# Smart Grid Deployment

# Delivering Benefits to Consumers and the Environment

June 22, 2011

EDF
ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

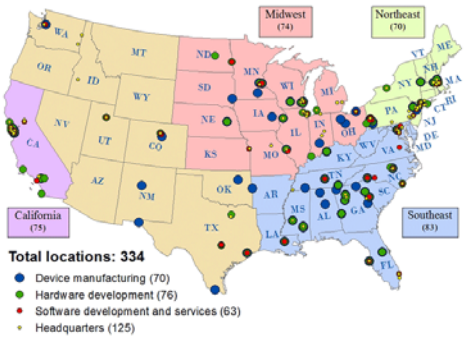
# Environmental Defense Fund

- Founded in 1967, EDF tackles the most serious environmental problems with:
  - A commitment to sound science
  - Efficient, market-based solutions
  - The power of unlikely partnerships
  - Smart, non-partisan policy

- EDF has more than 350 scientists, economists, attorneys and other professionals on staff

# Why is EDF working on SG?

- **Environmental opportunity**
  - 30% cut in air and climate pollution from electric sector
  - 25% cut from on-road transport sector
- **Consumer opportunity**
- **Economic opportunity**



# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

- Example: Electric Energy Storage (EES)

For Solar DG, even small amounts of energy storage can be particularly useful. DG solar's peak energy production tends to be in the early afternoon while the electric demand peak (also when energy is the most expensive) is usually in the early evening.* By extending solar systems one or two hours, energy storage managed with smart grid infrastructure will lower system prices, improve reliability beyond current measures and increase the value of solar DG, enabling further deployment.

*Since peak production and demand curves are not uniform across utility service territories, the impact of EES will vary from region to region

# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

- Example: Demand Side Management (DSM)

DSM includes demand response, energy management, energy efficiency and conservation. All of these forms are enabled by SG deployment. By tapping into extremely responsive demand side resources (which can react within seconds as opposed to 15 minutes or more for many peaking power plants), the smart grid will allow the fluctuations of DG (particularly solar) to be more easily balanced.

# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

- Example: Electric Vehicles (BEVs and PHEV)

BEVs or PHEVs can serve as mobile energy storage units, particularly when aggregated or located at or near a facility. In the home, if plugged in during the day, EVs can help manage the minute fluctuations that may come from cloud transients or other conditions in residential solar systems. When managed on a small & local level, this can prevent those fluctuations from impacting the larger grid, thereby enabling more solar DRG on the grid.

## EDF High level observation:

## Smart grid deployment can deliver a significant amount of distributed generation to the California grid through a number of mechanisms

# Smart Grid Deployment Planning

**A full scale effort that requires a system wide approach with a clear vision, long term goals, meaningful metrics, and a thoughtful deployment roadmap.**

**Implemented through SB 17, R. 08-12-009, D.10-06-047**

# Smart Grid Deployment Planning

**By adhering to D.10-06-047, utility smart grid plans will create the opportunity for DG to participate on par with other investments**

# Smart Grid Deployment Planning and Distributed Generation

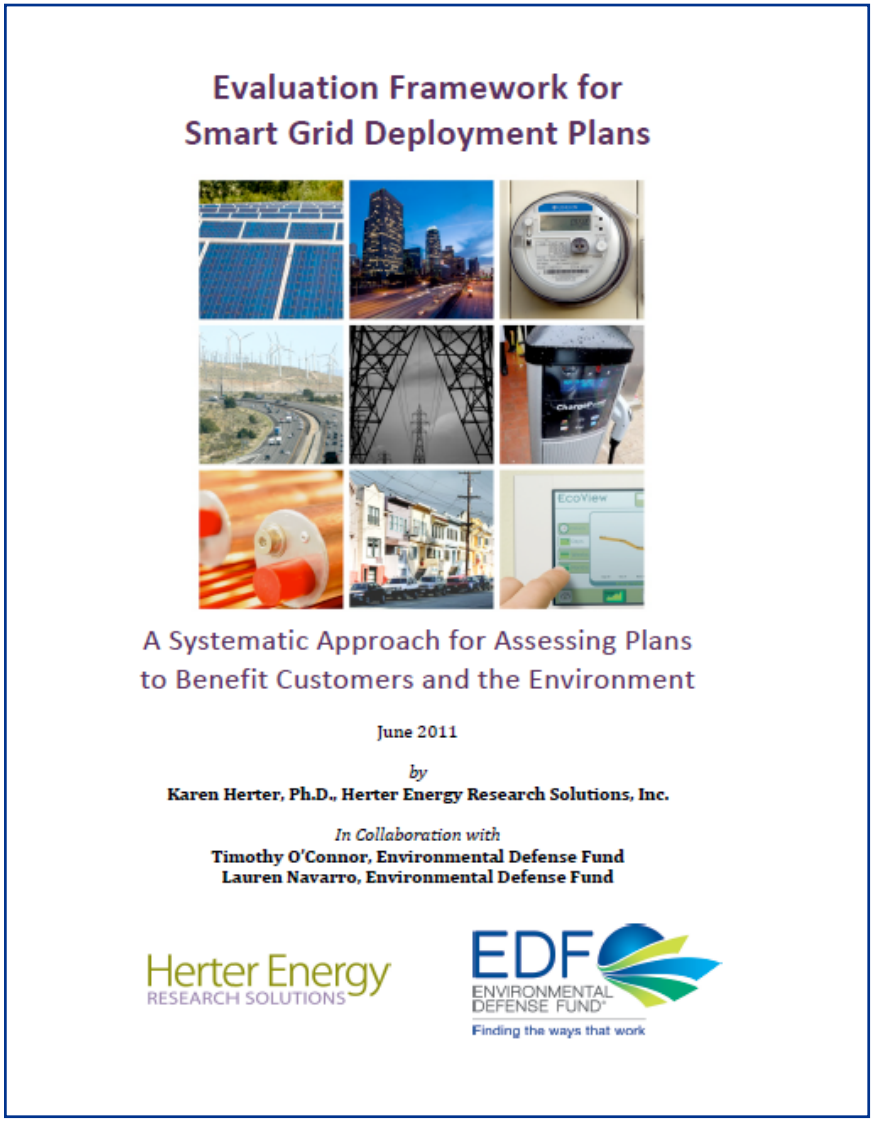
The smart grid should have the infrastructure and policies necessary to enable and support the sale of demand response, energy efficiency, **distributed generation**, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources. The smart grid should also allow deployment and integration of cost-effective advanced electricity storage and peak shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air-conditioning.

D.10-06-047
and SB 17
(paraphrased)

# Smart Grid Deployment

## Delivering Benefits to Consumers & the Environment

## Smart Grid Evaluation Framework June 2011



# California evaluation framework

- EDF tool for regulators to evaluate IOU (PG&E, SDG&E and SCE) smart grid plans' abilities to deliver benefits required by CPUC

  - Empower consumers
  - Create platform for innovative technologies and services
  - Enable sale of demand-side resources into wholesale energy markets on equal footing with conventional supply
  - Reduce the environmental footprint of the electric system and achieve CA clean energy and climate change mandates (AB32, 33% RPS, EEPS, CAA)

# EDF California Smart Grid Deployment Plan Evaluation Framework

| | | SECTIONS | | | | | |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | |
| | | Vision | Strategy | Metrics | Baseline | Roadmap | Total |
| GOALS | (i) Empower Consumers | 1 | 1 | 1 | 1 | 1 | |
| | (ii) Create a Platform for Technologies & Services | 1 | 1 | 1 | 1 | 1 | |
| | (iii) Enable Sales of Demand-side Resources in Wholesale Markets | 1 | 1 | 1 | 1 | 1 | |
| | (iv) Reduce the Environmental Footprint | 1 | 1 | 1 | 1 | 1 | |
| **Step 1: GOAL Score** *(sum of i-iv above)* | | 4 | 4 | 4 | 4 | 4 | **20** |
| **Step 2: SECTION Score** | | 4 | 4 | 4 | 4 | 4 | **20** |
| **Final PLAN Score** | | | | | | | **40** |

A points and discussion based scoring based on each plan's vision, strategy, metrics, baseline and roadmap specific to each goal

# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

- Goal: Consumer empowerment
  - Plug and play devices
  - Consumer technology
  - Electric vehicles
- Goal: Platform for technologies and services
  - Interoperability
  - Energy storage

# Examining the Application of the Smart Grid to Facilitate 12,000 MW of Distributed Generation

- Goal: Demand-side sales
  - New commercial markets
- Goal: Environmental benefits
  - Renewable generation integration

# Thank You

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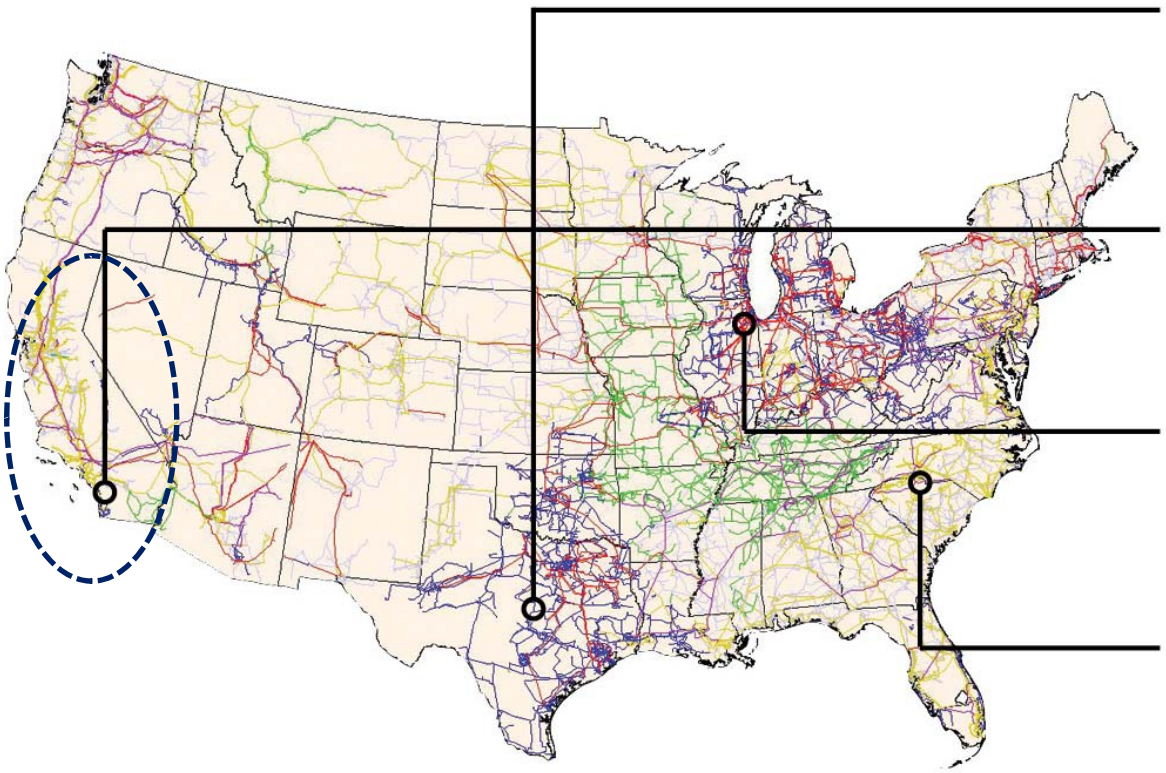
# Additional Background information on EDF and Smart Grids

# Where is EDF working on the Smart Grid?



Austin / Texas
(Pecan Street)

California
(San Diego and CPUC)

Chicago / Illinois
(Legislation and HIA)

Charlotte/ North Carolina
(Envision Charlotte)

Federal Government
Advocacy

# Why is EDF working on SG?

## Environmental opportunity

- 30% cut in air and climate pollution from electric sector

- 25% cut over next two decades from on-road transport sector

(Climate Group – 15% by 2020)
(IEA – 50% by 2050)

# Partial List of CO2 Reductions from Smart Grid in 2030

EDF Energy Program's analysis of the best studies and utility experience

| Electric Sector $CO_2$ Emissions Savings | % of $CO_2$ savings in electric sector | Source |
|---|---|---|
| **END USE EFFICIENCY** | | |
| Conservation from automated sensors, controls, smart appliances; in home displays and pricing; customer info and feedback. | 5 - 10% | Silver Spring Networks |
| Diagnostics in residential and small/medium commercial buildings; continuous commissioning. | 3% | PNNL/Battelle |
| Efficiency measures enabled by acurate monitoring and verification. | 1.5% | PNNL/Battelle |
| **DEMAND RESPONSE** | | |
| Load management from utility cycling of high consuming appliances, remotely on a rotating basis, to avoid using peaking resources to meet demand needs. | 3% | Austin Energy |
| **GRID OPTIMIZATION** | | |
| Voltage reduction and advanced voltage control for conservation; reduced line loss. | 2% | PNNL/Battelle, Silver Spring |
| **SUPPORT RENEWABLE ENERGY** | | |
| Allowing higher % of intermittent renewable energy to be integrated into system by better forecasting, response, and using demand response to balance renewables. | 12% | Silver Spring Networks, Energy Information Administration |
| **Total Electric Sector Emissions Savings** | **~30%** | |
| **Transportation Sector $CO_2$ Emissions Savings for Light Duty Vehicle (LDV)** | **% of LDV $CO_2$ emissions reductions** | **Source** |
| **SUPPORT EV/PHEV's** | | |
| Reduced vehicle emissions as a result of enabling PHEV's and EV's generally and charging with low carbon resources. | **25%** | UC Berkeley[5], based on projection of 24% of the light vehicle fleet being PHEVs or Evs by 2030 |

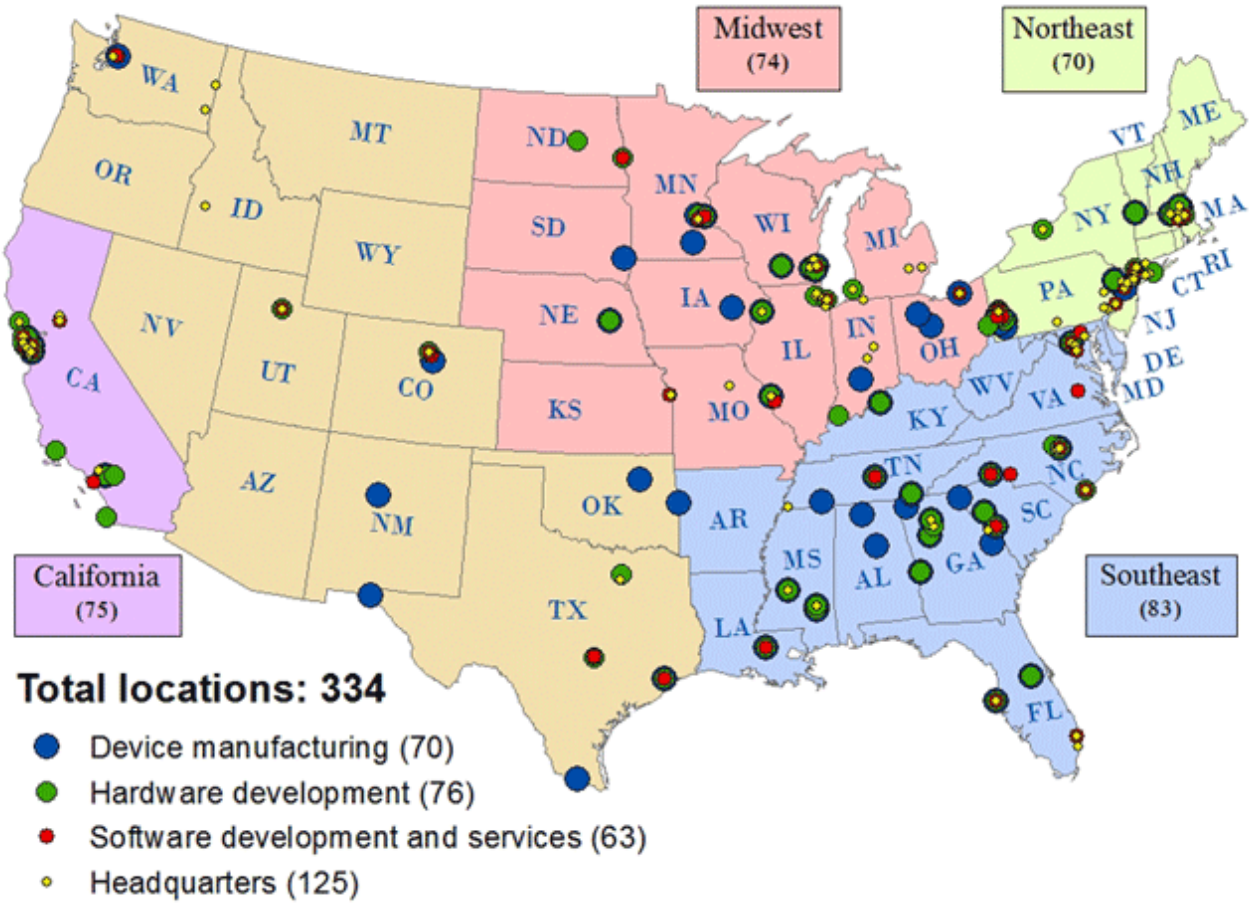
# Why is EDF working on SG?

Consumer opportunity

- More reliable service
- Empowerment to manage use, bills and environmental footprint
- Participation in energy markets—selling distributed supply and demand

# Why is EDF working on SG?

## Economic opportunity



# EDF principles – tracking closely with CPUC requirements

- Deliver environmental and public health benefits, as well as avoided costs
- Empower customers to make choices about energy use, to save money and support clean energy
- Protect consumers from undue financial risk
- Create platform for wide range of innovative energy technologies and management services

# EDF principles continued…

- Ensure grid operators can see, rely on energy efficiency, demand response, distributed generation and storage as confidently as they rely on conventional resources
- Reduce costs of operations by eliminating waste and improving utilization of generation, transmission and distribution assets
- Set clear performance goals and comprehensive metrics
- Pursue systems approach
- Phase in technologies to maximize benefits

# Smart Grid Deployment

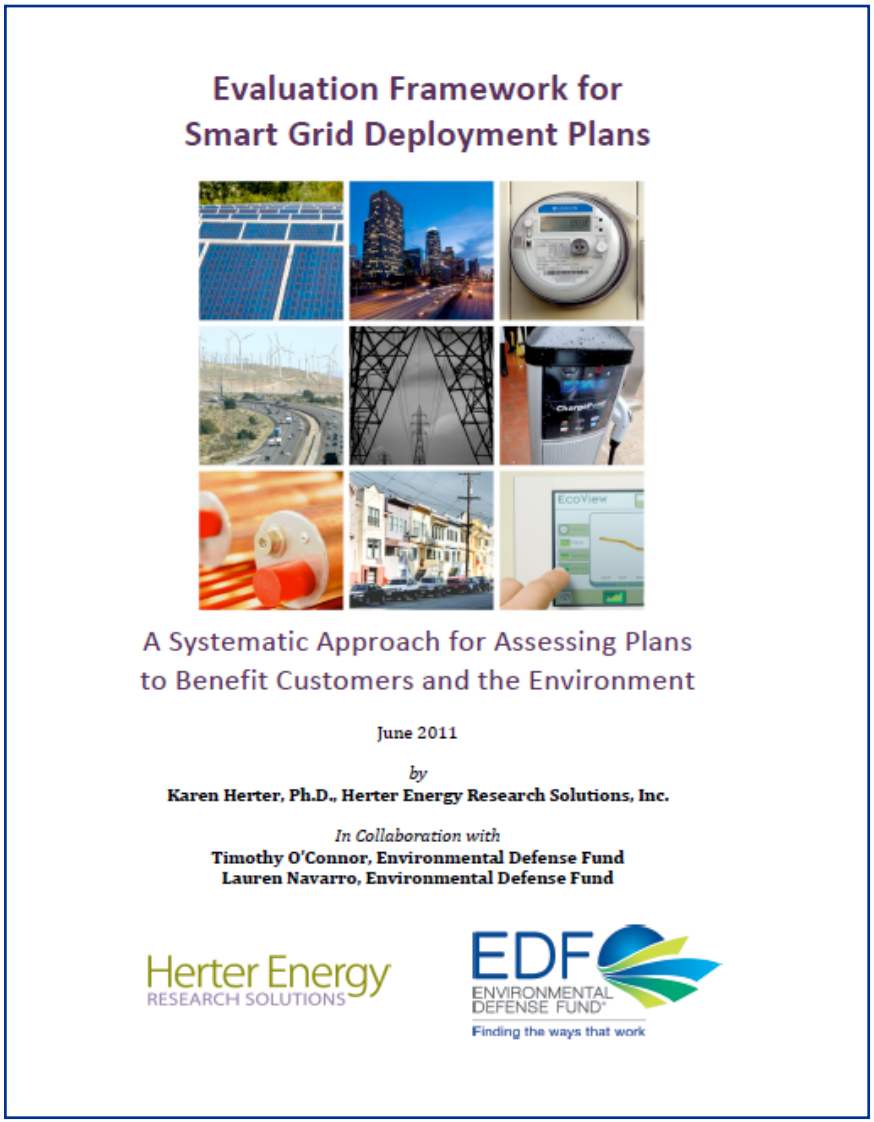
## EDF framework content related to:

**Empowering consumers**

**Create platform for innovative technologies and services**

**Enable sale of demand-side resources into energy markets**

**Reduce the environmental footprint of the electric system**



# Smart Grid Deployment and Consumer Empowerment

The smart grid should enable consumers to change their behavior in response to dynamic prices. Further, it should incorporate cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices for metering, grid communications, and distribution automation.

D.10-06-047
and SB 17
(paraphrased)

# Smart Grid Deployment and Consumer Empowerment

*"The smart grid should empower consumers with **better information** and **expanded choices** in how they use, produce and store energy. Consumers should have the **opportunity to respond** to price signals and other economic incentives to decide if and when to purchase electricity and whether to produce or store it. Similarly, customers should be able to **access technology** that enables them to better control the magnitude and timing of their electricity use. Finally, consumers should be able to **incorporate electric vehicles** into homes, offices, parking garages, and other locations, with rates that reward them for charging off peak."*

EDF 2011

# Smart Grid Deployment and Consumer Empowerment

***Required in California***

- ***Dynamic rate options***
- ***Demand management***
- ***Plug-and-play devices***
- ***Consumer technologies***
- ***Access to electric vehicles***
- ***Information***
- ***Customer service***
- ***Power reliability***

***Add'l Recommended***

- ***Generation choice***
- ***Customer bills***
- ***Customer equity***
- ***Data access & privacy***
- ***Power quality***

# Smart Grid Deployment and Creating a Platform for Technologies and Services

The Smart grid should enable maximum access to the grid by third parties, creating a welcoming platform for deployment of a wide range of energy technologies and management.

D.10-06-047
and SB 17
(paraphrased)

# Smart Grid Deployment and Creating a Platform for Technologies and Services

*"The smart grid should readily allow for **integration of new market** participants (third parties), technologies and energy management services, both on the **distribution system and behind the meter**, for both **demand and supply** side applications. This market for competition and participation can create a platform to reward innovation, promoting business agreements and technologies that engender new opportunities for improvements in the energy system.."*

EDF 2011

# Smart Grid Deployment and Creating a Platform for Technologies and Services

***Required in California***

- ***Interoperability***
- ***Standard protocols***

***Add'l Recommended***

- ***Upgradable software***

# Smart Grid Deployment and Demand-Side Sales

The smart grid should have the infrastructure and policies necessary to enable and support the sale of demand response, energy efficiency, distributed generation, and storage into wholesale energy markets as a resource, on equal footing with traditional generation resources. The smart grid should also allow deployment and integration of cost-effective advanced electricity storage and peak shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air-conditioning.

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# Smart Grid Deployment and Demand-Side Sales

*"Smart grid technologies can enable the participation of demand-side resources (i.e. **demand response, energy efficiency, distributed generation, and energy storage**) based on the ability to facilitate changes in energy use. … The smart grid should enable brokers, integrators, aggregators and individual consumers to **interact in real time** with the electricity market, new commercial goods and services. Interaction that leads to healthy competition for energy goods and services will engender new markets and cause restructuring of existing ones."*

EDF 2011

# Smart Grid Deployment and Demand-Side Sales

***Required in California***

- ***Real time market integration***

***Add'l Recommended***

- ***Data access***
- ***Data transmission***
- ***New commercial markets***

# Smart Grid Deployment and Environmental Benefits

The smart grid should significantly reduce the total environmental footprint of the current electric generation and delivery system in California. Similarly, the CPUC should to evaluate the impact of the smart grid on achievement of state goals for reducing emissions of greenhouse gases as set forth in the California Global Warming Solutions Act of 2006 and other state directives (i.e. NAAQS, Long Term EE Plan, Loading Order, RPS, Solar Initiative, etc.)

D.10-06-047
and SB 17
(paraphrased)

# Smart Grid Deployment and Environmental Benefits

*"The smart grid can **facilitate the integration** of low carbon, low emitting energy generation resources, while **also reducing demand** for new energy at peak times, thereby reducing the need for investments in new fossil fired generation equipment. Smart grid functions can also make the overall grid **more efficient**: improving load factors, lowering system losses, and reducing unnecessary consumption by providing optimal power for machine and engine performance. These improvements can lead to **reductions in air and water pollution, water use, land use and biological impacts.** Importantly, reductions in environmental impacts are directly correlated to **improvements in human health and welfare.**"*

EDF 2011

# Smart Grid Deployment and Environmental Benefits

***Required in California***

- ↓ ***System losses***
- ↓ ***Criteria air pollutants***
- ↓ ***Greenhouse gas emissions***
- ↓ ***Solid waste***

- ↑ ***Renewables***
- ↑ ***Asset utilization***

***Add'l Recommended***

- ↓ ***Water use***
- ↓ ***Land use***

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