

Understanding Energy



How Critical Innovation Technology Will Be to the Future of the Energy Industry



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December, 2011



Notes

Thank you for the opportunity to speak about energy and how innovation will have an impact on our future..

My mission today is to give you an overview of our industry and provide some insights into an energy perspective that includes supply and demand, growth of energy requirements and some example of innovations that we are implementing to take advantage of new technologies and concepts for the future

Technology Use Explodes



Computers in use around the world has exceeded 1 billion and will double by 2014.

Source: The Gartner Group

73.5 M Sold
425,000 Apps

1960's Technology Driver - Space & Industry ...
1990's Driver – Mobility & Personal Use ...
2000's – Wireless, Information and Entertainment

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Notes

During the space program development in the '60s, our lives we improved through technology breakthroughs for dehydrating foods, battery life improvements, synthetic fabrics and integrated circuit board designs. Computing technologies were in their infancy. Products were developed and adapted to the home, businesses and industry. In the 1990's the breakthroughs in technology were being embraced for the first time more by the general population that within government and industry. This was primarily due to the every –increasing rate at which technology was changing and the cost of keeping up with the technology changes within business and industry.

The result of this shift lead to requirements for personal devices and miniaturization for mobility. Today, there are a billion computers in use around the world - this will double by 2014 at a 12% annual rate. According to experts, emerging markets will account for 70 percent of the next billion PCs that will come online. This number does not reflect the X86 units still in service or larger mainframe units.

The Blackberry which was introduced in 1999 has reached over 70 million subscribers as of October 2011 (less than 12 % of the Market). The iPhone which was just introduced in the past several years has topped 73 million customers. Two of every three adults in industrialized nations use cellular phone services and emerging countries are quickly catching up.

Energy Demand Rises



Petrochemical



Refinery



Largest synthetic fuels facility in the world

Sasol Secunda Plant



Burj Dubai - United Arab Emirates
- world's tallest man-made structure
at 818 m (2,684 ft)

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Notes

Expanding communications and distribution channels are expanding trade around the world and making it easier to supply product to customers across the world. This has created expansion in geographic areas that would not have been possible 25 years ago. Construction projects are bigger, more complex and are unique in design and function. Expansion adds additional burden upon existing energy capabilities that has required more complex solutions such as co-generation where power sources are site located and can provide unused capacity back to the power grid for redistribution. Location shown here like Burj Dubai in the United Arab Emirates and the Sasol Secunda Plant in South Africa are examples places that have exploded with electric energy demand due to emerging presence within the world.

Energy Demand Rises



Electric Vehicle or EV

- 14 Manufacturers

Chevrolet Volt
Smart Car
Nissan Leaf
Tesla Electric



*MSRP = \$40,280 before
\$7,500 tax credit + incentive!*



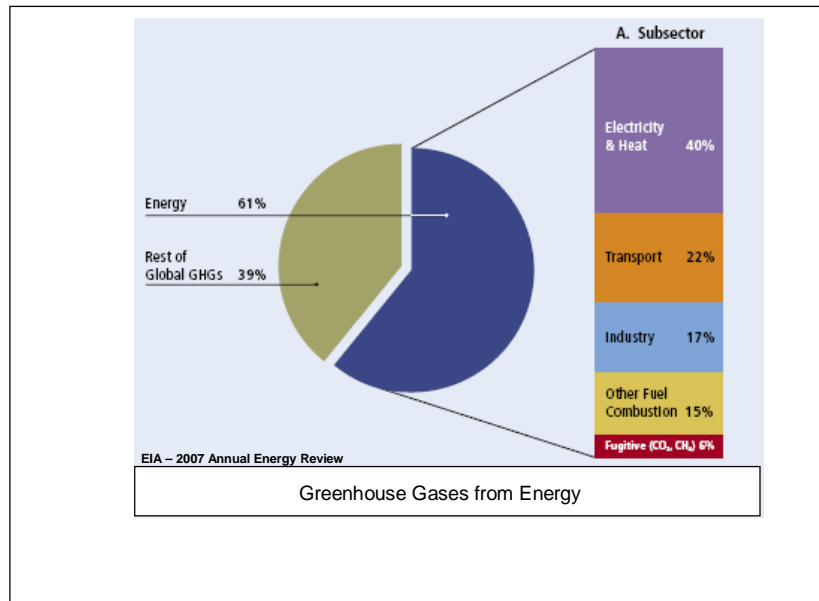
electricwheels.com

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Electric and hybrid cars are viable commercial technologies that are now mass-produced for customers. The EVs are limited by the current battery technology, but it is hi-tech enough to make the current car offerings available for commuters for short distances – work, school and shopping. Battery technology is being widely studied to get more energy and lighter batteries for portable use. The website electricwheels.com has a world-wide directory of car manufacturers that are producing EVs today. The technology has gotten better and we have found ways to use multiple batteries to eliminate the speed barriers that plagued early electric cars (top speeds of 32 km/h or 20 MPH). Distance, weight and competitive costs are still issues.

About Greenhouse Gas (GHG)

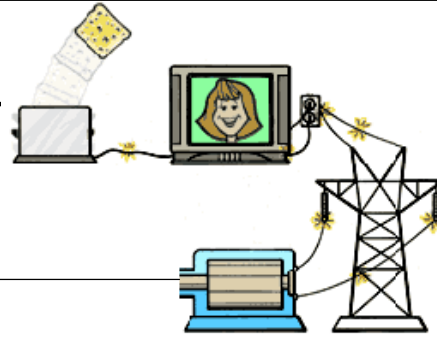


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Greenhouse gases naturally blanket the Earth and keep it about 33 degrees Celsius (91 Degs F) warmer than it would be without these gases in the atmosphere. This is called the "Greenhouse Effect". Over the past century, the Earth has increased in temperature by about .5 degrees Celsius and many scientists believe this is because of an increase in concentration of the main greenhouse gases: carbon dioxide, methane, nitrous oxide, and fluorocarbons. Since these gases are emitted when fossil fuels are burned, the electric industry is working on techniques to burn fuels more efficiently. 40% of the GHGs which are produced through man's impact on the environment are the result of burning fossil fuels with coal being the primary fuel due to it supplying base demand. Over the past 35 years, new technology to curb ash and SO₂ emissions have added electrostatic precipitators, scrubbers and filtration systems to power plants. Different techniques have been used to burn the fuel more effectively releasing more thermal capacity and cleaning up discharge gases. In the U.S., I predict that there will continue to be emphasis placed upon carbon capture and fuel efficiency technology to get the most out of this abundant resource.

Energy Supply



World needs more energy 3 – 5% per year

- Finite supply of oil and gas
- Coal plentiful - stricter environmental regs
- Nuclear relicensing and new development
- Renewable alternatives (thermal, wind, hydro)

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Projections from the Energy Information Administration indicate that although the world is working toward more energy efficient products and services, demand will steadily increase 3 – 5% per year through 2030. Growth in emerging markets will produce demand for additional goods and distribution channels will continue to strengthen. The world has a finite supply of oil and gas and it is projected that demand and the technology to deliver them will drive up costs even greater than what we saw over the past several years.

Coal is plentiful, but is not a clean fuel and restricted in its use in some areas. It is found on all continents with large deposits in North America, the former Soviet Union, China, India and Africa. The challenge according to the World Coal Institute is to provide cleaner more efficient energy, reducing pollution, and increasing the emphasis on environmental sustainability.

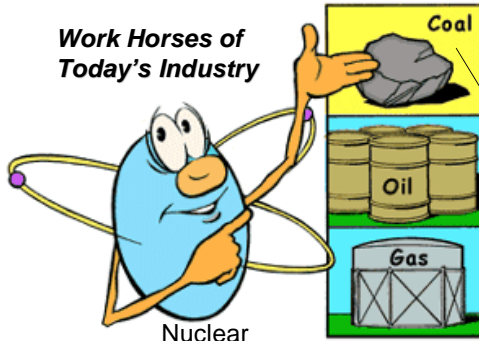
Continuing to use nuclear fuel in power plants is promising and gaining ground in the industry and across the world with 42 new plants currently under construction ... Plant Vogtle Near Augusta Georgia is the only one in the U.S (\$8.3 billion in loans).

Renewable energy sources are continuing to be expanded ... The National Renewable Energy Laboratory (NREL) is the United States primary laboratory for renewable energy and energy efficiency research and development (R&D). NREL's mission and strategy are focused on advancing the U.S. Department of Energy's energy goals.

Improved technology and engineering is supporting the expansion of renewable energy sources.

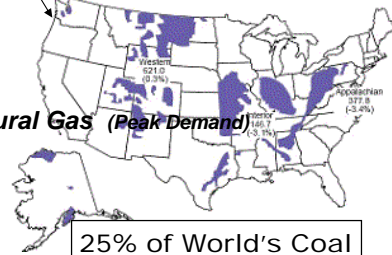
Energy Supply

Work Horses of Today's Industry



16% World's Electricity - 439 Nuc. Plants
57% World's Nuclear Cap. - Japan, US, France
20% U.S. – 104 Nuclear Plants
50% U.S. - 600 Coal-fired 24% U.S. – Oil and Natural Gas (Peak Demand)
6% U.S. - Others (Hydro, Thermal, Wind, Solar)

Natural Gas - \$7.83 to \$13.31 to \$5.79 to ~\$4.39
 Jan.'08 Jul.'08 Dec.'08 2011



Notes

Overcoming the challenges of getting sources of energy to where they are needed is multi-faceted.

Sources are spread all over the world and vary by continent. For example 25% of the world's coal is in the U.S. so it is important for us to come up with better technology so we can continue to use it. Over a billion tons of coal were mined every year and we use much of it to generate electricity. There are 600 coal-fired power plants in the U.S. that currently generate 50% of the electricity consumed here. It is truly the largest work horse of the electric base generation. In addition, Nuclear power in the U.S. is the other "Clydesdale" with 20% of electricity generated compared to 16% world-wide. Gas and oil burning units add to baseload in some areas where generating units were designed as larger base-load plants. Recent plants constructed within the past 10 years have been mostly peaking units that can come on-line quickly and augment baseload capacity during peak demand periods. – note the variance in gas prices

The world's nuclear electric capabilities continue to expand with almost 10% growth with the new plants under construction. Thirty countries operate nuclear power reactors producing 370K MWe with 57% of the world's nuclear capacity is in three countries - Japan, France and the U.S. Sixteen countries depend on nuclear power for at least a quarter of their electricity. France and Lithuania get around three quarters of their power from nuclear energy, while Belgium, Bulgaria, Hungary, Slovakia, South Korea, Sweden, Switzerland, Slovenia and Ukraine get one third or more. Japan, Germany and Finland get more than a quarter of their power from nuclear energy. Our biggest loss in the system is in transmission.

Energy – Overcoming Place Utility

Greatest Industry Efficiency Loss - 7% or More



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Notes

Historically designed to reliably deliver power to the major electric load centers such as major metropolitan areas, and to interconnect utilities for reliability reasons, the transmission grid is now relied on more heavily. It acts as a regional “highway” providing the physical link between sellers and buyers. It facilitates an ever-increasing amount of transactions among an increasing number of market participants, and over increasing distances.

Transmission and distribution losses in the USA were estimated at 7.2% in 1995 and in the UK at 7.4% in 1998. Because of the resistance losses and the requirements to move electricity through transformers to adjust transport and delivery voltages, the transmission grid provides the largest challenges for improvements. Several companies are supplying new grid technologies to support grid management and improve efficiencies. So I hope by now you understand that from capturing the fuel to delivery of a final commodity product to the consumer is a complex system with multiple variables.

Energy - What's Going On?



- A Need for 250-500 new **base load** power plants by 2030 (DOE)
- Approximately \$600 billion of *new investment needed*
- Limited resources/suppliers to build new plants
- Attracting financial capital to fund projects
- Concerns about Green House Gas (GHG) emissions; need environment – friendly ways to meet this demand (Clean energy including nuclear)

- Some States resisting fossil or nuclear construction
- DOE funding for standard nuclear design approach
- NRC Office established for “New Plants”
- Construction operating license (COL) - 17 received by USNRC (Jan '09)
- Utility and suppliers training programs – college/ high school/ tech / craft
- Construction relief in utility rates



Limited Immediate Options to Pick Up Load as Plants Become Obsolete

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Notes

Now, let's understand “What's going on?”

- A Need for 250-500 new base load power plants by 2030 (DOE)
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U.S. Economic Stimulus (February 17, 2009)



From \$787 to \$840 Billion U.S.

- \$11 Billion – Sweeping Upgrade to Century-Old Grid
 - 3,000 Miles of New Transmission Capacity
 - 40 Million “Smart” Meters in Homes
- Provide incentives for renewable energy
- Consider Restriction on GHG Emissions
- Administration’s Energy Policy and view on Nuclear?

Estimated American Recovery and Reinvestment Act expenditures have increased to be consistent with the President's 2012 budget and with scoring changes made by the Congressional Budget Office since the enactment of the Recovery Act in February 2009.



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Notes

The political change has taken place here in the U.S. and we have a new President with an economic stimulus package being pushed through our Legislative branch of government. There are some benefits for the country tied to electric infrastructure and renewables. There are also restriction for GHG emissions.

Innovations

The fundamental purpose of an Innovations function in the organization is to find and implement transformational concepts and technologies to improve the way business is done in order to drive more value out of the work performed.



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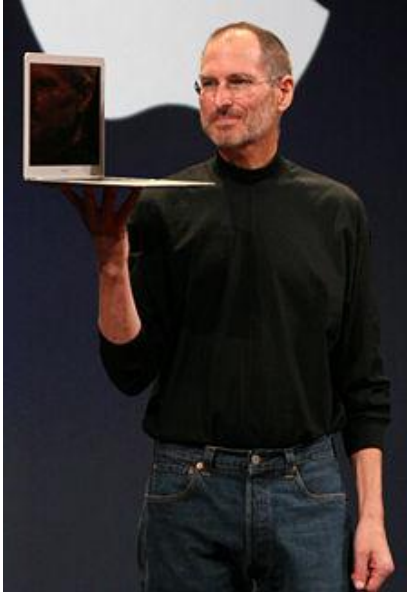
Notes

Read Slide: "Innovations - The fundamental purpose of an Innovations function in the organization is to find and implement transformational concepts and technologies to improve the way business is done in order to drive more value out of the work performed."

Harvard Business Review recently published a paper on distributed innovation groups and enterprise integration groups to assist management in driving out new ideas into work processes and products.

The companies in our industry are investing in efficiency projects and new plants to ensure that the energy we need is available. I'll introduce some areas in the next few slides on what we are doing and the direction we are headed,

Crazy?



Steve Jobs
co-founder of Apple and Pixar

“Here’s to the crazy ones, the misfits, the rebels, the troublemakers, the round pegs in a square holes, the ones who see things differently. They’re not fond of rules. You can quote them, disagree with them, glorify them, but the only thing you can’t do is ignore them because they change things ... They push the human race forward.

While some may see them as the crazy ones, we see genius because the ones who are crazy enough to think they can change the world are the ones who do!”

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Notes

Crazy? ... “Here’s to the crazy ones, the misfits, the rebels

the troublemakers, the round pegs in a square holes, the ones who see things differently ...

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While some may see them as the crazy ones ... we see genius because the ones who are crazy enough to think they can change the world, are the ones who do!”

Steve Jobs has made a career out of capturing innovation and getting brand new products to markets and creating wealth for those who believed in him and his teams. ...

Innovation and Energy

Operations

- Safety
- Plant Performance
- Avoid Unplanned Shutdowns
- Equipment Reliability
- Business Measurements



Organization

- Retain Highly Skilled Workforce
- Optimize Structure
- Standardize Processes
- Use Technology Effectively
- Outsource Selectively



Transform for the Future

“Find and implement transformational concepts and technologies to improve the way business is done.”

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Notes

Finally, with all this new knowledge about the electric business, we can talk about technology ... Here are the keys to success in our business (READ THEM). Some are fundamental to other industries as well as ours, but the context of producing reliably and getting electricity delivered where it is needed is the basis for success. Safety – both industrial and nuclear safety is a requirement and in our business.

Innovation and Energy



Process Improvement

- Regulatory/ Construction/ Business
- Automation / Standardization
- Business Measurements

Technology and Automation

- Computing and Wireless Infrastructure
- Radio Frequency I.D. Tags / Rube™
- Robotics
- Laser Scanning / 3D Modeling

Lifecycle Management (LM)

- Reliability & Outage Management
- Prognostics & Health Monitoring
- Thermal Performance Uprates

Organizational Efficiencies

- Eliminate Waste
- Collaboration
- Selective Outsourcing

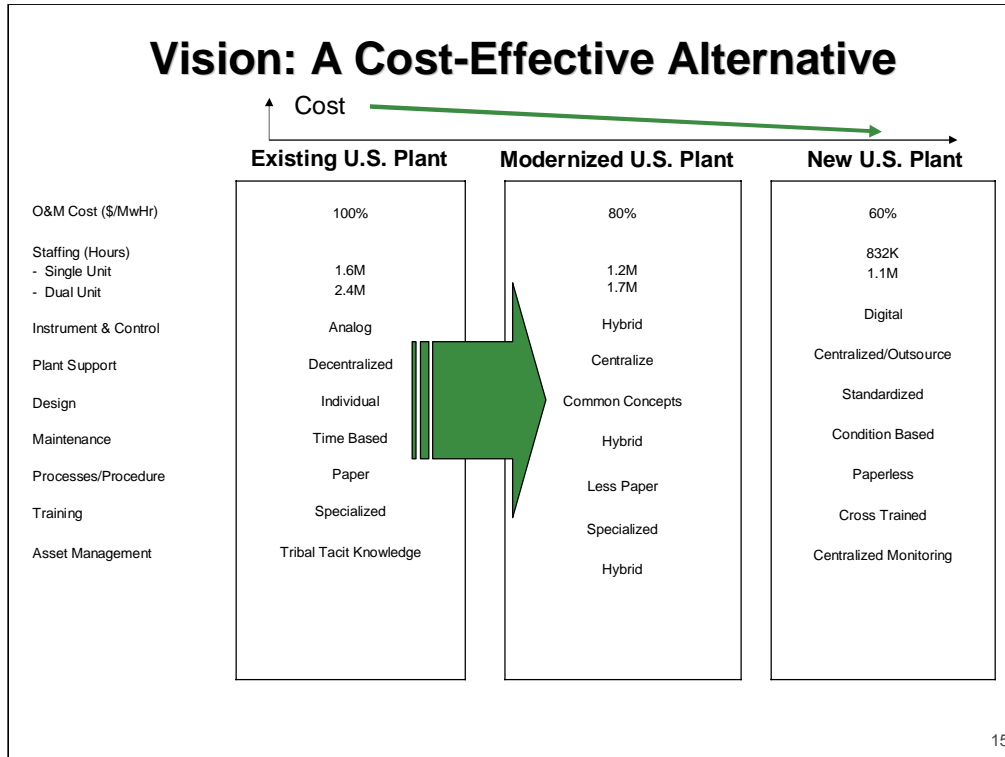
“New” Applied Sciences

- Carbon Capture Technologies (Fossil)
- Smart Grid / Next Generation Distribution
- Advance Reactors (HTGR, SMR)



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I've chunked our initiatives into focused areas for the discussion today. They are at the heart of our industry and we continue to evaluate opportunities



I'm down to my last few slides and I wanted to get all the overview information down into one vision for where we want to go and where our modernization strategy needs to take us. Of course, we understand that the effectiveness of the industry and the investments we need to make includes investment in our people and investment in our processes as well as investment in our plants ... and foundational systems such as the ones we've discussed today.

This slide provides the vision. Existing U.S. plants as they operate today on the left ... new proposed standard design plants under development on the right and a modernized plant in the middle.

Our vision is to move our fleet from the left to the center with strategic investment in our people, processes and plants. The expectation with this investment strategy is to drive operational cost down over time while improving performance and maintaining the high level of operational safety as we move ahead.

Innovation and Energy



Industry Alliances and Partners – Utility Specialists

- Construction
- Engineering
- University R&D
- Asset and “Spares” Management
- Services



Industrial Product Improvements – Wide Use in Many Industries

- Alternative Large Bore Piping Materials and Welding
- Field Programmable Gate Arrays (FPGAs)
- Modular Technologies
- Communications
- Telemetry
- Wireless Instrumentation and Networks



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Notes

As an industry we are using advanced services and specialty technologies available for our industry. This has created opportunities for partnerships in areas where services are seasonal or are projects. Some areas are in Construction, Engineering & University R&D; Asset and “Spares” Management and other technical services.

Industrial Product Improvements – Wide Use in Many Industries

Alternative Large Bore Piping Materials and Welding

Field Programmable Gate Arrays (FPGAs)

Modular Technologies

Communications

Telemetry

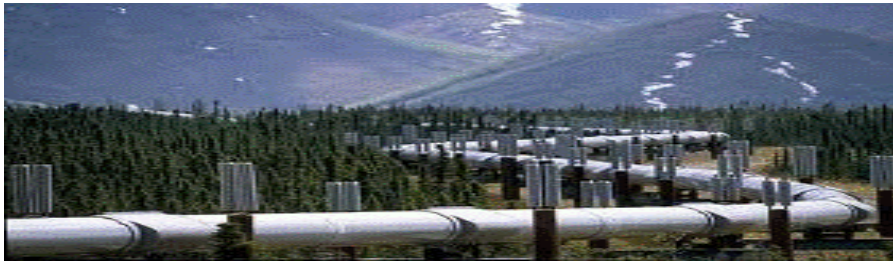
Wireless Instrumentation and Networks

Natural Gas for 100 Years?



Today

- *Natural gas is a fungible asset (interchangeable)*
- *U. S. natural gas prices are substantially under priced*
- *Liquid Natural Gas terminals are preparing for export*
- *Shale gas reserves are large, but retrieval costs unknown*



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Notes

There has been a lot of discussion about natural gas and the new finds and low cost projections over the next decade or longer. Prices of natural gas have fluctuated over the past several years to more than 3 times the cost of what it is today. Unfortunately for some business sectors, gas prices drive their ability to compete in the marketplace and some manufacturing jobs have moved to other areas of the world outside of the U.S. Now that the gas prices in the U.S. are under priced compared to other areas of the world, there is movement underway in the marketplace to take North American gas and export it to other parts of the world where gas ranges from ~\$8 to \$14 per million btu.

It is expected that over time demand will rise and parity across the globe will increase gas prices. No one is certain of when that will happen, but some predict prices will start rising by the middle of this decade. Others believe it will take longer and relatively cheap energy will last through mid-century or longer.

As our ability grows to extract gas with improved technology, the extraction methods and their cost will be incorporated into delivery costs. Recent reports show that projections in gas supply in known fields was overstated and extraction methods are being developed. The overall cost is currently unknown, but expected to rise as advanced technologies take the place of convention ones currently used to access natural gas at currently producing wells.

Focus for the Future – Near Term



Demand-Side Management

- Energy Saving Machines & Appliances
- Engineering & Construction
- Efficiency Improvements

Supply-Side Management

- Energy Portfolio and Asset Management
- Effective Operation (Explore, Refine, Generate, Deliver)
- Efficiency improvements
- Waste Management

Technology Innovation – Wide Use in Many Industries

- Alternative Large Bore Piping Materials & Welding
- Digital Instrumentation & Control
- Modular Technologies
- Communications
- Wireless devices
- Battery & Storage Devices



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Notes

Near-term demand and supply side management concepts are intended to improve efficiencies and reduce waste.

Investment in new technologies will make existing assets will increase life, reduce operating costs and improve efficiencies.

Focus for the Future - Long term



Transformation

- *From efficiency to new sources*
- *Replace oil-based economy*
- *Change political policy*
- *Clean energy to reduce effects of people*



The Electric power industry is on track to reduce waste and improve reliability. As an industry, we are investing in programs, research and technologies that modernize for the future while applying carbon capture technologies to reduce GHG emissions.

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Notes

Transformational Technologies are expected to be developed over the next several decades and will be main-stream by mid-century.

From efficiency to new sources

Replace oil-based economy

Change political policy

Clean energy to reduce effects of people

Questions ?



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Ref: www.world-nuclear.org
www.doe.gov
www.eia.doe.gov
www.nrel.gov
www.worldcoal.org

December, 2011

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