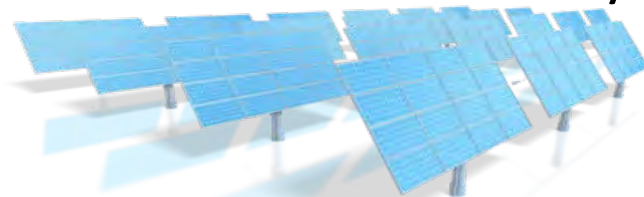


Internet of Energy

for Electric Mobility



IoE
Internet of Energy



Connecting Energy - All the Time Everywhere



Joint EC / European Green Cars Initiative Clustering Event 2012

Dr. O. Vermesan, Chief Scientist, SINTEF, Norway

12 July 2012, Brussels, Belgium

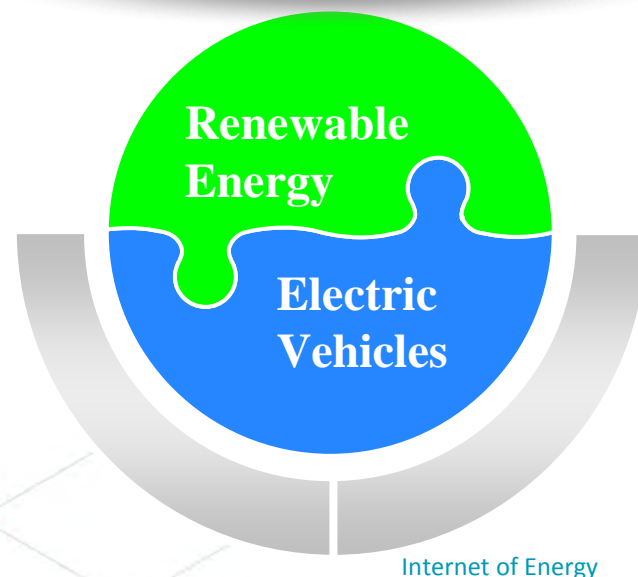
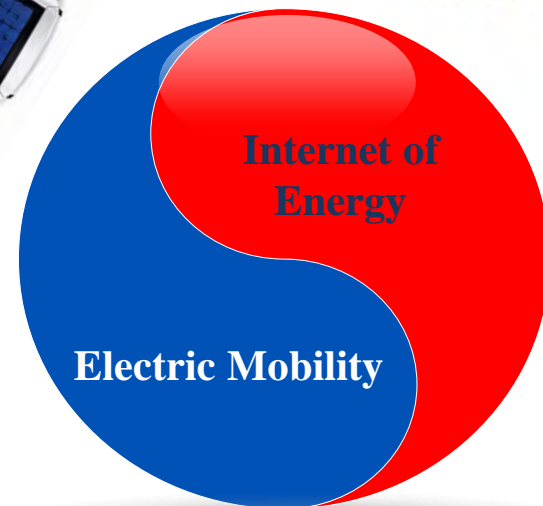


Advanced Research & Technology for Embedded Intelligence and Systems

Presentation Outline



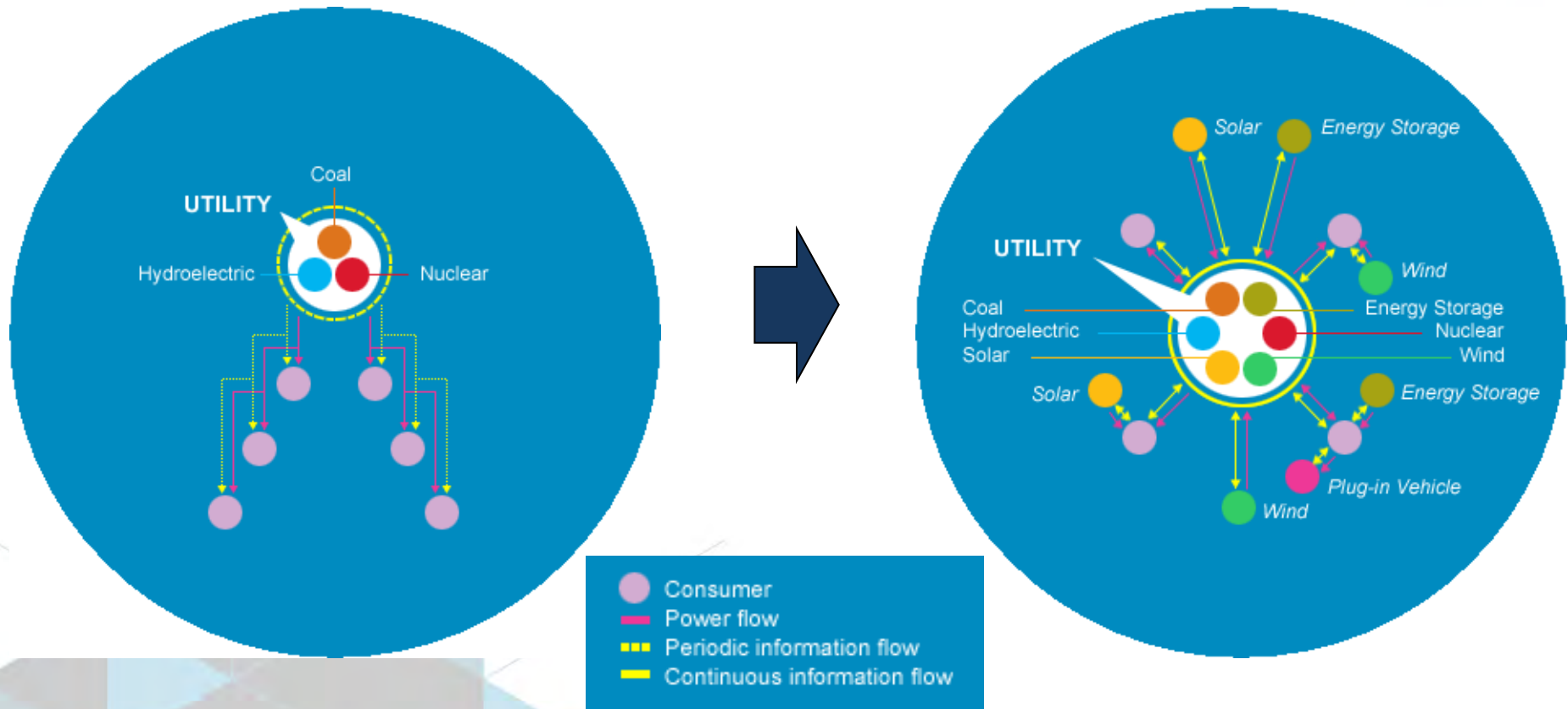
- ▶ Future Trends
- ▶ IoE Consortium
- ▶ Objectives
- ▶ Project Overview



Future Smart Grid



► From centralised to distributed

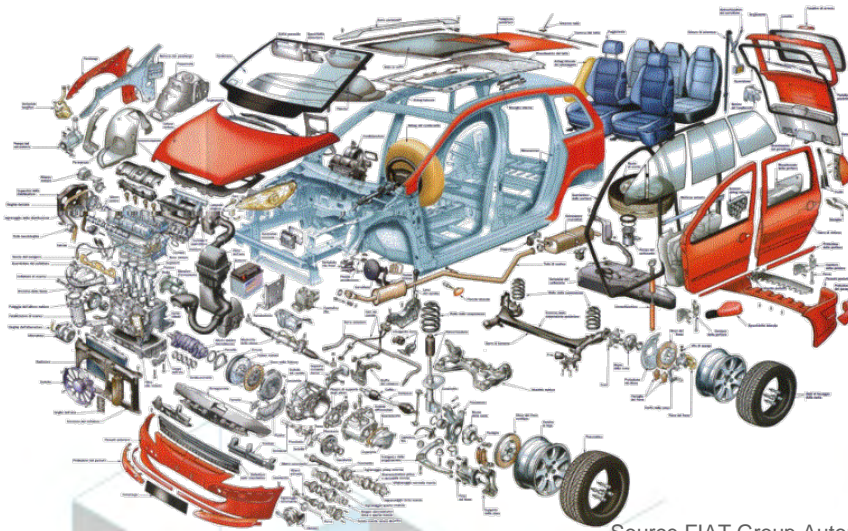


Source: IBM

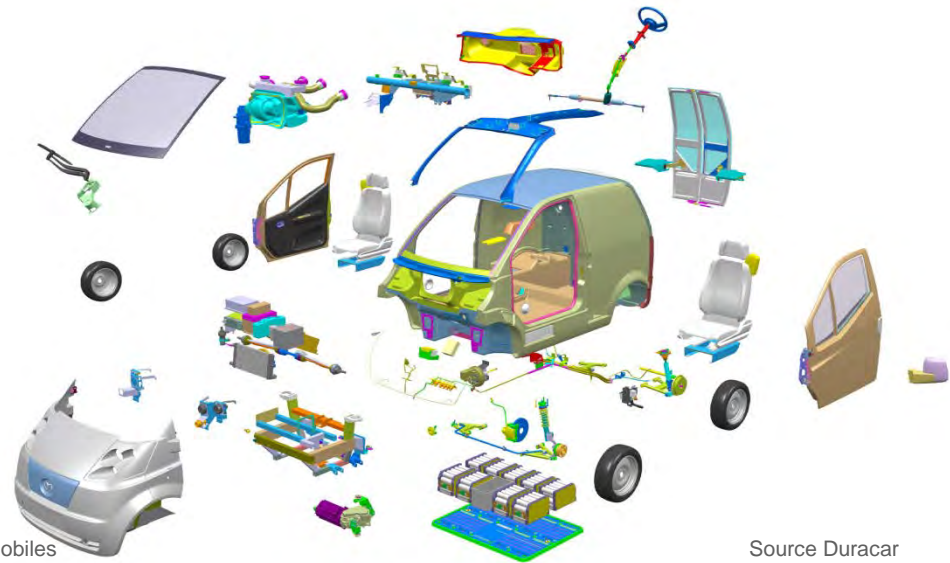
Future Vehicle



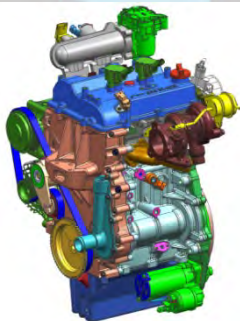
► From mechanics to mechatronics



Source FIAT Group Automobiles



Source Duracar



Mechanical
Craft



Computer on
Wheels



Source FIAT Group Automobiles
ARTEMIS Joint Undertaking

Internet of Energy

Future Infrastructure



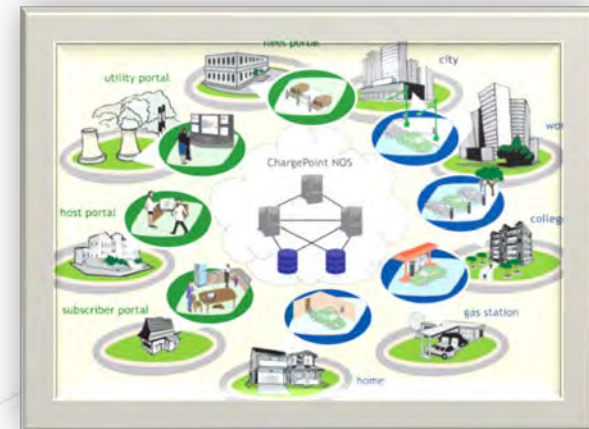
► From slow to fast



From
Station



To
Ecosystem



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

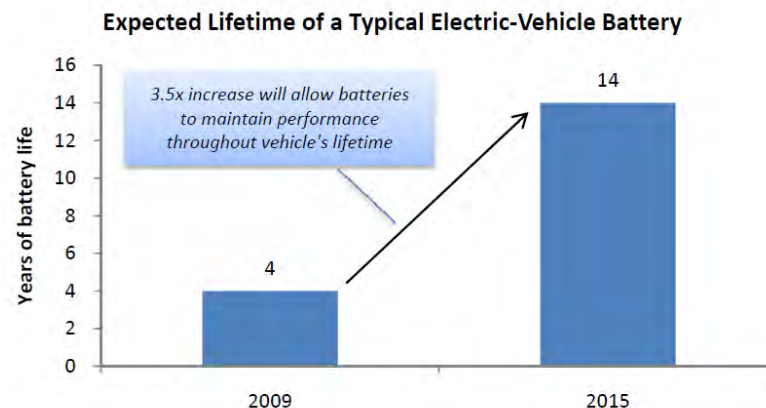
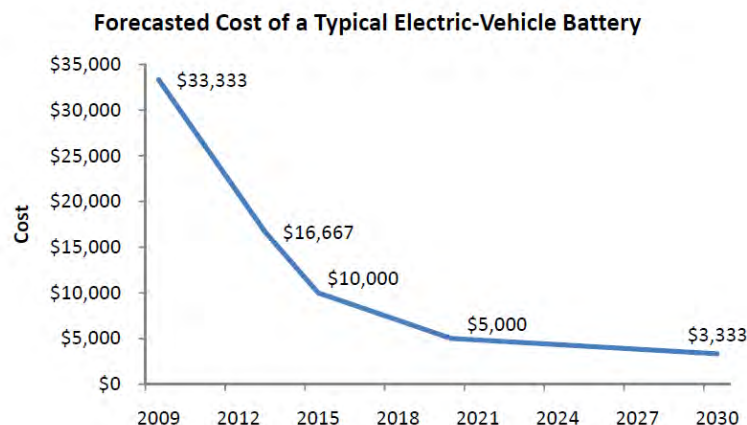
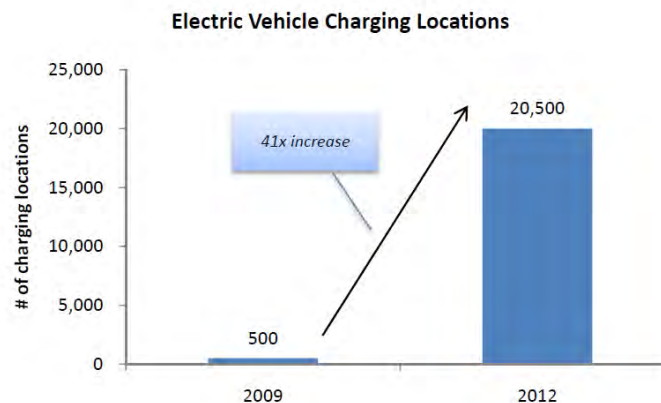
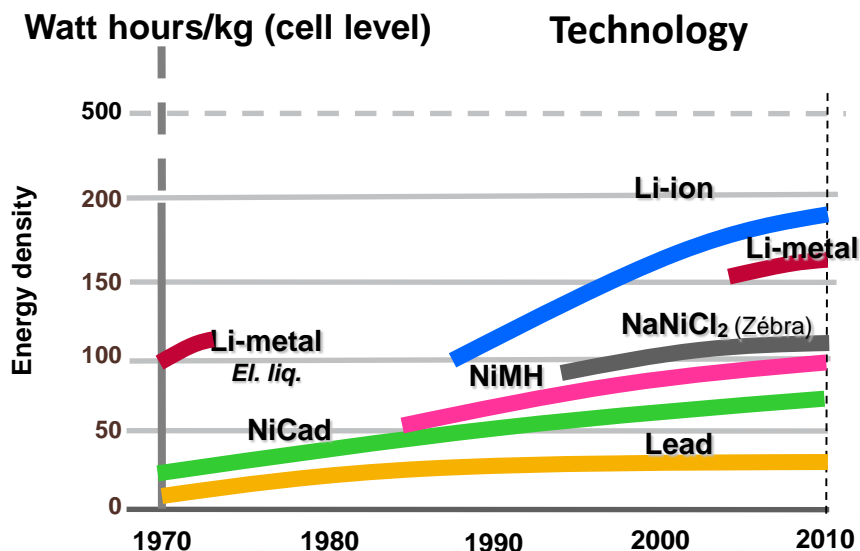
Electric Vehicle

Fuel-Cell Electric

Battery

Electrification

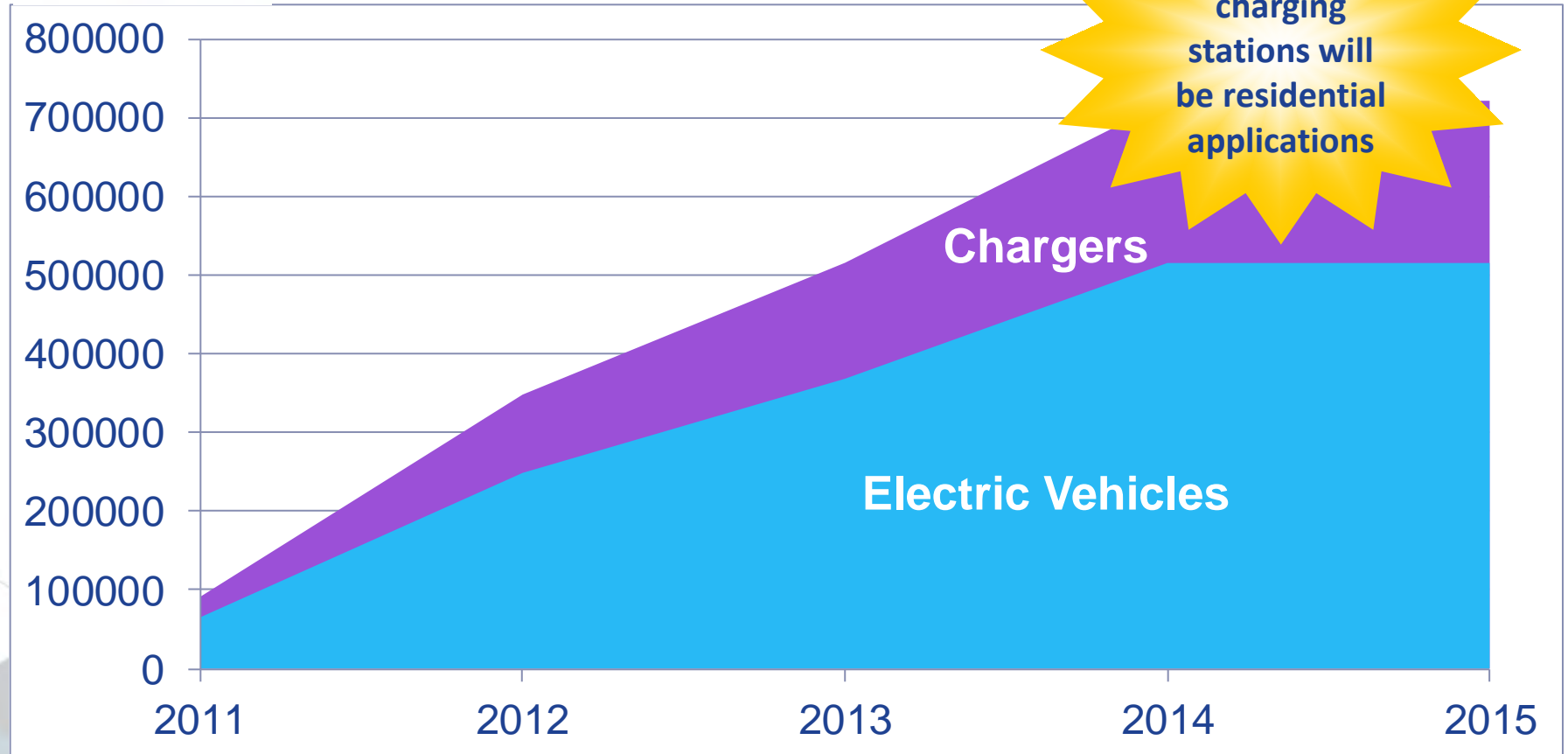
Future Batteries



Source: DoE

► Increasing expected lifetime, decreasing cost and weight

One Million Electric Vehicles



Source: DoE Report (Feb 2011)

For every EV sold, is expected that there will be demand for 1.4 charging stations

Fundamental Transformation

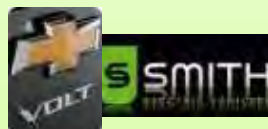


Auto OEM **Fuel Production** **Fueling Location** **Data Collection** **Vehicle Sales**

Gasoline



Electric



EV Tax Credits Prius, Focus 200 000 EVs 25% of new vehicles electric 90% of new vehicles electric by 2030

Leaf, Volt

New Generation EVs

Electric Vehicle
Timeline

2010

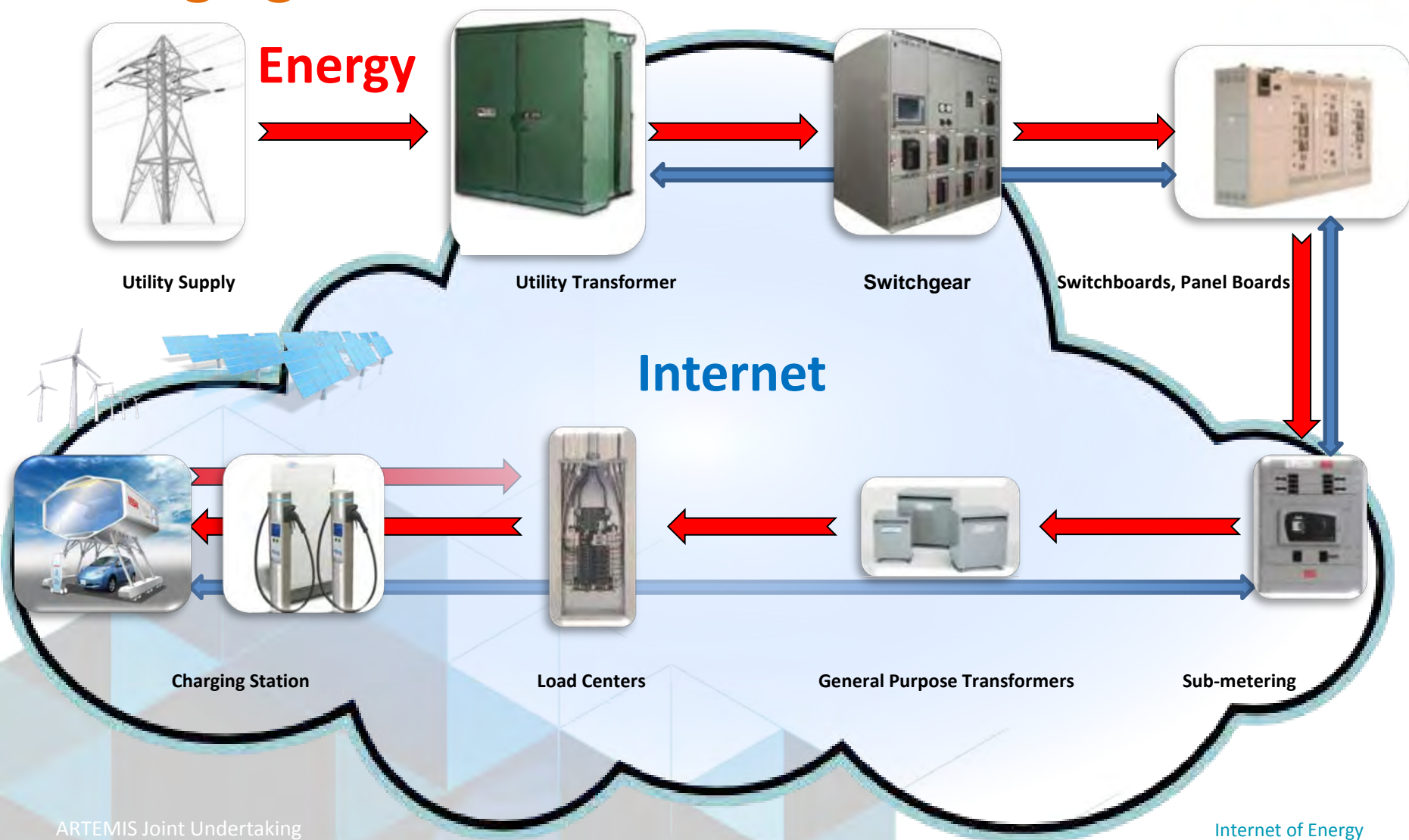
2015

2020

2025

Electrical Infrastructure

Charging station infrastructure

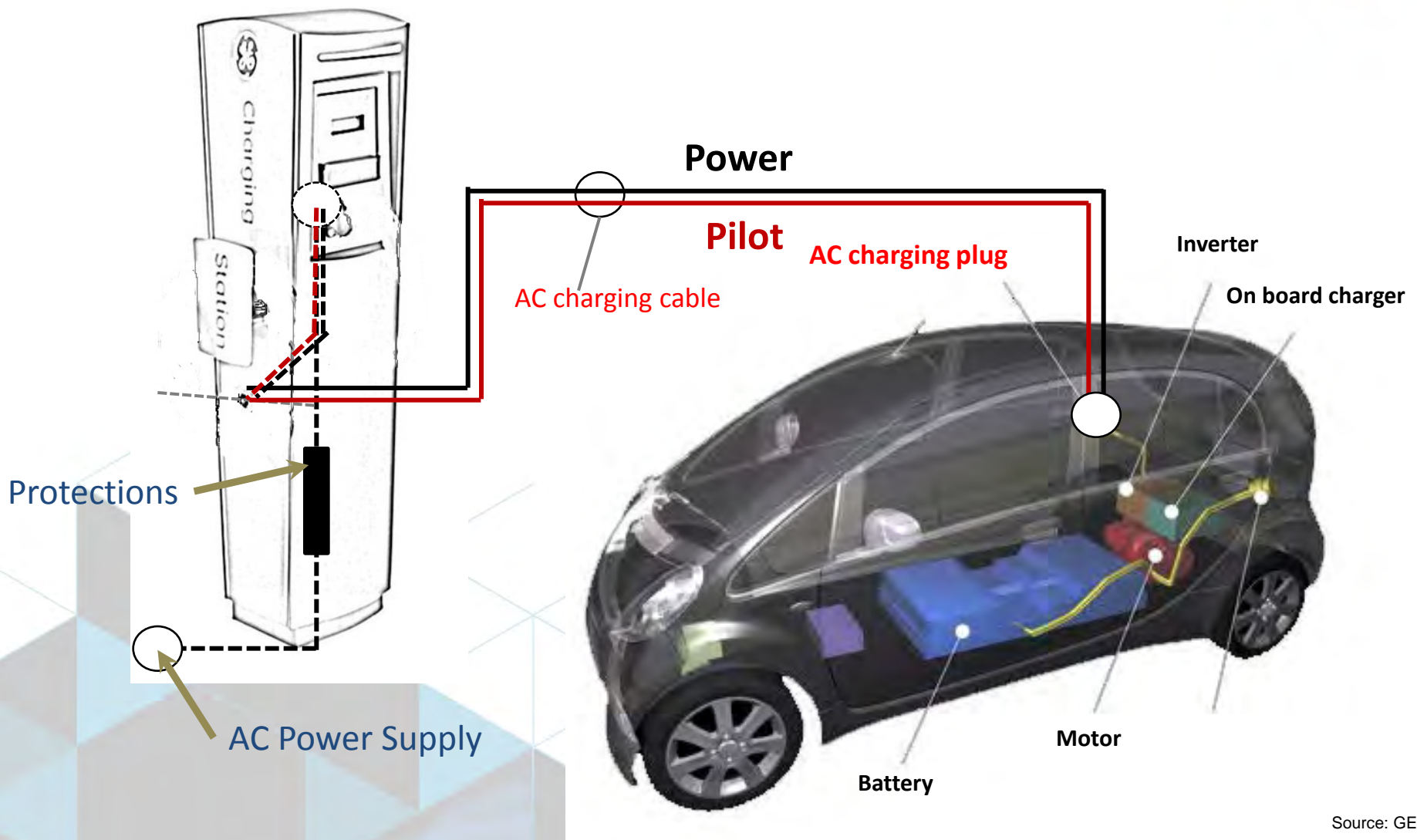


Charging station

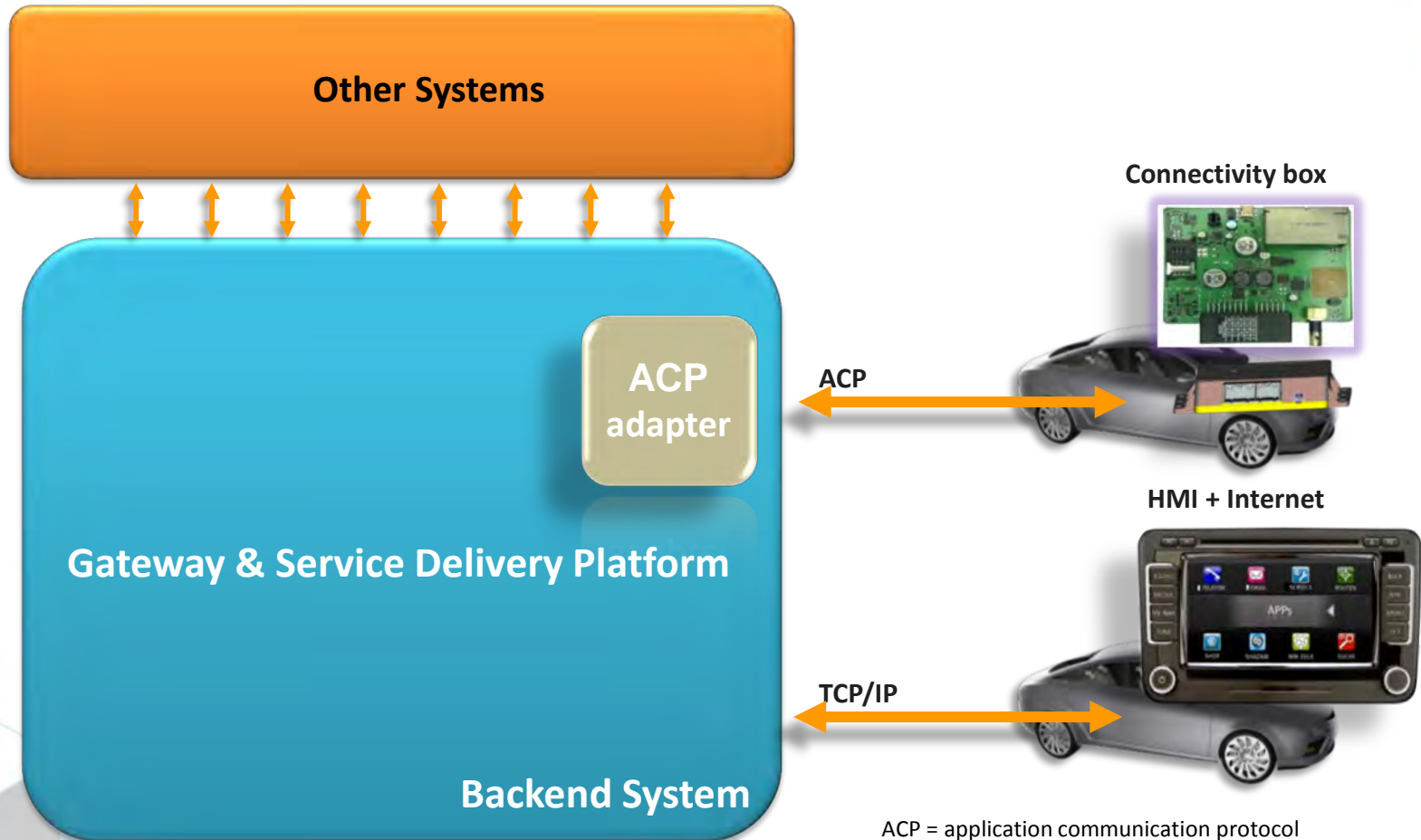


► **EVSE** electric vehicle supply equipment

► **EV** electric vehicle



Backend and Interfaces



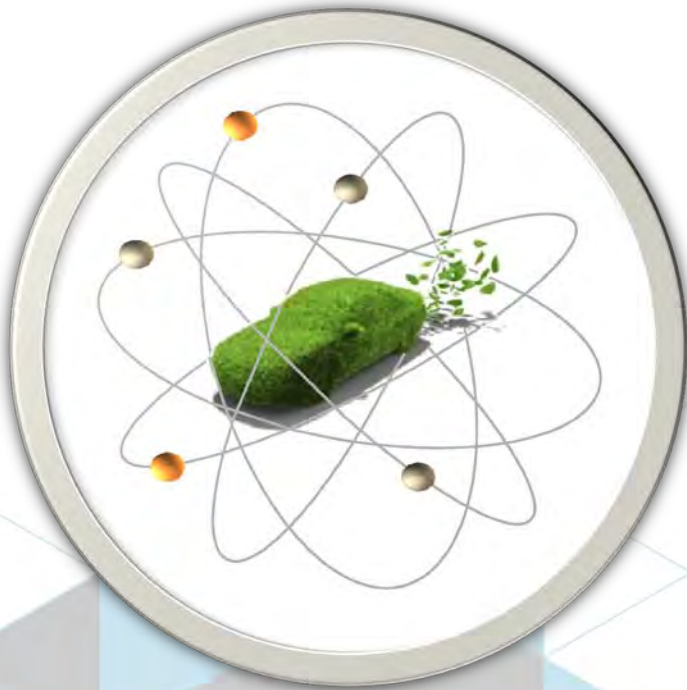
ACP = application communication protocol

TCP/IP = transmission control protocol / internet protocol

Electric Vehicle Ecosystems



- ▶ 'Total environments' to support operation of thousands of vehicles

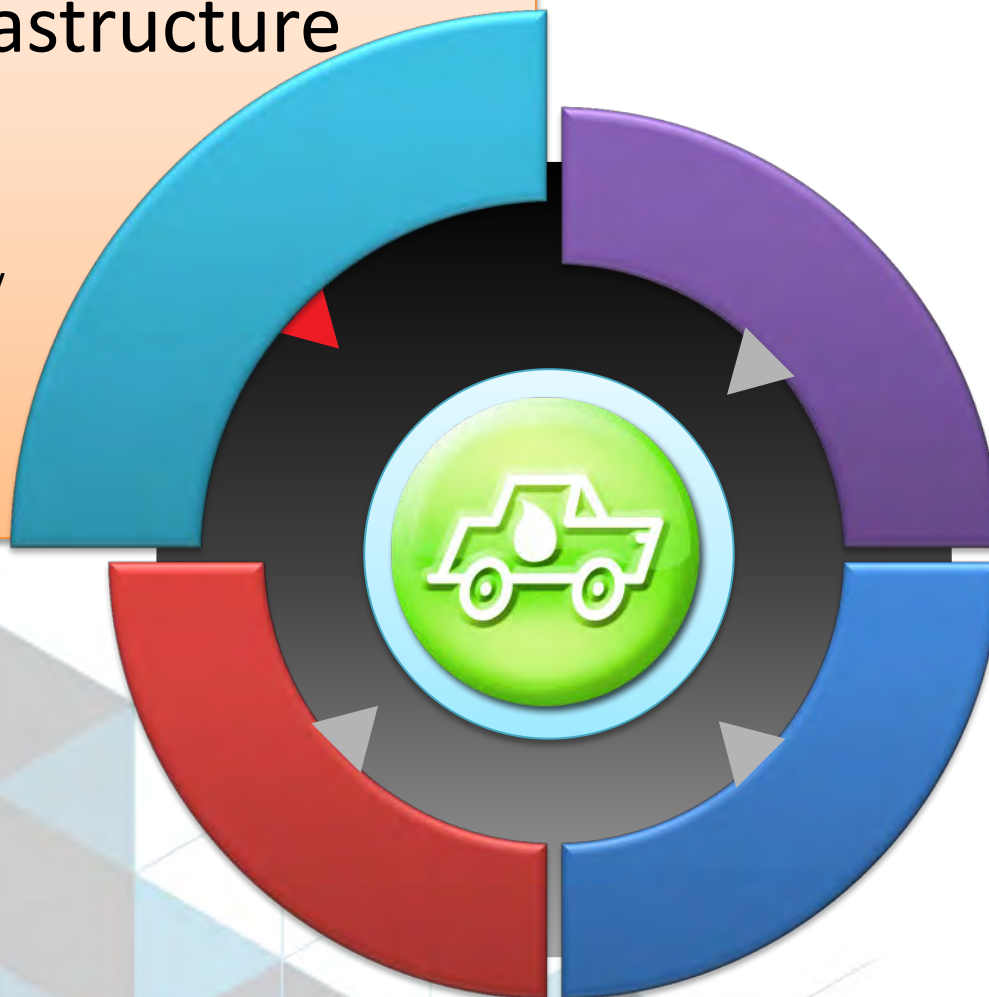


Electric Vehicle Ecosystems

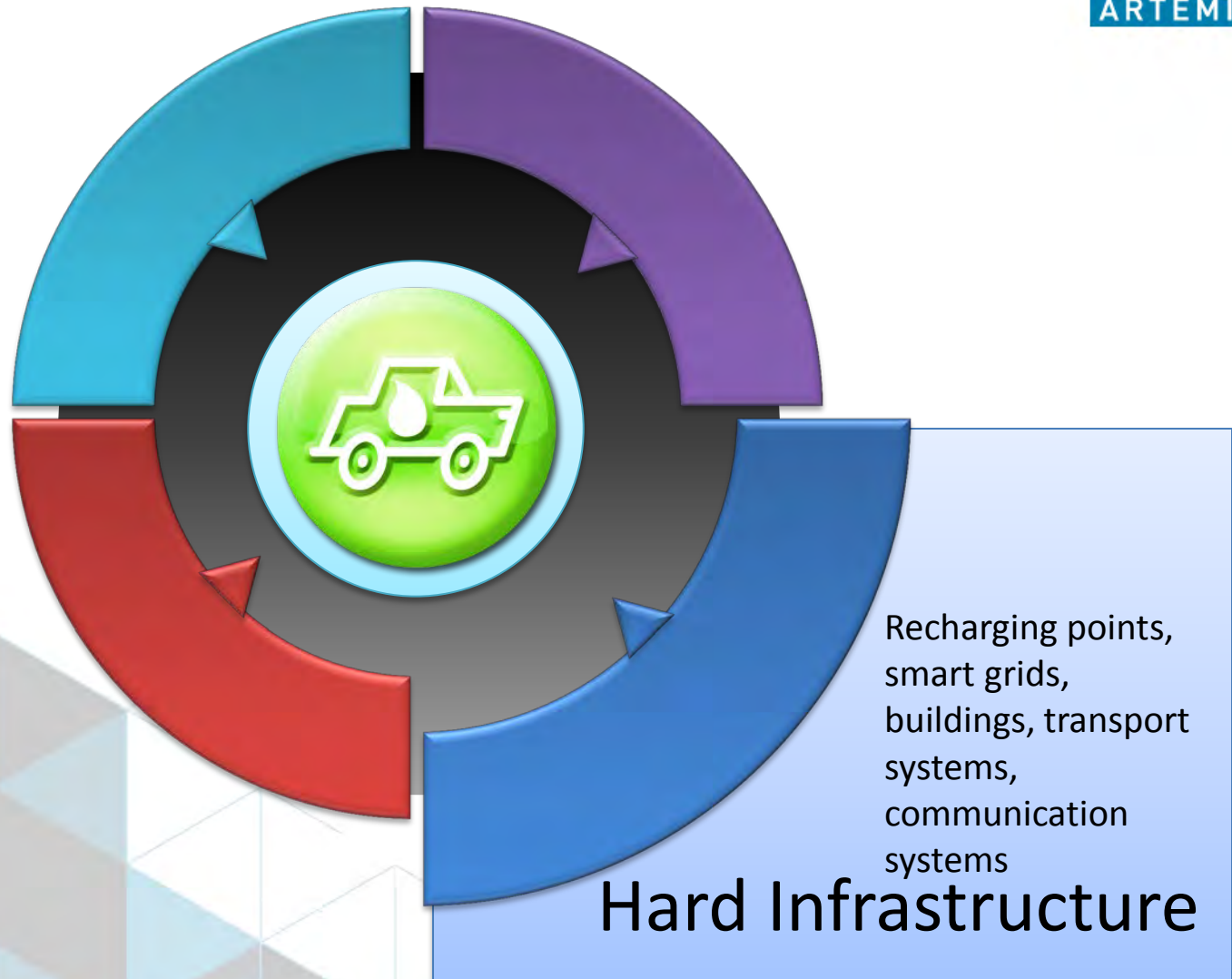


Soft Infrastructure

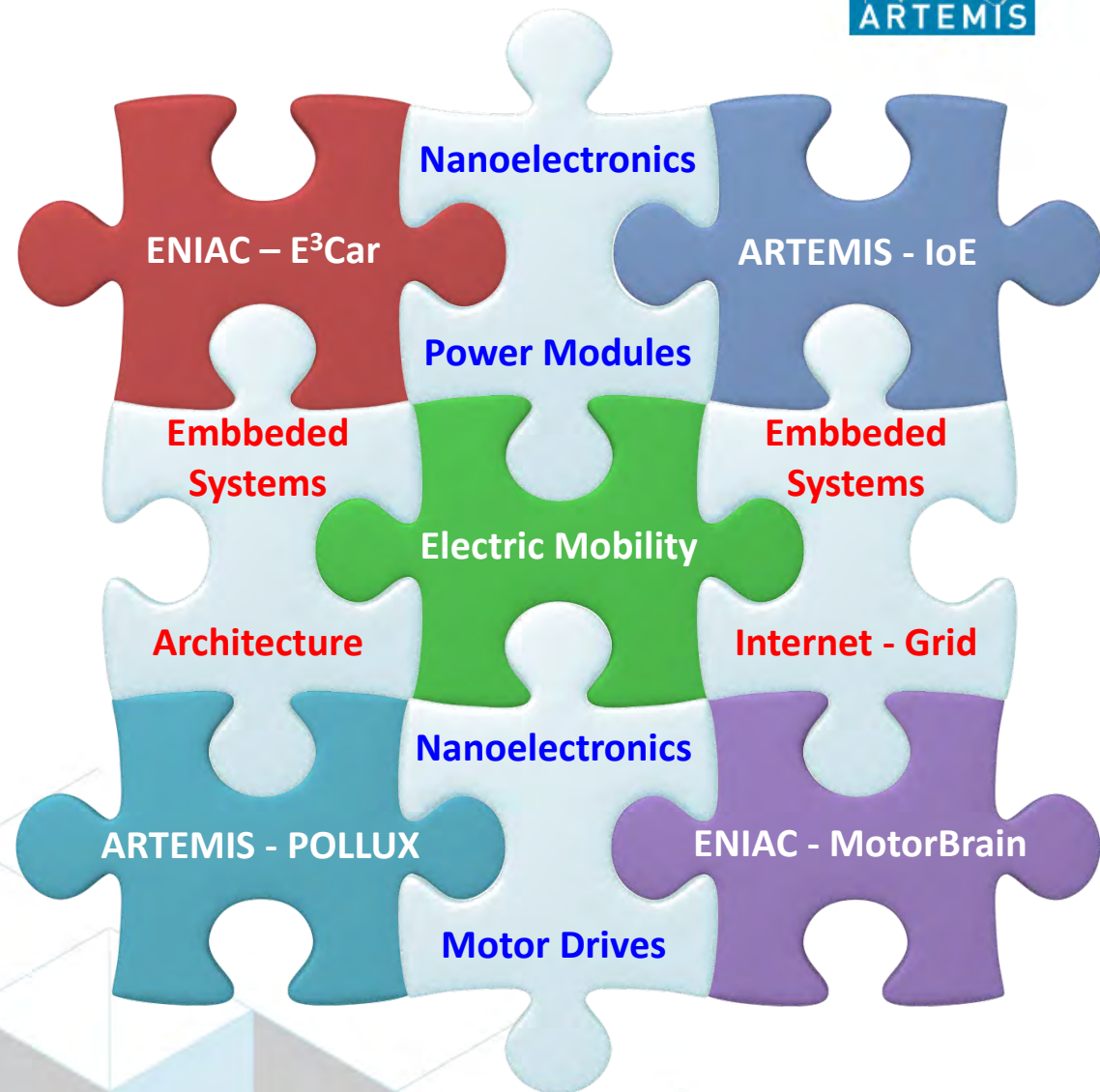
Regulation,
business models,
incentives,
skills, community
engagement



Electric Vehicle Ecosystems



Synergies among European Programs



ARTEMIS IoE Project Partners

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



	 Germany		 Germany			
		 Italy	 CENTRO RICERCA FIAT	 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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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

Energy

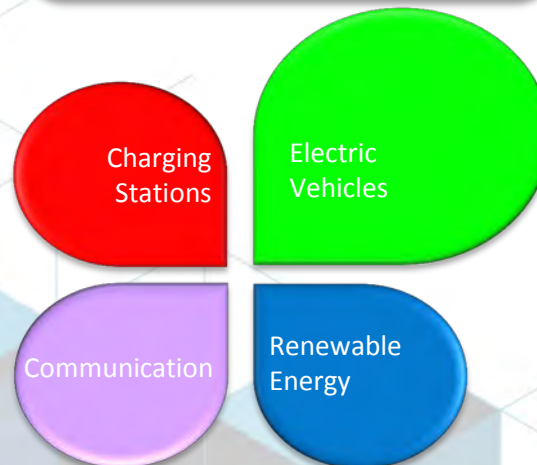


Implement real time interface between the power network/grid and the Internet.

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

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?



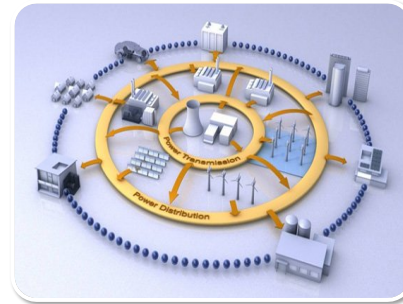
Nanoelectronics and Embedded Systems *for Electric Mobility*



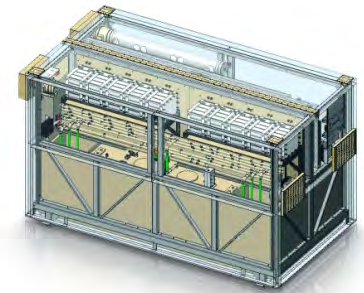
**Embedded
Systems**



**Ubiquitous
Charging**



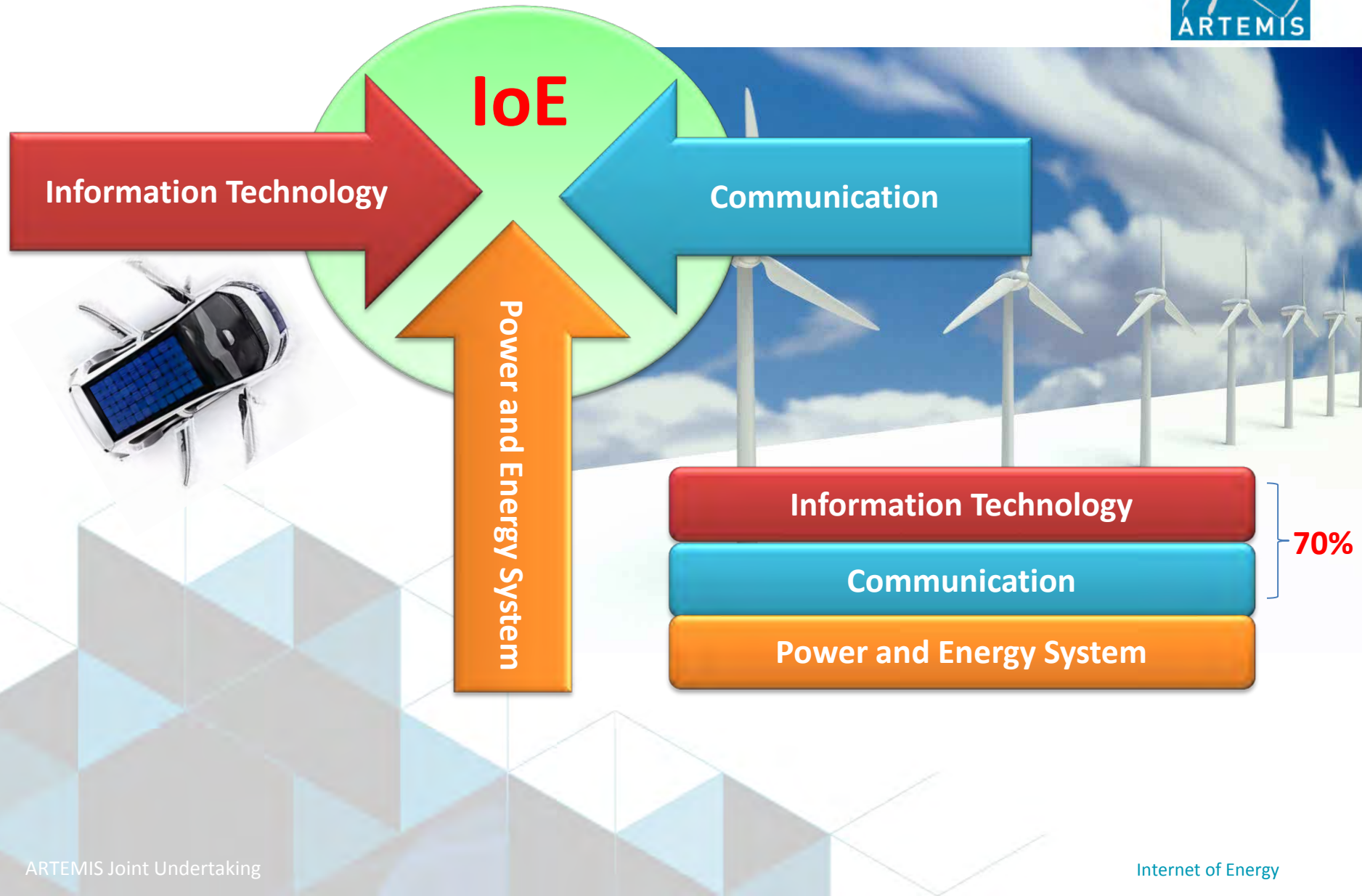
**Communication
Smart Grid**



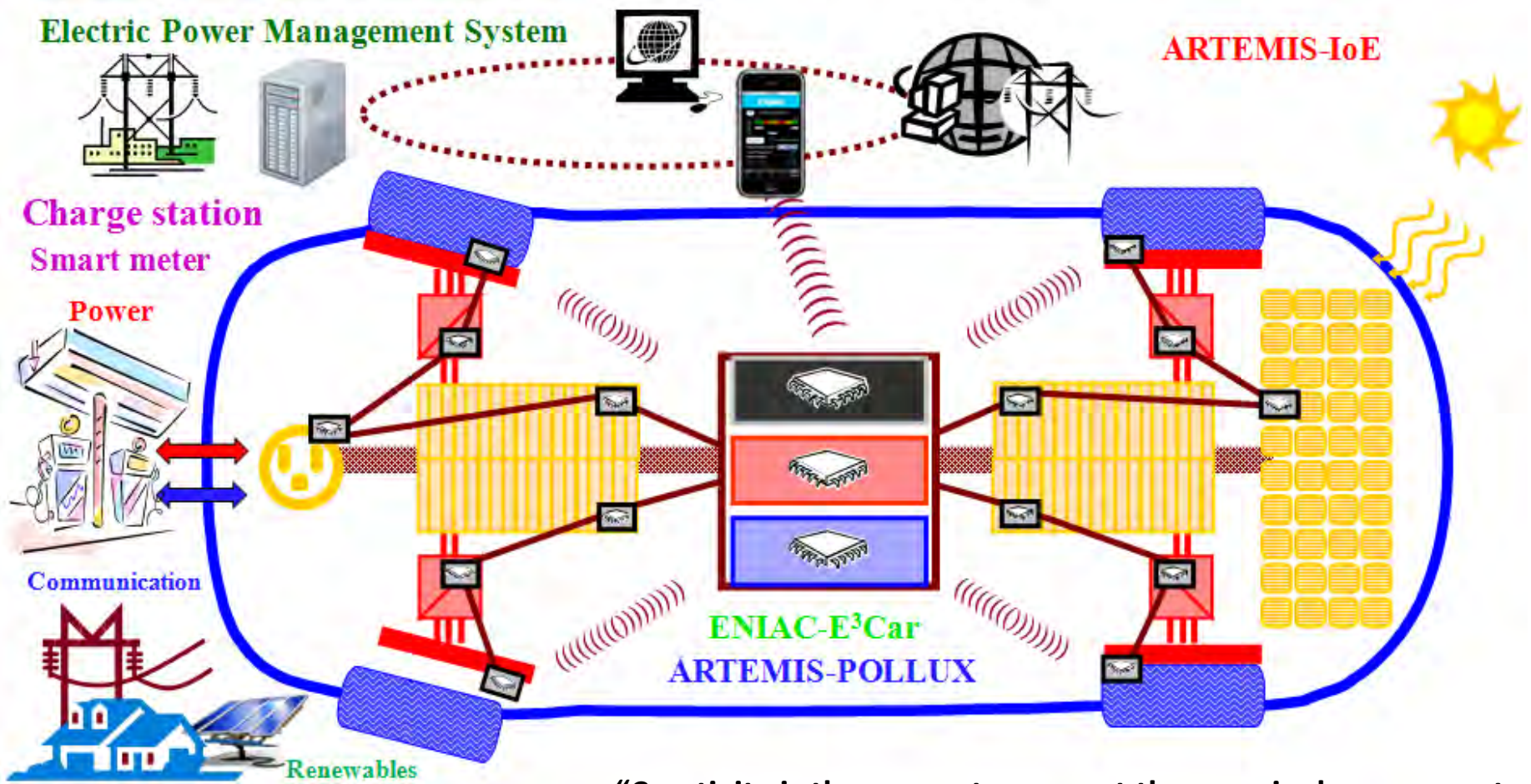
**Energy Storage
Systems**

Security, Privacy, Safety, Dependability

IoE Architecture Fundamental Layers



IoE - ENIAC E³Car - ARTEMIS POLLUX



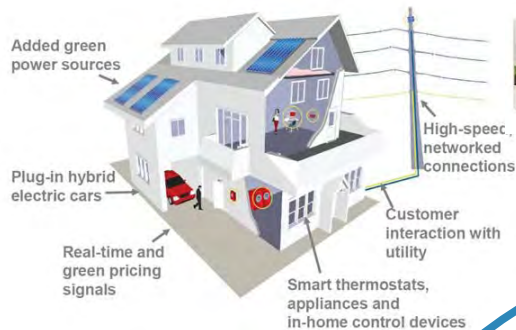
“Creativity is the power to connect the seemingly unconnected.”

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

IoE - Overview



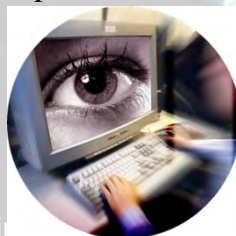
User



Smart meter



On computer



Information

ARTEMIS Joint Undertaking



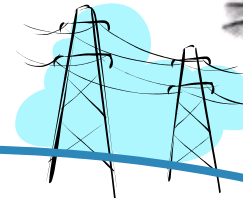
Optimized Energy Storage



Generation



Transmission



Smart Power Grid

Internet of Energy

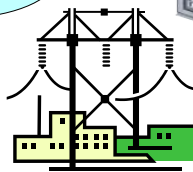
Future Internet

Web centric remote control

Load

Charge station

Distribution



Controller

Transformer

Electric Power Management System



Current Power Grid Communication Network

On phone



On Board



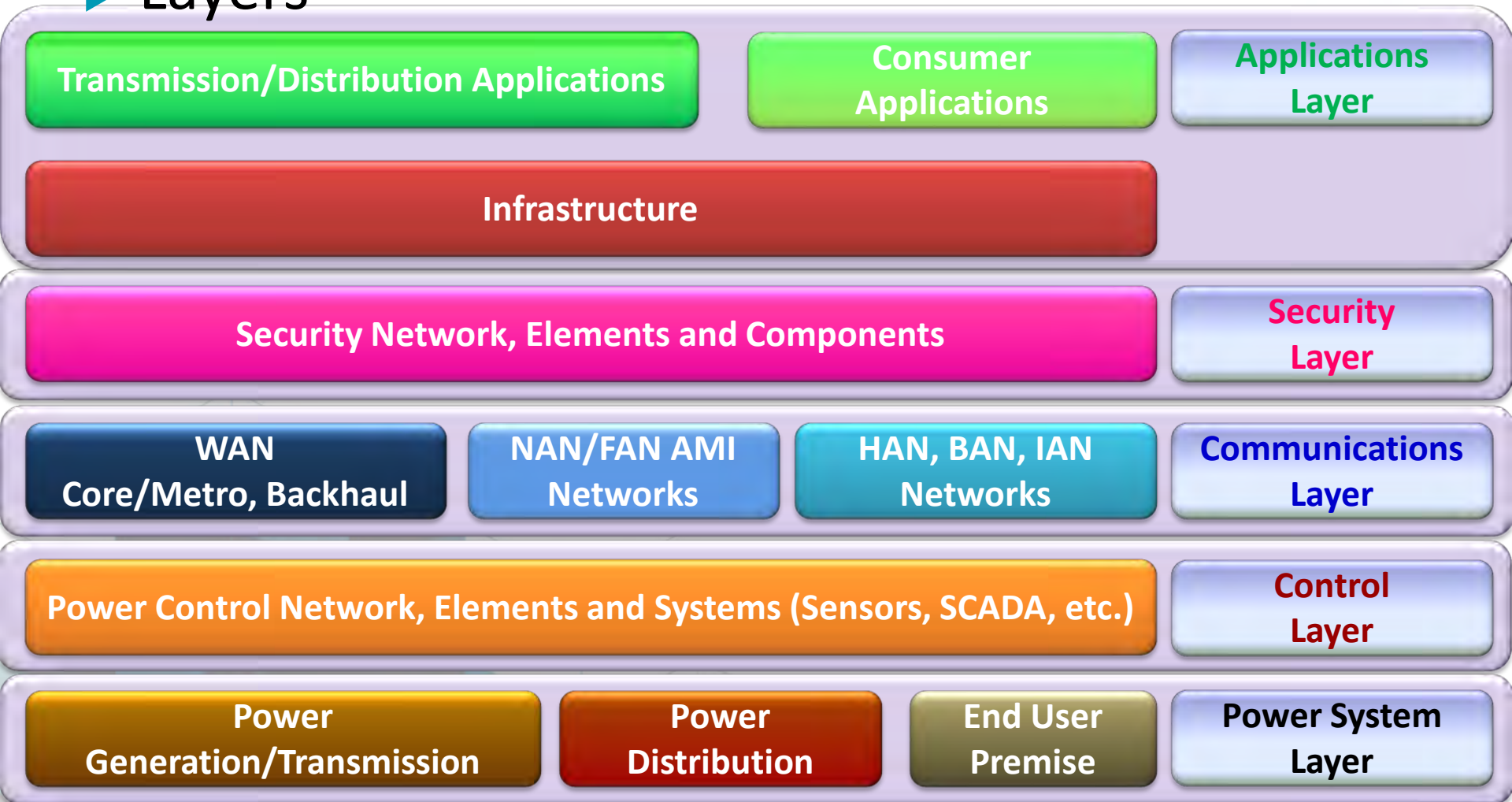
Internet of Energy

ARTEMIS IoE

Architecture



► Layers



IoE Communication Domains



Internet of Energy

Renewables



Energy Storage



Street Lighting



Adaptive wireless



Internet

WAN 3G/4G

WiMax

WiFi



Communication

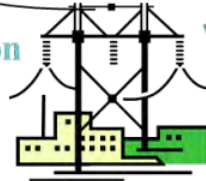
RF, PLC

RF, PLC

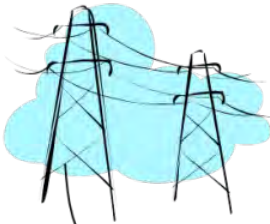
RF, PLC

RF, PLC

Transformer



Substation



Smart Appliances



WiFi

LoWPAN

ZigBee

RFID Charge station

NFC

PEVs, EVs

Internet of Things

Smart meter

ZigBee



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



Thank you for your attention!

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



Advanced Research & Technology for Embedded Intelligence and Systems

www.artemis-ioe.eu