



THE SMART GRID

A look at how technology and data can revolutionize the energy industry

GROUP MEMBERS:

OMAR MAHMOOD

DREW FELDMAN

EDWIN VARGAS

WILLIAM WEI

TYLER COWAN

DEREK TROPF

WHAT IS A SMART GRID?

- Computerized and automated electricity grid
- Uses sensors to collect data
- Allows utilities and consumers to use this data to reduce carbon emissions

WHAT IS A SMART METER?

- Measure current, voltage, frequency; store and transmit data
- Two-way communication between consumer and utility
- Some technical details:
 - Phasor Measuring Units measure parameters
 - Measurements time-stamped using GPS time – now called synchrophasors
 - Synchrophasors can be meaningfully aggregated and compared

Source: NERC

WHAT DO WE NEED?

- Your investment!
 - \$ 338 billion over 15 years for entire US grid – install smart meters and sensors, upgrade old infrastructure, develop billing and communication systems
 - Huge benefit – \$1.3 trillion to \$2 trillion
- Smaller budget? Don't panic!
 - Focus on smart meters and sensors, and for a smaller geographical area

Source: EPRI

WHY SHOULD WE DO THIS?

- Reduction in energy use and carbon emissions*
 - Direct reduction: 12 %
 - Indirect reduction: 6 %

* "Assumes 100% penetration of smart grid technologies"

Source: PNNL

The background is a blue gradient with white circuit-like lines in the corners. These lines consist of straight segments and small circles, resembling a stylized electronic circuit board.

HOW WILL SMART METERS AND SENSORS CHANGE EVERYTHING?

HOW DOES DATA REALLY HELP US?

The slide features a blue gradient background with decorative white circuit-like lines in the corners. These lines consist of small circles connected by straight lines, resembling a stylized electronic circuit.

REDUCE VARIABILITY OF RENEWABLES

- Renewables are intermittent
- Aggregate power from various geographic areas when needed – more steady/reduced variability
- Make use of interruptible rates

ENABLE DISTRIBUTED GENERATION

- Utilities currently wary of letting people put electricity into the grid
- Sensors, smart meters give live information, control over distributed systems
 - Utilities more reassured and willing to encourage distributed generation
 - Better valuing and pricing of distributed systems

The slide features a teal-to-blue gradient background. In each of the four corners, there are decorative white line-art elements resembling circuit boards or neural networks, with lines of varying thickness and small circles at the ends.

DISTRIBUTED GENERATION – MORE RENEWABLES

- Renewables have high initial fixed cost but low operating costs
- Utilities do not have capital to finance many projects
- Distributed generation allows private sector to finance projects
- Utility as mediator – (heavily regulated) capitalism!

DISASTER RESILIENCE

- Distributed generation spreads risk
- Data immediately indicates which areas are affected and how
 - Greater accuracy
 - Faster response times
 - Fewer resources needed

CONSUMER-DRIVEN SUSTAINABILITY

- Consumers can be told when electricity is being produced by a high proportion of renewable sources through their smart meters
- People can be expected to shift consumption to renewable-heavy time periods



WHAT SHOULD THE FUTURE HOLD?

The slide features a blue gradient background with white circuit-like lines and circles in the corners, resembling a stylized circuit board or network diagram.

CYBER-SECURITY

- Interconnected grid – concerns over privacy, hacking, attacks
- Create security architecture
- Create algorithms to detect suspicious activity, protect against intrusions
- Create legal framework to handle data usage

A decorative graphic consisting of white circuit-like lines and circles on a blue gradient background, located in the corners of the slide.

A SMARTER GRID

- Install more smart meters and sensors so that we can meet the 2030 target
- Retrofit grid infrastructure
- Incentivize buildings to upgrade
- Expand distributed generation
 - Incentivize private sector involvement
- Improve algorithms

URLS FOR REFERENCE

- <http://www.nerc.com/docs/oc/rapirtf/RAPIR%20final%20101710.pdf>
- http://energyenvironment.pnnl.gov/news/pdf/PNNL-19112_Revision_1_Final.pdf
- <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001022519>