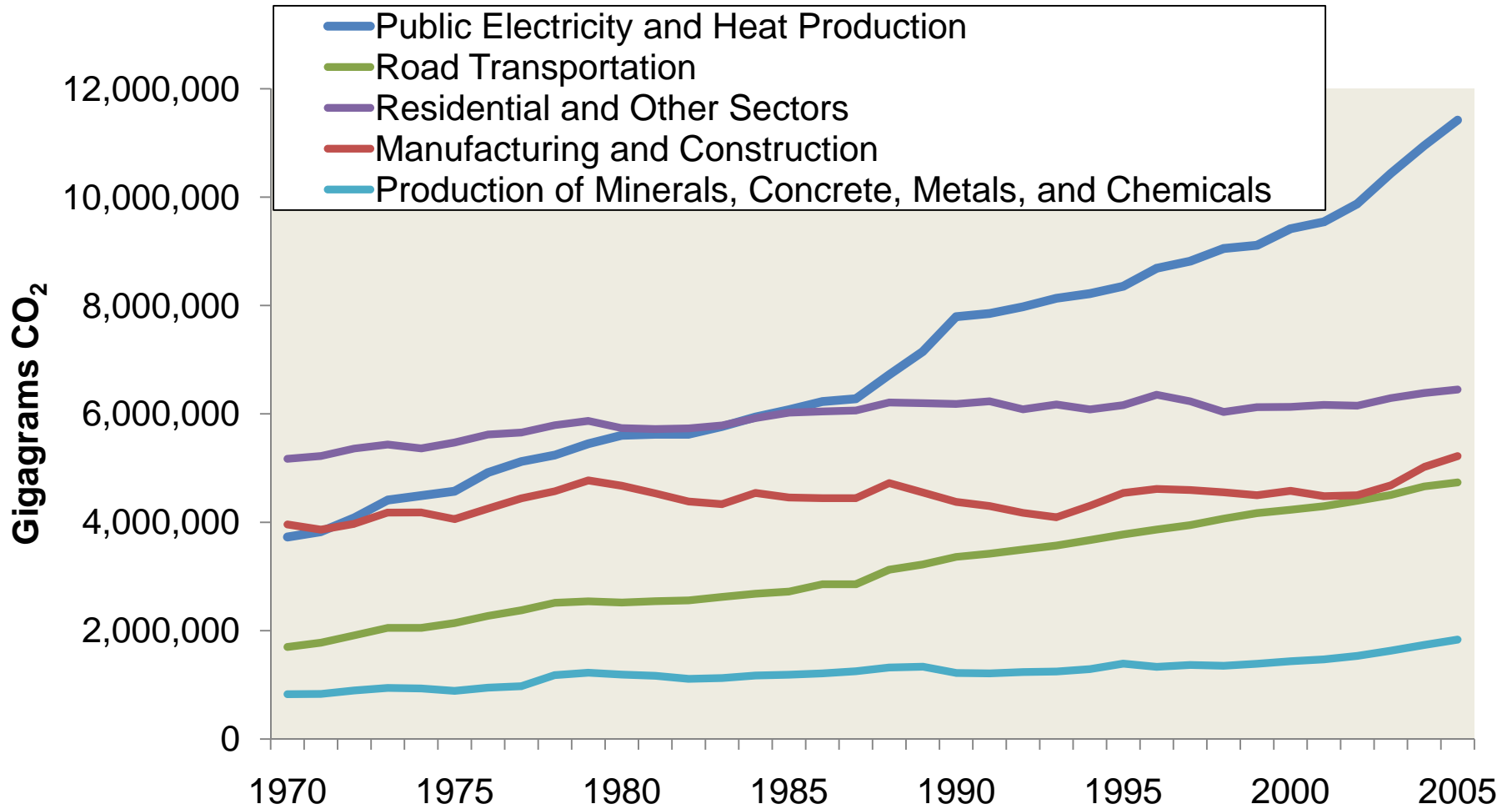


# The Role of Natural Gas in a Low Carbon Economy



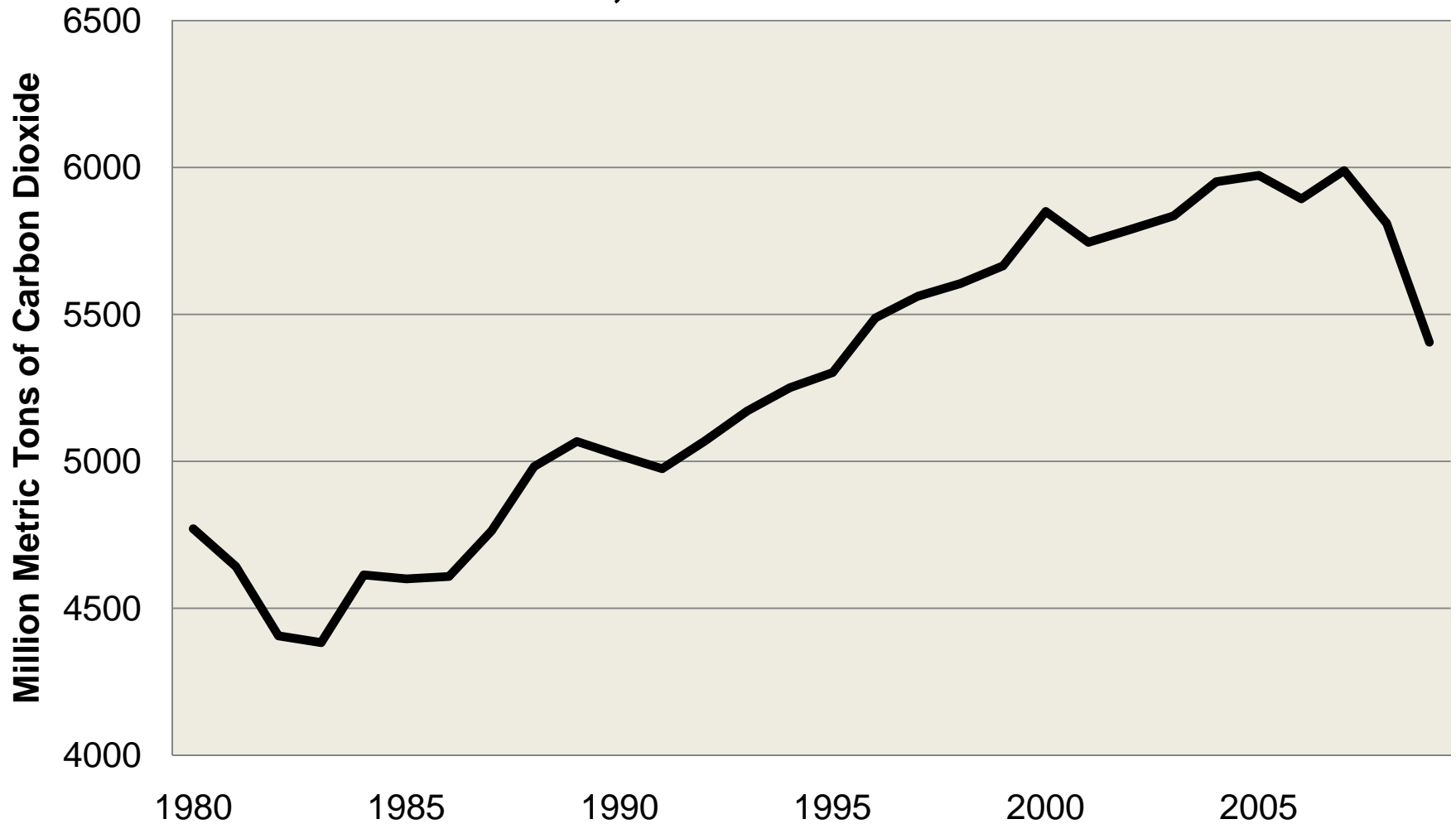
**Saya Kitasei**  
**November 2010**

# Global CO<sub>2</sub> Emissions from Major Sources 1970 - 2005

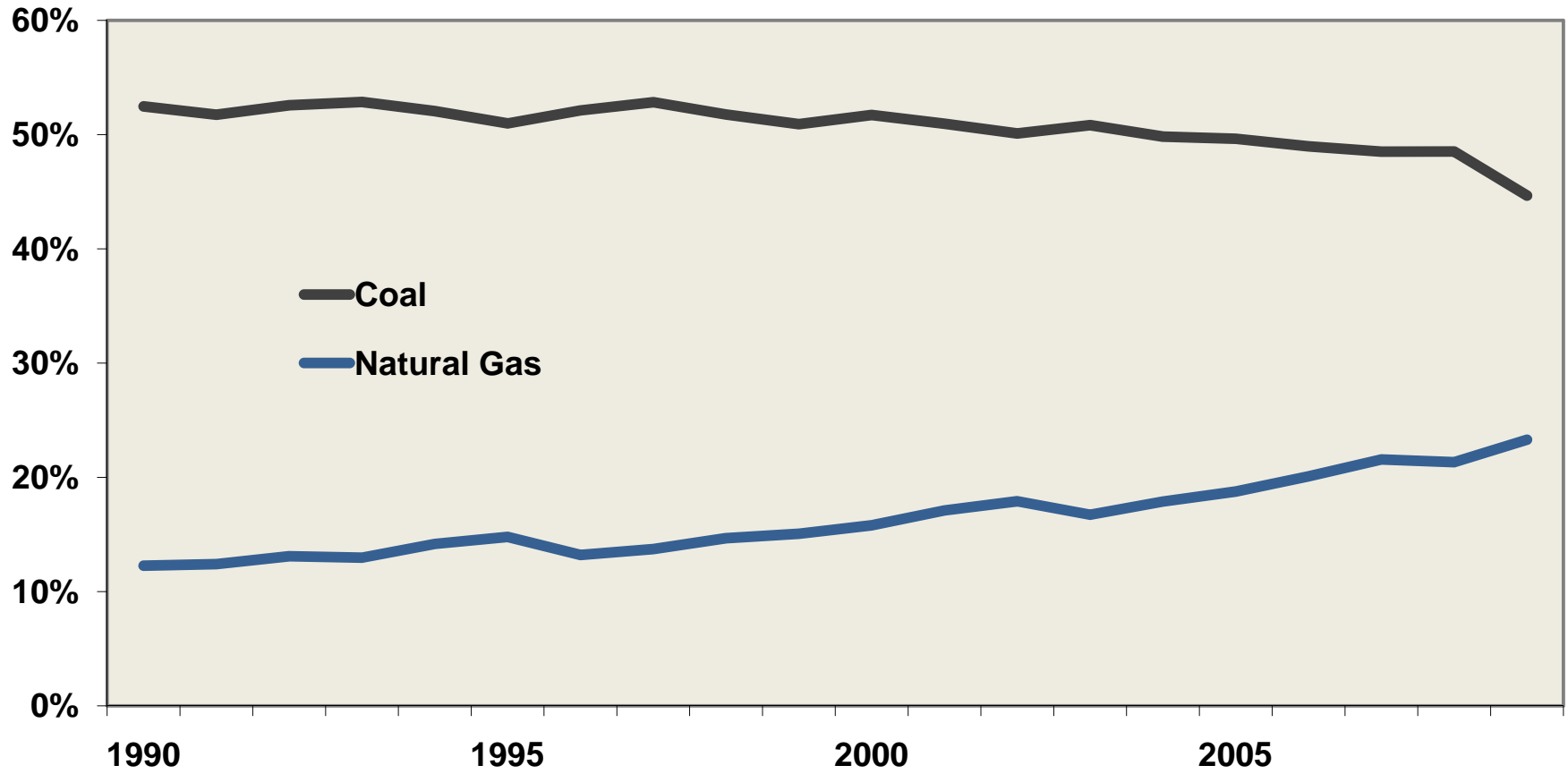


Source: EC-JRC/PBL. EDGAR version 4.1.

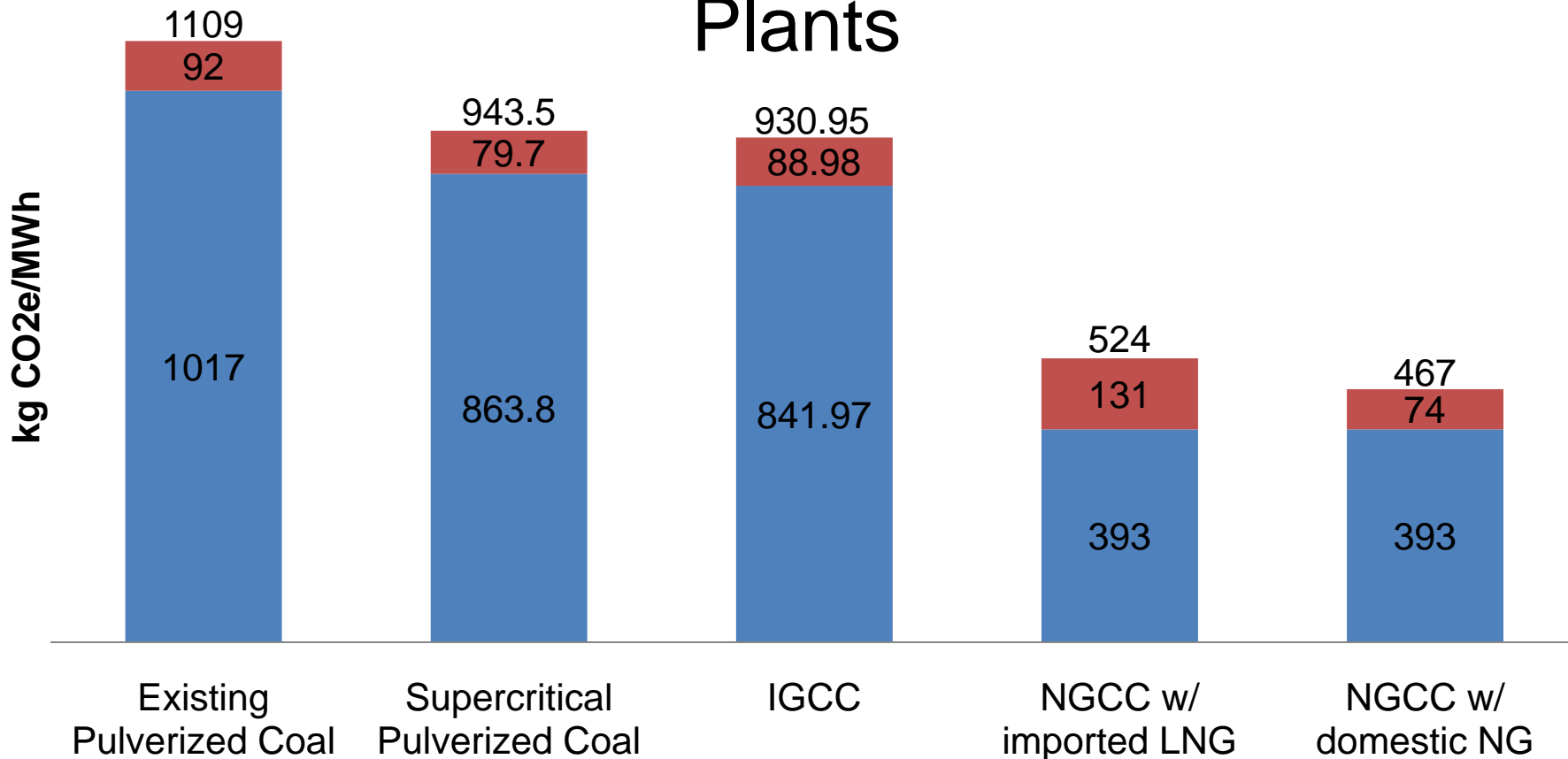
# U.S. Carbon Dioxide Emissions from Energy Use, 1980-2009



# Share of U.S. Electric Generation from Coal and Gas, 1990-2009

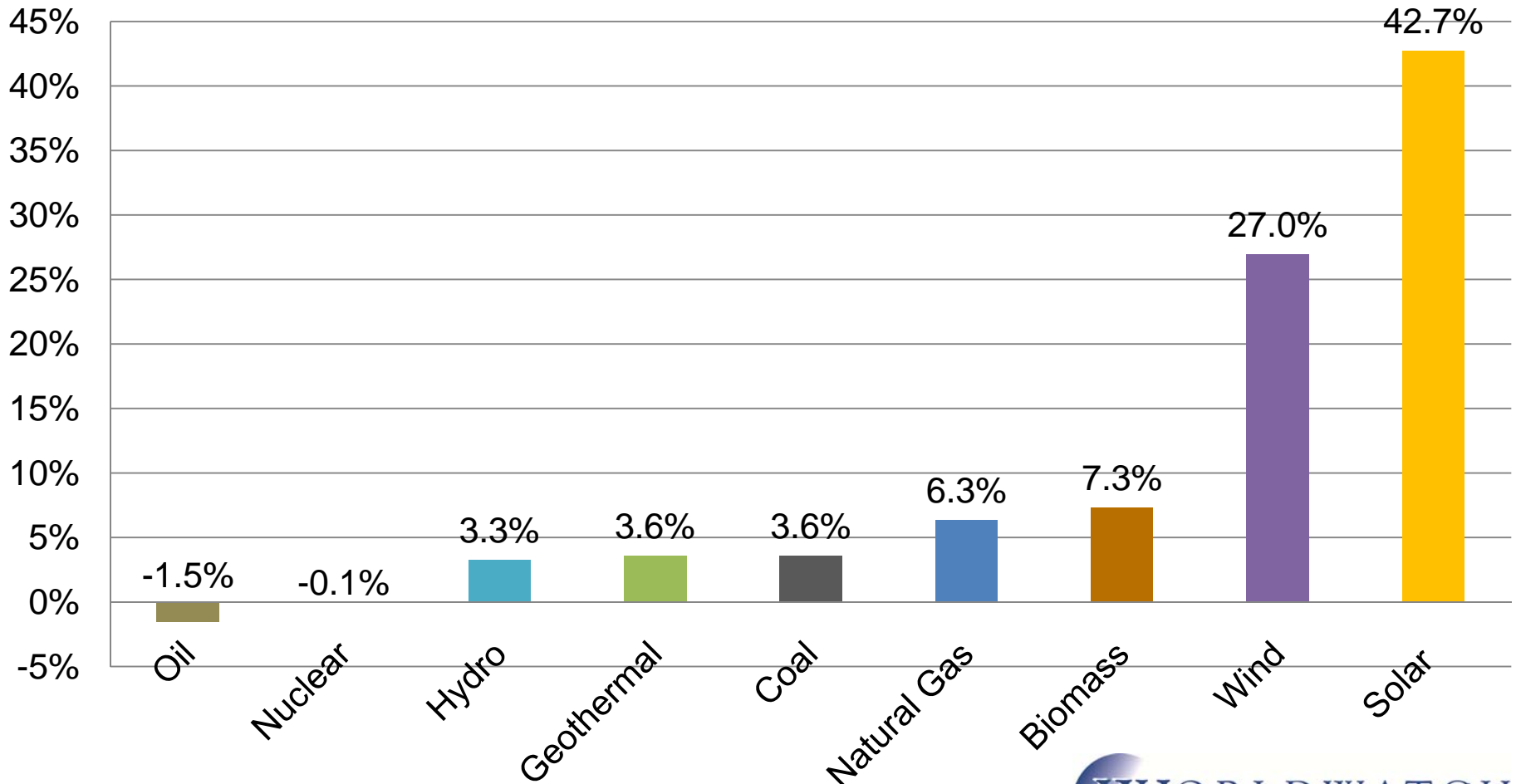


# Life Cycle Greenhouse Gas Emissions from Coal and Natural Gas Plants



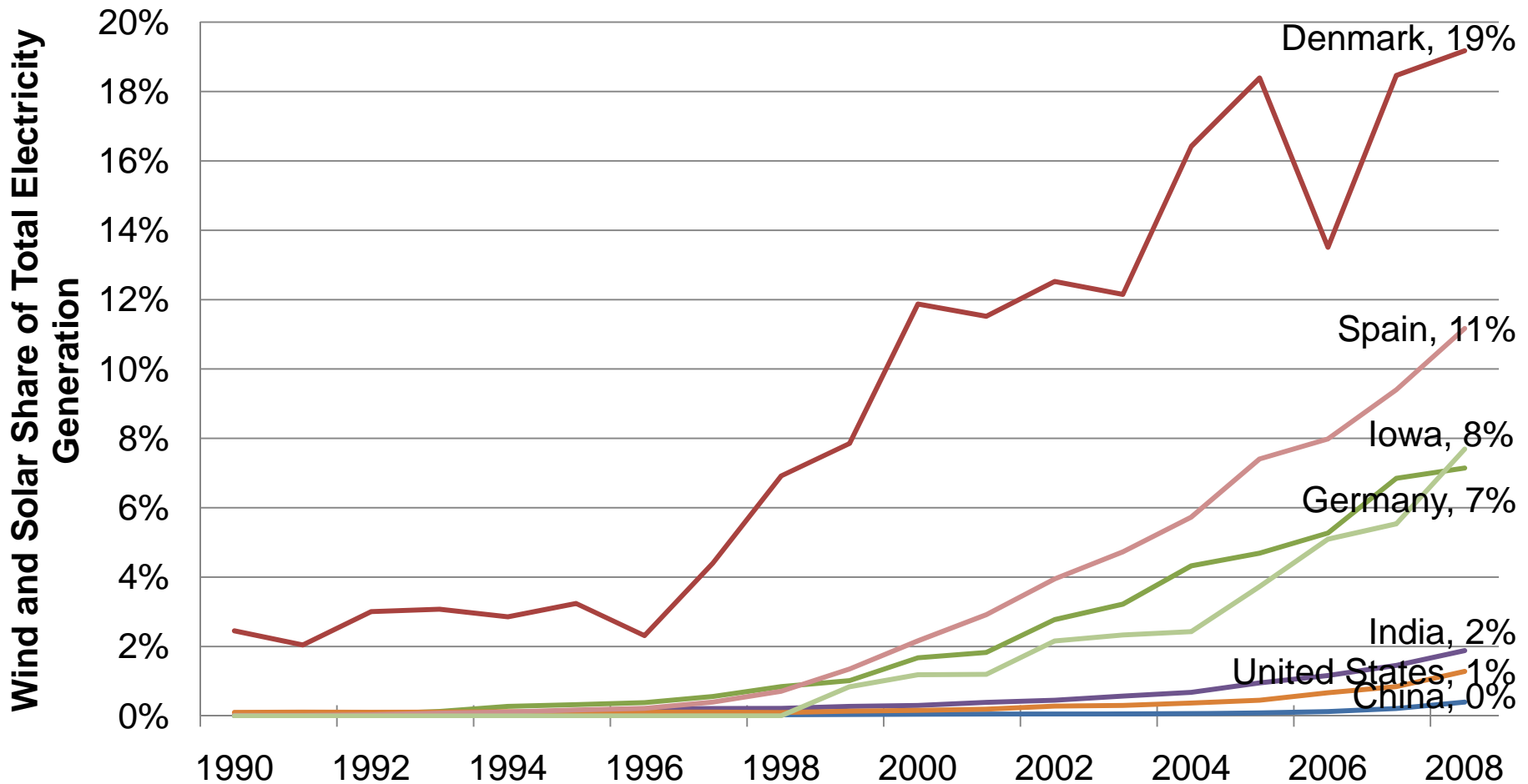
IGCC = Integrated Gasification Combined Cycle. NGCC = Natural Gas Combined Cycle. Imported LNG = liquefied natural gas from Trinidad and Tobago. Domestic NG = compressed natural gas from combination of a) onshore conventional gas, b) onshore associated gas, c) offshore gas, d) Barnett Shale, and e) various coalbed methane fields. Source: NETL

# Average Annual Growth Rates in Electricity Generation by Fuel 2004-2008



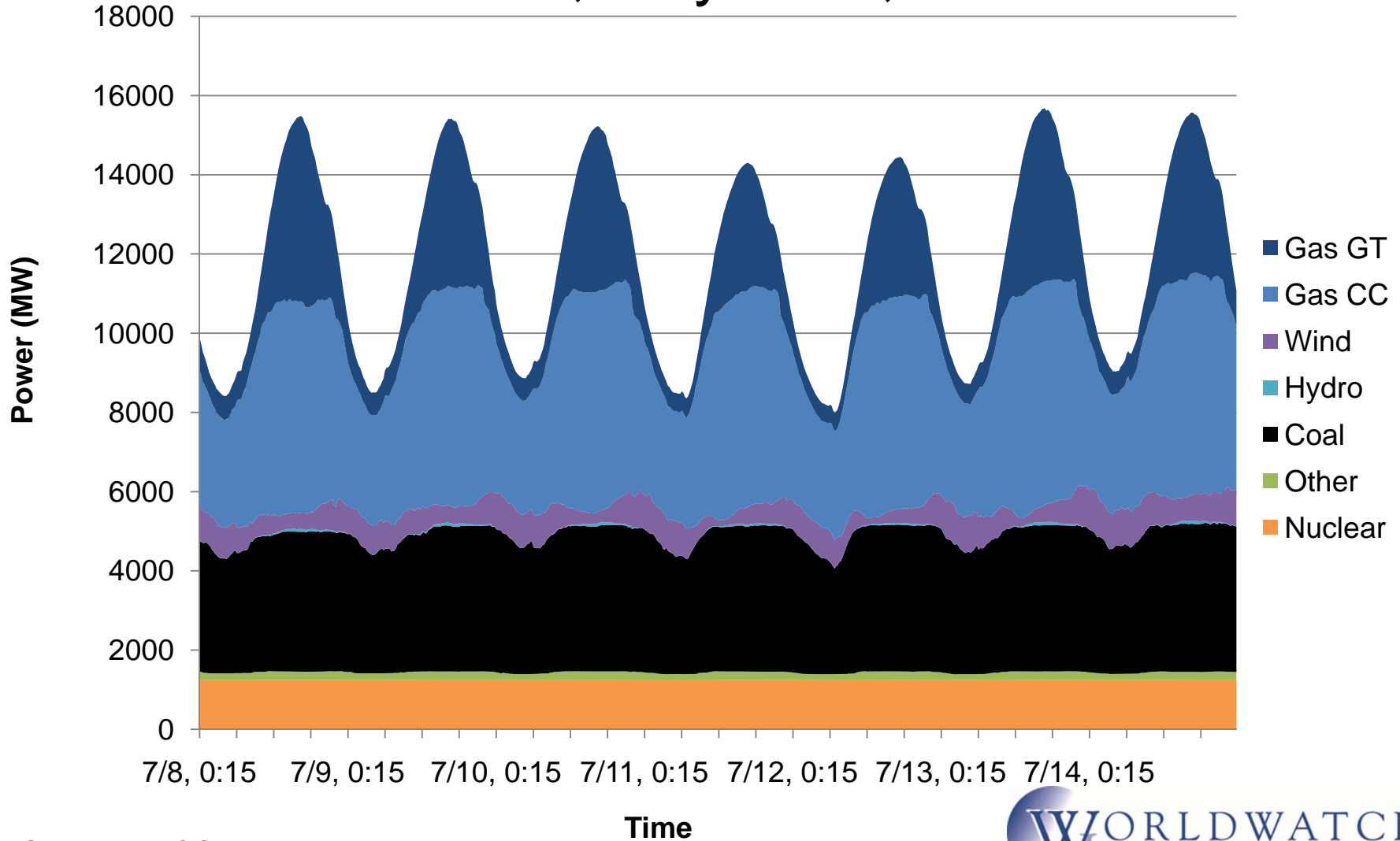
Source: IEA

# Wind and Solar Share of Total Electricity Generation, 1990-2008



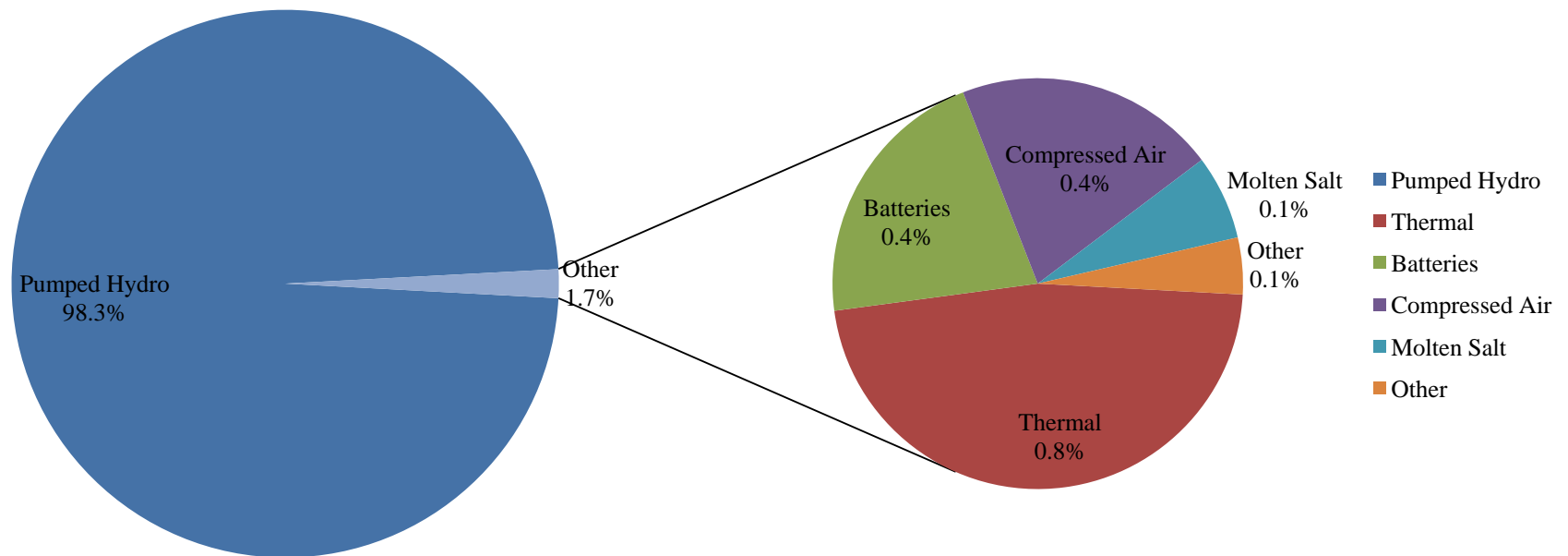
Source: EIA

# 15-min Generation Data by Fuel, ERCOT, July 8-14, 2009



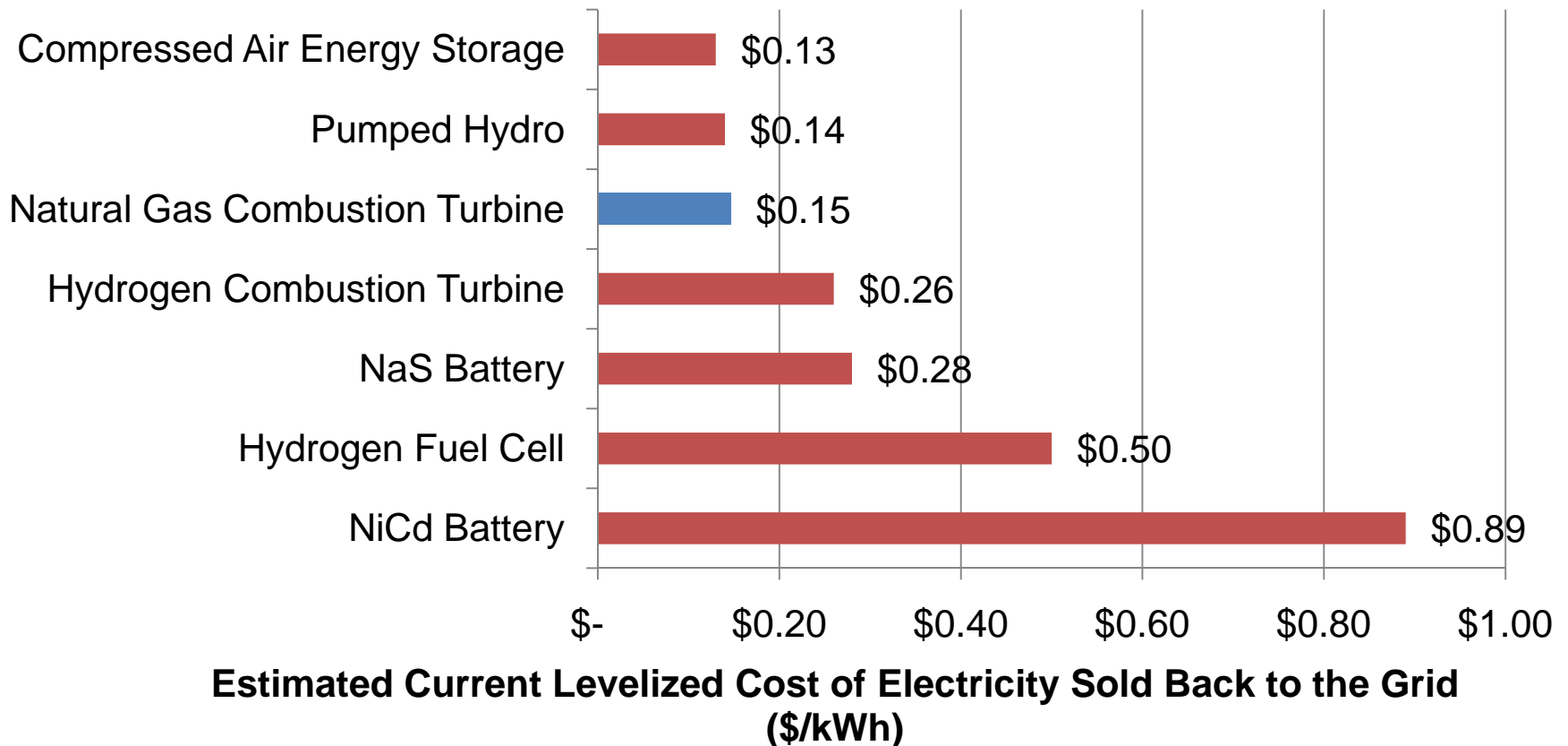
Source: ERCOT

# Global Installed Capacity of Energy Storage



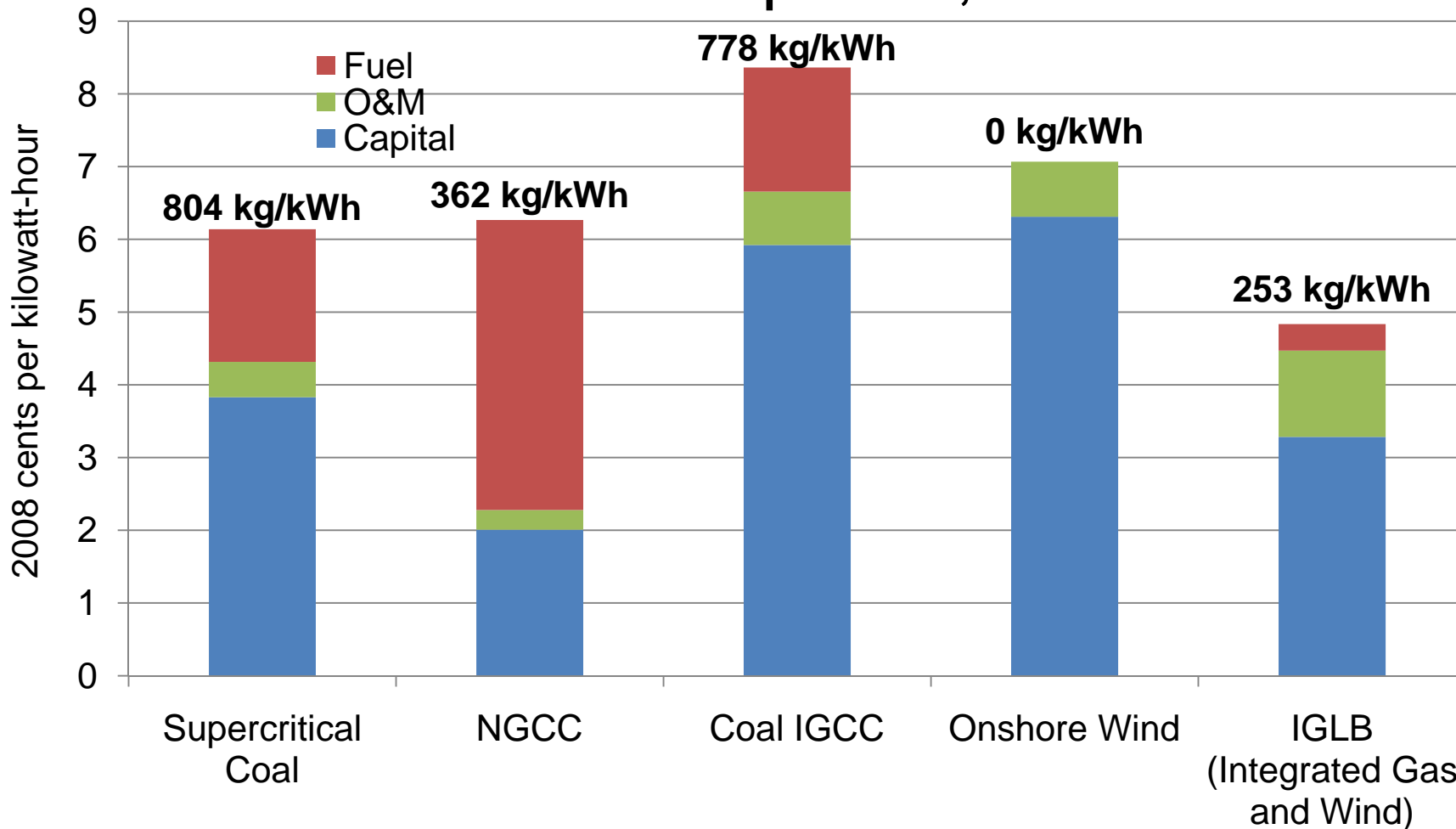
Source: Janice Lin

## Estimated Levelized Cost of Backup Electricity



*Natural gas price for compressed air energy storage system and natural gas combustion turbine assumed to be \$7/MMBtu. Capacity factor of natural gas combustion turbine assumed to be 20 percent. Cost of purchasing off-peak electricity for storage assumed to be \$0.025-\$0.06/kWh. Estimates reflecting conservative estimates for current technologies are used, rather than projections based on estimated technology improvement. Hydrogen assumed to be produced through electrolysis from off-peak electricity. Source: NREL, Worldwatch estimates.*

# Levelized Cost of Electricity for Select New Power Options, 2008



Figures above bars show carbon dioxide emissions per kWh of electricity generated.

Source: Worldwatch estimates, Lazard, CRS, Altresco

# Micro-Combined Heat and Power

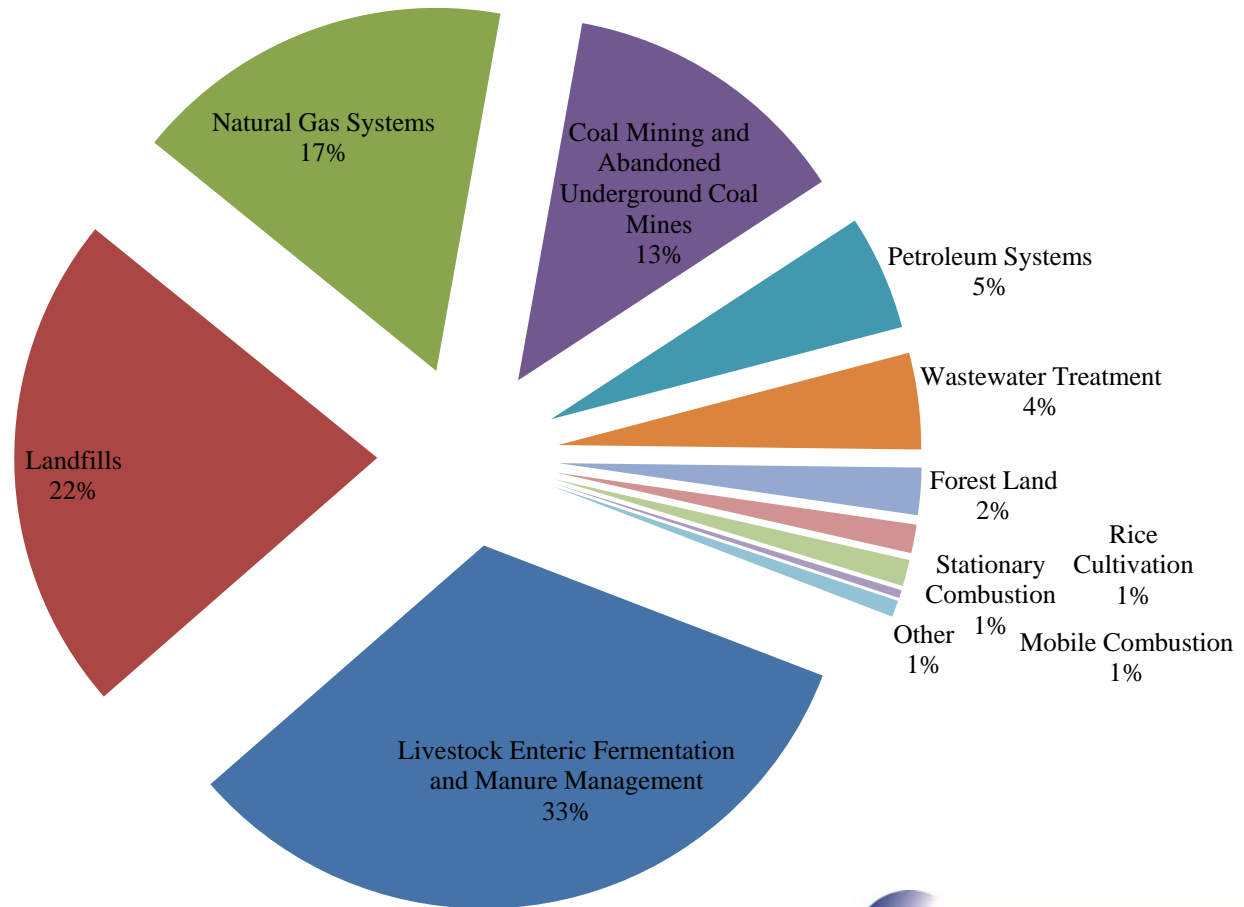


Honda ECOWILL  
Combined Heat and  
Power and Hot Water  
Unit

> 85 % total efficiency

Almost 100,000 sold in  
Japan to date.

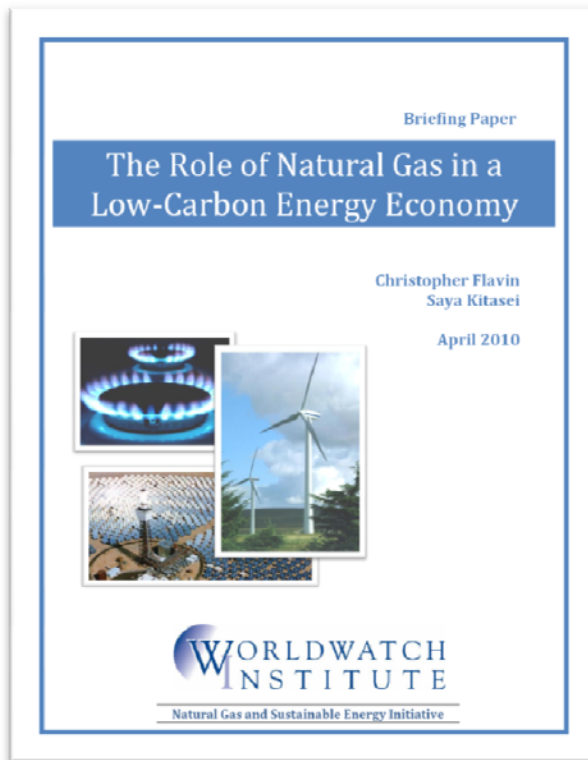
# Estimated Methane Emissions in the United States by Source, 2008



Source: EPA

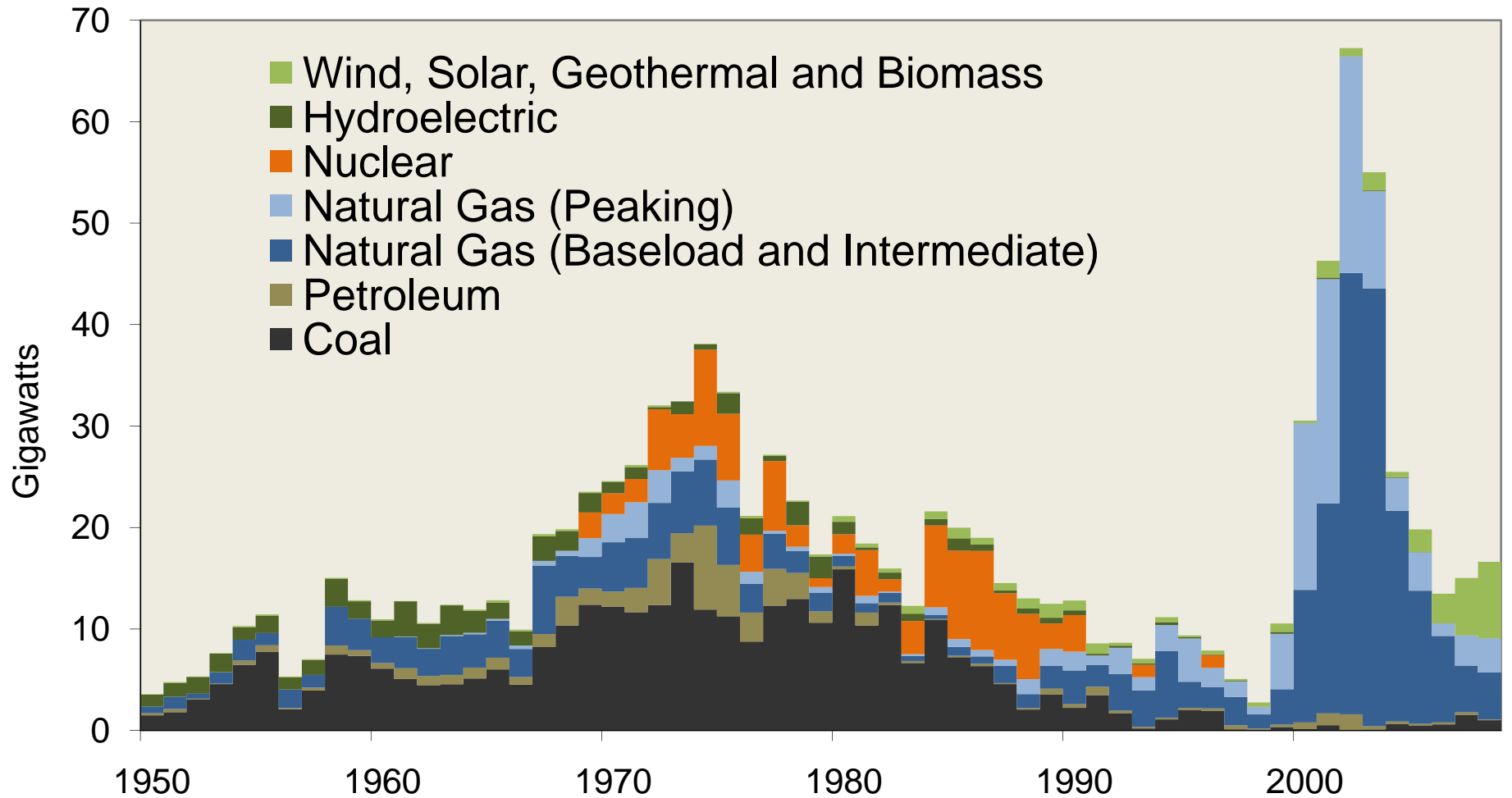
# New Natural Gas and Sustainable Energy Initiative publications available for free download from

[www.worldwatch.org](http://www.worldwatch.org):

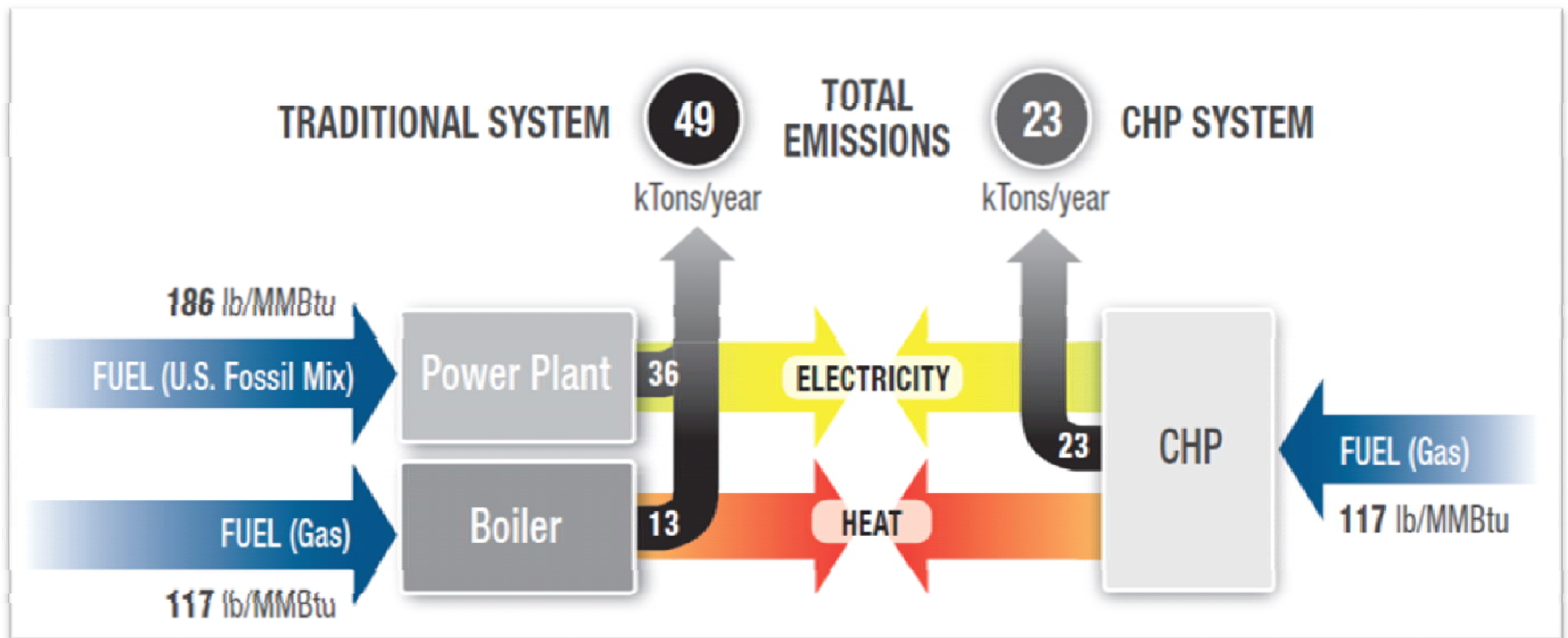


- *The Role of Natural Gas in a Low-Carbon Energy Economy*
- *Addressing the Environmental Risks of Shale Gas Development*
- *How Energy Choices Affect Fresh Water Supplies: A Comparison of U.S. Coal and Natural Gas*

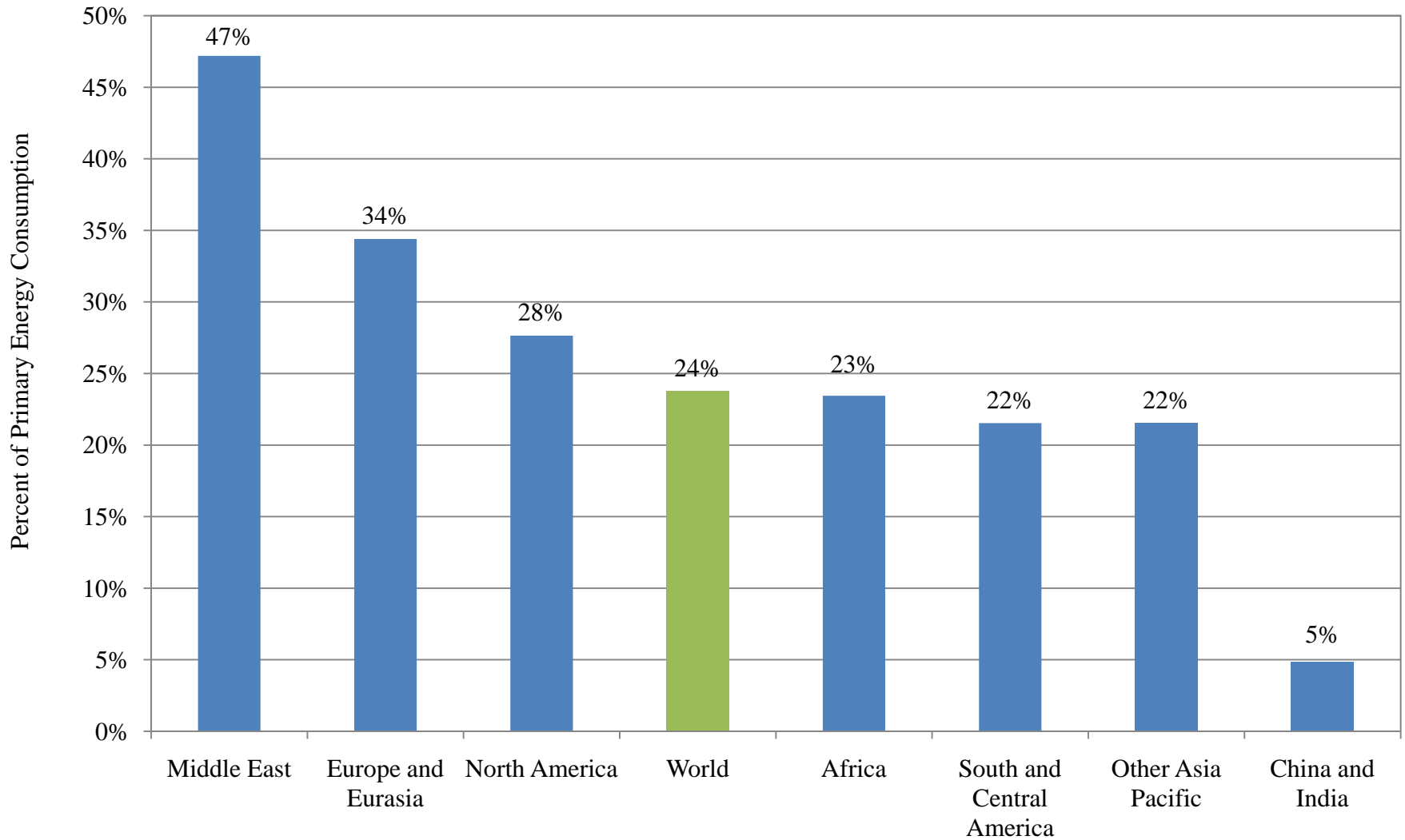
# U.S. Generating Capacity, 2008 By Fuel and Initial Year of Operation



# Stand-Alone Generation vs. Cogeneration



## Natural Gas Share of Primary Energy Use by Region, 2009



Source: BP