Load Management with Demand-Side Management, an overview.

IEA Demand Side Management Task XVI Competitive Energy Services (Energy-Contracting, ESCo Services) & Task XVII Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages

Rob Kool
Chair IA DSM/EGRD, Manager NL Agency
This presentation

• Technology Implementing Agreements
• “World” of IA Demand Side Management & Strategy
• The simple problem
• The more complex reality
• Load Management: Present work & some results
  • Esco’s
  • Integration of DSM
• Summary
• Q&A
IEA & Electricity: Technology Implementing Agreements

- Energy End-Use party
  - Electricity Workinggroup “coordinates”
    - Enard (Electricity Networks Analysis, Research & Development)
    - ISGAN (International Smart Grid Action Network)
    - DSM (Demand Side Management)
      - Load Shape Cluster
      - Load Level Cluster
    - Wind
    - Hydrogen
    - High-Temperature Superconductivity (HTS) on the Electric Power Sector
    - Hybrid and Electric Vehicles
The strategy of the IEA DSM Programme

• Vision: Demand side activities should be the first choice in all energy policy decisions designed to create more reliable and more sustainable energy systems.

• Mission: To deliver to our stakeholders useful information and effective guidance for crafting and implementing DSM policies and measures, along with the necessary technologies and applications, which together can transform markets and facilitate energy system operations.
The simple problem: The issues!

• Load level
  • a wasteful demand requires too much supply for the specific needs
    (*The customer do not need energy! They need the service that
    energy, combined with an installation, provides*)

• Load shape
  • high peaks,
  • little reserve capacity,
  • bottlenecks in transmission and distribution

• Market responsibilities
  • who is the owner of the problem?
Source for GHG reductions till 2030

Source: IEA WEO 2009
Efficiency is under-utilized, since...

Result = Potential * Acceptance

And make this more affordable

Acceptance is needed to release this Potential

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*Efficiency is under-utilized, since... Result = Potential * Acceptance*

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**Exhibit 1**

*Global GHG abatement cost curve beyond business-as-usual – 2030*

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €100 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0
Load shape, simplified “Start of DSM”

Figure 1: Load Shape changes. (Adapted from Clark Gellings, speech made 1982)\(^5\)

Table 1: Comparison between The IEA DSM-Programme tasks and the application “Load Management”\(^6\)

<table>
<thead>
<tr>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
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<th>XI</th>
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| Current task |
| Completed task |
| Most relevant for this application |
Solution, over simplified

• Day – Night Tariff
• Real Time Pricing
• Shut down distribution

The more complex reality...
The more complex reality: Load shape on national level

Figure: Demand and generation geographical distribution in Spain
The more complex reality: Load shape in Time

Figure 11: Demand peaks in Spain in 2005-2007

All these challenges create opportunities for the development of DG, RES and DR/DSM.
The more complex reality
Annex 7: Country report of USA

<table>
<thead>
<tr>
<th>2006</th>
<th>Changing Supply Mix</th>
<th>2035</th>
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</thead>
<tbody>
<tr>
<td>1% renewable</td>
<td>Requires increased margins</td>
<td>20% renewable</td>
</tr>
<tr>
<td>20% nuclear</td>
<td>Requires additional transmission</td>
<td>40% nuclear</td>
</tr>
<tr>
<td>30% natural gas</td>
<td>Requires control/communications</td>
<td>10-20% natural gas</td>
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<tr>
<td>49% coal</td>
<td></td>
<td>20-30% clean coal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demand Transformation</th>
<th>50% Demand growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanding Digital Economy</td>
<td>Load curves - increased peaking</td>
</tr>
<tr>
<td>Power quality needs</td>
<td>Plug-in hybrids (26% increase demand)</td>
</tr>
<tr>
<td>Demand growth</td>
<td>More electrically sensitive equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complexity of Grid</th>
<th>Nodes within control area increase 5-10x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanding footprint, overlay of markets, operating “closer to the edge”</td>
<td>Energy Mgt Systems (70%)</td>
</tr>
<tr>
<td></td>
<td>Additional 30,000 miles needed</td>
</tr>
<tr>
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<td>~ 22 million DG units (2.5x increase)</td>
</tr>
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</table>

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<tr>
<th>Vulnerability of Energy Infrastructure</th>
<th>Infrastructure protection</th>
</tr>
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<tbody>
<tr>
<td>Interdependencies of electric and energy systems</td>
<td>Increased globalization</td>
</tr>
<tr>
<td></td>
<td>Materials and resource limitations</td>
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<tr>
<td></td>
<td>All-hazard risks will continue to increase</td>
</tr>
</tbody>
</table>

1,000 GW capacity
Hybrids, No PHEVs
Electrically-sensitive equipment (8 hrs/yr)

140 control areas
Energy Mgt Systems (<1%)
180,000 miles wires
~10 million DG units

Blackouts
Aging Infrastructure
Vulnerability of assets
The more complex reality: Stakeholders

Korean Electric Market Structure

- **GENCO**
- **IPP**
- **KPX (Electricity Markets)**
- **KEPCO (T&D, Sale)**
- **District Supplying Company**
- **PPA Company**
- **Customers**
- **Large Consumers**

*PPA: Power Purchase Agreement

Electricity Flow and Sale

July 6, 2011
Workshop Johannesbrug: IEA Demand Side Management
So demand side management is complex

- Energy mix
- Design / age net
- Demand in time (sec. Min. Hour. Day etc...)
- Development of / Stakeholders in the energy market

- .....Every country is unique
So demand side management is complex.
Load Management: Present work & some results

**TECHNOLOGIES**
- Electric Vehicles PEV/PHEV
- Heatpumps / Cooling
- PV (residential)
- μCHP (residential)
- Thermal energy storage
- Electric energy storage
- Other emerging Technologies

**EFFECTS**
- Quantitative & country specific
- Power System & stakeholders

**STAKEHOLDERS**
- Customers
- Retailers
- DSO
- TSO/ISO
- Aggregators
- Other service providers (ESCOs)
- Regulators, energy agencies, governmental agencies

**BENEFITS**

**COSTS**

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Esco’s (1/3)

Energy-Contracting: Components of service package and outsourcing of interfaces and guarantees to an ESCo

- **Know-How**
  - Engineers, architects, consultants, innovation...

- **Technology**
  - Suppliers, construction, operation & maintenance...

- **Energy**
  - Gas, fuel oil, solar, woodchips...

- **Money**
  - Equity capital, banks, TPF, subsidies...

- **Legislation**
  - Laws, procurement, technical rules...

- ESCo Client

  - Supply (MWh) or Savings (NWh) incl. function, performance + price guarantees

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Esco’s (2/3): Lessons learned

• Successful market development was demand side driven, meaning ESCo customers defined their needs and goals for energy service packages and put out request for proposals on the market.

• To foster market development, the role of independent market facilitators as mediators between ESCOs and their (potential) clients has proved to be of great value.

• Financing is not necessarily the core business of ESCOs. Their core competence lies in technical, economic, and organizational matters. ESCOs should serve as finance vehicle, not necessarily as financiers.
Esco’s (3/3): Lessons learned

• Energy-Contracting is a flexible and modular energy service package. This also implies the ESCo customer may define – depending on his or her own resources – what components of the energy service will be outsourced and which components he carries out himself.

• Energy efficiency improvements are not the driving force for many of the projects but rather a (beneficial) side effect.

• It is important to optimize investment decisions according to project (or better life) cycle cost and to ensure the results of the energy efficiency measures on a long-term basis.
## Change Agents (companies, intermediaries, catalysts)

<table>
<thead>
<tr>
<th>DSM-concept</th>
<th>Change agent role</th>
<th>Example</th>
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<tbody>
<tr>
<td><strong>Classic (addressing utilities as they are)</strong></td>
<td>Monopolised markets</td>
<td>Paradip Port (India)</td>
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<tr>
<td></td>
<td>Customer aggregation</td>
<td>Public Benefit Charges (USA)</td>
</tr>
<tr>
<td>Liberalised markets</td>
<td>Mandate utilities to achieve a set level of energy efficiency</td>
<td>White Certificates (Italy and some Australian states) and EE Commitment (UK)</td>
</tr>
<tr>
<td>Incentivising utilities to deliver energy efficiency</td>
<td>Decouple profit from sales volume</td>
<td>California Investor-owned Utilities</td>
</tr>
<tr>
<td>Energy Efficiency Power Station</td>
<td>Aggregate energy efficiency projects to the scale of a virtual power plant</td>
<td>Jiangsu, Shanghai and Guangdong (China) Efficiency Vermont</td>
</tr>
<tr>
<td>Government Deployment schemes</td>
<td>Aggregation of purchasing power</td>
<td>FEMP (USA), Technology procurement (Sweden)</td>
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</tbody>
</table>

**Note:**
- **DSM Concept:** Change agent role that can be classified into Classic (addressing utilities as they are) and Liberalised markets.
- **Monopolised markets:** Change agent role of delivering products and services.
- **Customer aggregation:** Change agent role of fundraising.
- **Liberalised markets:** Change agent role of mandating utilities to achieve a set level of energy efficiency.
- **Incentivising utilities to deliver energy efficiency:** Change agent role of decoupling profit from sales volume.
- **Energy Efficiency Power Station:** Change agent role of aggregating energy efficiency projects to the scale of a virtual power plant.
- **Government Deployment schemes:** Change agent role of aggregation of purchasing power.
New Technologies

- More ICT
- New (smaller) generation units
- New applications

Source: An EPRI Initiative to Advance the Efficient and Effective Use of Energy
Figure 3. Impact of a smart grid on the need for energy system capacity. Two basic alternatives for the future electric systems: “Fit and forget” and “Integrated DG&DSM/DR” (Distributed Generation, Demand Side Management/Demand Response.
Links:


• [www.ieadsm.org](http://www.ieadsm.org)
Thank you!

Q&A?
### Past, Present and Future Tasks

#### Past, Present and Future IEA DSM Programme tasks

Further information on the activities can be found at [www.ieadsm.org](http://www.ieadsm.org).

<table>
<thead>
<tr>
<th>Status of Task</th>
<th>Peak Load</th>
<th>Load Level</th>
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</table>
| Completed      | Task II: Communications Technologies for Demand-Side Management  
Task VIII: [Demand-Side Bidding in a Competitive Electricity Market](#)  
Task XI: Time of Use Pricing and Energy Use for Demand Management Delivery  
Task XIII: Demand Response Resources  
Task XV: Network-driven DSM | Task I: Subtask 9 – Evaluation Guidebook on the impact of DSM and Energy Efficiency Programmes  
Task III: Technology procurement  
Task V: Marketing of Energy Efficiency  
Task VI: Mechanisms for Promoting DSM and Energy Efficiency in Changing Electricity Businesses  
Task VII: Market Transformation  
Task IX: The Role of Municipalities in a Liberalised System  
Task X: [Performance Contracting](#)  
Task XIV: Market Mechanisms for White Certificates Trading |
| Current        | Task XVII: Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources  
Task XIX: Micro Demand Response and Energy Saving  
Task XXIII: Role of the Demand Side in delivering effective smart grids | Task XVI: Competitive Energy Services  
Task XVIII: Demand Side Management and Climate Change  
Task XX: Branding of Energy Efficiency  
Task XXI: Standardisation of Energy Efficiency Calculations  
Task XXII: Energy Efficiency Portfolio Standards  
Task XXIII: DSM University  
Task XXIV: DSM from theory to practices |
| Proposed       |           |            |
Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages

• study how to achieve the optimal integration of flexible demand with Distributed Generation, energy storages and Smart Grids,

• increase the value of Demand Response, Demand Side Management and Distributed Generation

• decrease problems caused by intermittent distributed generation (mainly based on RES) in the physical electricity systems and at the electricity market

• provide integration based solutions and examples on successful best practices to the problems defined above.
Assessment the effects of the penetration of emerging DER technologies to different stakeholders and to the whole electricity system

The emerging DER technologies in Task XVII discussed include:

- plug-in electric and hybrid electric vehicles (PEV/PHEV)
- different types of heat pumps for heating and cooling
- photovoltaic at customer premises
- micro-CHP at customer premises
- energy storages (thermal/electricity) in the connection of previous technologies
- Other technologies seen feasible in 10 – 20 years period
  - Smart metering,
  - emerging ICT
  - (and perhaps wind power at customer premises).