Smartgrids: a buzz word, an industry push or a necessity for saving THE planet?

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Global Smart Grid Federation

Facilitate the collaboration of national and international Smart Grid organizations to conduct and foster research in the application of Smart Grid technologies

Support implementation of Smart Grid technologies by establishing itself as the global centre of competency

Foster international exchange of ideas and best practices on energy issues

Facilitate dialogue and cooperation between the public and private sectors in countries around the world

Potential growth areas for GSGF (1)

	Population (2012) * World Bank	Electric utility structure	Generation capacity (currently/estimated 2020)	Source of generation
Malaysia	●29.2 million	●Vertically integrated by area ●TNB (Malay peninsula), SESB (Sabah), SESCO (Sarawak)	●22GW/---	●Mainly thermal, some hydro
Singapore	●5.3 million	●Generation, transmission is separated by ownership ●Multiple generation companies ●One transmission company (SP PowerGrid ●Wholesale market exists	●11GW/---	●Thermal
Thailand	●69.5 million (2011)	●Generation, transmission, distribution unbundled ●Generation: EGAT and several IPP ●Transmission: EGAT ●Distribution: MEA (Capital area), PEA (rest of country)	●28GW/46GW	●Mainly thermal
Viet Nam	●88.8 million	●Vertically integrated (EVN) ●3 load dispatch offices (North, mid, south) manage each area	●12GW/61GW	●Thermal and hydro
Indonesia	●246 million	●Indonesian national electric utility PLN was the only company until 1992. Since then, IPPs have been able to enter generation.	●35GW/92GW (2021)	●Mainly thermal (coal), thereafter thermal (oil, gas), geothermal, hydro

Potential growth areas for GSGF (2)

	Public research institute	University	Remark
Malaysia	●KeTTA (Ministry of Energy, Green Technology and Water)	●Univ. Malaya ●UNITEN (Universiti Tenaga Nasional), etc.	●Electric utility TNB (Tenaga Nasional Bhd.) have most knowledge
Singapore	●Agency for Science, Technology and Research, A*STAR	● Nanyang Techno-logical university (nTu)	●A*STAR might be adequate for the member of GSGF.
Thailand	●NASTADA (National Science and Technology Development Agency) ●Nectech(National Electronics and Computer Technology) (Subsidiary of NASTADA)	●Chulalongkorn University ●KMUTT - King Mongkut's University of Technology Thonburi	●Public research institute, university, utility are all possible partners. ●Joint projects between these players are under way, to test smart grid and certification schemes (KMUTT have a facility called CES Solar Cells Testing Center (CSSC) where they operate on command from utilities.)
Viet Nam	●IE (Institution of Energy) * An energy research institute under the Ministry of Industry and Trade		●Public research institute would be best for the member of GSGF.
Indonesia	●BPPT (Agency for the Assessment and Application of Technology: They are in charge of developing new tech.) ●MEMER(Minister of Energy and Mineral Resources)		●Public research institute would be best for the member of GSGF.

GSGF Collaborative Partners

- GSGF has established a number of collaborative relationships with global energy organizations.
  - Major Economies Forum on Energy and Climate (MEF)
  - Clean Energy Ministerial (CEM)
  - International Smart Grid Action Network (ISGAN) (co-organizing Smart Grids project award)
  - International Energy Agency (IEA)
  - Global Green Growth Forum (3GF)
  - EIT KIC InnoEnergy

GSGF Work Groups 2015

- 3 areas of research and collaboration
  - **Smart Grids System flexibility**
    Leader; Laurent Schmitt, Smart Grid France
  - **Energy storage in the power grid**
    Leader; Hiroshi Kuniyoshi, Japan Smart Community Alliance
  - **Cyber Security**
    Leader; Subodh Belgi, Indian Smart Grid Federation

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GRID CONNECTIVITY OF DISTRIBUTED GENERATION

A GENERATION PARADIGM SHIFT

- Historically:
  - Centralized generation
  - Fossil fuel, nuclear, large hydropower
- Current situation:
  - More dynamic
  - More distributed
  - More renewable generation (wind, solar PV, biomass,..)

➔But some aspects remain unchanged!
  - Need for balancing supply & demand
  - High reliability standards

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DEFINING DISTRIBUTED GENERATION

- Generation of electricity from many decentralized, smaller than conventional, energy sources
- Connected to distribution grids
- Often based on renewable sources
  - wind, solar, biomass,...
- Possibly based on conventional methods
  - Diesel, natural gas,...

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SCOPE & OBJECTIVE

- Connectivity of distributed generation to distribution grids
- Overview of global trends
- Country-specific assessment (Denmark, Ireland, Japan, Canada, Korea, Australia, USA)
- Focus on technological, economic and policy/regulation aspects
- Discussion of national trends, challenges, work-in-progress, success stories

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GENERAL CONCLUSIONS

- Many national differences in:
  - Generation mix (due to economic/geographical properties)
  - Distribution system structure
  - Energy policy
- BUT global trends:
  - More distributed generation
  - More renewable generation
  - Increased electricity demand
  - Objectives related to sustainability

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TECHNOLOGICAL FINDINGS

- Challenges:
  - Power quality
  - Voltage and frequency management
  - Increased loads and lack of grid capacity
  - Standardization and interoperability
- Measures are being taken:
  - Public funding of R&D pilots
  - Grid reinforcement
  - active demand/distributed storage

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POLICY & REGULATORY FINDINGS

- Challenges:
  - Regulatory instability
  - Regulatory complexity
  - Lack of standardization and interoperability
  - Unclear roles and responsibilities
  - More emphasis on cost-efficiency and competitiveness than on innovation
- Regulatory measures:
  - Incentive schemes for smart grid investments and "green" solutions
  - Feed-in tariffs, tax benefits, subsidies, accelerated depreciation,..

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ECONOMIC FINDINGS

- DG stimulates economic progress
- DG affects government spending and revenues
- DG positively impacts reliability of the power system
- DG lowers international dependency, thus increases security of supply

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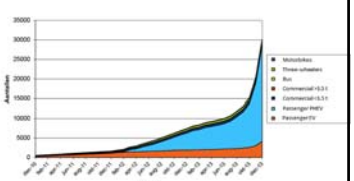
GRID USER INTERACTIONS AND INTERFACES

Electrification of passenger vehicles

STATUS UPDATE

- Strong increase in EV sales in countries with strong incentives schemes
  - Norway & the Netherlands discussed as example countries

EV/PHEV sales in Norway



EV/PHEV sales in Netherlands

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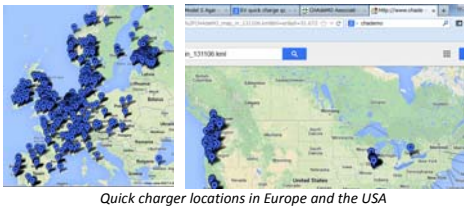
STATUS UPDATE

- More and more charging stations are being built
  - Quick chargers

  e.g. Estonia:

  163 DC quick charging stations, 60 km range



Quick charger locations in Europe and the USA

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FAST CHARGER DEPLOYMENT

- Nationwide charging networks
  - Willingness to pay to proceed trip
- Both public and private
- Reduction of Range Anxiety
- No standardization
  - multi-standard chargers




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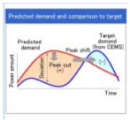
SMART CHARGING

- Charging flexibility
  - Adapt the charging profile
- Home energy management
  - Adapt charging to home energy consumption
- Other solutions
  - EV power management
  - Battery combined charging station
  - Multi-Channel Quick Charger (M:N Charging)

HEMS: Toyota's H2V manager



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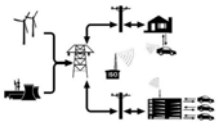
EV AS ENERGY SOURCE

- V2H: Vehicle to home
  - Peak shaving at house level
  - Backup power for emergencies
- V2B: Vehicle to Building
  - Aggregated at workplace level
- V2G: Vehicle to Grid
  - Economic objectives
  - Ancillary services

Nissan's V2H product

M-tech labo



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CONCLUSIONS

- Need for promotion for the spread of EV/PHEV
  - Incentives are important
  - Lessons can be learnt from Norway & Netherlands
  - Charging stations needed
  - Need for sustainable promotion measures
- Need for standardization of interface with grid
- EV/PHEV technologies are available
  - Proven technologies through demo programs
- Importance of policy support mechanisms

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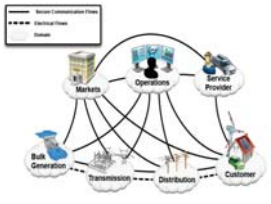
SMART GRID INTEROPERABILITY

The ability of technologies, systems and organizations to work together

SCOPE & OBJECTIVES

- What is interoperability?
- Why is it important?
- How does it provide value?
- Existing frameworks/best practices?
- Global differences?
- Measures needed?

→ Focus on distribution systems



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INFLUENCE ON MARKETS

- Reduced investment uncertainty
- Limited lock-in effects
- Fewer first-mover advantages
- Faster market growth
- Increased value creation for consumers

→ Crucial for development of new products & services!

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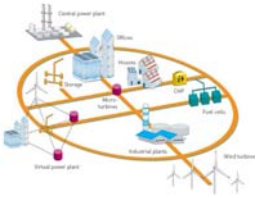
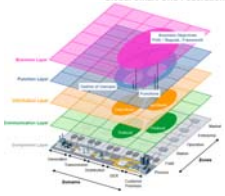
AREAS OF INTEREST

- Distribution grid management
- Network communication
- Metering infrastructure
- Cyber/system security
- Market design
- Regulatory frameworks
- Interoperability from a manufacturer's point of view



GLOBAL EFFORTS

- International Electrotechnical Commission (IEC)
- CEN/CENELEC/ETSI
- National Institute of Standards and Technology
- The Smart Grid Interoperability Panel
- IEEE Smart Grid Standards
- …



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CONCLUSIONS

BUT room for improvement: need for further harmonization!

- Standards
  - IEC 61850 still has no unique definition
  - Mapping identified at least 530 different smart grid standards
  - Time consuming and lack of experts
  - Attention needed regarding:
    - Upgradability
    - Independent testing for compliance

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CONCLUSIONS

- Regulation
  - Many global differences
  - Unclear roles & responsibilities
  - Follow-up needed on new services (demand response, renewables curtailment,..)
- Cyber/system security
  - Increased use of ICT/data processing
  - Emerging security threats
  - "Security by design"
  - Digital protection imact assessment/best practices

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RECOMMENDATIONS

- GSGF workshops and webinars on interoperability and standards
- Follow-up studies
- Knowledge-sharing among GSGF members on:
  - Market regulation
  - Cyber/system security

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The Global Challenge

DECARBONISE GENERATION + TRANSFORM NETWORK + ALTER CONSUMPTION

Renewables

Carbon Capture Clean Coal & Gas

Nuclear

Smart Grids/Networks

Distributed Generation

Electric Vehicles

Electrification of Heating

Smart Meters

Efficiency

What are the Levers?

- Technology Investment
- Policy
- Engagement

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G20 Energy Efficiency Action Plan (Australia 2014)

- Voluntary collaboration on energy efficiency
- New work
  - Improving vehicle efficiency & emissions performance
  - Networked devices: standby losses
  - Enhancing capital flow towards energy efficiency investments
- Accelerating existing international work
  - Improving metrics and performance for buildings
  - Making industrial processes more energy efficient
  - Sharing high-efficiency, low-emissions technologies

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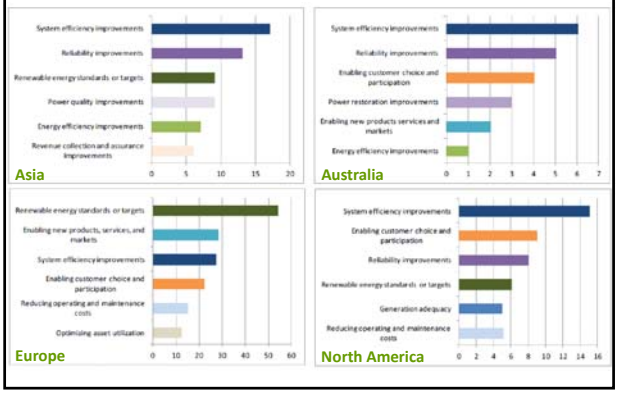
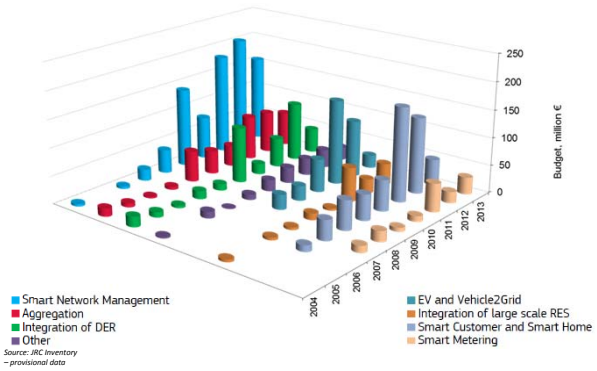
Technology Investment

Smart Grid Technology Investment Drivers



European smart grid projects – application, year, budget



Policy

Engagement

Smart Grid in Flanders

Multi stake holder Smart Grid approach
Demand Response System for Research Purposes

Controlled Appliances – one example in Flanders

Thank you !