

# Energy Management, Utilities and Public Policy

*What Professionals Need to Know*

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FirstEnergy

# Energy Management

## What is it?

*“Proactive, organized and systematic coordination of procurement, conversion, distribution, and use of energy to meet requirements, taking into account environmental and economic objectives.”*

# Discussion Areas

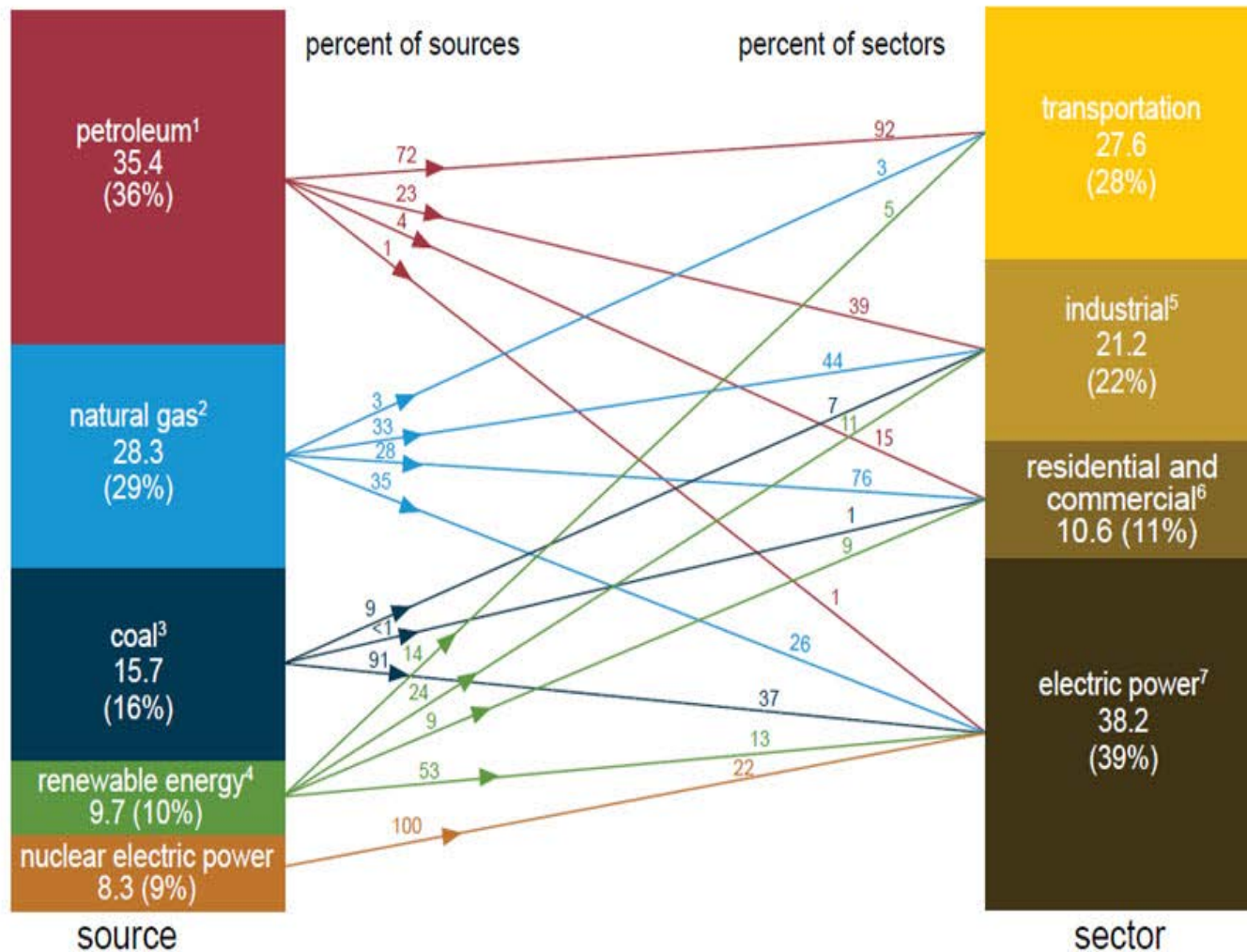
- ▶ **Energy Sources and Uses**
- ▶ **Electricity/Power Generation**
  - Current Issues
  - Fuel Sources
  - Projections
- ▶ **Environmental Considerations**
- ▶ **Economics**
- ▶ **Global Outlook**
- ▶ **Challenges**



# U.S. Energy Sources and Uses

## U.S. primary energy consumption by source and sector, 2015

Total = 97.7 quadrillion British thermal units (Btu)



# U.S. Energy Mix Trends

- ▶ **Coal production peaked in 2008**
  - *Trending down*
- ▶ **Natural gas production peaked in 2015**
  - *Dominated by fracking, and it continues*
  - *Exporting gas – Liquid Natural Gas (LNG) terminals*
- ▶ **Crude oil production declined 1970 – 2008**
  - *Trend reversed since 2009; improved technology*
- ▶ **Renewable energy as a source is growing**

Fossil fuels (oil, coal, gas) still dominate at 80%

# For the Electricity Sector...

- ▶ **Production of electricity is dominated (86%\*) by thermal conversion of fuels**

- Boiler/Turbine/Generator Cycle
- Gas, Coal, Oil, Nuclear



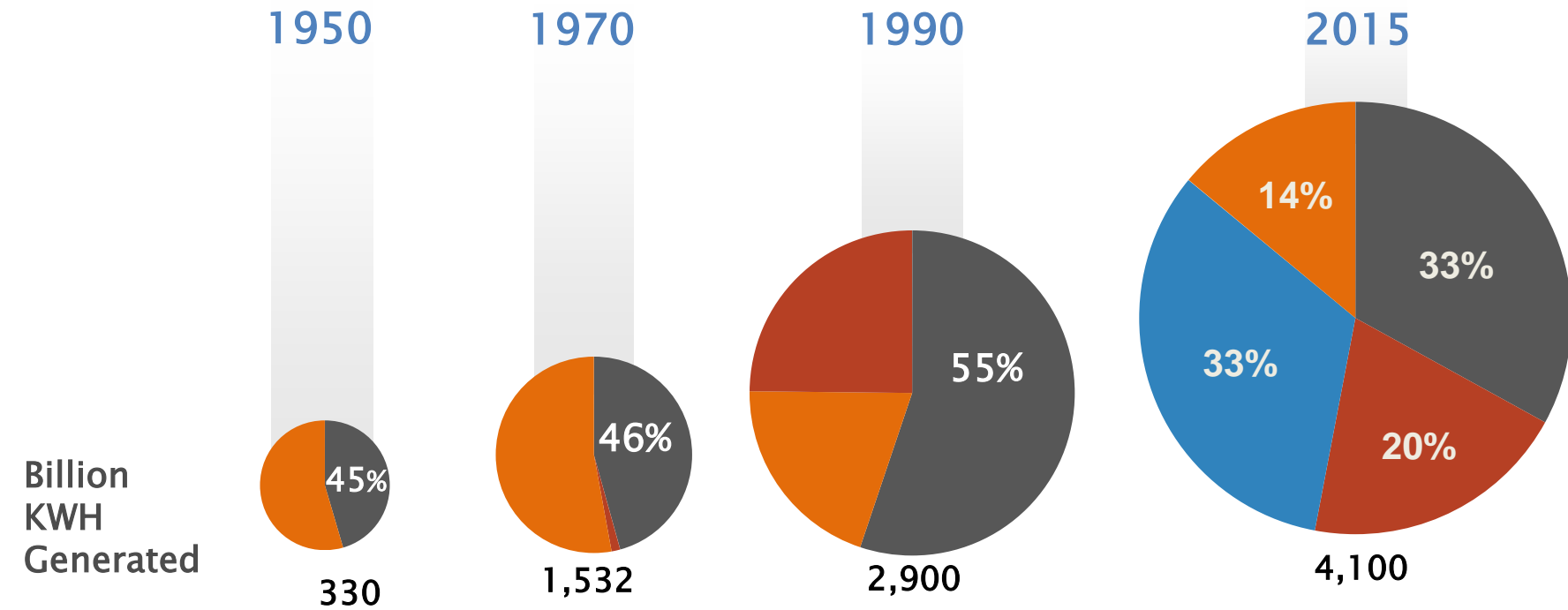
- ▶ **Direct conversion accounts for 14%**

- Hydro, wind, solar
- Large scale storage needed



\*Year-end 2015 data EIA

# U.S. Electric Generation Has Grown Twelve-Fold Since 1950: Coal Percentage Has Been Significant ....



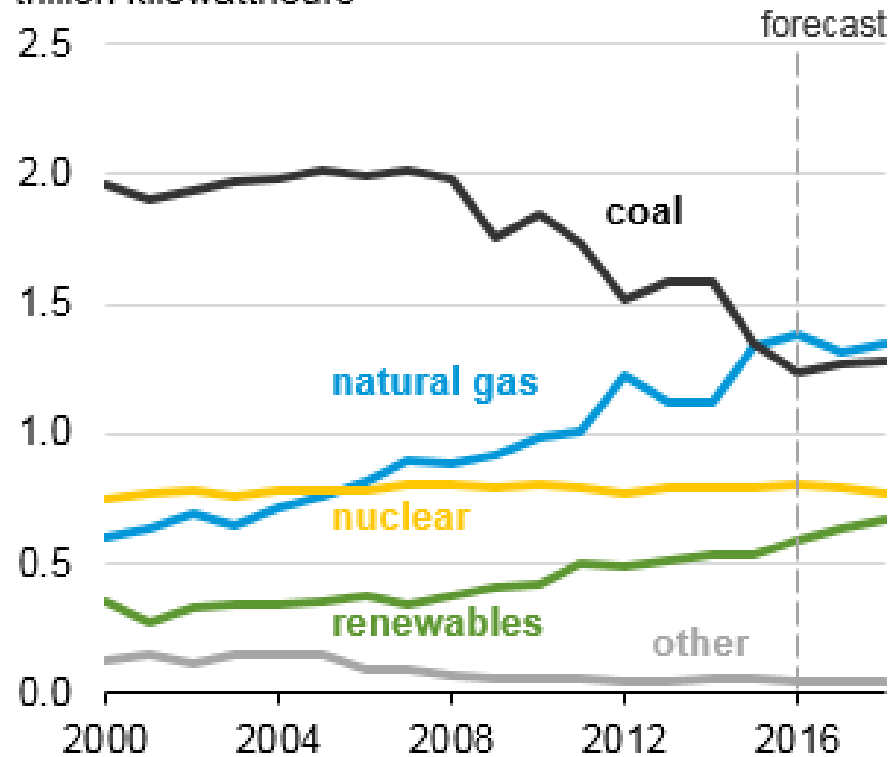
	1950	1970	1990	2015
Coal	150	700	1,600	1,350
Nuclear	0	22	580	820
Other	180	810	720	580
Natural Gas	N/A	N/A	N/A	1,350
<b>Billion KWH</b>	<b>330</b>	<b>1,532</b>	<b>2,900</b>	<b>4,100</b>

Sources: [http://www.eia.gov/cneaf/electricity/epm/table1\\_1.html](http://www.eia.gov/cneaf/electricity/epm/table1_1.html)  
 EIA Electricity Data Browser net generation from electricity plants

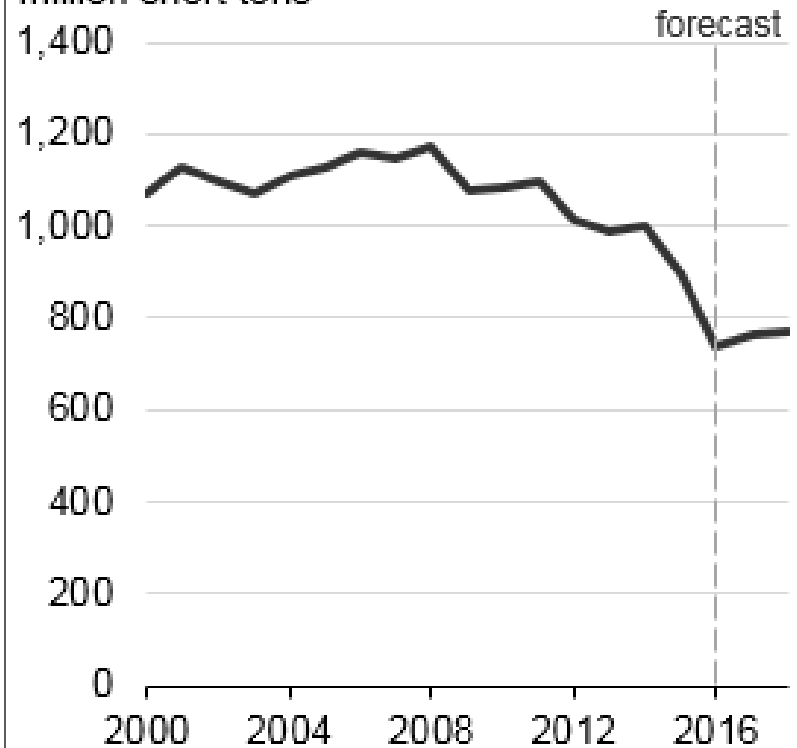


# Coal and Natural Gas Now “Head to Head”

U.S. net electricity generation  
trillion kilowatthours



U.S. coal production  
million short tons

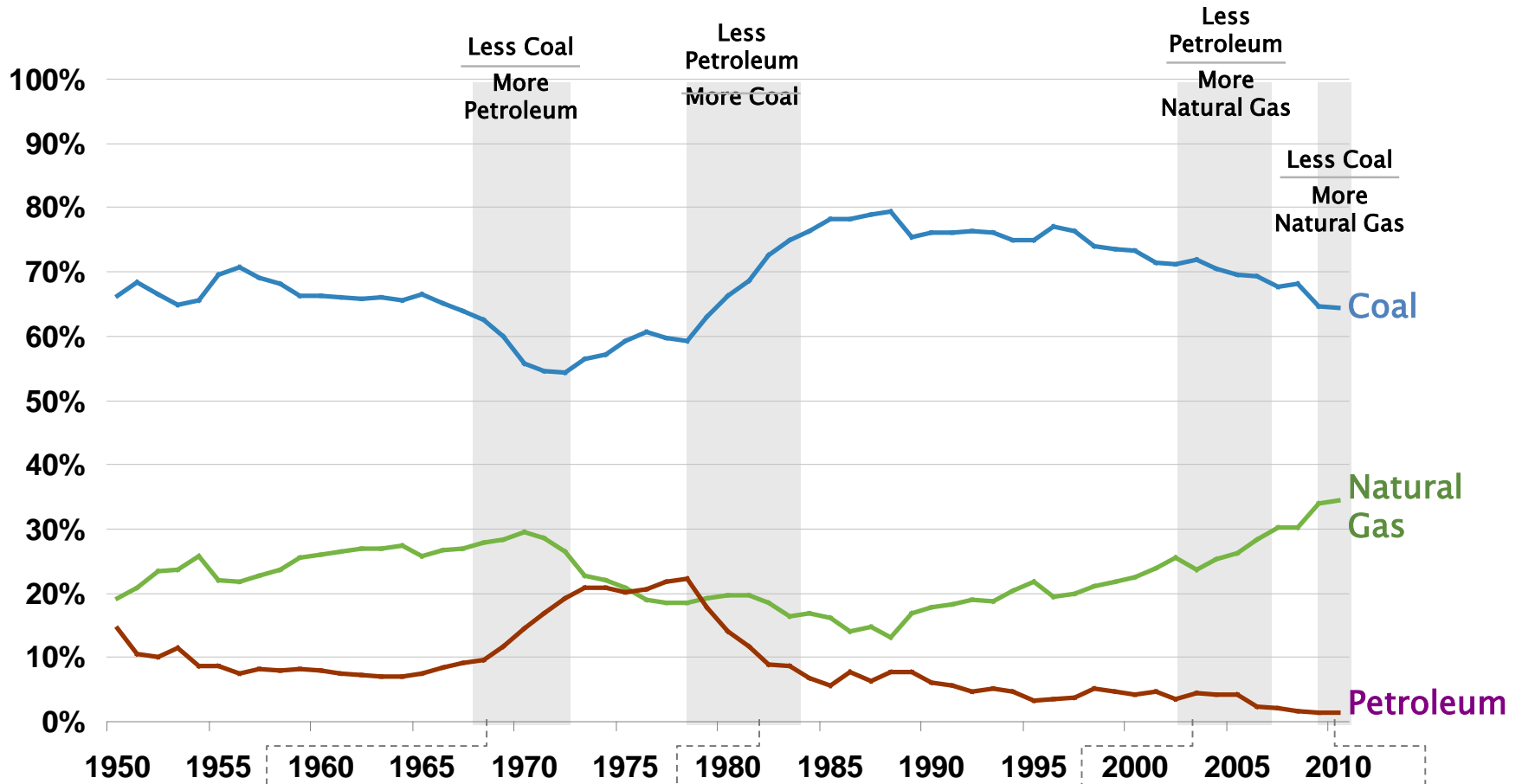


Source: EIA Website



# Fossil “Tradeoffs” are Part of our History

Annual Generation 1950–2012\*



\*2012 reflects Jan to Apr data

Low oil prices during 1960s, combined with smog concerns, spur new additions to petroleum-fired capacity

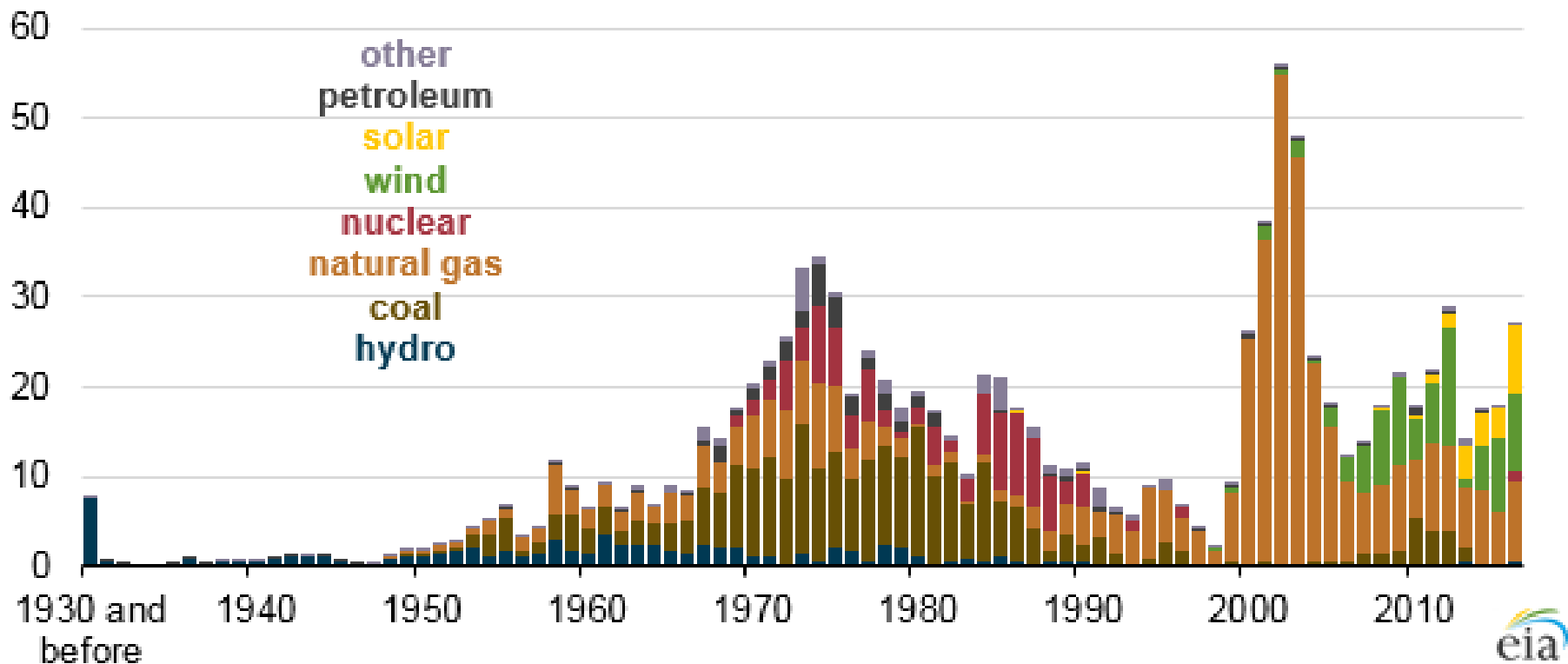
Oil price shocks during 1970s led to increased utilization of coal-fired capacity for baseload generation

Rapidly rising oil prices lead many generators to switch oil-fired peaking capacity to natural gas

Historically low natural gas prices lead to increased utilization of combined cycle plants at expense of coal units

# Historical Build.....Capacity Installed by Initial Year and Fuel Type

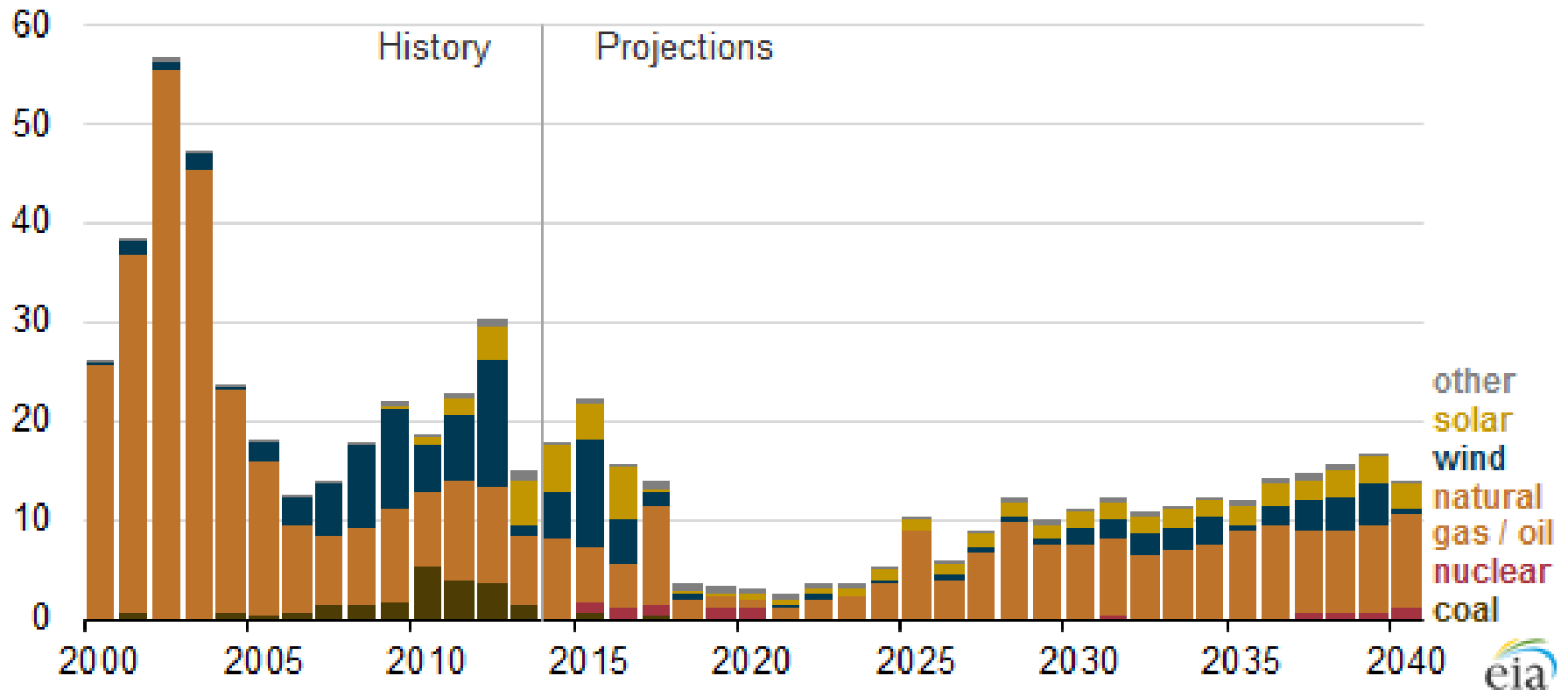
U.S. utility-scale electric generating capacity by initial operating year (as of Dec 2016)  
gigawatts



Source: EIA Website

# Planned Additions: Primarily Natural Gas

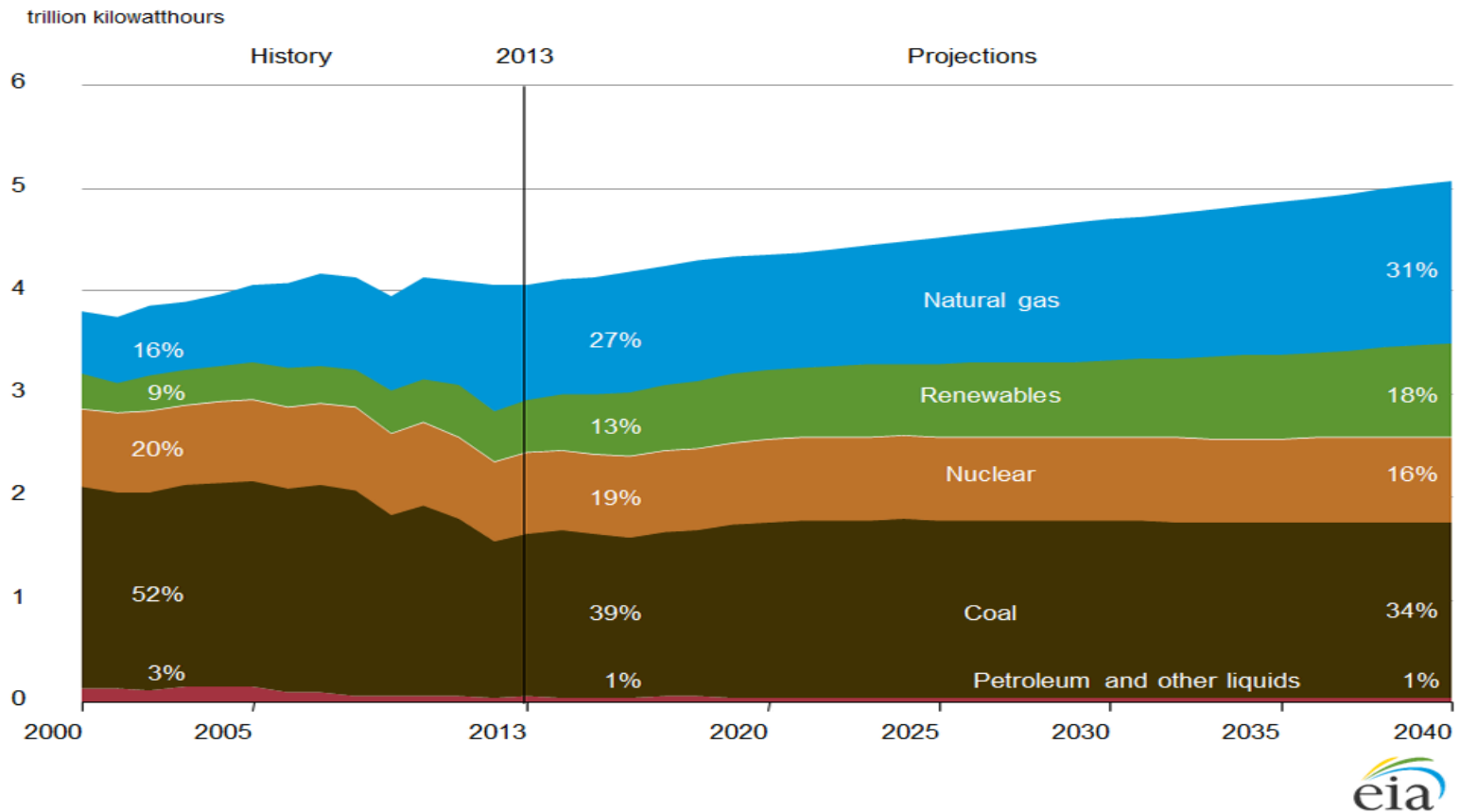
Additions to electricity generating capacity in the AEO2015 Reference case, 2000-2040 gigawatts



Source: EIA Website

# Fuel Diversity Remains in the Forecast...

Figure 31. Electricity generation by fuel in the Reference case, 2000-2040

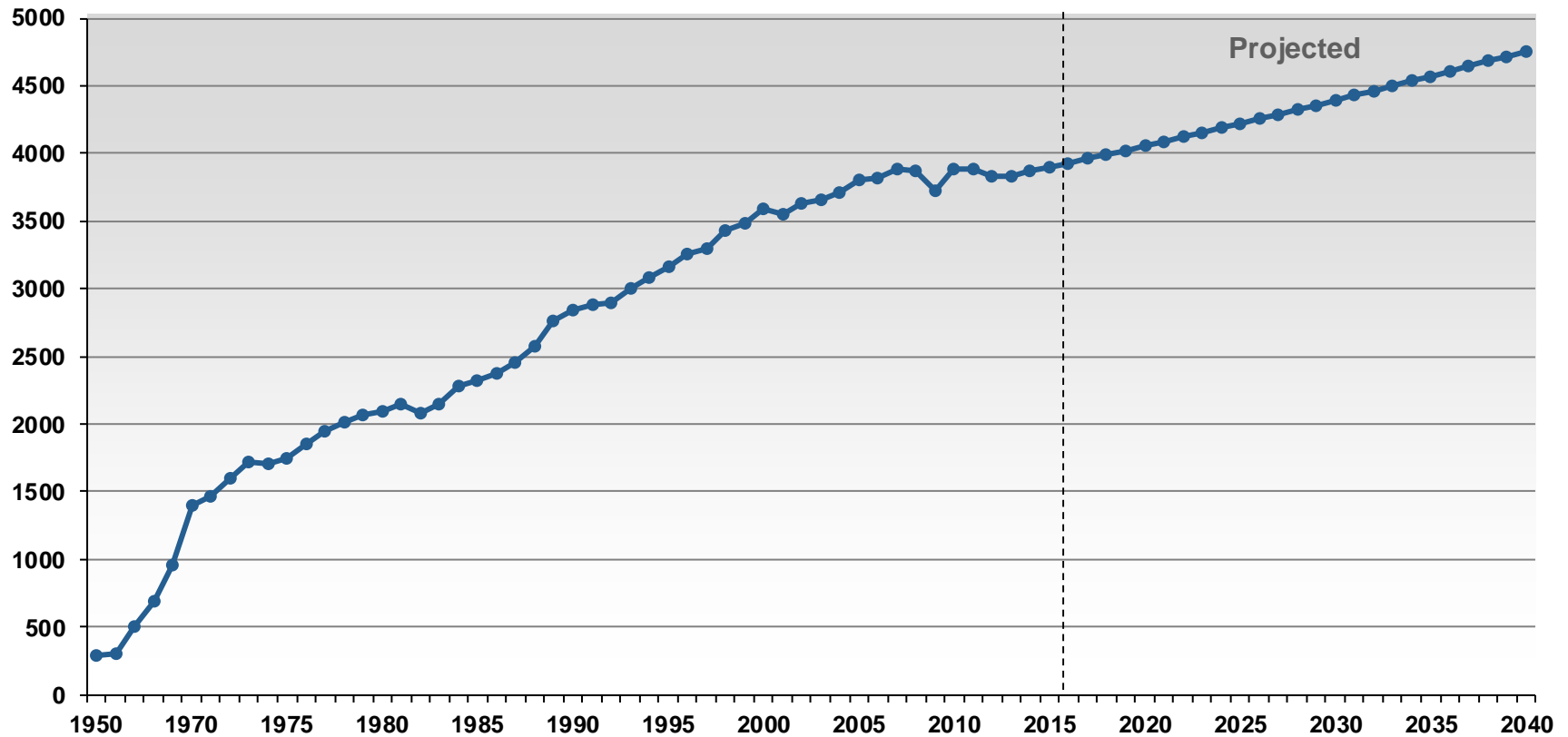


Source: EIA Website

# Our Appetite for Electricity “Marches On”

KWH  
(billions)

## Annual U.S. Electricity Consumption 1950-2040



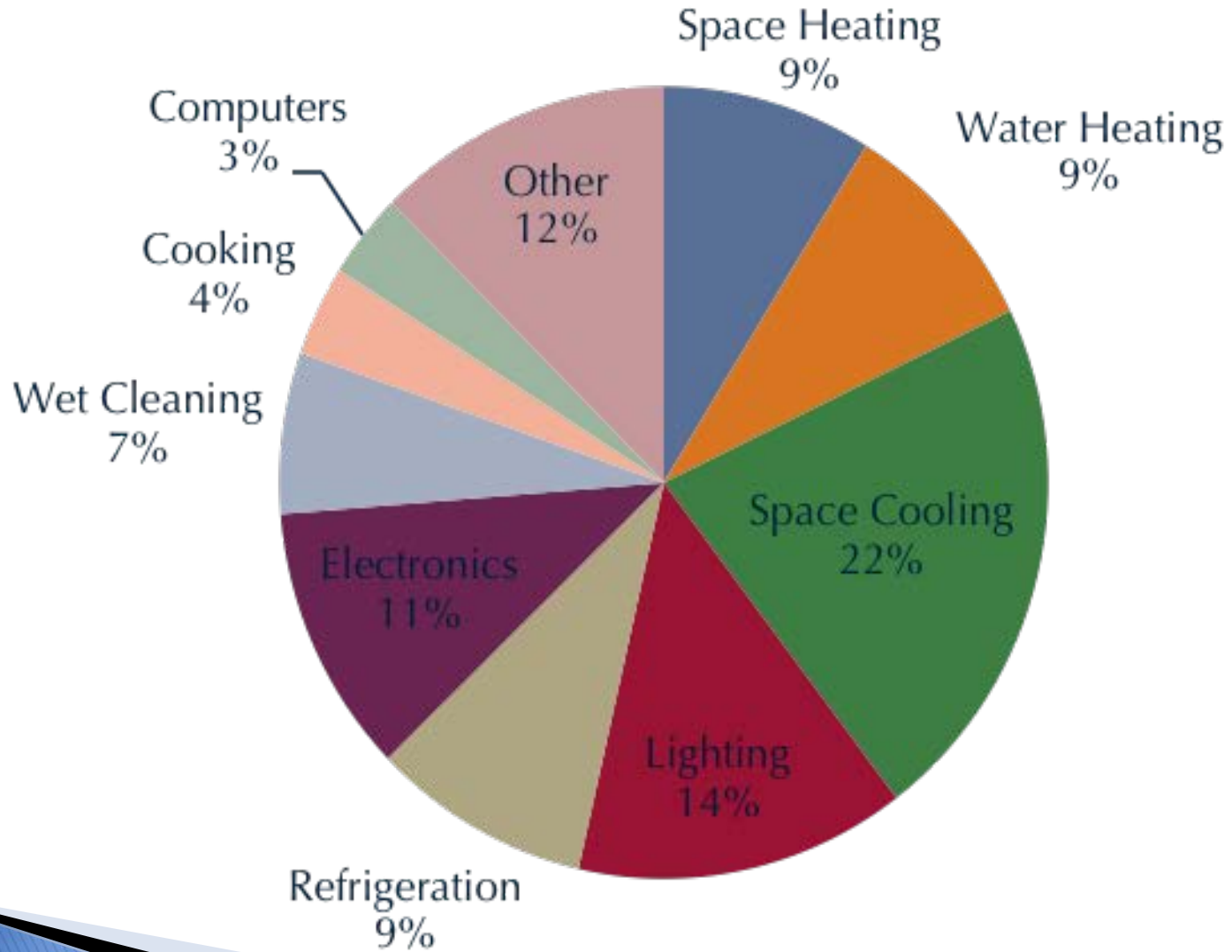
Source: Energy Information Administration, Annual Energy Outlook 2015

# Electricity at Home and Work





# Electricity at Home...



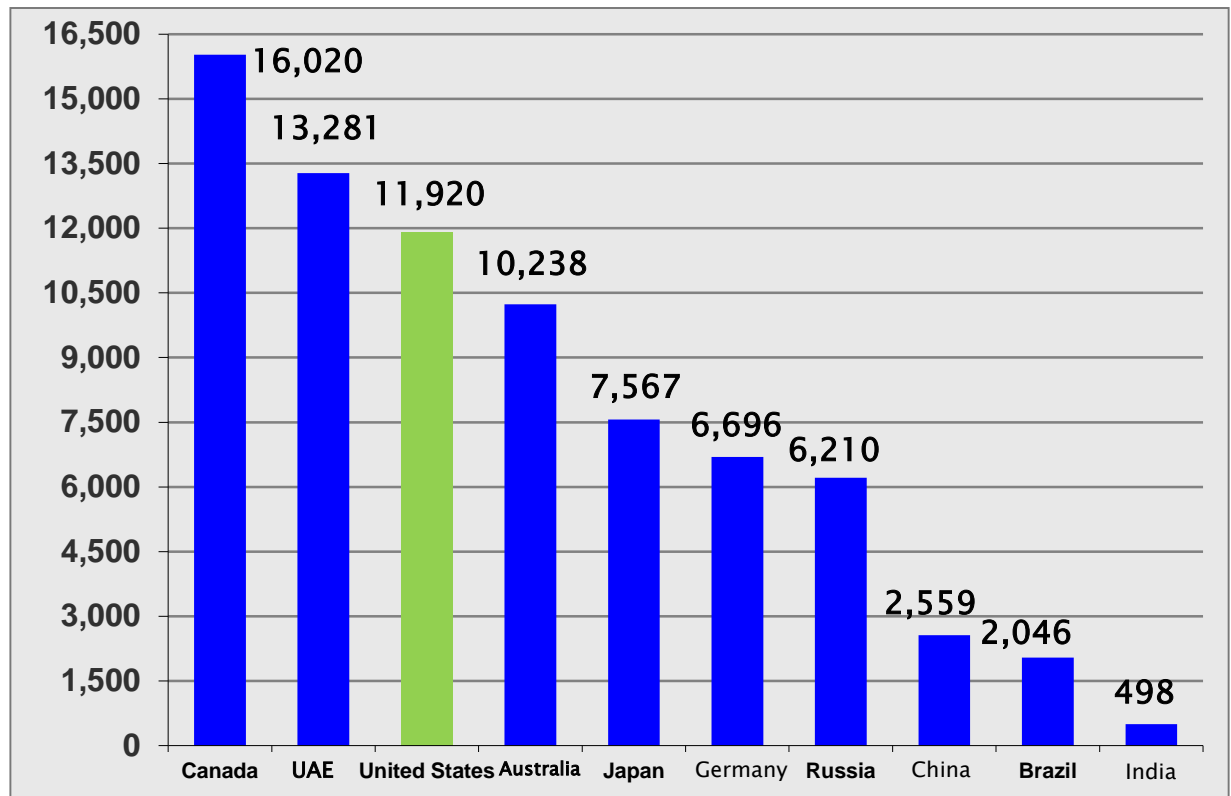


# U.S. Per Capita Electricity Consumption Among Highest in the World

- ▶ Lifestyle
- ▶ Larger houses
- ▶ Heating and cooling
- ▶ Comfort and security
- ▶ Entertainment

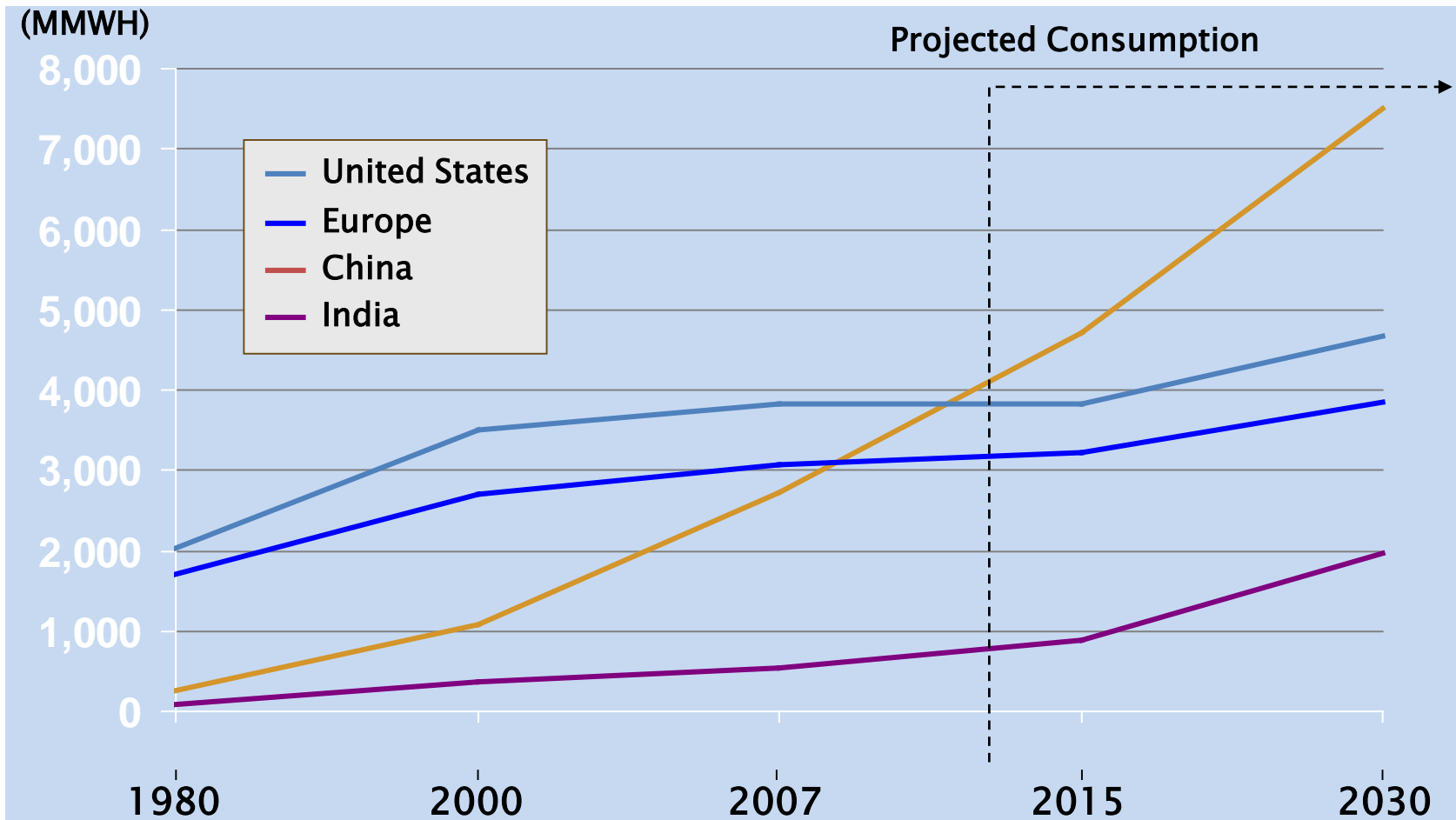


Annual KWH Per Capita



Source: (1) CIA, World Fact Book, 2012

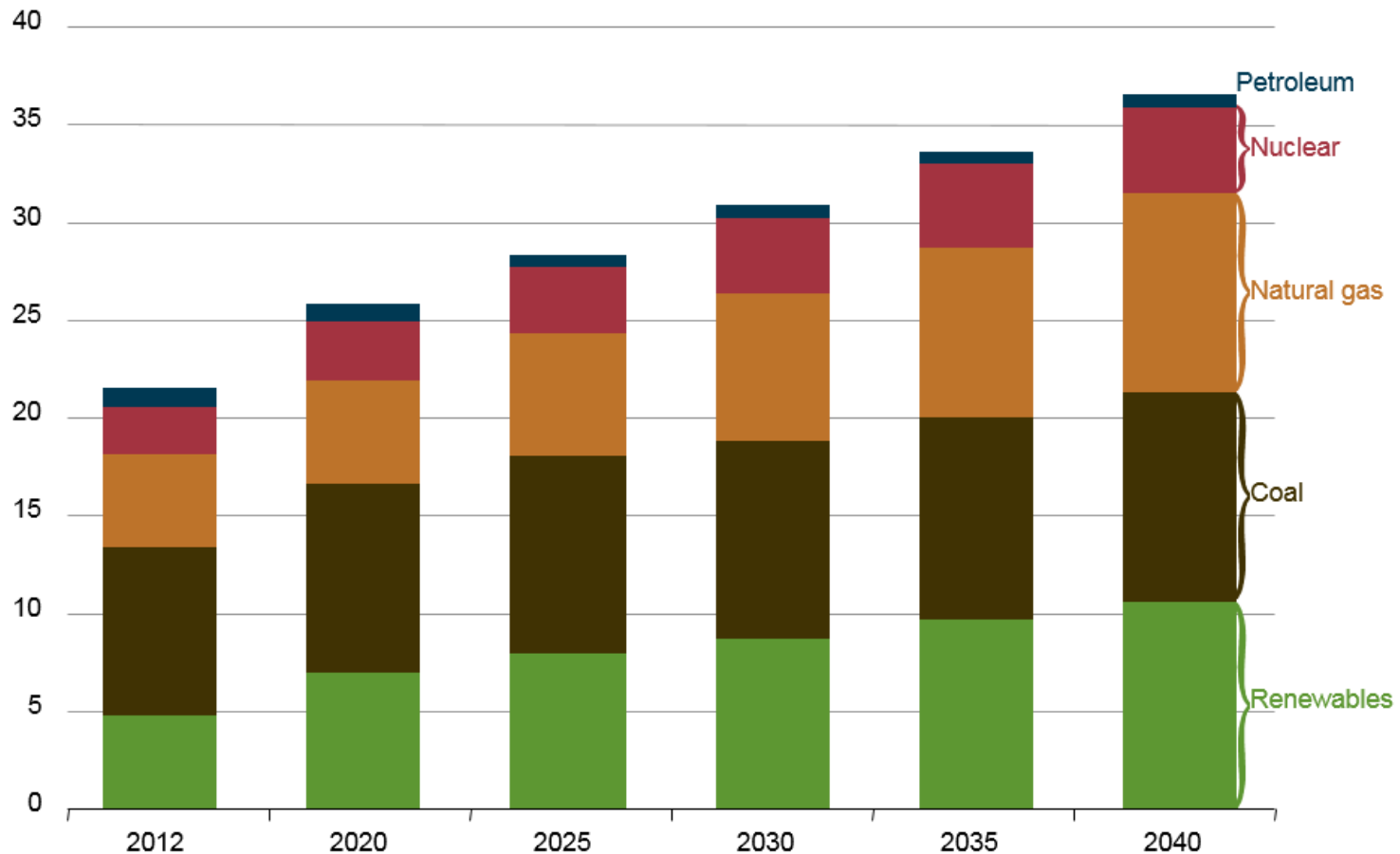
# Thus, Global Electricity Growth is Expected to Continue



Source: World Energy Outlook

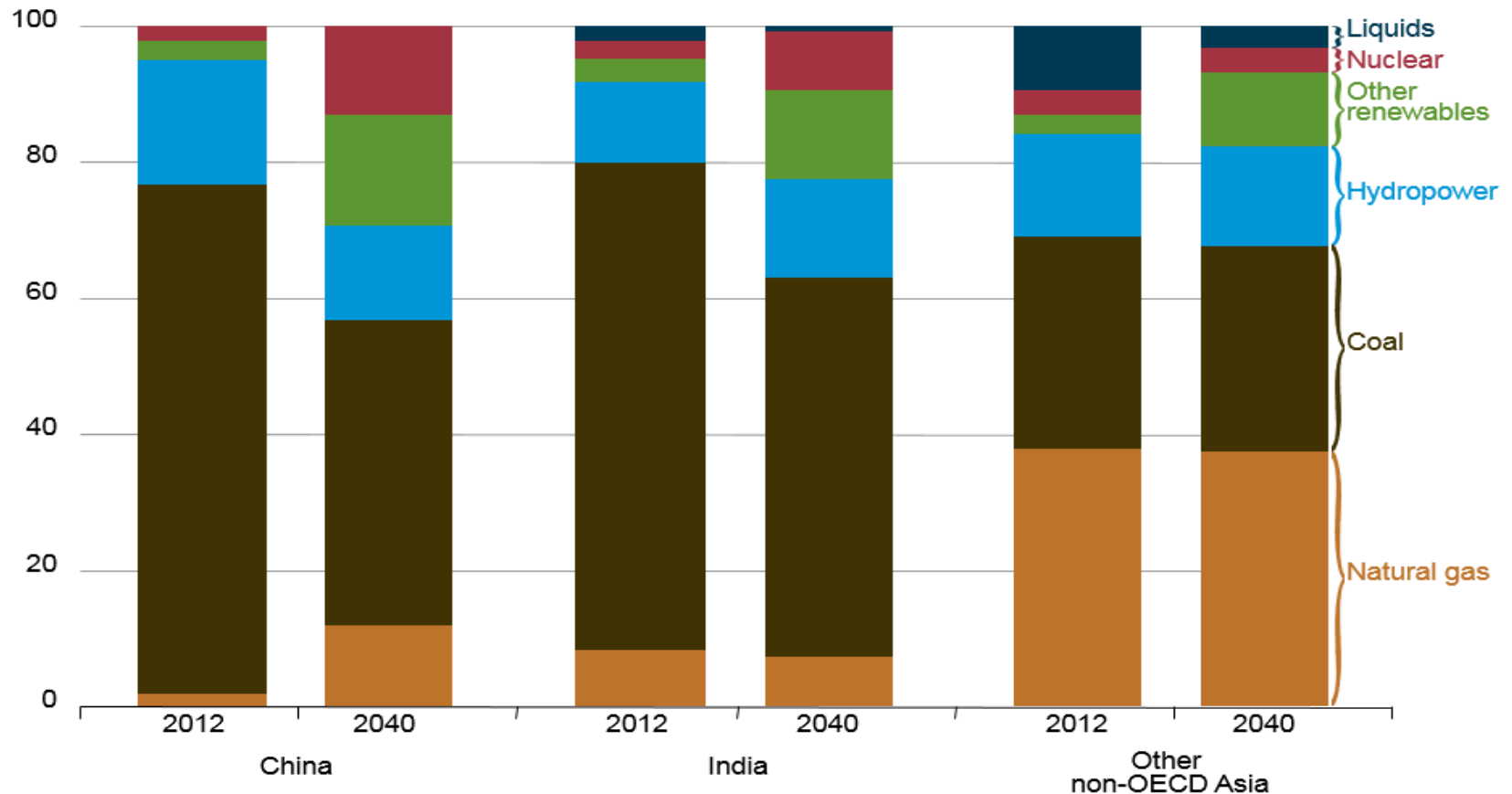
# Global Electricity Growth by Fuel Source

Figure 5-3. World net electricity generation by fuel, 2012–40  
trillion kilowatthours



# The Fuel Mix Varies by Region.....

Figure 5-10. Non-OECD Asia electricity generation fuel mix by region, 2012 and 2040  
percent of total



# The Global Growth “Punchline”



	<u>2012</u>		<u>2040</u>
<b>Electricity Use</b>	<b>22 TKwhr</b>	<b>➡</b>	<b>37 TKwhr</b>
U.S. Portion	4.1 TKwhr	<b>➡</b>	5.1 TKwhr
<b>Total Energy Use</b>	<b>540 QBTU</b>	<b>➡</b>	<b>815 QBTU</b>
U.S. Portion	95 QBTU	<b>➡</b>	106 QBTU

# Public Policy Drivers

- ▶ “Energy Policy” – Federal/State
- ▶ Environmental Policy
- ▶ Renewable Incentives – solar/wind
- ▶ Power Markets and FERC
- ▶ End–use efficiency
- ▶ Oil/Gas Independence



# Environmental Considerations

- ▶ **Federal Regulation (...uncertainty)**
- ▶ **Regional/Local Pressures**
- ▶ **Fundamental Stewardship/Sustainability**
- ▶ **Global Political Situation**





# The Economics of Energy

## ► Sources

- Infrastructure efficiencies
- Fuel and operating costs
- Electric system reliability
- Physical and cyber security



## ► End User

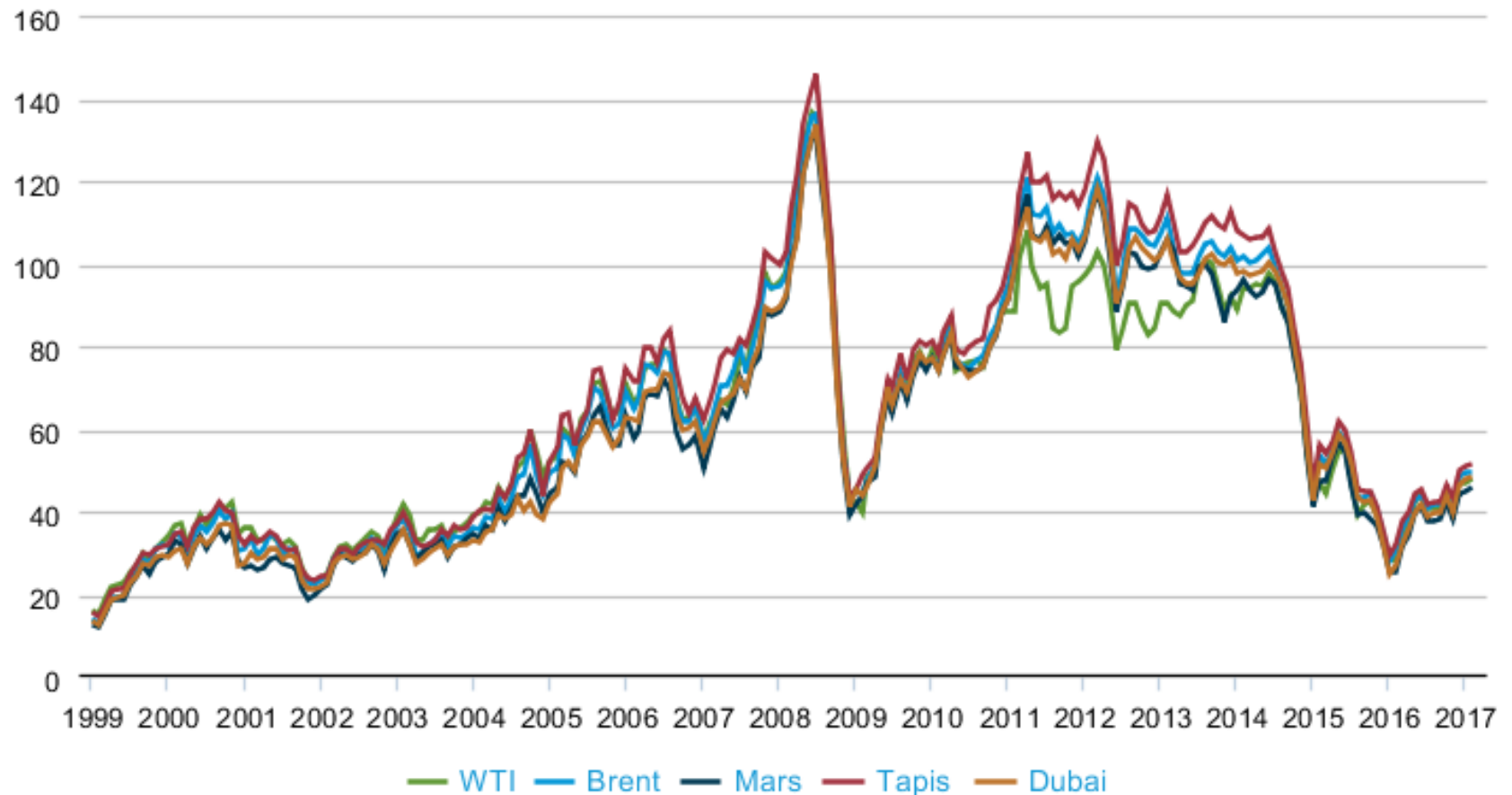
- Demand management/efficiency
- Electric sector “Smart” devices
- Affordability



# Oil Price History ....

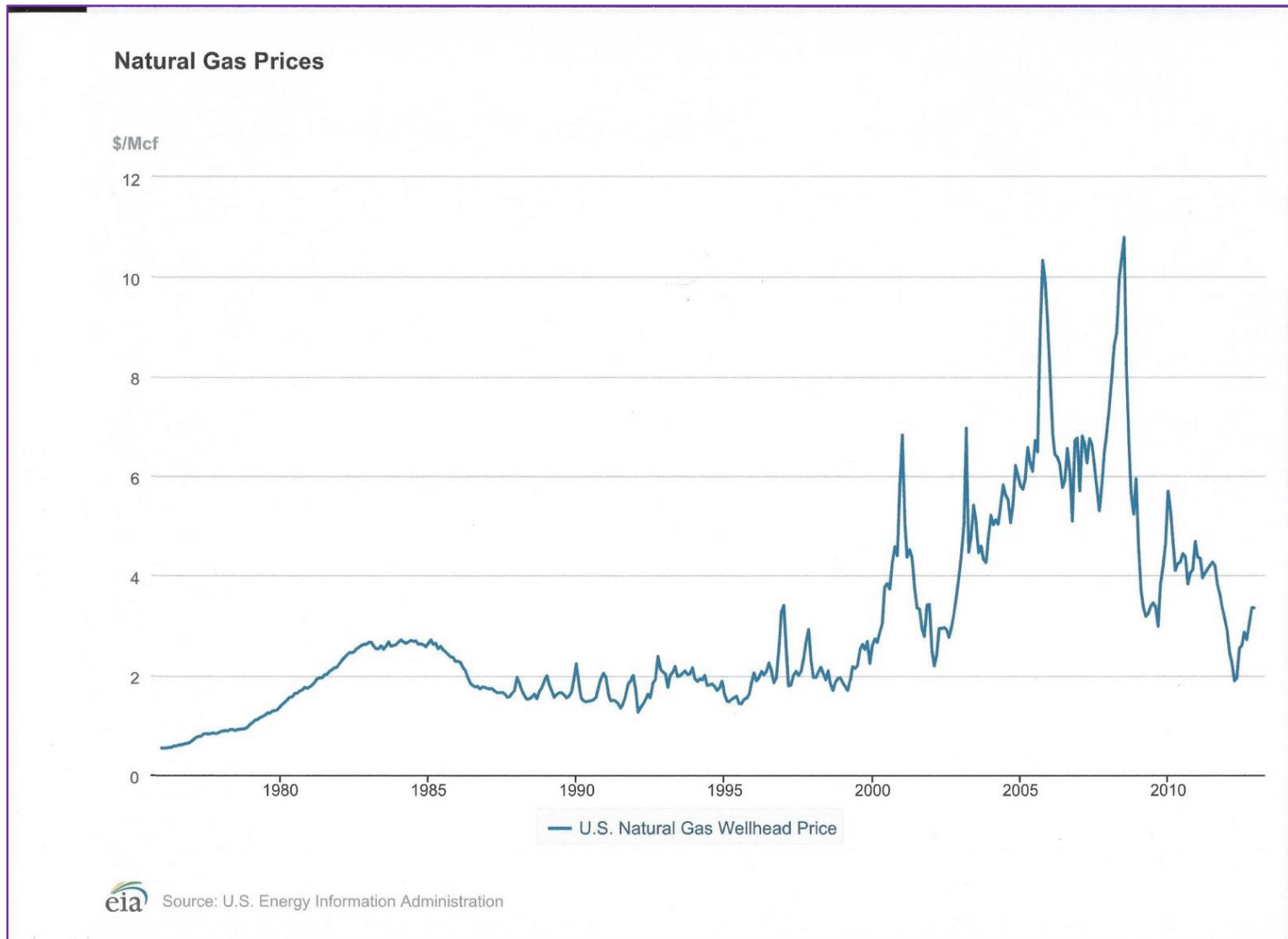
## World crude oil prices

\$/bbl (real 2010 dollars, monthly average)

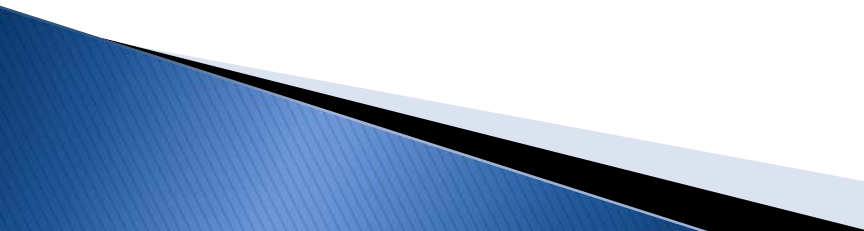


Sources: Bloomberg L.P., Thomson Reuters. Published by: U.S. Energy Information Administration.

# Natural Gas Price History ...



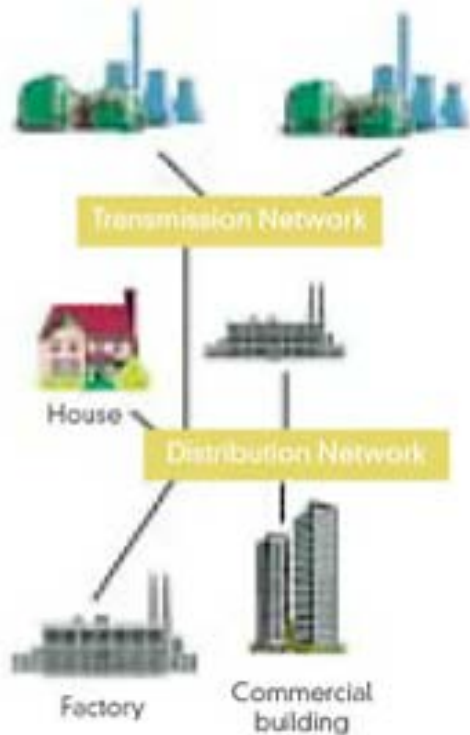
# Challenges Going Forward .....

- ▶ **“Levelized” Global Economy for Energy**
  - ▶ **Meeting Global Growth Demands**
  - ▶ **Efficient Transportation Systems**
  - ▶ **Continued Reliance on Fossil Fuels**
  - ▶ **Environmental Impact of Fracking**
  - ▶ **Storage to Support Electricity**
  - ▶ **Security of the Electric System**
  - ▶ **Safe Integration of Technology**
- 

# The Past and Future Electricity System

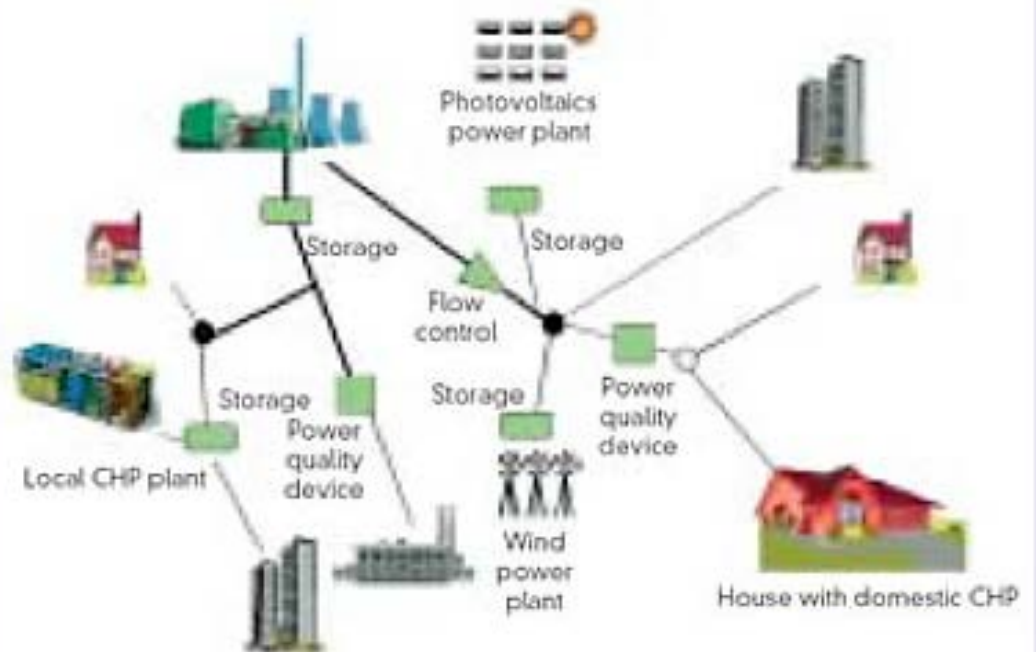
## Yesterday

Central power station



## Tomorrow

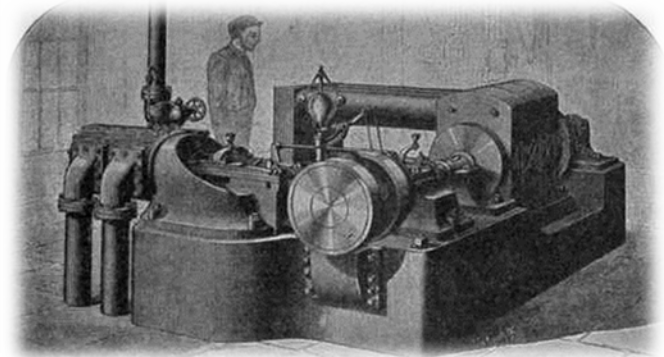
distributed/on-site generation with fully integrated network management



What challenges do you see ahead to advance electricity ?



# Where it All Began.....



**NYC: Madison Ave at 36<sup>th</sup>, late 1870s**

# A Final Thought ...



*What is Electricity's "Cell Phone"...*



# *Questions and Answers...*



# As a Matter of Background

- Majored in Power Systems, BSEE/MSES University of Toledo, 1973
- Began career in Nuclear Plant Design and Construction
- Involved in first merger of Toledo and Cleveland companies, 1986
- Ran System Planning for new company, then Human Resources
- Became VP of Admin and CFO, then President of Generation
- Merged company with Ohio Edison to form FirstEnergy, 1998
- Five years as Executive VP at INPO
- Returned to FE in 2002 for Davis-Besse restart
- Chief Nuclear Officer and President of Generation for FE
- 26,000 Mwe in seven states, including Retail Subsidiary FES
- Three years as Senior VP, Utility Operations, all T&D functions
- Executive VP of FE, ran merger with Allegheny Energy
- Retired end of 2011. Currently chair WECC Board, University of Toledo Foundation and consult for the industry