SmartGrids

Technology Platform

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KULeuven

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2nd General Assembly

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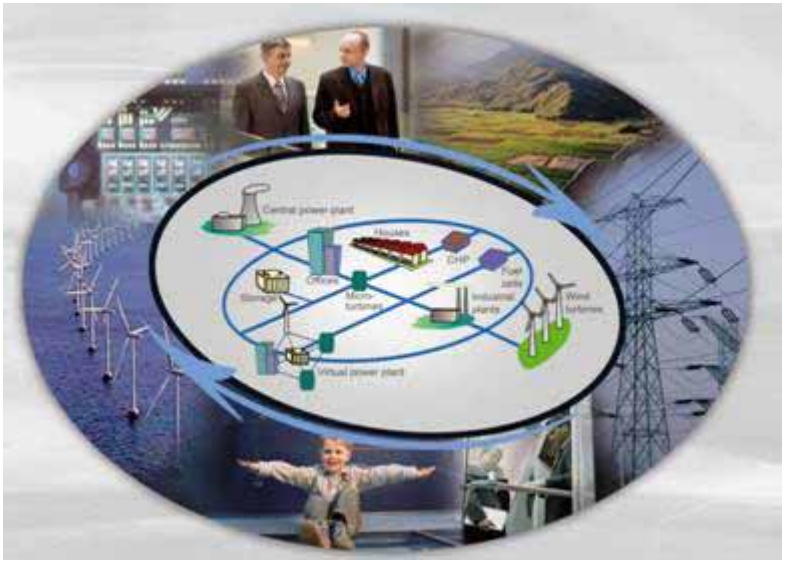


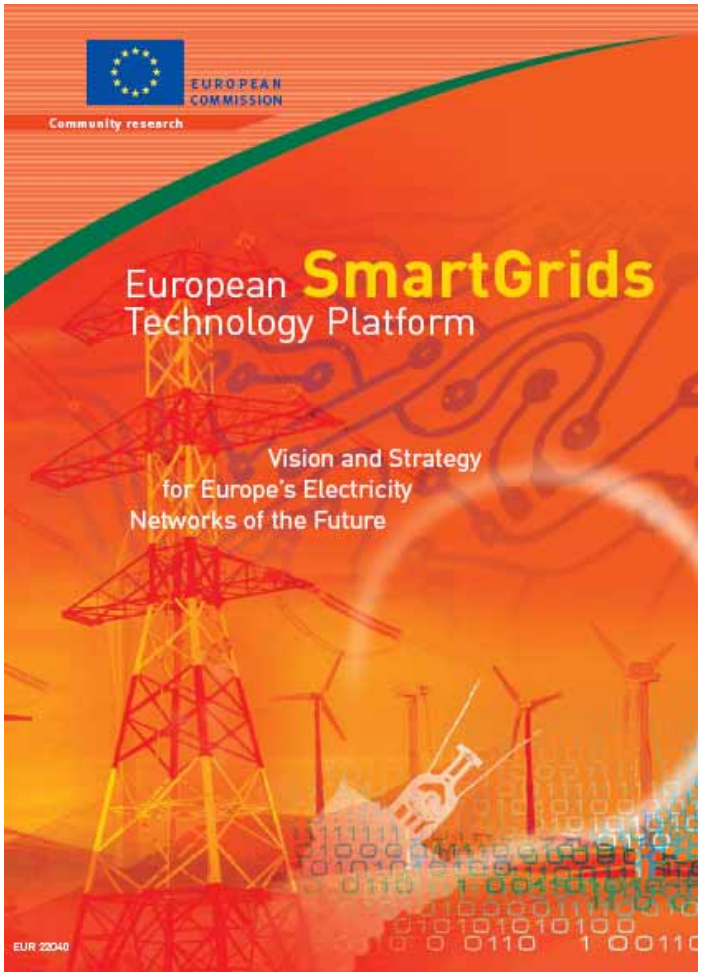
- Where are we?
- How to move further?
- How to get it deployed?
- How to get all stakeholders involved?

Making the Earth Move

We had a vision …

More than 200 experts:

- Engineers
- Business
- Academia
- Politicians



A shared vision

Sustainability, competitiveness, security of supply, innovation

- **Flexible: fulfilling customers needs**
- **Accessible: to all network users, particularly RES and high efficiency DG with zero or low CO_2 emissions**
- **Reliable: assuring and improving Quality of Supply and resilient to hazards and uncertainties**
- **Economic: best value through innovation, efficient energy management and level playing field competition and regulation**

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The future

We had a vision …

More than 200 experts:

- Engineers
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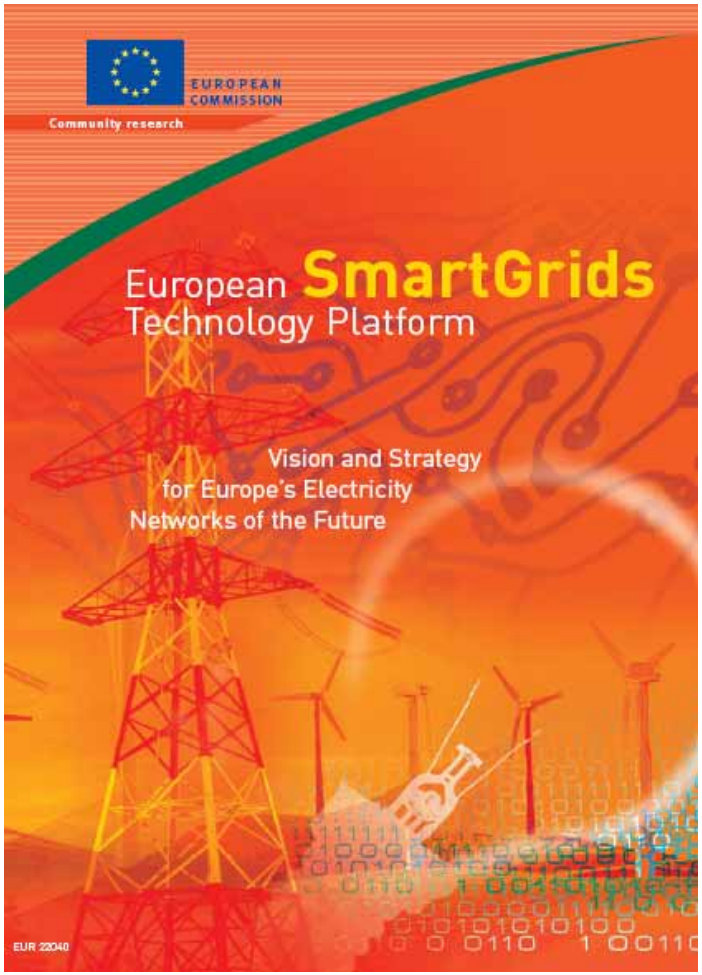
- Politicians

… and……



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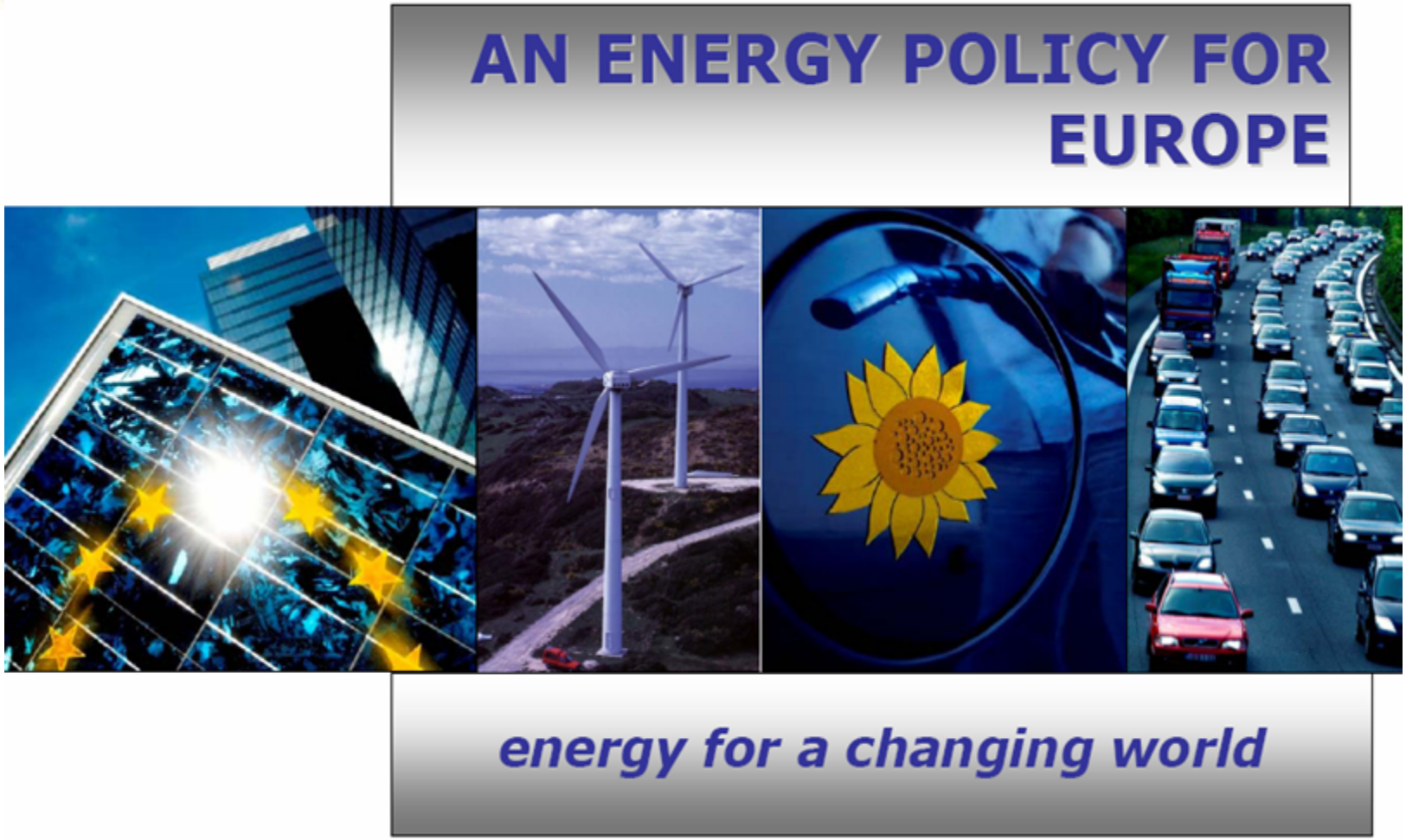
EU energy policy



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Climate is HOT

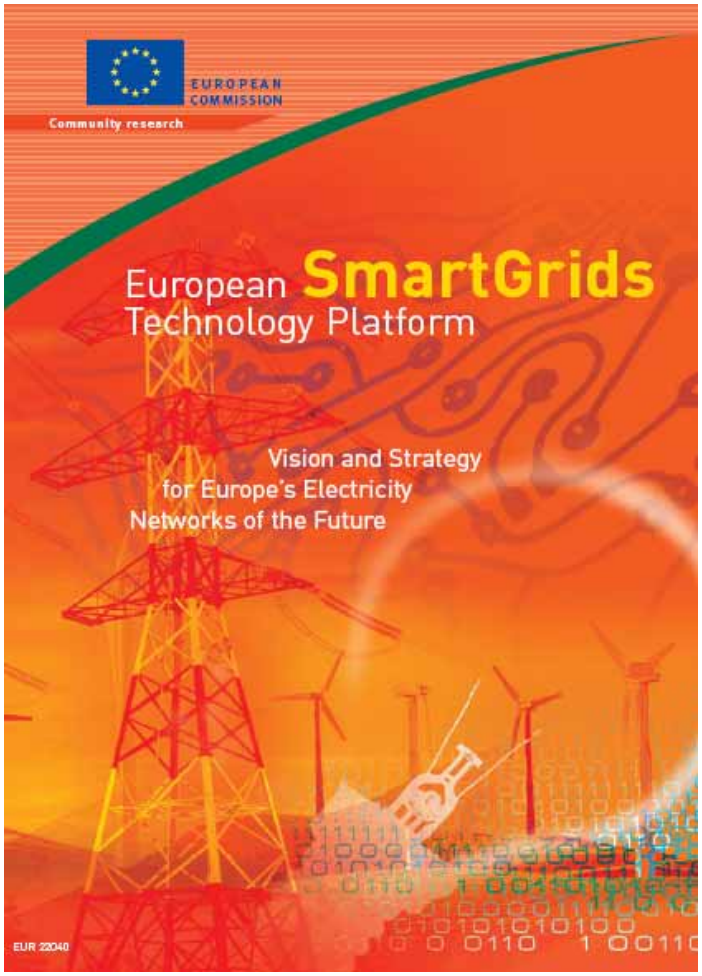
We had a vision …

More than 200 experts:

- Engineers
- Business
- Academia
- Politicians

… an it was confirmed by

- **EU Energy Policy**
- **Al Gore**



EU targets give a clear signal

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- **EU leaders 2007:**
  - 20% (30%) CO_2 emission reduction in 2020 (compared to 1990)
  - 20% increase in energy efficiency by 2020
  - 20% renewable energy by 2020
- **Investing heavily in low carbon technology.**
- **Agreement to develop the single energy market.**
- **Strengthening the EU's carbon market**
  - covers 50% of our energy emissions
  - market value over 20 billion euros.

…for defining the way forward

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- **Transition to a more CO_2-efficient society**
- **There is a common trend to higher reduction targets**
- **The EU has the ambition to take the lead**
- **Impact on customers business**
  - Huge investments
  - More R&D in new energy solutions
  - Changing energy demand characteristics
  - New products (generation, car fuels, CO_2-credits, ….)

Drivers towards SmartGrids

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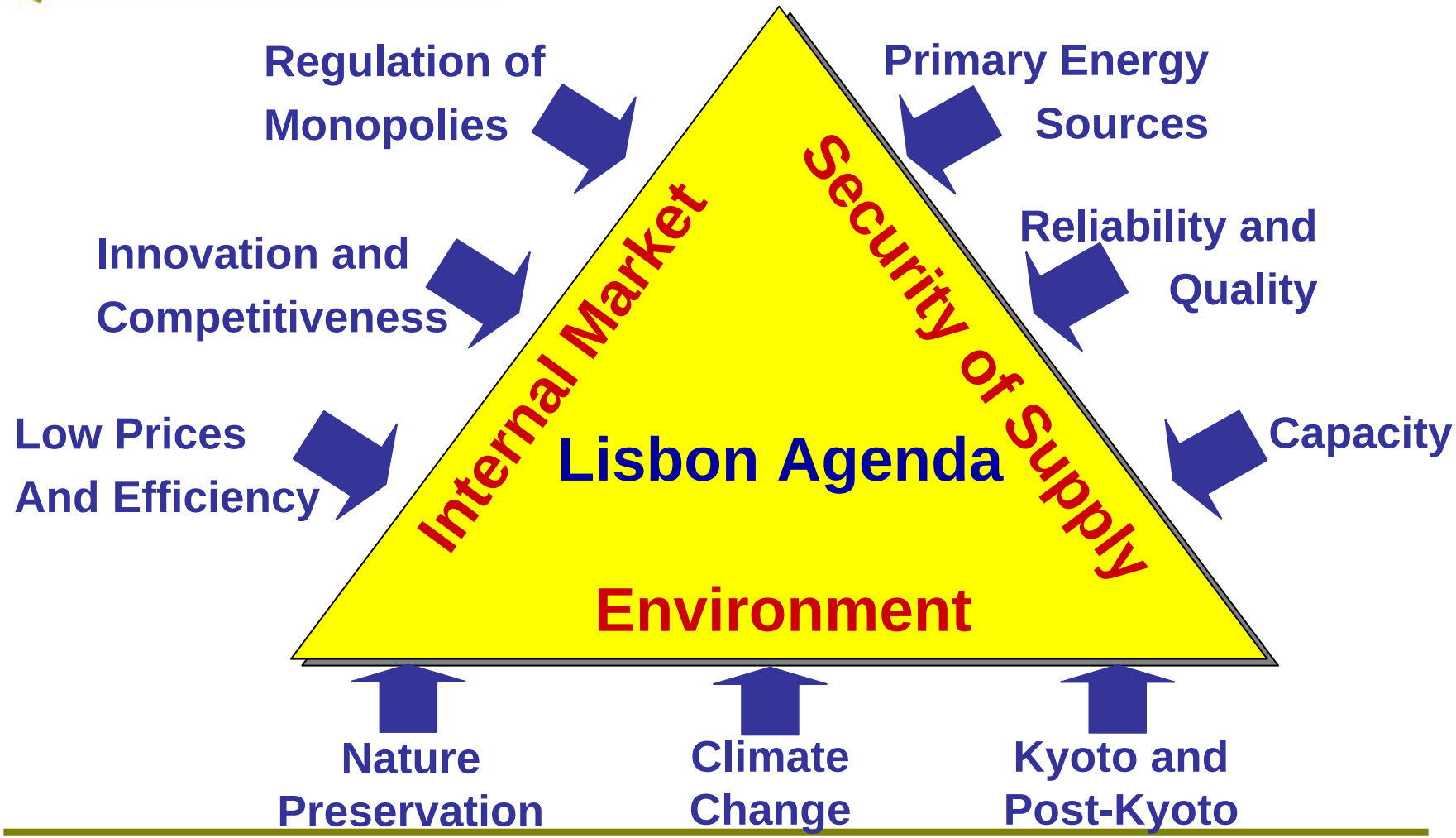

Why SmartGrids?

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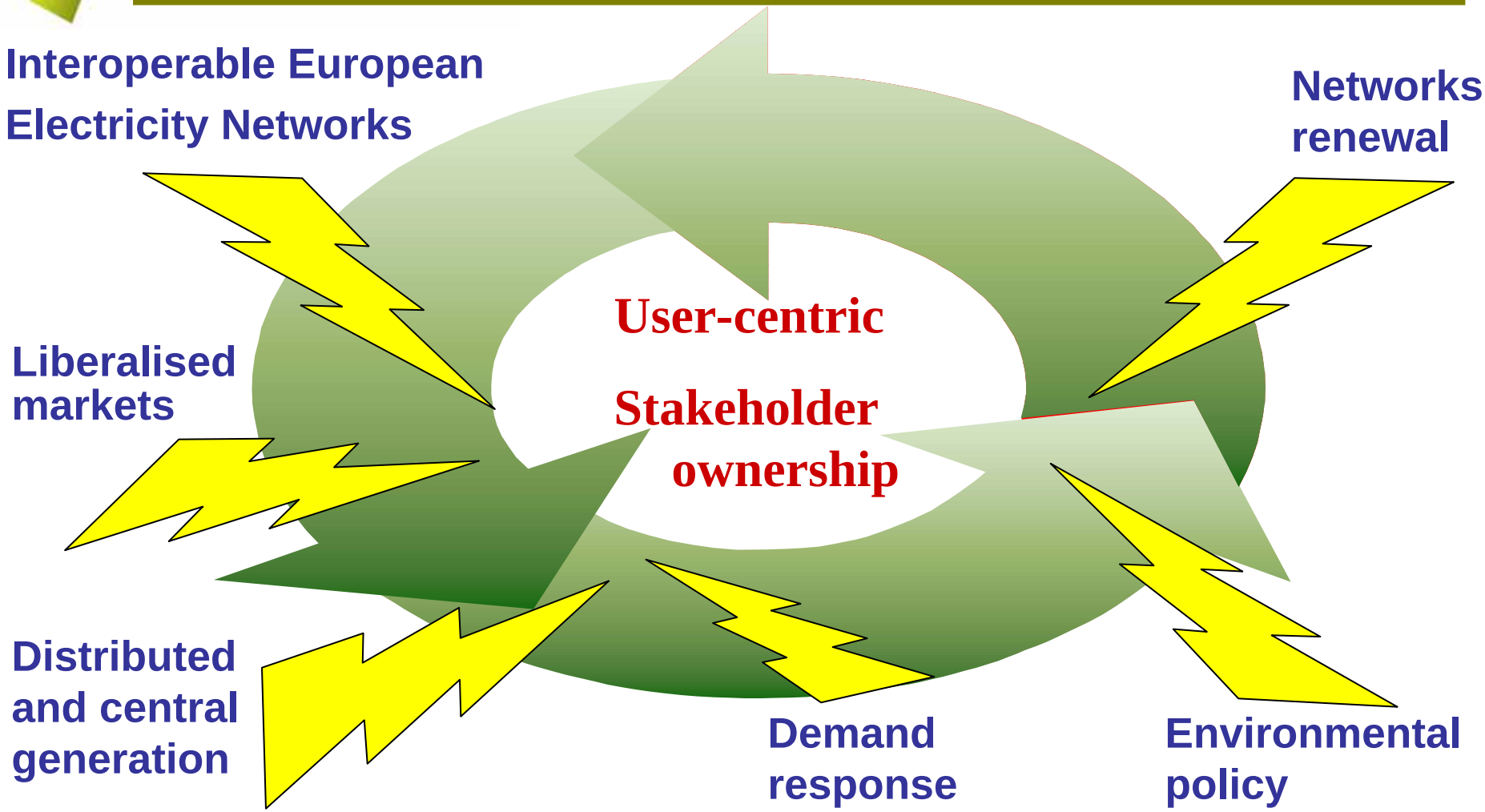
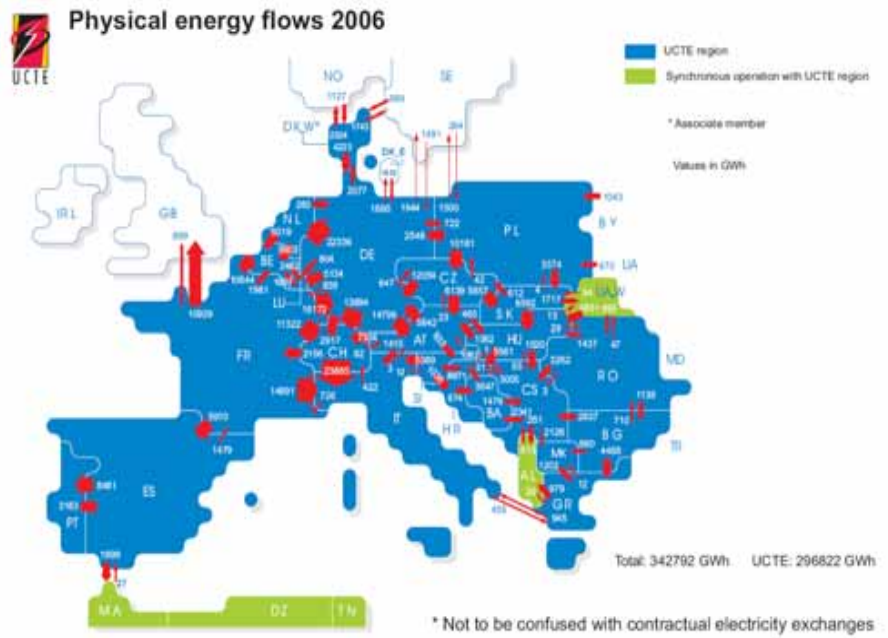


The world's engineering marvels

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Gas Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-Performance Materials

JARED SCHNEIDMAN DESIGN



Source:

National Academy of Science (USA)

European Power System

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To remember:

- 430 million people served
- 2500 TWh used

- 560 GW installed capacity @ 500€/kW = 280G€
- 230.000 km HV network @ 0.4M€/km = 90G€
- Approx. 5.000.000 km MV+LV network

- 1500€ investment per EU citizen

- Largest man-made system

Investment needs 2030
750 billion € in grid

- **Demand**
  - Growth 2%/year = +1250 TWh until 2030
- **Generation also**
  - Replacement & expansion 900 GW needed until 2030
  - RES 500 GW_{peak} needed until 2030
- **Transmission & Distribution**
  - Ageing assets, expansion and RES+DG integration 500G€ until 2030 needed
- **Markets & Regulation**
  - Data + information need > 20G€ investment (based on 100€ per connection)

New distribution grid emerges

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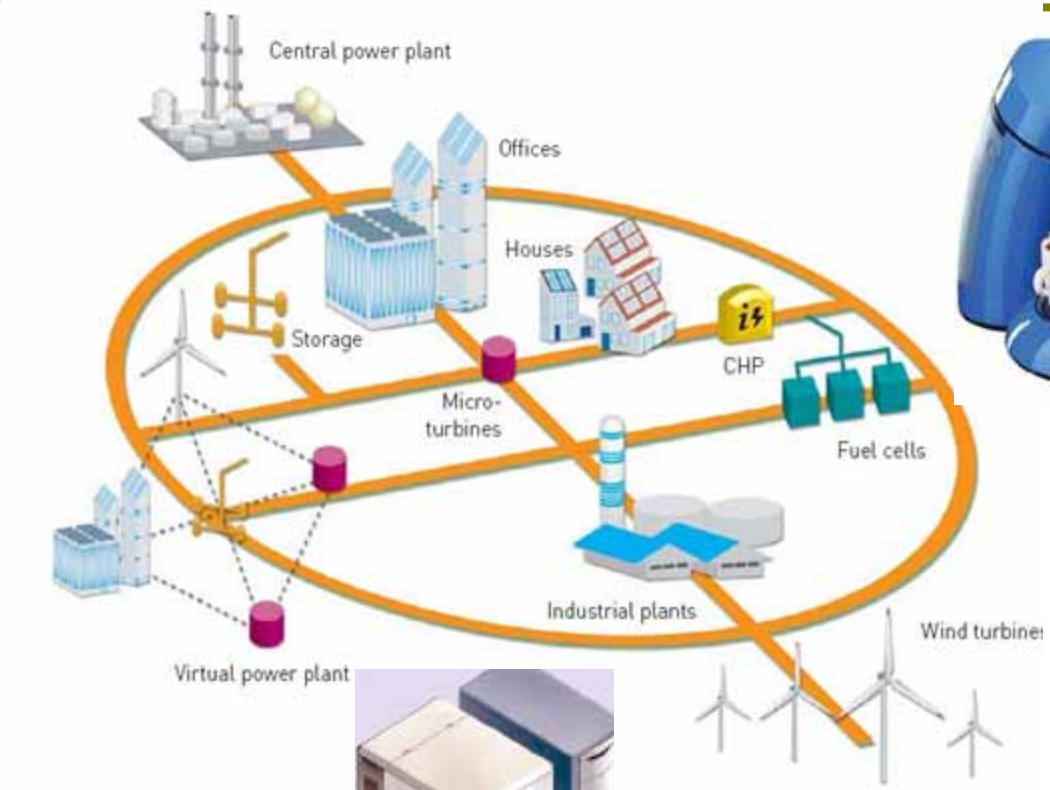

Convenience & health

Smart power electronics

Mini- and micro turbines

SmartGrid characteristics

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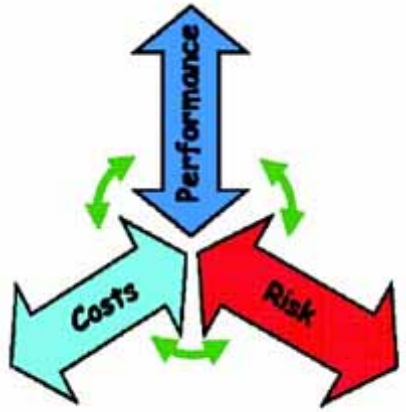
- **Customers are part of the "network-loop", both producer and consumer of electricity = *"prosumer"***
  - Real-time price information (smart meters)
  - Automated and embedded systems (DR/DSM)
  - Adequate investment and reward incentives
- **Integration of millions small scale generators**
- **Bulk power and small scale sustainability coexistence**
- **Demand and supply balance solutions**
- **Efficient operated (and reliable) network**
- **Differentiated Power Quality at connection point**
- **Mature markets and regulation**

Transition: driving factors

- Increased customer participation
- European and national policies encourage lower carbon generation, RES and efficient energy use
- Integration of RES and DG into the grids
- Need for investment in end-of-life grid renewal (ageing assets)
- Handle grid congestion (with market based methods)
- Reduce uncertainty for investment
- Progress in technology



The SmartGrids move

20th Century Grid	21st Century Smart Grid
Electromechanical	Digital
Very limited or one-way communications	Two-way communications every where
Few, if any, sensors – “Blind” Operation	Monitors and sensors throughout – usage, system status, equipment condition
Limited control over power flows	Pervasive control systems - substation, distribution & feeder automation
Reliability concerns – Manual restoration	Adaptive protection, Semi-automated restoration and, eventually, self-healing
Sub-optimal asset utilization	Asset life and system capacity extensions through condition monitoring and dynamic limits
Stand-alone information systems and applications	Enterprise Level Information Integration, inter-operability and coordinated automation
Very limited, if any, distributed resources	Large penetrations of distributed, Intermittent and demand-side resources
Carbon based generation	Carbon Limits and Green Power Credits
Emergency decisions by committee and phone	Decision support systems, predictive reliability
Limited price information, static tariff	Full price information, dynamic tariff, demand response
Few customer choices	Many customer choices, value adder services, integrated demand-side automation

We are not the only ones

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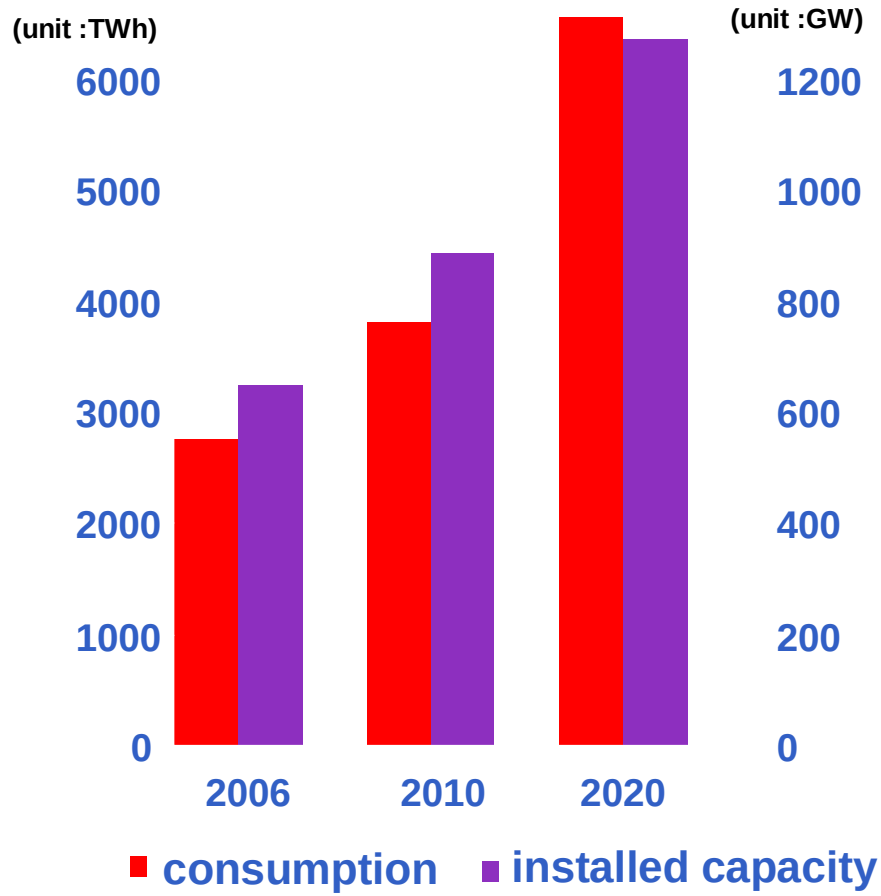
China

- **2006**
  - 622 GW Installed capacity
  - 2820 TWh Consumption
- **2010**
  - 860 GW Installed capacity
  - 3810 TWh Consumption
- **2020**
  - 1320 GW Installed capacity
  - 6580 TWh Consumption



China UHV Technology

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1000 kV AC

800kV HVDC links

UHV research laboratory

- At 2000 metres altitude in Kunming/Yunnan,
- Highest testing capability and will be the first national lab in Chinese electricity utility sector.
- Primarily used for R&D, maintenance, long term verification tests, etc.
- Test DC equipment up to 800kV and AC equipment up to 1100kV.
- RMB 480 mio

Common Research Agenda

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More than 200 experts:

- Engineers
- Business
- Academia
- Politicians

And it was confirmed by

- ERA-net
- Reliance
- FP7

Research Areas & Tasks (1)

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Resesearch Area	Research Task
RA 1 – Smart Distribution Infrastructure (Small Customers and Network Design)	RT 1.1: The distribution networks of the future – new architectures for system design and customer participation RT 1.2: The distribution networks of the future – new concepts to study DG integration in system planning
RA 2 – Smart Operation, Energy Flows and Customer Adaptation (Small Customers and Networks)	RT 2.1: The networks of the future – a system engineering approach to study the operational integration of distributed generation and active customers RT 2.2: Innovative energy management strategies for large distributed generation penetration, storage and demand response RT 2.3: The distribution networks of the future – customer driven markets
RA 3 – SmartGrid Assets and Asset Management (Transmission and Distribution)	RT 3.1: Network asset management – Transmission and Distribution RT 3.2: Transmission networks of the future – new architectures and new tools RT 3.3: Transmission networks of the future – long distance energy supply

Research Areas & Tasks (2)

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Resesearch Area	Research Task
RA 4 – European Interoperability of SmartGrids (Transmission and Distribution)	RT 4.1: Ancillary services, sustainable operations and low level dispatching RT 4.2: Advanced forecasting techniques for sustainable operations and power supply RT 4.3: Architectures and tools for operations, restorations and defence plans RT 4.4: Advanced operation of the high voltage system – seamless smart grids RT 4.5: Pre-standardisation research
RA 5 – Smart Grids Cross-Cutting Issues and Catalysts	RT 5.1: Customer Interface Technologies and Standards RT 5.2: The networks of the future –Information and Communication RT 5.3: Multiple Energy Carrier Systems RT 5.4: Storage and its strategic impact on grids RT 5.5: Regulatory incentives and barriers RT 5.6: Underpinning Technologies for Innovation

Our Milestones

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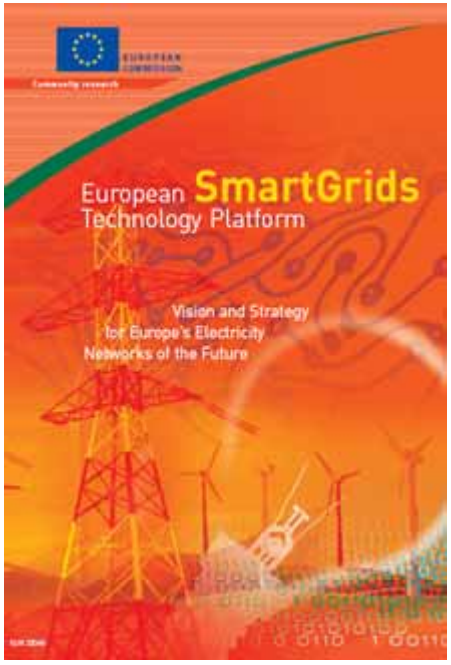
- April 2006 Vision and strategy published
- February 2007 Strategic Research Agenda
- End 2007 Strategic Deployment Document



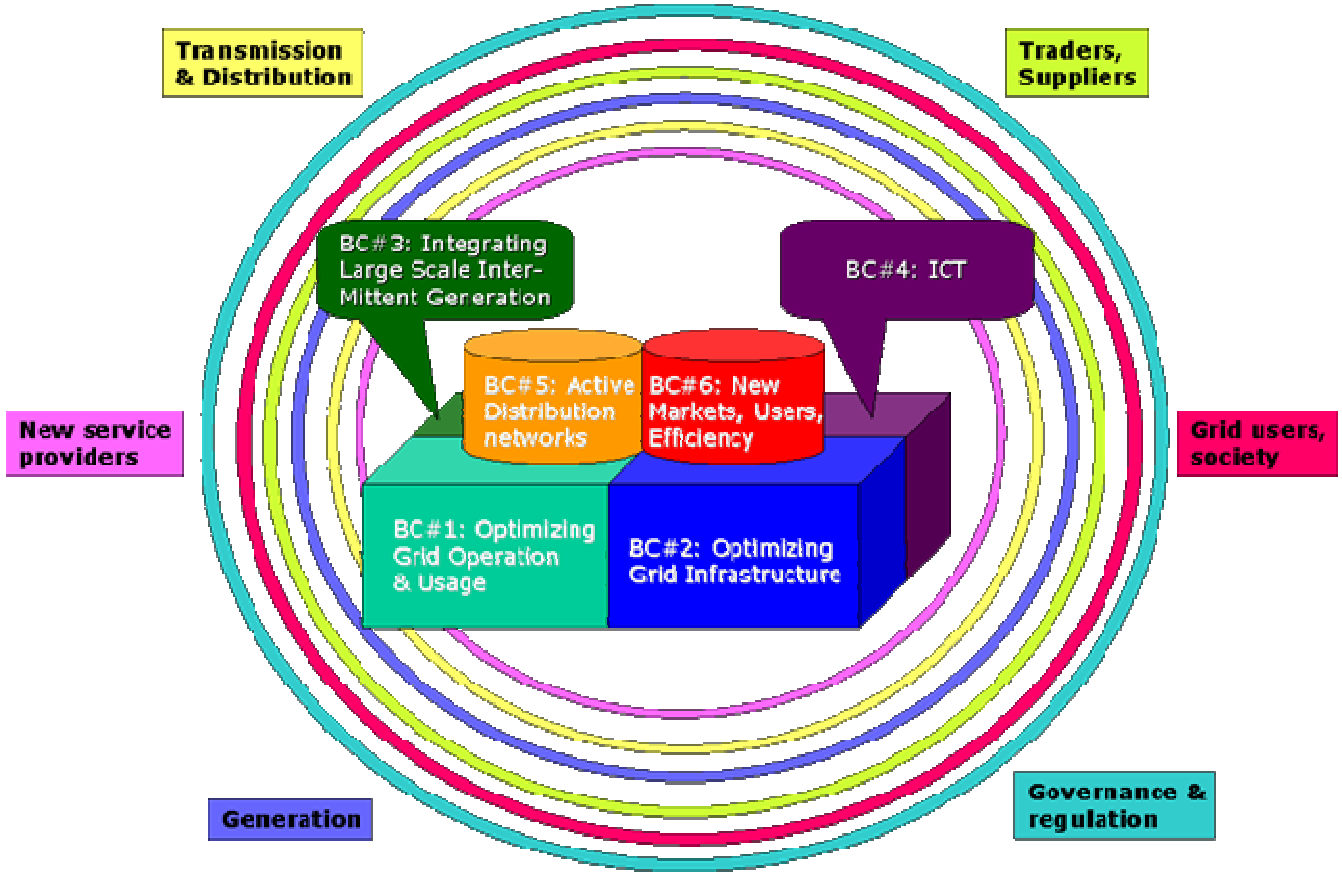
SDD

Strategic Development Document

- **Smart Grids for efficient electricity market, for security of supply and large scale RES, with four specific business cases:**
  - BC #1: Optimizing Grid Operation and Usage
  - BC #2: Optimizing Grid Infrastructure
  - BC #3: Integrating Large Scale Intermittent Generation
  - BC #4: Information and Communication Technology (ICT)

SDD

- **Value added services to SmartGrids customers, with two specific business cases**
  - Business Case #5: Active Distribution Networks
  - Business Case #6: New Market Places, Users and Energy Efficiency


Transmission & Distribution
Traders, Suppliers
BC#3: Integrating Large Scale Inter-Mittent Generation
BC#4: ICT
BC#5: Active Distribution networks
BC#6: New Markets, Users, Efficiency
New service providers
Grid users, society
BC#1: Optimizing Grid Operation & Usage
BC#2: Optimizing Grid Infrastructure
Generation
Governance & regulation

Innovation

Music is always there, but what is the business life time of its carrier?

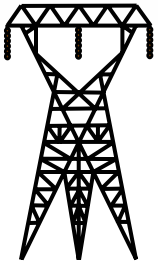
Shorter than you wish to be …

From wax roll to Long Play vinyl records in the 50's
From magnetic cassette to Compact Disc in the 90's
From MP3 to iPod + iTunes today
From iPod to…fulfilling customer needs even better

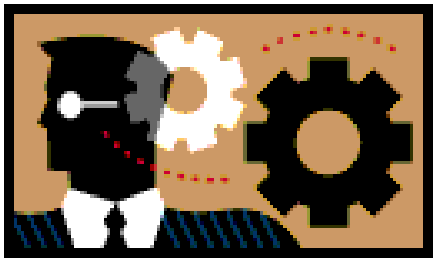
Price/performance always improves,

But it needs vision to be developed

The Stakeholders

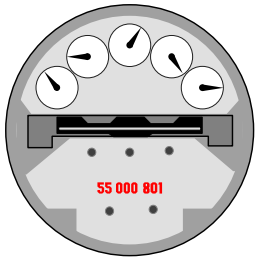


Network companies

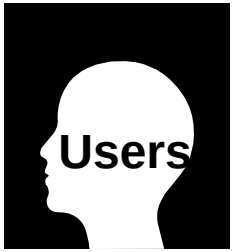


Technology providers

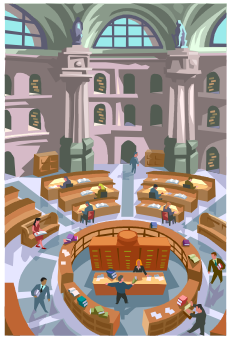
Researchers



Energy service providers

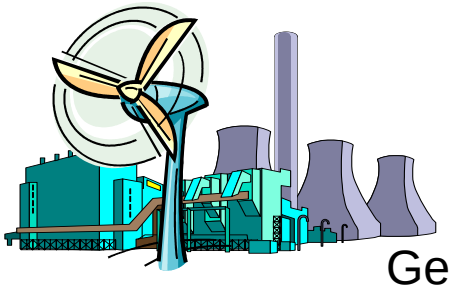


Regulators



Governmental agencies

Traders



Generators

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The SmartGrids Revolution is part of the Third Industrial Revolution

The best way to predict your future is to create it

(Peter Drucker)

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Thank you for your attention!

Ronnie Belmans

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