Smart Grids and Energy Markets (SGEM) program building Finnish Smart Grid 2.0

ETSI Smart Grids Workshop
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Nokia Siemens Networks

Story

Driven by a eDream
CLEEN vehicle
SGEM drives change
Finnish Smart grid 1.0
SGEM Smart Grid 2.0
Proven assets
Building windmills & bridges
SGEM driven by a eDream

It’s easy in my everyday life to manage my zero emission living and energy use with innovative services from my energy suppliers.

I comfortably continue my daily activities requiring energy in spite of possible short problems in the electricity grid.

I trust my energy suppliers who guarantee electricity with reasonable price without any surprises.

It was ‘plug and play’ to set up my own small scale energy production. Contracts with market players enable me to buy and sell from the energy market and every now and then will deliver surplus of energy to my friends and neighborhood.

Some of my friends live in the energy independent societies without connection to the centralized energy system.

I know people around me working in start ups and SMEs complementing basic electricity infrastructure system by offering me innovative services and application for easier, more comfortable and sustainable living in a cost efficient way.

I have EV and it’s easy and convenient to use it in my home country and abroad in Europe.

I trust the energy system. I know it to be reliable, secure and keeps my privacy.

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CLEEN - The vehicle for SGEM
Centre for Strategic Science, Technology and Innovation (CSTI)


Funded by partners and the Finnish Funding Agency for Technology and Innovation (Tekes)

Unique in it’s way of serving 28 industry and 16 research shareholders by driving

• Renewal
• Novel co-operation across industries
• Strategic focus
• Industry’s Commitment and Guidance
• World class competence and resources
SGEM focus on energy sector transformations

**SMART CUSTOMER**
- Enabling Active Consumers
- Improving System Reliability
- Facilitating Active Resources
- Enabling real time energy markets

**SMART GRID**
- Energy efficient industry
- Smart meters
- Smart house
- Plug-in vehicles
- Distributed generation

**SGEM - Changing the way we do business**

<table>
<thead>
<tr>
<th>POWER &quot;ELECTIONS&quot;</th>
<th>INFORMATION &quot;BYTES&quot;</th>
<th>MONEY &quot;DIGILABIS&quot;</th>
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<tbody>
<tr>
<td><strong>TODAY'S GRID</strong></td>
<td></td>
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<td>Producer(s)</td>
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<td><strong>A SMART GRID</strong></td>
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<tr>
<td>Producer(s)</td>
<td>Demand response</td>
<td>Producer(s)</td>
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<td>Consumer</td>
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Utilities and ICT infrastructures have high similarity in future challenges

- Reducing complexity & controlling cost
- Establishing sustainable role in the ecosystem
- Managing the traffic explosion
- Driving efficiency and environmental sustainability
- Keeping today’s customers & adding value

From network efficiency to customer experience

Efficiency | Experience
--- | ---
Service | Customer Experience
Network | Extreme Network Efficiency

Consumers will decide who gets the “business” based on the user experience - They don’t care how smart are the grids!
It’s not about towers but bridges

Multi-dimensional connectivity challenge call for effective cross industry collaboration to meet scale, cost and fast-to-market targets

Burning platform
The smartness gap to cross
SGEM key imperatives & facts

Key Imperatives
• Create **Innovation foundation** to enable the Smart Grids eDream
• Build **internationally applicable** solutions
• **Validate** in real environment
• Ensure **competence** accumulation in research and business
• Utilize **interactive** international research environment

Facts
• Focus on power **distribution** and **interfaces**
• The program consists of 7 interlinked work packages and spearhead demo projects.
• **Industry** make up 56% of the volume. 19 industry & 8 research partners.
• **ICT** companies contribute 29%
• 5 year program, 55 M€ budget.
• **CLEEN** CSTI (Centre for Strategic Science, Technology and Innovation) program with **Tekes** public funding.

Phased **evolution** approach build on Finnish Smart Grid 1.0

**Overall Drivers**
- Minimizing CO₂ emissions
- Energy Efficiency
- Grid Reliability
- Activated role of small customers

**Phase 1**
- **2009**
  - Change Drivers in Business
  - New active resources
  - Enabling technologies

**Phase 2**
- New Grid Architecture
- New Grid solutions
- Demonstrations

**Phase 3**
- 2011
  - New Energy Markets on SG
  - Smart Customer Interfaces
  - Safe operation of SG

**Phase 4**
- New ICT & Automation
- New ways of planning grids
- New Business Opportunities

**Phase 5**
- Next generation of management systems
Finnish Smart Grids 1.0 milestones

- SCADA systems 1970
- Tariff control through PLC 1975
- Network information systems 1970’s
- Remote controlled disconnector stations 1982
- Microprocessor based relays 1982
- 1. generation AMR-systems 1980’s
- Distribution management system 1992
  - Fault analysis, automated fault location of MV-feeder stations
  - Real state network monitoring
- Open energy market 1995
- Electricity stock 1998
- 2. generation AMR-systems 2000’s
- Market for service providers, 2000’s
- 20/1/0.4 kV distribution systems, 2003
- Outage costs as a part of economic regulation of DSO’s, 2008 (CENS value 11 €/kWh and 1.1 €/kW for reclosings)
- Real time indication of LV-faults, 2008
- Real-time billing 2010
- LVDC (± 750 DC, active voltage control) distribution systems 2010
- Interactive customer interface pilots 2010
- Full scale (all customers) AMR-system 2013 (kWh, power quality, voltage quality)

Distribution management system widely used at Finnish DSOs

- PC-workstations
- DMS
- SCADA
- LAN
- WAN
- Data bases
  - network data
  - customer data
  - load models
  - maps
- communications
- remote use
- customers
- field crew
- GPS
- substations
- equipment
- distribution network
IT- solutions for fault location in use down to distribution networks

Results

Average outage time of customer in one Finnish distribution company

1.0 IT- solutions for fault location in use down to distribution networks

AMR works for distribution network management

AMR system is used as an extension of SCADA and DMS for controlling and monitoring also the fuse protected networks, especially LV-networks
Demonstrating Smart Grid 2.0 in real life grids

Key Imperatives
1. Enabling Active Consumers
2. Improving System Reliability
3. Facilitating Active Resources
4. Real time energy markets

SGEM takes **Systemic** approach across domains

Utilities operating on deregulated market
Leading ICT industry
Wide research Co-operation
Leading Energy Technology Providers

1. Empowering Active Consumers

Think Customers Not Meters and Create Valuable Information from Data
2. Improving System Reliability

- Active, self-healing networks
- Intended islanding
- Real-time condition management
- Smart HV grids
- DC distribution
- Improved planning and design
- Cabling
- Nanotechnology, MEMS

3. Facilitating Active Resources

- Virtual power plants
- Aggregator business models
- Active customer models
- Local production
- Electric vehicles
- Storages
- Controllable loads
- Demand side management
4. Demonstrating in real life grid

Elements of a carbon neutral power system
- Distributed renewable generation and market based demand response
- eMobility
- Energy efficient buildings and energy systems of the buildings adapting to the needs of the inhabitants

Fault tolerant power grids
- Self-healing concept by a high level of grid automation
- Island mode operation of the distribution grid and distributed energy storages

New end customer services
- New services for eMobility
- New market based energy services
- VPP concepts including solar, wind and demand response
- Energy storages

Implementation
- 2010 Planning
- 2011 Concepting
- 2012 Implementation

Utilization of existing assets
speed up development and reduce cost

Enterprise integration
Smart objects service enablement
Smart objects connectivity

Service enablement
Object management
Managed connectivity
Data management
Charging & Billing
Energy
Transport
Home
Security
Payment
Health

Smart services enabled by smart objects
Managed connectivity
Smart transport
Smart traffic
E-Mobility
Smart metering
Windmills get Smart trial makes renewable generation affordable thru smart network management

Solution helps operators to
- Maximize energy production
- Reduce operating costs
- Enhance production planning accuracy

Fully utilizing proven Telco assets
- A common multi technology and multi vendor management system
- Fast time to market by decoupling integrations from applications
- In-built scalability and high availability
- Reduced risk with open mainstream IT technologies

Telco Energy Metering
Demonstration of rating & billing functionality

1. Notifications
2. Invoice
3. Portal
EMO - Enables customer friendly and flexible electric vehicle user experience

eMobility fully utilizing Telco assets

Charging Station
Communication Network
Charging Service backend (Database, IDM, Rating / Billing …)

Smart Grid

SGEM Field force optimization across utilities - New business model and cloud service

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Expanding Telco Site Management Capabilities to Micro Grids

Current NetAct scope
- NetAct Unify (OES based)
- PM/FM data
- Telco equipment

Mediation Framework
- Site equipment integration
- Very basic CM
- Site controller
- Solar, wind
- Other sources
- O&M agent
- Telco equipment content pack
- Telco equipment

Total Site Management for telco

Micro-grid management for energy

And lessons learned
Once upon a time Telecoms were...

Don’t try to own, control or manage your customers
Don’t try to plan how customers will use smart grid
All the bits either electrons aren’t equal and customers are different
It’s not about towers but bridges
It’s not about technology but your business case, operations and customer engagement
It’s not about meters or the smart grid – enablers or platform to springboard innovations
When it moves, it moves quickly!

1980  2010
Conclusions

CLEEN SGEM consortium fully leverage Finnish core assets in Smart Grid 1.0 and ICT in making 2.0 happen.

Smart Grid applications will increasingly need a) data communication and collection capabilities and b) data analysis applications and solutions to utilize the data.

Multi-dimensional connectivity challenge call for effective cross industry collaboration to meet scale, cost and fast-to-market targets.

Networks of the future will combine high efficiency with individual experience - Consumer / prosumer will decide who gets the "business".

Leveraging proven solutions will shorten time-to-market, minimize technology risks, maximize revenues and reduce cost of ownership.

Standardization helps creating healthy and sizeable ecosystem. Many ICT success stories rely on standards, either defacto or community created.

There are significant opportunities for new business and consumer services in Smart Grid - Innovation is required to introduce these to people.

“When the wind of change blows, some people build walls, others build windmills.”

Old Chinese proverb
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4. Tampere Uni of Tech
5. Uni of Eastern Finland
6. Uni of Oulu
7. Uni of Vaasa
8. VTT, Technical Research Centre of Finland

TSO and DSOs
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2. Fortum
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4. Suur-Savon Sähkö
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2. Elektrobit
3. Emtele
4. Nokia Siemens Networks
5. Techtronica
6. There Corporation
7. Viola Systems

Energy Technology Industry
1. ABB
2. Aidon
3. Alstom Grid
4. Empower
5. Tekla
6. The Switch

R&D Cooperation – not commercial consortium
Joint sharing of Full Access Rights to all results
High level of publicity
SGEM Work Packages

WP1: Drivers and visions
3 tasks
- Electricity from society’s point of view
- Migration scenarios towards future Smart Grids,
- Industry landscape, standardization

WP2: MV+LV networks, 6 tasks
- Strategic planning
- Large scale cabling
- Phase earthing systems
- LVDC networks

WP3: HV networks, 5 tasks
- Utilizing increased controllability for balancing the power system
- Regional subtransmission networks
- Interconnection of large-scale wind power in HV networks
- FACTS devices, Wide area monitoring and control systems

WP4: Active Customer
8 tasks
- Behavior of active customers, trust and privacy
- Estimation of loads, DG and storage, DR potential
- Smart control of active resources
- DER aggregator’s optimization
- Customer gateway, ICT architectures

WP5, Active resources
3 tasks;
- Distributed generation
- Electrical vehicles
- Energy storages

WP6: Intelligent management and operation of Smart Grids
13 tasks
- New ICT in network management, information security
- New substation and measurement technology
- Protection schemes, active network management, microgrids
- Disturbance and field force management, self-healing networks
- Network analysis and planning methods, proactive monitoring

WP7: Energy markets
5 tasks
- Business impacts and models for DSO and retailers
- Integrated European market
- Opportunities and models for different market players
- Optimal deployment of smart resources
- Functioning of the electricity markets in different countries

WP8: Intelligent management and operation, 13 tasks
- New ICT in network management, information security
- New substation and measurement technology
- Protection schemes, active network management, microgrids
- Disturbance and field force management, self-healing networks
- Network analysis and planning methods, proactive monitoring

WP9: Drivers and visions
3 tasks
- Electricity from society’s point of view
- Migration scenarios towards future Smart Grids,
- Industry landscape, standardization

WP10: Active resources
3 tasks;
- Distributed generation
- Electrical vehicles
- Energy storages

WP11: HV networks, 5 tasks
- Utilizing increased controllability for balancing the power system
- Regional subtransmission networks
- Interconnection of large-scale wind power in HV networks
- FACTS devices, Wide area monitoring and control systems