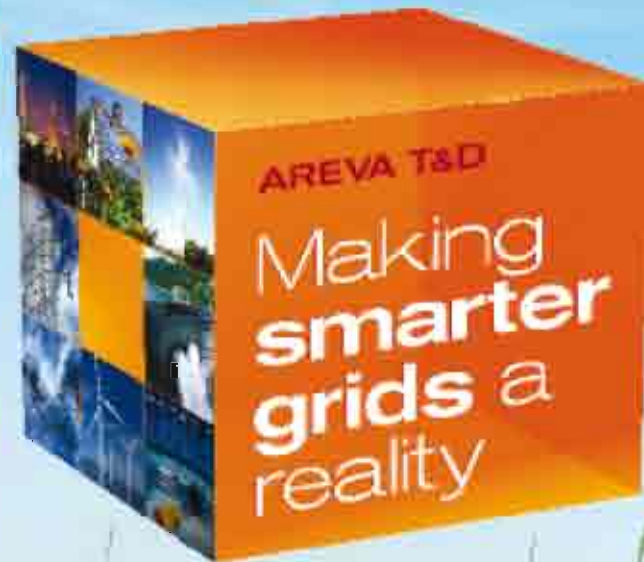


Smart technology and teamwork for smarter grids



Why the Smart Grid revolution?



Running today's digital society through yesterday's grid is like running the Internet through an old telephone switchboard



energy future
COALITION

Reid Detchon



New challenges to the electricity network



Our clients are facing 4 main challenges



1

▶ **Fast growing energy needs, especially electricity**



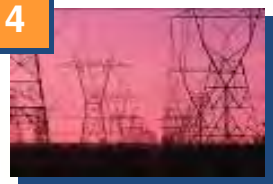
2

▶ **Race for a low carbon energy mix**



3

▶ **Volatile energy prices and critical energy losses**



4

▶ **Emergence of large regional transmission network**

「 **Raising the network's complexity** 」



Reinforcing customers' needs



Reinforcing existing needs



▶ Reliability and quality

- Ensure security of supply, reliability of the network and quality of the electricity delivered



▶ Stability

- Monitor oscillations and manage the network to prevent blackouts and maximize availability of power



▶ Environmental concerns

- Provide clean energy (CO₂ free) and reduce environmental impact



▶ Energy efficiency

- Deliver the maximum of electricity to the end-user, starting from a given quantity of energy and from existing assets



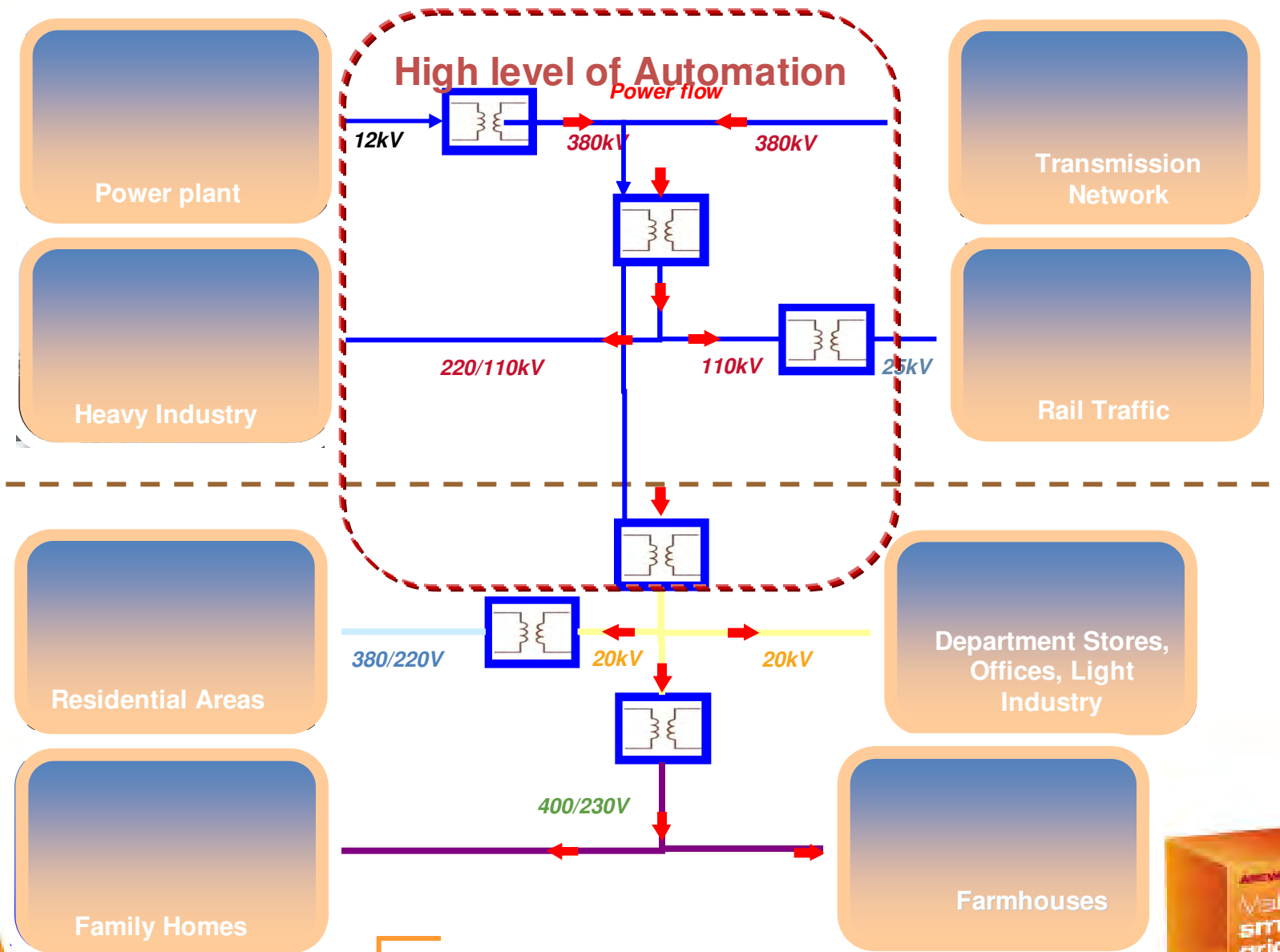
▶ Market efficiency

- Set up tools and processes to fully enable energy markets
- Enable customers / end-users dynamic participation

The network must be smarter with more intelligence at all levels



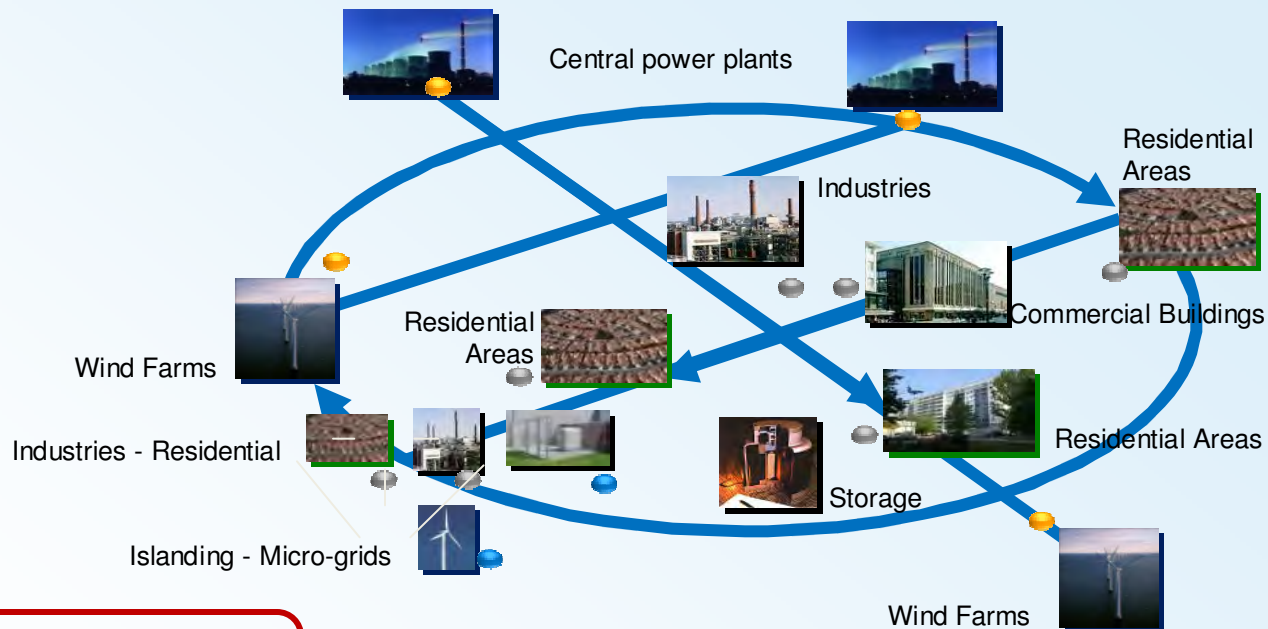
Today's one-way centralized electricity network...



... needs to evolve



...towards a bidirectional and dynamic network



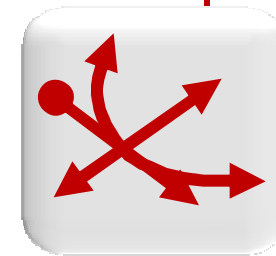
- Central generation
- Consumption
- Decentralized generation

FULL T&D SCOPE

Systems

Products

Automation



**One-way
power flow
Two-way
power flow**



**Limited data
flows**

**Exponential
data flow**



**Smarter
Grids**

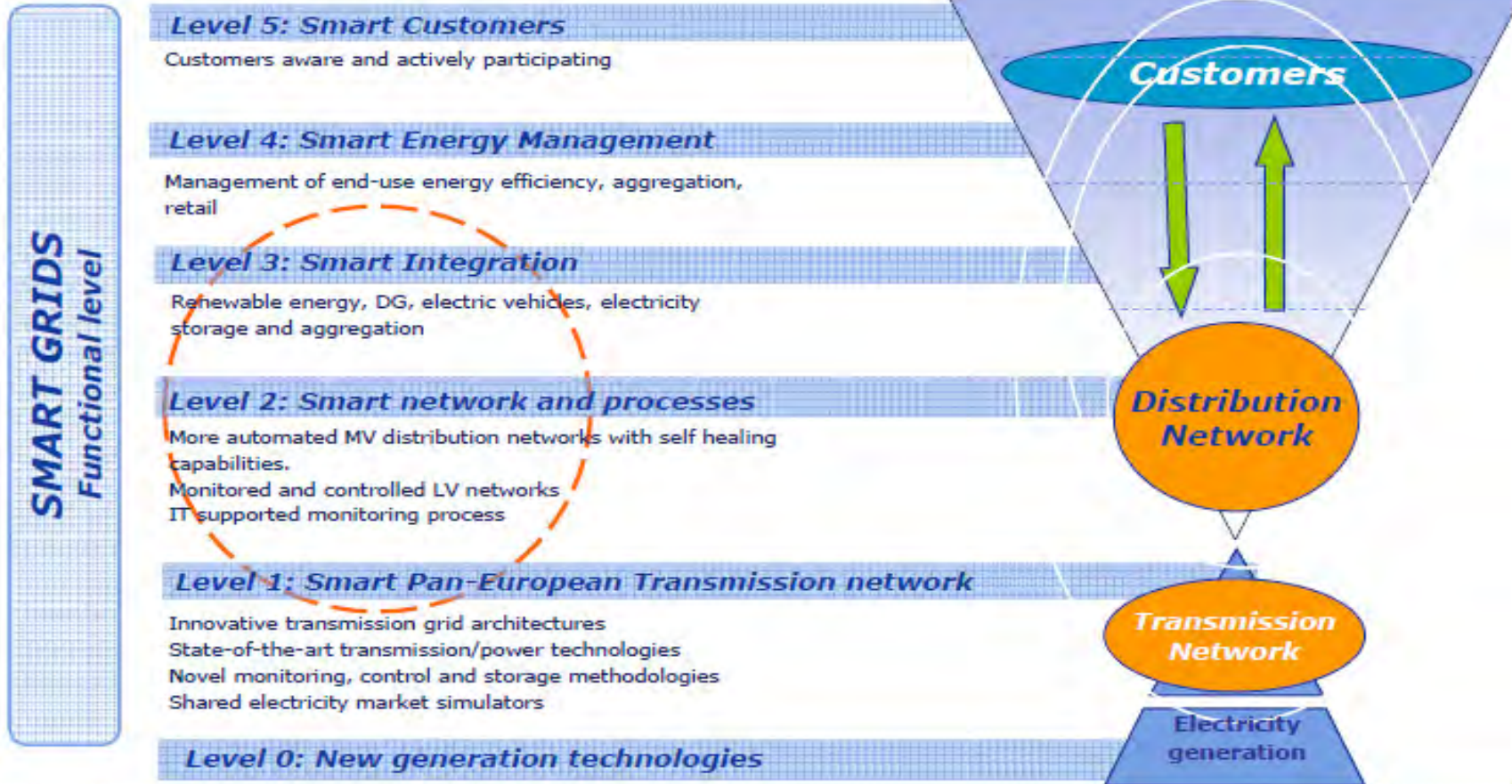


Smart Grid model proposed by European TSOs and DSOs

Smart Grids Model

Smart meters

Areva T&D footprint



...with support from regulation and new technologies

New technology Capabilities



- ▶ New technology capabilities
 - ◆ Technological Convergence
 - ◆ Modeling and simulation
 - ◆ Complex systems control
 - ◆ Energy storage
 - ◆ Power electronics...

Energy policies / Regulatory push

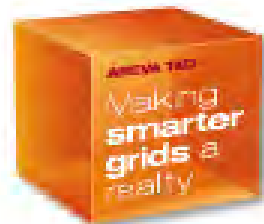


- ▶ Emerging governmental energy policies for energy & environmental efficiency:
 - ◆ Energy supply
 - ◆ Blackout prevention
 - ◆ Energy demand management



Bringing on Smarter Grids

AREVA T&D



Smarter Grids



**More efficient,
More reliable,
Environmentally-friendlier,
...SMARTER GRIDS!**



Today's Smarter grids references

EXAMPLES



DLR – Ireland
Distributed Gen.



National Grid
Phase Shifting Transfo.



Hydro Q
HVDCIce



Energinet
Distributed Gen.

A €5Bn
market in
2012 ¹⁾



North China Grid
Online Stability



Florida Power & Light
Integrated Distrib.



E.ON
MS 3000



Emirates
SVC MaxSine



1) On T&D current scope i.e. excluding LV applications such as Smart Metering and excluding new paradigms such as Electric Vehicles...



Reducing Environmental Impact

- ◆ Through increasing integration of renewable energy sources and deployment of greener products, the environment is being improved for everyone.



- ▶ AREVA T&D already monitors wind farms in Denmark, France, Portugal and Spain
- ▶ Thousands of Wind Power MW flows through AREVA T&D equipment across the world
- ▶ AREVA T&D connected to the grid half of all solar PV farm in France





Ensuring reliability and stability of supply

- ◆ In a more complex environment, power electronics, stability solutions and real-time control and monitoring make the network more robust.



AREVA T&D already delivers:

- ▶ Energy and Market Management Systems (e-terra)
- ▶ Online stability solutions (PMU, PDC, EMS applications)
- ▶ Condition monitoring tools MS3000 and CBWatch
- ▶ FACTS devices and HVDC
- ▶ Fault-current limiters etc.



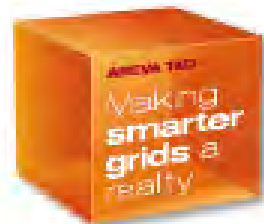


Improving energy efficiency

- ◆ **Efficiency solutions enable utilities to operate their assets closer to the limit, to reduce equipment losses and to optimize their generation portfolio.**



- ▶ **Smarter dispatch**
- ▶ **Low-loss transformers**
- ▶ **Phase-shifting transformers**



Developing our Smarter solutions

- Strategic customers
- Universities
- Software and technology
- IT and communication

Partnerships

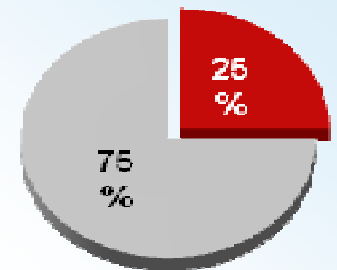
- NCIT
- Network consulting

Acquisitions

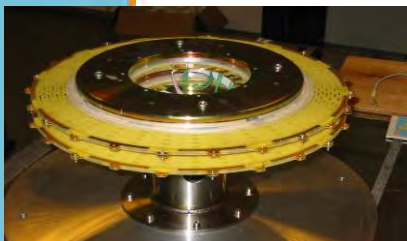


R&D development

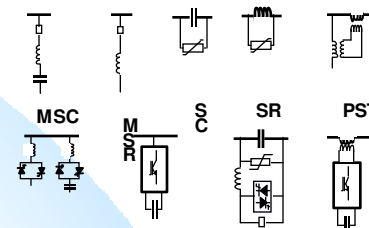
**Smarter Grids
25% of R&D budget**



Among Smarter Solutions to come...

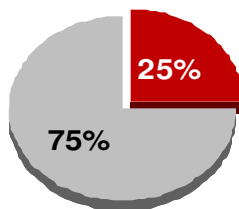


Fault current limiter

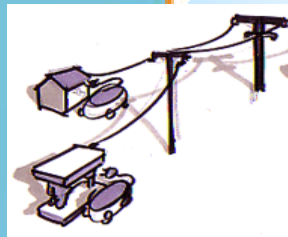


IGBT based FACTS

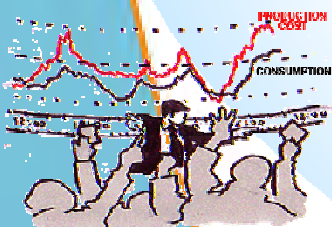
Smarter Grids
25% of R&D budget



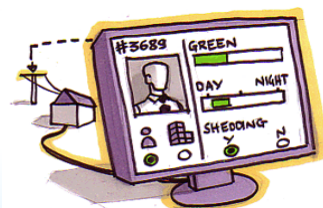
SF6 free products



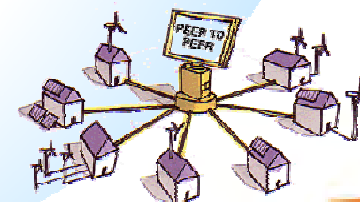
Electric Vehicle



Demand response



Smarter homes



Microgrids for
Residential



AREVA T&D

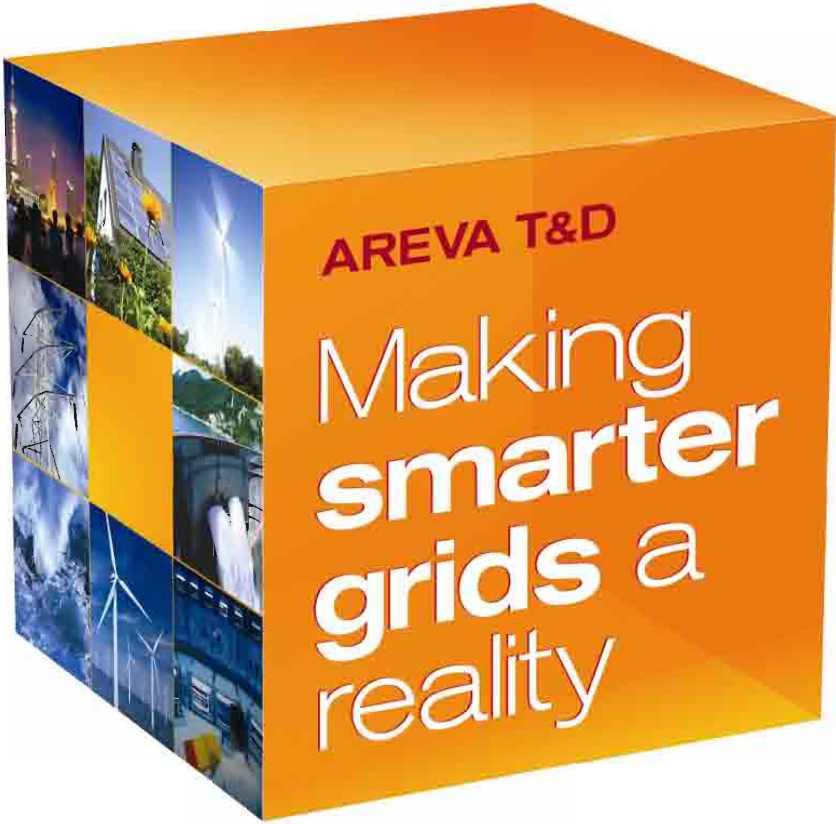
Conclusions

- ▶ **The Smart Grid revolution is the shift from today's centralized network to a new, bidirectional and dynamic network integrating a large part of distributed and renewable energy**
- ▶ **Smarter Grids will be able to manage this increasing complexity**
- ▶ **AREVA T&D enhances its offering and develops new technologies to provide customers with “smarter solutions” to answer their needs and requirements**





AREVA T&D



AREVA T&D

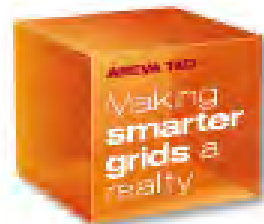
Making
smarter
grids a
reality

Back-up slides

AREVA T&D



European Union and US Stimulus Packages



European Energy Programme for Recovery - EEPR



- ▶ The EEPR regulation establishes a financing instrument for the development of projects in the field of energy in the EU.
- ▶ By providing a financial impulse EEPR will contribute to economic recovery, the security of energy supply and the reduction of greenhouse gas emissions.
- ▶ EEPR establishes sub-programmes to advance these objectives in the fields of:
 - ◆ gas and electricity infrastructures; (« Interconnections") – budget: **2 365 million €**
 - ◆ offshore wind energy; ("OWE") - budget: **565 million €**
 - ◆ carbon capture and storage ("CCS") – budget: **1 050 million €**



US Energy Related Stimulus (Pre Obama)

- ▶ **2005 “Smart Energy Bill”**
 - ◆ **Funds the \$12-billion 2005 Energy Act, which includes a call for nationwide standards for reliability & other provisions likely to stimulate new technologies and new applications that bring “intelligent” systems into the electricity management system.”**

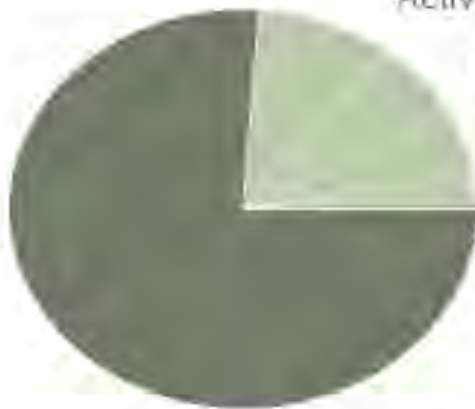
- ▶ **2008 “Bush Bailout Bill- Energy Improvement & Extension Act”**
 - ◆ **Extended Energy Tax Credits – Wind, Solar, Fuel Cells, Combined Heat & Power < 50MW, Small Scale Wind, Residential Wind & Solar, Carbon Mitigation & Coal Provisions, PHEV up to \$15,000 Credit**
 - ◆ **Renewable & Qualified Energy Conservation Bonds**
 - **Limitation \$800,000,000**
 - **Green Communities Programs, Renewable Energy Programs, Building Efficiency Program**
 - **R&D & Demonstration Projects – Reduce Peak Energy Usage, Battery Technologies, Public Education Programs, etc.**
 - ◆ **Accelerated Recovery Period For Depreciation Of Smart Meters and Smart Grid Systems**



Obama Energy Stimulus

Energy and environment: \$98.234 billion

Department of the Interior: \$9.241 billion



Atomic Energy Defense Activities: \$6.537 billion

Corps of Engineers: \$4.6 billion

Bureau of Reclamation: \$1.4 billion

Other Agencies: \$1.755 billion

Department of Energy: \$74.701 billion

Department of Energy: \$74.701 billion

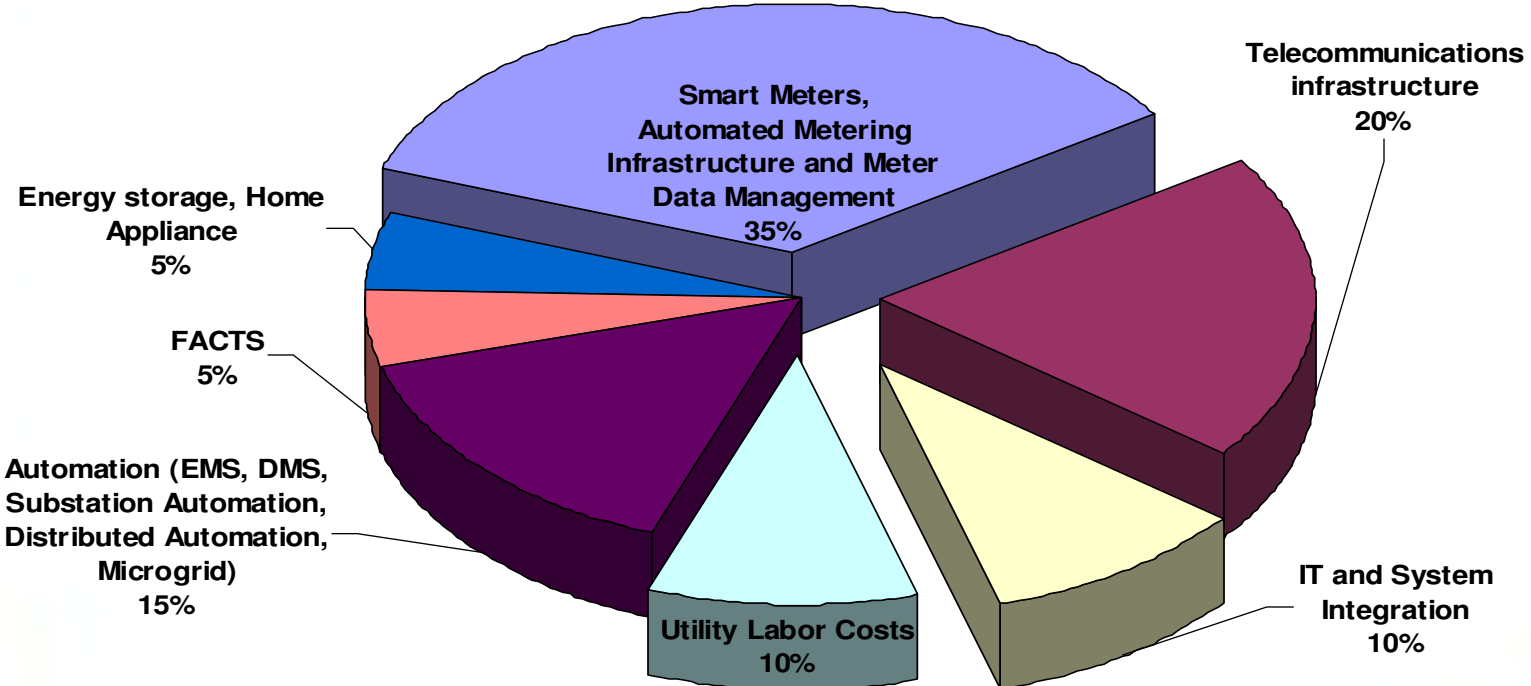
\$50 billion	Innovative Technology Loan Guarantee Program	
\$14.398 billion	Energy efficiency and renewable energy	
\$4.6 billion	Fossil energy research and development	
\$4.500 billion	Electricity delivery and energy reliability	
\$483 million	Nondefense environmental cleanup	
\$390 million	Uranium plant decommissioning	
\$330 million	Science	

Sources: CNN



US Stimulus Plan Submitted Smart Grid Projects Value Breakdown

US Stimulus Plan Submitted Projects Value Breakdown - Total Value 60 Bn US\$

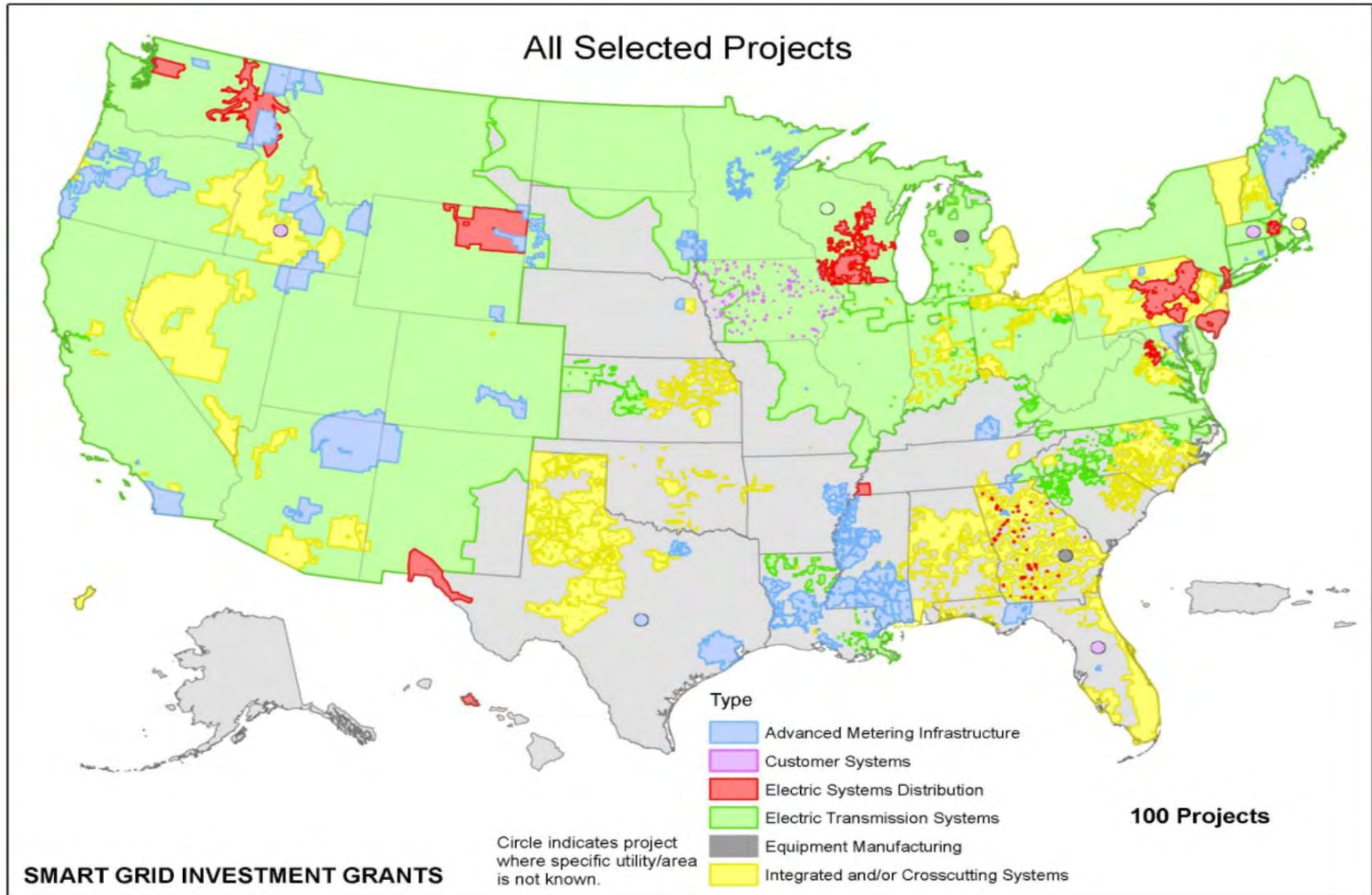


Source: Areva T&D research

Smart Meters, AMI and MDM dominate in terms of value, followed by telecoms, grid automation & DG



Stimulus Investments in Smart Grid Map

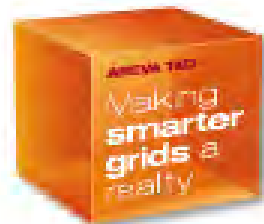


Oct 23, 2009

Source: US Department of Energy

US Smart Grid Investment Grant Results

- ▶ **Total of 100 Awards**
- ▶ **Maximum award size was \$200million**
 - ◆ **Progress Energy, Exelon PECO, Duke, Florida Power & Light, Baltimore Gas & Electric**
- ▶ **Key DOE objectives**
 - ◆ **Empowering Consumers to Save Energy -- \$1 billion**
 - ◆ **Making Electricity T&D More Efficient -- \$400 million**
 - ◆ **Integrating and Crosscutting Across Different “Smart” Components of a Smart Grid -- \$2 billion**
 - ◆ **Building a Smart Grid Manufacturing Industry -- \$25 million.**
- ▶ **Key Sector Wins:**
 - ◆ **Smart Meters & Advanced Metering Infrastructure**
 - ◆ **Phasor Measurement Units & Applications**
 - ◆ **Distributed Automation, DR & Dynamic Pricing**
 - ◆ **Renewable Integration**



US Smart Grid Investment Grant

Key Metrics

- ▶ **Create jobs, jobs, jobs ...**
- ▶ **Leverage over \$4.7 billion in private investments (match)**
- ▶ **Reducing power outages that cost \$150 billion a year**
- ▶ **Install more than 850 Phasor Measurement Units**
- ▶ **Install more than 200,000 smart transformers**
- ▶ **Install almost 700 automated substations**
- ▶ **Install more than 40 million smart meters**
- ▶ **Install more than 1 million in-home displays, 170,000 smart thermostats, & 175,000 load control devices**
- ▶ **Reduce peak electricity demand by more than 1400 MW, saving more than \$1.5 billion in capital costs**
- ▶ **Put US on a path to get 20 percent or more of our energy from renewable sources by 2020**



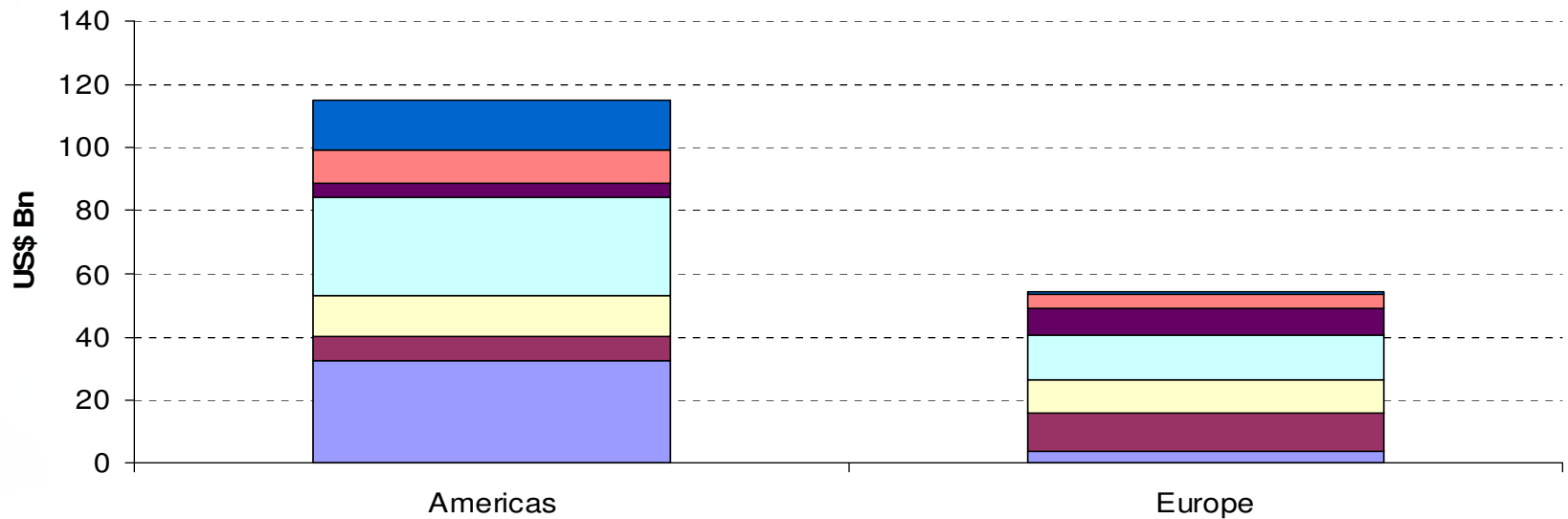
Comparison of European & US Packages



Comparison of US and European Budgets

▶ Total US budget is more double than the European total...

US and European Stimulus Budgets announced



Source: HSBC

Sum of Renewable Sum of CCS/Other Sum of Grid Sum of Building EE
Sum of Low C Vech Sum of Rail Sum of Water/Waste

But investment duration is 10 years for US vs. 3 years for Europe

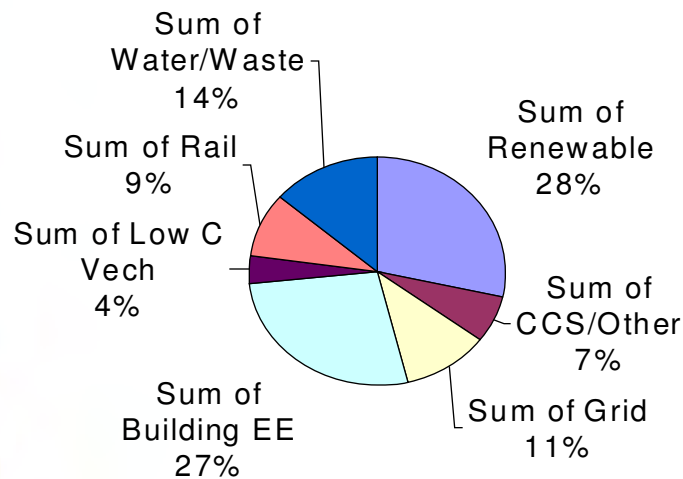


Comparison of US and European Budgets

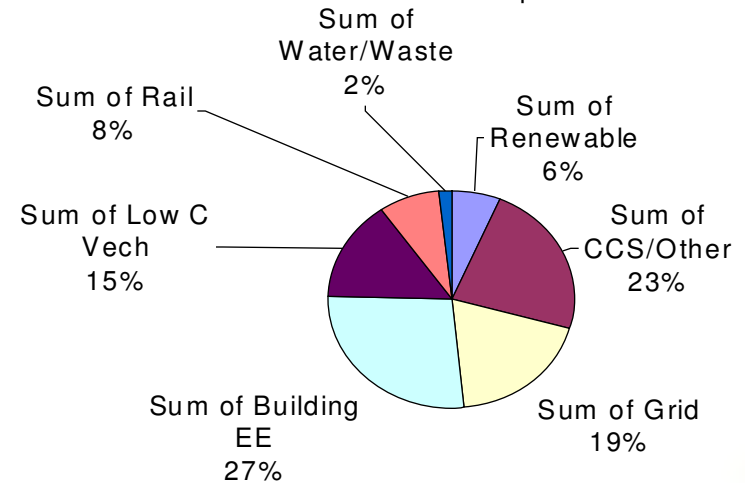
▶ **US plan focuses on Renewables and Energy Efficiency**

▶ **European plan is more balanced, with more effort on CCS, Interconnections and Smart Grids**

US budget breakdown by category - Total 115 US\$ Bn



European budget breakdown by category - Total 54 US\$ Bn



Source: HSBC

US will catch up in terms of renewable penetration whereas Europe will try to address CCS challenges

