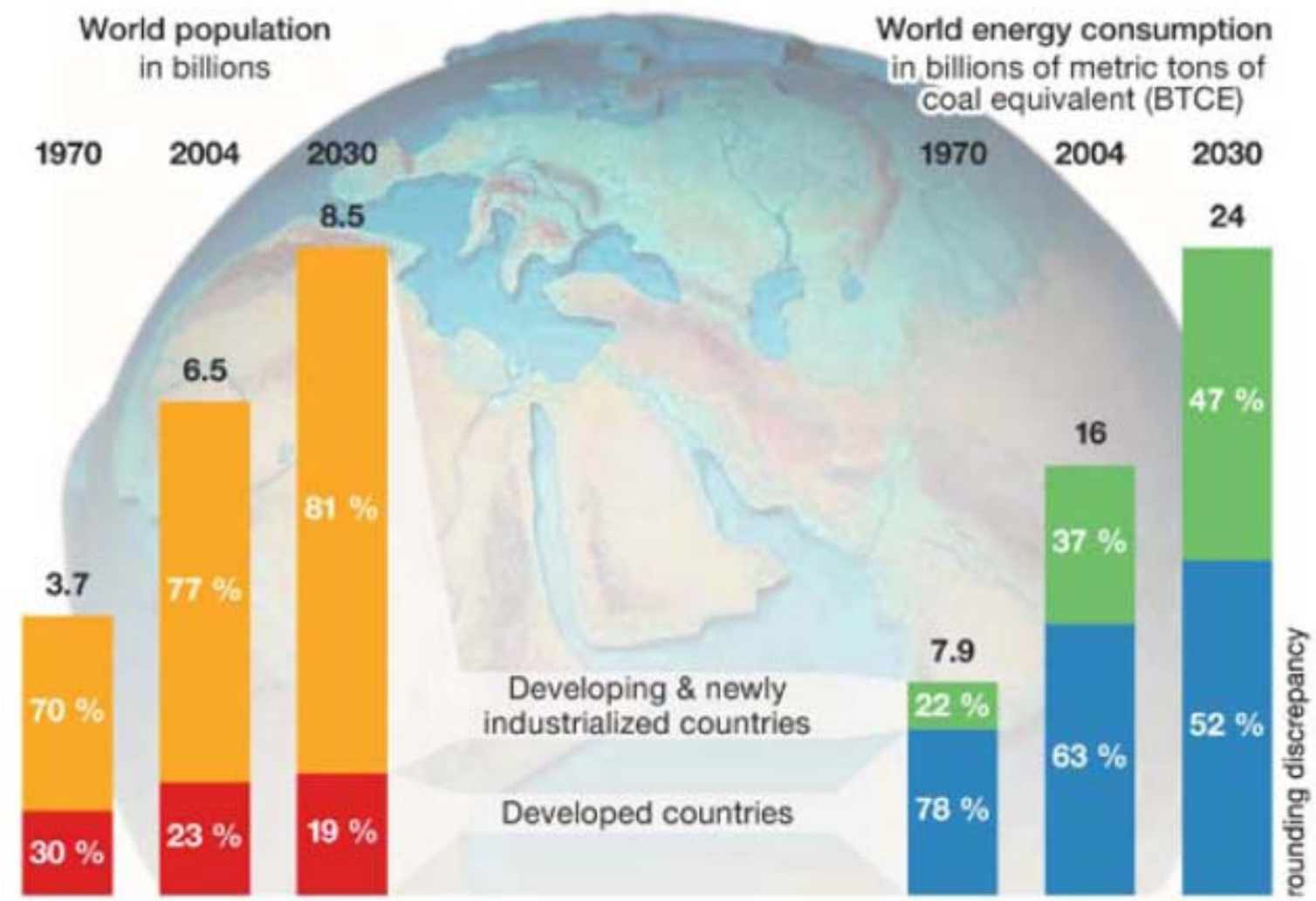
Standardization in the field of energyefficiency and renewable resources

DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE

Dr. Bernhard Thies

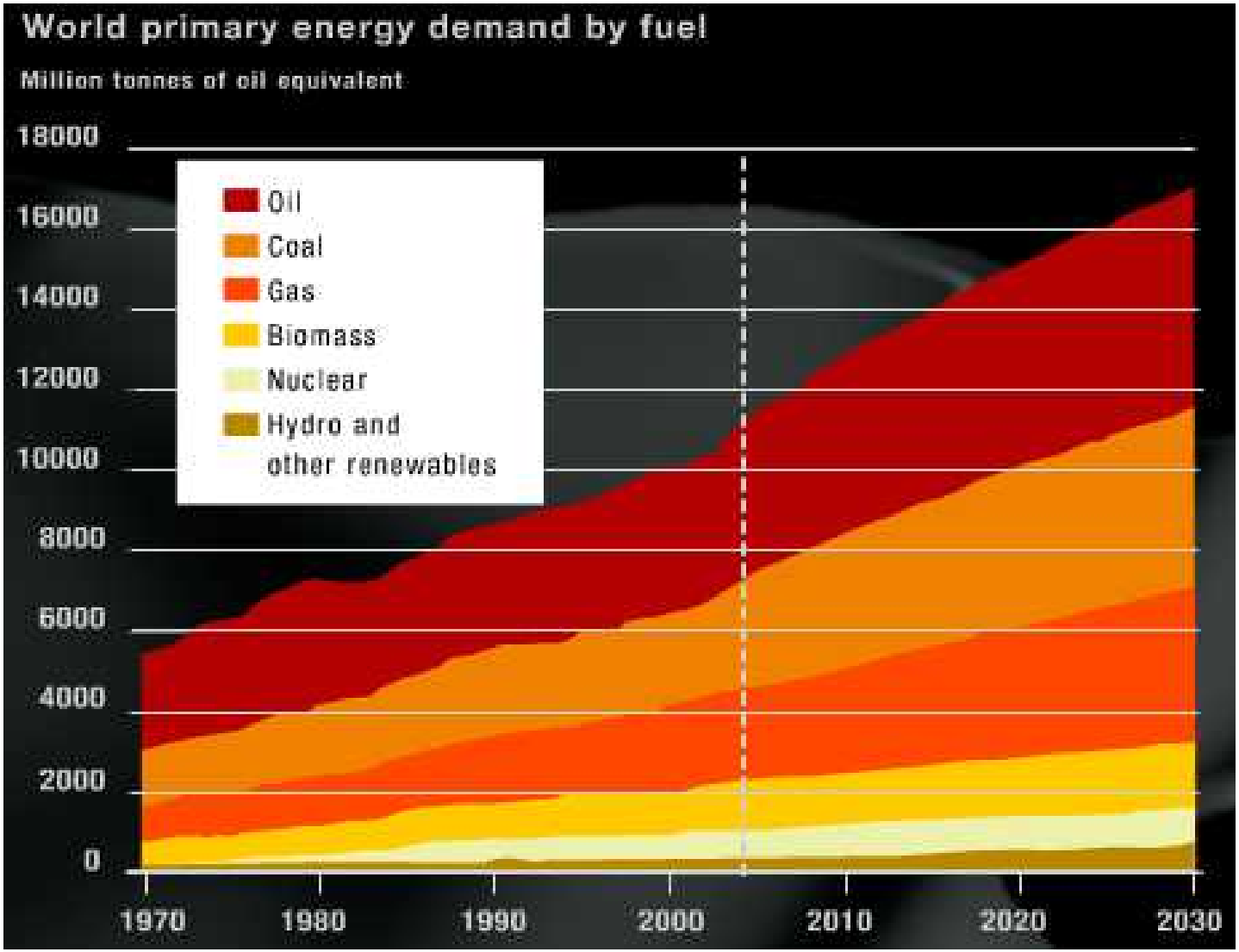
Chairman of the Board of Directors

The Challenge lies ahead



Source: International Energy Agency, World Energy Outlook 2004

Energy demand by fuel until 2030



Source: International Energy Agency Energy Review 2006

The potential of ocean energy for electricity generation

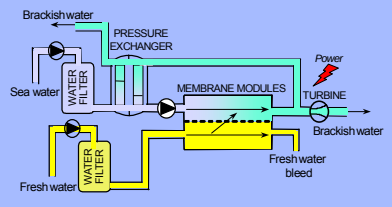
... ranges from 21 000 TWh/y to 93 000 TWh/y:

Global electricity production 2004:

17 400 TWh/y

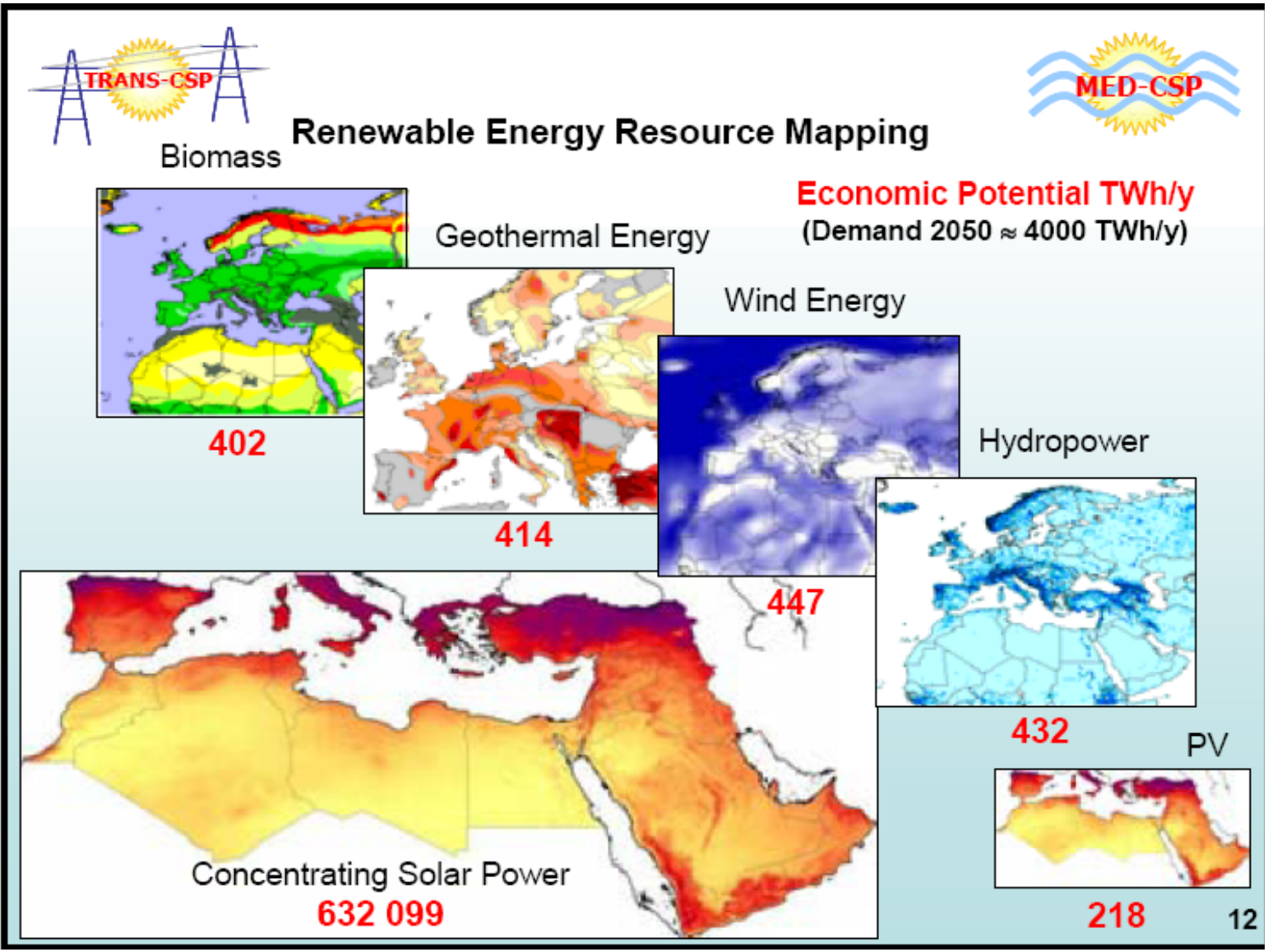
OCEAN ENERGY

- **TIDES (300 TWh/y)**
- **MARINE CURRENTS (800 TWh/y)**
- **WAVES (8 000 to 80 000 TWh/y)**
- **SALINITY GRADIENT (2 000 TWh/y)**
- **THERMAL GRADIENT (10 000 TWh/y)**



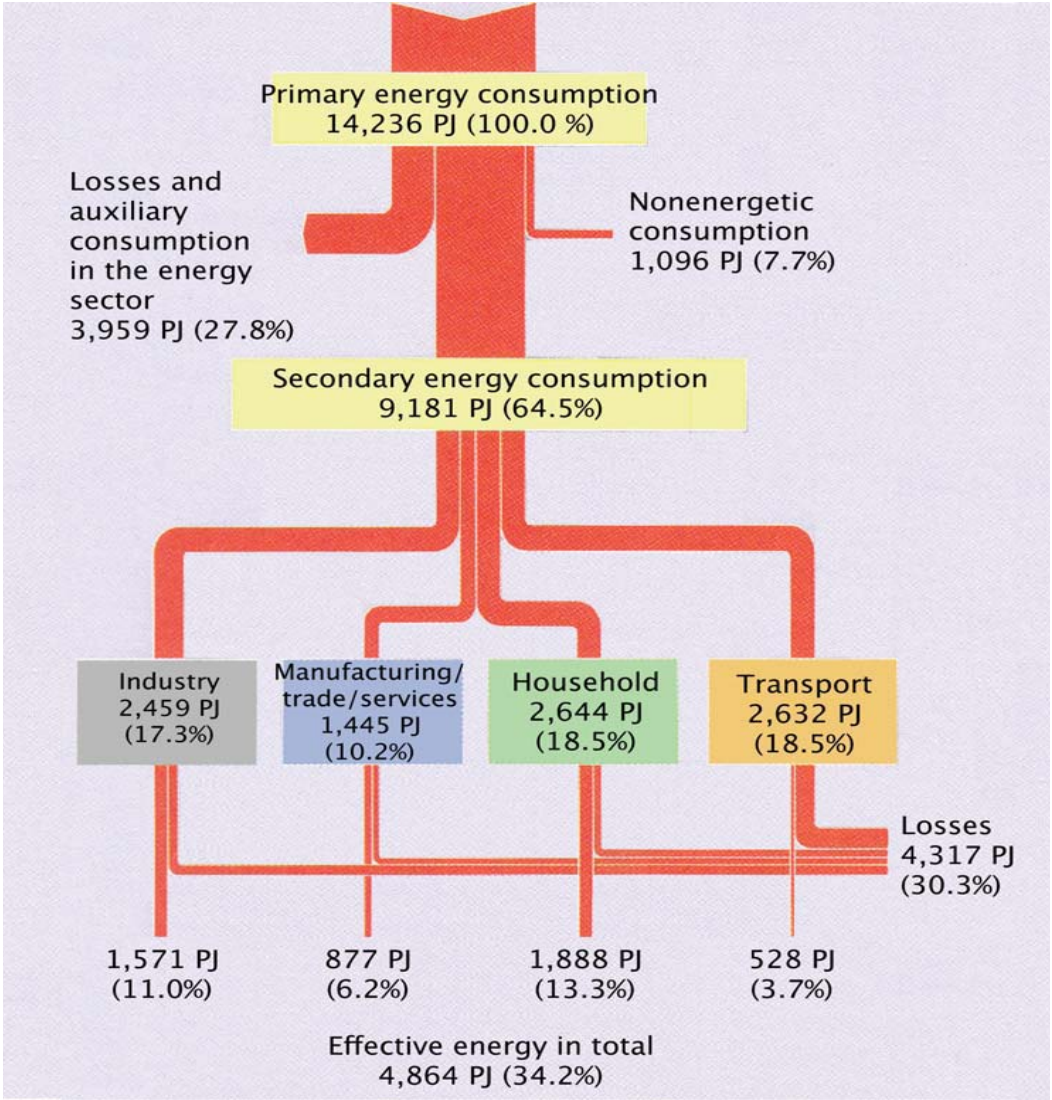
Source: IEA - Ocean Energy Systems

Desertec Project



Source:
Dr.-Ing. Hani El Nokraschy
DESERTEC Foundation

Energy Balance in Germany



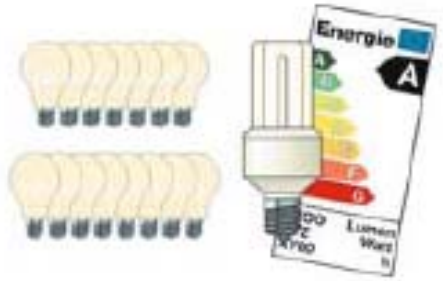
Source: BWK Bd. 58 (2006) Nr. 1/2

More than 60% of the primary energy supplied „dissapears“ via energy loss (e.g. derating) and consumption of auxiliaries (e.g. own consumption)

Respectively 50% - in the domain of transformation and commutation - in the domain of electrical machinery and devices

Energy sector plays a key role

Energy conservation

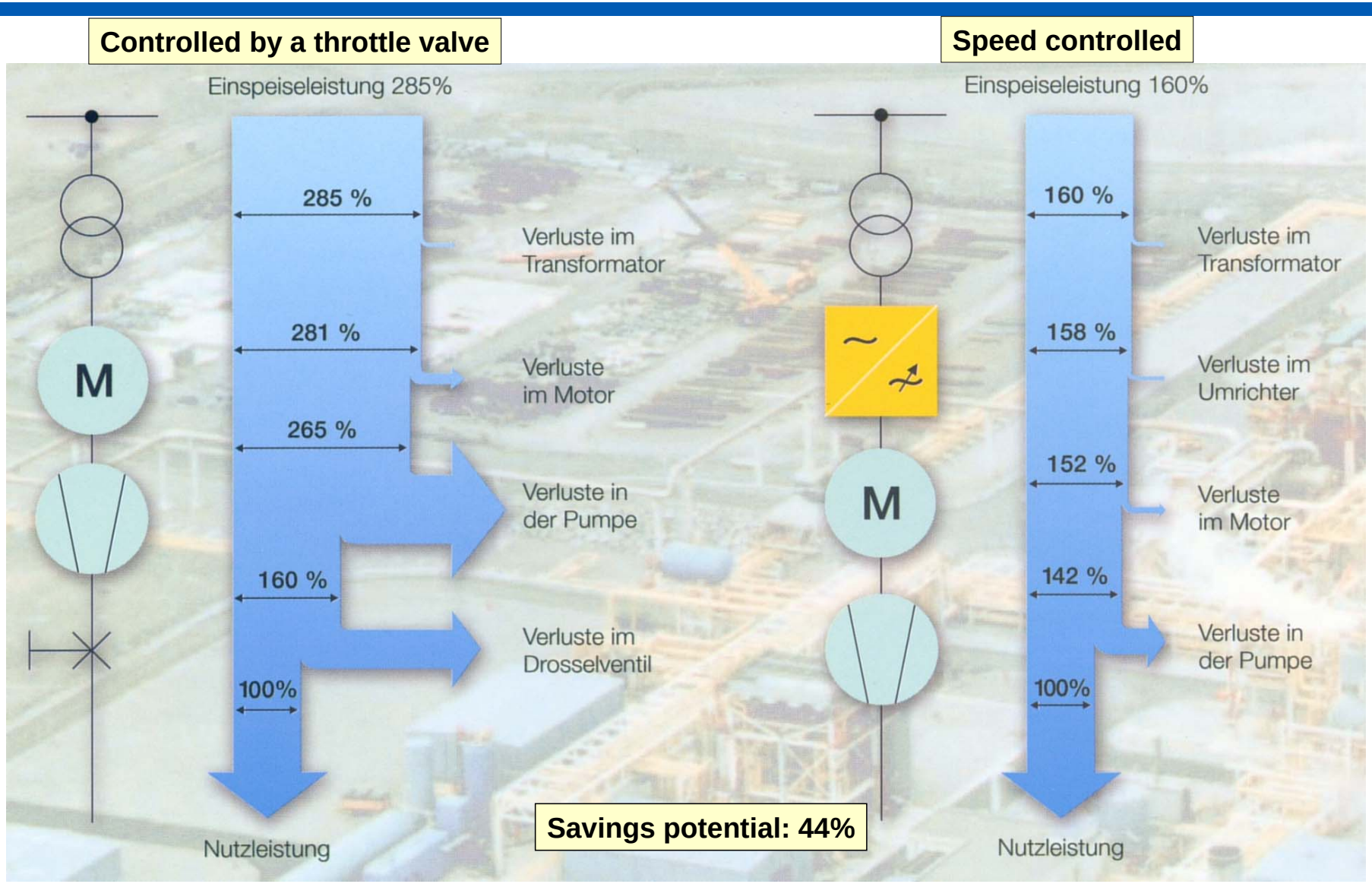


Energy efficiency

Renewables

Figures: EWE AG

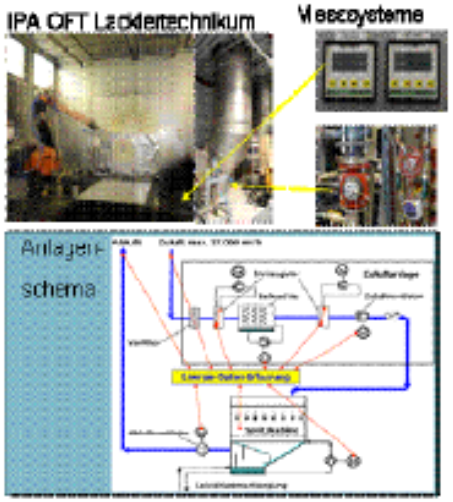
Example: Throttle-/speed control of a pump system



Source: „Energiesparen mit elektrischen Antrieben“, ZVEI, 1999

Example: Production Management

Resource Efficiency and Production Technology



Total Energy Efficiency Management (TEEM) on the factory floor

Why?

- The amount of energy consumed by specific process chains on the factory floor is usually not known
- There is no integrated approach for planning and optimizing the use of energy on the factory floor

How!

- Evaluation, supply and consolidation of information on energy consumption and on the potential for energy efficiency in specific process chains
  — which is only partially available today —
- Development and implementation of a monitoring, analysis, and simulation system for the systematic assessment and optimization of production processes

Source:

Fraunhofer IPA

Conditions precedent to standardisation in the area of energy efficiency

- Distinct, reasonable and coherent definition of „efficiency“
- Definition of test and measuring methods for the evaluation and rating of efficiency
- Definition of efficiency levels (classes) for standard and commodity products
- To start standardisation only in those areas where a significant savings potential exists; priority on „high potentials“
- Mandatory limiting values shall be prescribed by the authorities

Supply Chain Matrix

Energy efficiency significance per application field

Appli-cation fields \ Supply chain	Power Generation	Power Transmission	Power Distribution
Lighting	Box 1 	Box 2 	Box 3 
Rotation	Box 4 	Box 5 	Box 6 
Heating Cooling	Box 7 	Box 8 	Box 9 
Data processing	Box 10 	Box 11 	Box 12 

- high significance
- medium significance
- low significance
- no significance

Supply Chain Matrix

Energy efficiency significance per application field

Appli-cation fields \ Supply chain	Power Generation	Power Transmission	Power Distribution
Lighting	Box 1	Box 2	Box 3
Rotation	Box 4 Recommendation 2 ✓	Box 5	Box 6
Heating Cooling	Box 7 Recommendation 2	Box 8 Recommendations 3a, 3b ✓	Box 9 Recommendations 4, 5 ✓
Data processing	Box 10 Recommendation 2	Box 11 Recommendations 13, 24 ✓	Box 12 Recommendations 13, 24 ✓

- high significance
- medium significance
- low significance
- no significance

✓ done

(✓) implicitly covered

Consumption Matrix

Energy efficiency significance per application field

Application fields \ Consumption	Industrial	Commercial buildings (tertiary)	Domestic	Transport
Lighting	Box 13	Box 14	Box 15	Box 16
Rotation	Box 17	Box 18	Box 19	Box 20
Heating Cooling	Box 21	Box 22	Box 23	Box 24
Data processing	Box 25	Box 26	Box 27	Box 28

- high significance
- medium significance
- low significance
- no significance

As of 2008-02-13

Consumption Matrix

Energy efficiency significance per application field

Consumption / Application fields	Industrial	Commercial buildings (tertiary)	Domestic	Transport
Lighting	Box 13 ✓	Box 14 Recommendation 6 ✓	Box 15 Recommendation 6 ✓	Box 16 (✓)
Rotation	Box 17 Recommendation 7 ✓	Box 18	Box 19	Box 20 Recommendations 8, 9, 10 ✓
Heating Cooling	Box 21 Recommendation 11 ✓	Box 22 (✓)	Box 23 Recommendations 14, 15, 16 ✓	Box 24
Data processing	Box 25 Recommendation 21 ✓	Box 26 (✓)	Box 27 Recommendations 17, 18, 19, 20 ✓	Box 28

- high significance
- medium significance
- low significance
- no significance

✓ done

(✓) implicitly covered

Renewable resources

- **Wind turbines**
  - IEC/TC 88
- **Solar photovoltaic energy**
  - IEC/TC 82
- **Conventional hydraulic turbines**
  - IEC/TC 4
- **Marine energy – Wave, tidal & other water current conversion**
  - IEC/TC 114, established 2007 after consultation with IEA-OES
- **(Geothermal energy)**

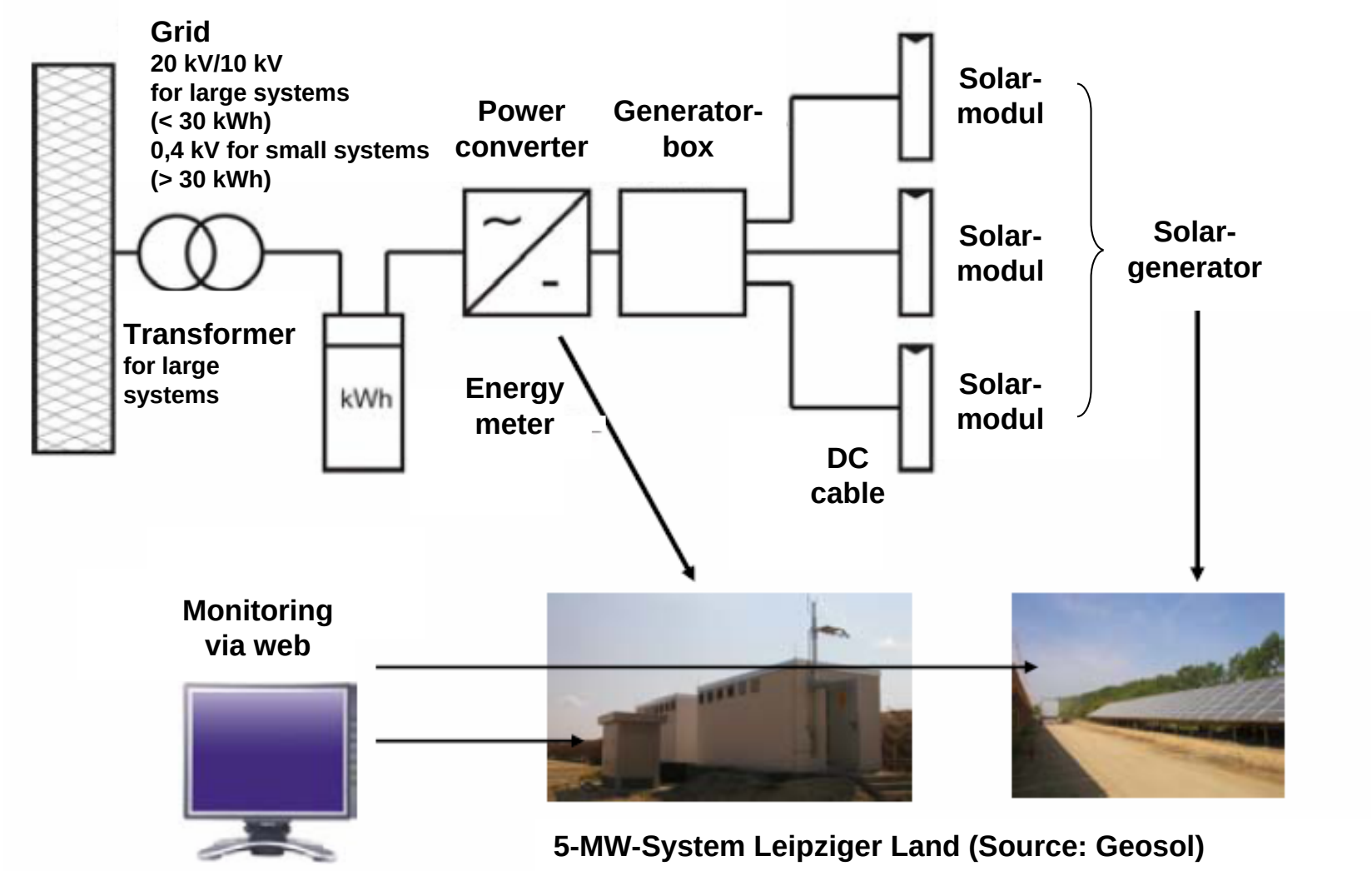
Standardization – A Challenge in the Field of Smart Grid

Source: Sputnik Engineering AG, Biel (CH)

IEC/TC 82 “Solar Photovoltaic Energy System”

Standardization – A Challenge in the Field of Smart Grid

Grid Connected System



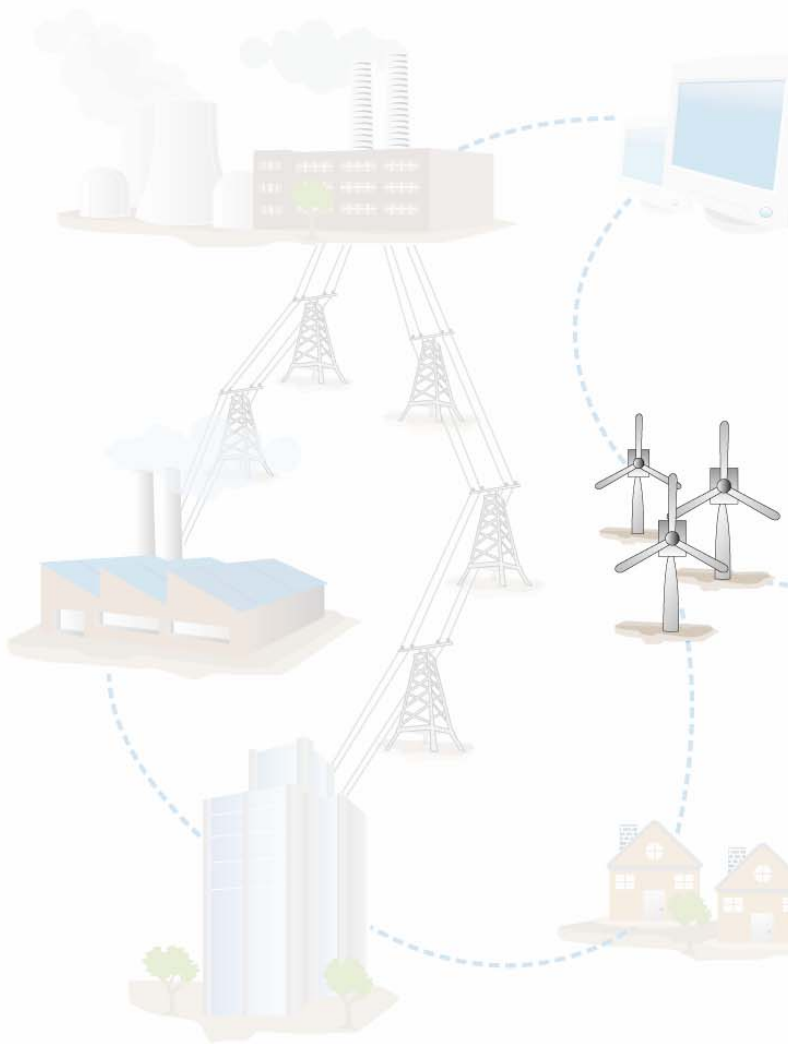
5-MW-System Leipziger Land (Source: Geosol)

Standardization – A Challenge in the Field of Smart Grid

Wind Turbine

IEC/TC 88 “Wind Turbines”

Standardization – A Challenge in the Field of Smart Grid



Wind Energy :

- IEC/TC 88 "Wind turbines"
- Grid Connecting Specifications

Marine Energy:

- IEC/TC 114 "Marine energy - Wave, tidal and other water current converters"

Standardization – A Challenge in the Field of Smart Grid

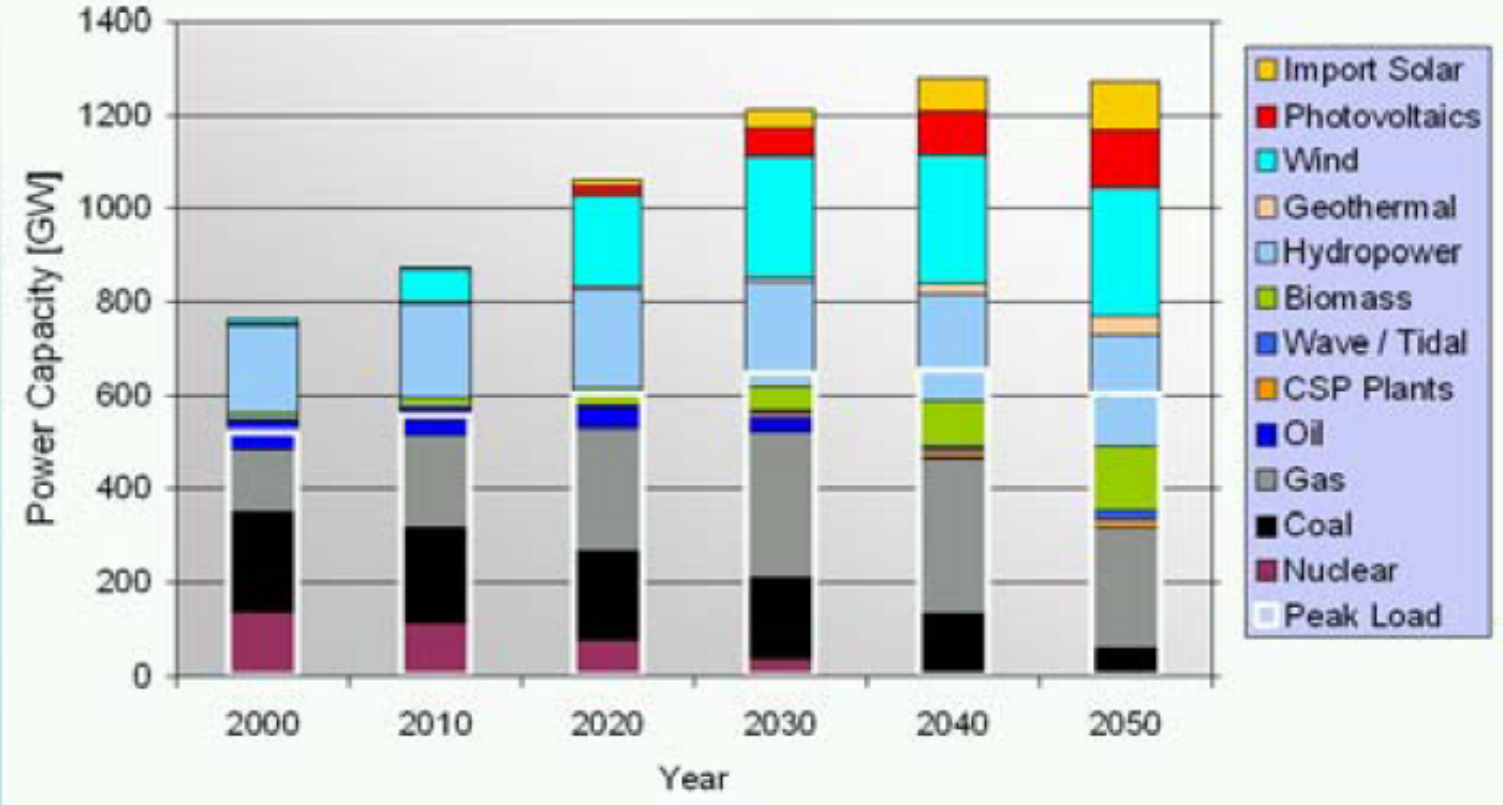
IEC/TC 114 “Marine Energy – Wave, Tidal and other Water Current Converters”

DESERTEC

TRANS-CSP

NOKRASCHY ENGINEERING
Mechanical Vibrations and Infrasound under Control
Solar Power for Sustainable and Everlasting Energy

Installed Capacity in Europe



30

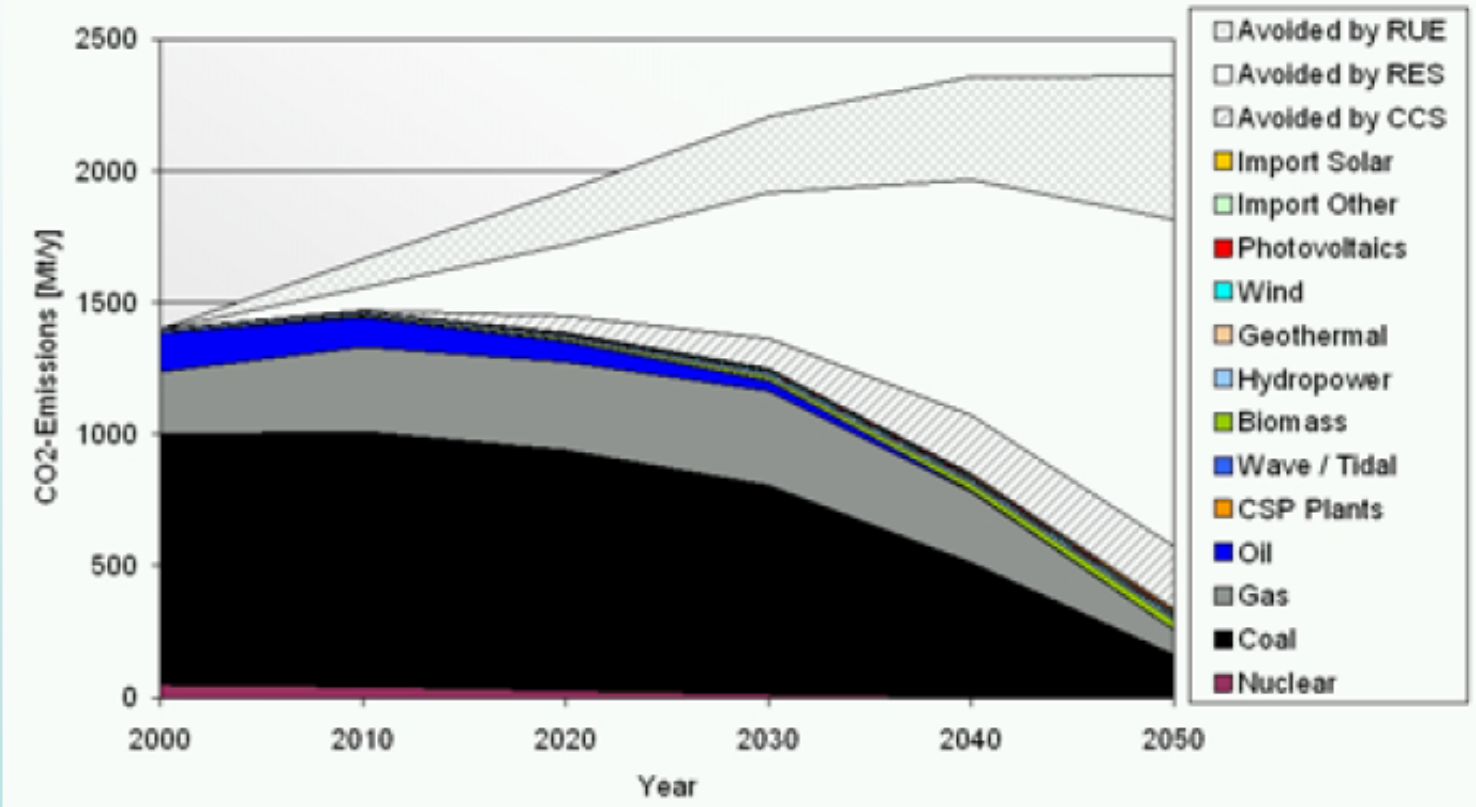
Source:
Dr.-Ing. Hani El Nokraschy
DESERTEC Foundation

DESERTEC

TRANS-CSP

NOKRASCHY ENGINEERING
Mechanical Vibrations and Infrasound under Control
Solar Power for Sustainable and Everlasting Energy

Required = Possible CO_2 Reduction 80%



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Source:
Dr.-Ing. Hani El Nokraschy
DESERTEC Foundation

Rural electrification with renewables

Battery station in Ghana

Foula Island, UK

Greek Island

Uganda countryside

Himalayian village

All pictures by „SMA Solar Technology AG“

Rural electrification (1)

IEC/TS 62257 „Small renewable energy and hybrid systems“

- Multi-part specification (so far 16 documents)
- General introduction to rural electrification (Part 1)
- Project development and managament (Part 3)
- System selection and design (Part 4)
- Protection against electrical hazards (Part 5)
- Acceptance, operation, maintenance & replacement (Part 6)
- Generators, Generator arrays, Selection of Generator sets (Part 7)

Rural electrification (2)

- IEC/TS 62257 „Small renewable energy and hybrid systems“
  - Selection of batteries, battery management systems (Part 8-1)
  - Micropower systems & grids, integrated system aspects (Parts 9-X)
  - Selection of self-ballasted CFL lamps, household lighting (Part 12-1)
- IEC 61194 „Characteristic parameters of stand-alone (PV) systems“
- IEC 61683 „Power conditioners - Procedure for measuring efficiency“

Integration of renewables into the power grids

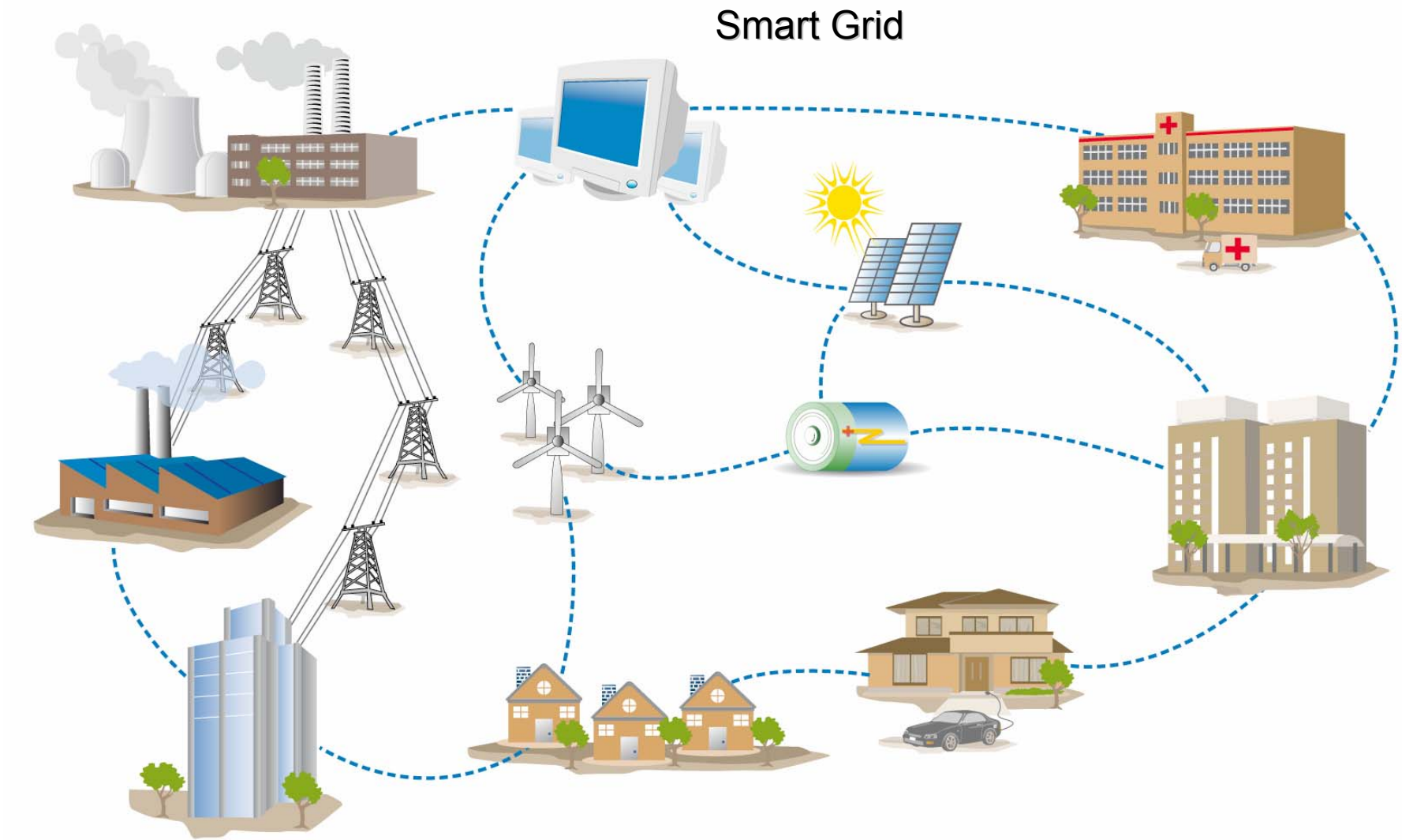
Electricity generation by

- Wind turbines
- Solar photovoltaic energy
- Marine energy

is characterized by asynchronism of demand and generation.

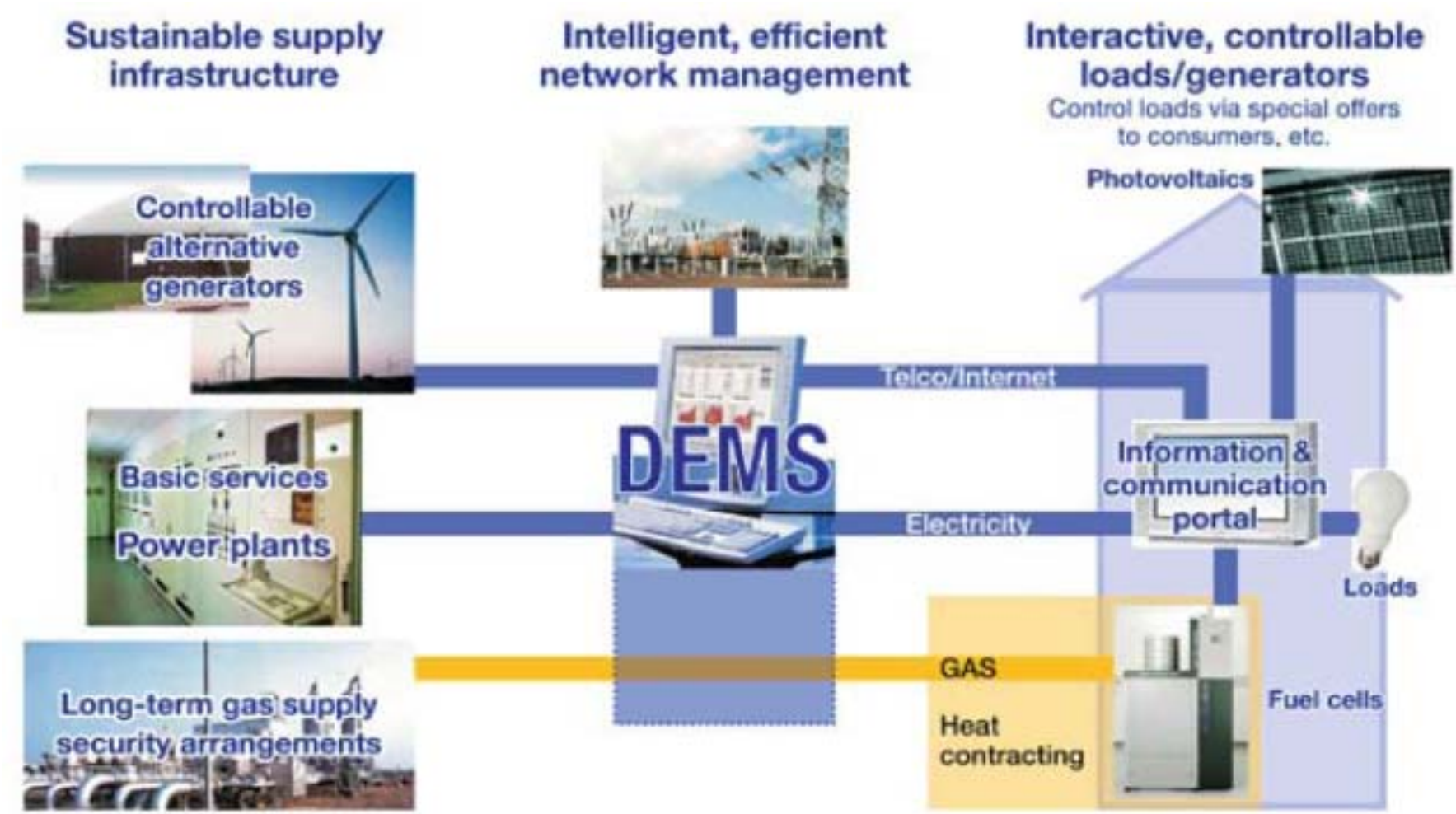
- This requires
  - high-capacity storage systems for electricity
  - intelligent grids allowing for distributed energy management
  - to fully exploit the potentials of renewables for electricity generation.

Standardization – A Challenge in the Field of Smart Grid



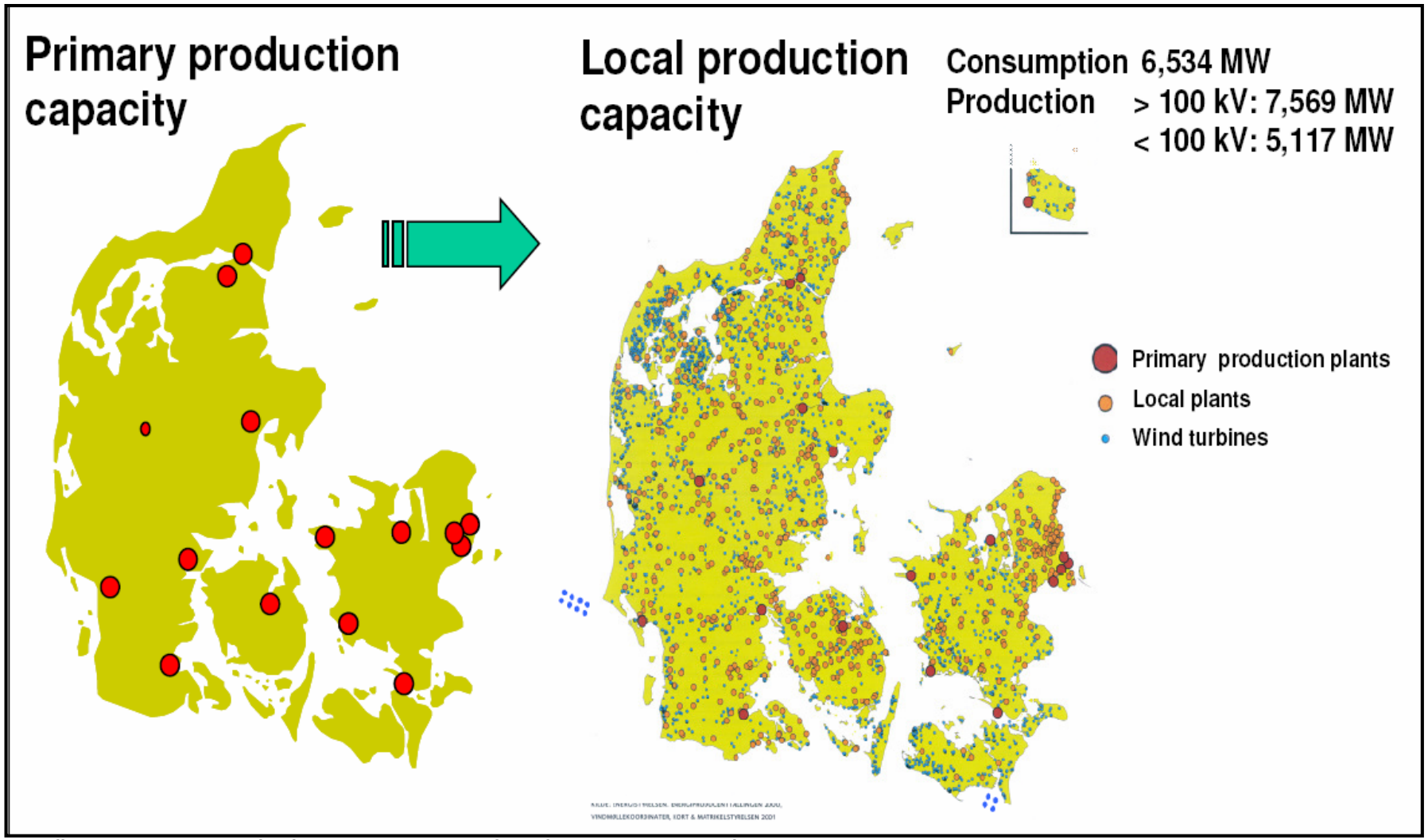
Standardization – A Challenge in the Field of Smart Grid

Vision of the future power grid



Source: EWE AG

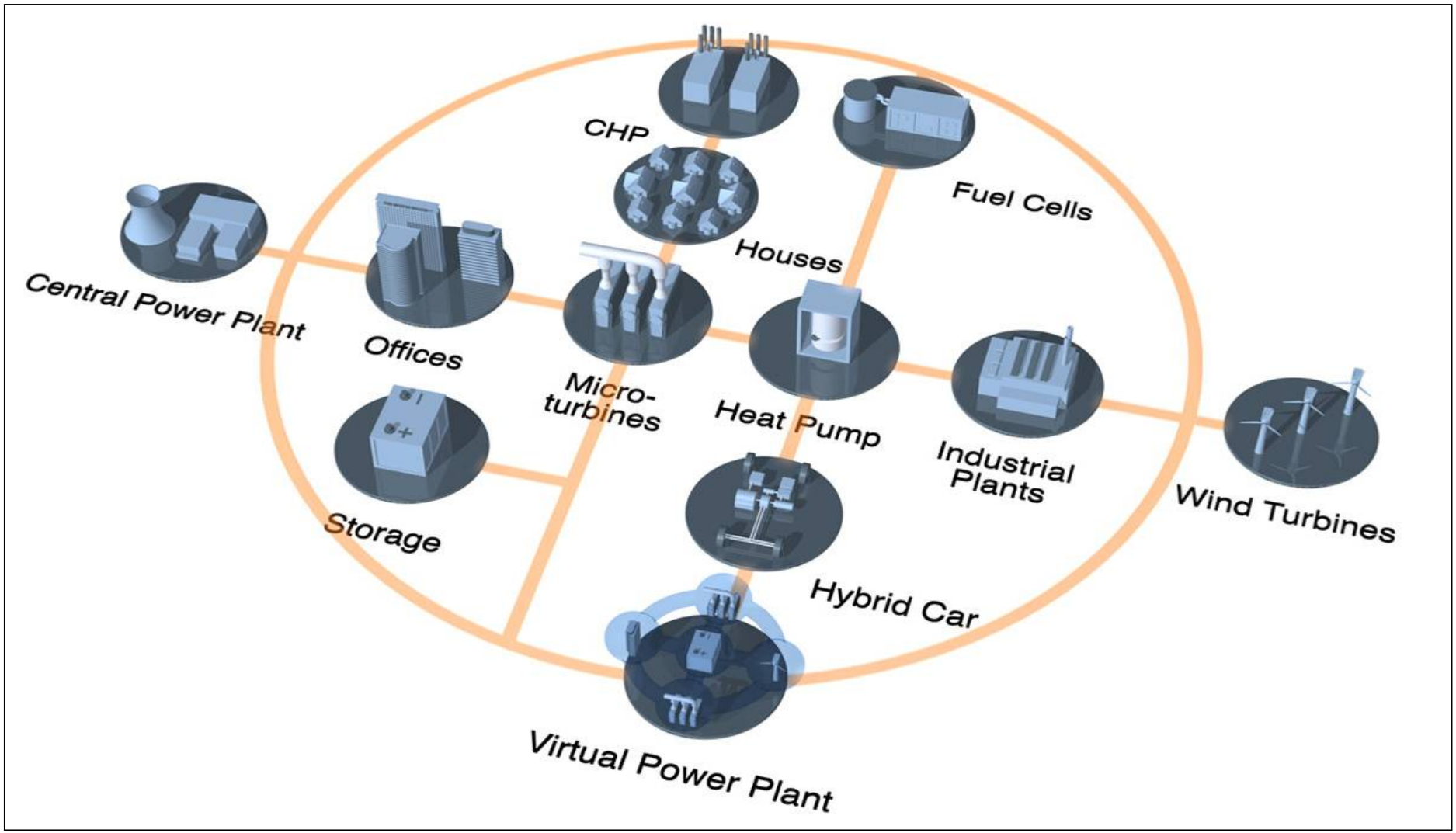
Example: Denmark – Paradigm Change from 1985 to 2005



Quelle: A*STAR Energy Technology R&D Program, Prof Ho Hiang Kwee Program Director, 31.8.2007

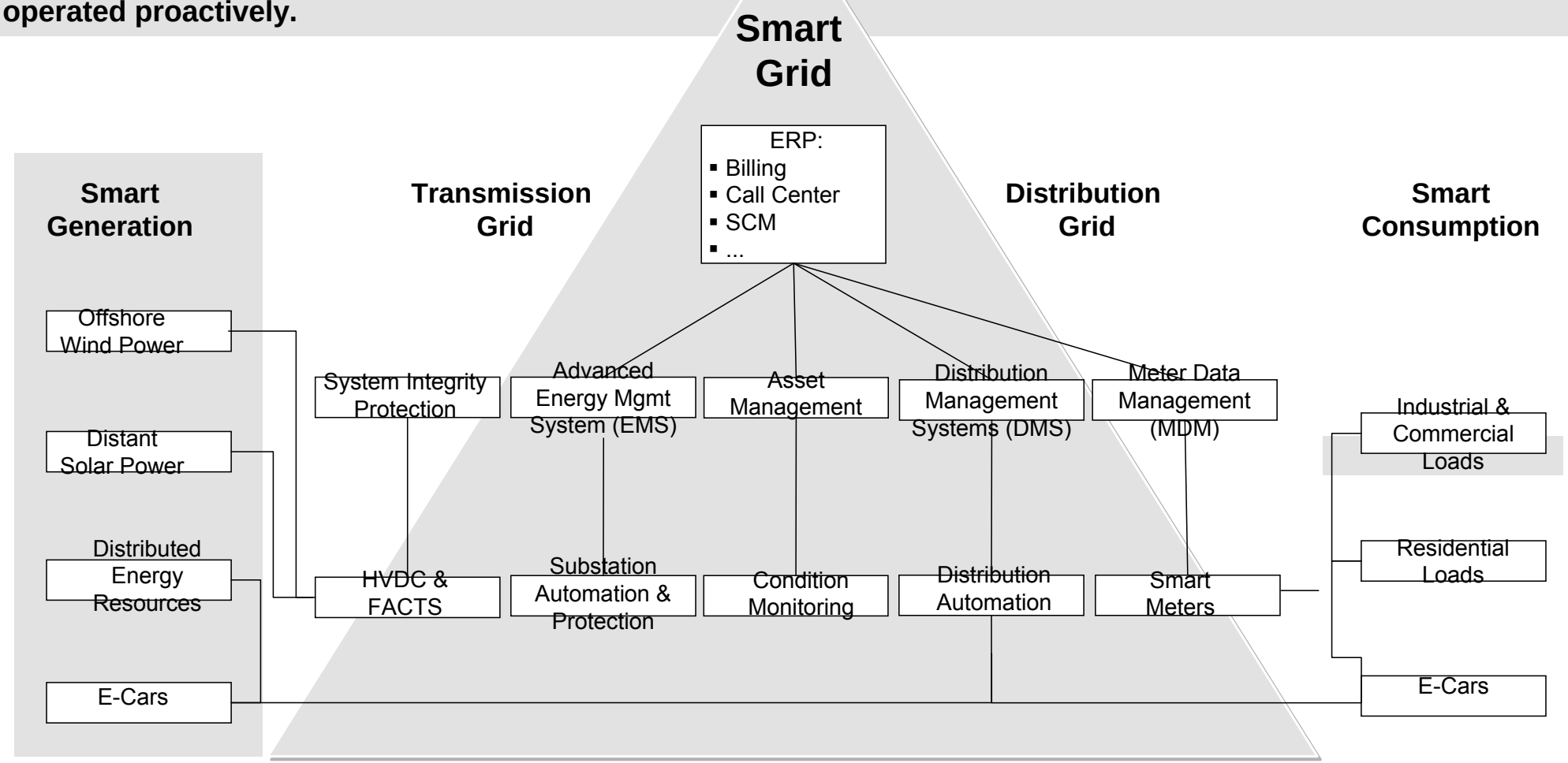
Standardization – A Challenge in the Field of Smart Grid

The Smart Grid is the Coordinator of all Elements of Generation and Consumption



The Smart Grid Landscape (1)

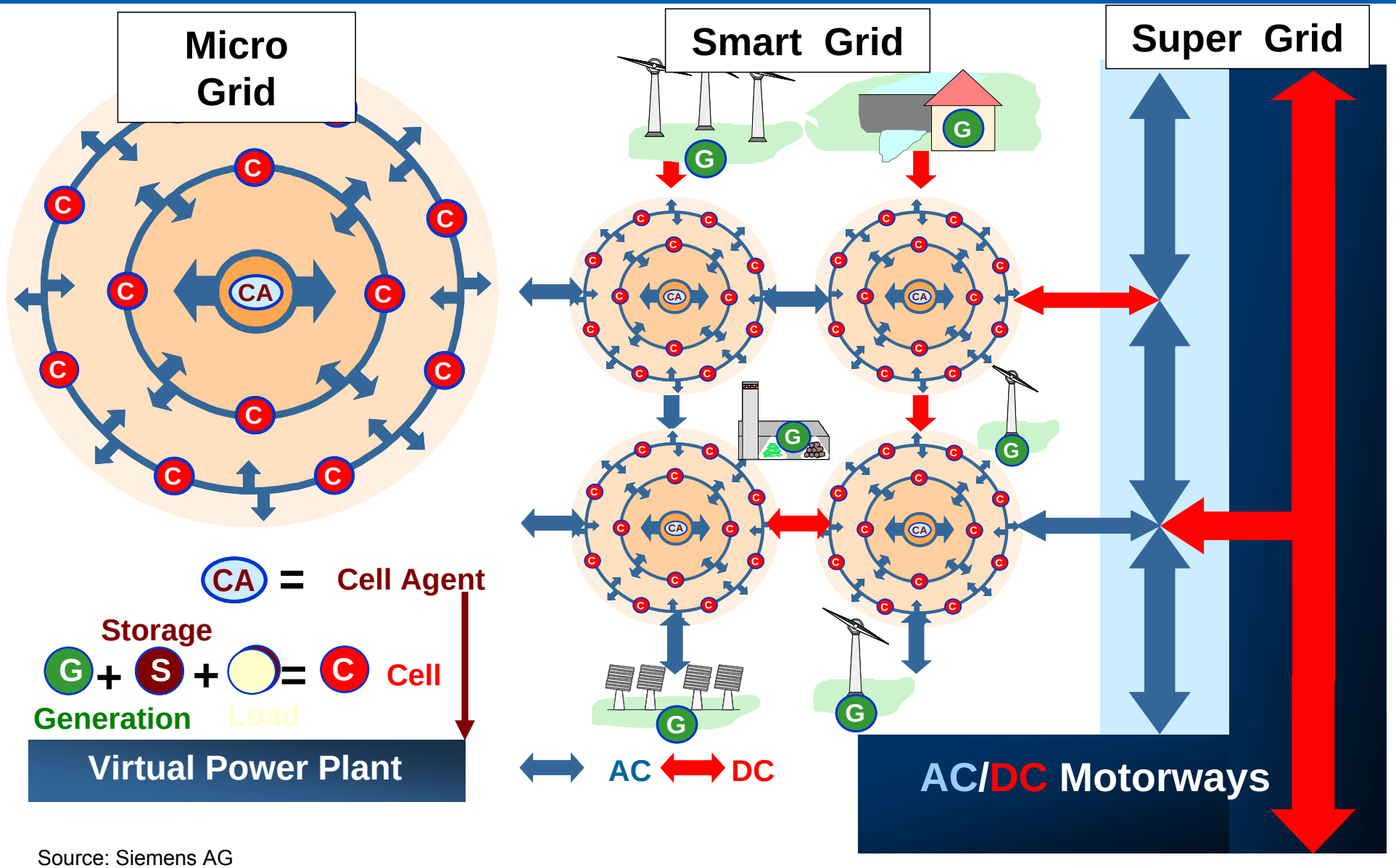
Smart Grid technologies improve the observability and controllability of the power grid and thereby convert it from a static infrastructure to be operated as designed to a flexible, "living" infrastructure operated proactively.



Source: Siemens AG

The Smart Grid Landscape (2)

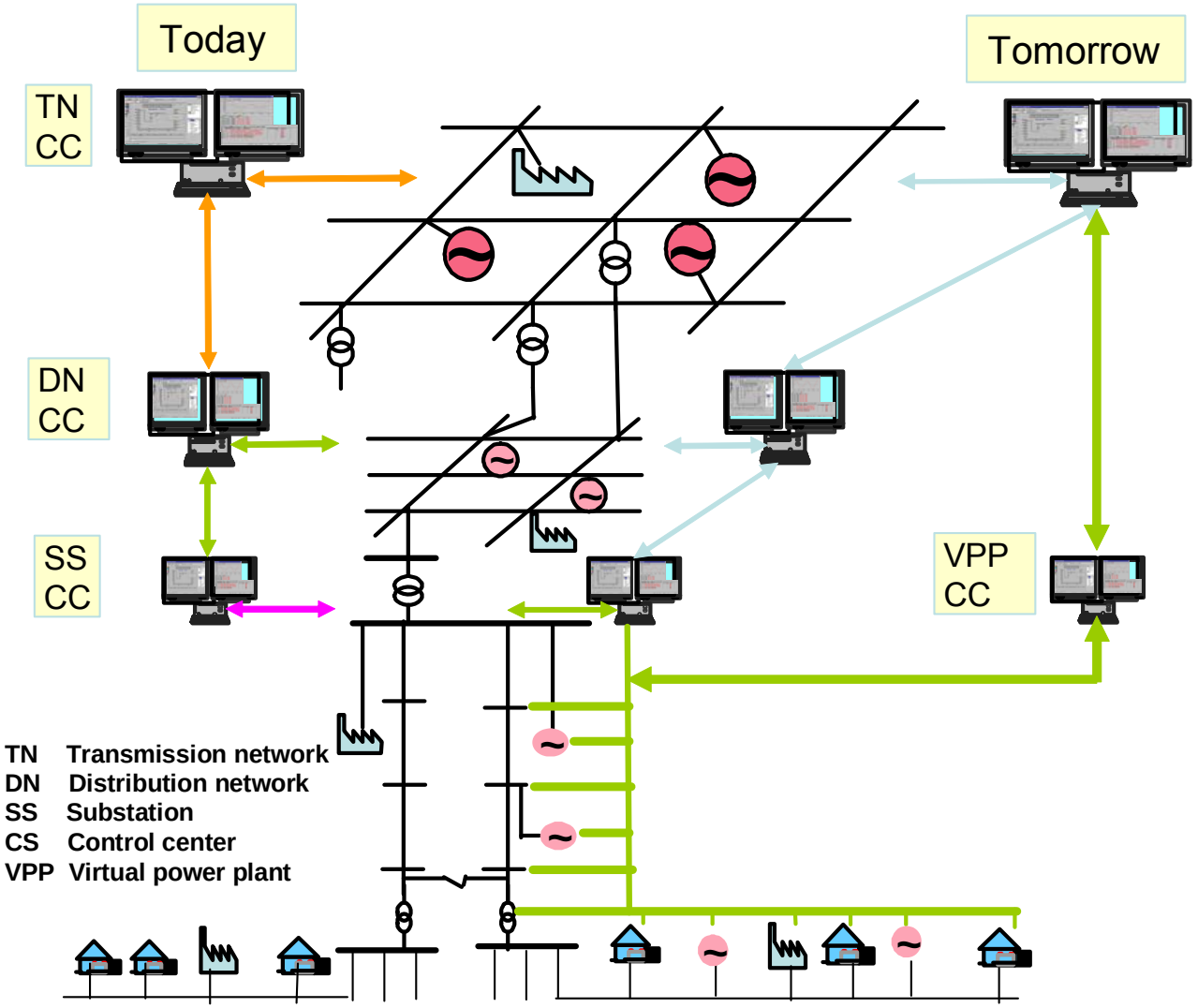
Vision of future networks



Source: Siemens AG

The Smart Grid Landscape (3)

Communication today and future

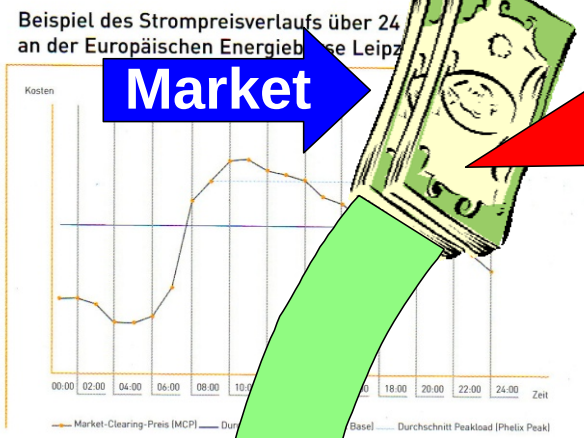


1. **Uniform standard communication on all network levels**

2. **The communication must extend from the single customer to all control centers**

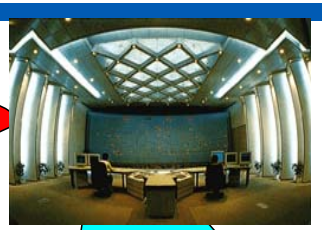
? **An extended communication network is the prerequisite for virtual power plant and smart grid operations**

Smart Metering

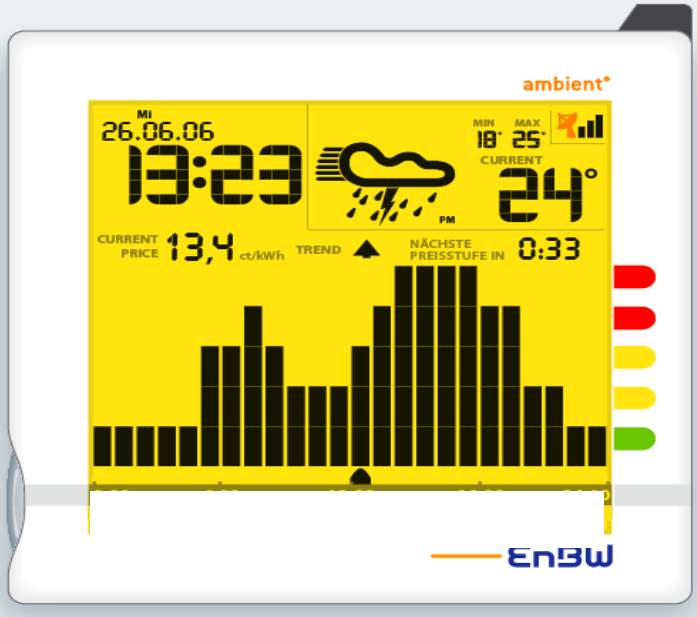


Market

Billing



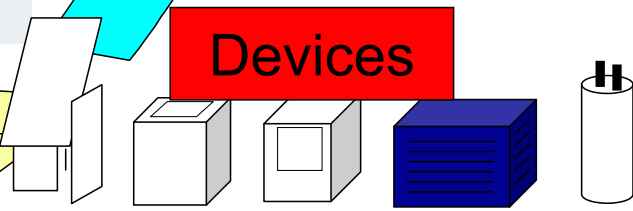
Dynamic tariffs



Collection

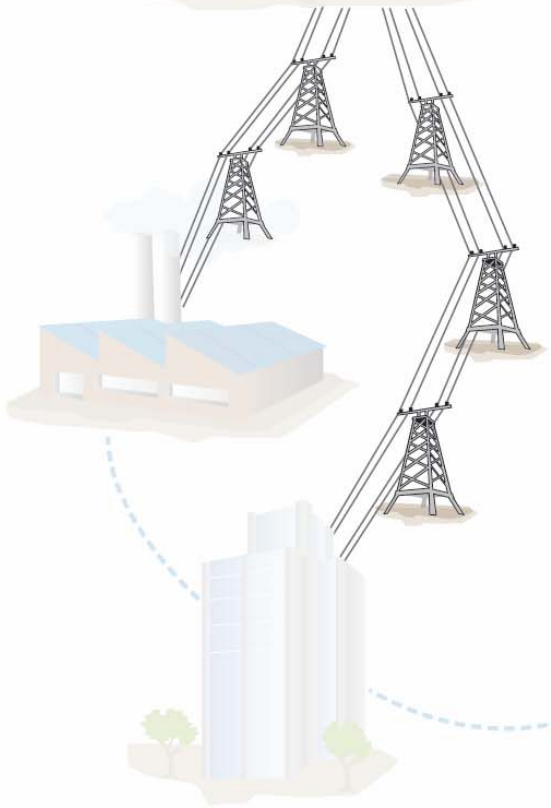
Smart Metering is the prerequisite for the customers to participate in the market

Home Automation



Standardization – A Challenge in the Field of Smart Grid

Power Distribution (Smart Grid):



- **IEC Strategic Group 1:**
  "Energy efficiency and renewable resources"
- **IEC Strategic Group 2:**
  "Ultra-high voltage (UHV)" & "Joint IEC/CIGRE Group"
- **IEC Strategic Group 3:**
  "Smart Grid"
- **IEC Strategic Group:**
  "Low voltage direct current (LVDC) distribution systems"

- IEC/TC 115 "High voltage direct current (HVDC) transmission for DC voltages above 100 kV"
- IEC/TC 99 "System engineering and erection of electrical power installations …"
- IEC/TC 57 "Power systems management and associated information exchange"
- IEC/TC 8 "System aspects of electrical energy supply"
- IEC/TC 22 "Power electronic systems and equipment"
- DKE FOKUS GROUP "Dezentrale Energien"

Standardization – A Challenge in the Field of Smart Grid

Solar Energy:

- **IEC/TC 82 "Solar photovoltaic energy systems"**

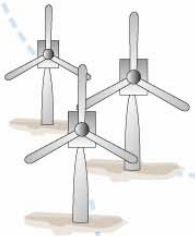
- **IEC/TC 64 "Electrical installations and protection against electric shock"**

- **Mandate M/441 "Smart Utility Meters" and Smart Metering-Coordination Group:**
  - IEC/TC 13 "Electrical energy measurement, tariff- and load control"
  - IEC/TC 57 "Power systems management and inform. exchange"
  - CEN/TC 294 "Communication systems for remote reading of meters"
  - ETSI M2M "Machine to machine communications"

- **Grid Connecting Specifications** (e.g. in Germany subject to national regulations)

Standardization – A Challenge in the Field of Smart Grid

Decentralized Power Generation & Renewable Energy



- **IEC Strategic Group 1 "Energy efficiency and renewable resources"**
- **IEC Strategic Group 3 "Smart Grid"**
- **IEC/TC 57 "Power systems management and information exchange"**
- **IEC/TC 8 "System aspects of electrical energy supply"**
- **CEN/CLC Sector Forum Energy Management (SFEM)**

Standardization – A Challenge in the Field of Smart Grid

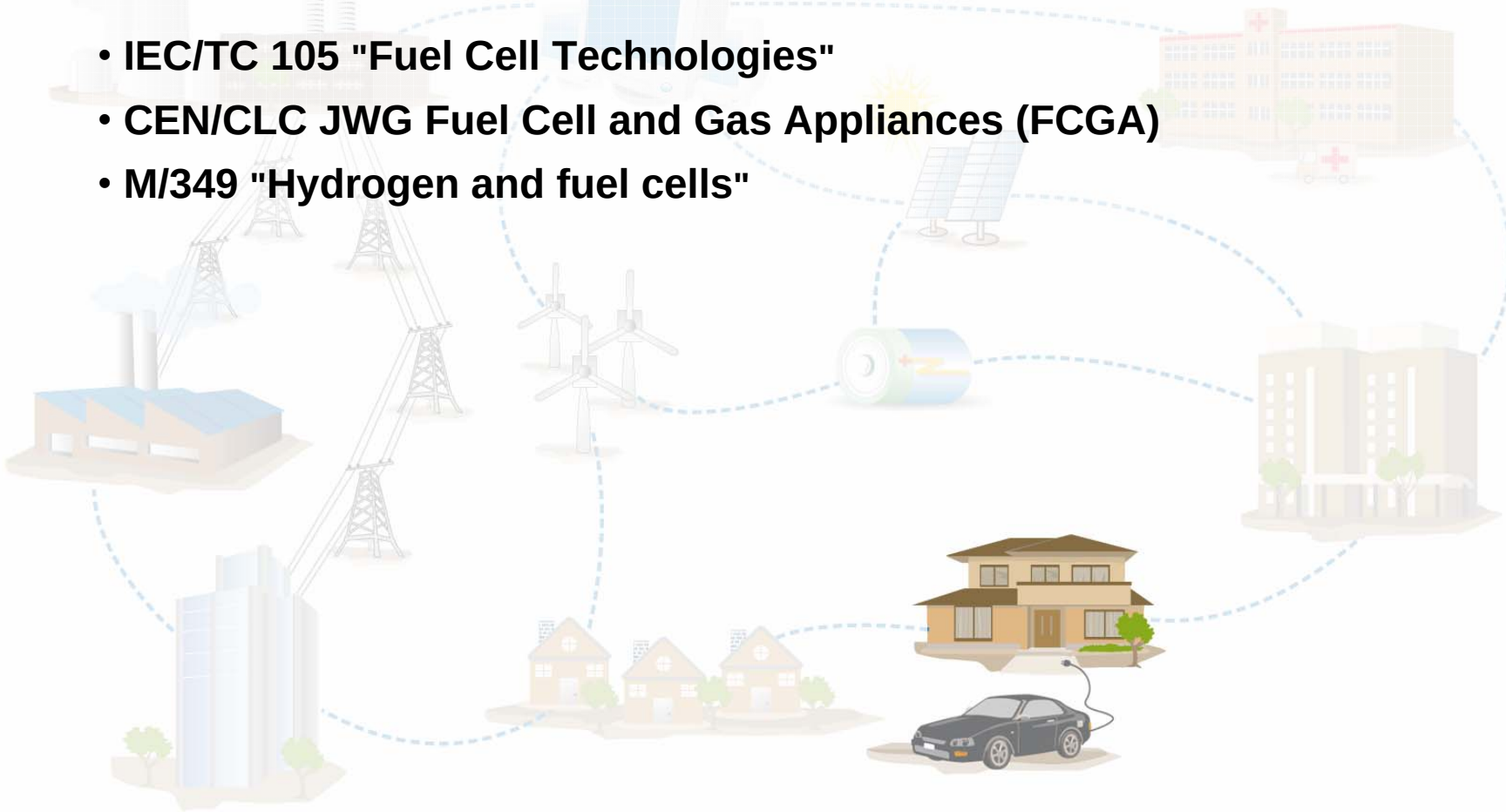
Home and Office:

- **Mandate M/441 "Smart utility meters"**
- **Mandate M/341 "Eco-design of energy-using products"**
- **Mandate M/439 "Standby and off mode power consumption"**
- **IEC Strategic Group "Low voltage direct current (LVDC) distribution systems"**
- **IEC Strategic Group 1 "Energy efficiency and renewable resources"**
- **CEN/CLC Sector Forum Energy Management (SFEM)**
- CLC/TC 205 "Home and building electronic systems (HBES)"
- IEC/TC 72 "Automatic controls for household use"
- IEC/TC 59 "Performance of household and similar electrical appliances"
- IEC/TC 61 "Safety of household and similar electrical appliances"
- IEC/TC 100 "Audio, video and multimedia systems and equipment"
- IEC/TC 108 "Safety of electronic equipment (audio/video, IT)"

Standardization – A Challenge in the Field of Smart Grid

Fuel Cell:

- **IEC/TC 105 "Fuel Cell Technologies"**
- **CEN/CLC JWG Fuel Cell and Gas Appliances (FCGA)**
- **M/349 "Hydrogen and fuel cells"**

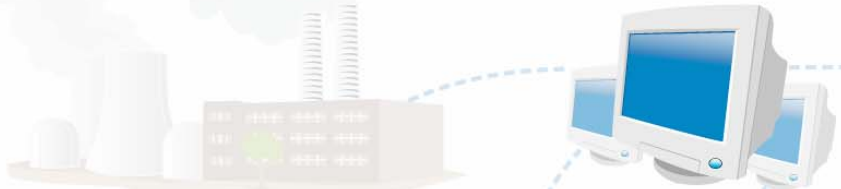


Standardization – A Challenge in the Field of Smart Grid

Power Plants & Industry:

- IEC/TC 45 "Nuclear instrumentation", here
- IEC/SC 45A "Instrumentation and control of nuclear facilities"
- IEC/TC 65 "Industrial-process measurement, control and automation"
- IEC/TC 44 "Safety of machinery – Electrotechnical aspects"
- IEC/TC 22 "Power electronic systems and equipment"

Standardization – A Challenge in the Field of Smart Grid



Green Data Centers:

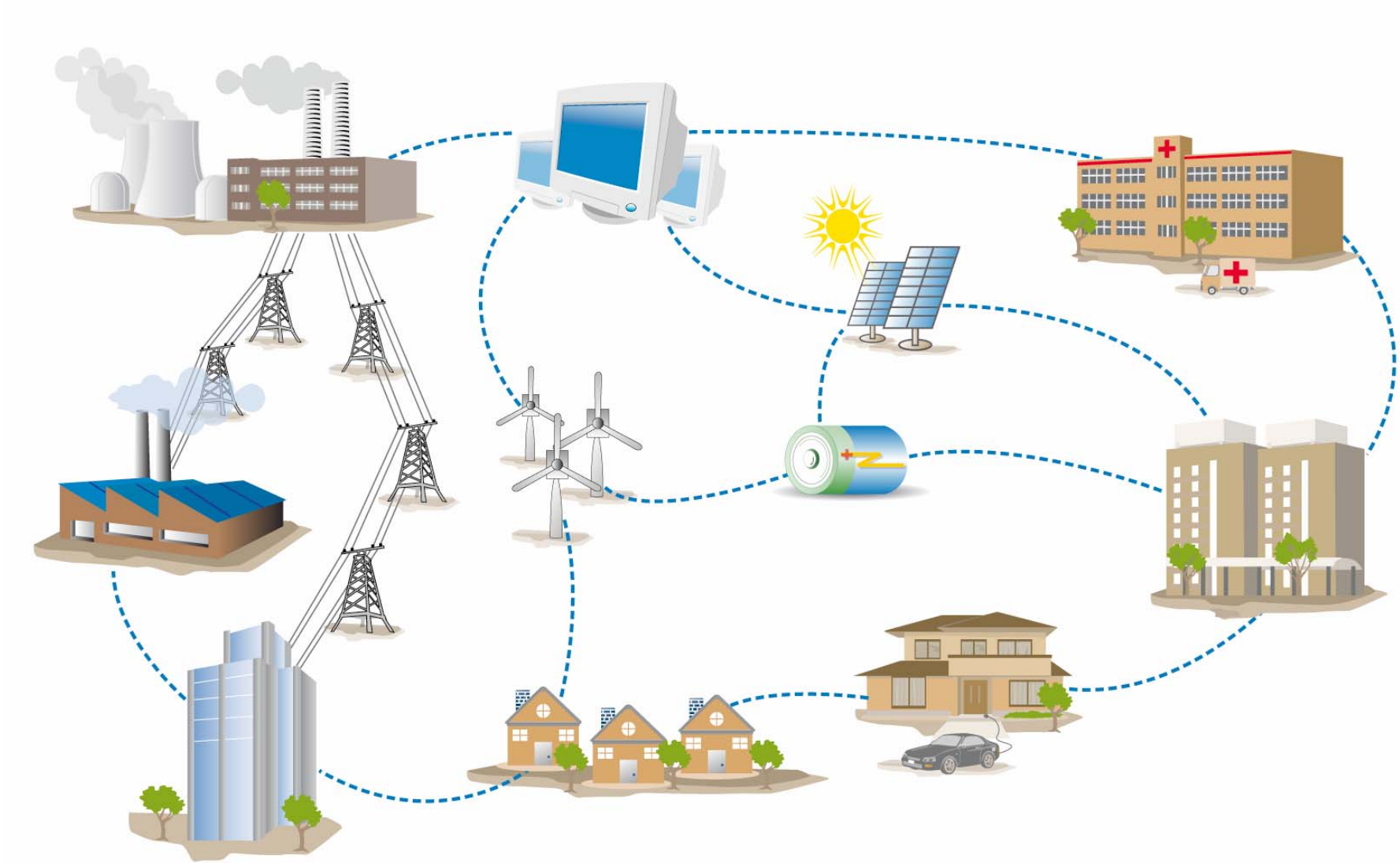
- **CLC BTWG 132-3 "Green Data Centers"** in Co-operation with:
- CLC/TC 215 "Electrotechnical aspects of telecommunication equipment"
- CLC/TC 22X "Power electronics"
- CLC/TC 111X "Environmental standardization for electrical and electronic products"
- CLC/TC 213 "Cable management systems"
- IEC/SC 22H "Uninterruptible power systems (UPS)"
- IEC/Strategic Groups e.g. SG "Low voltage direct current (LVDC) distribution systems"
- CoC for Data Centers - European Commission
- ETSI Task Force 362 "Energy Efficiency & Broadband Deployment"

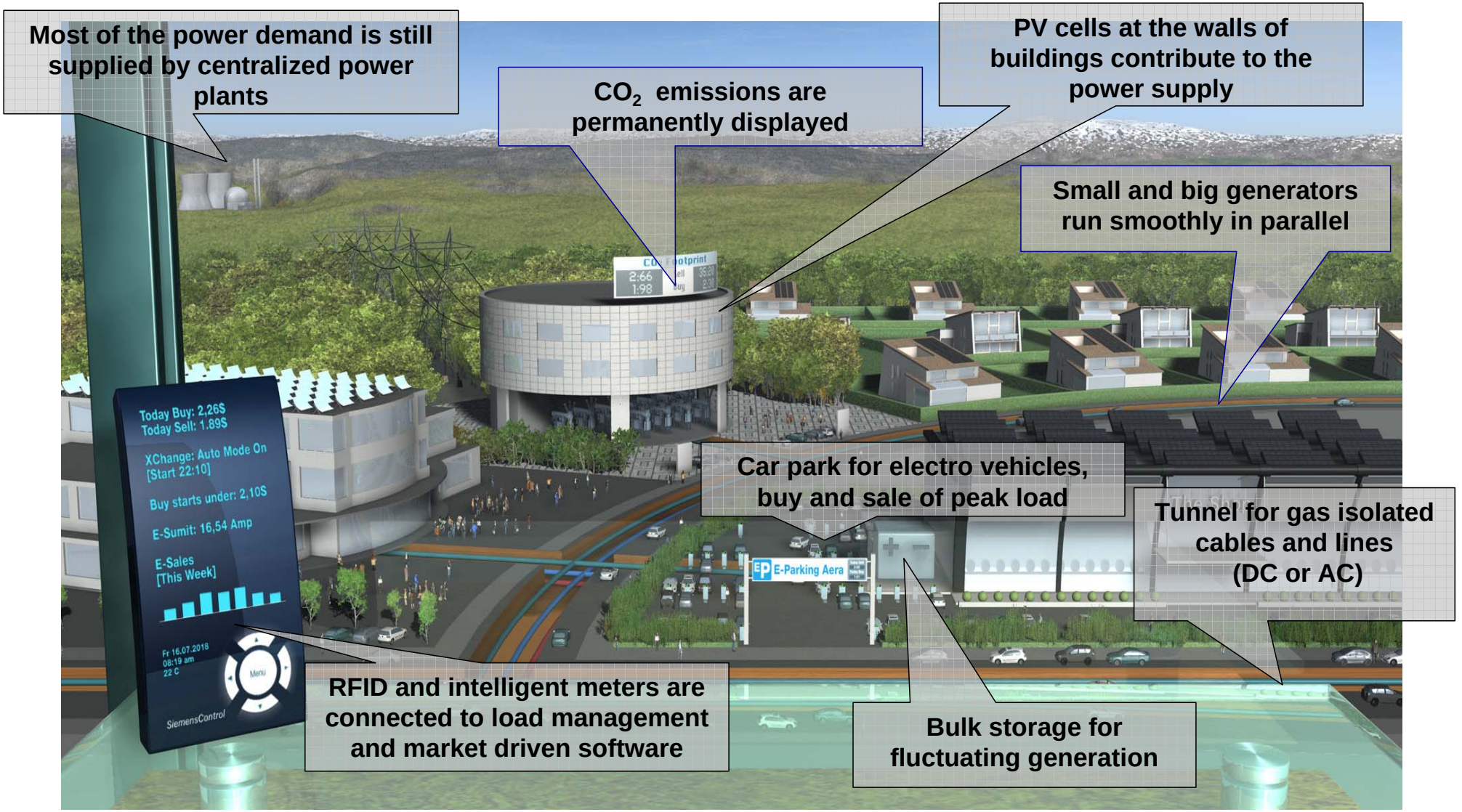
Standardization – A Challenge in the Field of Smart Grid

Health Care:

- **IEC/TC 62 "Electrical equipment in medical practice"** in Co-operation with: IEC/TC 87 "Ultrasonics" und TC 76 "Optical radiation safety and laser equipment"
- **Mandate M/403 "ICT eHealth"**
- **Mandat M/436 "Radio frequency identification (RFID)"**
- **CEN/CLC JWG AIMD**
- **Ambient Assisted Living – e.g. VDE/BMBF Initiative**

Standardization – A Challenge in the Field of Smart Grid

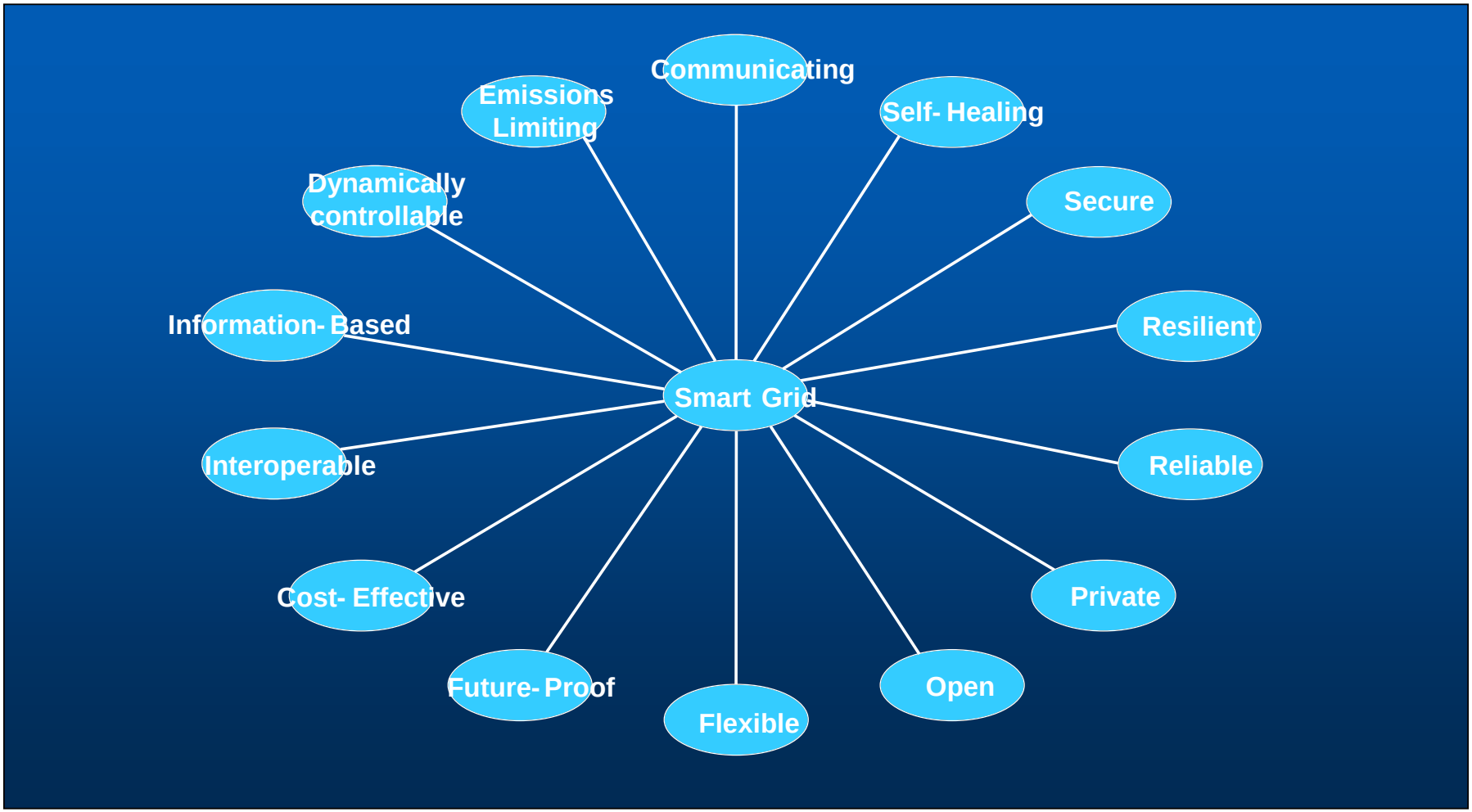




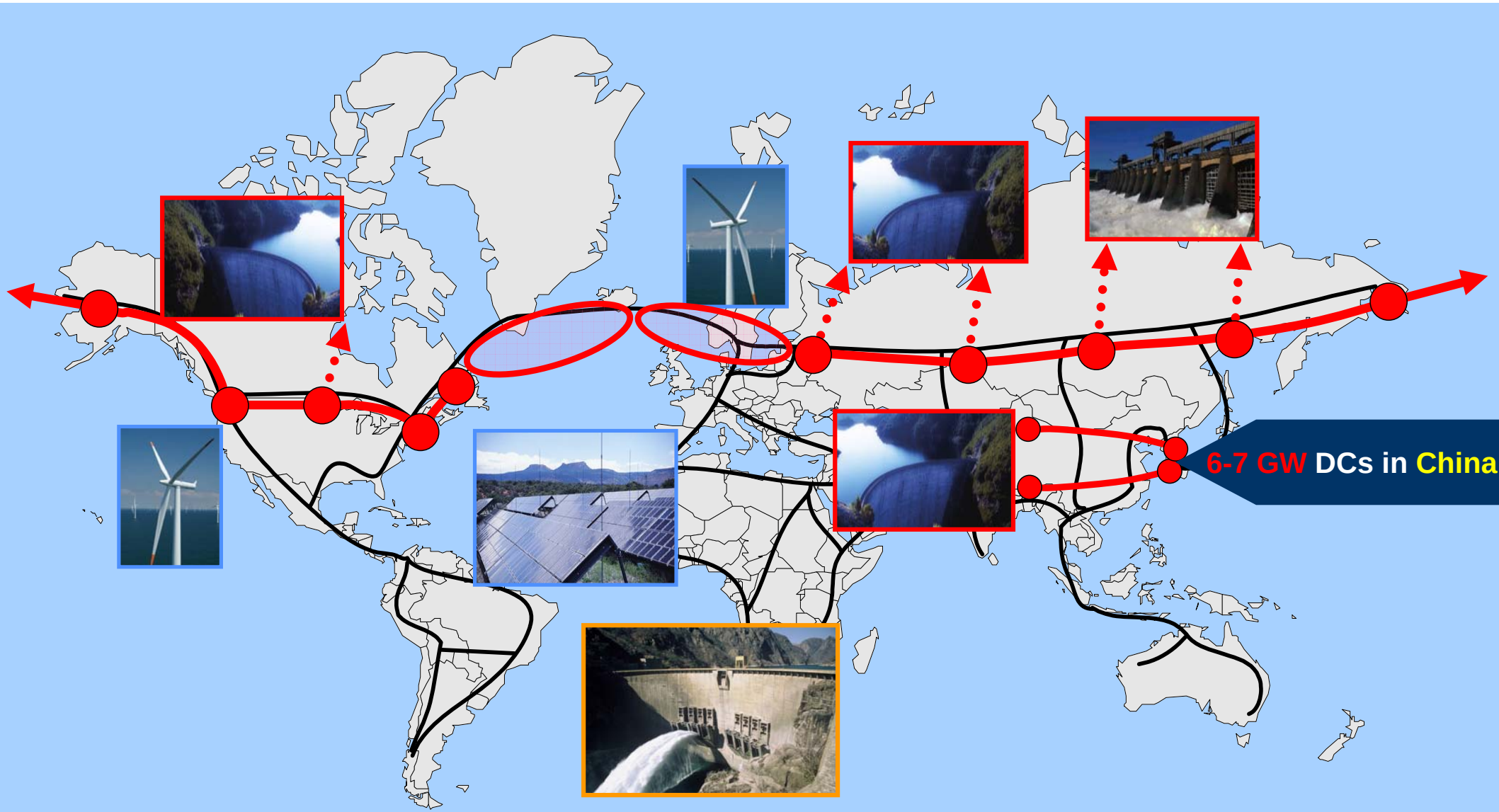
Quelle: Siemens AG

Standardization – A Challenge in the Field of Smart Grid

Smart Grid – The Desirable Attributes



Standardization – A Challenge in the Field of Smart Grid



Source Siemens

Benefits of a "Global" Solution *for*

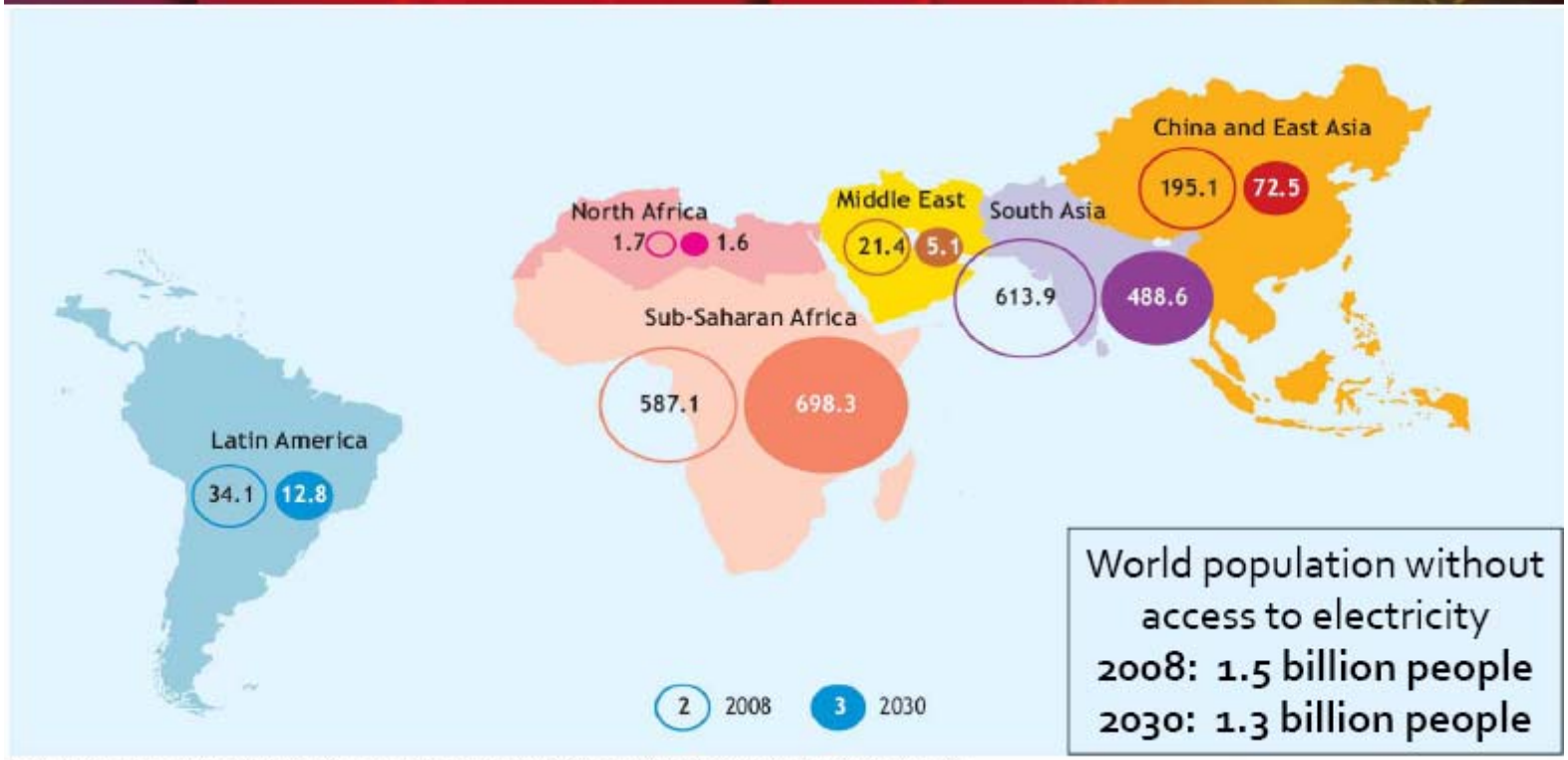
Hybrid System Interconnections:

- Solving local Problems of Energy Resources by worldwide Energy Trading
- Improving transmission capability and reliability of the system
- Chance to use remote Regenerative and clean Energy Sources:
  - Solar Fields in Deserts
  - Offshore Wind Farms
  - Hydro Energy
- Independent from the Time Zones

Source Siemens

World Energy Outlook 2009

Number of people without access to electricity in the Reference Scenario (millions)



The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

$35 billion per year more investment than in the Reference Scenario would be needed to 2030 – equivalent to just 5% of global power-sector investment – to ensure universal access

Summary

- Electrical energy will be the energy of the future
- The various renewable energies can be integrated intelligently and efficiently by electrical networks of smart grid type
- Generation, distribution and consumption of electrical energy must work together much closer than in the past.
- The link is the „Smart Grid“ The Internet of Energy
- The speed of implementation of Smart Grids should be improved by market stimulation
- The power market regulation must set the attractive conditions to the investors to push Smart Grid technology

Thank you for your attention!