Universidad Politécnica de Cartagena

Departament of Electrical Engineering

Doctoral Course on “Industrial Technologies”.

Subprogram “Neurotech, Control, Robotics and Energy Management”

Analysis of Distributed Energy Resources: an Introduction to Demand Response

Cartagena, 2011

Lesson 3.

Demand Response from 1973 to 2000

- DSM, Demand Side Management
- LM, Load Management
- EC, Energy Conservation

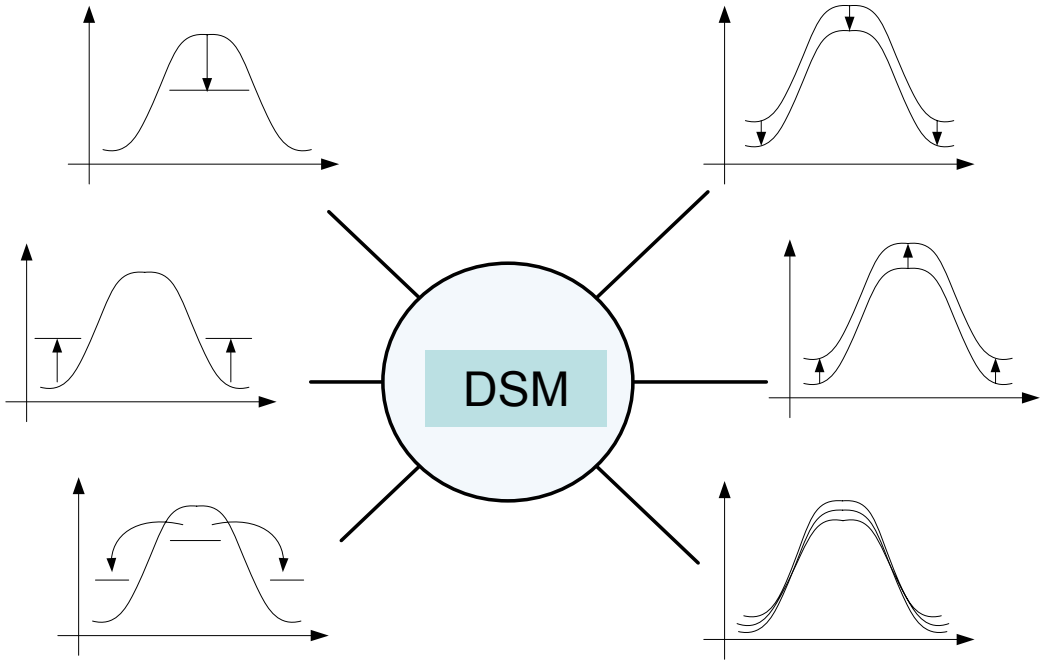
Regulation: vertically integrated utilities.

- **Until the 70's: Policies SSM (Supply Side Management)**
  - The power system grows following the changes in demand (peaks).
- **From 1973 the DSM comes. Drivers:**
  - Δ Oil prices (production costs)
  - ↑ rates of inflation (double digits)
  - ↑ price of money (two digits), it triggers the economic cost of new investments
- **A change in the background:**
  - Planning processes (uncertainty large investments)
  - Change in the regulation of Power Systems
  - A new interest in Energy Efficiency and Conservation
  - Users viewpoint: to control its energy costs (mainly in the industry segments)

Demand-Side Management (DSM)

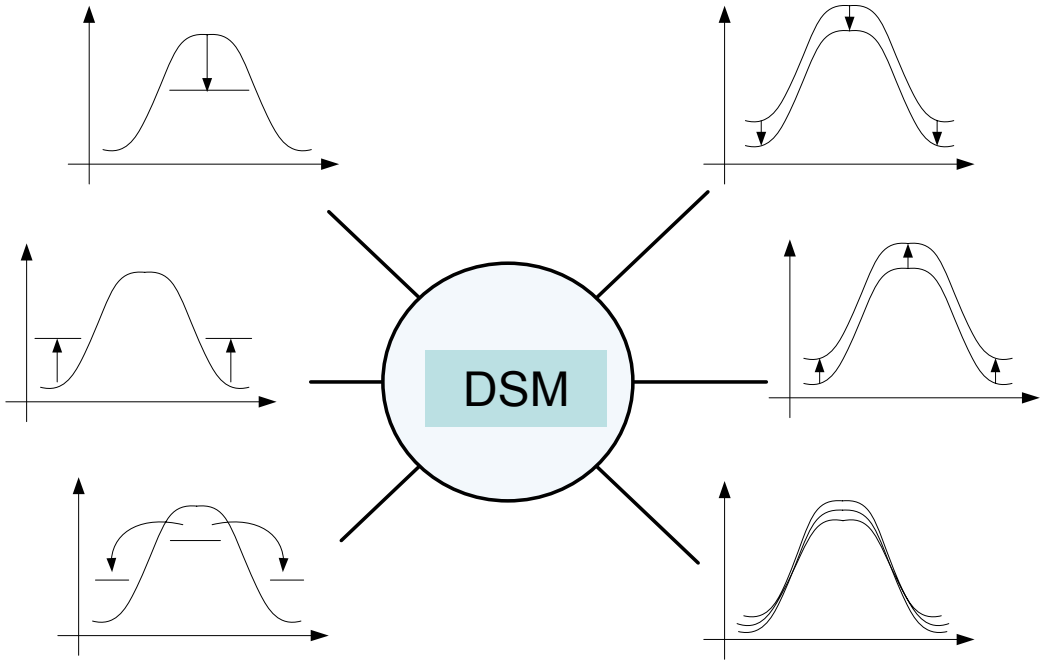
- Concept (C.W. Gellings, EPRI, 1981)
  - To change the electricity use patterns (directly or stimulated by the utility)
  - To modify the load curve (time, values)

→ according to the utility needs



Demand-Side Management (DSM)

- These activities include:
  - Load Management (the shifting of Load from high cost to lower cost periods)
  - Strategic Conservation (reductions in usage)
  - Electrification (replacement of primary supply, ex. Gas)
  - Strategic Growth (increase market share)



- **The DSM includes critical components of the traditional planning of the company:**
  - Influencing the use of electricity (customers)
  - Should provide user response
- **Additional objectives include:**
  - Reductions / new tariffs
  - Customer satisfaction
  - Increased network reliability
  - The SSM is no longer the only alternative
- **May be compared with alternative policies (DSM) that can achieve similar goals.**
- **The DSM is influenced by the shape of the load curve (transformer, feeder, substation, ...)**
- **DSM achieves a considerable success from 1980-95**

- **Environmental considerations. History repeats itself**
  - Very important since 1980
    - Ex. Nuclear Energy (Three Mile Island, June 79)
    - Climate change (greenhouse effect)
    - Acid rain (conventional units)
  - Environmental assessment: It is very complicated. Many companies and governments try to include it in their planning processes.
    - Northwest Power (USA) -10% for conservation
    - California: [10%, 25%] in generation projects
  - Explicit monetization: allocating costs associated with each impact (impact mitigation)
    - NOx: 22000 $ / ton emitted
    - SOx: 16000 $ / ton emitted
    - CO: $ 300 / ton
- **Clean Air Act (USA, 1990)**
  - The regulation of emissions appears.
  - Emission rights: offers and bids

DSM Drivers (I)

- **Positive effects**
  - New devices and technologies
    - Saving capacity (100% from 1980 to 1990)
    - Lower costs (electronic components, PC, controls,…)
    - Between 25% to 50% could be saved if the best technology available is applied
      - Sometimes, this technology is very expensive and unrealistic
  - EPRI forecasts (1990, USA)
    - Residential segments (27 to 46% savings): conditioners, water heaters, lighting
    - Commercial sector (23 to 49% savings): lighting, refrigeration, office equipment
    - Industry: (24% to 49%): electronic drives (more than 70% of consumption is due to other
  - Other alternatives: the replacement of primary sources. Replacing gas or oil supply. Estimated savings:
    - Industry: 407×10^{12} BTU (1 BTU = 1054kJ)
    - Transportation: 95×10^{12} BTU

DSM Drivers (II)

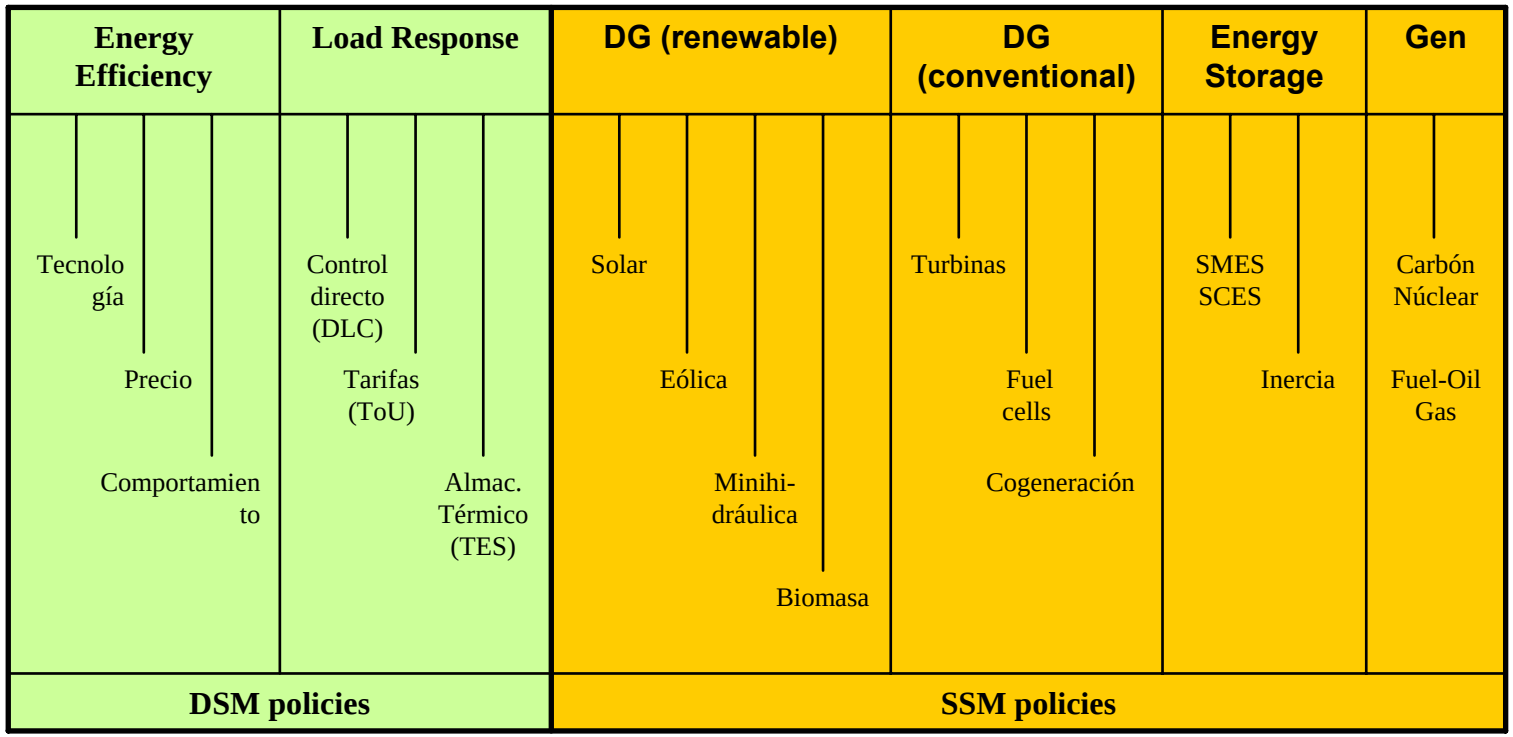
- **Negative effects**
  - Sales policies and incentives to purchase efficient appliances:
    - Sometimes, they were higher than the cost of the appliance (ex. Residential heat storage in Spain, 90´s) and independent of rated power and efficiency.
    - They were not "socially" efficient
    - They don't produce change in patterns
  - Alternative: To improve standards (source: NAECA)
    - Example: Fridges and Air Conditioning in Residential segments

Appliance	1990 Standard	1993-95 Standard	2004-06 Standard
Refrigerator	1013 kWh/year	730 kWh/año	620 kWh/year
Freezers	1100 kWh/year	835 kWh/año	-
Central Air Contitioner (split)	None (Avg: SEER 9)	10 SEER	(proposal) 13 SEER

- **Regulatory changes (80´s): Least cost planning (LCP)**
  - Definition (R. Sants & A. Lovins, 1979): find the maximum efficiency/conservation potential with technologies that are competitive.
  - The process: (can be useful to evaluate the response of demand, there are important similarities)
    - Understand how energy is used
    - Identify the existing technical potential
    - Assess costs and benefits to society
    - Find the optimum to minimize costs and maximize the social benefit
  - LCP problems
    - User viewpoint: no equity.
    - Policies can be beneficial only for one party (participant)
    - Utility viewpoint: The LCP is contrary to the expansion and competitiveness
      What about network reliability?
  - At the beginning, no one considers the load control

Regulation (late 80´s): Integrated Resource Planning (IRP)

- Concept (Schweppe, 1989): to integrate LCP and DSM
- The new planning portfolio



- **Some benefits of DSM experience:**
  - There are more data and consequently problems can best be studied.
  - Prevent missed opportunities
  - Establish incentives
  - Examples of individual cases
  - Make it easier to share user
  - "Markets" are underexploited: commercial and industrial
- **The residential market is a problem (in USA and other countries) because he was the one who had more experience in DSM, and this experience usually was not positive:**
  - Low service levels (large interruptions)
  - Low feedback to customers (value of customer participation)
  - ***I.e. A lack of customer satisfaction with conventional DSM***

Weakness of DSM policies (1995-2000):

- **Influenced by several factors:**
  - Comfort: 90% of users (commercial and institutional customer) considered a serious drawback to reduce demand.
  - Outdated policies: Demand-Side is driven by the Supply Side
  - User Rating: More interested in EMS systems
    - Looking for information on energy use and operation of new technologies
- **Lack of interest of the regulator: it focuses on other goals (new "deregulated" markets).**