7 Drivers of Change in the Electric Utility Industry

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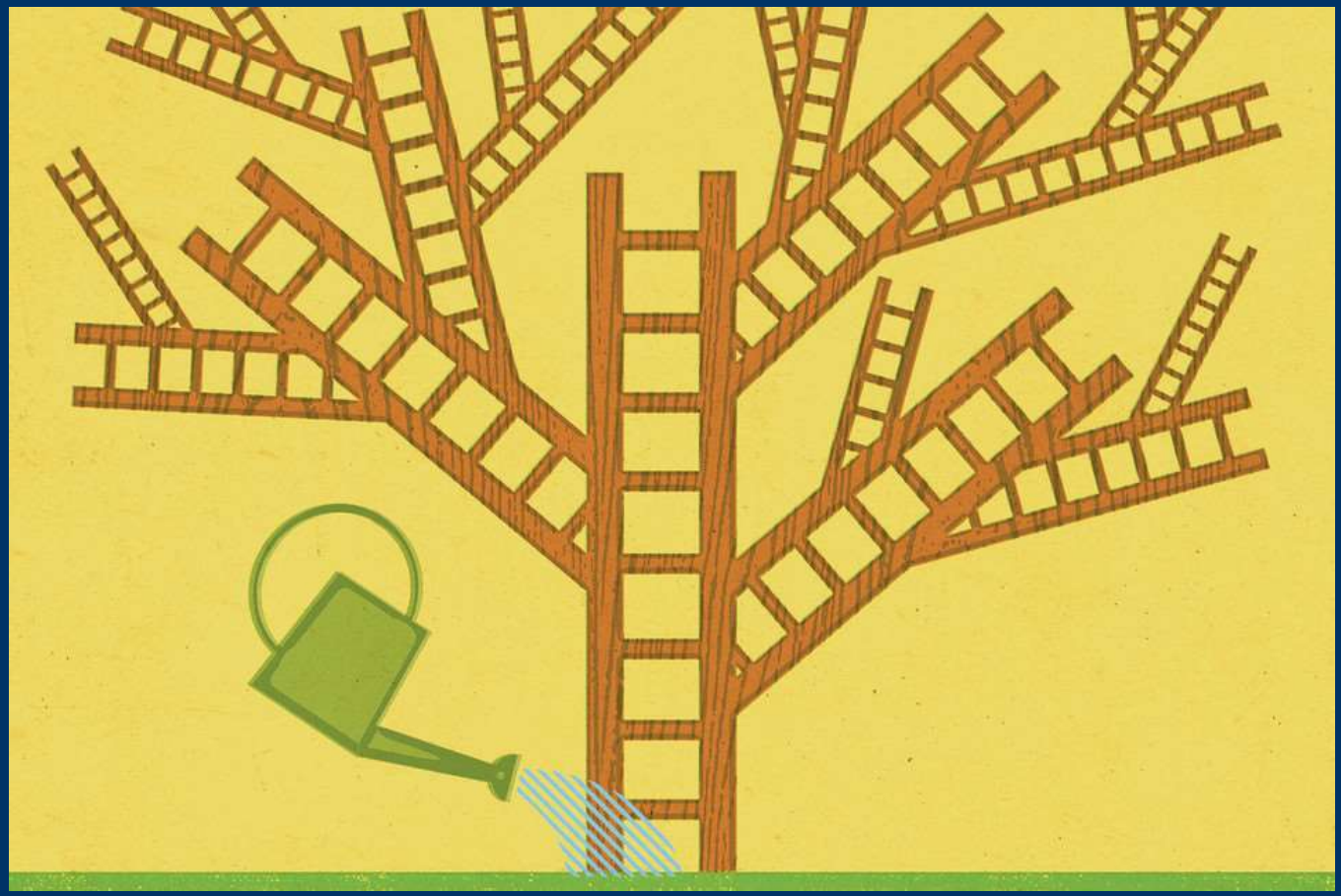
Conclusion

1. Make a list of programs/technologies/ ideas you'd like to investigate
2. Examine pros and cons of each
3. Understand financial, environmental & operational impacts
4. Update regularly
5. Pilot/test if possible

How many are 55+

How many are 40-54?



How many are younger than 39?

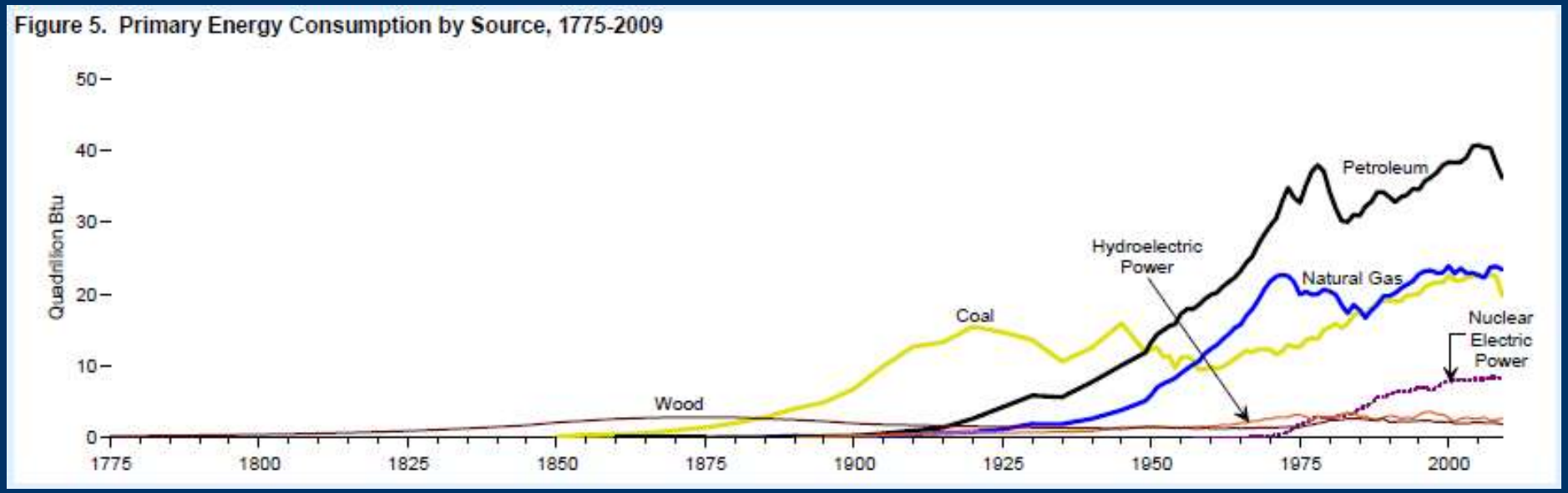
Who Knows What:

New trends

How to get things done

Priorities

U.S. Energy Use since 1775



Things change!

5 Points About Change

1. Things don't change overnight
2. Cost is important. But not always…
   - Environmental impact & jobs are key, then cost & reliability
   - In 49 other states, cost generally is key.

5 Points About Change

3. Results matter

- But sometimes people want options with a variety of results
- Sometimes results can be difficult to quantify, such as addressing climate change, or determining the value of diversity

5 Points About Change

4. You have time, but you must act.

Ok to let others jump first and learn from their experience.

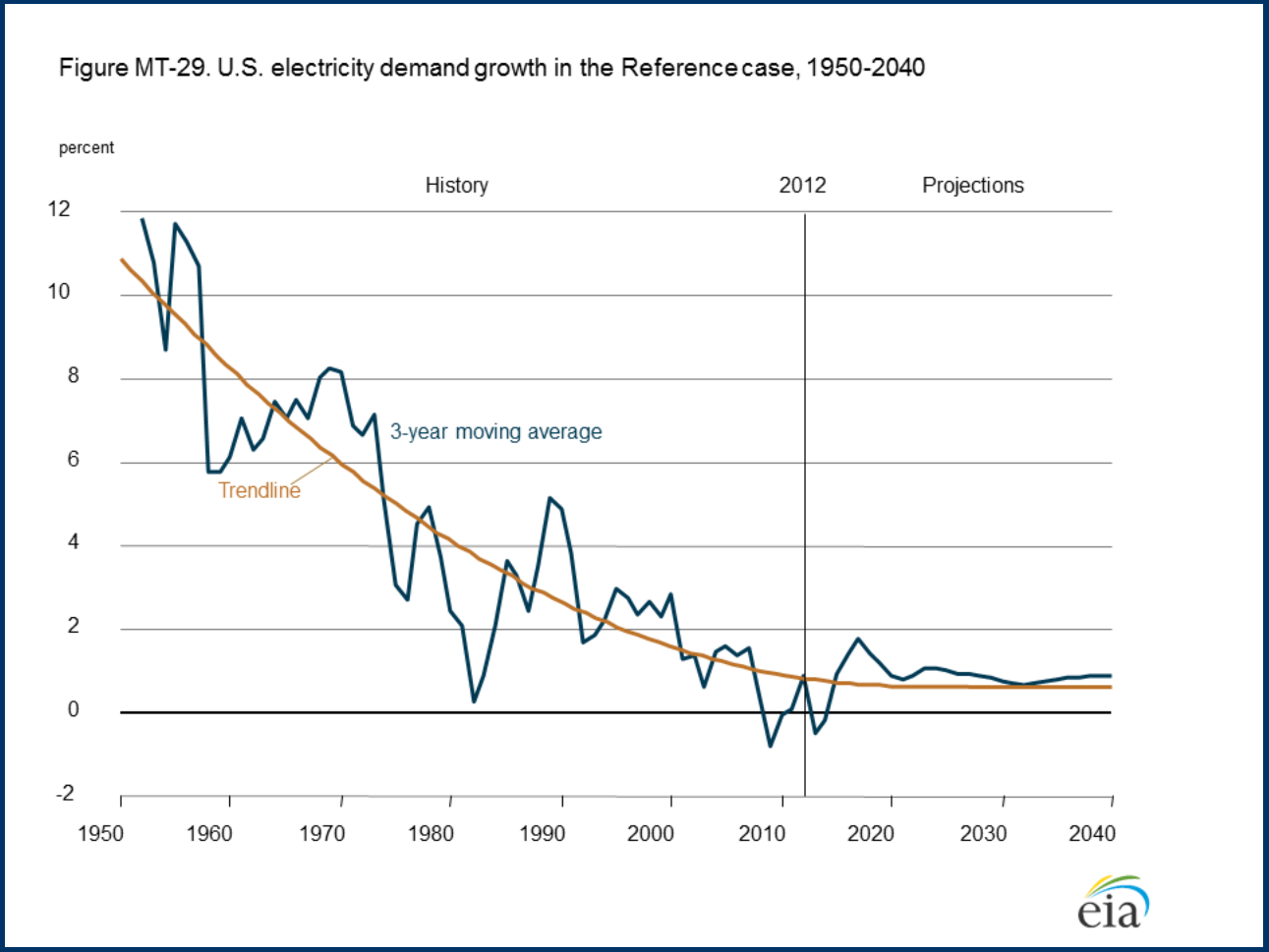
5 Points About Change

5. If you stand still, you will get run over

What's Happening Today?

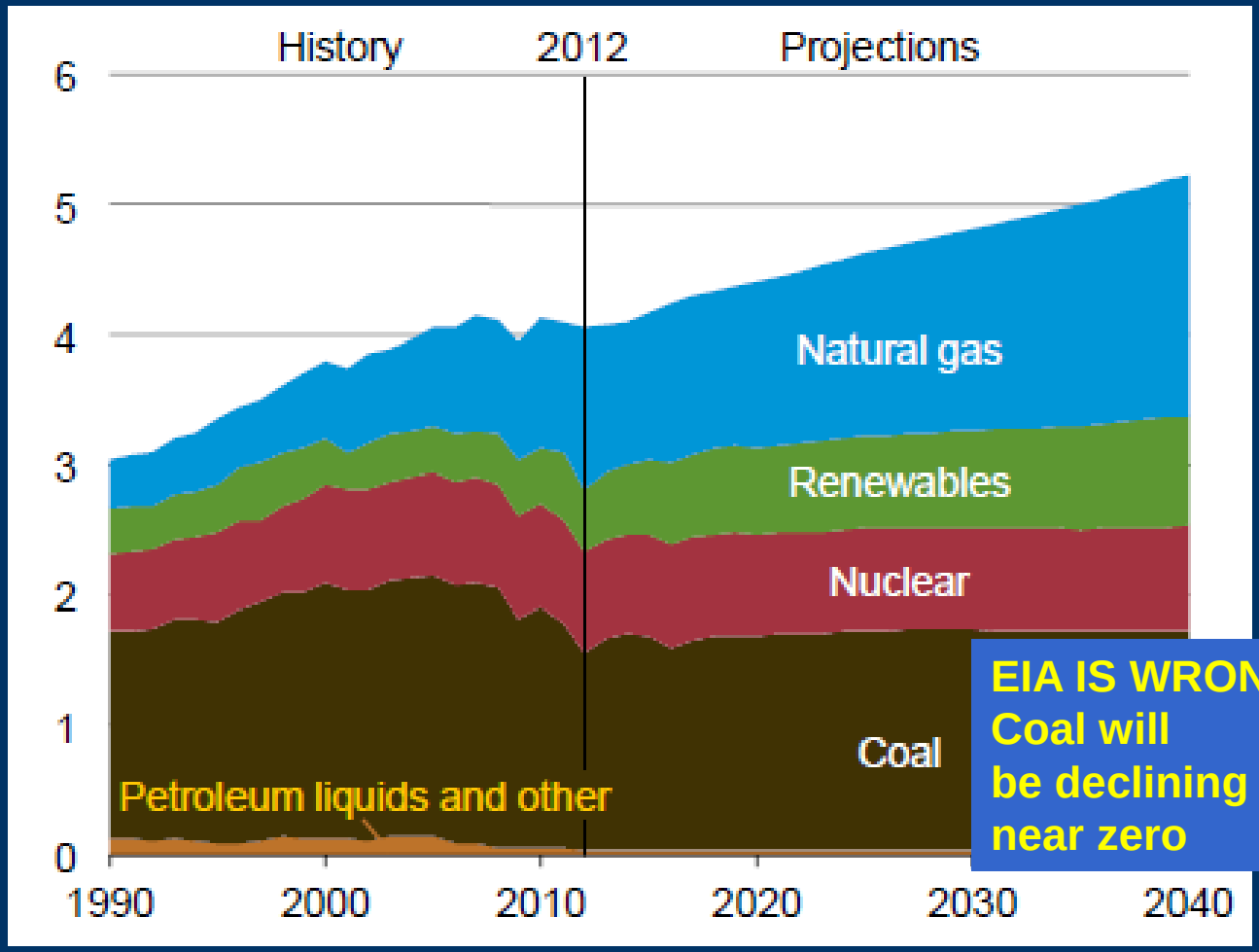
- Energy costs down
  - Supply up: oil, tar sands, fracked gas
  - World demand low but growing
- EPA Clean Power Plan – Gone for now, but killed coal
- Growing, but still challenges
  - Solar & wind
  - Electric Cars
  - Battery storage
- Lots of automation

EIA Annual Electricity Growth



http://www.eia.gov/forecasts/aeo/MT_electric.cfm

EIA: Electricity Generating Resources



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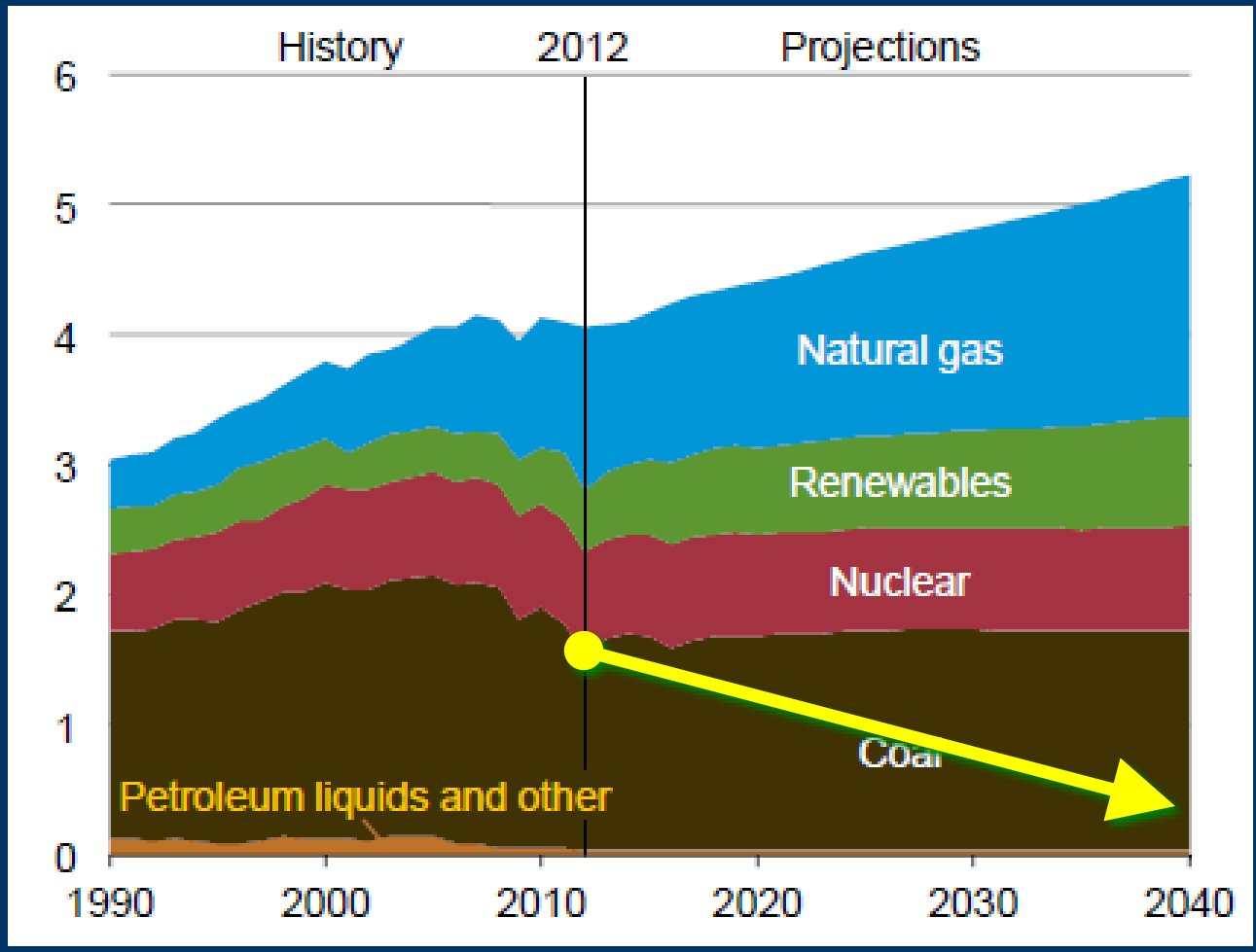

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Next 10 Years

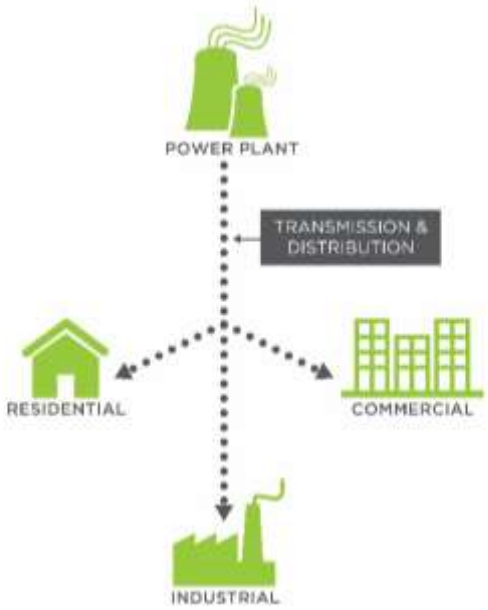
1. High reliability
2. Controlling costs
3. Cyber/physical security
4. Growing customer options
5. Customers expect service
6. Changing power supply
7. Workforce training & turnover

1. High Reliability

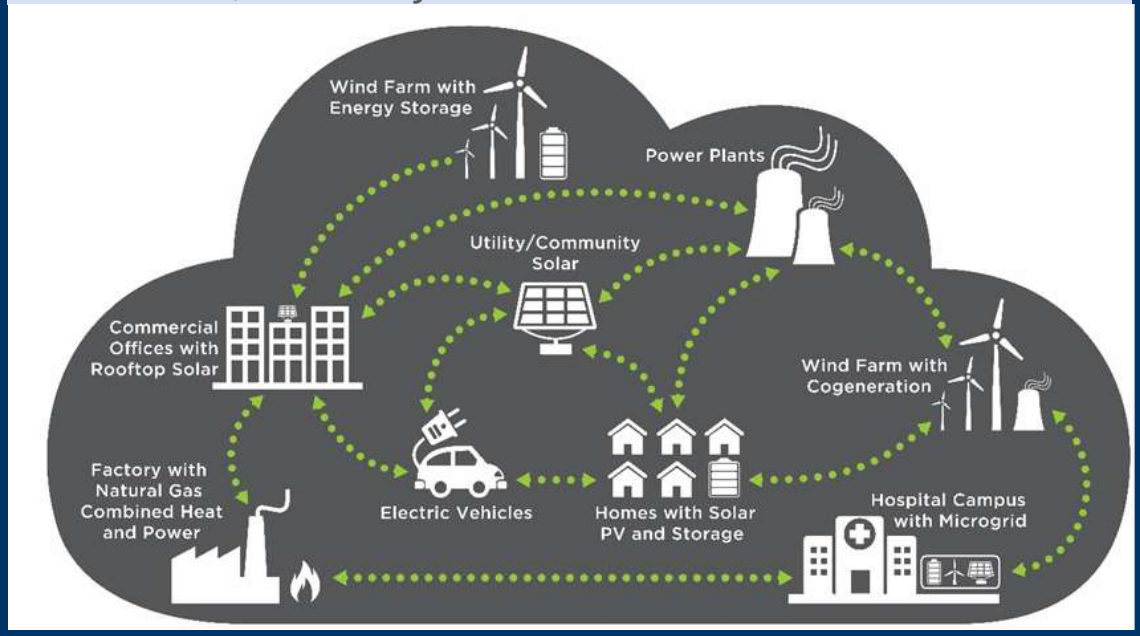
- How's your distribution system?
  - System evaluation and upgrade plan
- Automated metering infrastructure
  - Smart Grid
  - Customer information
  - Utility information ➡ demand response
    - ➢ AMI is the future

Moving toward an increasingly clean, decentralized, Intelligent grid

TODAY: Traditional Power Grid
Central, One-Way Power System



EMERGING: The Energy Cloud
Distributed, Two-Way Power Flows



Source: Navigant

2. Reasonable Cost

- Not lowest cost, but not highest
  - Cost tied to results
- Balanced energy portfolio
- Power supply is competitive
- Growing environmental regulations = Higher risk of ownership
- Partnerships to share risk

3. Cyber/Physical Security

FACE the NATION

FBI: Cyber threat might surpass terror threat

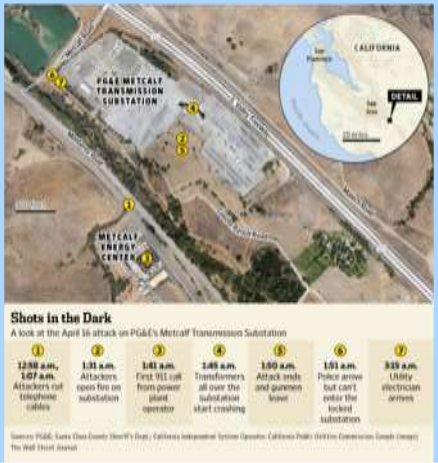
National Journal

America's 3 Biggest Cybersecurity Vunerabilities

The Obama administration has put cyberattacks at the top of the list of global threats, and concerns are rising about at-risk infrastructure.

February 5, 2014

THE WALL STREET JOURNAL.



Assault on California Power Station Raises Alarm on Potential for Terrorism

Hacker hits on U.S. power and nuclear targets spiked in 2012

OnMoney

The White House

BLOG PHOTOS & VIDEO BRIEFING ROOM ISSUES the ADMINISTRATION

Home • Briefing Room • Presidential Actions • Executive Orders

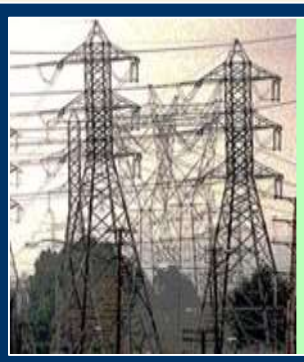
The White House
Office of the Press Secretary

For Immediate Release February 12, 2013

Executive Order -- Improving Critical Infrastructure Cybersecurity

EXECUTIVE ORDER

IMPROVING CRITICAL INFRASTRUCTURE CYBERSECURITY



The Washington Times
Wednesday, April 16, 2014

Inside the Ring: U.S. power grid defenseless from physical and cyber attacks

3. Cyber/Physical Security

- **What you don't know CAN HURT YOU**
  - Protect your utility and customer data
- **Backup offsite**
- **Facilities: Theft, vandalism and terrorism**
  - Ask Police Dept. for review of facilities
- **2 Reasons**
  - Breach is clearly bad
  - PR bad

4. Growing Customer Options

- What is the most frequent way your customers interact with you?

ELECTRIC COMPANY
P.O. BOX 123, Anytown, USA

ACCOUNT NUMBER	ACCOUNT NAME	RATE	CYCLE	SERVICE ADDRESS
123456789	XYZ Manufacturing	Large General Service	708	123 Main Street

SERVICE PERIOD FROM	TO	NO. DAYS	BILL TYPE	METER READING PREVIOUS	PRESENT	MULTIPLIER	kWh USAGE	PEAK DEMAND	POWER FACTOR
08/13	09/11	29	O	66543	71345	300	1,440,600	440 kW	75%

		$ AMOUNT
CUSTOMER CHARGE		$10.00
ENERGY CHARGE:	(1,440,600 X $0.005/KWH)	$57,624.00
FUEL COST ADJUSTMENT ($0.005):	(1,440,600 X $0.005/KWH)	$7,203.00
DEMAND CHARGE:	(440 kW x $5/kW)	$2,200.00
POWER FACTOR PENALTY:	(440 kW x $5/kW)	$800.00
SALES TAX - STATE:	(4%):	$2,713.48
SALES TAX - SPECIAL:	(1%)	$678.37
TOTAL AMOUNT DUE:		$71,228.85

4. Growing Customer Options

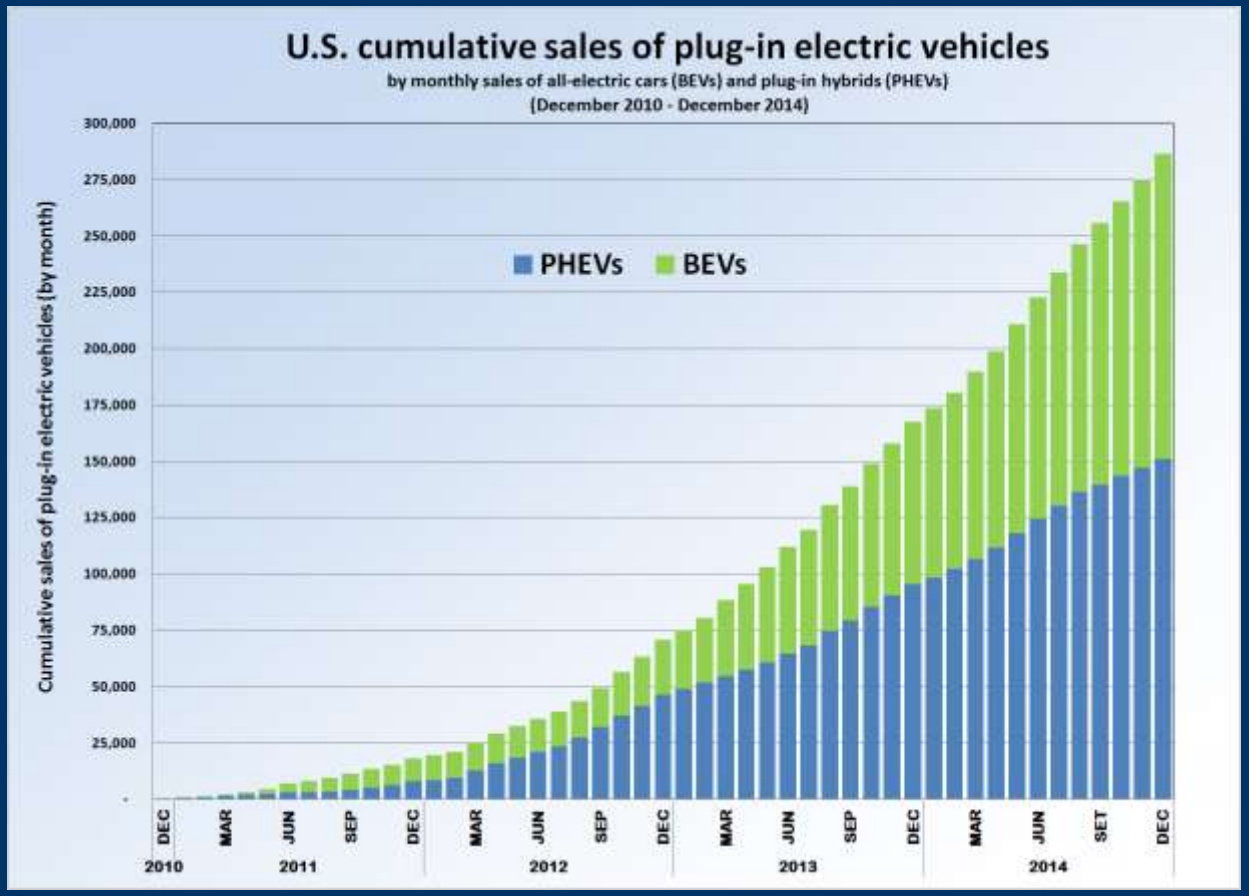
- How many options do you give customers?
  - Renewable energy
  - Energy Efficiency information, rebates
  - Flexible rates (evenings and weekends)
  - Demand response (water heaters, AC, peak gen)
  - Products and Services
    - Surge protection
    - Home warranty
    - Community Solar
    - Online billing
    - PrePaid billing

4. Growing Customer Options

- **Electric vehicles**
  1. Efficient (114 mpg, $1/gallon, 90% of trips local
     - Tesla: 270 miles/charge, 20 minutes recharge time)
  2. Energy independence
  3. Faster acceleration
  4. Lower carbon emissions
  5. Lower operating costs
  6. Combined with solar = Zero emissions
  7. All automakers involved
  8. Electric utility sales growth?

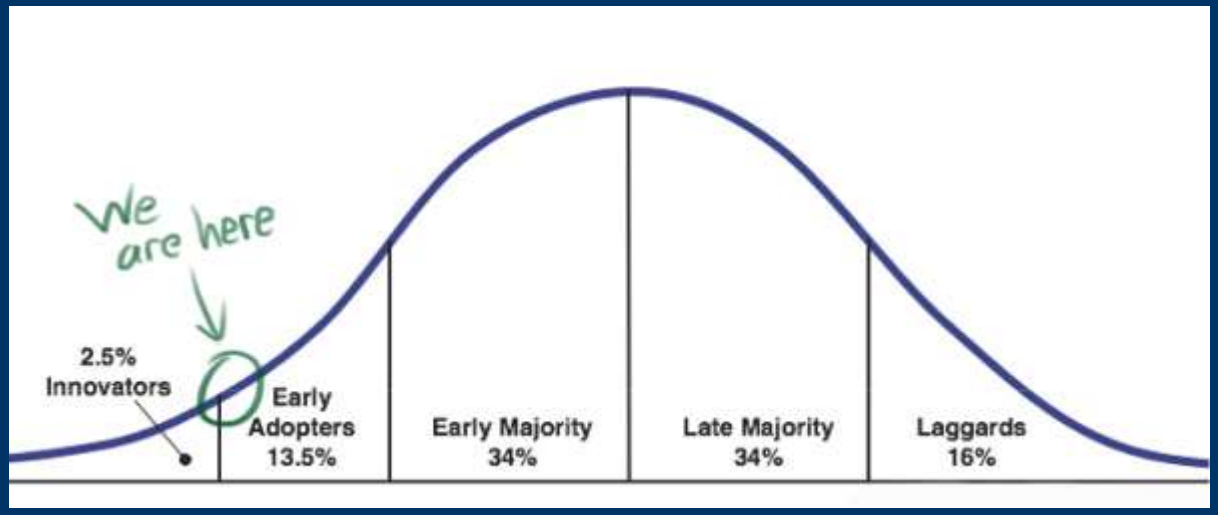
4. Growing Customer Options

- Electric vehicles



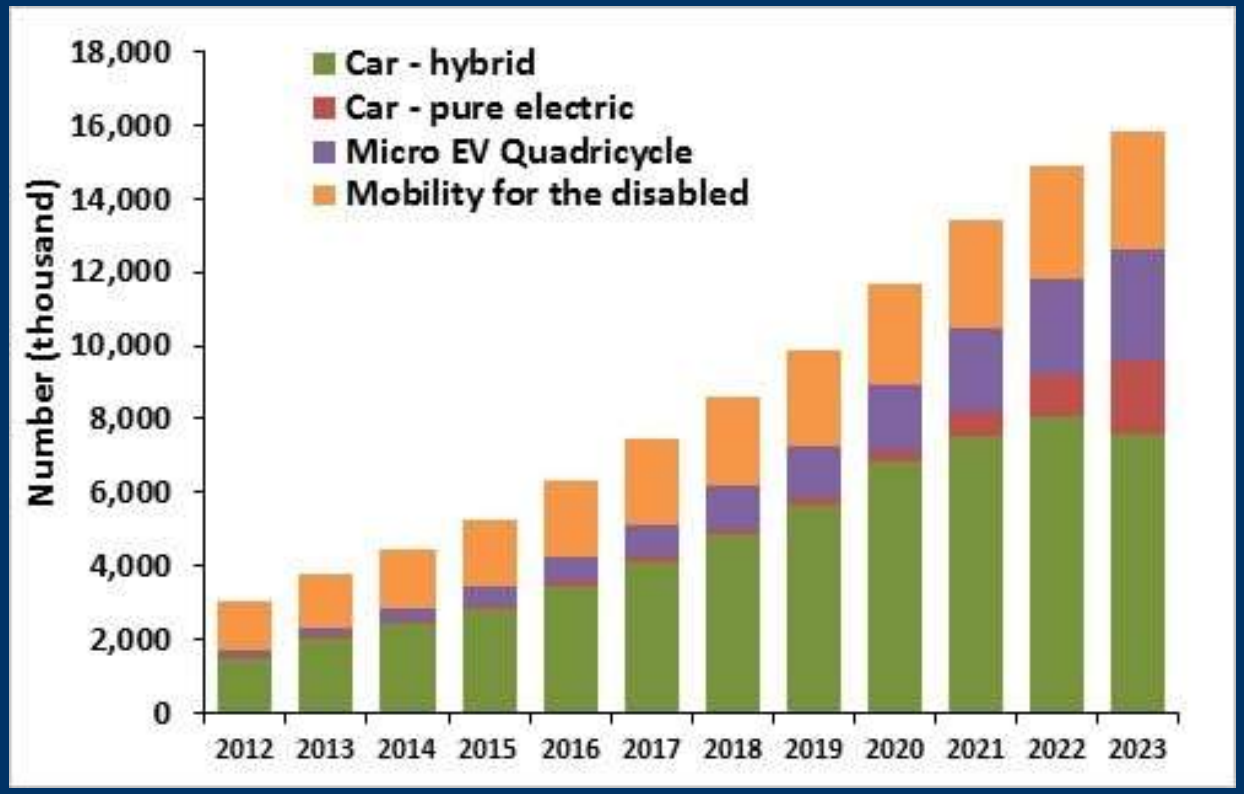
4. Growing Customer Options

- Electric vehicles



4. Growing Customer Options

- Electric vehicles



5. Customer Expect Service

- What is your best customer experience?
  - Starbucks? Mo's? Your utility?
- Ask yourself: What do we want our customer experience to be?
  - Define it
  - Do it well
  - Measure it
- Who here works in customer service?

5. Customer Expect Service

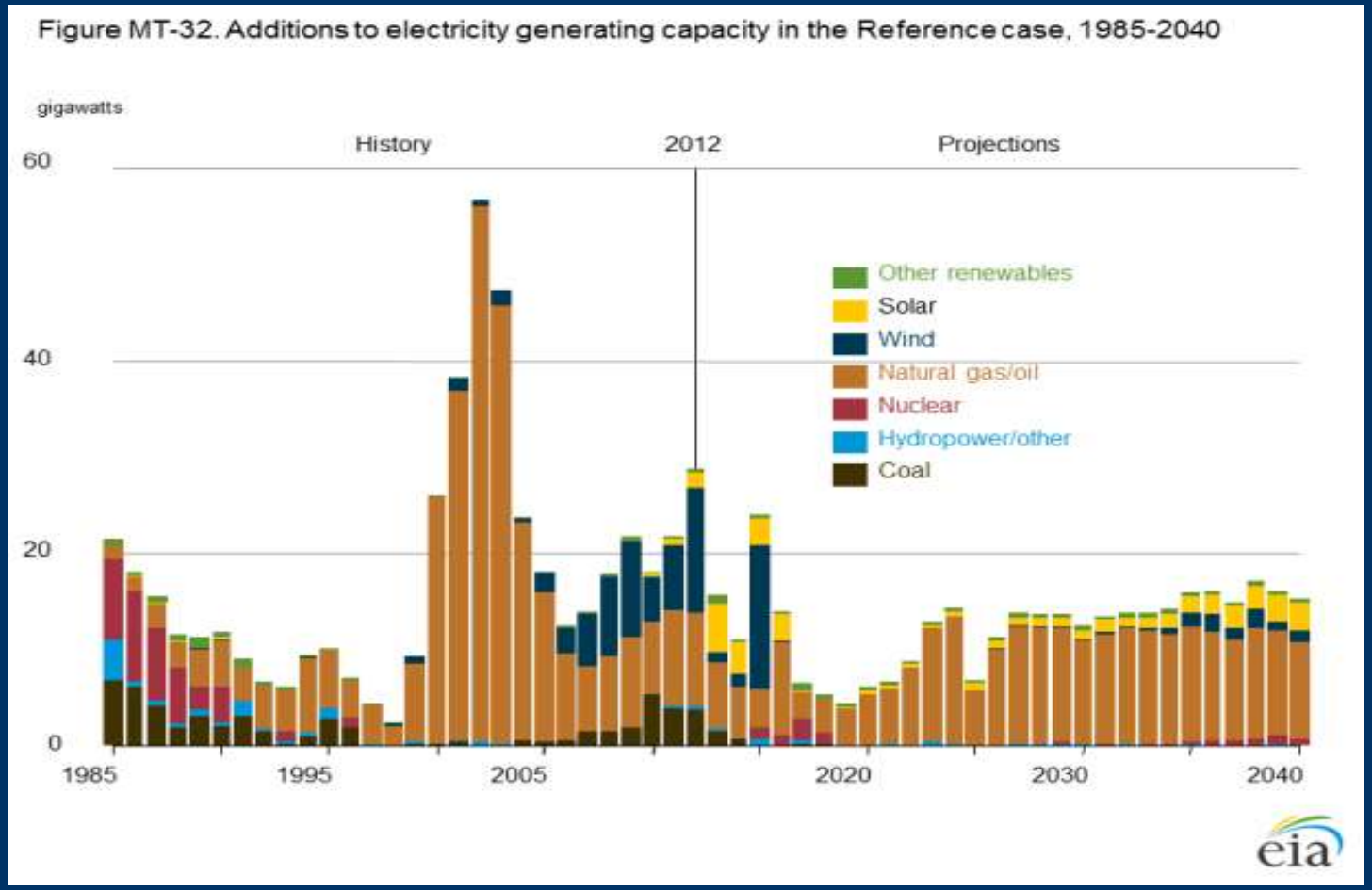
- **Customers want to be educated, informed and want it NOW!**
  - 24 x 7 access to information
  - Instant gratification
  - Little tolerance for mistakes
- **How's your website?**
  - Your website is your window for the world to see you!
- **How's your Facebook page?**
  - Daily updates
    - Great for outage updates

5. Customer Expect Service

6. Changing Power Supply

http://www.eia.gov/forecasts/aeo/MT_electric.cfm

EIA: New Generating Capacity



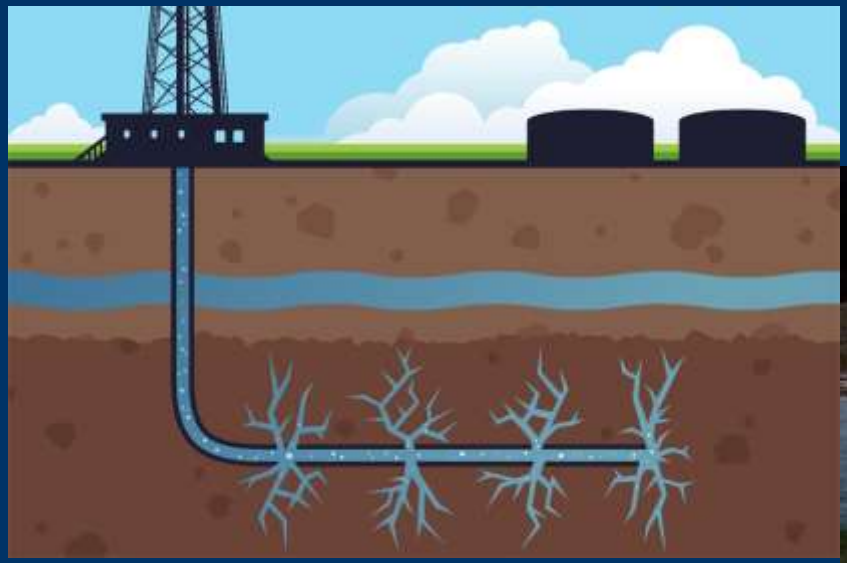
http://www.eia.gov/forecasts/aeo/MT_electric.cfm

6. Changing Power Supply

- What's changing?
  - More gas, less coal
  - More single-fuel risk
- New utility models
  - Utility-scale solar
  - Large-scale distributed generation

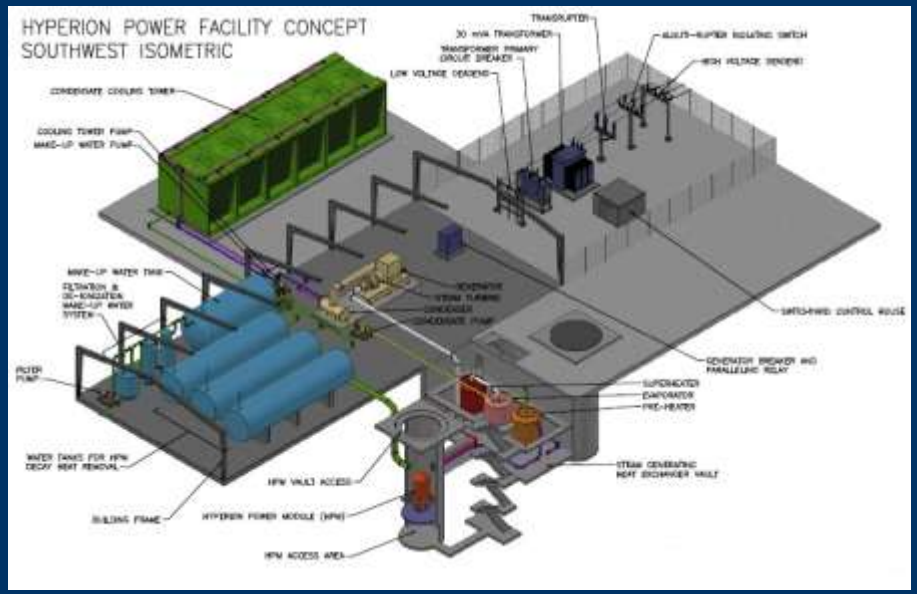
6. Changing Power Supply

- If fracking runs into problems, cost-effective natural gas supply will dry up
- Prices will rise



6. Changing Power Supply

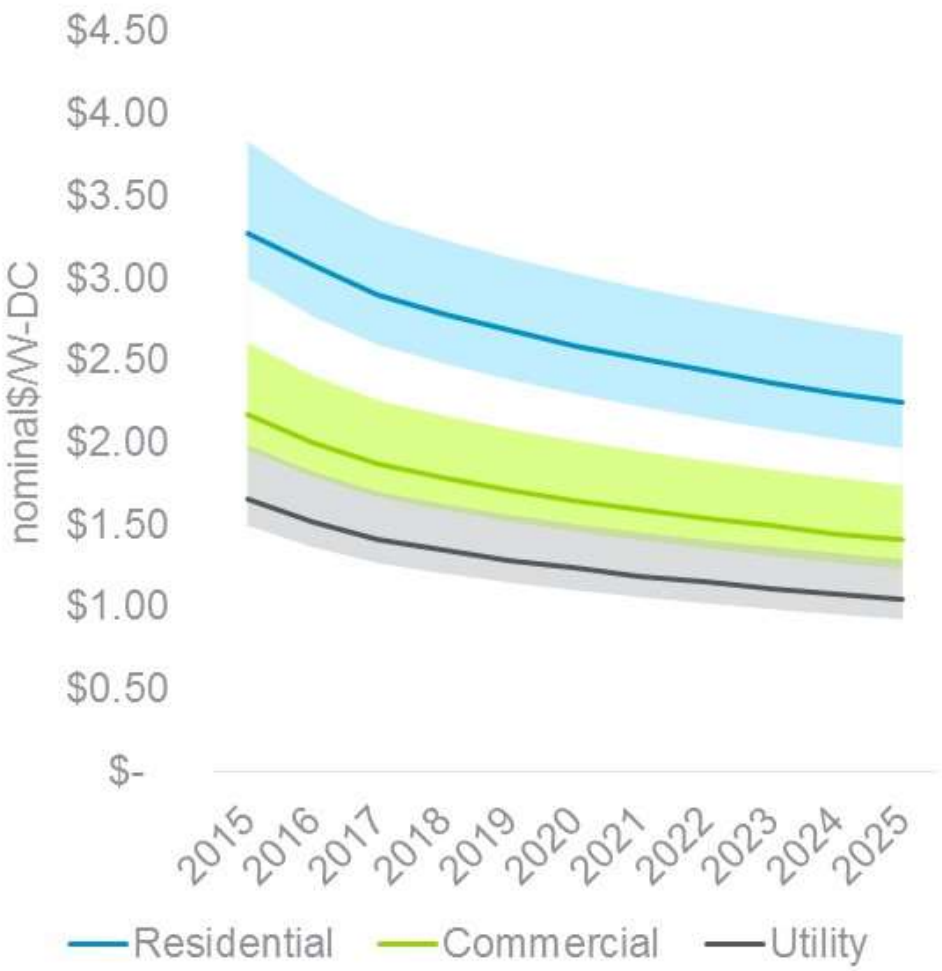
- Small Modular Reactors (Nuclear)
- Safe, small, cost-effective
- 500 MW facilities, carbon-free energy
- Size of a natural gas combined-cycle plant



6. Changing Power Supply

- **Utility-scale solar**
  - **Growing everywhere**
  - **Most cost-effective way to deliver solar**
  - **Can create operational problems when solar not available**
  - **Half the day is night**

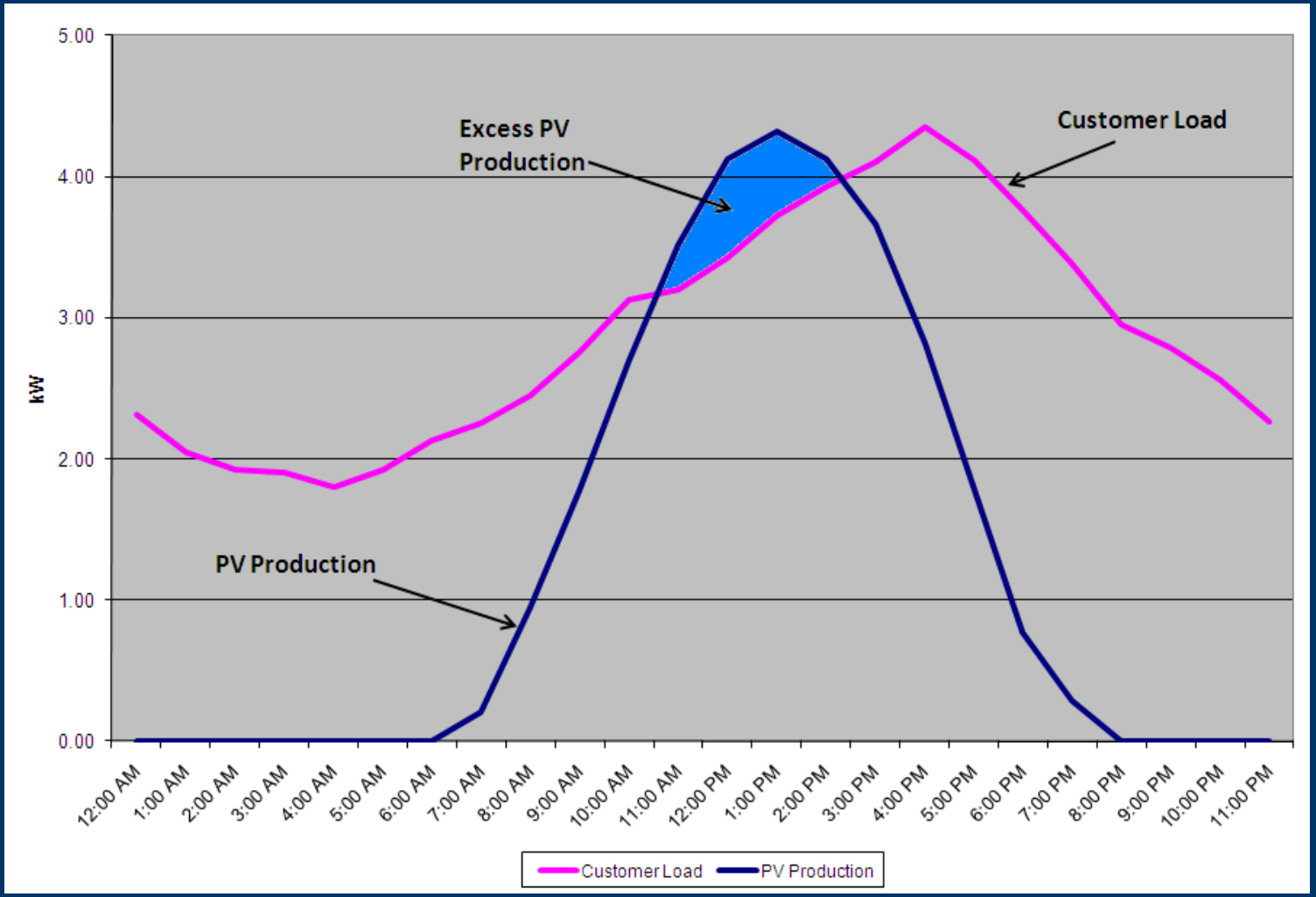
Solar PV Cost Reduction Scenarios



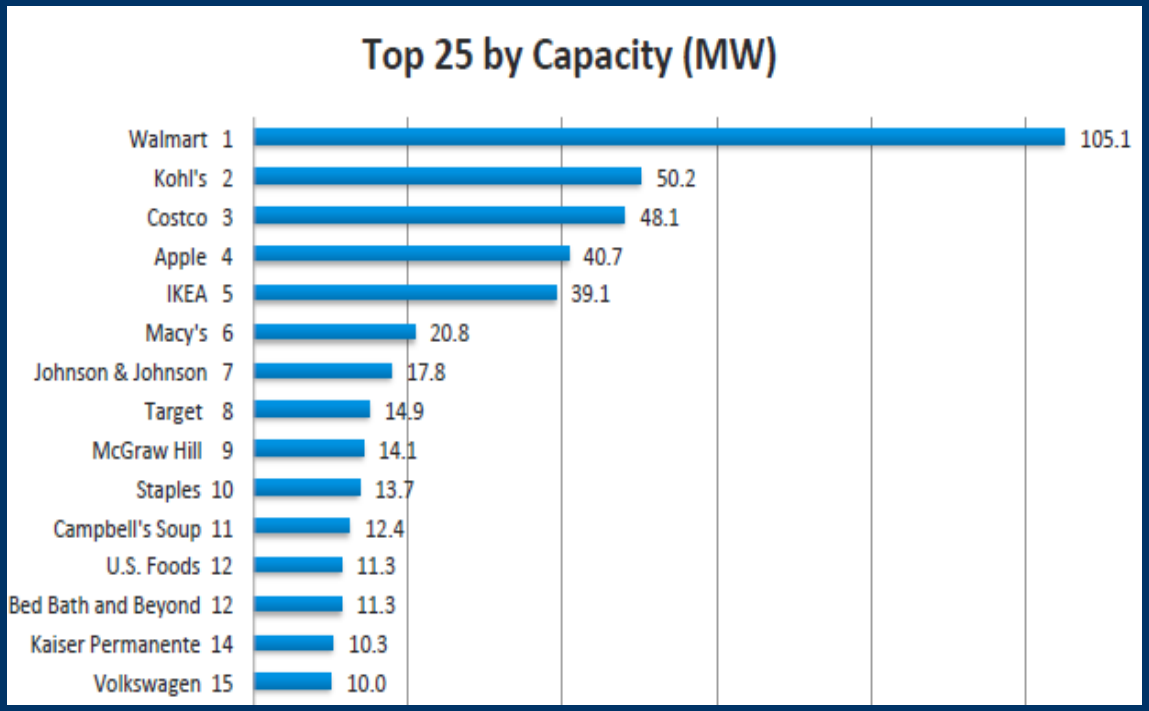
Source: Navigant, January 2016

Daily PV Production (5 kW) vs Typical Customer Load

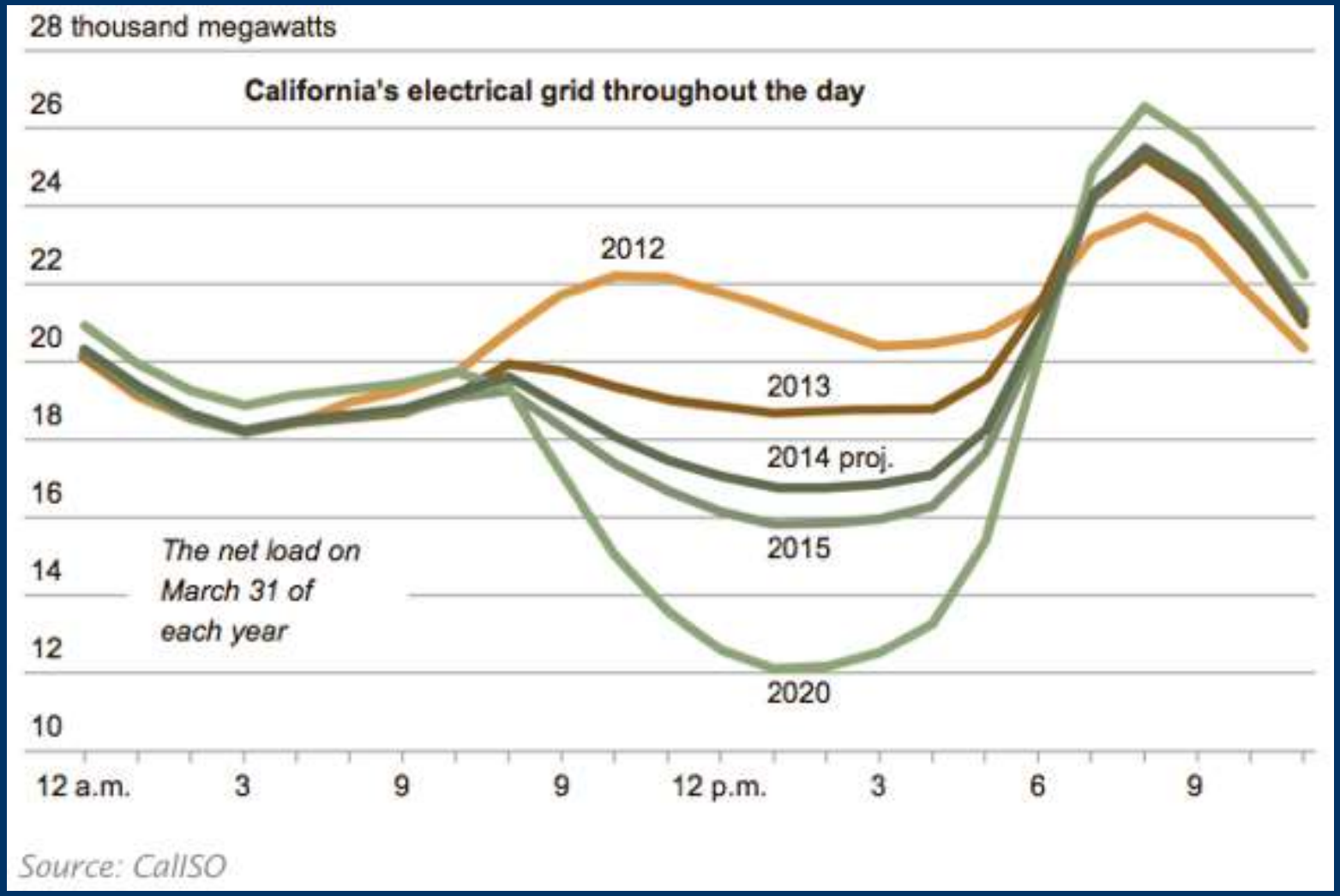
Summer



Top 25 U.S. Fortune 1000 companies installed 500 MW of on-site solar PV



Solar Impacts – The Duck Curve

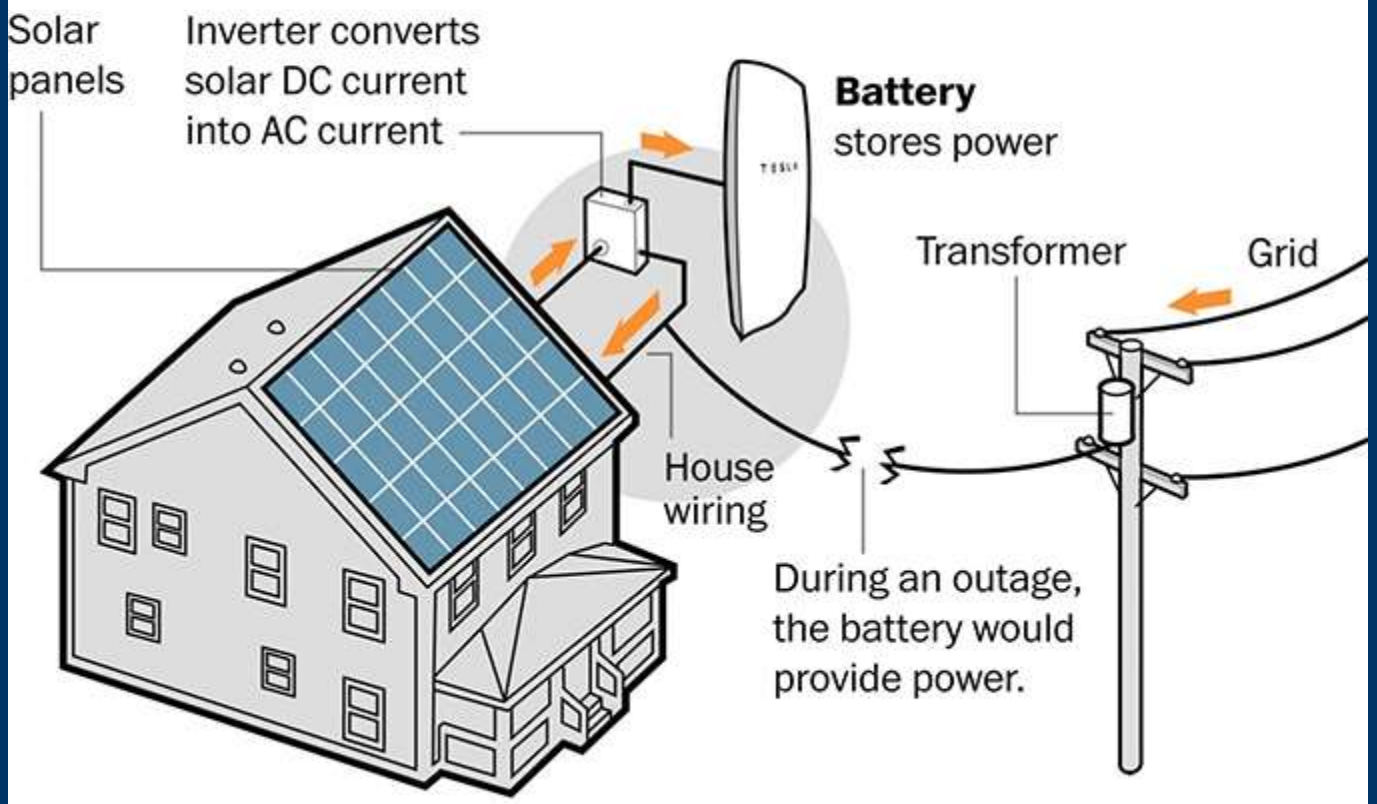


Tesla Powerwall

Energy Storage

How Tesla's home battery will work

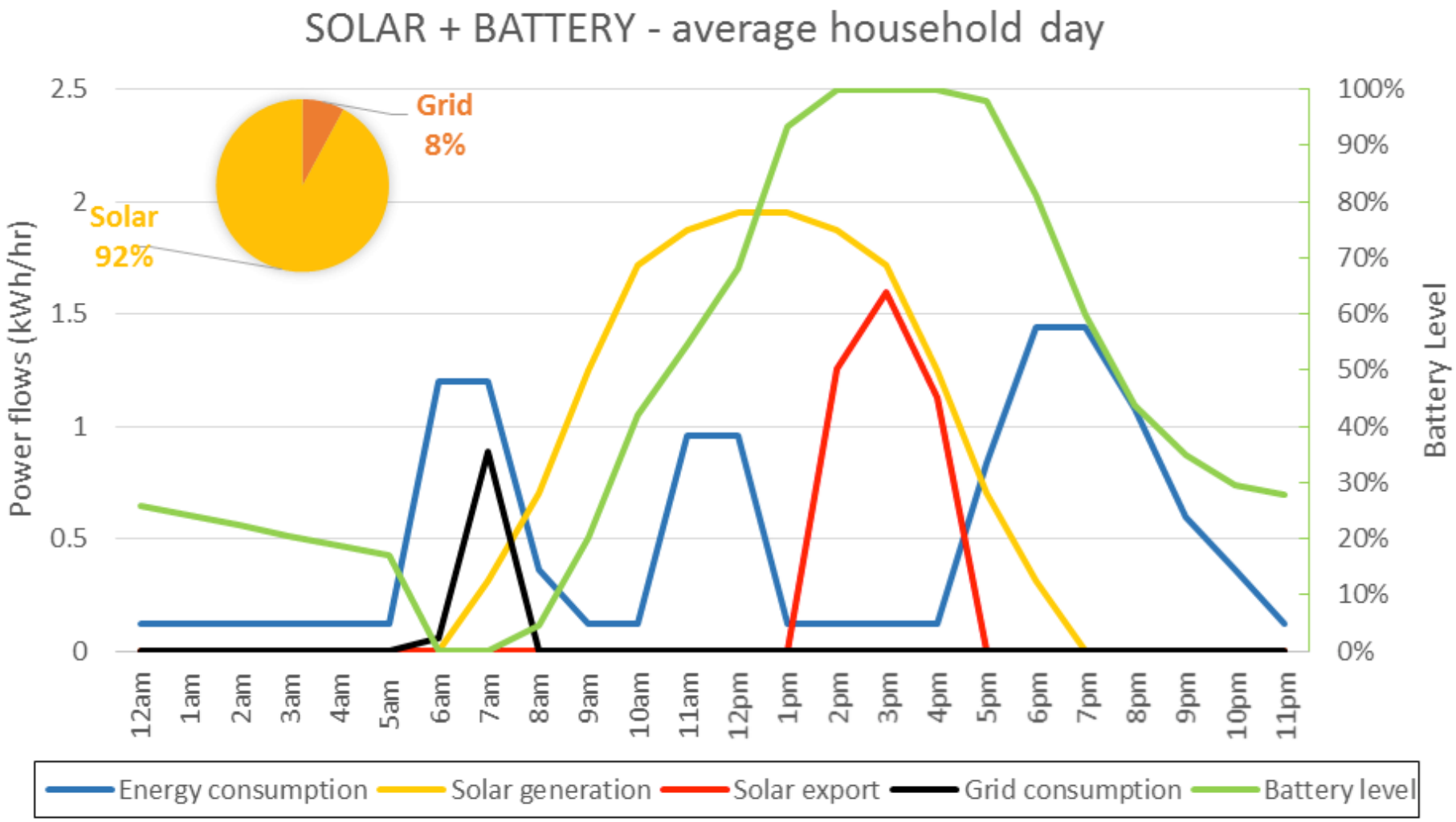
Tesla introduced a new battery system that can draw power from home solar panels or the grid to use during electrical outages. The battery is the size of a suitcase and can be mounted to an indoor or outdoor wall. It holds up to 10 kilowatt-hours of energy, about one-third of what the average U.S household uses per day.



Sources: SolarCity, Tesla, U.S. Energy Information Administration, staff reports

THE WASHINGTON POST

Utility of the Future?



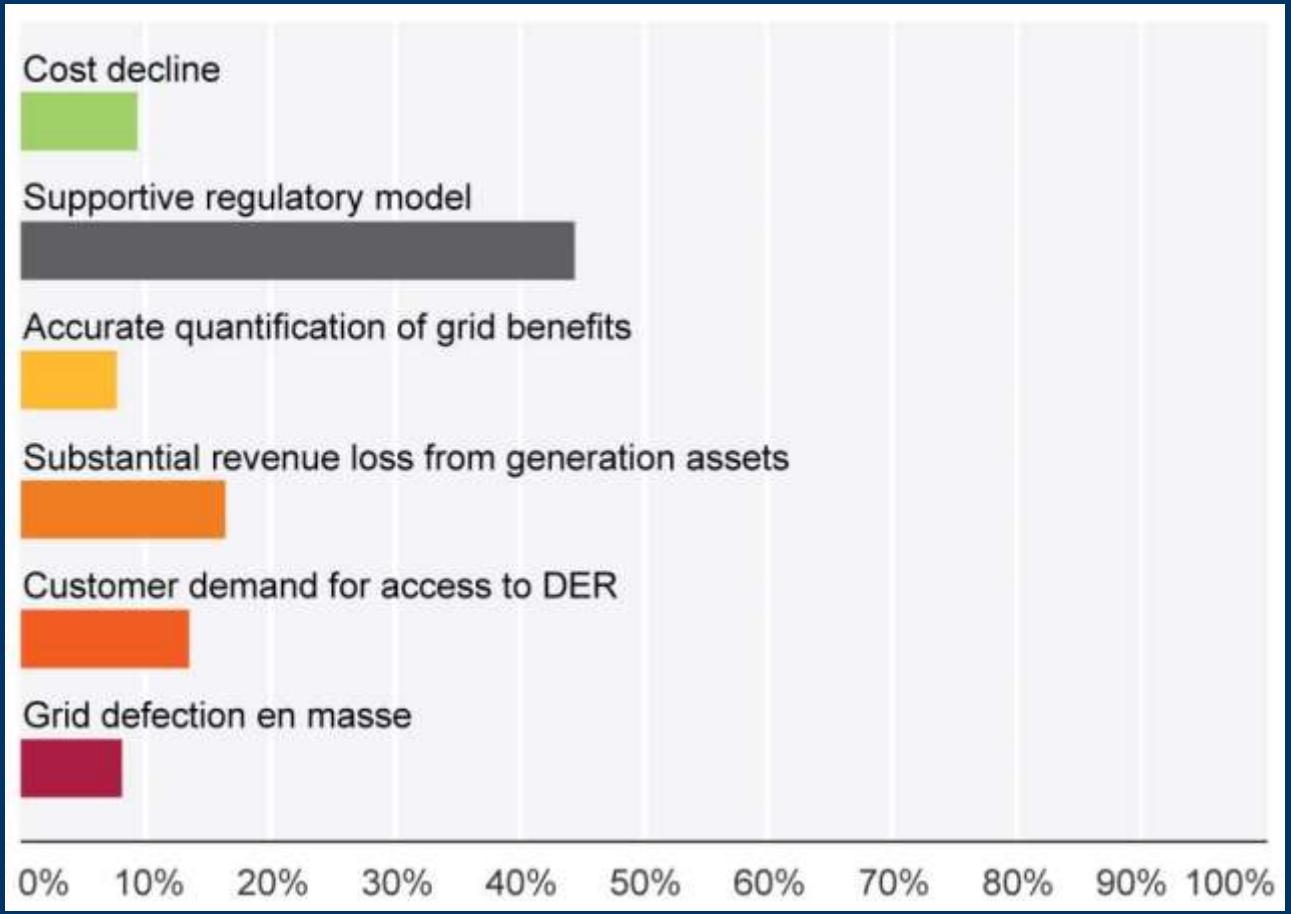
6. Changing Power Supply

100%

6. Changing Power Supply
Large-scale energy storage

- Vital to wind and solar
- Fast discharge
- Eliminates variability
- Provides capacity
- Will be cost-effective compared to peak

What is the **most important tipping point** for utilities to aggressively pursue owning and operating distributed energy resources?



6. Changing Power Supply

- Cap and Trade
- IRP
- Energy Efficiency
- Clean Peak
- ~~Nuclear~~
- Jobs, Jobs, Jobs
- CCAs
- Dilithium Crystals

6. Changing Power Supply

- Cap and Trade
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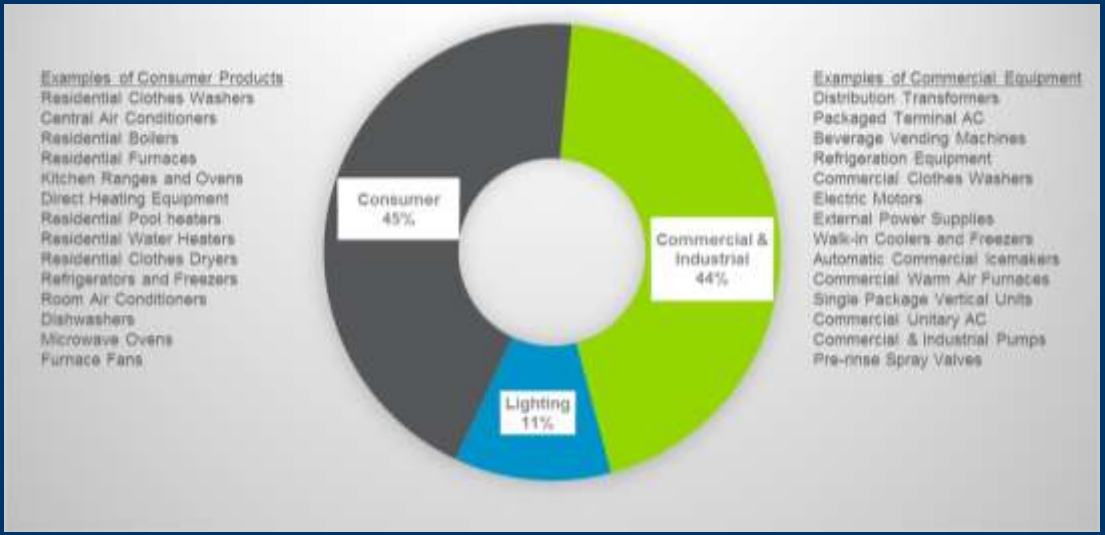
- Jobs, Jobs, Jobs
- CCAs
- New technology!

Since 2000, the DOE has published over 45 appliance standards



Energy Efficiency savings from DOE rules issued since 2000

- 100 quads of energy savings[1]
- Equivalent to eliminating all U.S. residential energy consumption for 4 years

[1]energy savings based on rules issued since 2000 over a period of 30 years after they were issued

6. Changing Power Supply

“Off the grid” can mean different things to different people…

7. Workforce Training and Turnover

Improving economy = more retirements

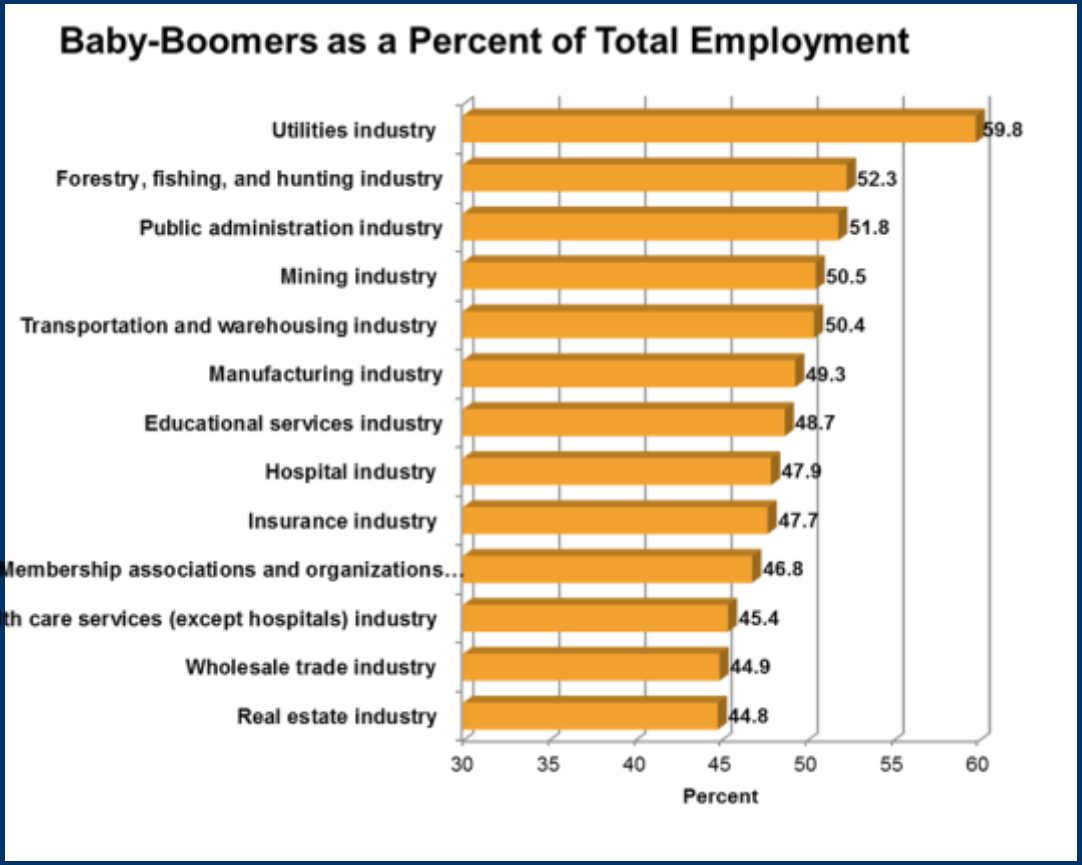
Workforce Changes

- **Increasing retirements**
  - **Poor economy stalled retirements in last 10 years, but growing again**
- **Smaller employment pool to fill senior positions**

Workforce Changes

- **Changing employee interests**
  - Boomers lived to work while Gen Y works to live
  - Employer and employee loyalty is in the past
  - Gen Y looking for "hip and cool" place to work
    - Needs to be fun, rewarding, meaningful and flexible
    - Needs technology (don't want to work for a dinosaur)

Utilities Have Biggest Risk



- 78 million Baby Boomers will retire over the next 17 years, but 75% plan to continue working.
- Only 50 million Generation X exist and they are in short supply.
- 76 million Generation Y are entering the workforce.

Recap: 5 Points About Change

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   - Environmental impact & jobs are key, then cost & reliability
   - In 49 other states, cost generally is key.

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Recap: 5 Points About Change

1. Things don't change overnight
2. Legislation, regulation, cost, environmental impact, jobs & reliability
   - In 49 other states, cost is key. Not here.

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Go Forth and Fight!

We Need to Start Somewhere

IBM Mainframe

Apple Watch

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