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Demand Response – The Green Ancillary Service for Variable Generation

5th Annual Carnegie Mellon Conference on Electric Industry

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Global Energy & Utility Transformation

TOGETHER. FREE YOUR ENERGIES

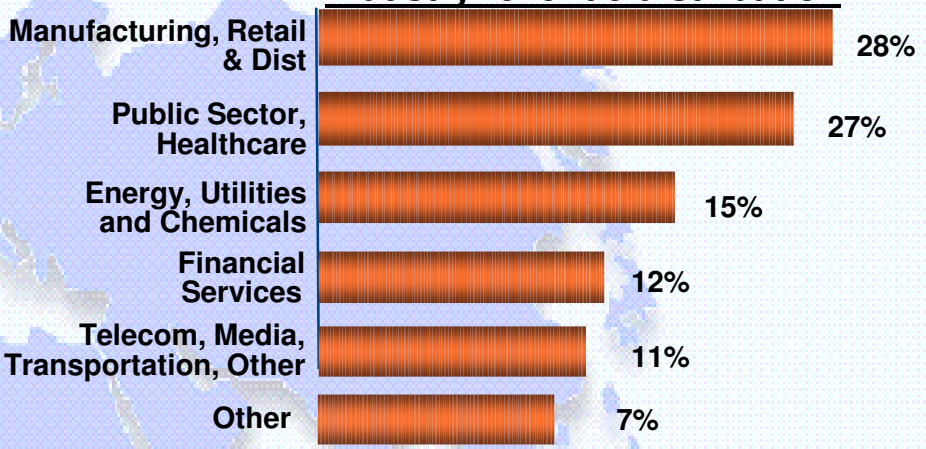
Agenda

- 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

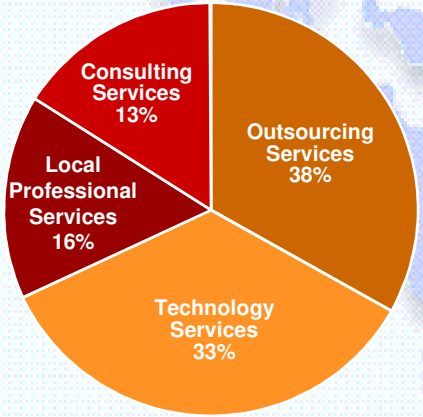
Industry revenue distribution



Our Services

Consulting	Transformation Consulting	Customer Relationship Management	Supply Chain Mgmt	Finance Transformation
Technology	Architecture & Infrastructure Services	Package Implementation	Application Development & Integration	
Outsourcing	Applications Management	Infrastructure Management	Business Process Outsourcing	
Professional Services	Local IT Services (Staff Augmentation)	Hardware and Network Management		

Business Mix



Annual results 2005

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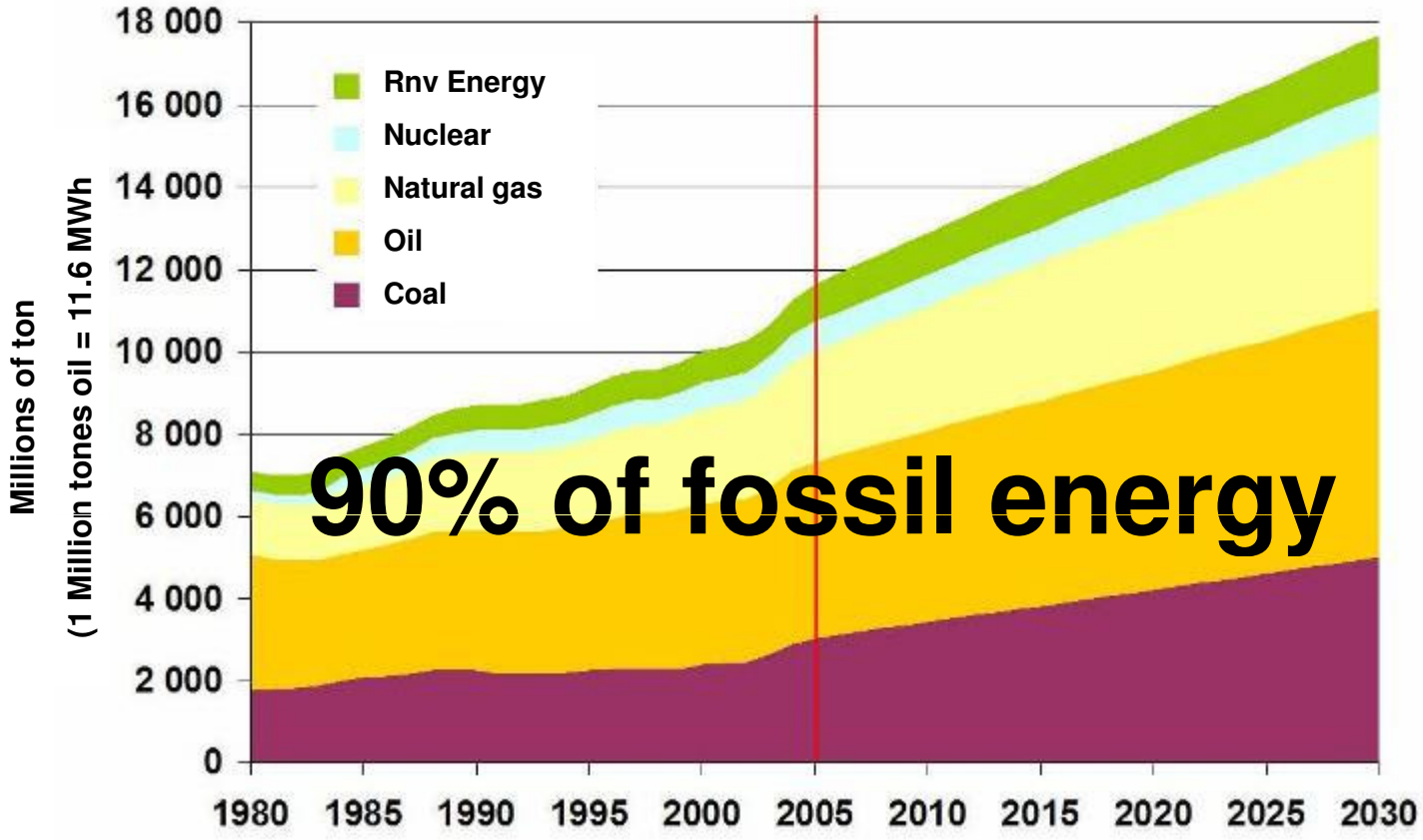
A Few Facts …

- 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 $C0_2$ while increasing generation capacity

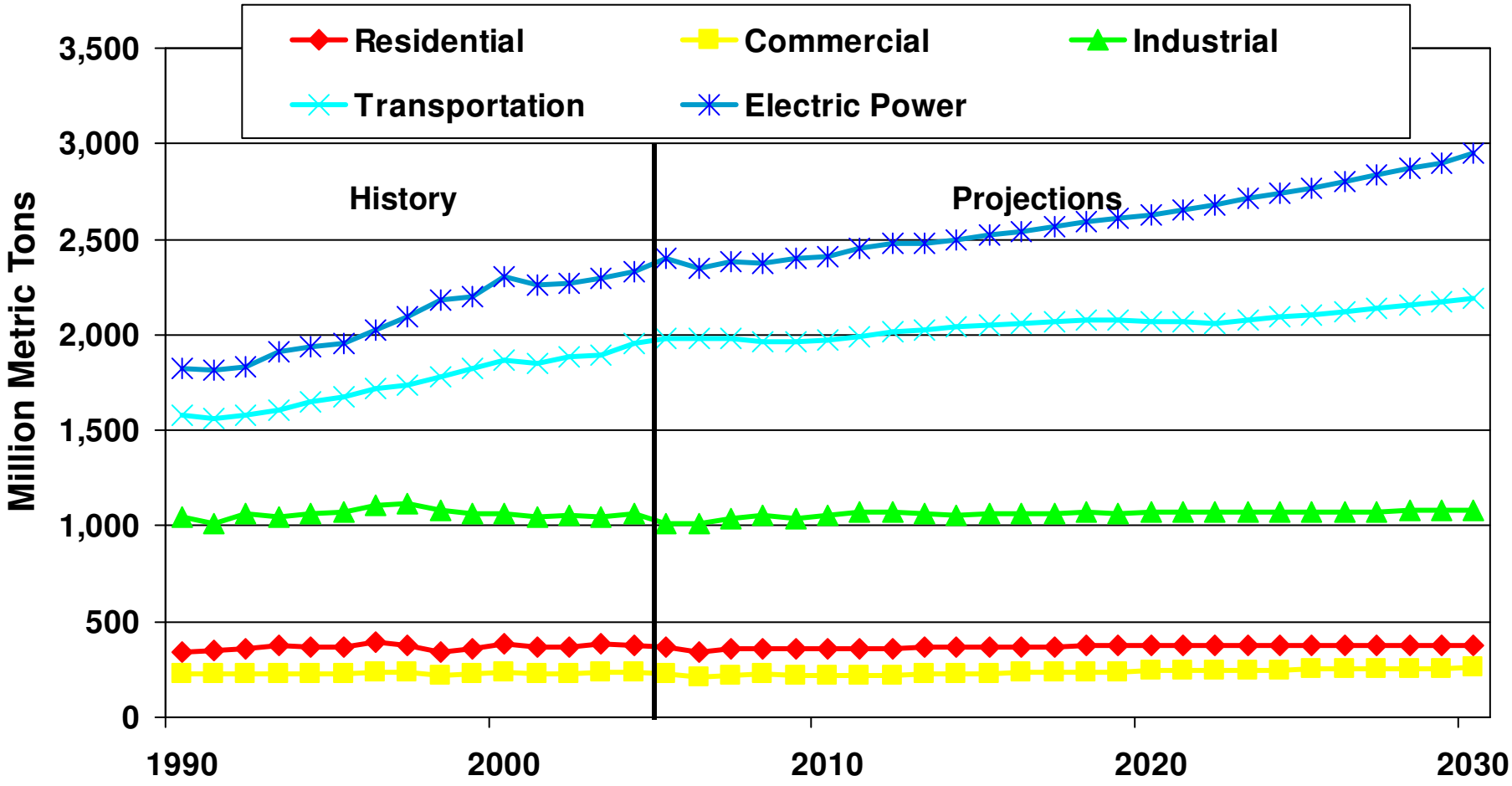
Fact: World Population is Growing Exponentially Causing the World Energy Consumption to Increase



Source : IEA, Mai 2007

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

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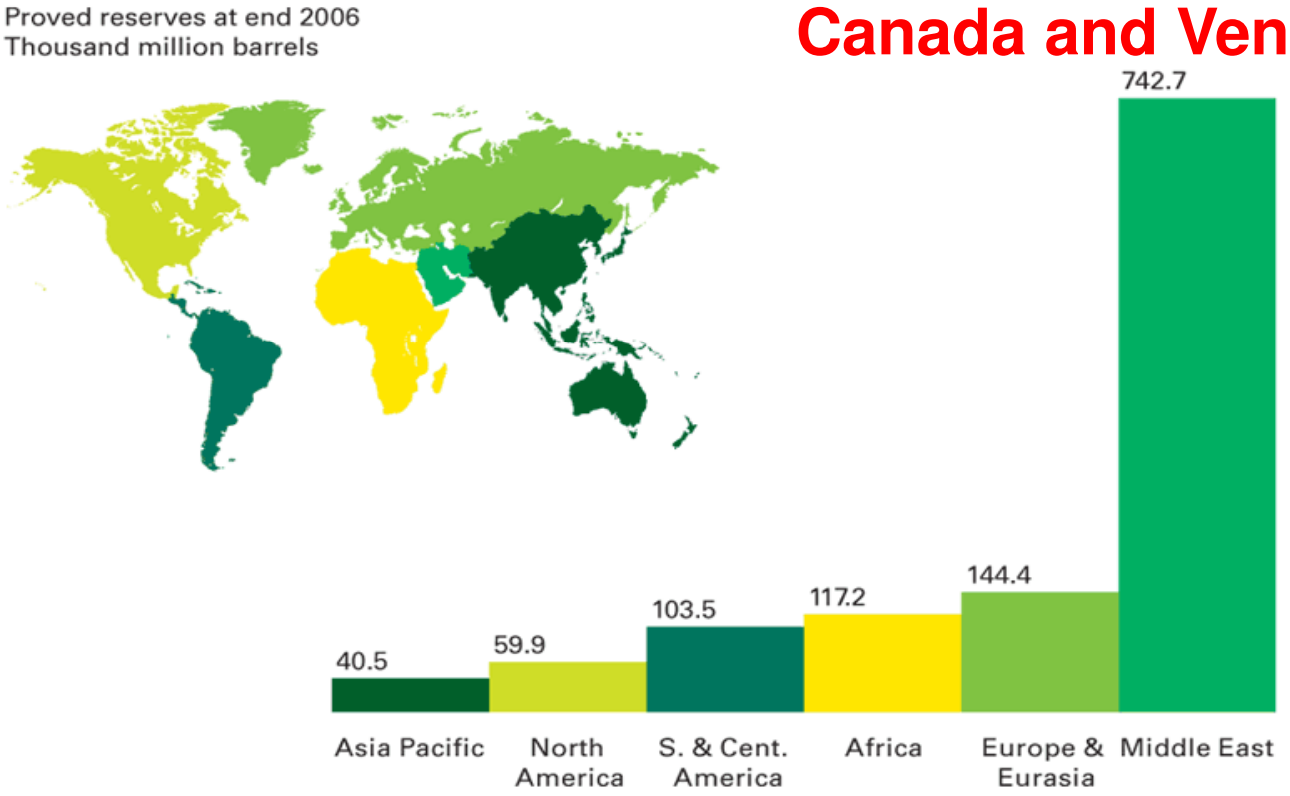
Fact: World's Proven Oil Reserves is Limited, But World Consumption Continues to Grow

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

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Fact: Energy Consuming Devices in the Home have been grown over the last decades

Device	1980	Energy Star	Device	1980	Energy Star	Device	1980	Energy Star
Refrigerators		Yes	Radio		No	Computer Monitor	No	No
Incandescent		Yes	Jacuzzi		No	Large Screen TV	No	No
Fluorescent		Yes	Television sets		No	Digital Camera	No	No
Pool heaters		Yes	Sewing Machine		No	Dehumidifier	No	No
Dishwashers		Yes	Water Bed		No	Microwave	No	No
Room A/C		Yes	Stereo		No	Clock Radio	No	No
Freezers		Yes	Vacuum		No	Hot Glue	No	No
Water (tank) heaters		Yes	Water (tankless) Heater		No	Garage Door Opener	No	No
Cooktops/ovens		Yes	Water Pump		No	Trash Compactor	No	No
Clothes washers		Yes	Hair Dryer		No	Cable box	No	No
Clothes dryers		Yes	Ceiling Fan		No	Broadband	No	No
Central A/C		No	Electric Furnace		No	Portable Phones	No	No
DIY Tools		No	VCR	No	No	Fax Machines	No	No
Toaster Oven		No	Portable Heater	No	No	Ice Cream Maker	No	No
Coffer Maker		No	DVD	No	No	Game Console	No	No
Electric Kettle		No	Computer	No	No	Printer	No	No
Toaster		No	Laptop	No	No	Home Security	No	No
Electric Blanket		No	MP3/Game Player	No	No	Cellular Phone	No	No
Clothes Iron		No	Juicer	No	No	Answering Machine	No	No

… 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

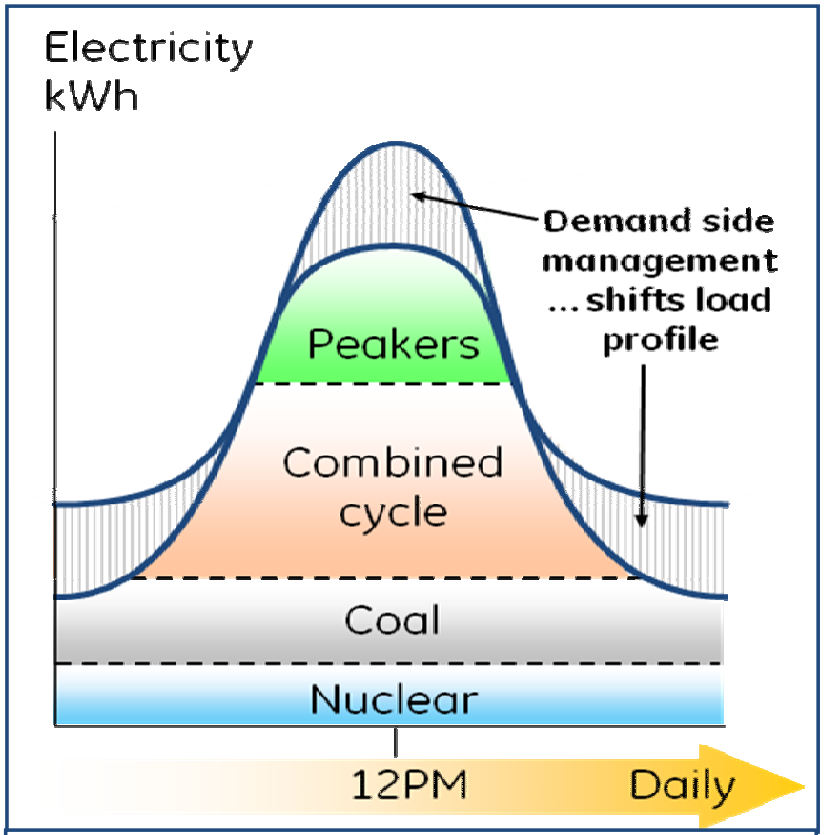


Figure 1: Demand Peak

- 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

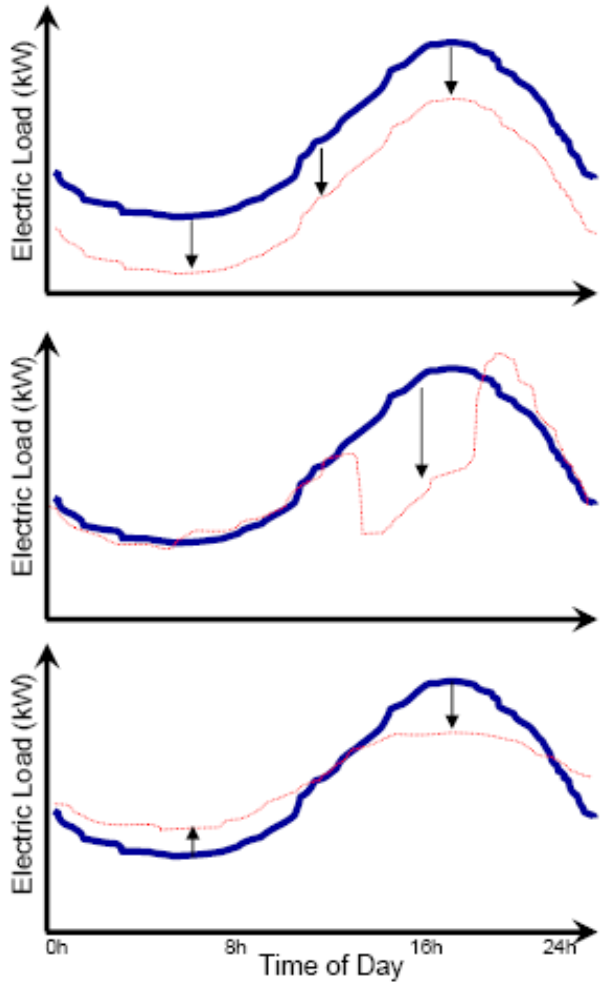
- Reduce total kWh of loadshape with permanent efficient technologies.
- E.g.: CFLs, PE Motors, T8's, etc..

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



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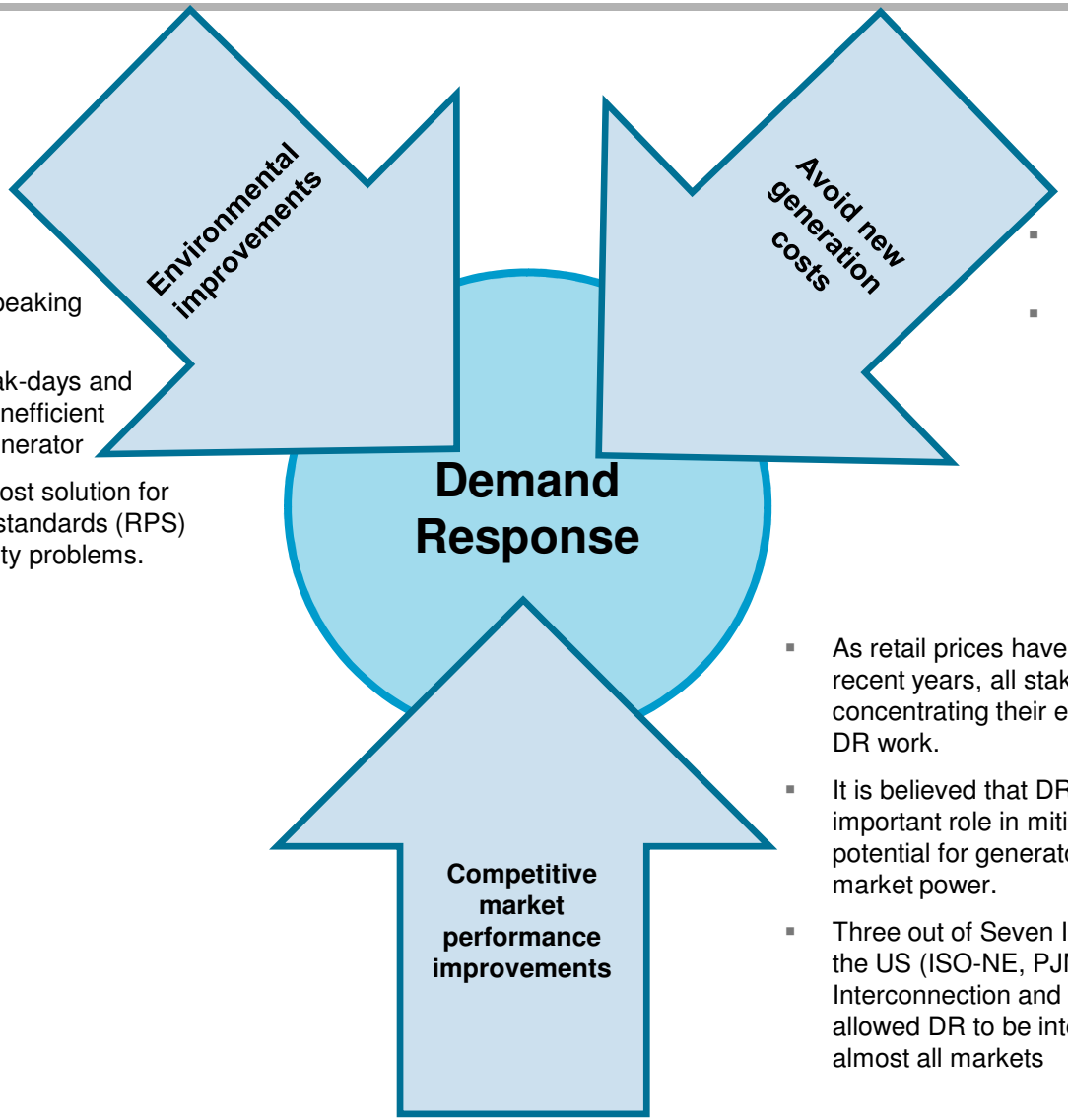
Types of Demand Response

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

- ***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



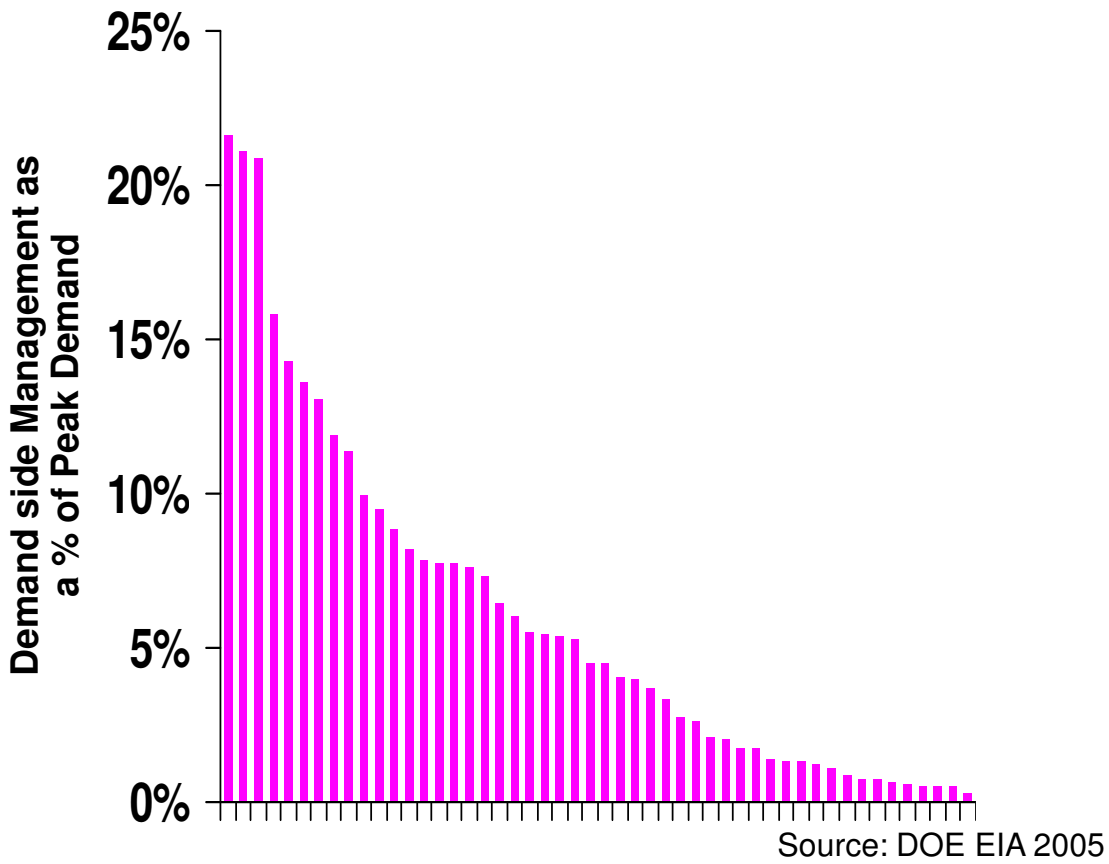
- Avoid building new peaking generation
- Shift load during peak-days and avoid operating the inefficient marginal peaking generator
- Provide the lowest cost solution for renewable portfolio standards (RPS) transmission reliability problems.

- Defer new base load generation
- Better manage capital budgets

- 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

UtilityPoint Dec 2008, "Making Demand Response More Efficient: Start Setting DR Goals (Part II in a Series)"

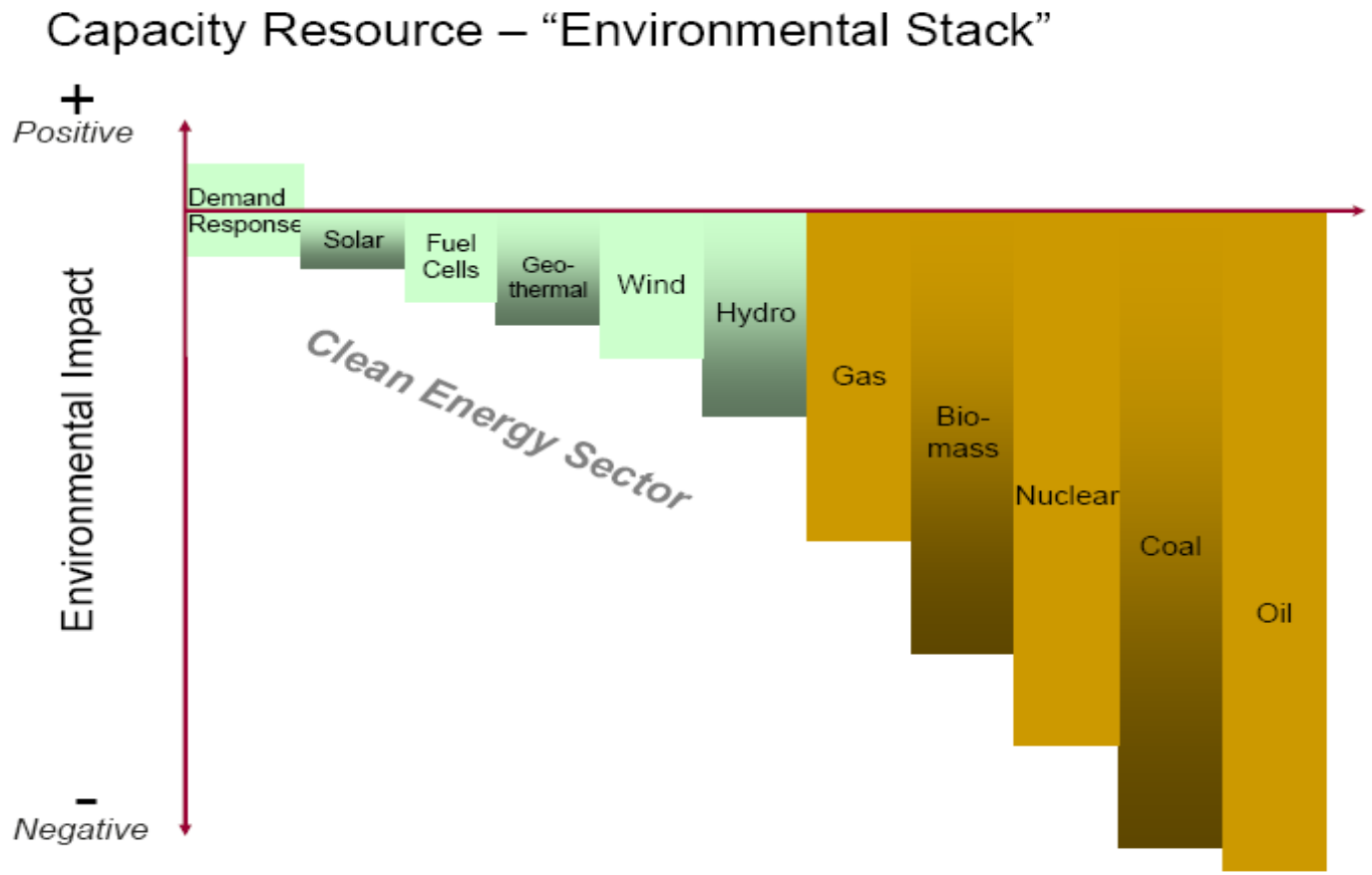
The Opportunity for Demand Response



Source: DOE EIA 2005

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

Environmental Impact is Now a Priority



Source: GoodCompany Associates, Robert J. King

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 sliver 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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