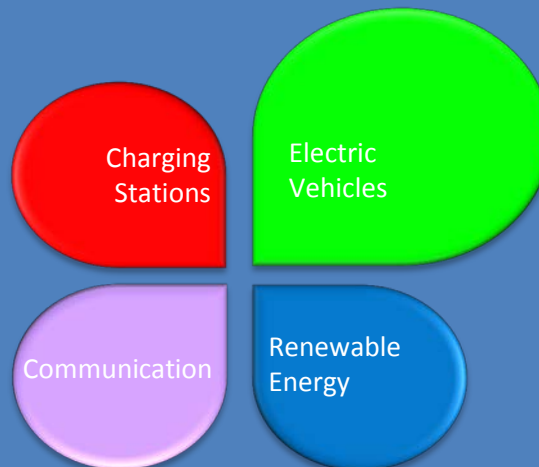
Implement real time interface between the power network/grid and the Internet.

Develop reference designs and embedded systems architectures for high efficiency smart network systems

Energy

Managing key topics:
Demand response,
Modelling/simulation,
Usage monitoring,
Real time energy balance and billing

Creation of value added services using both wired and wireless devices with access to the Internet



Why Internet of Energy?



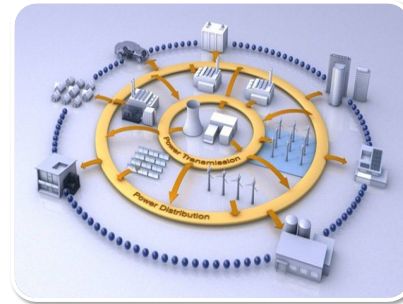
Nanoelectronics and Embedded Systems *for Electric Mobility*



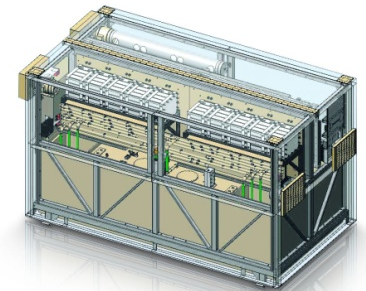
**Embedded
Systems**



**Ubiquitous
Charging**



**Communication
Smart Grid**



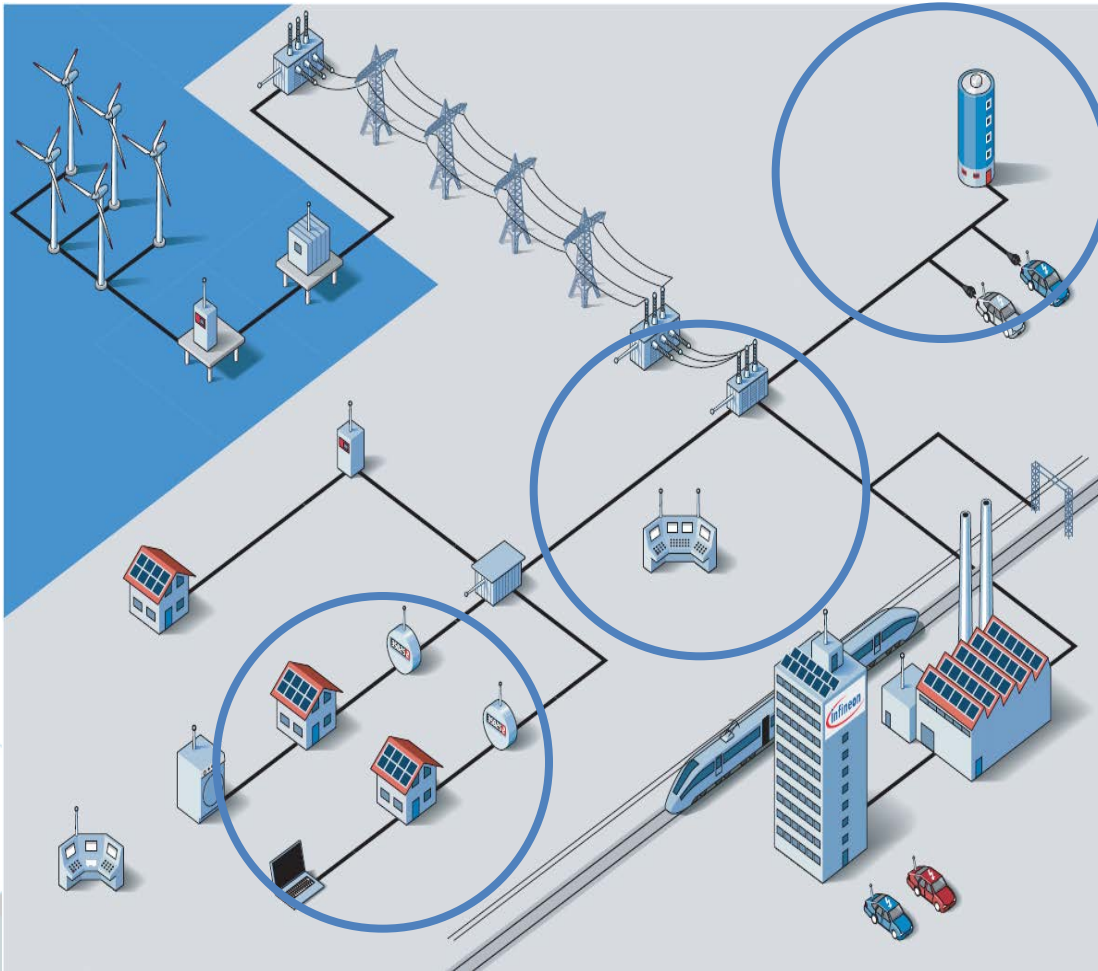
**Energy Storage
Systems**

Security, Privacy, Safety, Dependability

Power, Intelligence, Communications



Internet of Energy



Business models

- Demand dependent real time tariffs

Intelligent Management

- Self-communicating grid nodes
- Improved load simulation and control
- Efficient use of decentralized generated power

Optimized Power consumption

- Automated grid controlled appliances
- Remote controlled appliances

Connected Devices

Market Requires System Security

- Storing, processing and exchanging data in numerous distributed devices is the backbone of our economy.
- HW based security provides protection against physical attacks.

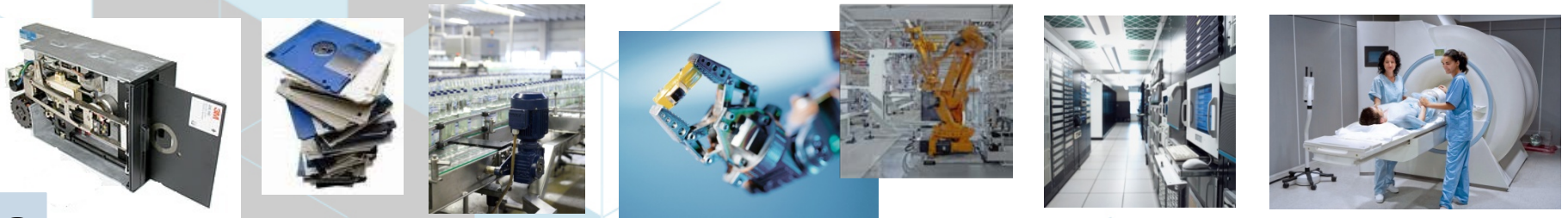
INTEGRITY GUARD SOLID FLASH™



2010 Security Need



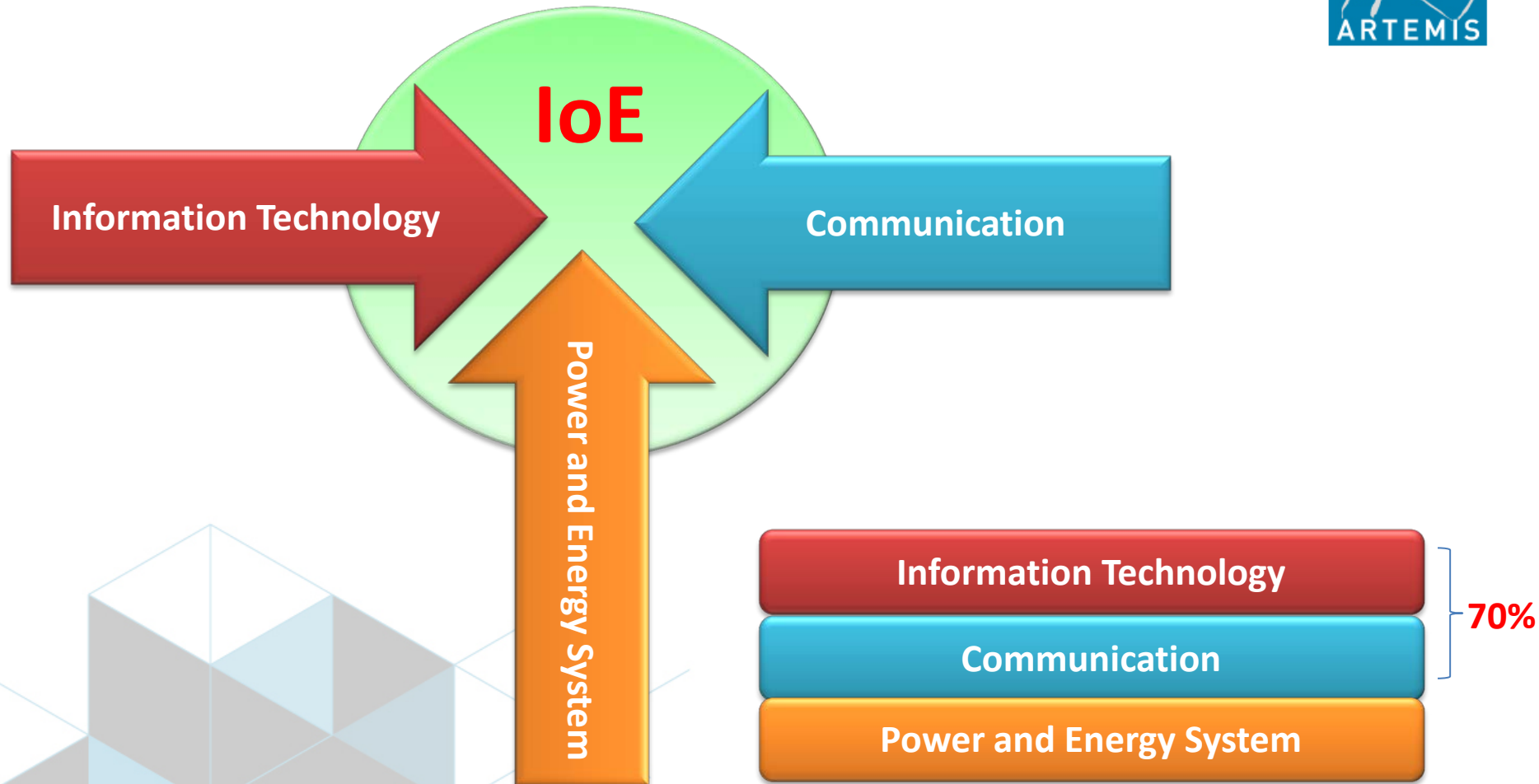
2000 Connectivity



1990 Functionality

Source: Infineon

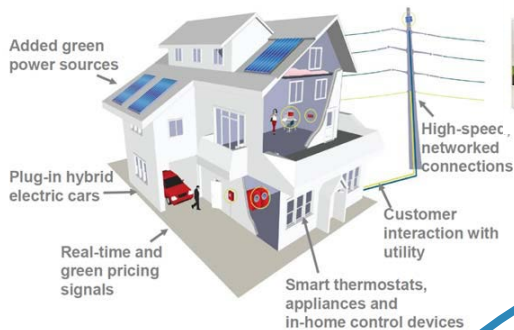
IoE Architecture Fundamental Layers



IoE - Overview



User

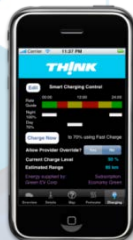
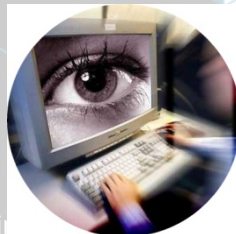


Smart meter



On computer

Information



On phone



On Board



Internet of Energy



Optimized Energy Storage



Generation



Transmission



Smart Power Grid

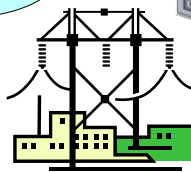
Internet of Energy

Future Internet

Web centric remote control

Load

Charge station



Distribution



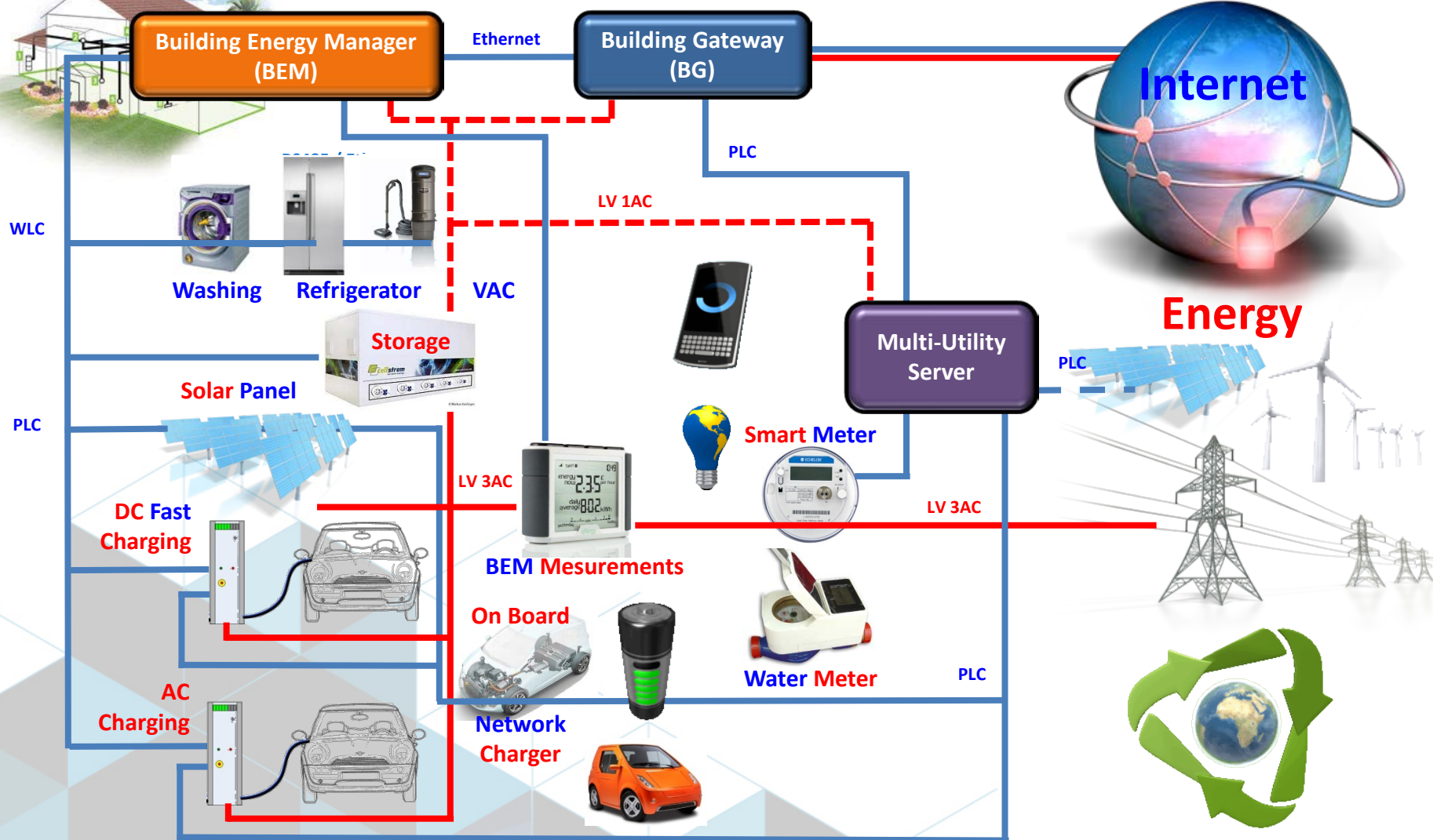
Controller

Transformer

Electric Power Management System

Current Power Grid Communication Network

ARTEMIS IoE Architecture



IoE Applications



Electric Vehicles

Automotive

Network energy management



Automotive

Bidirectional fast charger



Automotive

Communicator ecosystem



IoE Architecture

IoE Architecture Renewables /Solar / Wind

Smart grid architecture



ICT Platform

Energy station platform



Internet

Security privacy dependability



IoE Infrastructure

Fast charging station



IoE Infrastructure

Energy storage station



Smart Buildings

Building energy gateway



NFC Communication

NFC identification station



PLC/Wireless Communication

Power line communication



PLC/Wireless Communication

Smart metering



Embedded Systems

Wireless/Wired Communication

ARTEMIS IoE Project Partners

- ▶ 10 European countries
- ▶ 45 Million € budget
- ▶ 42 partners



	 Germany			 Germany		
		 Italy		 ENERGY IN TUNE WITH YOU.	 renewable energies	
				 UK		
			 Inspiring Business		 Infraestructuras	 Austria
 Austria						

Norway	Germany	Italy	Netherlands	UK	Spain	Austria	Czech Republic	Belgium	Finland
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IoE Project Targets



IoE Devices Connected to the Smart Grid

☐ **E-Mobility (+3 Millions Evs)** ☐ + 25% by infrastructure, seamless use, integration

☐ **Renewable Energy to Grid** ☐ + 10% by need balance

☐ **Power Generation to Grid** ☐ + 10% by control and flexibility of energy sources

☐ **Storage to Grid (Load/Generation)** ☐ + 5% by grid reserve balancing

☐ **Household to Grid (Load)** ☐ + 5% by demand control and cut peak energy

IoE Total Potential Weighted Mean Value +20%

Summary



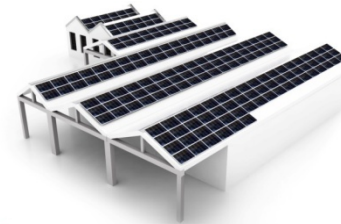
- ▶ Internet of Energy is the answer to a number of the energy challenges related to electric mobility.



Bluecar
Source: Pininfarina/Bolloré



e-tron
Source: Audi



Phylla
Source: Fiat



Think City
Source: Think



Peugeot BB1
Source: Peugeot



Buddy
Source: Pure Mobility AS



Renault Electric Concepts
Source: Renault



Leaf
Source: Nissan



Thank you for your attention!

Dr. Ovidiu Vermesan, Ovidiu.Vermesan@sintef.no



Advanced Research & Technology for Embedded Intelligence and Systems