Meeting the challenges of the next decade

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U.S. Energy Information Administration
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GE Energy businesses

82,000 employees - 140 countries  25% world’s electricity from GE technology

Power & Water
• Thermal power gen
• Renewables
• Gas Engines
• Nuclear
• Gasification
• Water treatment
• Process chemicals

Energy Services
• Maintenance agreements
• Smart Grid
• Field services
• Parts and repairs
• Optimization technologies
• Plant management

Oil & Gas
• Drilling/production for … land, offshore, subsea
• LNG and pipelines
• Refining/petrochemical
• Industrial power gen
• Complete lifecycle services

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The next decade

Confronting new **challenges**

Diverse **technology** solutions

Pragmatic **policies** needed

**Who will lead?**
Growth centers are shifting

Electricity generation

(TWh)

Developing economies (non-OECD)

Developed economies (OECD)


Source: GE analysis

Driving power generation technology mix

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Diverse power generation mix
10 year global investment

2,700 GW

- Coal: 34%
- Wind: 19%
- Solar: 4%
- Other Renewables: 7%
- Hydro: 6%
- Nuclear: 9%
- Gas/Oil: 21%

Green energy growing … coal still 1/3 of additions

Source: GE analysis

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Revolution in North American NG?

Game changing success

Major North American unconventional plays

- Horn River Basin Shales
- Montney Tight Sands
- Pinedale Tight Sand
- Jonah Tight Sand
- Piceance Tight Sand
- Powder River CBM
- Marcellus Shale
- Eastern Canadian Shale
- Woodford Shale
- Fayetteville Shale
- Haynesville Shale
- Deep Bossier Tight sands

... In a policy driven marketplace

U.S. gas demand for power outlook range

Bcf per day

- More renewables & cleaner coal; lower demand growth
- Near-term softness
- Larger role for gas
- Higher demand
- CO2 policy

Source: EIA, OG&J, GE Energy

Orange: shale gas
Blue: other unconventional gas
Integration of two infrastructures

Electrical infrastructure + Information infrastructure

Roll-out of smarter grid ... energy efficiency

Sources: (1) UtilityPoint, by Ethan Cohen 7/18/10 (2) EPRI® Intelligrid

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The power / water nexus

U.S. total water withdrawals today

Billion gallons per day (BGD)

410 BGD

Irrigation 128
Livestock 2.1
Mining 4.0
Public water supply 44.2
Aquaculture 8.8
Industrial 18.2
Private wells 3.8

Thermoelectric power plants 201

50%
US water usage due to power plants

30%
Worlds population water constrained today...

60% by 2025

Power 1st to be curtailed in a water scarce world

Carbon emissions and water scarcity challenges interlinked

Source: GE analysis

Source: The 2030 Water Resources Group, Centre for Environmental Systems Research, University of Kassel
The next decade

Confronting new challenges

Diverse technology solutions

Pragmatic policies needed

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Diverse technologies delivering solutions

Wind
Gas engines
Nuclear
Combined-cycle
IGCC w/CCS
Water technologies

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Diverse technologies delivering solutions

Renewables - Wind

- Onshore well-established, offshore emerging … “0” carbon & water
- EU 20-20-20: 160GW onshore 30GW offshore … US #1 installs ’08, fell to #3 ’09
Diverse technologies delivering solutions

Combined-cycle

- Low CAPEX - High efficiency - Short project cycle
- Replacing 10GW of old coal = 50 million tons/yr CO$_2$ reduction

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Diverse technologies delivering solutions

Gas engines

• Distributed generation … alternative gas to power
• Global flare gas = 5% global gas production
Diverse technologies delivering solutions

**IGCC w/CCS**

- Base load coal with 90% carbon capture capability and 30% less water use*  
- High cost & sequestration regulations must be addressed

* Compared to pulverized coal
Diverse technologies delivering solutions

Nuclear

- Base load generation, near “0” carbon emissions solution
- 39 GW new plants under construction … U.S. financing obstacles

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Diverse technologies delivering solutions

Water technologies

- Advanced membranes & chemicals, zero liquid discharge
- Solutions exist for 70%+ water reuse today

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Confronting new challenges

Diverse technology solutions

Pragmatic policies needed
National long-term policy critical

EU: 20% by 2020

China: 100GW Wind by 2020

India: -20 GW Solar by 2022

Spain: 11% reuse today ... 40% by 2015

Israel: 85% reuse today 90% by 2016

Saudi Arabia: 11% reuse today ... 65% by 2016

Many countries taking action ... US currently stalled

Water data source: GWI
Renewables data source: REN21

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US Clean Energy Standard

Opportunity for “creative” Energy bill in ’10 …
A down payment on climate change

• Widen the technology tent … + CCS, efficiency, nuclear
• Meaningful goals … short and medium term impact
• Upgrade the system … incentives to retire old inefficient coal
• Build U.S. future … large markets will prevail, sustainable “green” jobs

Long-term … price for carbon essential
Impact of CES ... higher deployments

US Clean Energy Additions (2009-2030)

- Drives ~120 GW of clean energy by 2020
- Renewables growth near-term ... nuclear & CCS medium-term
- Incentivizes retirement of older, less efficient coal

Source: GE Energy. For illustrative purposes only. Preliminary analysis of Graham CES proposal (RECAST 03.31.10)
Clean energy includes renewables, carbon capture and storage technologies, and nuclear power.
CES ... potential reduction impact

Cumulative $\text{CO}_2$ reductions from power sector (2009-2030)

- ~400 mmt of $\text{CO}_2$ emission reductions through ’30
- Stabilizes power sector $\text{CO}_2$ emissions at current levels
- Equal to taking ~75 million cars off the road for one year

Source: GE Energy. For illustrative purposes only. Preliminary analysis of Graham CES proposal (RECAST 03.31.10)
Compared with new supercritical pulverized coal.
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