Demand Response – The Green Ancillary Service for Variable Generation

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Global Energy & Utility Transformation
Agenda

- Capgemini
- The Energy Situation
- Demand Response
  - Definitions
  - Types
  - Drivers
  - Impact
- Conclusions
Capgemini is One of the World’s Largest Management and IT Consulting Firms

- **Revenue and personnel**
  - €7.7 billion
  - Over 75,000 Professionals
  - More than 300 offices in 30 countries

- **Geographic revenue distribution**
  - 77% Europe
  - 22% North America
  - 1% Asia

### Industry revenue distribution

- Manufacturing, Retail & Dist: 28%
- Public Sector, Healthcare: 27%
- Energy, Utilities and Chemicals: 15%
- Financial Services: 12%
- Telecom, Media, Transportation, Other: 11%
- Other: 7%

### Annual results 2005

#### Our Services

<table>
<thead>
<tr>
<th>Consulting</th>
<th>Technology</th>
<th>Outsourcing</th>
<th>Professional Services</th>
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<tr>
<td>Transformation Consulting</td>
<td>Customer Relationship Management</td>
<td>Supply Chain Mgmt</td>
<td>Finance Transformation</td>
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<tr>
<td>Architecture &amp; Infrastructure Services</td>
<td>Package Implementation</td>
<td>Application Development &amp; Integration</td>
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<td>Applications Management</td>
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<td>Local IT Services (Staff Augmentation)</td>
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<td>Hardware and Network Management</td>
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#### Business Mix

- Consulting Services: 13%
- Outsourcing Services: 38%
- Local Professional Services: 16%
- Technology Services: 36%
- Annual results 2005
A Few Facts …

- U.S. electricity demand growing 1.5 – 3.0 % annually
  - Invest $900B in Generation, Transmission & Distribution by 2020
  - U.S. needs 50,000 Mw of new generation by 2014 and 258,000 Mw (40% increase) by 2030
  - Less than half of this is currently planned

- U.S. electricity prices will rise "fairly dramatically" over the next 3 to 5 years as rate caps put in place during an earlier wave of utility mergers expire
  - 30 – 50% in the Northeast

- U.S. produce ~20% of the world’s greenhouse gases and the electric utilities produce 40 percent of that (8% of the world's greenhouse gases)
  - Foreign governments are demanding the U.S. reduce its production of such gases
  - Most practical way for utilities to add generation is to build coal- fired plants

*It is Not realistic to think that we can build enough coal-fired plants to keep up with surging U.S. electrical demand given the rising opposition to global warming. It is a very daunting task to reduce CO₂ while increasing generation capacity*
Fact: World Population is Growing Exponentially Causing the World Energy Consumption to Increase

According to the “World Energy Council” – To provide a reasonable quality of life for all people we will need 33 TW of power by 2050. That is:
- 500 Million barrels of oil a day
- Globally 18,500 additional 1 GW generation plants by 2050 = 1.3 plants a day
Fact: CO$_2$ is a Major Concern In the Electric Power Industry

Recent and Projected Growth in U.S. GHG Emissions is Concentrated In the Transportation and Electric Power
Fact: World’s Proven Oil Reserves is Limited, But World Consumption Continues to Grow

1200 billion barrels + 600 billion barrels (to extract from tar sands in Canada and Venezuela)

With a world oil consumption growth of 1% per year …the oil reserves will be exhausted in less than 40 Years
Fact: Energy Consuming Devices in the Home have been grown over the last decades

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… Some Things to Think About

- Making electricity create 37% of all greenhouse gases (EIA)
- The fastest growing fuel for making electricity is COAL
  - 2/3 of all new generation is coal
  - In Europe and the US the newest Nuclear plants just turned 30
  - In Ontario, $70 billion is required for new and renewed generation (OPA)
- Coal is the dirtiest fuel from a greenhouse gas standpoint
- Local use of electricity is rising at between 1 and 11% per year
  - Globally it is 2.2% in 2005 (EIA)
- Since 1970 the average refrigerator consumes 50% less power per cubic foot – the average refrigerator is 67% larger.

- North American Home sizes (New construction):
  - 1950: 1400 Square feet (60 amp electric service)
  - 2000: 2000 Square feet (200 amp electric service)
  - 2005: 2400 Square feet (400 amp electric service)
... That’s Leads to an Energy Supply and Demand Dilemma

- Many parts of the world are seeing their peak margin (reserve) disappear with a robust economy and residential demand for more power
  - Residential customers are buying ever more TV’s and other gadgets that required energy, homes are getting larger, we want a more controlled environment.

- Many parts of the world are trying to reduce carbon and other emissions into the environment
  - The last 10% of generation used in a peak situation can generate 30% or more of the emissions

- The ability to build more infrastructure is limited by law, environmental concerns and public opinion
  - New power plants can take a decade or more to complete from the opening discussion – given permit and hearing requirements
  - Many old plants, built after World War II are now nearing the end of their useful life span, even with the excellent maintenance that they have had
  - Gas fired plants, the rage in the 1990’s are too expensive to run, except at peak times

... so, What is the Answer?
Part of the Answer Needs to be Demand Response

- Proactive management of electric and gas utility loads in order to more efficiently and reliably market, produce, transmit and deliver energy.

- Applications of demand response are:
  - Direct Load Control or active demand-side management: Utility interrupting load in response to severe grid transients or supply shortages
  - Passive demand-side management: Millions of customers voluntarily reducing their consumption / load in response to price signals

- With the exception of having to address emergencies, DR is generally used to flatten the demand peaks
Energy Efficiency, Demand Response and Load Shifting

1. ENERGY EFFICIENCY
   - Reduce total kWh of loadshape with permanent efficient technologies.
   - E.g.: CFLs, PE Motors, T8’s, etc..

2. DEMAND RESPONSE
   - Temporary reduction of peak energy usage for a defined duration.
   - Curtailment “events” triggered by either reliability or high prices.
   - E.g.: Load-control switch, Thermostats

3. LOAD SHIFTING
   - “Flattening” the loadshape by using off-peak power in place of on-peak power.
   - Often permanent shift driven by combining appropriate technology and rates (TOU).
   - E.g: Thermal Energy Storage
## Types of Demand Response

<table>
<thead>
<tr>
<th>Program</th>
<th>Benefits</th>
<th>Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling Blackouts</td>
<td>95% of expected reduction</td>
<td>Public outcry – regulatory nightmare</td>
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<tr>
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<td>This is last resort option</td>
</tr>
<tr>
<td>Direct Load Control</td>
<td>90% of expected reduction</td>
<td>Program design – incentives that are expected by customers and regulator</td>
</tr>
<tr>
<td>Direct Load Control – override</td>
<td>70% of expected reduction</td>
<td>Reduction is least in most needed areas</td>
</tr>
<tr>
<td>Financial Incentives</td>
<td>40% of expected reduction</td>
<td>Least reduction on critical peak days - Effective but not when you need it</td>
</tr>
<tr>
<td>Price Signals</td>
<td>30% of expected reduction</td>
<td>Consumers making 10 penny decisions</td>
</tr>
<tr>
<td>Voluntary</td>
<td>15% of expected reduction</td>
<td>Scattered use of the program, high cost to maintain</td>
</tr>
<tr>
<td>Education</td>
<td>No expected reduction – get what you get</td>
<td>Has little lasting impact - Need to start in 1st Grade</td>
</tr>
</tbody>
</table>

- *With today’s technologies we should see significant improvements*
- *Earth hour is a good example of today’s generation*
- *Toronto Hydro measured more than 5% impact on load*
Demand Response Drivers

- Avoid building new peaking generation
- Shift load during peak-days and avoid operating the inefficient marginal peaking generator
- Provide the lowest cost solution for renewable portfolio standards (RPS) transmission reliability problems.

As retail prices have soared in recent years, all stakeholders are concentrating their efforts to make DR work.

- It is believed that DR can play an important role in mitigating the potential for generators to exert market power.
- Three out of Seven ISOs/RTOs in the US (ISO-NE, PJM Interconnection and NY-ISO) have allowed DR to be integrated into almost all markets.

The Opportunity for Demand Response

- 82 Utilities with peak demand >= 3000 Mw
- ~9 Gw of load under control by Utilities

Source: DOE EIA 2005
Environmental Impact is Now a Priority

Capacity Resource – “Environmental Stack”

Demand response is more environmental friendly than Solar and Wind. We do not have to generate the electricity we not consuming.
Tale of one program – 20 years in the making

- Florida Power & Light (FPL) started a direct load control program in 1986 following a pilot program using the call center to reach residential customers.
- Today the program has more than 600,000 residences with an average 2.77 KW per residence. Each residence receives a $45 per year reduction in bills.
- Results
  - Savings (Transmission, Generation, Power Purchase, Distribution) – more than $8 billion
  - Costs approximately $1 billion
- Customer response to the program
  - Waiting list is more than 2 years long with no marketing
  - Customers who move to a new house are 99.8% likely to ask to have the equipment installed in the new home

#1 Program According to JD Power’s Customer Satisfaction Survey
The Best Way to Address Those Issues is ….

- Find a way to reduce our consumption
- Create a smarter grid that will minimize the electricity losses
- Find technological solutions that will supply endless energy

There is no silver bullet, and we have to start now

*Until that endless source of energy is found, we need to spread the message of efficiency and reduced consumption*
Thank You

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