

# The Future Energy Resource Mix In A Carbon Constrained World

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# Outline

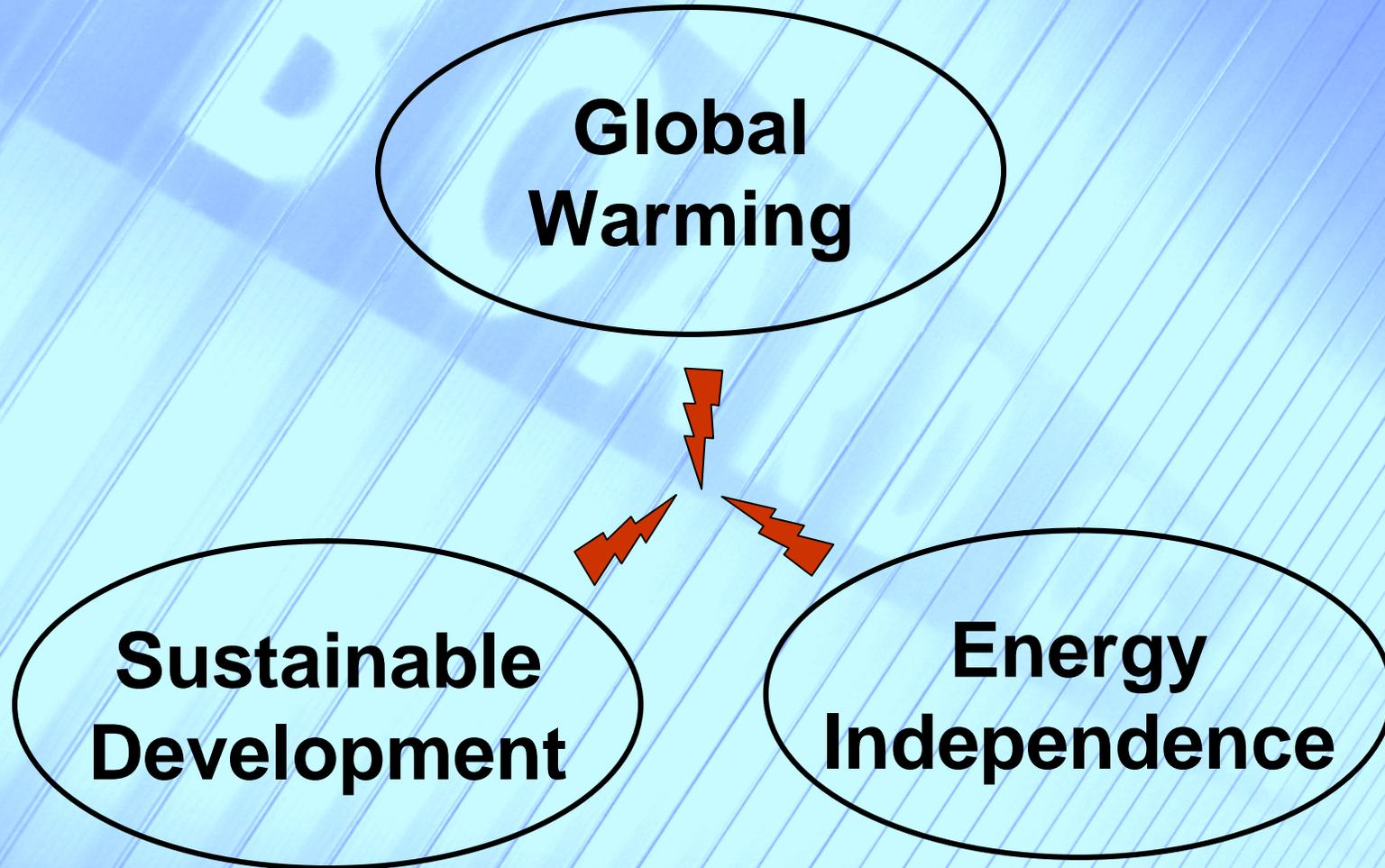
- What is happening in the industry?
- What should be happening in the industry?
- My mission today offer you a choice
  - **blue pill** - blissful ignorance
  - **red pill** - the painful truth

# Al Gore - December 2006

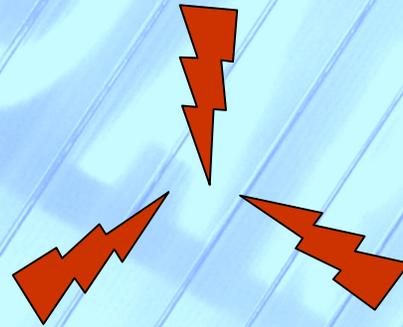
By 2020, I hope the environment agenda recognizes the interconnectedness of our environmental, social and economic challenges. The days of **silo thinking** are over. Today, it is impossible to understand the implications of climate change without understanding the related issues of ecosystem services, water security, public health, urbanization, migration, and even poverty.

*<http://www.mistra.org/mistra/english/news/news/asystemsviwofclimatechange.5.51ddd3b10fa0c64b248000833.html>*

# Energy Industry Torn by Opposing Forces



- **Global Warming**
  - Fossil fuel (BAD)
  - Ozone depletion
  - Arctic ice
  - Carbon tax



- **Sustainable Development**
  - Reduce - Reuse - Recycle
  - Energy efficiency
  - Demand response

- **Energy Independence**
  - Clean coal & nuclear
  - Off-shore drilling
  - Pickens plan
  - Renewable energy
    - wind – solar

# Problem Perception

If I view the problem as opposing forces I will choose to work on what I perceive as the most important, or what I understand the best, or what I am most comfortable with, or what I can fix at the least cost.

This leads to “silo thinking” where each expert works on developing the optimum solution for his problem to the detriment of the other problems and the system as a whole.

# Systems Approach

## Global Warming

- Fossil Fuel (BAD)
- Ozone Depletion
- Arctic Ice
- Carbon Tax

## Sustainable Development

- Reduce - Reuse - Recycle
- Energy Efficiency
- Demand Response

## Energy Independence

- Clean coal & nuclear
- Off-shore Drilling
- Pickens Plan
- Renewable Energy
  - Wind – Solar

# How we frame the problem leads to how we try to fix the problem and where we spend money on infrastructure

- *Bigger generators, “clean” coal & nuclear*
- *Renewable energy wind, solar and energy storage*
- *Distributed generation, Energy Efficiency, Demand Response, Smart grid*
- *Electric or natural gas vehicles*

# *SLEDGE HAMMER* Problem Solving

“Yet the genius of Henry Ford was his ability to cut through complicated problems. He said to me one day in Florida, “Jimmie, I feel that life is an obstacle course, and what we’re here for is experience. That’s what’s going to count in the end.” The direct approach. He and Firestone shared an ability to “cut through the cackle and get to the corn.”

Thomas Edison’s son Charles told me a couple of stories about Ford’s way of doing this in the early days. He had been at the River Rouge plant one day with Ford, whose concern at that moment was the fenders on a current model of automobile. He thought they needed to be changed. A week or so earlier, Ford had instructed his engineering department to make the alteration. A few days later he was told they hadn’t been able to work it out. Days later still, the same story.

The following day, when the younger Edison was there, Ford showed up at the plant unannounced. He went directly to the section where several large stamping machines were still pressing out the old fenders, ordered the machines stopped, called over two of the biggest mechanics and asked them to remove the molds and put them on the floor. “Get your sledgehammers and break each of them,” he said. And then he walked out.

Two days later, the new fenders were in production. “

*Uncommon Friends: Life With Thomas Edison, Henry Ford, Harvey Firestone, Alexis Carrel & Charles Lindbergh; by: James Newton; © 1987*

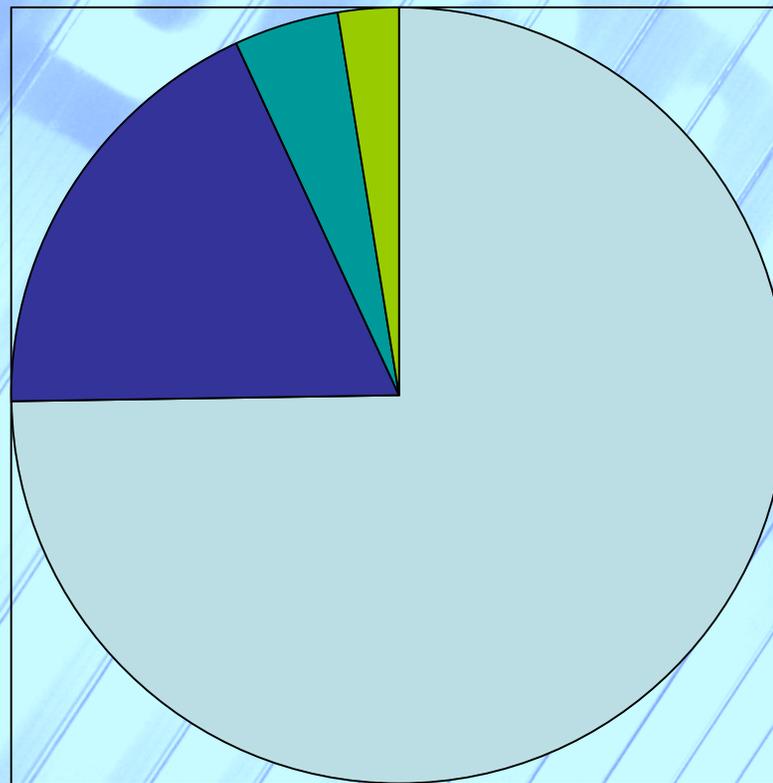
# Jon Wellinghoff FERC Chairman

- No new nuclear or coal plants may ever be needed in the United States, Wellinghoff told reporters at a U.S. Energy Association forum on April 22, 2009 (*Earth Day*) “We may not need any, ever.”
- “I think baseload capacity is going to become an anachronism,” he said. “Baseload capacity really used to only mean in an economic dispatch, which you dispatch first, what would be the cheapest thing to do. Well, ultimately wind’s going to be the cheapest thing to do, so you’ll dispatch that first.”

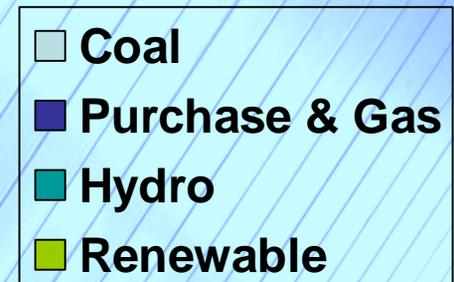
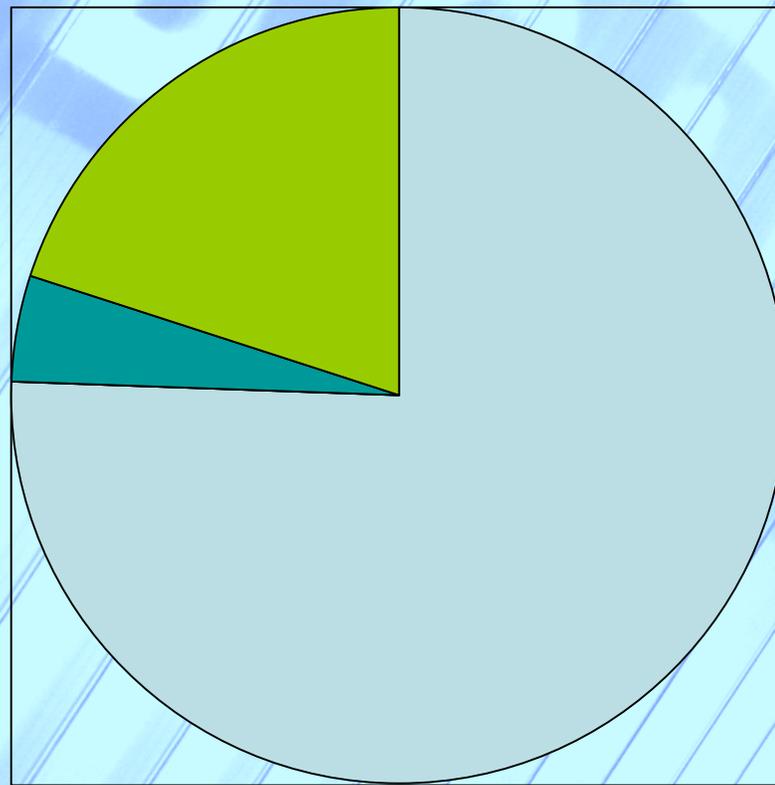
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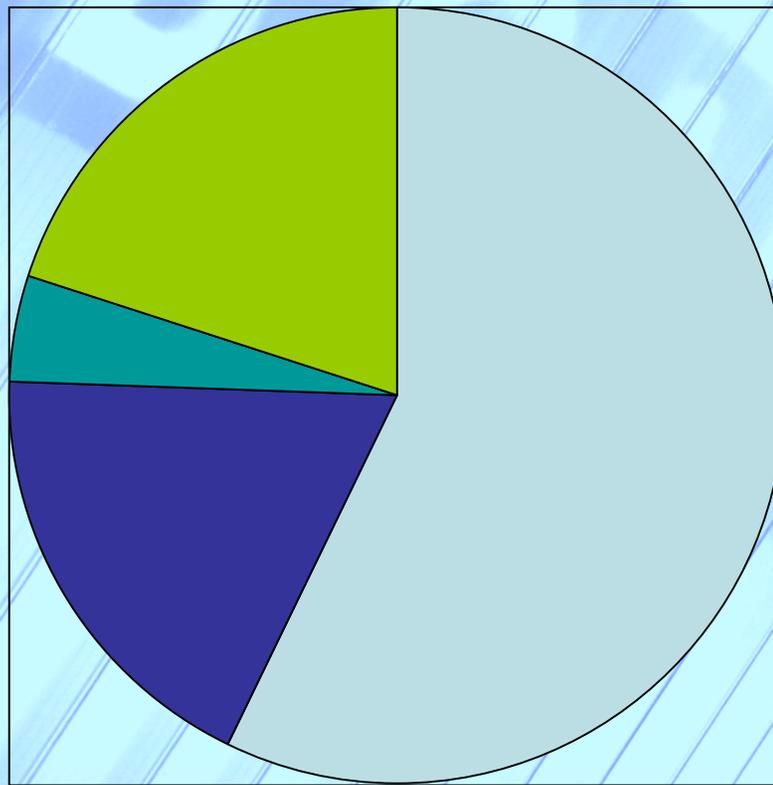
# 2008 Energy Resources Mix



# 2008 Energy Resource Mix Pickens Scenario



# 2008 Energy Resource Mix Green Scenario - 20% RPS



# Energy Resource Mix

	<b>Coal</b> \$18.5/MMWh	<b>PP &amp; Gas</b> \$65/MMWh	<b>Hydro</b> \$18/MMWh	<b>Renewable</b> \$100/MMWh
<b>Current</b>	75%	18%	4%	2%
<b>Pickens</b>	75%	0%	4%	21%
<b>Green</b>	57%	18%	4%	20%

# Altruistic Cost Comparison

	<b>Energy Cost</b>	<b>Price (¢/kWh)</b>	<b>Price Increase</b>
<b>Current</b>	\$ 100,000,000	2.89	
<b>Pickens</b>	\$ 123,000,000	3.55	23%
<b>Green</b>	\$ 150,000,000	4.33	50%

# Carbon Tax Cost Comparison

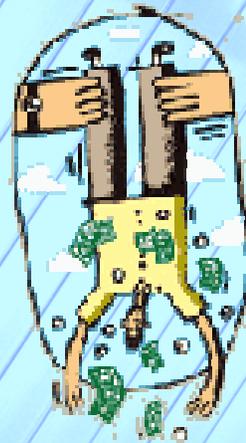
	CO2 (tons)	CO2 Reduction	Carbon Tax @ \$62.50/ton-CO2 Energy Cost Total Cost	Price (¢/kWh)
Current	3,681,100		\$ 230,000,000 <del>\$ 100,000,000</del> \$ 330,000,000	9.53
Pickens	3,363,100	9%	\$ 210,000,000 <del>\$ 123,000,000</del> \$ 333,000,000	9.62
Green	2,889,400	22%	\$ 180,000,000 <del>\$ 150,000,000</del> \$ 330,000,000	9.53

# Current to Green Energy Price

- 2.89 ¢/kWh Current Cost
- 4.33 ¢/kWh Altruistic Green Cost
  - 50% higher than today
- 9.53 ¢/kWh Carbon Taxed Green Cost
  - 230% higher than today

# Carbon Tax

- Where does the money go?
- Who wins & who loses?
- Who pays?
  - Customer



# Obama's 2010 Budget

- The budget also imposes higher taxes on carbon through a "cap and trade" system that generates \$645 billion over 10 years in new revenue by creating an auction among utilities and companies where they purchase pollution credits. These credits cover the "price" of the pollution each utility or company produces. Those who produce less pollution can sell them to companies that produce more.

# 2010 Budget Assumption

- \$650 Billion will be raised in 10 years based on a carbon tax assumption of approximately \$15/Ton-CO<sub>2</sub>
- If it actually takes \$60+/Ton-CO<sub>2</sub> to change industry behavior - then \$650 Billion becomes \$2.7 Trillion raised in 10 years

# Transmission System

- What is?
  - Conglomeration of extension cords between utilities to meet system reliability goals.
- What is needed?
  - Interstate highway like system to economically move bulk quantities of electricity long distances.
- Both/and reliable & economic?

# How Do We Get There?

- Current Transmission Request (study):
  - What incremental updates need to be made?
  - What are the costs?
  - Who benefits & Who pays?
  - Costs shared among beneficiaries on a pro-rata basis.
- Future Transmission Planning – Both/and
  - Socialized costs – everyone pays

# Renewable (*variable*) Energy

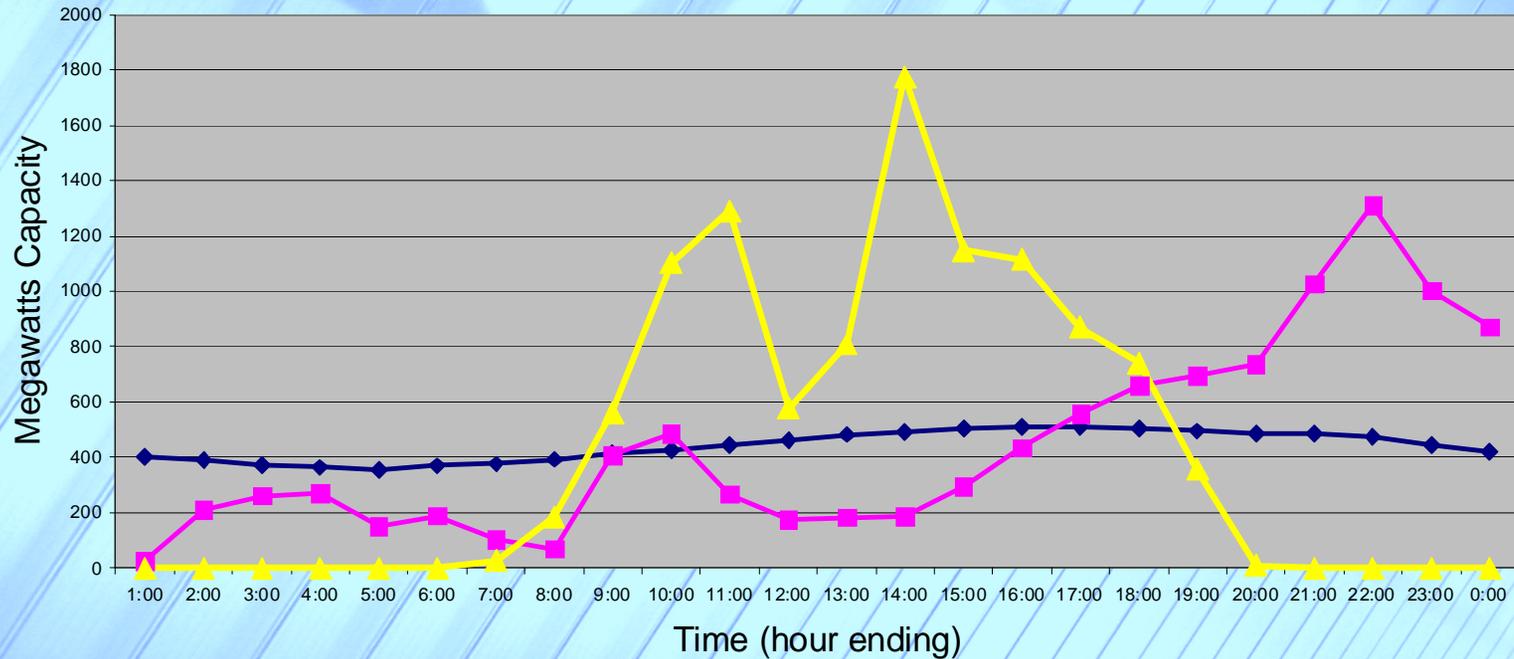
## 10,575 MWh Daily Patterns Summer Peak Day

◆ System Net (512 MW pk)    ■ Wind (2176 MW)    ▲ Solar (2900 MW)

\$1.7 billion coal  
\$6.0 billion nuclear

\$6.0 billion  
\$ ? storage

\$30.0 billion PV  
\$ ? storage



# Jon Wellinghoff FERC Chairman

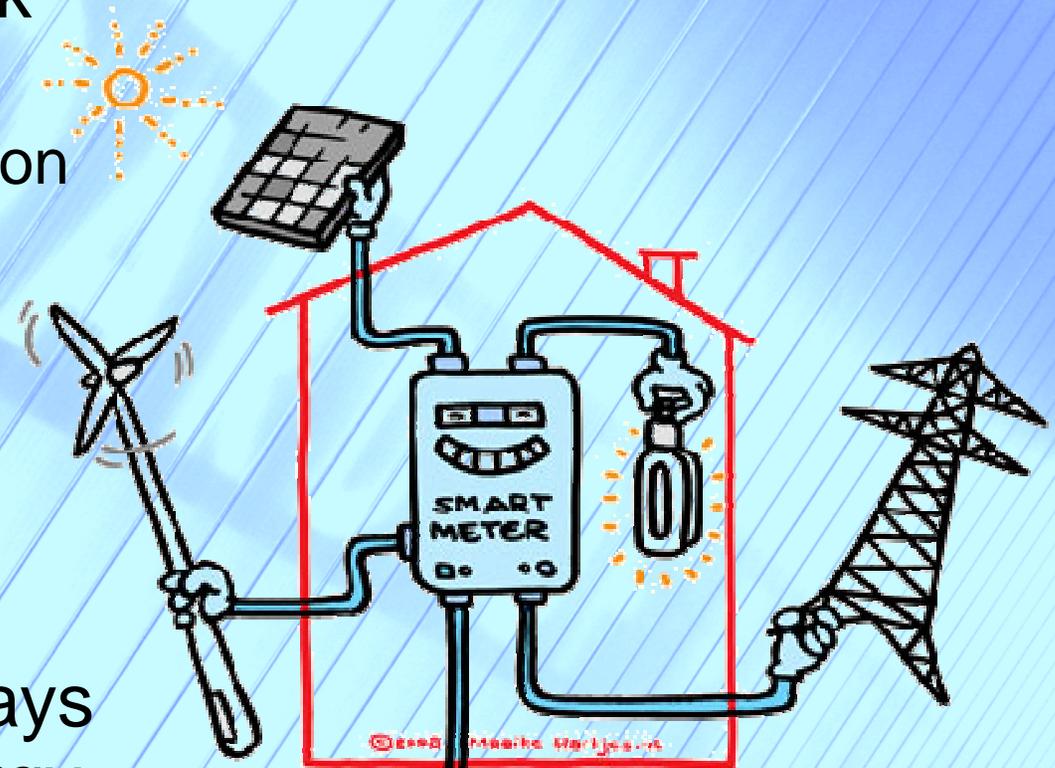
- Wellinghoff said renewables like wind, solar and biomass will provide enough energy to meet baseload capacity and future energy demands. Nuclear and coal plants are too expensive, he added.

# Variable Energy Requires

- Quick start units
- Variable load or “Smart” grid
- Energy storage media
  - batteries
  - hydrogen
  - compressed air
  - pumped hydro storage

# Smart Grid Needs A Smart House

- Home Area Network & smart devices
  - Distributed generation
  - Energy storage
  - PHEV
  - Thermostat control
  - Smart appliances
  - Time of Use Rates
- People are not always home to make energy decisions.



# Electric Cars

## Plug-in Hybrid Electric Vehicle

**Tesla Roadster - 200 mile range**



\$ 107,000

\$\$\$\$

\$ 40,000



**Chevy Volt - 40 mile range**

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# Electric Car - 100 Mile Range

- Gasoline car 20 mpg with 100 mile range
  - 5 gallon gas tank
- 5 gallons of gasoline in tank (114,100 BTU/gal)
  - 570,500 BTUs or 168 kWh (*assumes equal efficiency*)
- Pump 5 gallons of electrical energy equivalent
  - 10 MW rate for 1 minute
  - 21 KW rate for 8 hours  
(210 x 100W light bulbs)
  - 1.8 KW rate for 93+ hours (*15A home charger*)



# Future Infrastructure Investment

- If there is an urgency for action and resources to build infrastructure are limited? (money & people)
- What do we do first?

# Final Thoughts

- Sorry there's no



- Energy “*crisis*”

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Danger Opportunity

- Continue the discussion

# Questions

Are you glad you chose the **red pill**?