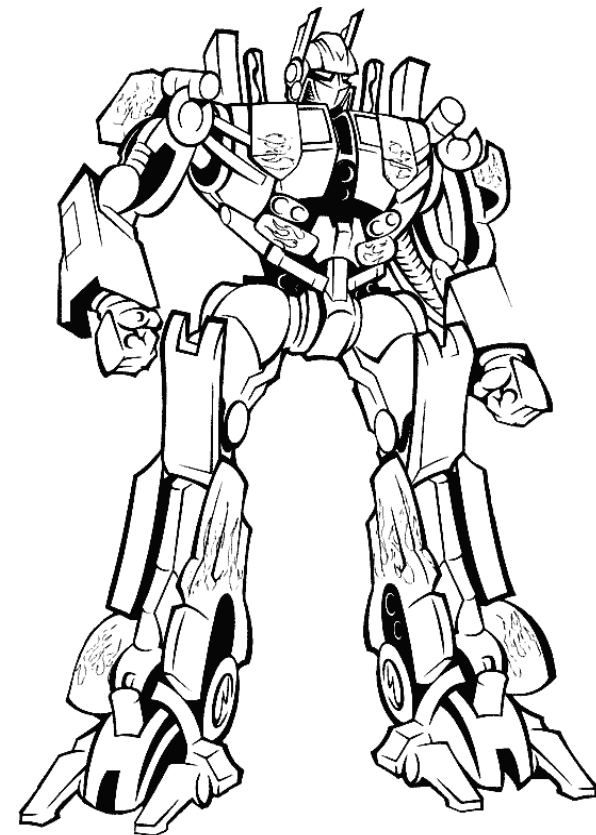


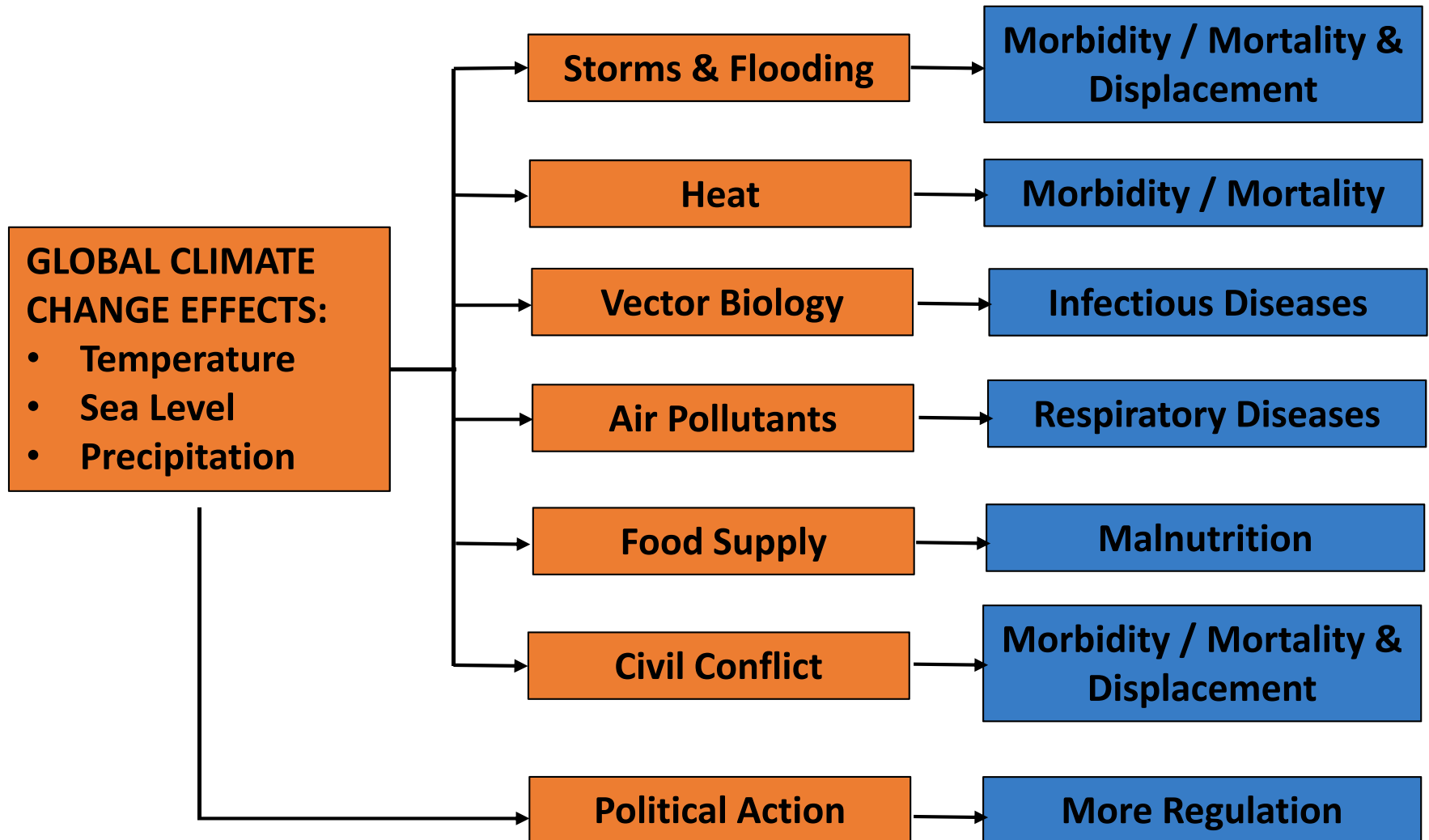
# Transforming the US Generating Fleet:

*More Than Meets the Eye*

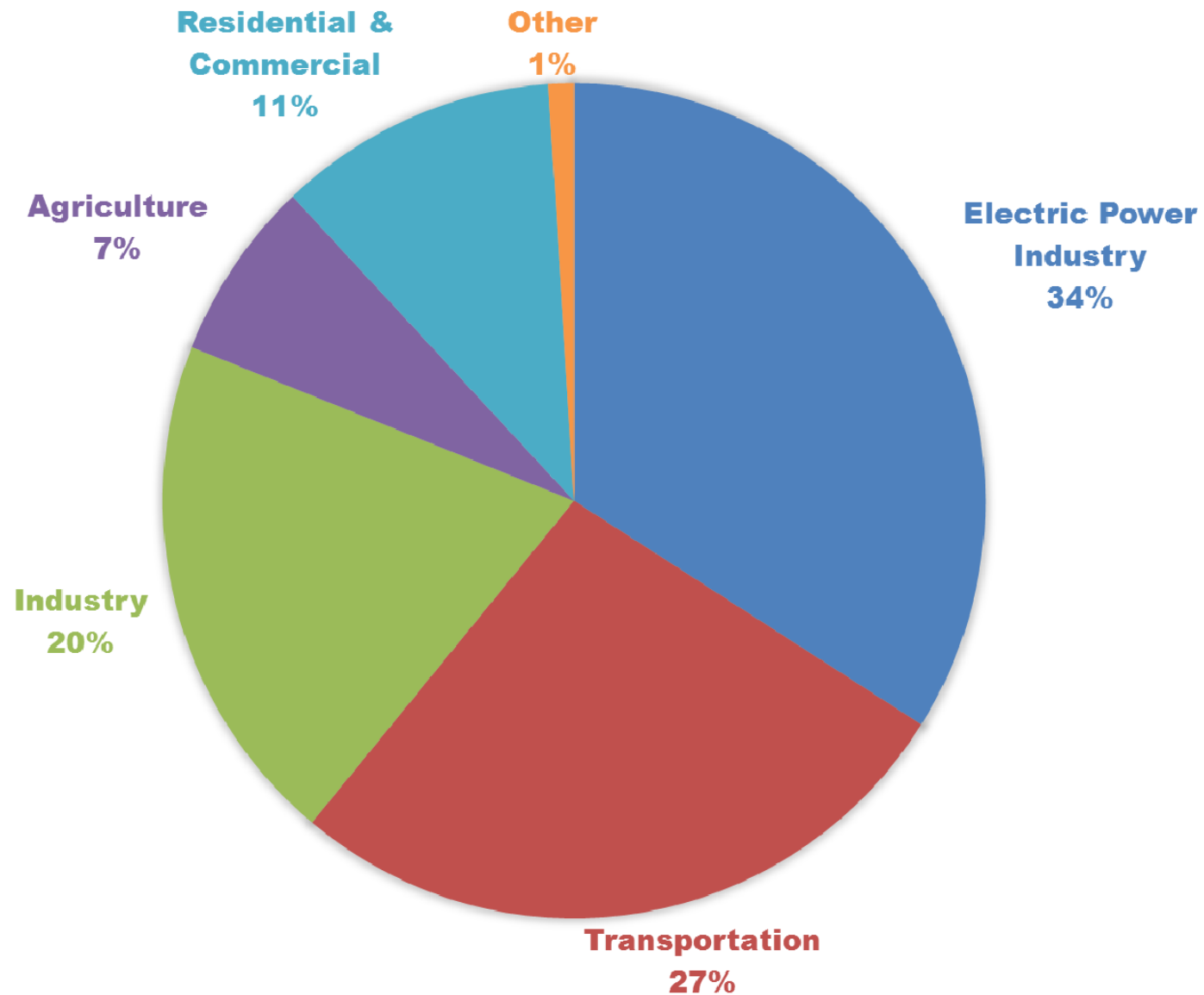
*Daniel Charles Mussatti*  
Senior Environmental Economist  
U.S. Nuclear Regulatory Commission  
Office for New Reactors



# Global Climate Change is a Real Phenomenon

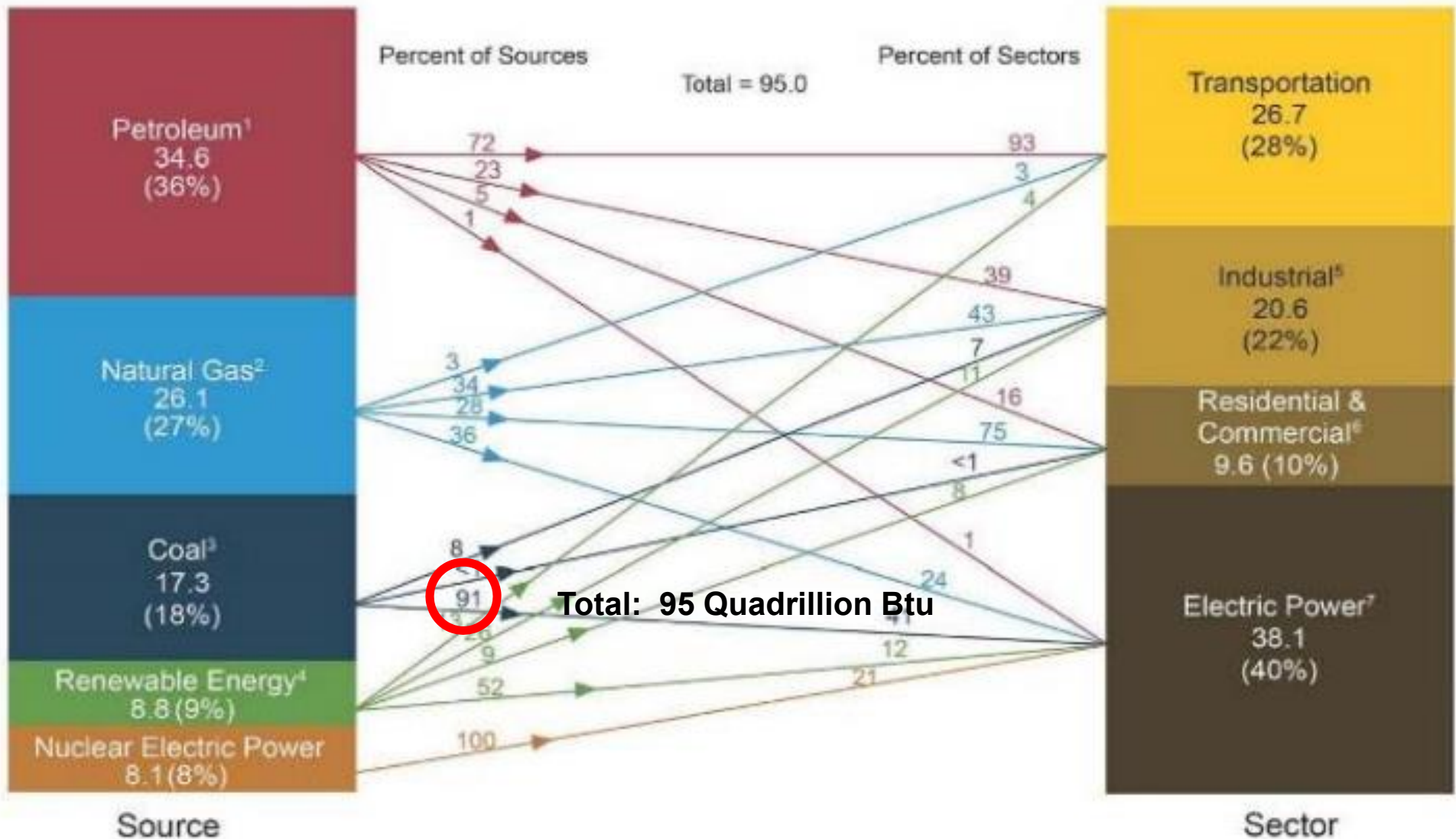


# U.S. GHG Emissions by Economic Sector 2010



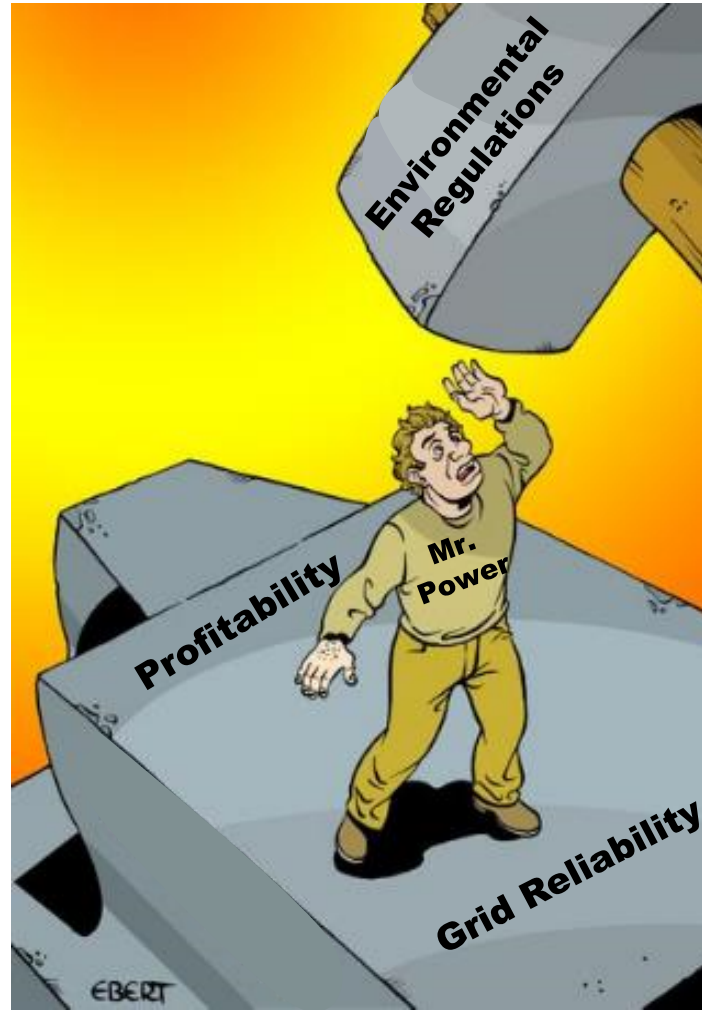
# Primary Energy Consumption by Source and Sector, 2012

(Quadrillion Btu)



SOURCE: EIA Annual Energy Review [http://www.eia.gov/totalenergy/data/monthly/pdf/flow/primary\\_energy.pdf](http://www.eia.gov/totalenergy/data/monthly/pdf/flow/primary_energy.pdf)

# Between a Rock and a Hard Place



# **Three Options for Transforming the US Power Fleet**

- **OPTION 1: DENIAL—Keep Using (Cheap) Coal**
- **OPTION 2: COLD TURKEY—Stop Using Coal Immediately, Immediately Replace With Renewables**
- **OPTION 3: DELIBERATIVE CHANGE—Phase Out Coal With Economically Sound Alternatives**

# Option 1: The Consequences of Coal-Fueled Generation

## Benefits

- Energy Independence
- Inexpensive **Baseload Power**
- Low Cost Operation

## Costs

- Continued externalities
  - Life Cycle Ecological Damage
  - Morbidity / Mortality
  - Pollution / Byproducts
- An aging fleet
- Government regulation

# **Option 2: The Costs of Abandoning Coal- Fueled Generation Too Fast**

- **SHORT TERM ISSUES**
  - The cost of electricity will increase
  - Baseload Issues
  
- **LONG TERM ISSUES**
  - Unbalanced portfolio
  - No CO2 solution



# **Option 2: The Challenges of Wind and Solar Generation**

- **Intermittency**
- **Geographic availability**
- **Synchronicity**
- **Capacity**

# **OPTION 3: DELIBERATIVE CHANGE**

**Phase out coal**

**Use fuel diversity as a hedge against price changes**

**Streamline regulatory processes**

**Subsidize research ONLY (not prices) for:**

**All generating technologies**

**Sequestration**

**Power storage**

# **Mussatti's Second Law of Economics**

**Every regulation breeds a new marketplace.**

**Corollary:**

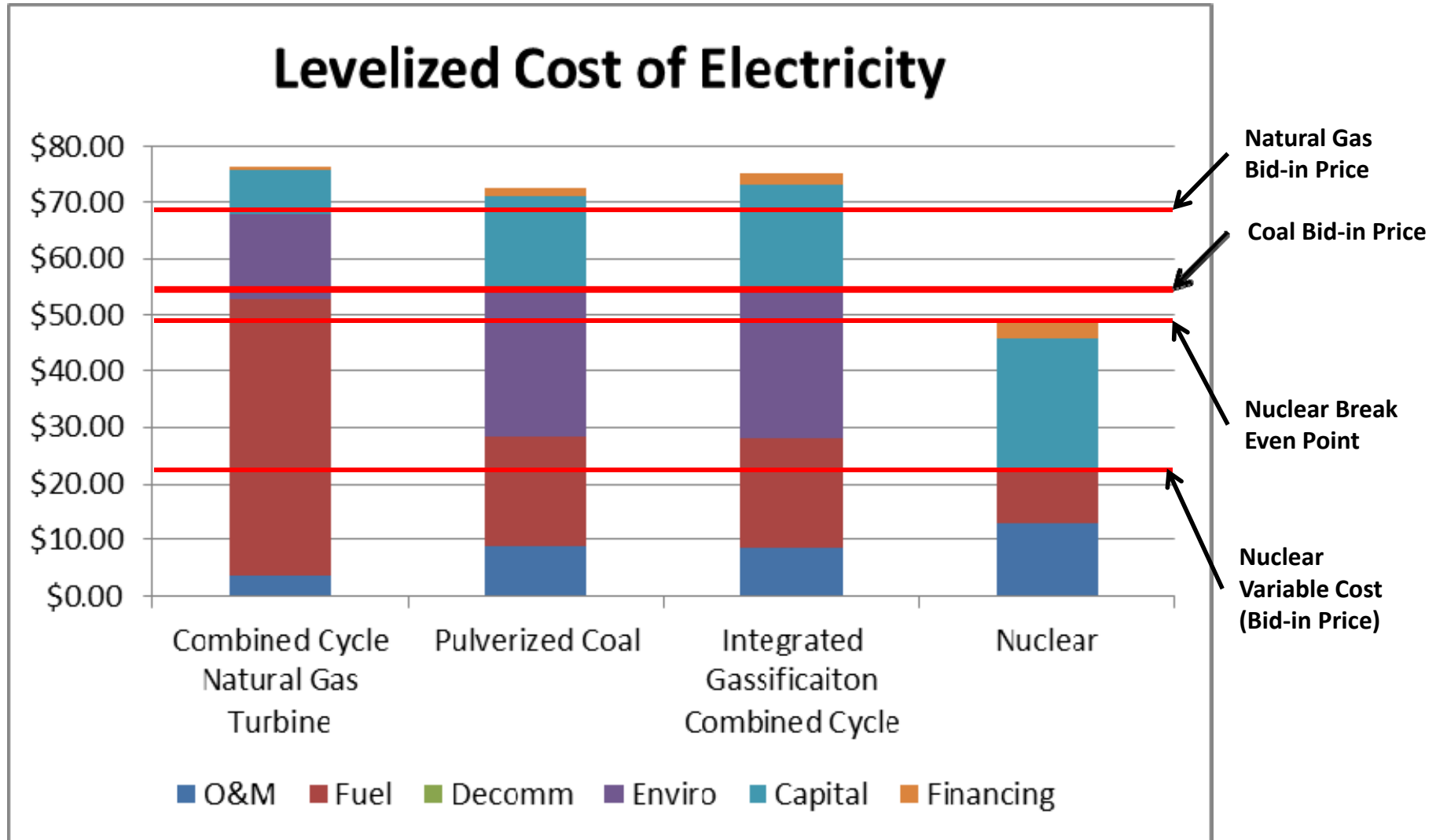
**You probably don't like it.**

# Unintended Consequences, an Example

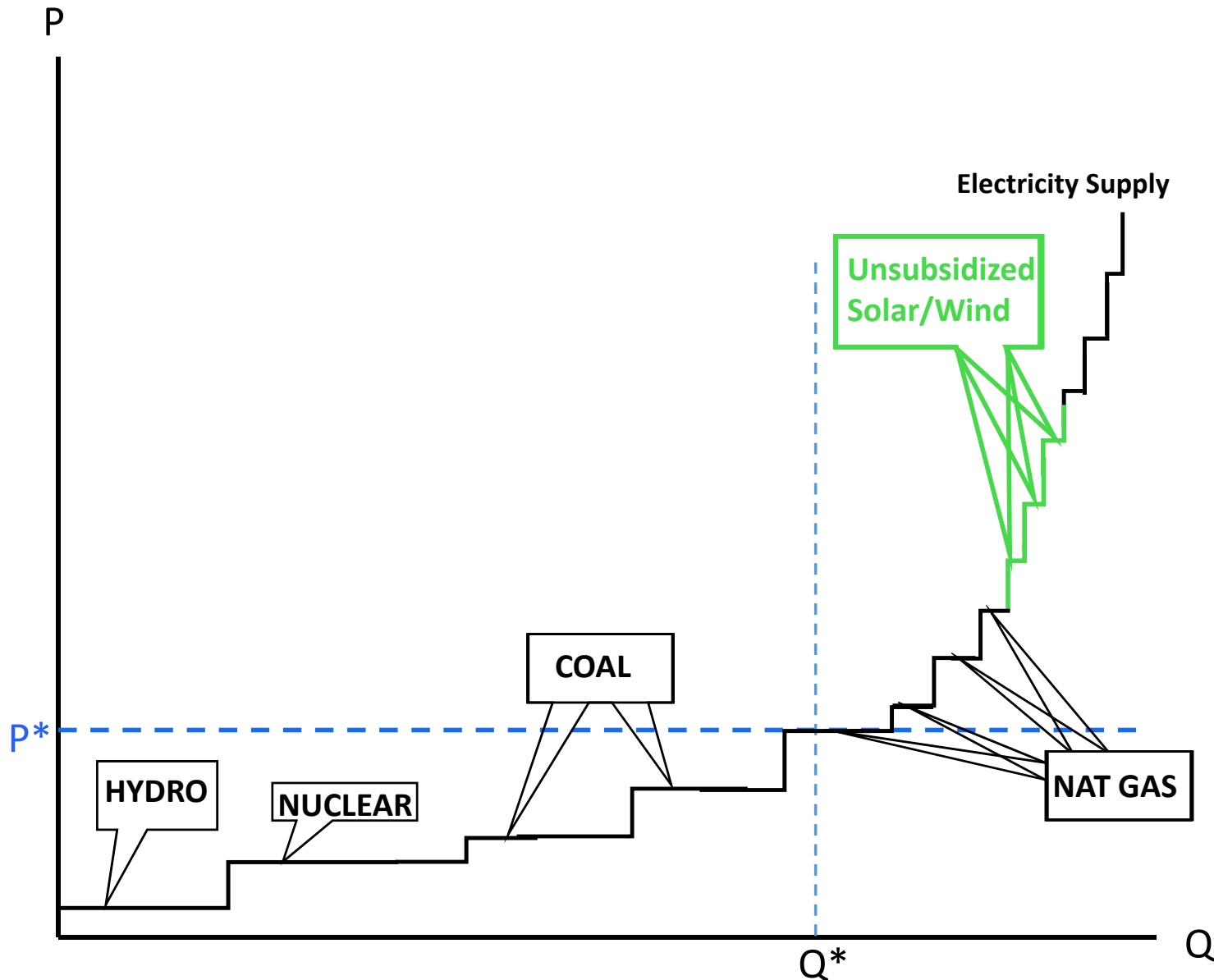


**Mexico City, 1992**

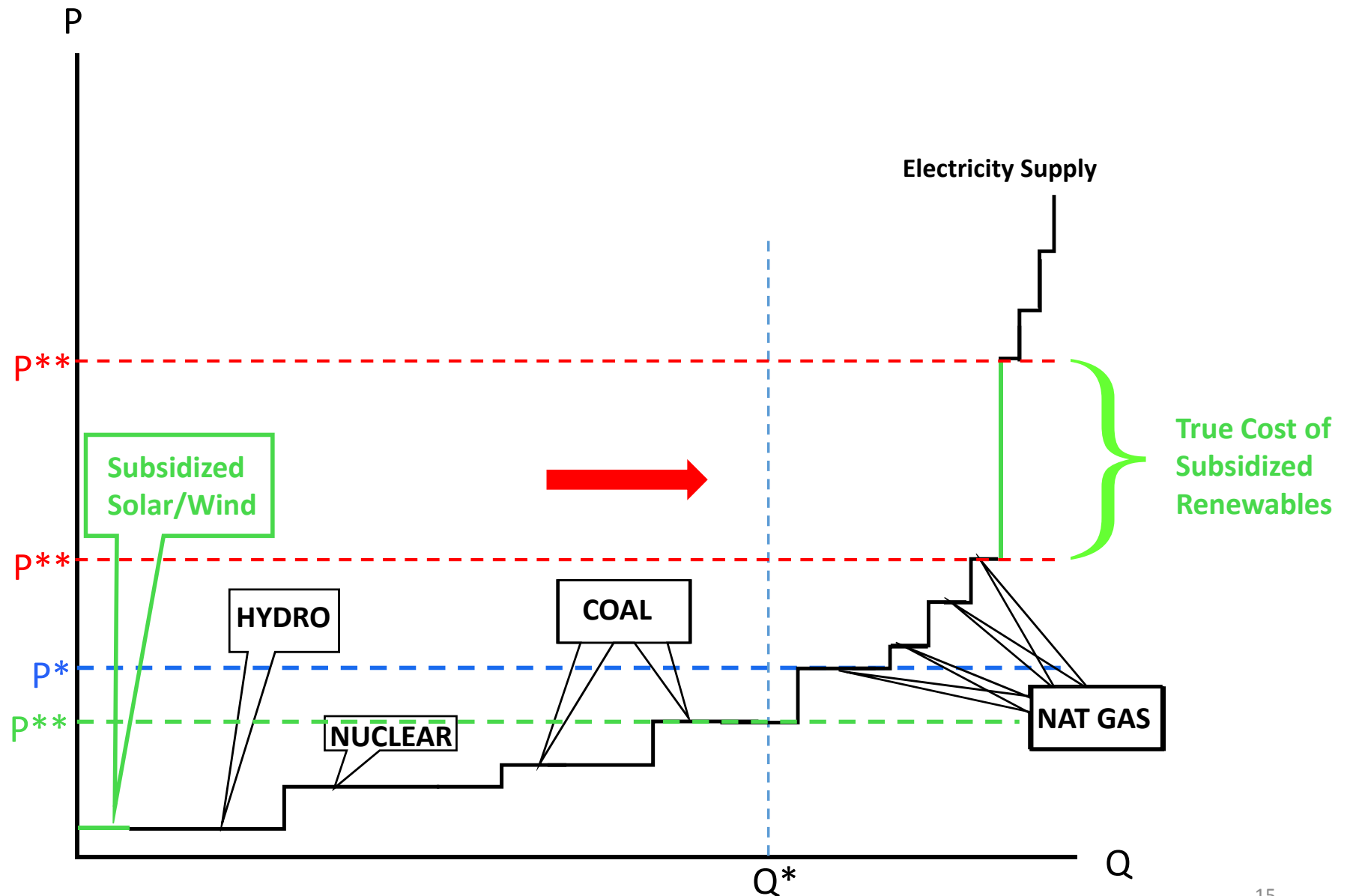
# The Price of Baseload Power (\$/MWh)



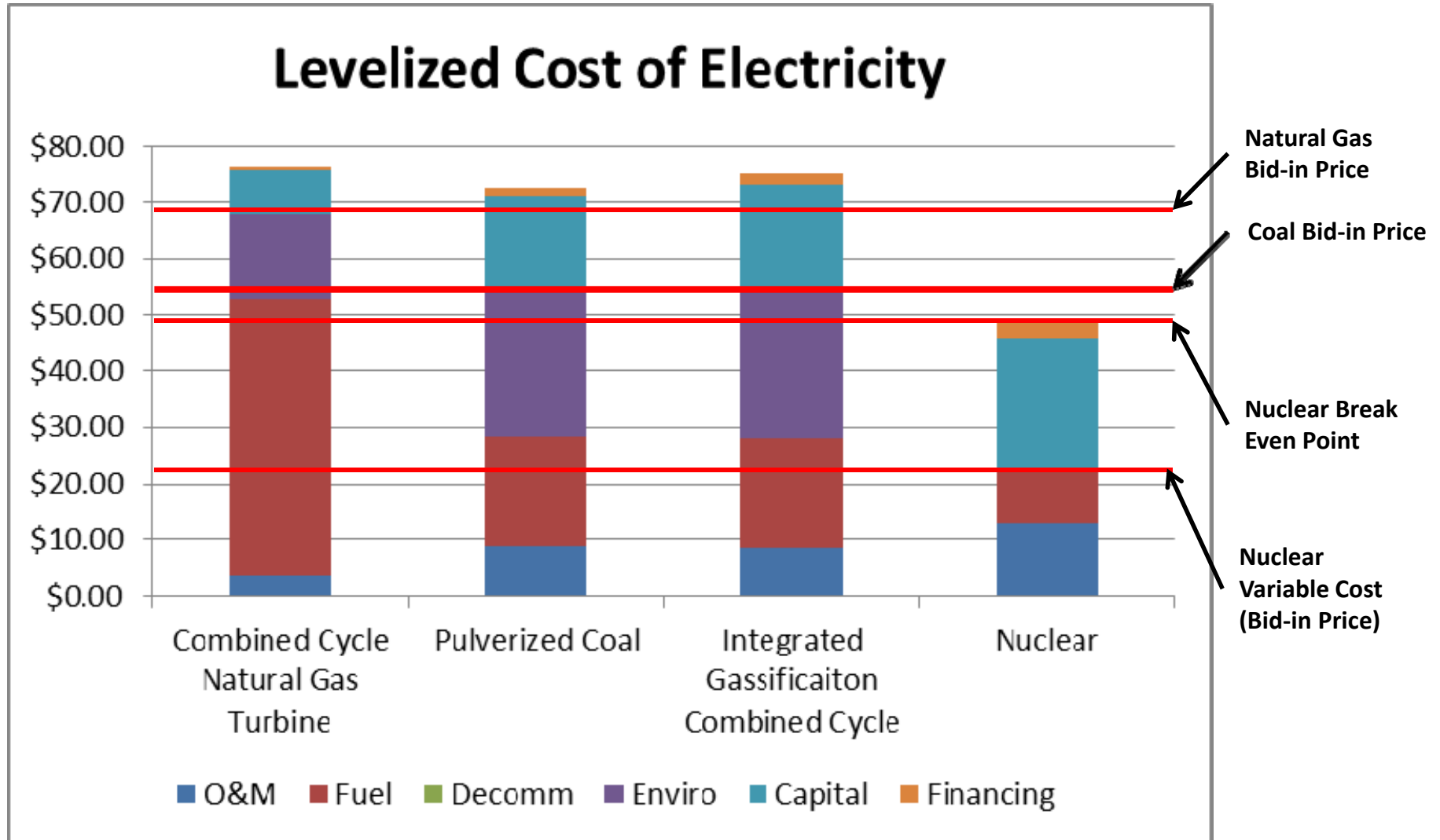
# A Day-Ahead Electricity Pricing Model



# The Optimistic Electricity Subsidy Model

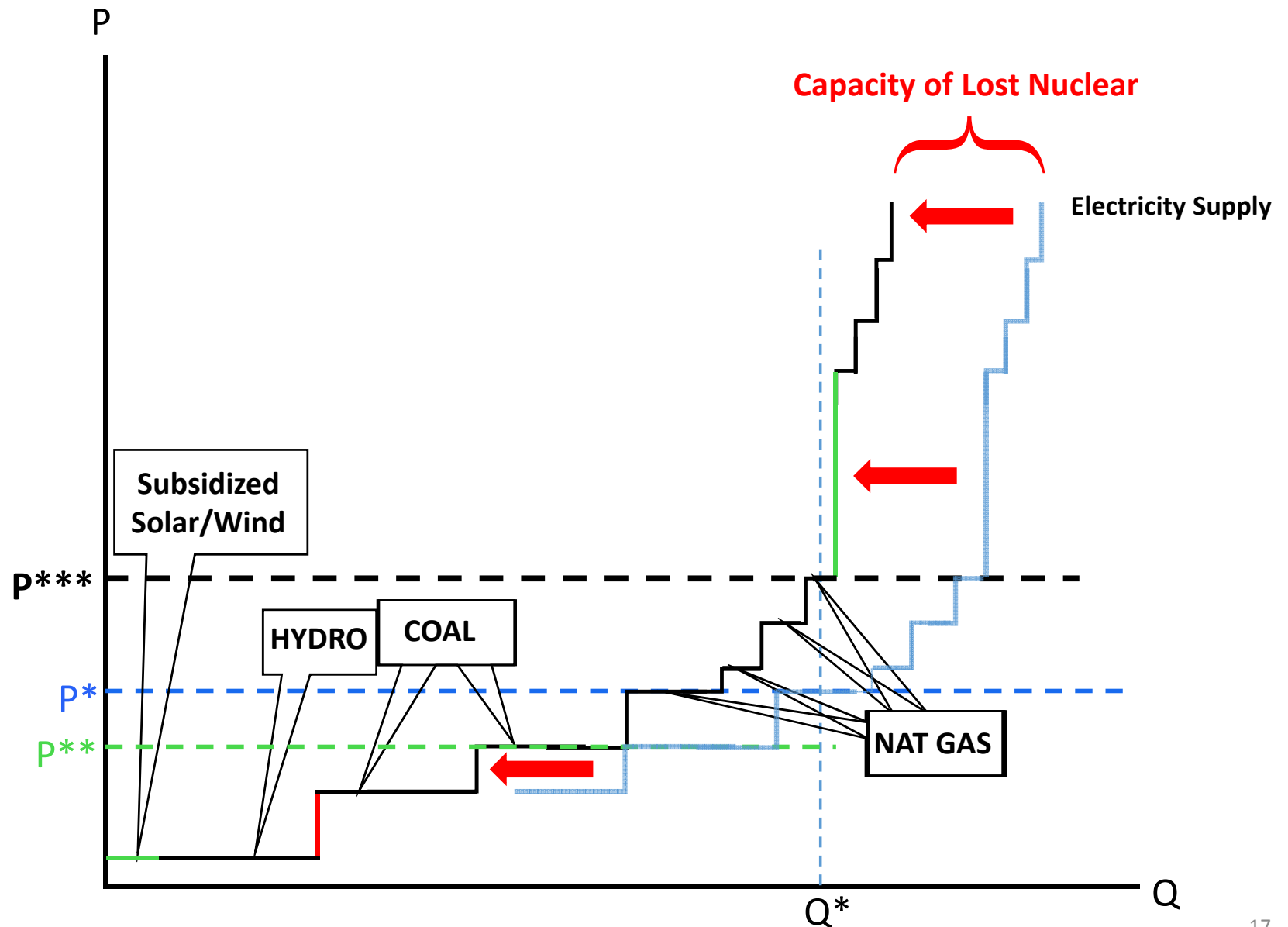


# The Price of Baseload Power





# The Unintended Electricity Pricing Model





Bonds | Tue Oct 13, 2015 9:33am EDT

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# Entergy to close Massachusetts Pilgrim nuclear plant by 2019



Oct 13 Entergy Corp said Tuesday it will close its Pilgrim nuclear power plant in Massachusetts no later than June 1, 2019, because of poor market conditions, reduced revenues and increased operational costs.

"Market conditions and increased costs led us to reluctantly conclude that we had no option other than to shut down the plant," Leo Denault, Entergy's chairman and chief executive officer, said in a press release. (Reporting by Scott DiSavino; Editing by Jeffrey Benkoe)

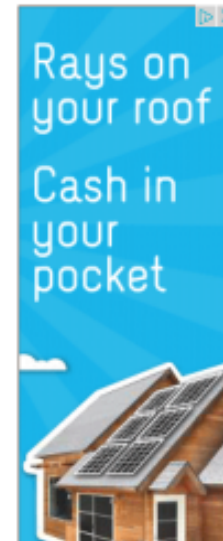


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# Final Thoughts

- **There is a future for renewables**
  - **Resolve issues**
  - **Improve efficiency and capacity utilization rates**
- **In the mean time:**
  - **Remove the disincentives to the nuclear industry**
  - **Fix the grid**
  - **Short term reliance on cheap natural gas**
  - **Development of new nuclear capacity**
    - **New large light water reactors**
    - **Advanced reactor designs**
  - **Reassess the need for new air quality and CO2 standards**
- **In the long run replace existing fleet with nuclear and (free fuel) renewable technologies using economic / financial decision measures, not partisan-based preference**