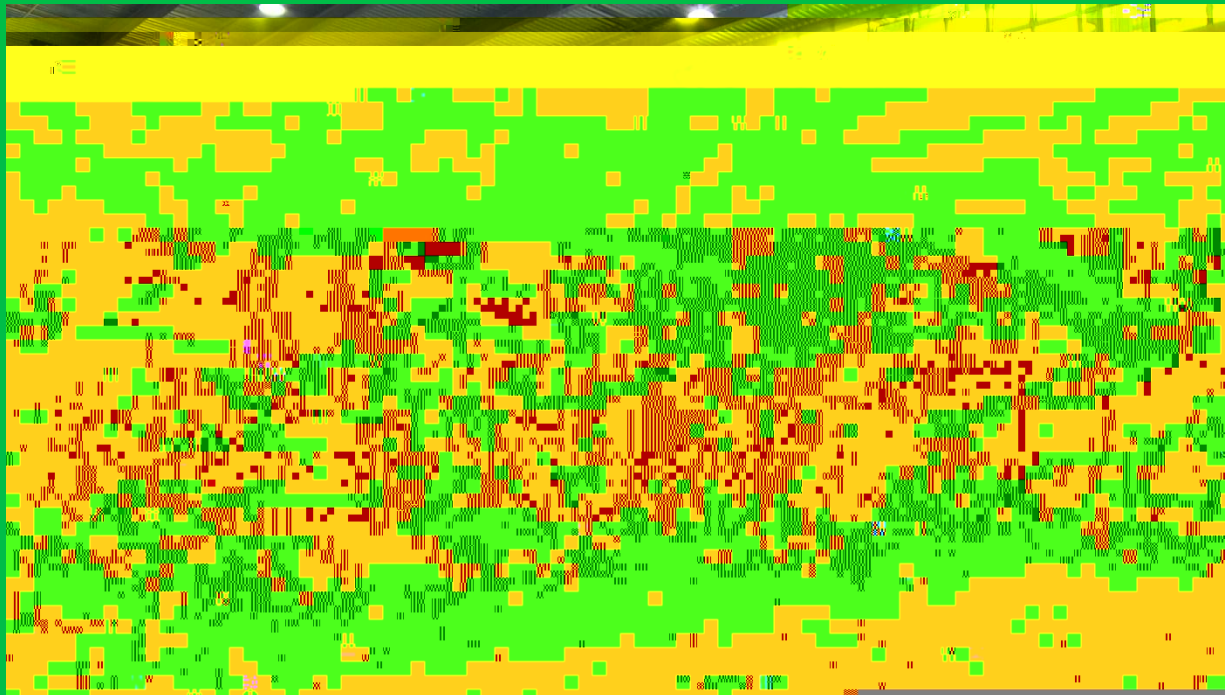
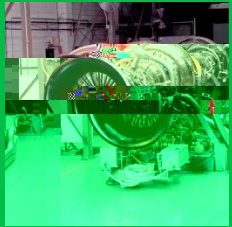


# Electric Power Industry Trends and the Role of Renewable Energy

Chuck Levey  
Vice President  
Pratt & Whitney Power Systems



# Product Portfolio



## Large Engines



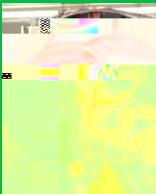
## ORC Heat to Power



# Power Systems



## After market



## Mobile Power



## Marine



## Wind Power





**Prett & Whitney**  
A Global Postgraduate Education

me



# ENERGY SUPPLY

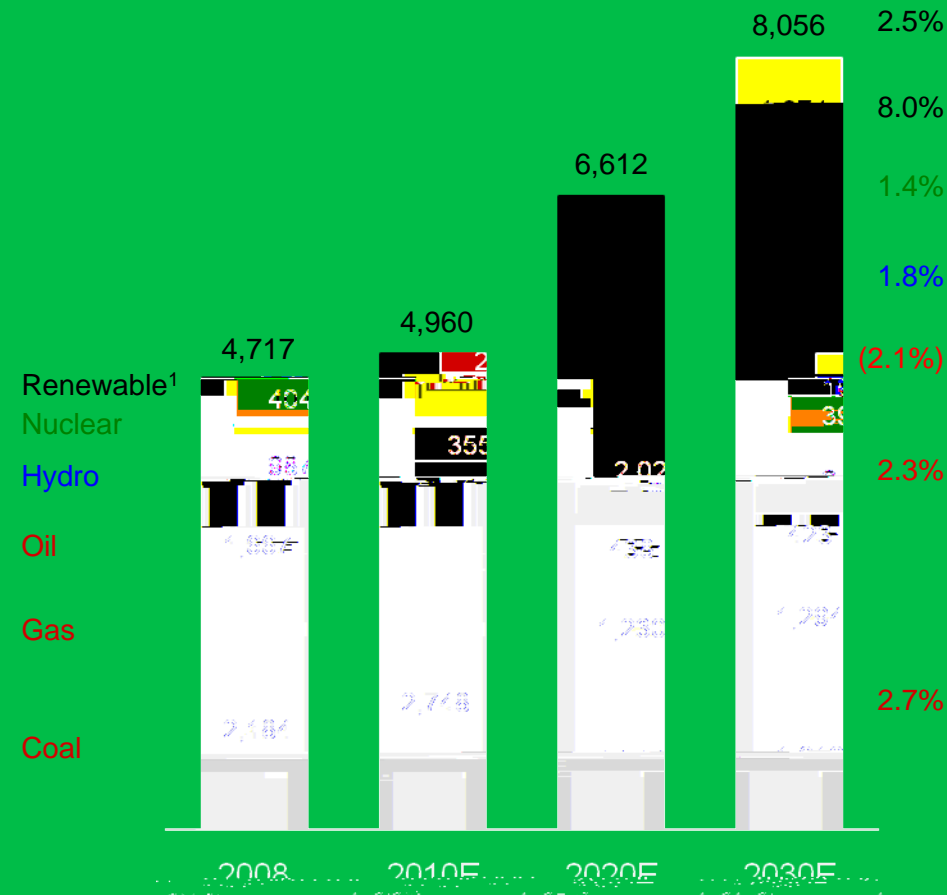
## Global energy mix (by fuel source)

(GW installed)

CAGR

(\$ trillions)

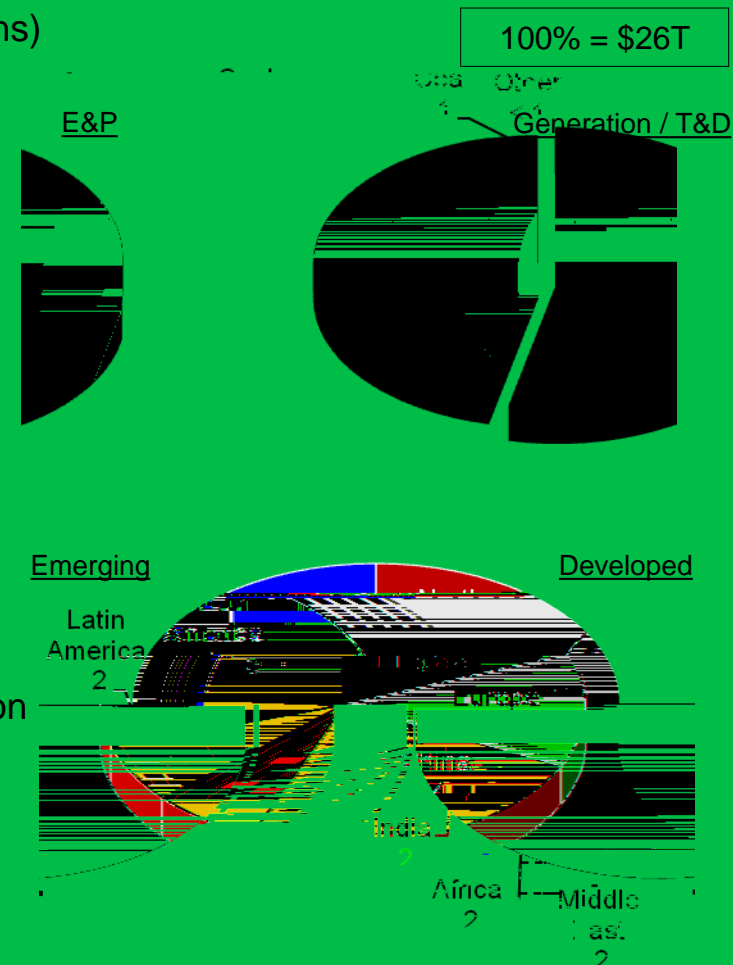
100% = \$26T



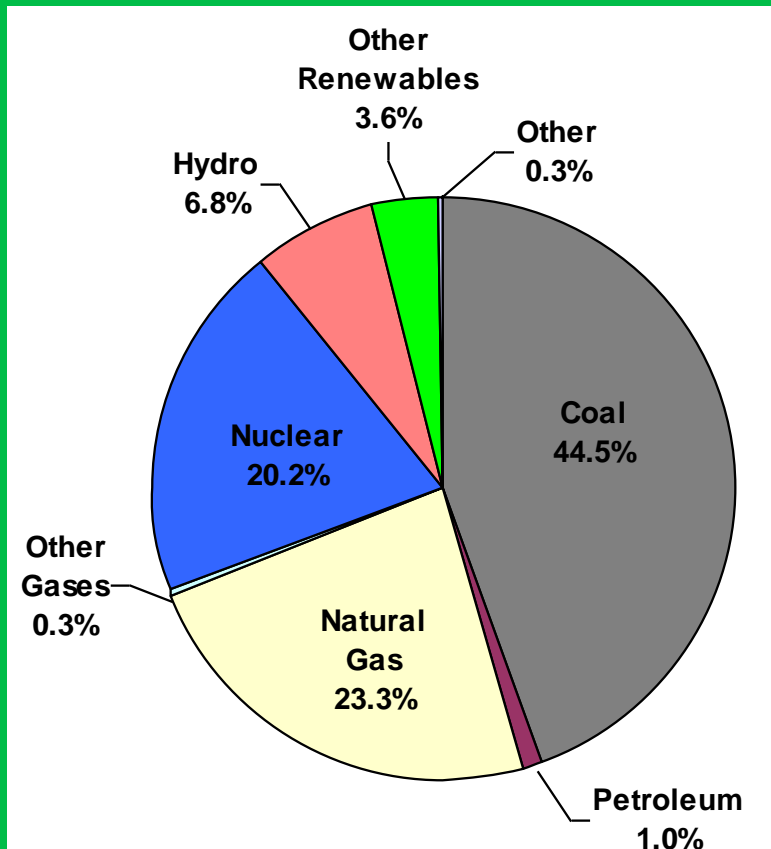
## Energy investments (2008 – 2030E)

By type

By region



<sup>1</sup>Includes Wind, Solar, Biomass, Geothermal  
Source: International Energy Agency – World Energy Outlook 2009, 2010



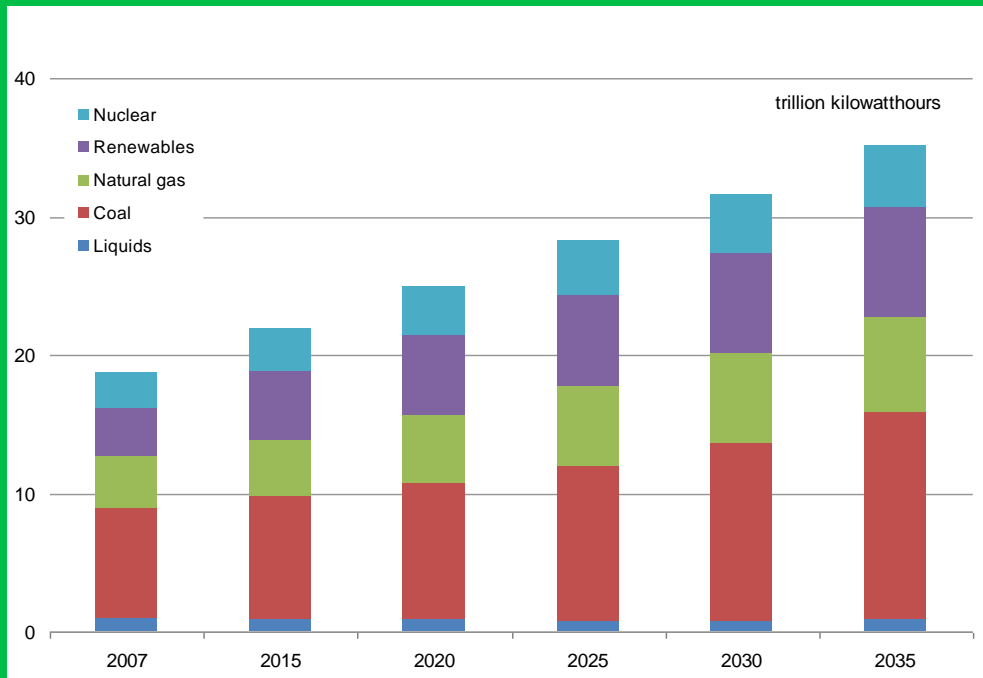
\* Energy Information Administration report, Nov. 2010

## Trends

- **↓ Coal:** Prices increased 84% from 2000-2009. Coal fired generation declined 11.6% in 2009 (lowest level since 1978)
- **↑ Natural Gas:** Wellhead prices fell to lowest level in 7 years. NG based generation increased by 4.3% in 2009 to the highest level since 1970
- **↓ Nuclear:** Decreased by about 0.9% in 2009 (outages and derates)
- **↓ Petroleum:** Peaked in 1973 (17%), steadily decreasing since, 15.8% decrease in 2009 compared to 2008
- **↑ Hydro:** Increased 7.3% in 2009 compared to 2008
- **↑ Renewables:** Increased 14% increase in 2009 following a 20% increase in 2008. Wind power increased the fastest (34% increase), solar 3%.

# ROW Electricity Generation Mix

## Trends



- ↑ Coal: Remains steady at 42% (2007-2035), annual increase of 2.3%
- ↑ Renewables: Highest rate of annual increase, 3% until 2035. Share of renewable generation is projected to increase from 18% (2007) to 23% (2035)
- ↑ Natural Gas: Increases at the annual rate of 2.1%
- ↑ Nuclear: Increases at the annual rate of 2% but considerable public concerns may hinder plans for new installations

\* Derived from EIA, International Energy Statistics database (as of November 2009), web site [www.eia.gov/emeu/international](http://www.eia.gov/emeu/international). Projections: EIA, World Energy Projection System Plus (2010).

- **Renewable energy accounted for approximately 11% of the domestically produced electricity in the US in the first six months of 2010.**
- **Renewable Energy Capacity in the world and US has more than tripled between 2000 and 2009.**
- **Over the last three decades, US geothermal power-generation industry has grown to be the largest geothermal market in the world with over 3,100 MW of installed electrical capacity.**

# Global Demand for Wind Power

Figure 9. Global Wind Power Capacity (GW)

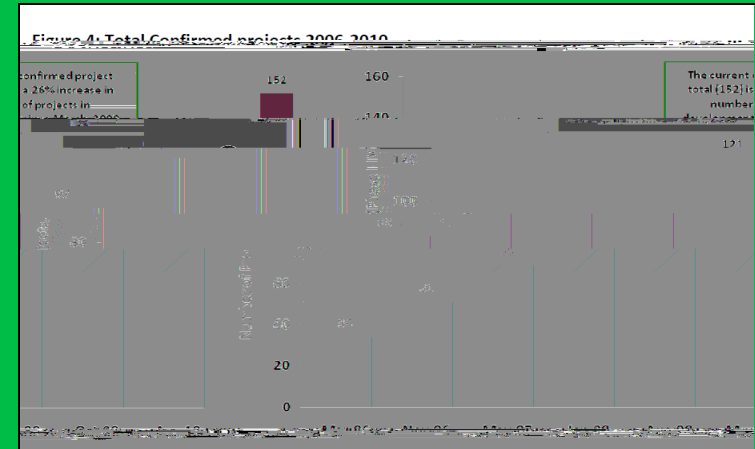






- Estimated 40% (~3000MW's) new capacity is ORC

## US Projects Under Development





Nine States generate the majority of this power in the U.S.:

- Alaska, California, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah, Wyoming.

(Source: GEA)

# Snapshot of US Renewable Energy Portfolio



Top States for Renewable Installed Nameplate Capacity – 2009 (Excluding Hydropower)



(Source: US DOE/ NREL 2010 Study)



## Top States for Renewable Installed Nameplate Capacity – 2009 (Including Hydropower)



# US Renewable Energy Profile

# Top Countries with Installed Renewable Electricity



•Majority of China's renewable energy is from small hydropower.  
(Source: DOE/NREL 2010)

# Top Countries with Installed Renewable Electricity by Technology

<u>Geothermal</u>	<u>Wind</u>	<u>Solar PV</u>	<u>CSP</u>	<u>Biomass</u>
US	US	Germany	US	US
Philippines	China	Spain	Spain	Brazil
Indonesia	Germany	Japan		Germany
Mexico	Spain	US		China
Italy	India	Italy		Sweden



# Federal Subsidies & Tax Relief/Incentives

## Federal Subsidies (2009-2012)

\$2.3 billion  
Carbon Capture  
and Storage

\$12.2 billion  
Traditional  
Renewable

Incentives need to be longer than 1-2 years.

The investment community needs clear picture of future incentives.

Longer term incentives



# Federal Subsidies & Tax Relief/Incentives



# Federal Subsidies & Tax Relief/Incentives



The American Recovery Reinvestment Act of 2009 (ARRA) provided \$1.64 billion for renewable projects, but many of those incentives have closed or close this year.

*(Source: DOE)*







## Germany's Phaseout Puts a Spotlight on the Cost of Its Renewables Strategy

June 10, 2011

“Germany's decision to phase out nuclear energy by 2022 will transform Europe's largest economy into a multibillion-dollar laboratory experiment on the rapid deployment of renewable energy and smart grid technologies...”

OR

“...if these initiatives fall short, it could leave consumers exposed to higher power prices and make German industry less competitive and the nation more dependent on fossil fuel sources and imports from France's nuclear plants.”

# Renewable Energy Market Challenges

- Assistance for renewables has been debated in Congress and is often the subject of controversy, leveraging alternative tactics, and inconsistent policy.

***This leads to market uncertainty, compromising investment opportunities, and technology development inefficiencies.***

- Renewable energy generation remote locations require electric power transmission grid infrastructure investments.
- Cyclic operating characteristics (non-geothermal) create electric power grid stability challenges.
- Ability for geothermal applications to attract investment/interest from the oil and gas sector, thus leveraging existing and characterized resources (co-produced fluids).



# Questions?

