

Smart Grid Primer

Energy Bar Association – Primer for Lawyers

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New Smart Grid role for NETL

- **“Modern Grid Strategy” to “Smart Grid Implementation” Strategy**
- **Develop materials to support SG implementation**
 - Implementation Planning
 - Building the business case
 - Best practices and lessons learned
- **Share, communicate, and educate stakeholders**
- **Provide strategic implementation support**

Integrate the capabilities of the existing MGS into the greater DOE OE Smart Grid “machine”, in an implementation support role.





What is the Smart Grid – really?



What's different with the Smart Grid?

- **Decentralized supply and control**
- **Two-way power flow**
- **Two-way information flow**

*Creating the intelligence and capability to
optimize:*

- *Reliability*
- *Security*
- *Economics*
- *Efficiency*
- *Environment*
- *Safety*

...for all stakeholders



Smart Grid Characteristics

The Smart Grid is “transactive” and will:

- *Enable* active participation by consumers
- *Accommodate* all generation and storage options
- *Enable* new products, services, and markets
- *Provide* power quality for the digital economy
- *Optimize* asset utilization and operate efficiently
- *Anticipate & respond* to system disturbances (self-heal)
- *Operate* resiliently against attack and natural disaster

...the enabler





Is it worth it?



The Beneficiaries

- **Utilities**
- **Consumers**
- **Society**

Maybe it depends on who you ask!



Utility Benefits

Operational improvements

- *Metering and billing*
- *Outage management*
- *Process improvement*
- *Work force management*
- *Reduced losses (energy)*
- *Asset utilization*

Asset Management improvements

- *System planning (deferral of capital projects)*
- *Maintenance practices*
- *Engineering*

These benefits are expected to improve customer satisfaction and reduce O&M and capital costs.



Consumer Value Proposition

Benefits

- More reliable service
- Reduced business losses and prices for goods & services
- Potential bill savings
- Transportation cost savings (PHEVs vs. conventional vehicles)
- Information, control, and options for managing electricity
- Option to sell consumer-owned generation and storage resources into the market

Costs

- Passed on to the consumer

Answers “What’s in it for me?”



An Example

Potential Bill Savings

Estimated residential bill/year	\$1,200
Expected reduction from EE/DR	10% – 15%
Potential savings/year	\$120–\$180
Assumed bill increase to pay for smart grid/year	\$60–\$120
Net consumer value/year	\$0 –\$120

Positive value but not very compelling!



Another Example

Potential Fuel Cost Savings

Assumed miles driven/year	10,000
Fuel cost (gas)/mile	\$0.10 – 0.15
Fuel cost (PHEV)/mile	\$0.03 – 0.05
Annual fuel cost (gas)	\$1,000 – \$1,500
Annual fuel cost (PHEV)	\$300 – \$500
Potential fuel cost savings/year	\$500 – \$1,200
Premium to purchase PHEV over gas	\$4,000 – \$10,000

More compelling but is it enough?



Societal Value Proposition

Benefits

- Energy independence
 - Deep penetration of electric vehicles –Smart Grid enabled – **could reduce oil imports by 52%**
 - Smart Grid supports conservation, demand response, and reduces T&D losses further reducing peak loads and total U.S. electricity consumption by **56 to 203B KWh's by 2030**
- National security
 - Smart Grid increases the decentralization of supply, greatly reducing its vulnerability to attack
 - 2-way flow of power and information enables the grid to anticipate and respond to problems (self-heals) dramatically reducing the impact and duration of disturbances.
- Downward pressure on electricity prices – *through improved operating and market efficiencies, consumer involvement, deferral of capital projects*



Societal Value Proposition

Benefits

- Improved environment
 - Deep penetration of electric vehicles –Smart Grid enabled – **could reduce CO₂ emissions by 60 to 211 Million metric tons in 2030**
 - New storage technologies—including EV's— will enable a much deeper penetration of intermittent renewables.
 - Smart Grid will reduce T&D losses thereby reducing the amount of generation needed to serve a given load.
- Growing the U.S. economy
 - New jobs—**280K new, 140K sustained**— to support the planning, design, construction, operation and maintenance of the Smart Grid
 - Economic development for new products and services demanded by Smart Grid consumers
- Improved reliability – **leading to reduction in consumer losses (~\$135B)**



Summary

- **Help the consumer “get on board”**
- **Develop the complete story**
 - consumer benefits
 - societal benefits
 - costs of doing nothing
 - address their concerns
 - answer their questions
- **If we do this right – we can all be winners**
 - Suppliers
 - Consumers
 - Society

We can make the Smart Grid a winner for all!



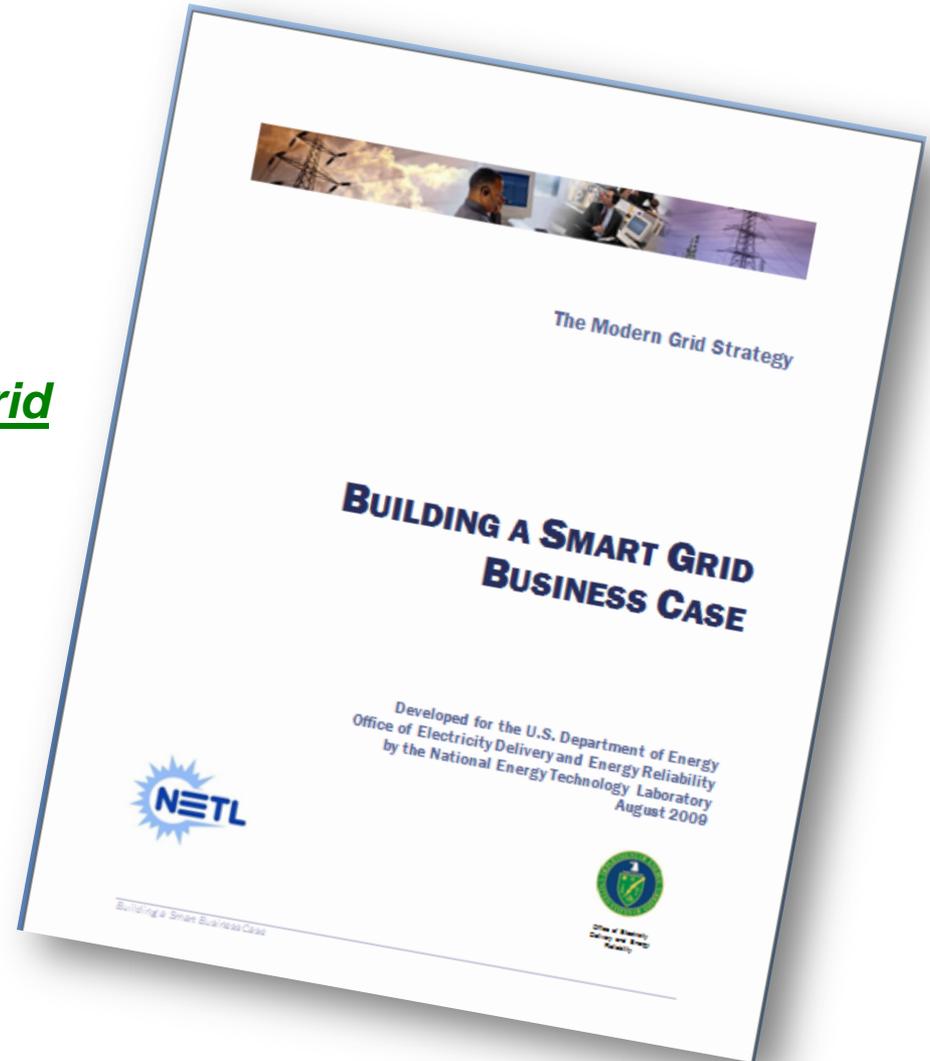
For More Information

For additional Information:

<http://www.netl.doe.gov/moderngrid>

Coming soon:

<http://www.smartgrid.gov>

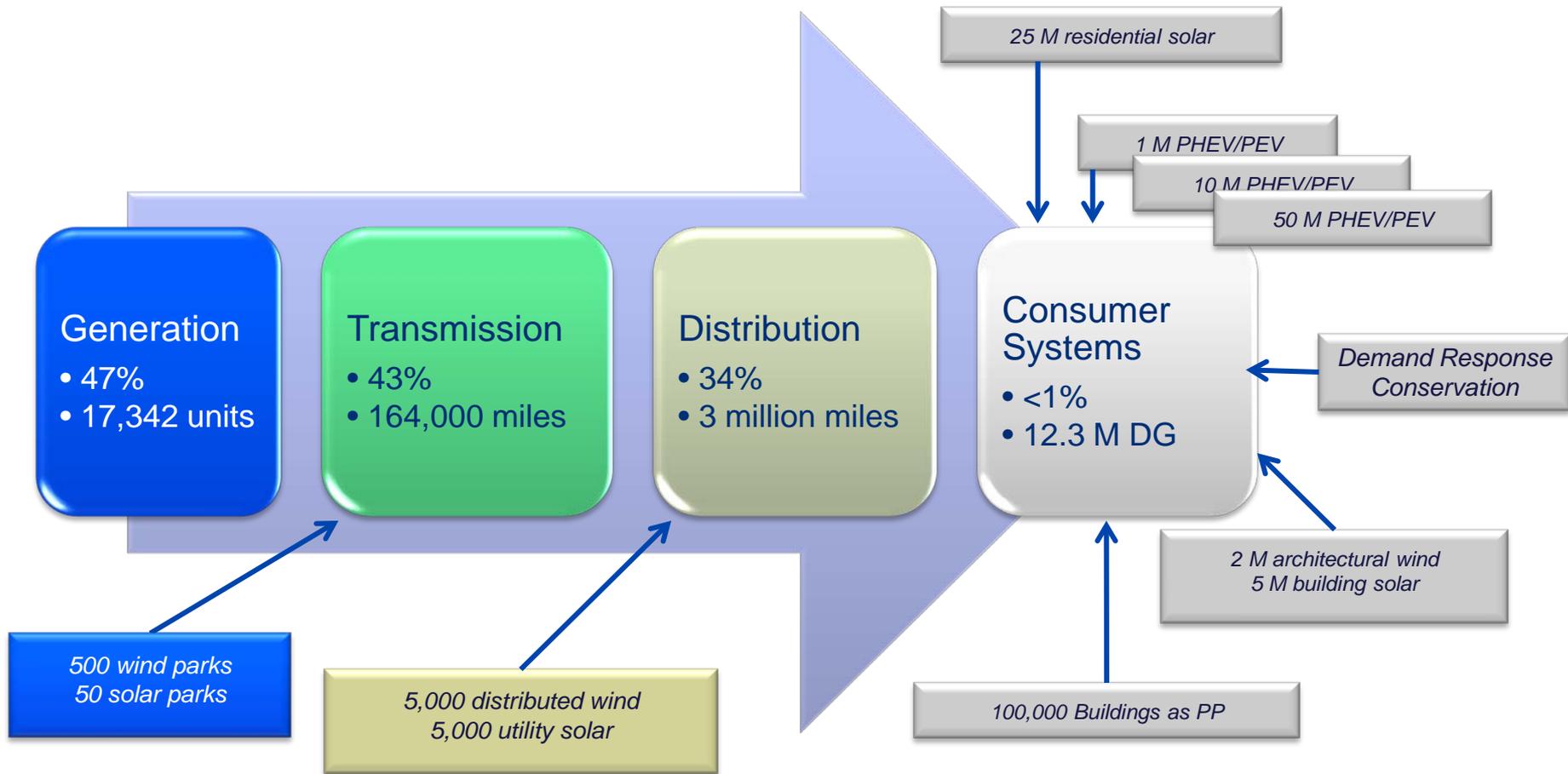




Back-up Slides



The Smart Grid will Optimize Supply



Some Challenges

- **Technology**
- **Interoperability and cyber security standards**
- **Regulatory Policy**
- **Workforce training and education**
- ***Consumer engagement (the market)***



WV Smart Grid Costs & Benefits

PV 20-yr Cost and Benefits (\$1000)

Solution	Cost	Benefits
AMI	\$399	\$1,377
IT	\$170	\$1,025
DR	\$22	\$877
DMS	\$454	\$3,286
DER	\$832	\$3,671
Total	\$1,878	\$10,236

Benefit to Cost Ratio for West Virginia – 5:1

Benefit to Cost Ratio for San Diego – 6:1

Benefit to Cost Ratio for US (EPRI 2004) – 4:1 to 5:1

How do we engage the consumers?

Three Step Process

- ***Create Understanding*** of Smart Grid concepts and issues through effective communication, education, and debate
- ***Create Alignment*** using a collaborative approach and by allowing consumers to impact the direction of the Smart Grid transition in their respective areas or regions
- ***Motivate*** :
 - *Value in moving forward*
 - *Cost/penalties of doing nothing*
 - *Address their questions and concerns*



Addressing Consumer Concerns

- **Burdensome new tools**
 - “keeping it simple”
 - Set it and forget it
- **Privacy**
 - How do we protect the privacy of consumers and gain their trust?
 - Other industries have addressed this concern. Let’s check with them
- **Cyber vulnerability**
- **Control and trust**
 - Utility control of prices that change frequently (“price of gasoline” model)
 - Bad experience with de-regulation
 - Worry that smart-grid technologies are just another way for utilities to make extra money off consumers
- **Technology obsolescence**



Answering Consumers' Questions

- **Why do we need to pursue the consumer side (smart meters) before smart grid upgrades are made to the distribution system?**
- **Why can't many of the benefits that Smart Grid provides be done with existing technologies, e.g., existing demand response technologies?**
- **All consumers will pay for Smart Grid investments, but only some will (can) take the initiative to achieve the benefits. Is that fair?**
- **Will consumers have to purchase additional devices to participate with the Smart Grid and enjoy its benefits, e.g., home area networks, in-home displays?**
- **Will Smart Grid technologies increase the risk of cyber security events resulting in a less secure grid?**

