

## Smart Grid Primer

Energy Bar Association – Primer for Lawyers

Joe Miller – Smart Grid Implementation Strategy Team Lead

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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.*





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**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***





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**Is it worth it?**

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# 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 CO<sub>2</sub> 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!***



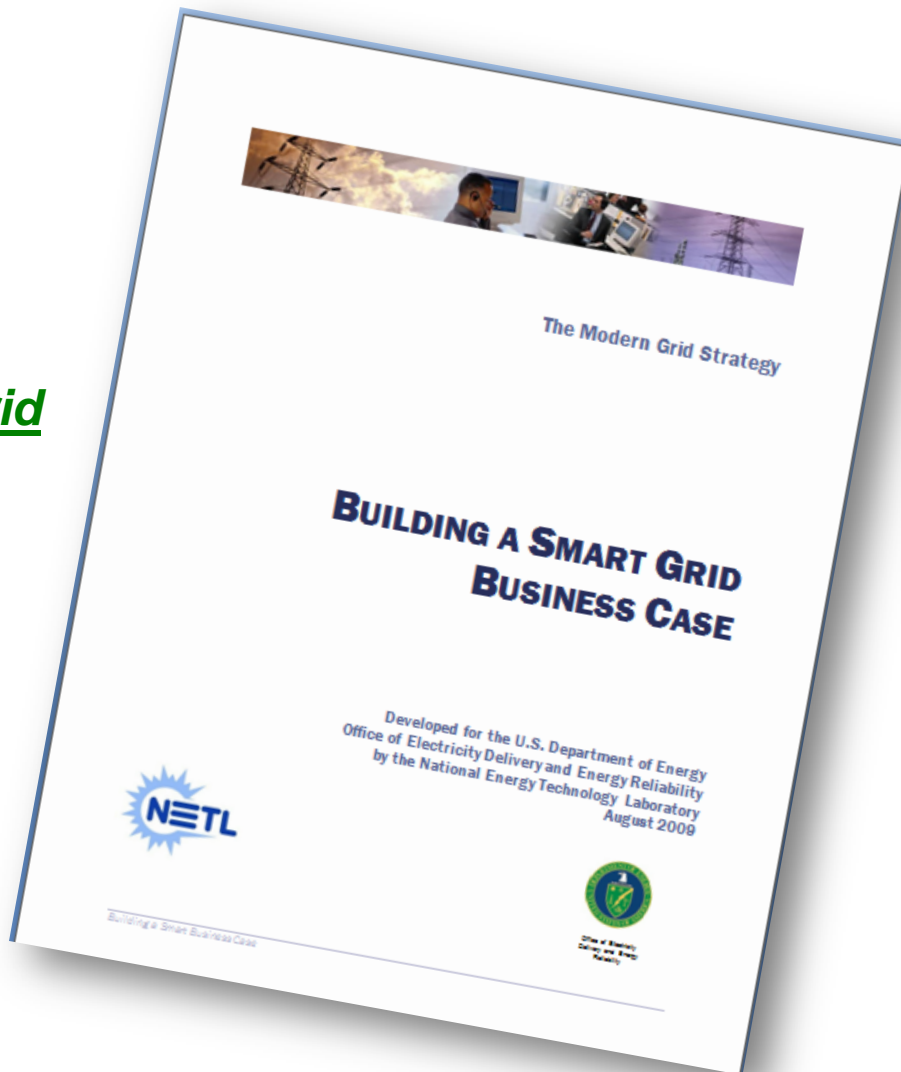
# For More Information

*For additional Information:*

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

*Coming soon:*

<http://www.smartgrid.gov>







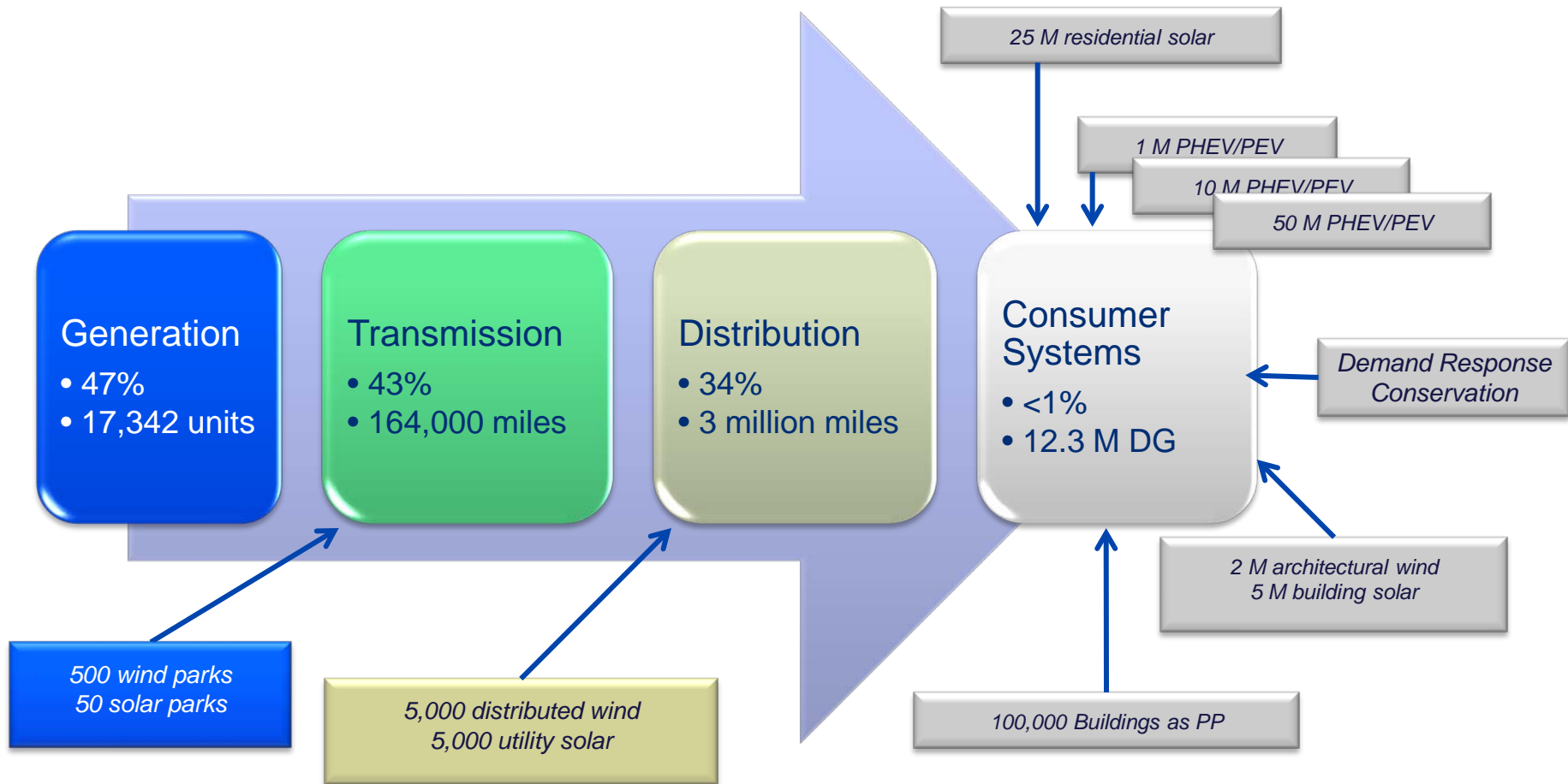
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## **Back-up Slides**

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# 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
<b>Total</b>	<b>\$1,878</b>	<b>\$10,236</b>

*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?**

