DSM in the 21st century
-
Large scale deployment of smart applications

Hans Nilsson
"Chairman Emeritus” of the
IEA DSM-Programme
Efficiency is under-utilized, since...

... Result = Potential * Acceptance

And make this more affordable

Acceptance is needed to release this Potential
Where we are heading

Coming up?

Required!

PROFITABLE!

Energy savings in 2035

<table>
<thead>
<tr>
<th>Energy savings</th>
<th>CPS to NPS</th>
<th>NPS to 450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency in end-uses</td>
<td>67%</td>
<td>66%</td>
</tr>
<tr>
<td>Efficiency in energy supply</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>Fuel and technology switching</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>Activity</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Total (Mtoe)</strong></td>
<td><strong>1 479</strong></td>
<td><strong>2 404</strong></td>
</tr>
</tbody>
</table>

Note: CPS = Current Policies Scenario;
NPS = New Policies Scenario;
450 = 450 Scenario.
WEO 2012
(six steps to energy efficiency)

- Visible
- Priority
- Affordability
- Normal
- Real
- Realisable
What is holding us back?

Energy Efficiency is not a Product, but a characteristic with a product.
A changing framework
Source for GHG reductions till 2030

Source: IEA WEO 2009
New Technologies

Source: An EPRI Initiative to Advance the Efficient and Effective Use of Energy
Difference in Electricity Investment in the Alternative vs. Reference Scenario 2003-2030

Additional investments on the demand side are more than offset by lower investment on the supply side.

Source: WEO 2004
Figure 10.10 - Change in investment across the electricity value chain in the Efficient World Scenario, compared with the New Policies Scenario, 2012-2035

- Additional investment due to:
  - End-uses
  - More efficient power plants

- Lower investment due to:
  - Lower demand

- Net change
Perspectives on the market

Standard (Neo)-classical model
ECONS

• Preferences are constant
• The prices contain the necessary information
• Customers have access to all necessary information on performance and prices

Behavioural economics model
HUMANS

• Preferences are changing
• Decisions are biased by the way we are treating information
• Offers need to be designed (choice architecture)

Good model to estimate the potential

Necessary to decide on policies for implementation
What is this thing they call DSM?
DSM is more than meets the eye

• DSM is universal and does not only apply to utilities, electricity or monopolies
• DSM encompasses the entire range of management functions (planning, evaluation, implementation and monitoring)
• DSM = Large-Scale Deployment of Energy Efficient Equipment by use of specially designed Programmes
The issues!

• Load level
  – a wasteful demand requires too much supply for the specific needs *(The customer do not need energy! He needs 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?
The imperative logic of Demand Side Management

• A better use of resources equals lower cost for service
• A balanced use of resources means more secure and reliable energy supply
• An expansion for products/services using less energy is an injection for future business
• A step change in improved energy efficiency is the only way to achieve wide-spread welfare without resources depletion
IEA Implementing Agreements

Hardware, Technology

Compatibility Applications

Software,
• "Policy"
• Behaviour
• Incentives
• Regulation
• Business

ISGAN, 4E, ECBCS, SHC, etc.

DSM
The Mechanics of DSM
DSM can change the LOAD LEVEL

- **Strategic growth**
  - From this
  - To This

- **Strategic Saving**
  - Adapts the system to the environmental requirements
  - From “carbon-fat” to carbon-lean
  - Or to this
DSM can change the LOAD LEVEL

Strategic growth

From this

Strategic Saving

Adapts the system to the environmental requirements

From “carbon-fat” to carbon-lean

Or to this

To This

Or to this

From this

?
DSM can Change the LOAD SHAPE

Adapts the load to the capacity of the system

<table>
<thead>
<tr>
<th>Winter Day</th>
<th>Summer Night</th>
<th>Winter or Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>After</td>
<td></td>
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</tbody>
</table>
DSM can Change the LOAD SHAPE

Adapts the load to the capacity of the system

Winter Day    Summer Night    Winter or Day
## Past, Present and Future Tasks

<table>
<thead>
<tr>
<th>Status of Task</th>
<th>Peak Load</th>
<th>Load Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Past, Present and Future IEA DSM-Programme tasks</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</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: 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 in Changing Electricity Businesses  
Task VII: Market Transformation  
Task IX: 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 XXIV: Behaviour change in DSM, from theory to policies and practice | |
| Proposed | - DSM University - DSM importance for TSOs | |
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.
Large-Scale Deployment
Use all the tools

LARGE-SCALE ENERGY EFFICIENCY

“Mandating”
- Standards 
  - e.g. MEPS; Top-runner
- Agreed actions 
  - e.g. Voluntary Agreements; Technology Procurements

“Market” Acceptance
- Delegated 
  - “Commoditise” for Non Price-responsive
    - e.g. ESCO; Labels
- Commitments 
  - e.g. White Certificates

Price-responsive customers
- e.g. Taxes; DR (elasticity)

Use all the tools
<table>
<thead>
<tr>
<th>DSM-concept</th>
<th>Change agent role</th>
<th>Example</th>
</tr>
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<tbody>
<tr>
<td>Classic (addressing utilities as they are)</td>
<td>Monopolised markets</td>
<td>Deliver products and services</td>
</tr>
<tr>
<td></td>
<td>Customer aggregation</td>
<td>Fundraising</td>
</tr>
<tr>
<td></td>
<td>Liberalised markets</td>
<td>Mandate utilities to achieve a set level of energy efficiency</td>
</tr>
<tr>
<td>Incentivising utilities to deliver energy efficiency</td>
<td></td>
<td>Decouple profit from sales volume</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>
</tr>
</tbody>
</table>
New concerns on the agenda

- **Environment and Climate** (codified in the Kyoto-Agreement)
- **Governance** (who has the responsibility?)
- Can we make business out of these concerns? (ESCOs, emissions trading)
- **Systems reliability** (e.g. black outs)
- **Customer market role** (price taker or player)
And in the future...?

- DSM is changing and may take into account supply (distributed generation)
- DSM has an impact on security of supply, diversification and systems reliability that has to be quantified and recognised
- DSM might be more business oriented with new actors
- The IEA DSM-Programme will be “the best show in town” for those who want to stay in the forefront.
But someone has to organise the DSM!

And then use the market to have energy efficiency delivered...
http://ieadsm.org

The centre of DSM excellence
Extra material
Horses for courses.

<table>
<thead>
<tr>
<th>APPROACH</th>
<th>TYPE</th>
<th>EXAMPLE</th>
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<tbody>
<tr>
<td>Mandated</td>
<td>Standards</td>
<td>☑ Minimum performance (MEPS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Top-runner standard</td>
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<tr>
<td>“Agreed Actions”</td>
<td></td>
<td>☑ Voluntary Agreements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Technology Procurements (III)</td>
</tr>
<tr>
<td>Delegated Actions</td>
<td>By actor</td>
<td>☑ Regional bodies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Municipalities (IX)</td>
</tr>
<tr>
<td></td>
<td>By Means</td>
<td>☑ Commitments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Certificates (XIV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Portfolios (XXII)</td>
</tr>
<tr>
<td>Market Acceptance</td>
<td>Price-responsive customers</td>
<td>☑ Taxes; Tax reduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Price elasticity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Demand Response) (II, VIII, XI, XIII, XIX)</td>
</tr>
<tr>
<td></td>
<td>Non-price responsive customers</td>
<td>☑ Energy Services, ESCO (X, XVI)</td>
</tr>
<tr>
<td></td>
<td>“Commoditising” energy efficiency</td>
<td>☑ Labels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Branding (XX)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☑ Market transformation (V, VII)</td>
</tr>
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</table>
Means for accelerated diffusion

- Technology Procurements, Demonstration
- Feed-in tariffs, Certificates, Campaigns
- Labelling, Training
- Comprehensive adaptable strategies
- Diffusion curve

Joint Research on Technologies, Market response
(result = Potential * Acceptance)
Towards a robust Sustainability

<table>
<thead>
<tr>
<th>End-Use of Energy</th>
<th>Supply</th>
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<tbody>
<tr>
<td>High Efficiency (Low Intensity)</td>
<td>High density, (Low availability)</td>
</tr>
<tr>
<td>e.g. CFL and LED lighting; Adjustable speed drives</td>
<td>(e.g. fossil, nuclear)</td>
</tr>
<tr>
<td>Low Efficiency (High Intensity)</td>
<td>Low density, (High availability)</td>
</tr>
<tr>
<td>e.g. Incandescent lamps, Direct electrical heating</td>
<td>(e.g. solar, wind, bio)</td>
</tr>
</tbody>
</table>

Legend:

- UNECONOMICAL
- SUSTAINABLE
- PRESENT SYSTEM
- HARDLY FEASIBLE
The Learning Curve

Cost

-20%

(times 2)

Old technology

New technology

1 2

Accumulated Volume
And the learning investments

Cost

Volume

Learning investments

...and profit

Existing technology

New Technology
Tracked learning for PV

PV Power Modules 1976-2001

(GHOTEX data from Strategies Unlimited)

$\rightarrow$ Technology Learning System

Learning Rate: 20%

Global Average Price (USD/(2001)/Wp)

Cumulative Global Shipments (MWp)

Oil crises
Solar vision Growth 84%

Commercial off-grid Growth 12%

"Roof-top" programmes Growth 35%

Source: Professor C-O Wene
Market Transformation

Market Penetration

Base case

Preferred Case

Aggregated proc. (AP) & Labels White Cert.

Standards & Directives

Technology Procurement (TP)

Product Performance
Winning < Loosing.

Prospect Theory

Subjective Value

The subjective value curve is sharply kinked at the reference point.

LOSSES

GAINS

The curve for losses is steeper than the curve for gains by a factor of $2 - 2.5$: people are LOSS AVERSE.
Choice architecture

• **iNcentives** (who pays/choses-pays/profits); what does changing of the thermostat yield?

• **Understand mapping** (Choices related to welfare); **Illustrate** consequences or “try free for X months”

• **Default** (Opt-in or opt-out); **computer screen-saver**

• **Give feedback** (Understand function); **Plug-out sign or warning lamps**

• **Expect errors** (Foolproof?); example insert a card 4-ways

• **Structure complex choices** (Filtering); **Models and features**

**Framing of the offers**

Source: Nudges by Thaler and Sunstein