E-Energy
Smart Grid made in Germany

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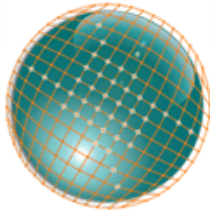
Federal Ministry of Economics and Technology



4th International Conference on
Integration of Renewable and Distributed Energy Resources
December 6-10, 2010
Albuquerque, NM, USA

Conference Sponsors

EPRI ELECTRIC POWER RESEARCH INSTITUTE
SMUD
PNM
Canada
Sandia National Laboratories
SEPA solar electric power association

Associate Sponsors

DERlab
NEDO

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Agenda

- The Programme
- The Network Idea
- The Model Regions
- First Results and Experiences
- Future Outlook

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The Programme – Owner

The German Federal Ministry of Economics and Technology BMWi
set up the sustainable technology programme:

“Information Society Germany 2010” (iD2010)

and its successor

“Germany Digital 2015”

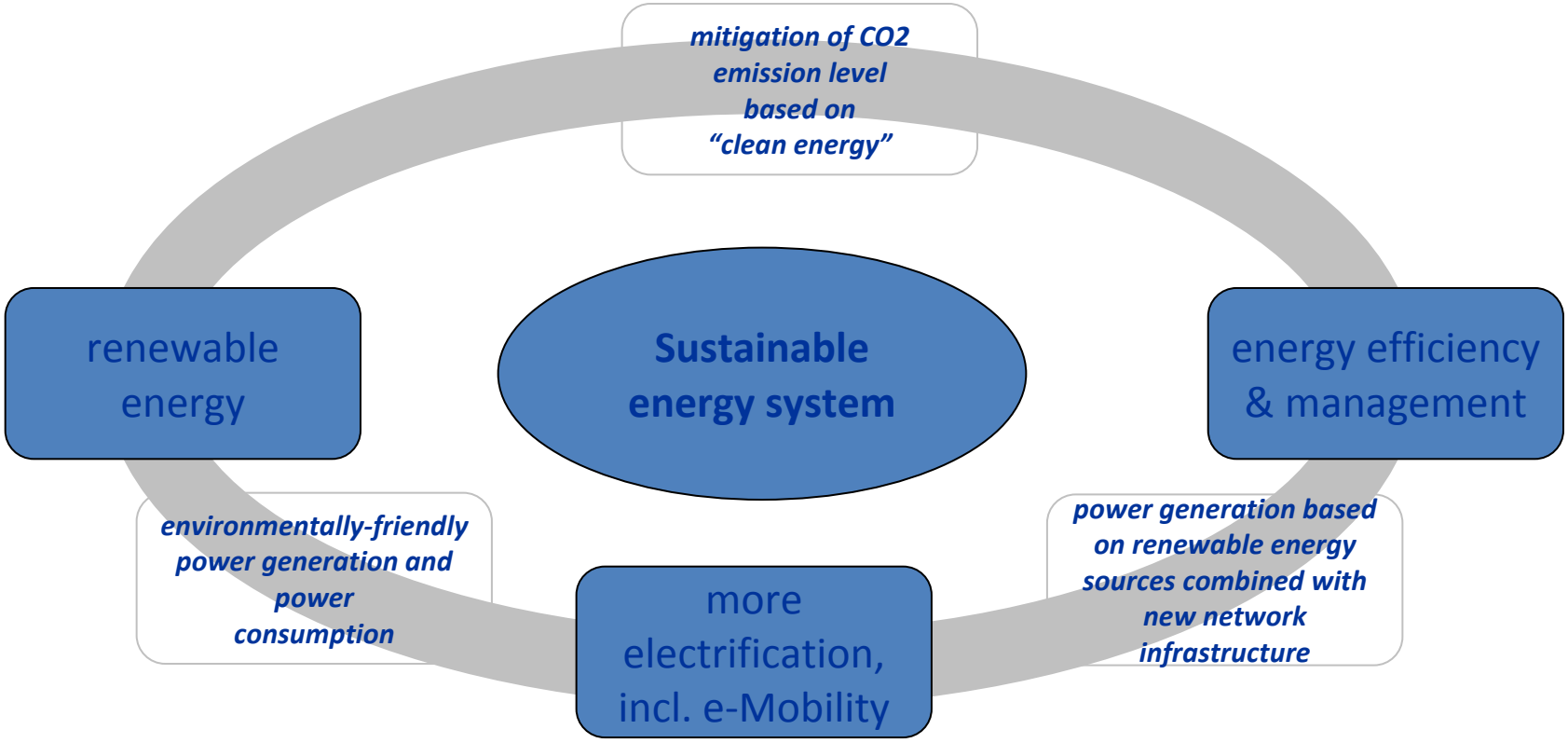
- Responsibility for leadership: Department for Development of Convergent Information and Communication Technologies (ICT); Dr. Goerdeler
- Responsibility for implementation: Project Management Agency at German Aerospace Center (DLR e.V.) (www.dlr.de), Department of Convergent ICT / Multimedia

Other projects within programme:

- THESEUS – New Technologies for the Internet of Services
- IT2Green – energy efficient ICT for SMEs, Administration and Housing
- Trusted Cloud – Secure Internet Services for SMEs and Public Sector

The Programme – Opportunities

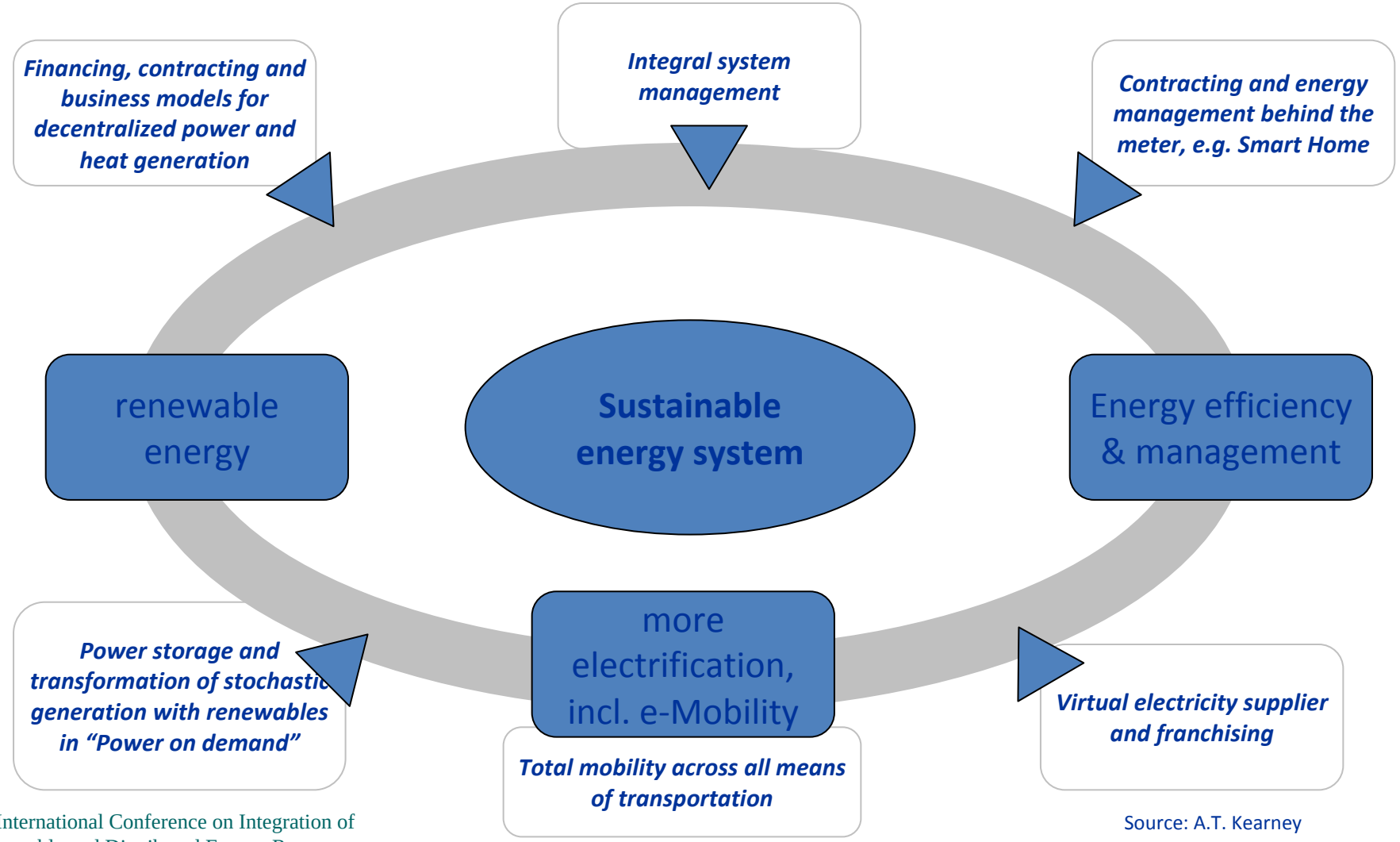
Possibilities for sustained economic growth



Source: A.T. Kearney

The Programme – Opportunities

New Economic Policy Opportunities

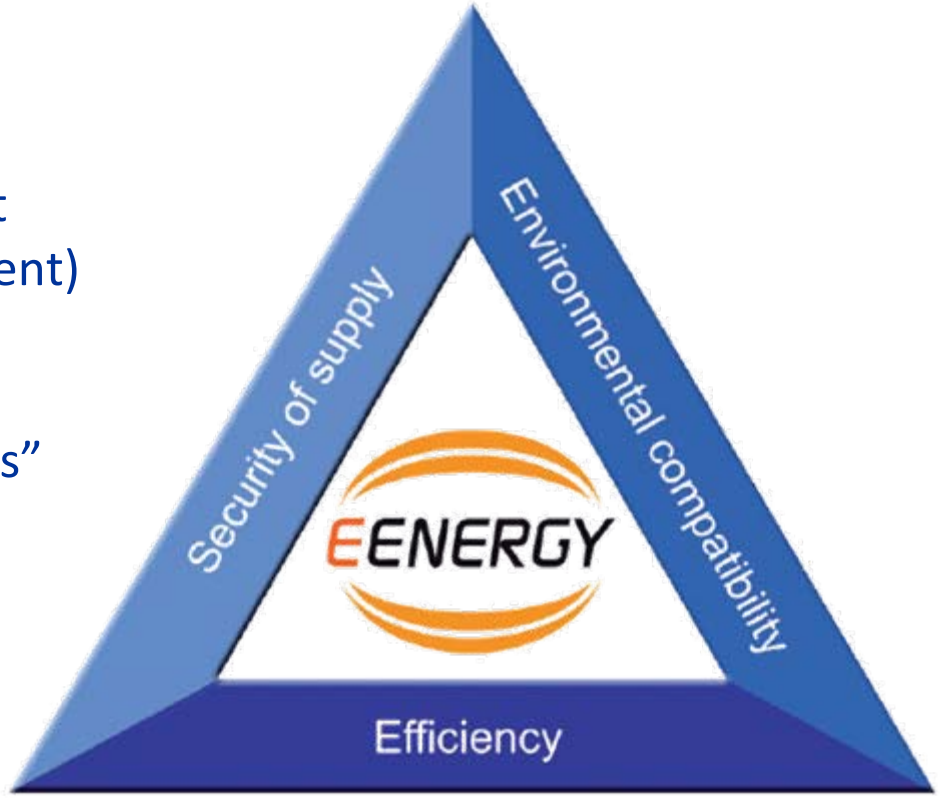


Source: A.T. Kearney

The Programme – Objectives

Contribution to the Energy Policy Triangle:

- Progress in liberalization and decentralization of the energy market
- Integration of renewables
- Intelligent energy management (esp. active demand management)
- New price structures
- Consumers become “Prosumers”
- e-Mobility

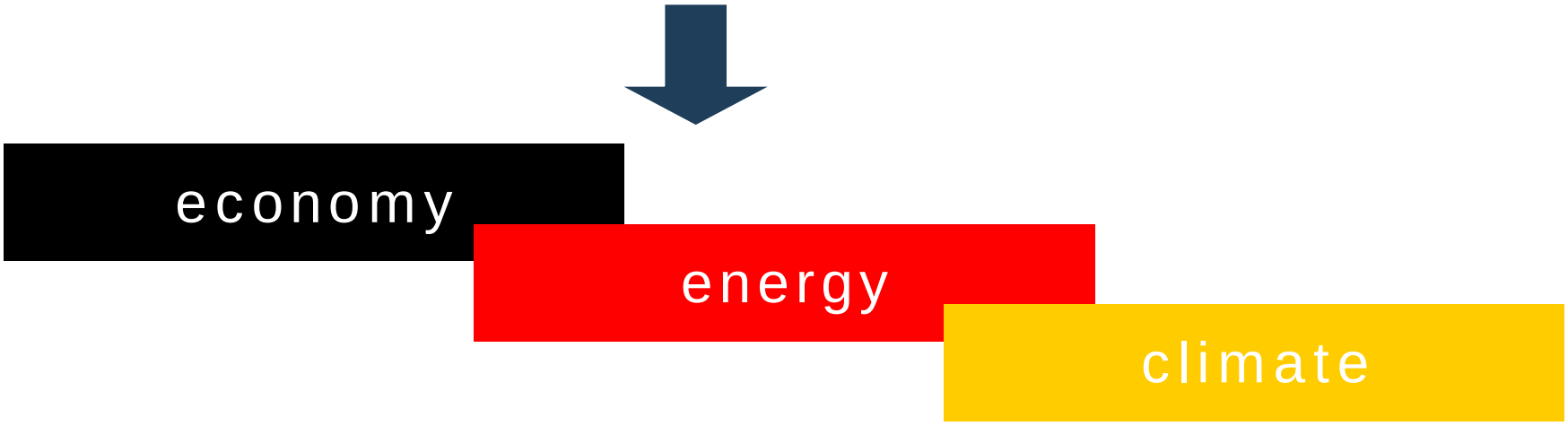


The Programme – Objectives

Contribution to Technology Policy priorities:

- Utilization of the potentials of digital networking and distributed intelligence for the power supply system
- Development of integrated concepts with flagship projects
- Practical and transferable
- Development of applications and services along the whole value chain

generation ▶ transport ▶ distribution ▶ end consumer



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The Programme – Organization

Launch of the e-Energy funding programme

2006: Analysis of current state and potential

2007: E-Energy technology competition

2008: Selection of 6 Model Regions (28 partners)

Total budget: 140 Mio. EUR

incl. funding from:

- Federal Ministry of Economics and Technology (approx. 40 Mio. € for four model regions)
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (approx. 20 Mio. € for two model regions)

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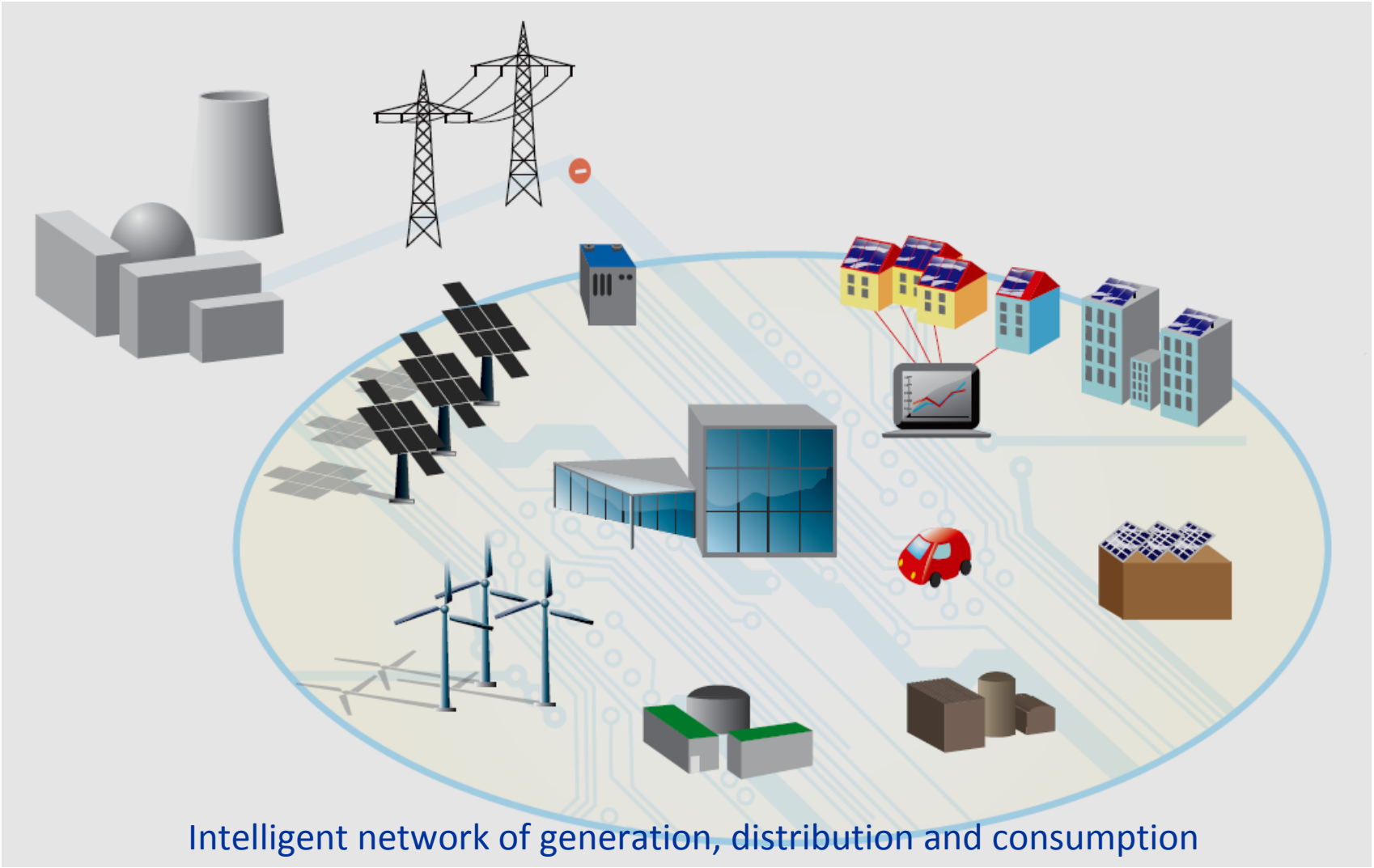
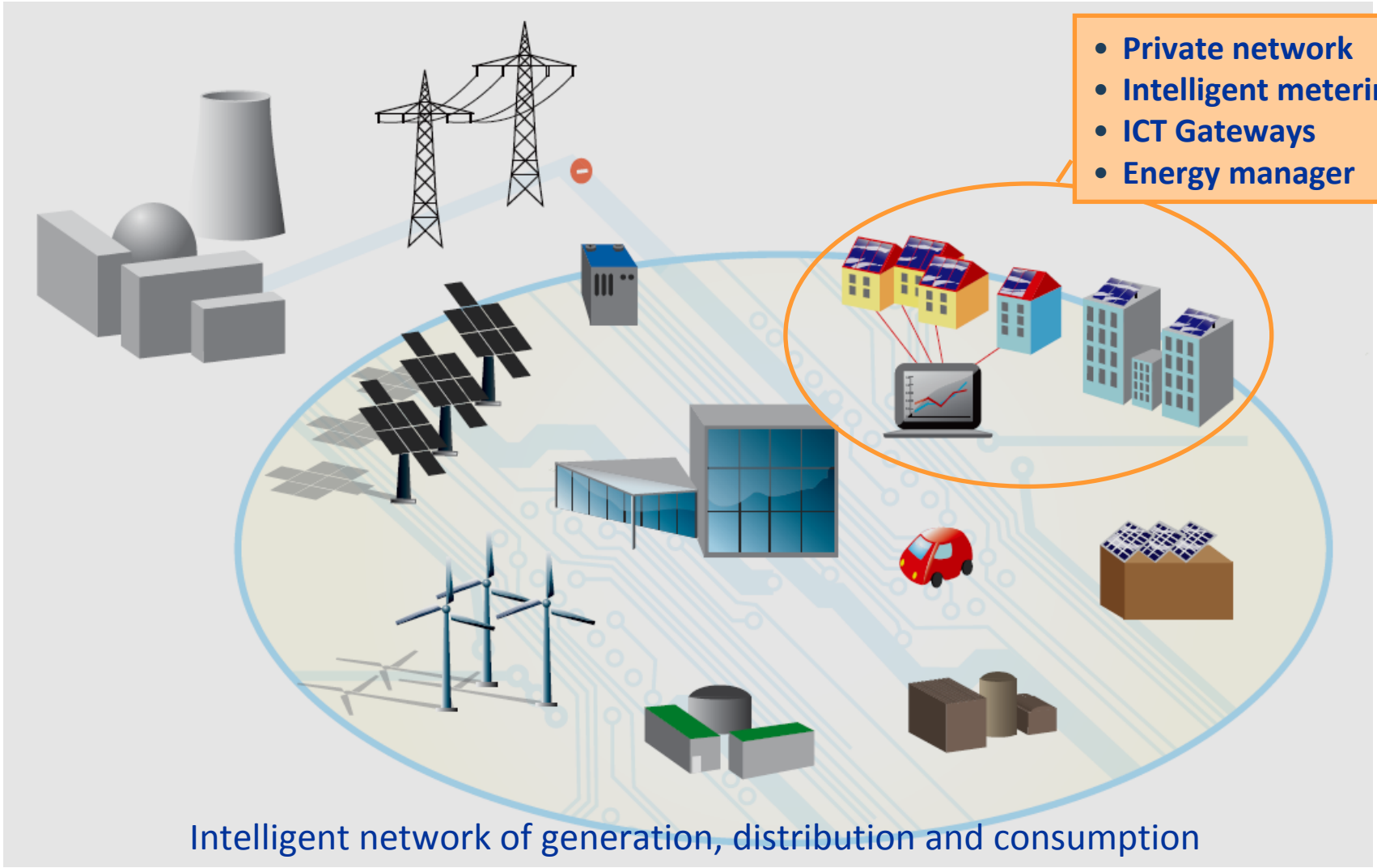
The Network Idea – Overview

EENERGY



Intelligent network of generation, distribution and consumption

The Network Idea – Consumer



Intelligent network of generation, distribution and consumption

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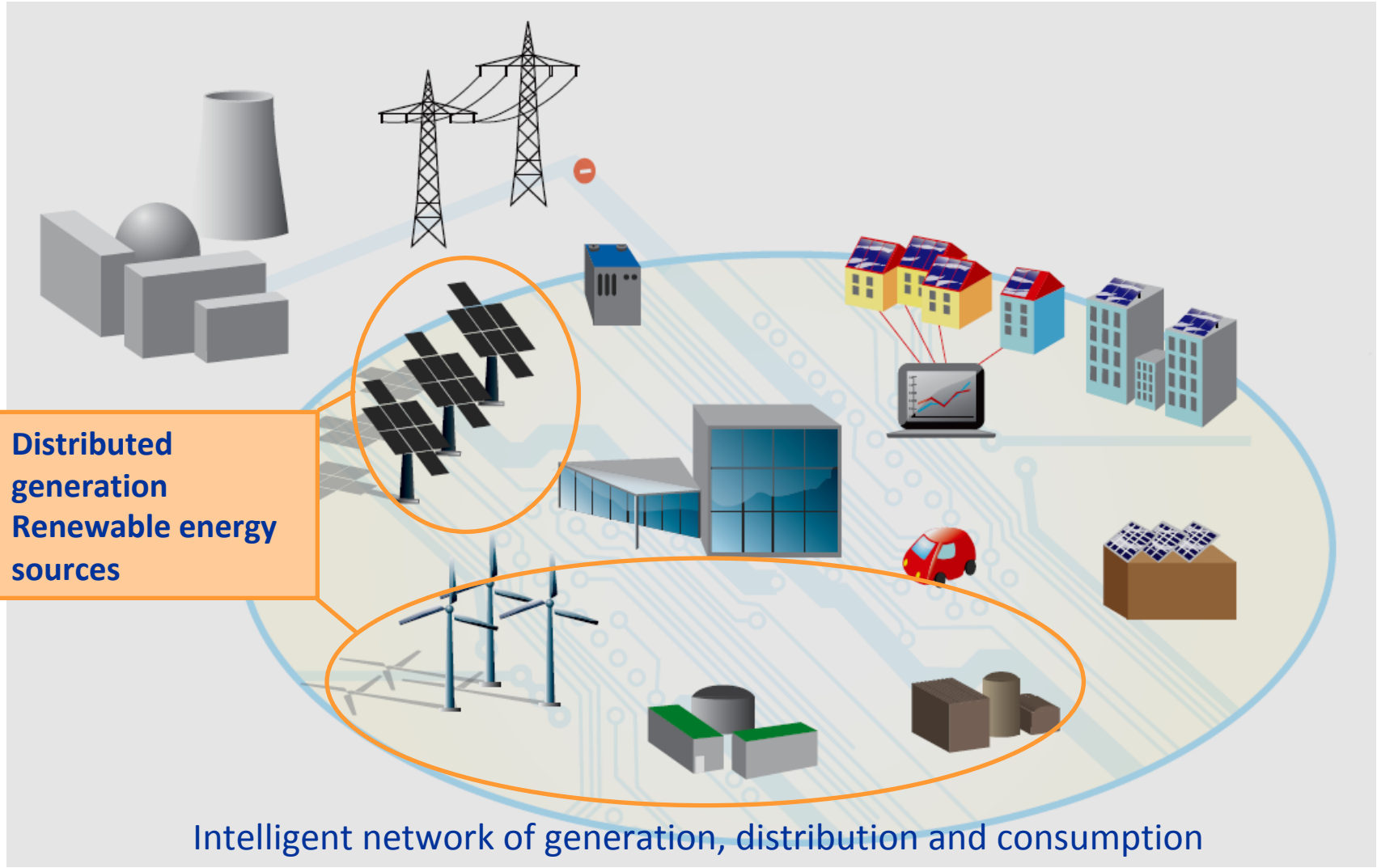
The Network Idea – Generation

EENERGY



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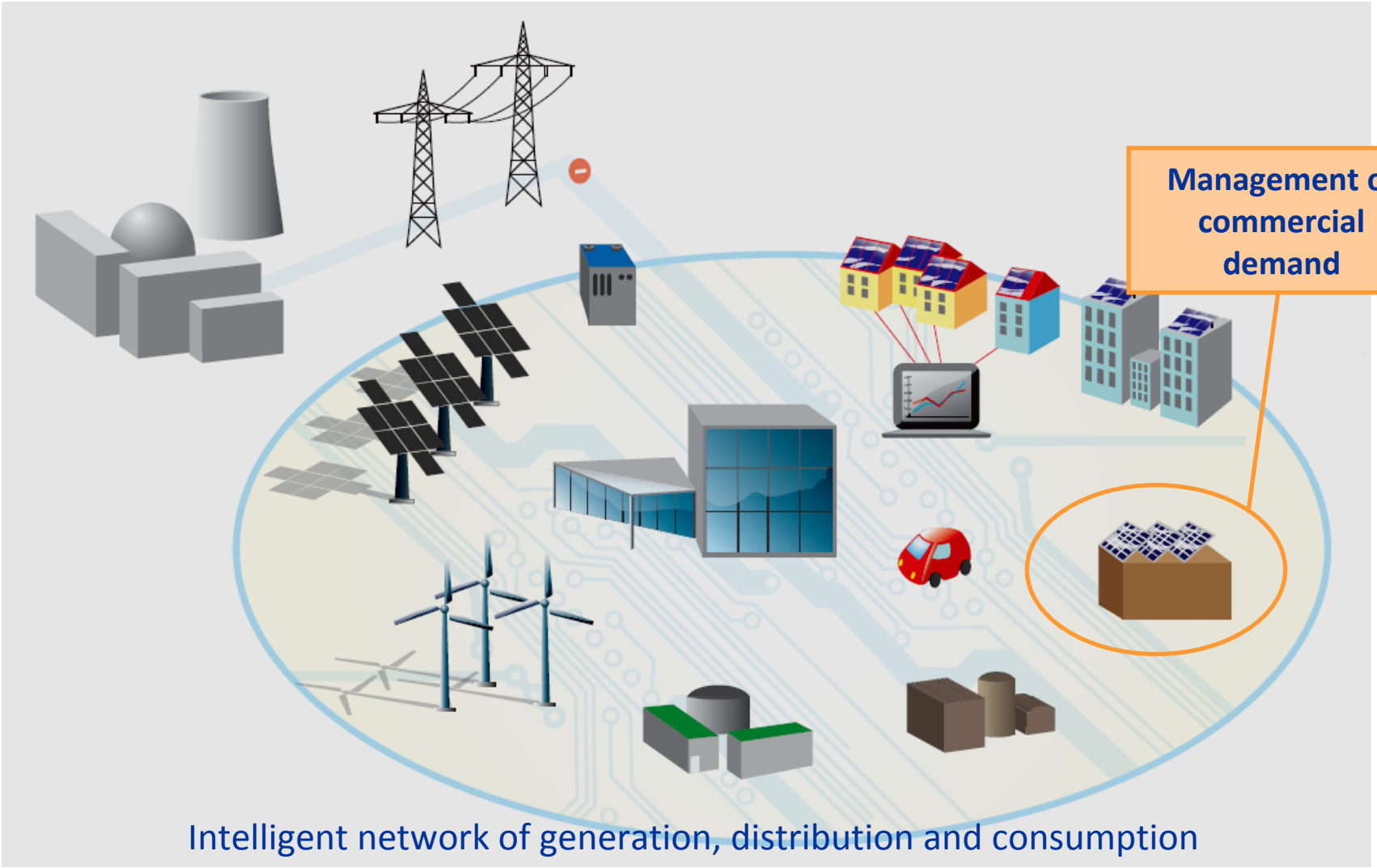
The Network Idea – Commercial

EENERGY



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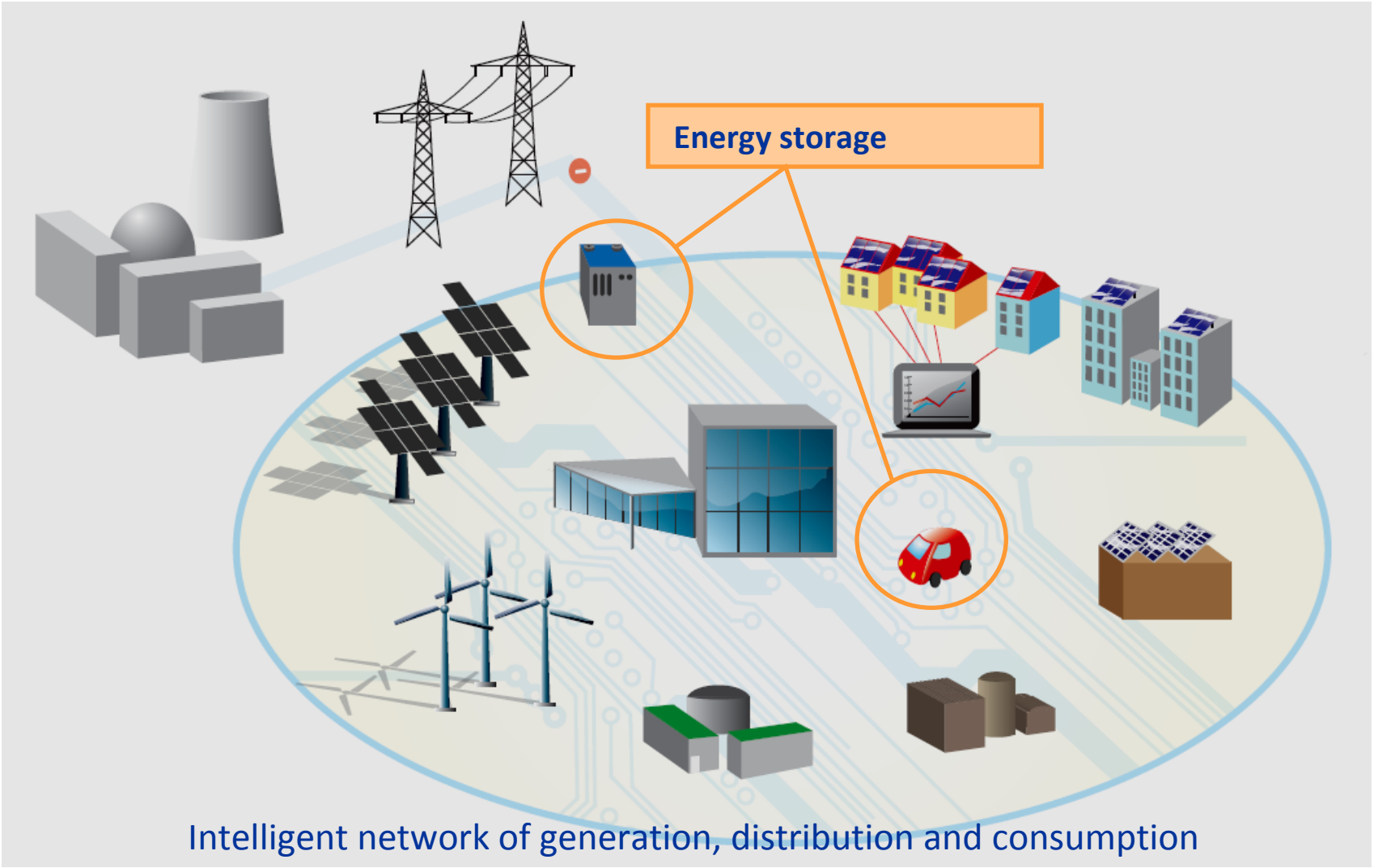
The Network Idea – Storage

EENERGY



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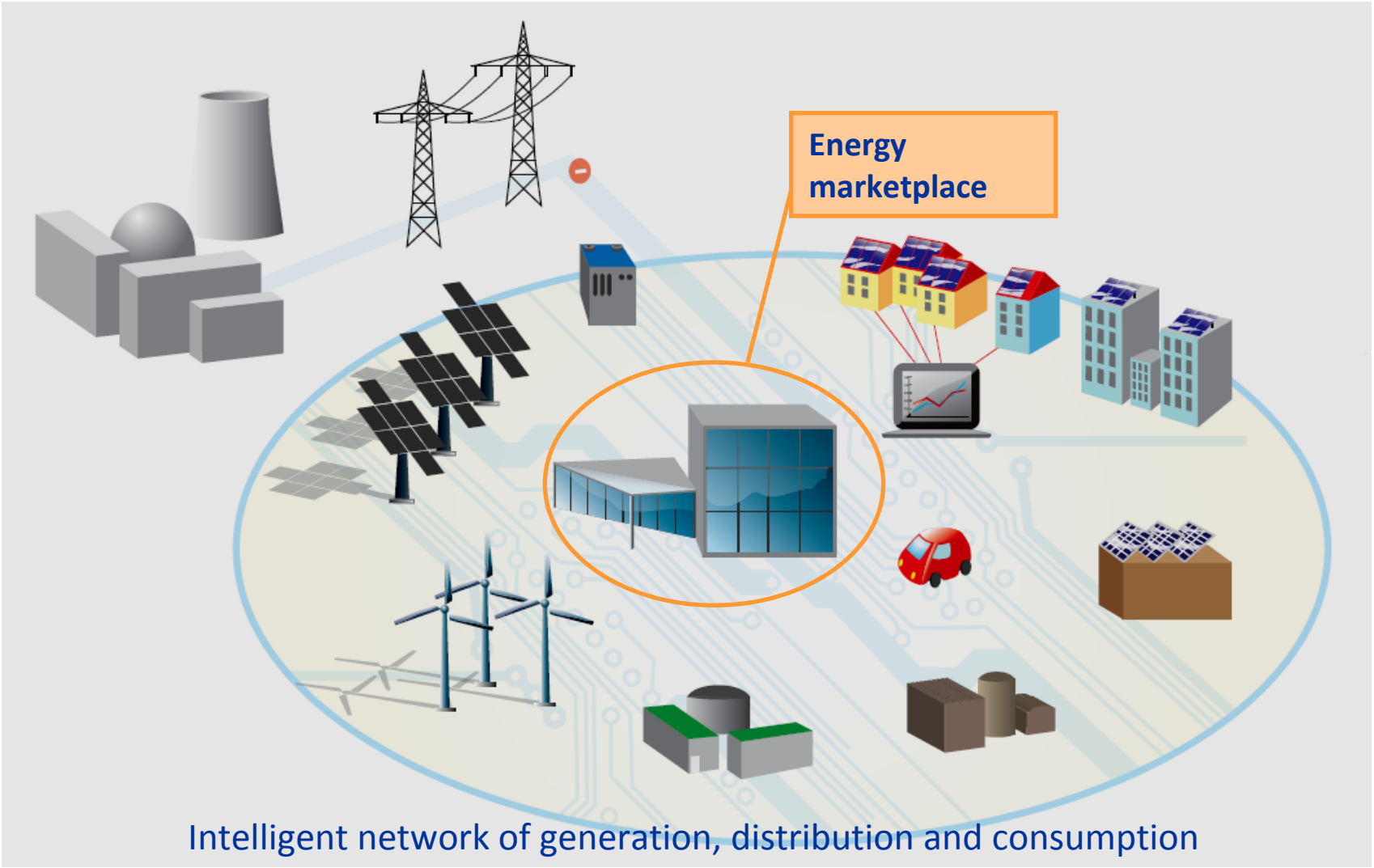
The Network Idea – Marketplace

EENERGY



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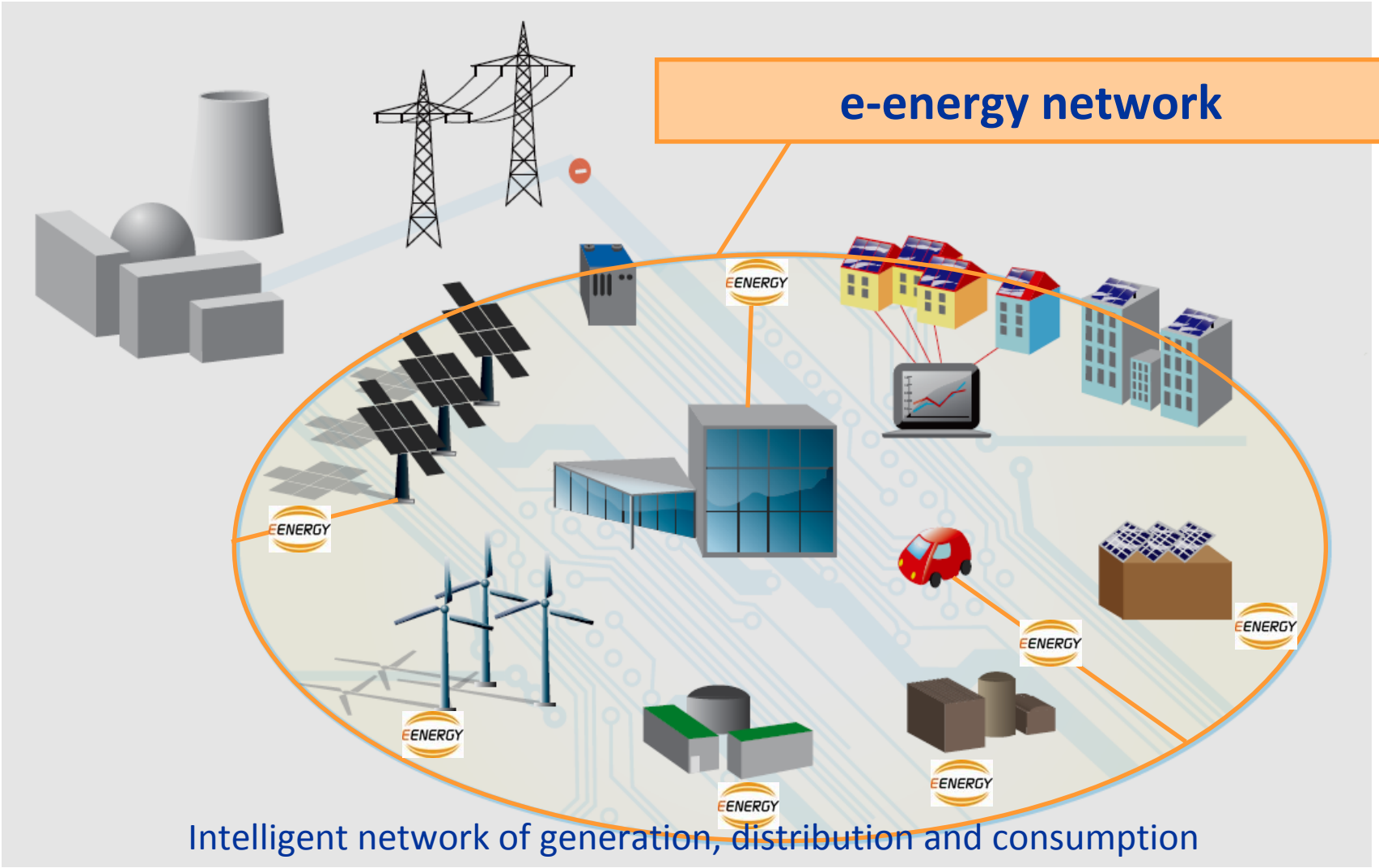
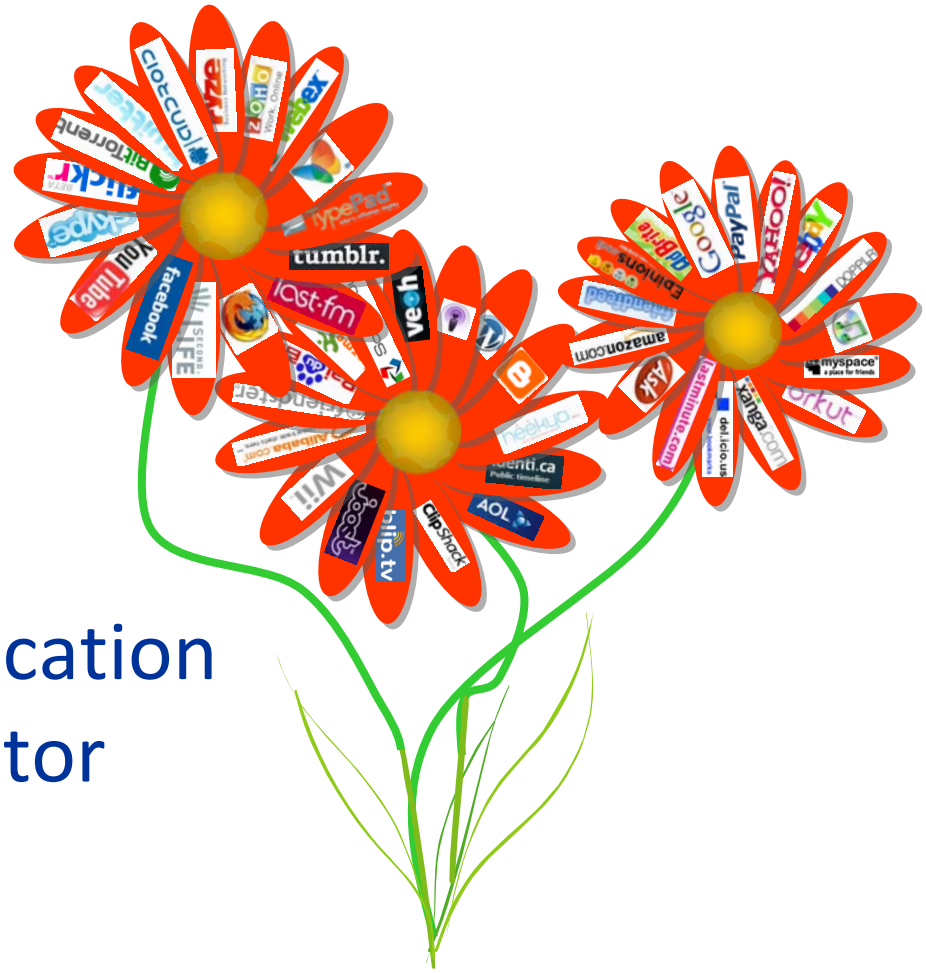
The Network Idea – e-Energy



The Network Idea – Convergence

Communication + IT Industry

- Web 2.0

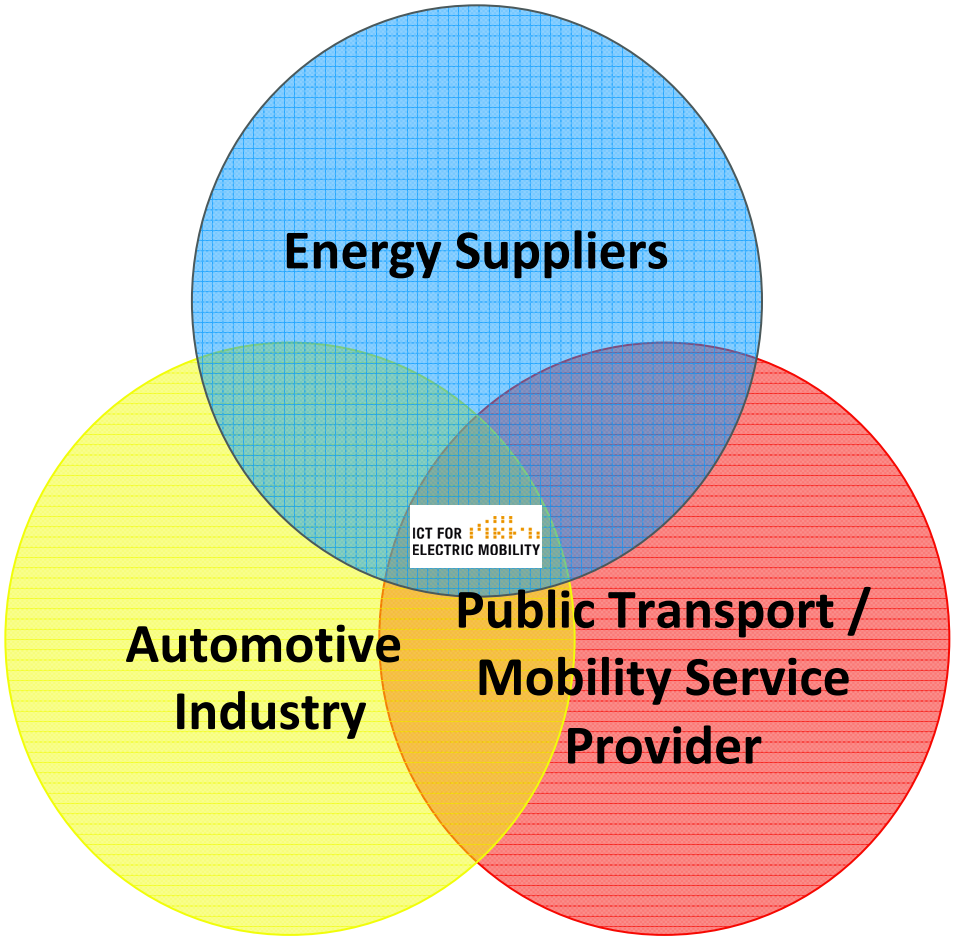


Information & Communication Technology + Energy sector

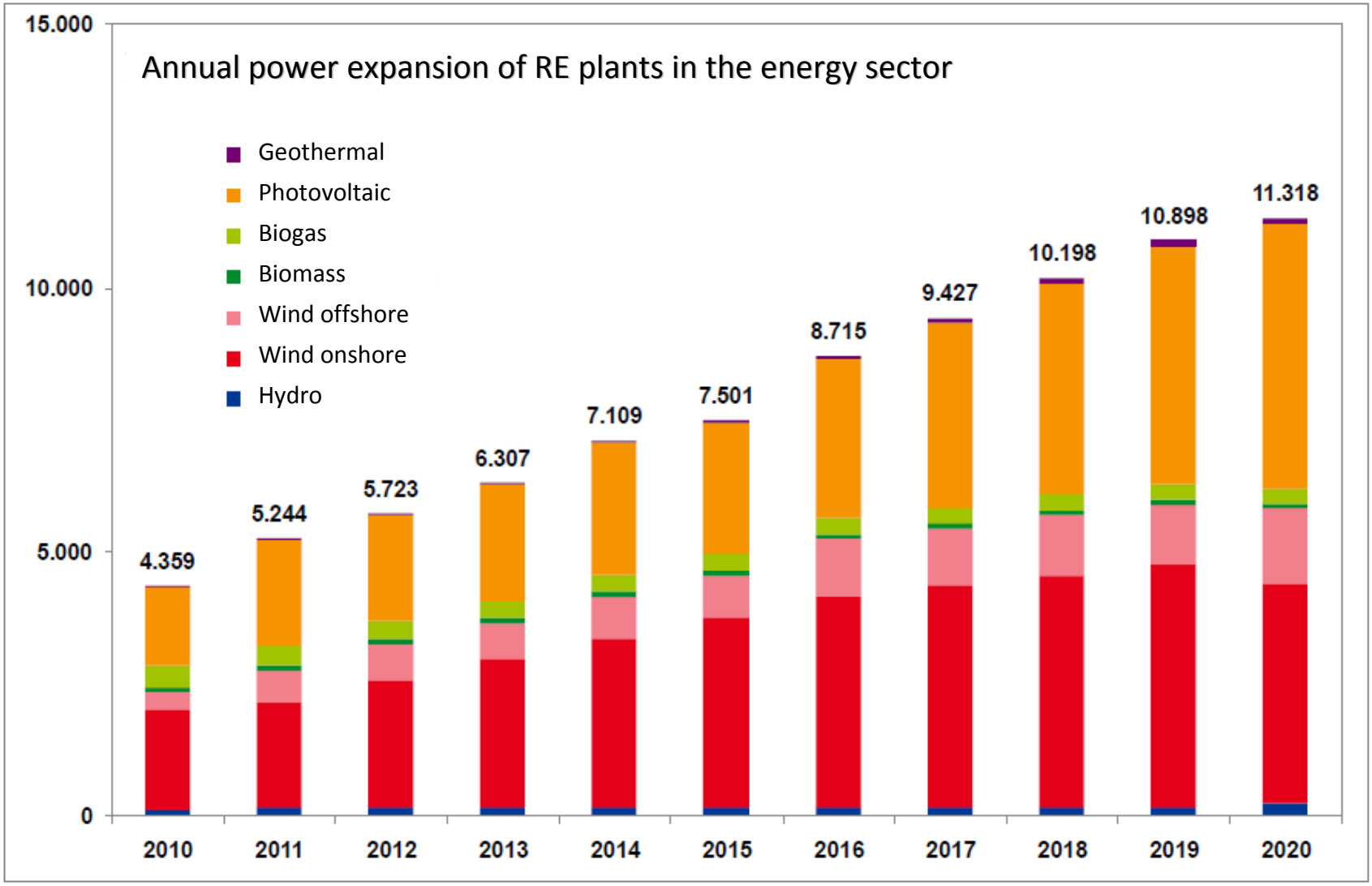
- e-Energy

The Network Idea – Convergence

The Next Convergence



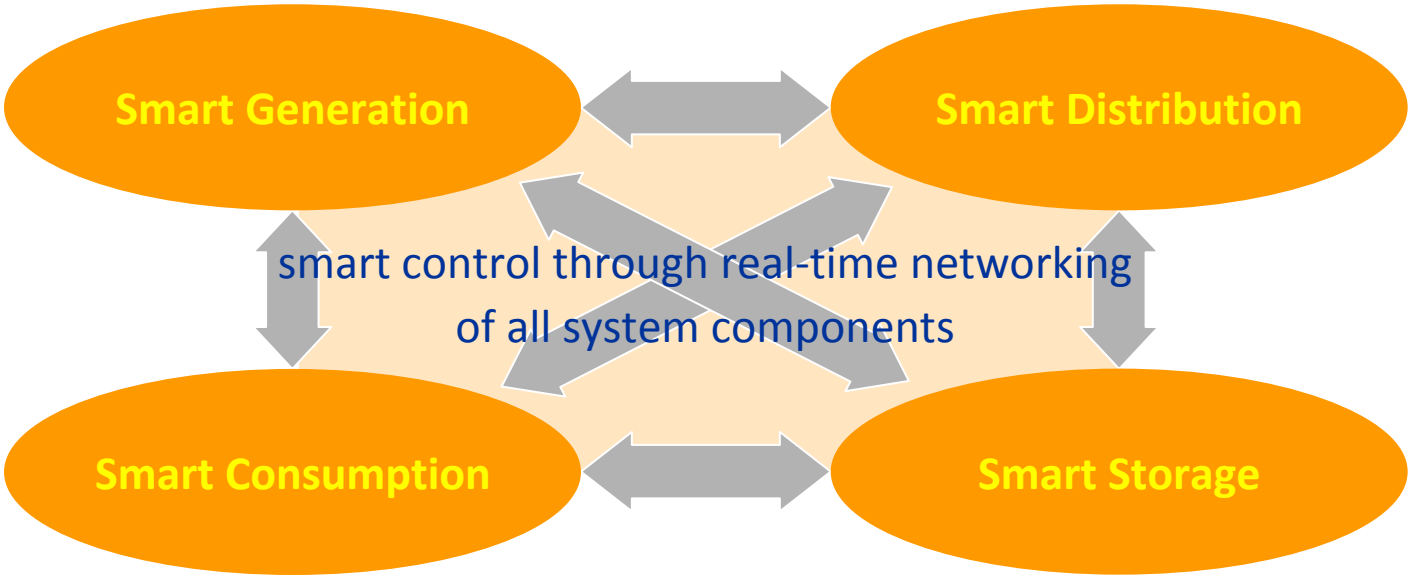
The Network Idea – German Situation



Source: German Renewable Energy Federation BEE (Bundesverband Erneuerbare Energie e.V.) Sector Forecast

The Network Idea – The Shift

process chain: demand-oriented production



Role change of the Customer

Today (passive):

- **Unidirectional** energy flow
- Last element of energy supply chain
- **Undifferentiated**, supply not demand-driven

Tomorrow (active):

- **Active** partners in energy supply chain, user and provider
- Multilateral contracts
- **Bidirectional** energy flow
- Individual, **demand-driven** supply
- Demand side management
- Demand side response

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The Network Idea – Psychology

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"Technical" consumption feedback often doesn't achieve the intended goals…

- Savings potential often below 3%
- Marginal user base
- Expensive equipment only used by a small segment of consumers
- Poor motivational approaches

What is the key driver when it comes to making decisions?

- Financial incentives OR
- Social recognition / social pressure?

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The Model regions – Landscape

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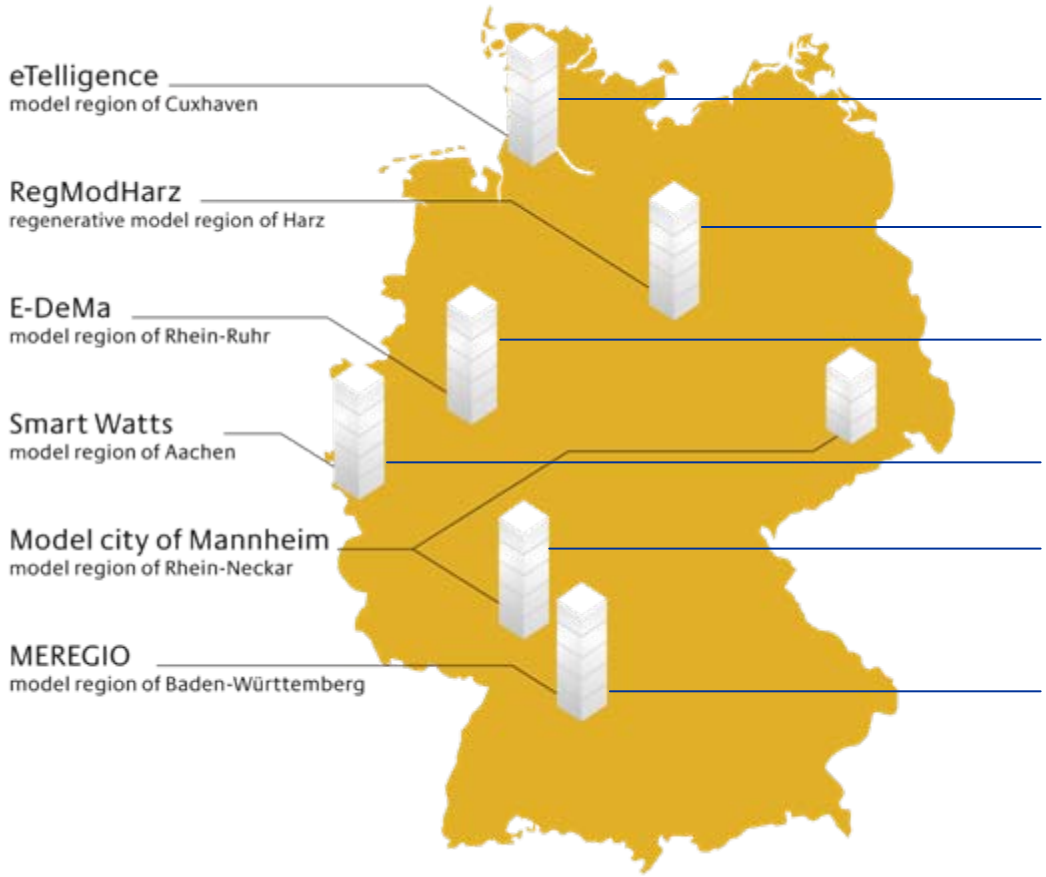
Different characteristics of each model region



Rural area, low supply density, high percentage of renewable energy

District with a lot of renewable energy producers

Changing from sectionalised energy to a centralized e-energy marketplace

Price and quality demands, increase of self-regulation

Urban area, high supply density, high percentage of renewable and decentralized energy

Price as financial incentive, minimum objective: emission certificate

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Model Region Baden

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MeRegio

Specifics:

Energy Efficiency in the Integrated House, incl. E-Car

Instruments:

- Smart meters and StromRadar©
- Price incentives at the outlet
- Minimum emission certificates
- Central platform to control and run the system

Lead partner: EnBW Energie Baden-Württemberg AG

Other partners: IBM, ABB, SAP, Systemplan, University Karlsruhe

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The Model Regions – Experiences

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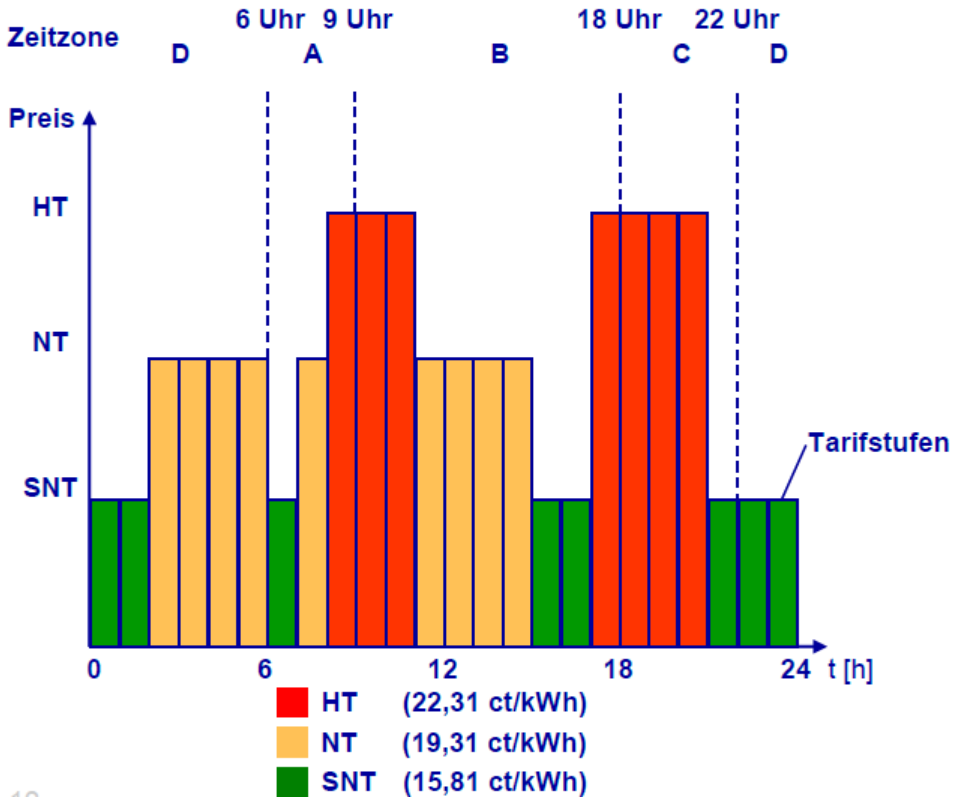
In phase 1 the price signal has 3 levels with relatively small spread between the high tariff and super-low tariff

MeRegio



- Mo-Fr 4 time zones according to the customers' daily life (6-9, 9-18, 18-22, 22-6h)
- Sa/So and holidays only 3 time zones (9-18, 18-22, 22-9h)
- Each tariff must be valid for at least 1 hour
- The tariff levels were assigned randomly

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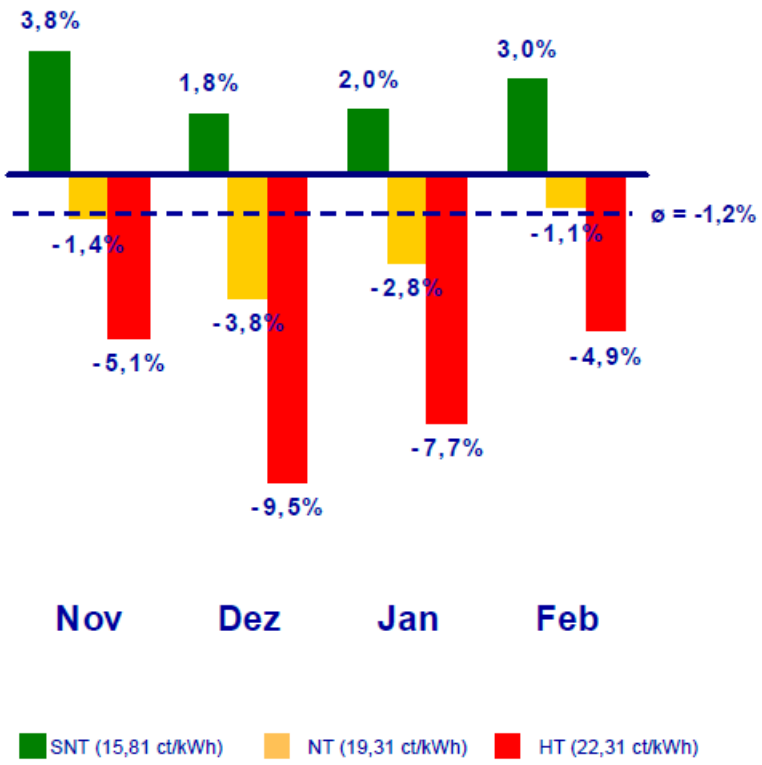
The Model Regions – Experiences

First result: Customers react considerably to the dynamic tariffs of MeRegio phase-1

MeRegio

Average load shift MeRegio clients [1)]



- In the first 4 months of phase 1 the MeRegio clients reacted stronger on HT as on NT
- Energy efficiency increased and consumption decreased an average of 1,2%, saving approx. 8 t of CO_2
- 88 customers with average norm consumption of 4,851 kWh were evaluated
- The measured load curves were compared with a reference group of 305 intelligent meter clients, who had demographic characteristics comparable to the MeRegio clients

[1)] preliminary results, confirmation pending

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The Model Regions – Experiences

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Average load shift MeRegio clients compared to reference group

Data set: measurement on weekdays except Saturdays Nov 2009 – Feb 2010

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Model Region Aachen

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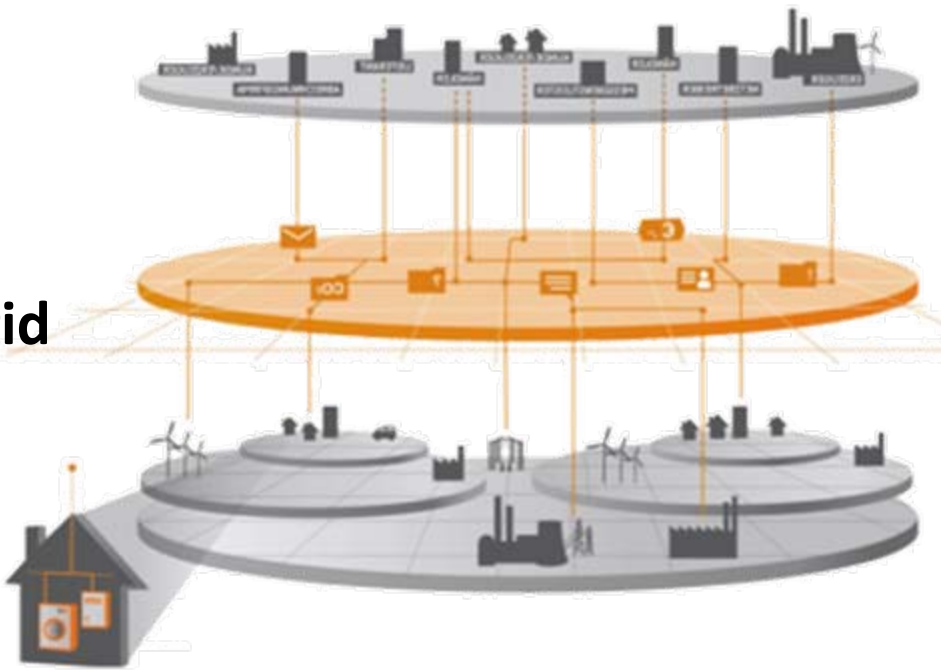
Smart@Watts



Specifics:

Pricing signals, self-regulating grid

Instruments:

- Prognosis system and optimization algorithms
- Device to upgrade household appliances
- EE BUS the 2-way bridge between grid and appliances

Lead partner: Utilicount

Other partners: Stadtwerke Aachen, FIR at RWTH Aachen, PSI Büsing & Buchwald, Kellendonk Elektronik

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The Model regions – Results

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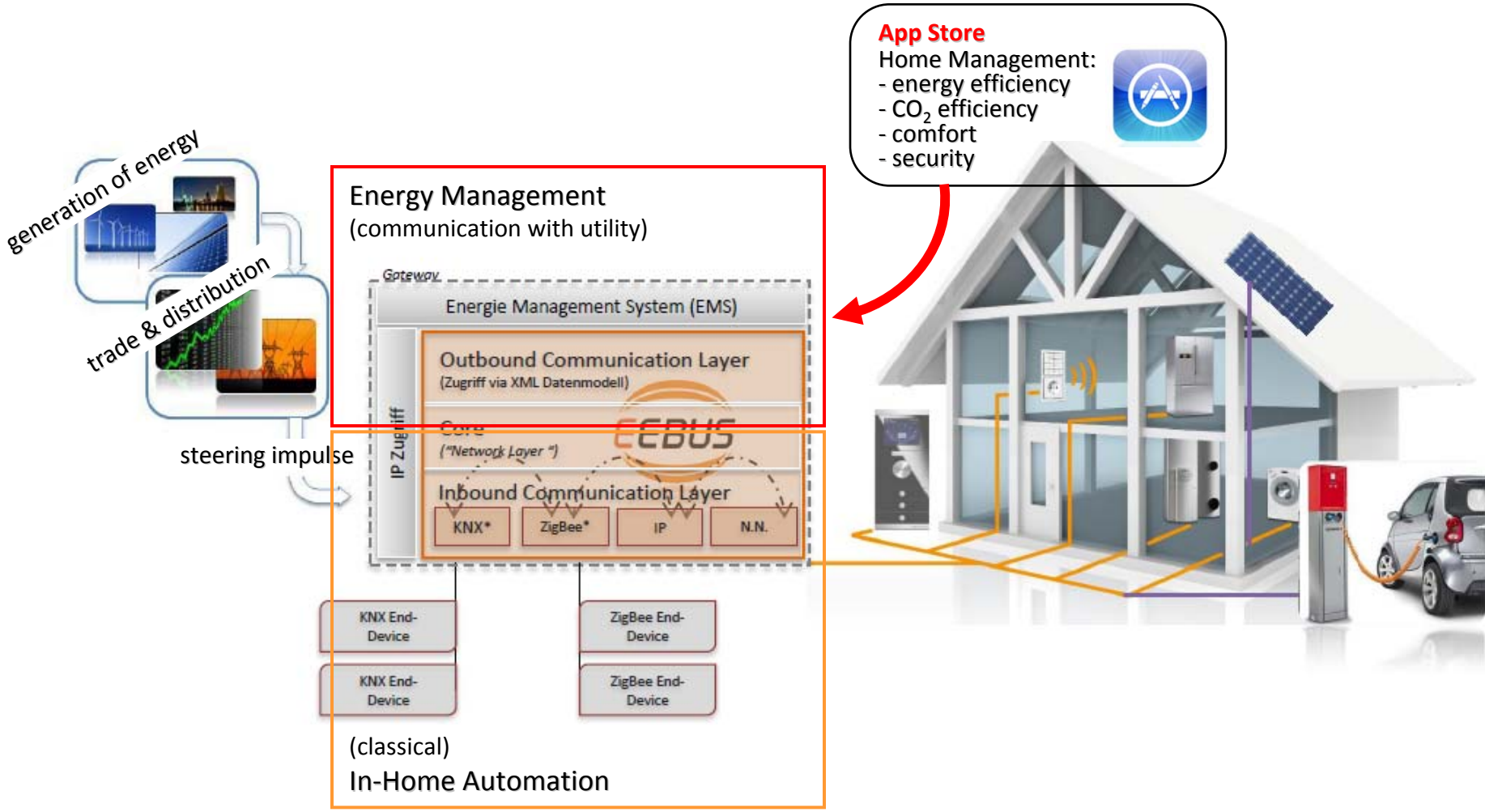
EE-Bus: Networking of appliances for efficient energy management



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Outcomes – Co-Operation

EENERGY

BNetzA

ZVEI

DStGB Deutscher Städte- und Gemeindebund

bdew Energie. Wasser. Leben.

DKE VDE DIN

verbraucherzentrale Bundesverband

BITKOM

BDI Bundesverband der Deutschen Industrie e.V.

vwew

Partner Regions

ICT FOR ELECTROMOBILITY

EENERGY

EENERGY

D-A-CH-co-operation

ENERGIE SYSTEME der Zukunft

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

E-Energy Annual Congress

- Jan. 11 & 12, Berlin
- International event (mainly European neighbours)
- Main topic: Standardisation

save the date

CeBIT

Kompetenzzentrum E-Energy

SMARTGRIDS COOPERATION

GRIDWISE ALLIANCE

IEC

cigré

CENELEC

IEEE

NIST

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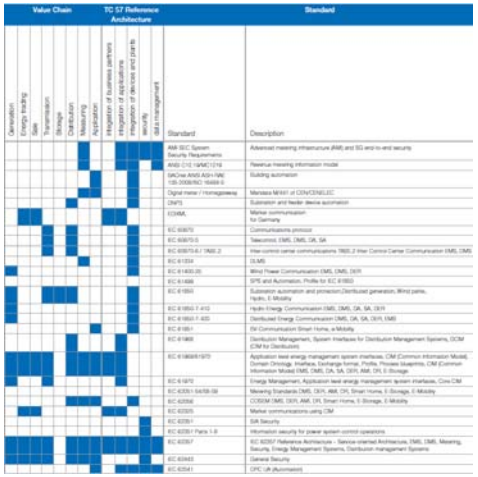
Outcomes – Standardisation

EENERGY

Establishing the centre of excellence for e-Energy within the German Commission for Electrical, Electronic & Information Technologies (DKE)

German Standardisation Roadmap E-Energy / Smart Grid

- Identification and analysis of several studies and initiatives, e.g.
  - IEC SMB SG 3 Smart Grid Roadmap (IEC)
  - NIST IOP Framework (NIST / EPRI)
  - German e-Energy Standardisation Roadmap (BMWi / OFFIS / BDI)
  - M/441 Mandate on Smart Metering (EU / CEN, CENELEC, ETSI)
  - Cigre D2.24
  - Comparison of identified standards



Results

- About 50 recommendations have been worked out by the experts
- A lot of standards are available
- Especially for the IEC/TC 57 framework we expect a broad consensus

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Outcomes – Standardisation

Identified core standards for Smart Grid

- IEC 62357: Seamless Integration Reference Architecture
- IEC 60870: Transport protocols
  e.g.EN 60870-5-104:2001-05
- IEC 61970/61968: Common Information Model (CIM)
  e.g. EN 61970-405:2007-09, EN 61968-3:2004-06
- IEC 62325: Market Communications using CIM
- IEC 61850, 61850-7-4XX: SAS, Communications, DER
  EN 61850-7-420:2009-06
- IEC 61400: Communications for monitoring and control of wind power plants
  EN 61400-1:2004-02
- IEC 62351: Security for Smart Grid
- IEC 61334: DLMS (Device Language Message Specification)
- IEC 62056: COSEM (Companion Specification for Energy Metering)
  e.g. EN 62056-53:2002-06
- EN 50090 (KNX)
  (ISO/IEC JTC1 SC25 -ISO/IEC 14543-3, CEN/TC 247 (BACS/HLK) -EN 13321 -1 und -2)
  ZigBee

Market communication

Integration of DER / RES

IT security

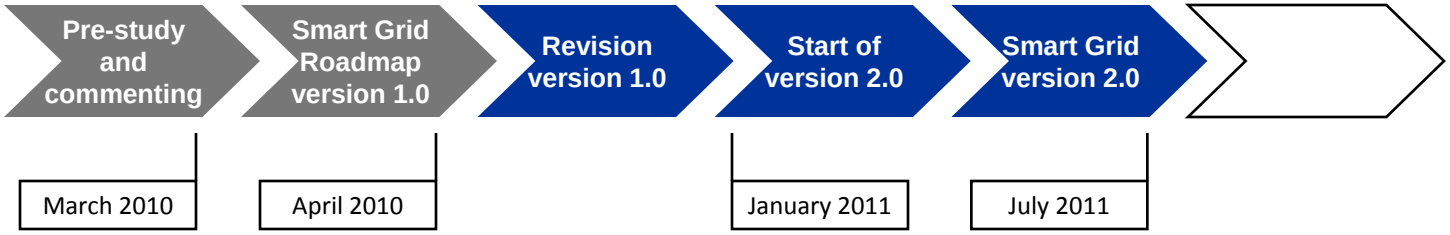
Smart metering

In-house automation

Outcomes – Standardisation

Summary and Outlook

- Version 1.0 of the Roadmap is available in English and German
- Standards for the Smart Grid of the future are available
  - Provided by the IEC TC 57 working groups
  - Enhancement and integration is needed
  - Changes within regulatory, technical, political and organizational aspects are needed for the Smart Grid
- Next Steps (planned)



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Outlook

“Flagship projects for the coming fleet”

Important for the Economy and Quality of Life

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The energy internet is a collaborative network. Network Economics are imperative.

EENERGY

www.e-energy.de

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"If you have an apple and I have an apple and we exchange these apples, then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas."

George Bernard Shaw