AKADEMIA GÓRNICZO-HUTNICZA
IM. STANISŁAWA STASZICA W KRAKOWIE

Wspólnota Wiedzy i Innowacji (KIC) Zrównoważona Energia - Węzeł w Krakowie CC PolandPlus

Konwent AGH, 8 kwietnia 2010

Tomasz Szmuc

EIT – Europejski Instytut Innowacji i Technologii

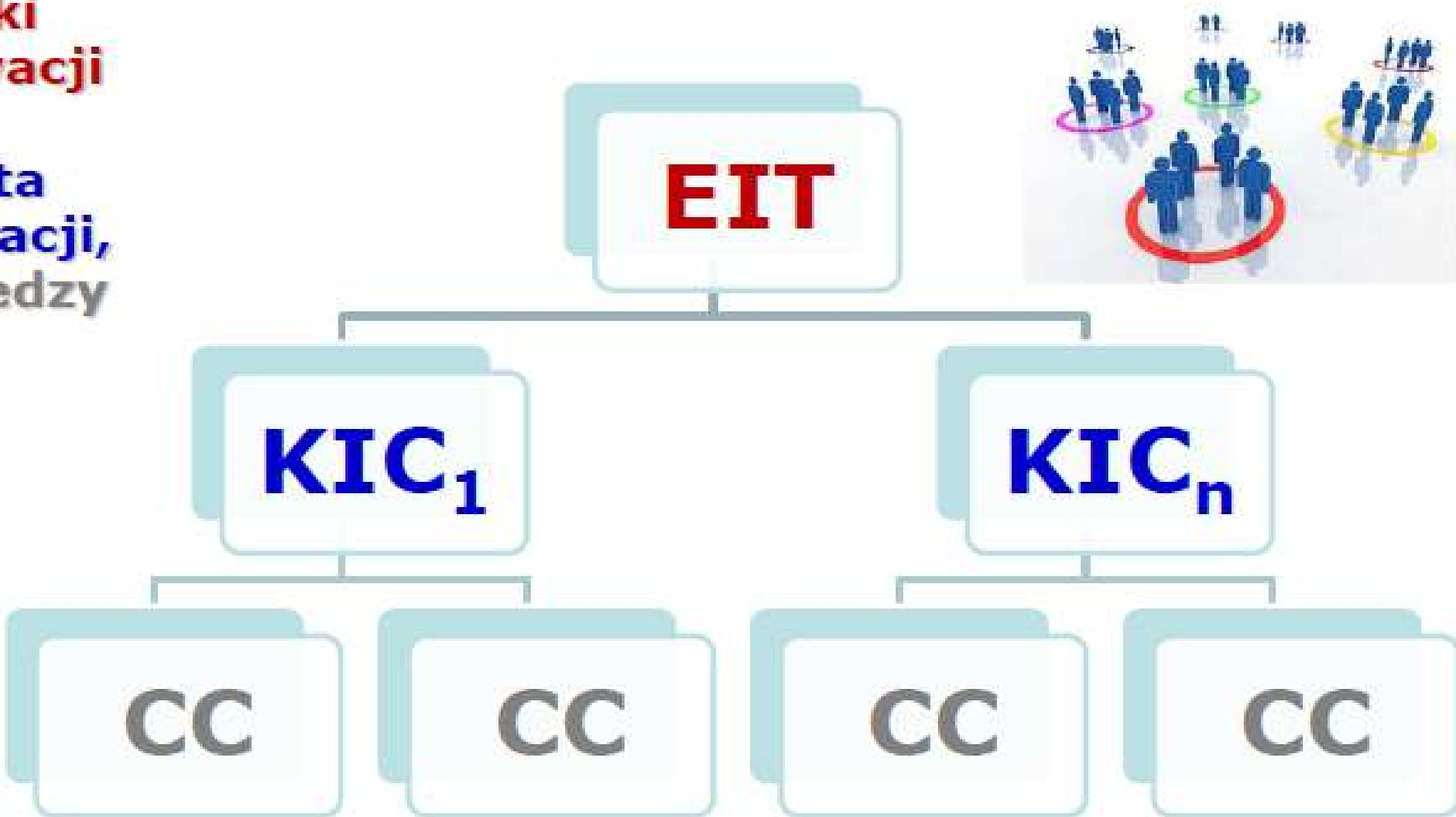
European Institute of Innovation and Technology (EIT)

z siedzibą w Budapeszcie.

Podstawowa europejska instytucja, której celem jest pobudzenie zrównoważonego rozwoju ekonomicznego i konkurencyjności poprzez rozwój innowacyjności na poziomie światowym.

Struktura

EIT – Europejski Instytut Innowacji i Technologii,
KIC – Wspólnota wiedzy i innowacji,
CC – Węzły Wiedzy i Innowacji



KIC- InnoEnergy

KIC- InnoEnergy składa się 6 węzłów rozmieszczonych w Europie. Na etapie projektu koordynowane przez **Karlsruhe Institute of Technology (KIT)**.

Karlsruhe Institute of Technology

Węzły - Tematyka

CC BENELUX

Thematic Coordination
Intelligent energy-efficient buildings and cities

CC IBERIA

Thematic Coordination
Renewables (wind, CSP, photovoltaics, wave and tidal energy)

CC ALPS VALLEY

Thematic Coordination
Sustainable nuclear & renewable energy convergence

CC SWEDEN

Thematic Coordination
European Smart Electric Grid and Electric Storage

CC POLAND PLUS

Thematic Coordination
Clean Coal Technologies

CC GERMANY

Thematic Coordination
Energy from chemical fuels

Węzły - tematyka

1. **CC Sweden**: Royal Institute of Technology (Stockholm), Uppsala, Vattenfal, ABB temat: ***Inteligentne europejskie systemy elektryczne i gromadzenie energii elektrycznej***
2. **CC Benelux**: TU Eindhoven, KU Leuven, Philips, Shell - temat: ***Inteligentne efektywne energetycznie budynki i miasta***
3. **CC Germany**: KIT, U Stuttgart, Bosch, Siemens, INTEL - temat: ***Energia z surowców mineralnych i biomasy***
4. **CC Alps Valleys**: Paris Tech, Grenoble, CEA, EdF, Total - temat: ***Zrównoważona energia nuklearna***
5. **CC Iberia**: UPC, ESADE Barcelona, CIEMAT, IBERDROLA temat: ***Energia odnawialna: słoneczna, wiatrowa, fal morskich i przypływów***
6. **CC Poland Plus - I poziom:** AGH, Pl.ŚI, GIG, IChPW, ZAK Kędzierzyn, **II poziom:** Tauron, LOTOS, PGE (?), Raffaco,PGNiG + inne uczelnie, temat: ***Czyste technologie węglowe i nowe podejścia do zarządzania węglem***

InnoEnergy Sweden

Smart Grids and Electric Storage Thematic Innovation Projects

Stockholm May 4th 2010

European Institute of Innovation & Technology

Sub-thematic projects / programmes

ICT for Smart Grids

I. Energy Market Design and Customer Interactions
II. Power Network Concepts covering Transmission to Distribution
III. Electric Energy Storage Technologies and Systems
IV. Smart Grid Components
V. Smart Grid Materials Technology
VI. Migration concepts of existing assets into the smart grid
VII. Major demonstrations and very large projects
VIII ICT Cross-thematic area

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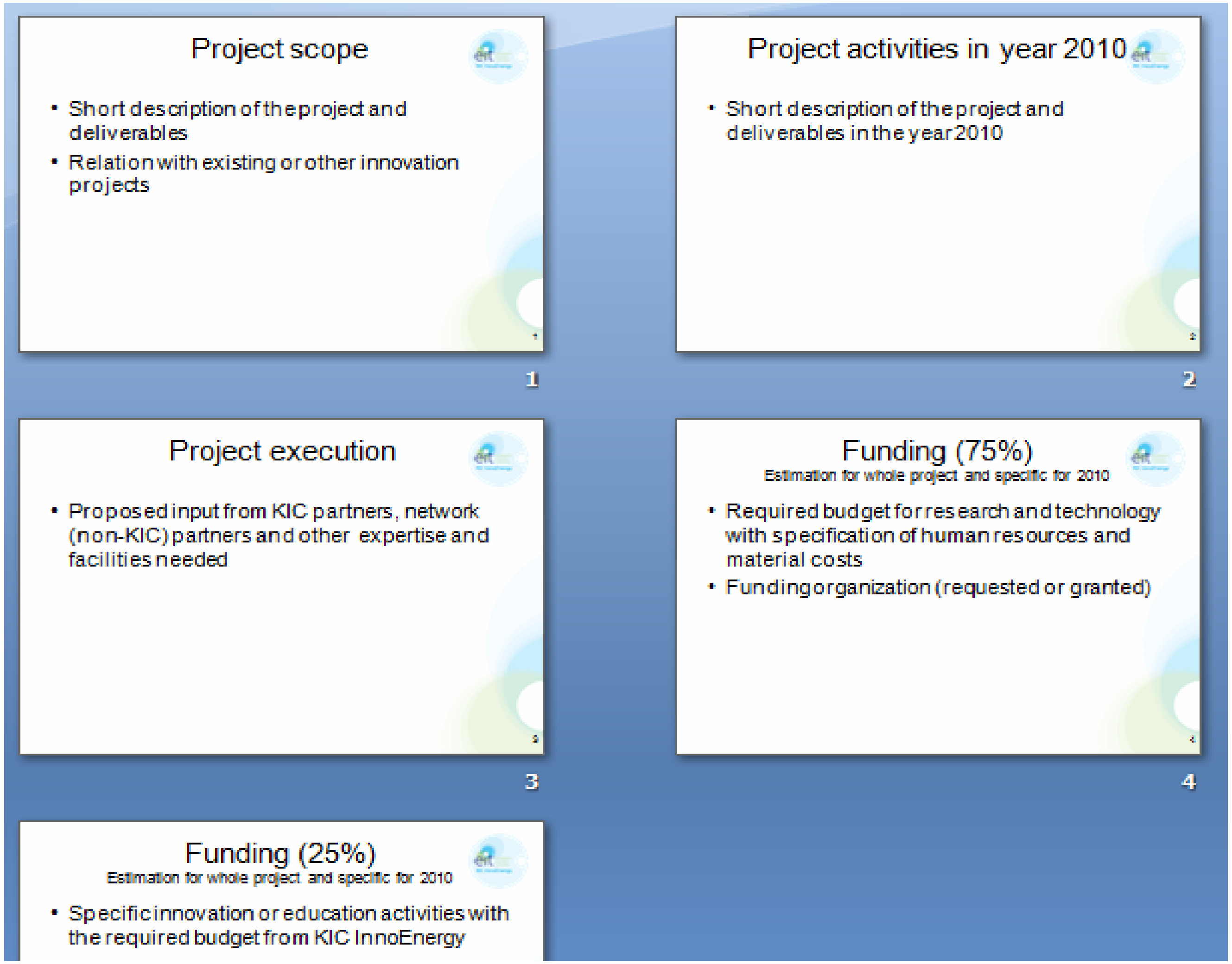
Five slide template

- Scope
- Activites 2010
- Execution, partners
- Funding 75%
- Funding 25% (EIT)



3. Criteria

Step 1: Eligibility criteria (Must-haves)

	Criterion	Yes / No	Comment
1	**Partners:** Involvement of Education, Research and Industry		
2	**Partners:** Minimum of 3 InnoEnergy partners (or Industry KIC level partner) from at least 2 CC		
3	**Transparency** in KIC network		
4	**Duration** 2-4 years		
5	No basic research		
6	Aligned with **SET plan** and **KIC strategy**		
7	**Results** within 1-3 years and easy to assess/with clear contribution to KPI: At least one new product / service or At least one new patent or At least on spin-off / patent transferred to SME **And** At least one scientific publication (after registration of patent)		

3. Criteria
Step 2: Selection - Qualitative criteria

	Criterion	Weighting	Score
1	**Technical criteria / Degree of innovation:** • Level of novelty • Alignmentto InnoEnergy strategy • Level of technical risk	25%	10 Points
2	**Market Criteria:** • Time to market • Obtainment of results (timing) • Specific results detailed in exploitation plan: – Potential to create start-ups or spin-offs – New products – New services – New patents – SME participation	35%	10 Points
3	**Economic Viability** • Total cost of the project • Requested % of EIT contribution • Value for money assessment • Level of financial risks	20%	10 Points
4	**Internal Criteria:** • Number of involved KIC InnoEnergy partners, CCs • High visibility / impact (e.g. large scale demonstration site) • Potential to integrate with Education programmes	20%	10 Points
	Threshold		**30 Points**

Workshop Session

ICT for Smart Grids

- **Group A (Magnus Callavik)**
  - I) Energy Market Design and Customer Interactions
  - II) Power Network Concepts covering Transmission to Distribution
  - VII) Major demonstrations and very large projects
- **Group B (Johan Söderbom)**
  - IV) Smart Grid Components
  - V) Smart Grid Materials Technology (related to III and IV)
  - VI) Migration concepts of existing assets into the smart grid
- **Group C (Kristina Edström)**
  - III) Electric Energy Storage Technologies and Systems

I

Energy Market Design and Customer Interactions

Energy Market Design and Customer Interactions

Electricity market design and the way it is regulated and implemented defines the conditions for economical incentives, innovation space and market actors.

Defintion of Thematic Innovation Project Area:

- Market Design addresses how electricity markets should be designed in an optimal way
- The overall goal is to use resources and investments as efficient as possible
- Conditions required for efficient flow of market signals between different actors.
- Possibilities (legislation, regulation, technical, economical) for consumers and producers to control their equipment based on market signals.

Strategy of Thematic Innovation Project Area:

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Development towards a European common electricity market

- **Based on existing knowledge and facts from the European markets**
- **Establish prerequisites for distributed generation, load management and DSP**
- **Develop models describing:**
  - different markets in Europe
  - market extensions and integration (vertical & horizontal) eg large scale renamables and supergrids
  - market roles
  - actors and their behaviour
- **Study and evaluate models with different market set-ups and from different actors perspectives**
- **Test and evaluate in full-scale experiments**

Current projects and activities:

- Short-term planning of hydro-thermal power systems with large amounts of wind power – new market rules, (contact: Lennart Söder)
- Market regulation impact on distributors interest in power distribution network investment for high reliability, (contact: Lennart Söder)
- Electric cars as a controllable part of the power system, 2010-2014 (contact: Lennart Söder)
- Design and operation of power systems with large amounts of wind power (contact: Lennart Söder)
- INTEGRAL – project (contact: Lars Nordström)
- Project "Gotland" – a source for many different studies (contact: Johan Söderbom)

New projects and activities:

- Investigation of prerequisites for distributed generation, load management and DSP
- Development of models describing different markets in Europe, market extensions (vertical & horizontal) as well as actors and their behavior
- Investigation of the economical potential with a common European electricity market
- Evaluation and comparison of efficiency of market rules such as reserve market, size of balancing areas, imbalance costs, congestion management, etc
- Development of power system models for evaluation of different regulations and set-up of rules concerning grid tariffs, reserve markets, capacity payments etc.
- Large scale integration of renewables
- New market concepts such as virtual power plants and markets for reactive power
- Study if current roles and their scope cover all market needs and perspectives

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II

Power Network Concepts covering Transmission to Distribution

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Power Network Concepts covering Transmission to Distribution

The technical design and controllability of the integrated electrical network energy enable and limit the possibility for an efficient, secure and reliable use of sustainable solutions for the future energy supply.

Defintion of Thematic Innovation Project Area:

- Power Network Concepts address how to design and operate all transmission and distribution networks in an optimal way
- The overall goal is to use resources and investments as efficient as possible
- Controllability is an essential criteria to maintain a voltage profile of the system on all voltage levels
- Power system security and stability is required to avoid wide-spread blackouts.
- Power system reliability should be kept high at a low cost
- Integration of flexibility for uncertain future need of transmission and distribution capacity and controllability

Strategy of Thematic Innovation Project Area:

Development towards an European integrated electricity market

- Efficient methods for transmission expansion between different areas in the system including dimensioning of Supergrids
- Efficient coordinated control and protection system methods for handling of contingencies in large integrated power systems
- Efficient use of modern technologies including FACTS, HVDC, WAMS, PMU etc to improve the overall efficiency.
- Efficient distribution automation for handling of contingencies and islanding
- Efficient integration in distribution systems of DSM and DSP
- Reliability assessment including risks for failure in use of new technology.

Current projects and activities:

KIC InnoEnergy CC Sweden currently has projects on

- Application of HVDC & FACTS devices to power systems
- Impact of large wind parks on the power system dynamics and stability
- Power system operation and dimensioning with large amounts of wind power
- Security-centered coordinated control for efficient use of AC-DC controllable transmission systems
- PMU-signal-based control of Power System Stabilizers (PSSs)
- Transmission system ICT architectures for transmission systems and active distribution

Invitation to new projects and activities:

- Pan-European networks: Super grid topology control & hardware
- The impact of Multi-Terminal HVDC (MTDC) systems on bulk power system stability
- Coordinated control of power electronic based controllable devices
- Simplified models of large scale power systems for fast simulation
- Generic dynamic and steady-state Models including power electronic devices, DC and AC grid.
- DC Grid Protection, fault identification and location philosophies.
- Efficient dimensioning of sub-transmission networks for integration of large amounts of wind power.
- Large-Scale PV-Solar power integration

III

Electric Energy Storage Technologies and Systems

Electric Energy Storage – Vision and Goals

To demonstrate and study large scale storage systems and their interaction with the grid. Focus on life-time, cost, influence of type electric energy generation on storage solution, adding intelligence and controllability for effective storage etc.

This implies studies at the system, component and materials level.

Electric Storage – Some Different Areas

Large Scale Storage Projects with reference to Large Demonstration Projects (Royal Seaport)

- Batteries
- Fuel cells
- Rotating storage
- Porjus – hydropower storage
- Compressed Air/Hydrogen Storage
- Grid: Frequency Regulation, Distributed Storage

Some suggested types of projects for batteries and fuel cells

Large battery and fuel cell systems

- Power-optimized batteries
  - Studies at system level of power optimized Li-ion batteries as a support for integration of intermittent renewable energy sources into the grid.
  - Cost studies.
- Energy-optimized batteries
  - Safer batteries with solid state Li-ion batteries for utility-scale storage
  - Life-time studies of batteries at material-, cell-, pack level and grid integrated batteries.
  - Cost studies.
- Fuel cells
  - Demonstrators. New fuel cell solutions.

Some suggested types of projects for other large scale electric storage

- Rotating storage
  - From prototype fly wheel to test in operation (100 W to 100 MW). New concepts: multi-power systems

- These projects can be tested at Porjus and Royal Seaport
  - intermediate storage solutions (supercaps, batteries, fly wheels etc.)

Workshop C Storage

Work plan:

Gather projects in 4 focus areas

1. Applications
2. Technologies (Challenges, are there really optimal technology)
3. Industry interests (Contributor needs focus area)
4. Ongoing projects (Short starting time to innovation)

The CC's will put their interests in each of the focus areas above. Among these suggested projects will be chosen for EIT

IV

Smart Grid Components

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Defintion of Thematic Innovation Project Area:

- Adding smartness (intelligence and controllability) to power components used in grid connection, transmission and distribution of electrical energy. This may be in the form of added functions to a component or new designs of components.
- The ability to extend the operating limits of components, increasing the robustness, safety and security of the components, environmental-friendly designs, and components with reduced losses and good energy quality are within the area.

Strategy of Thematic Innovation Project Area:

- Online monitoring of power components to diagnose deterioration, to determine real-time failure margins, to achieve dynamic rating, and for decision support mechanism for maintenance and replacement.
- Extremely fast detection of the real-time state of power system for fine control of energy flow and remedial action to rectify incipient problems.
- To increase the controllability of the energy flow, voltage, current, power quality and security of energy flow requires development of:
  - low-loss and fast power electronics that can withstand harsh environments
  - fast and robust power commutation devices contribute to less losses in the grid
  - eextremely fast fault detection and decision making algorithms to reduce stresses in the system, and for less expensive components.
- Improving performance of HVDC and FACTS devices by using emerging communication technology, signal processing and sensor technology
- Sensor technology, electromagnetic, signal and data processing, material knowledge are the useful interdisciplinary areas

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Current projects and activities:

- Electrotechnical Modeling of transformers
- Insulation and cable diagnostics
- Maintenance management
- Multilevel converters
- Monitoring
- Antennas (sensors) and electromagnetics
- HVDC & FACTS

Invitation to new projects and activities:

1. Non-contact voltage and current measurements (electromagnetic field sensors that can be easily deployed online either indoor or outdoor)
2. Develop dielectric response methods for PD diagnostics
3. High-frequency response methods using antennas for transformer on-line diagnostics
4. Natural transients and controlled transients for on-line diagnostics
5. Use on-line monitoring and diagnostics for dynamic rating of components
6. High-frequency transformer models (frequency dependent response) – other power components like capacitors, reactors
7. Fast detection of faults and fast commutation of power
8. Active online estimation and control of Smartgrid devices using natural excitations or small injected signals
9. New converter topologies for high-voltage high-power applications
10. Advanced control methods for high-power converters
11. Use of SiC technology in power converters for high-power applications

Workshop B: Summary of match-making

Area IV Smart Grid Components

General comments

- The area attracted a large interest and there were many universities and companies that had similar activities to those that were suggested in the slides.

Some additional suggestions that fits in the area

- “Custom Power”, Components that enhance the power quality in various locations in the network
- Wireless systems, the communication infrastructure should be regarded as one component in the future network.
- Powerline communication, same argumentation as above.
- Smart Metering

V

Smart Grid Materials Technology

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Definition of Thematic Innovation Project Area:

- Several of the goals for the future smart grid and electric storage are dependent on the development of new materials technologies. Technologies that enable step changes in the development within the area of smart grids and electric storage are defined as the thematic innovation project area. Normally the innovation projects have a longer time line compared to innovation project areas designed to be closer to the market.

Strategy of Thematic Innovation Project Area:

- The project area focuses on materials designed for the future smart grid and storage technologies that facilitates step-changes in performance and life time of components.
- The ability to extend the operating limits of components, increasing the robustness and security of the components, environmental-friendly designs, and components with reduced losses and good energy quality can be targeted via focused innovation projects within the materials technology area.

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Current projects and activitie:

- Contact materials
- Coatings (new materials and synthesis methods for functional coatings)
- Polymer based nanocomposites
- Materials for electronic components
- Modelling of materials
- Silicon Carbide
- Electromagnetic Compatibility
- Advanced Materials Characterisation

Invitation to new projects and activities:

Nanocomposite dielectric material characterisation and modelling and functional dielectric materials

Charge transport in solids and surfaces

New contact materials with high wear resistance combined with extremely low contact resistance

Anisotropic materials

Multilayer & composites insulation & Thermoplastics

Workshop B
Summary of match-making
Area V Smart Grid Materials

General comments

- This is an enabling technology that will probably result in longer projects.
- It is necessary to coordinate with the area of Electric energy storage
- Comments on being a separate area: in CIGRÉ the subject is treated in a specific sub committee, however so is also ICT

Specific comments on project areas

- Use of alternative insulation media (oils, SF6 etc)
- High temperature superconducting materials
- Material for “high temperature” components (example OH lines)

VI

Migration concepts of existing assets into the smart grid

Migration concepts of existing assets into the smart grid

The existing assets base in the distribution network is huge and will not be replaced prematurely in its entirety for technical nor economical reasons. Hence migration will foremost take place as added components, communication abilities, software upgrade, and management tools.

Defintion of Thematic Innovation Project Area:

- The majority of existing assets have a too high value to be exchanged.
- The smart grid will be an evolution not a revolution.
- New technology will be added to the old technologies.
- New information technology is opening new possibilities to enhance functionality/smartness.
- More information of the networks opens new opportunities to enhance functionality.
- Most cost effective solutions will be gradual enhancement in most cases.
- Today