



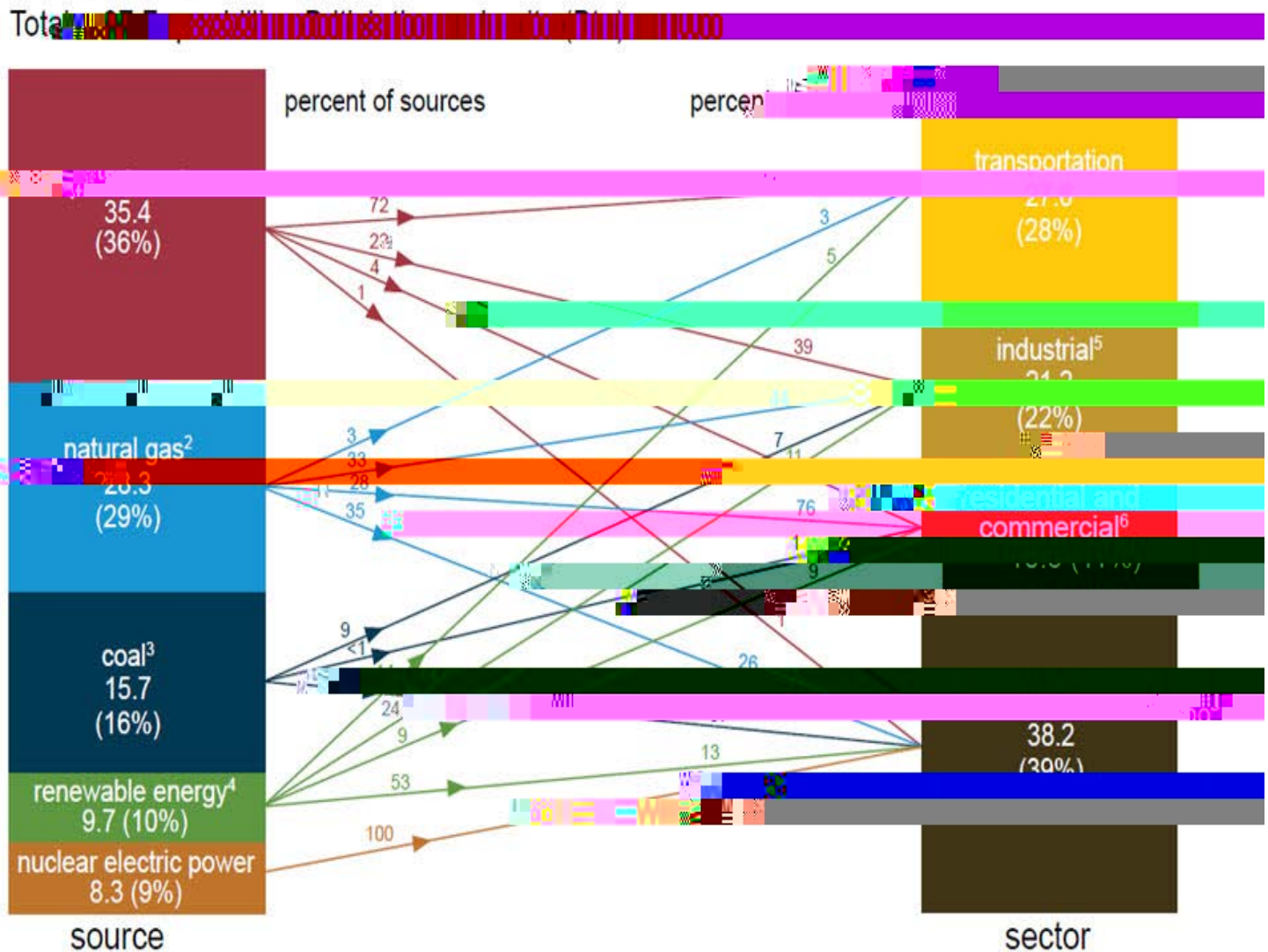
What is it?

“Proactive, organized and systematic coordination of procurement, conversion, distribution, and use of energy to meet requirements.”

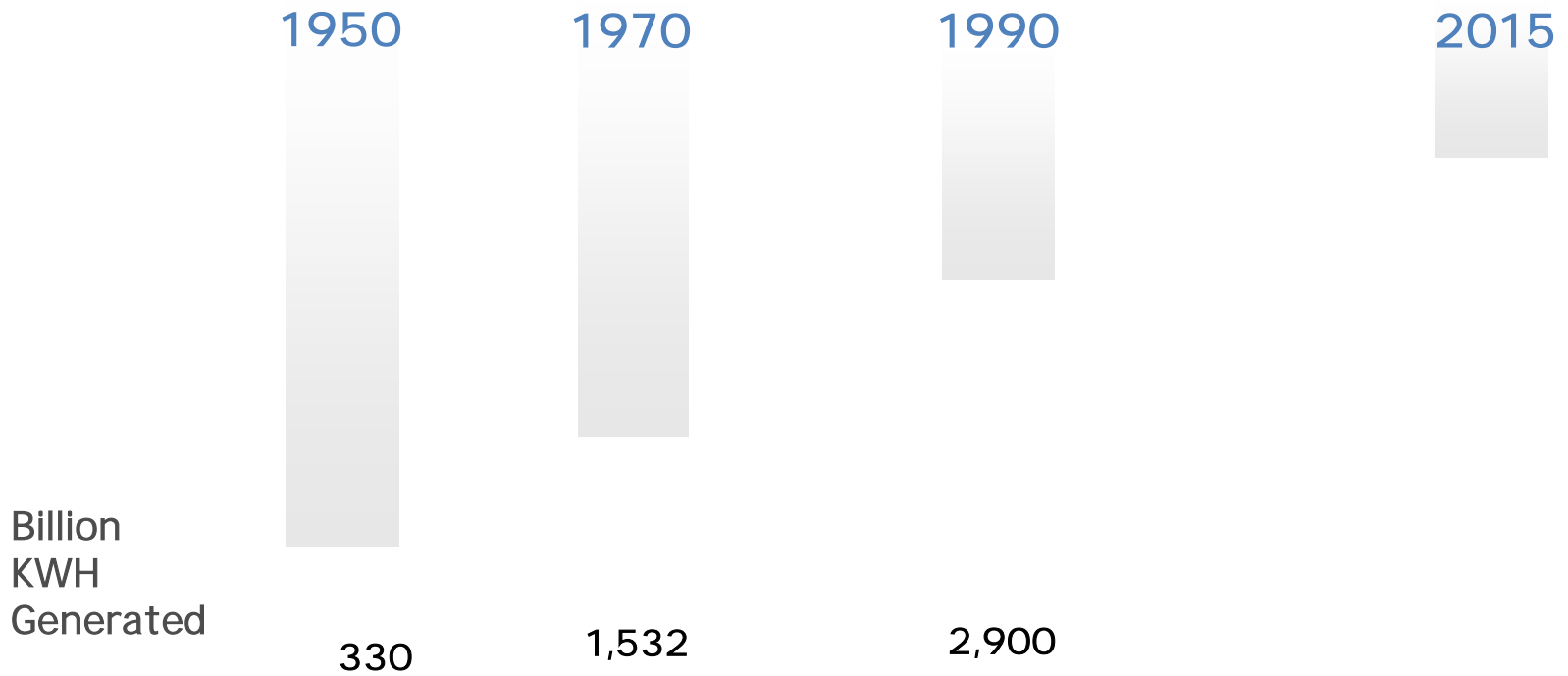


U.S. Energy Security and Supply

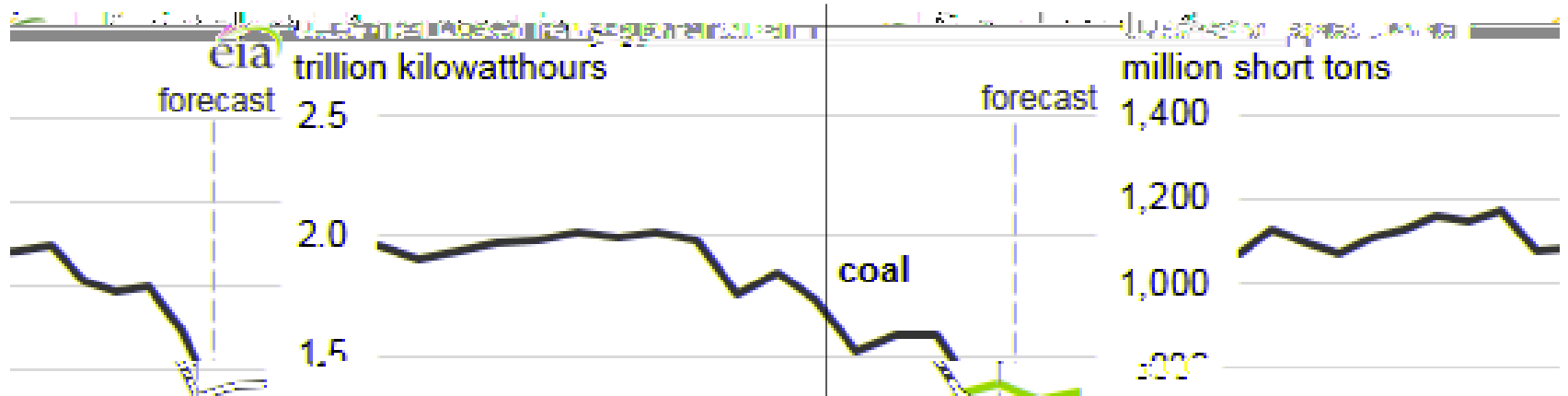
U.S. primary energy consumption by source and sector, 2015



- ▶ **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**

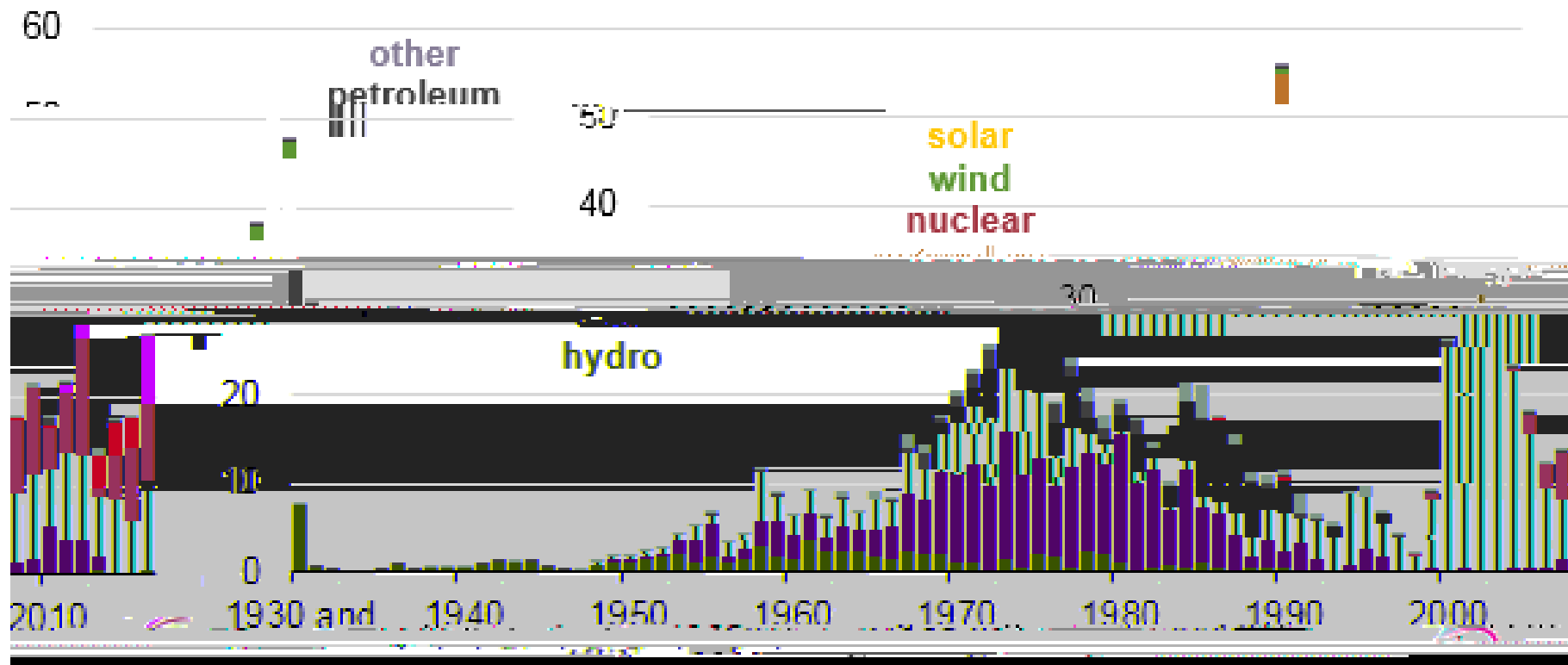


Coal and Natural Gas New "Useful Lines"



Source: EIA Website

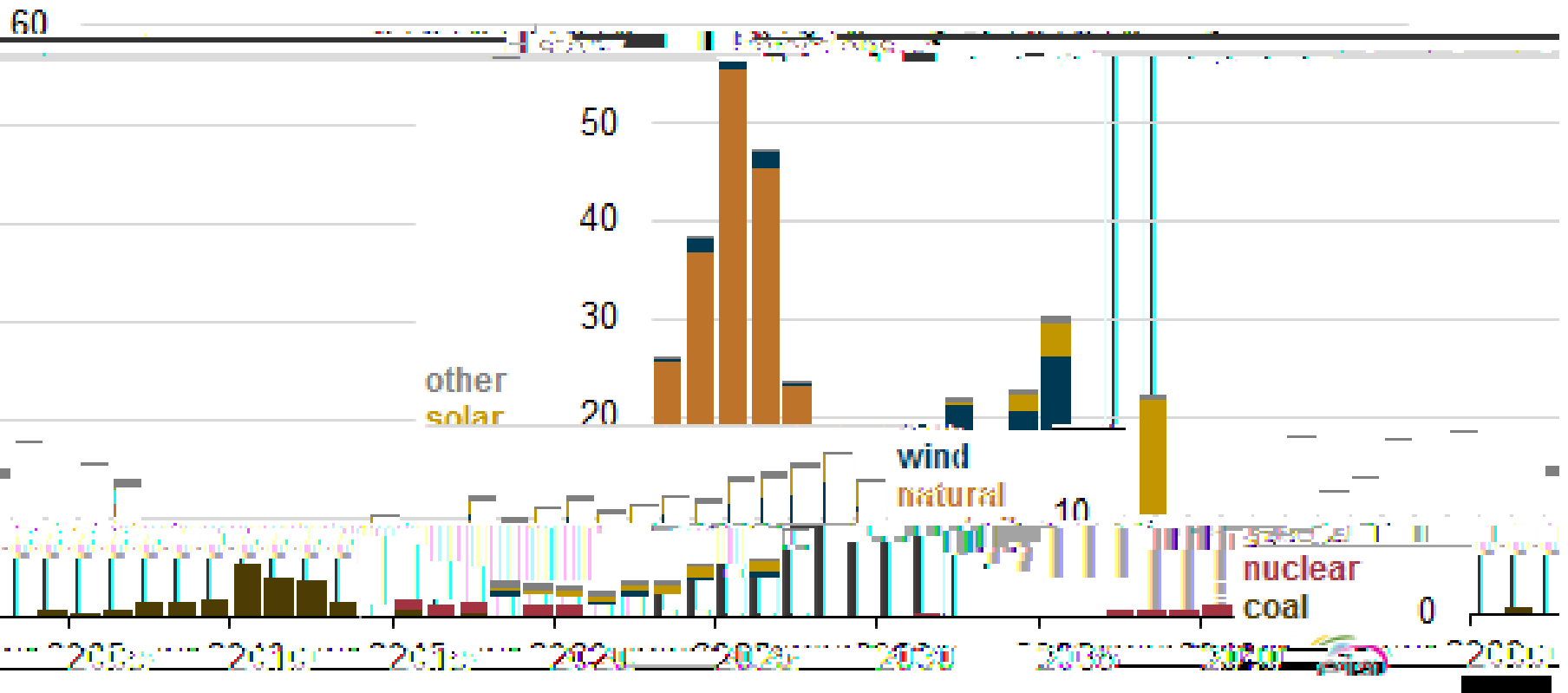
U.S. utility-scale electric generating capacity by initial operating year (as of Dec 2016) gigawatts



Source: EIA Website

Planned Additions: Driven by Natural Gas

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

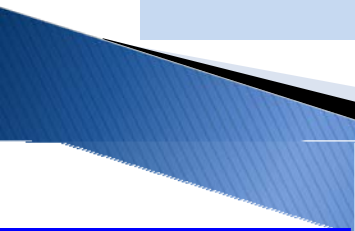
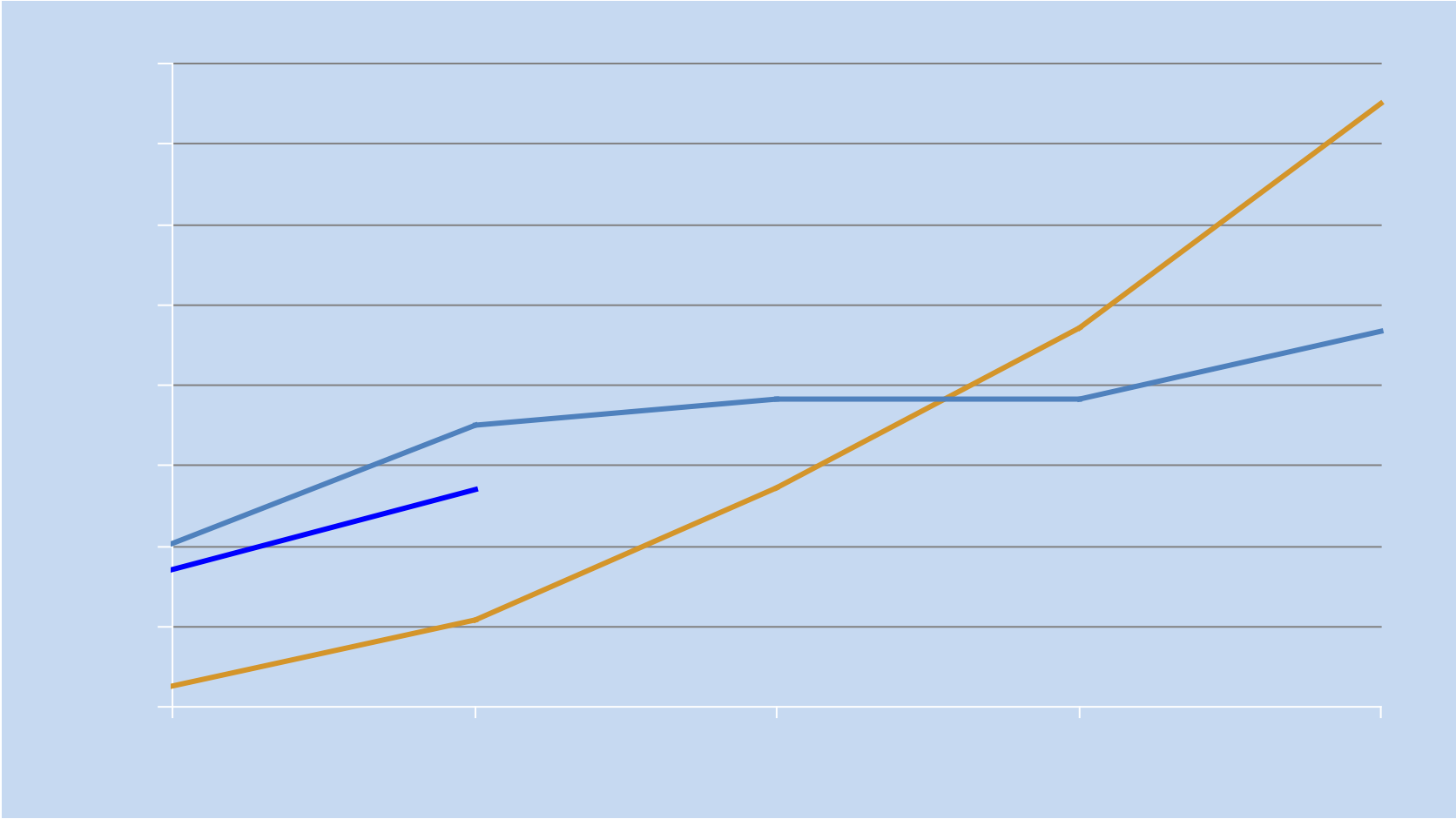


Source: EIA Website



Source: EIA Website

▶ Lifestyle



Global Electricity Growth by Fuel Source

Figure 5-3 World net electricity generation by fuel, 2012–40. Source: International Energy Agency, *World Energy Outlook 2012*. *trillion kilowatthours*

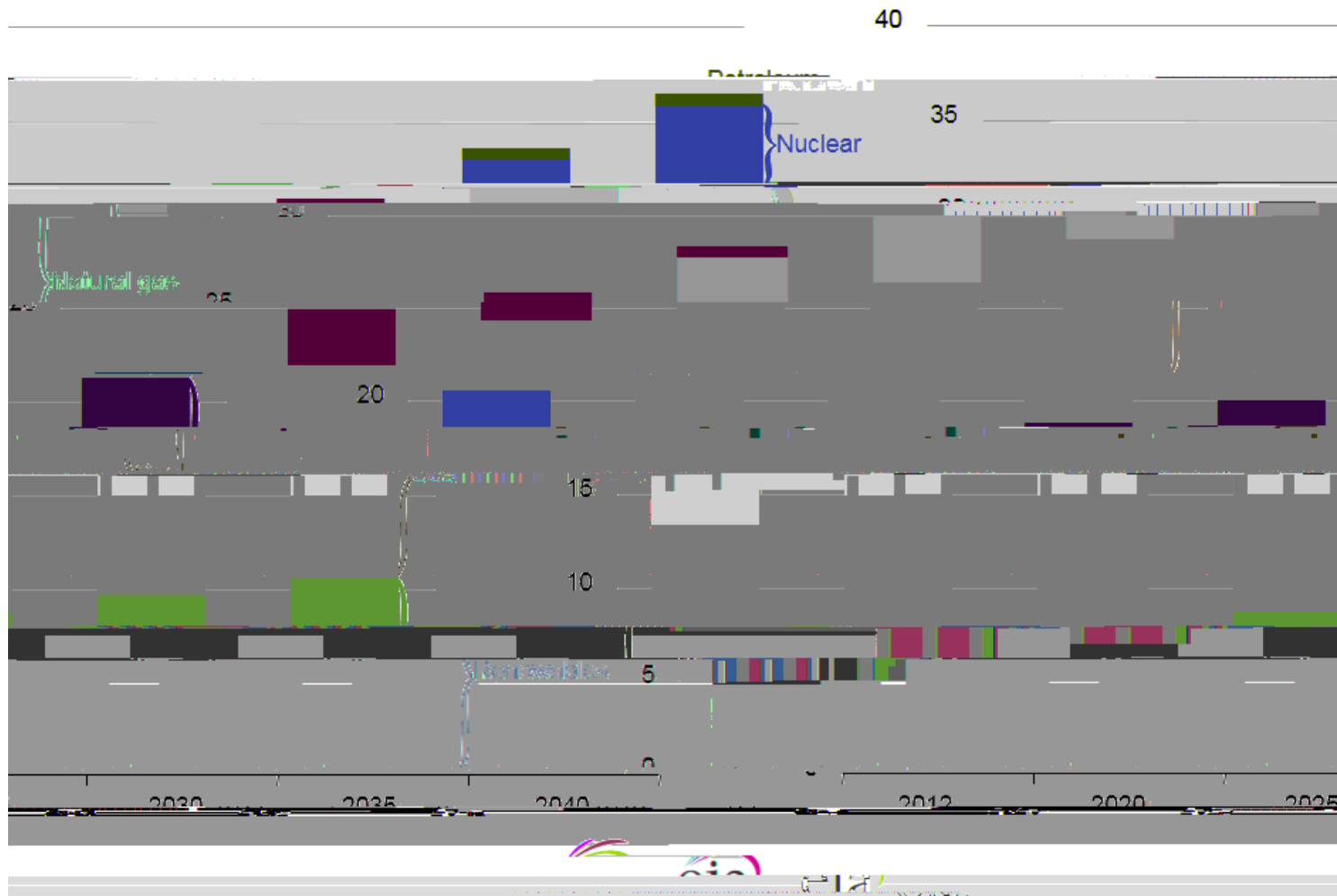
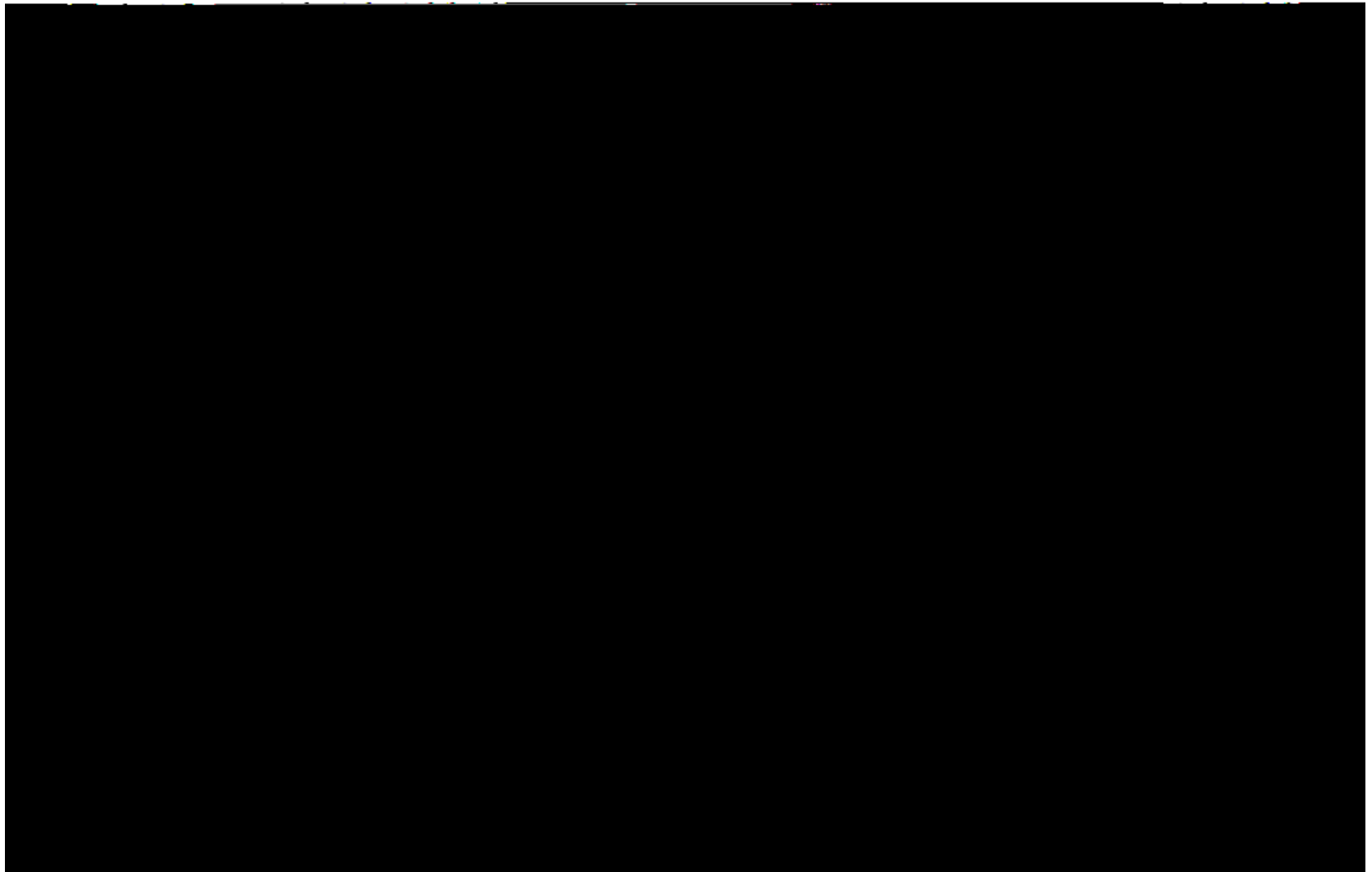




Figure 5-10 Non-OECD Asia electricity generation fuel mix by region, 2012 and 2040





2012

2040

Electricity Use

22 Kwhr



37 TKwhr

U.S. Portion

4.1 TKwhr



5.1 TKwhr

Total Energy Use

540 QBTU



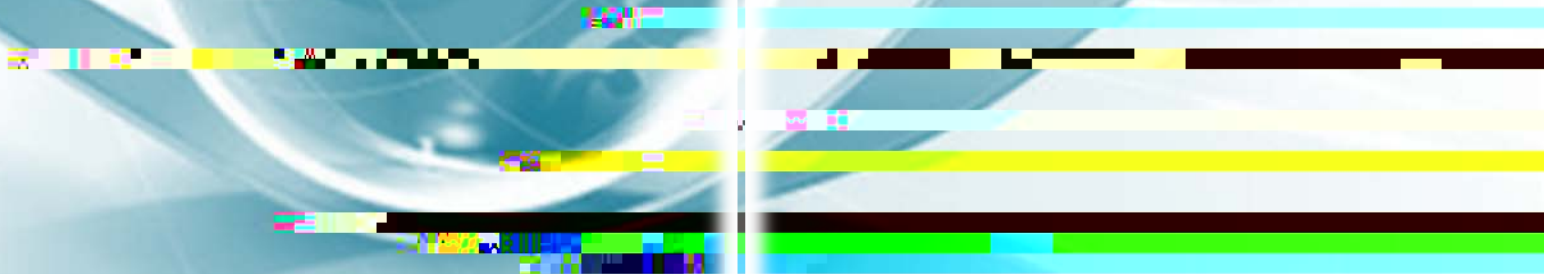
815 QBTU

U.S. Portion

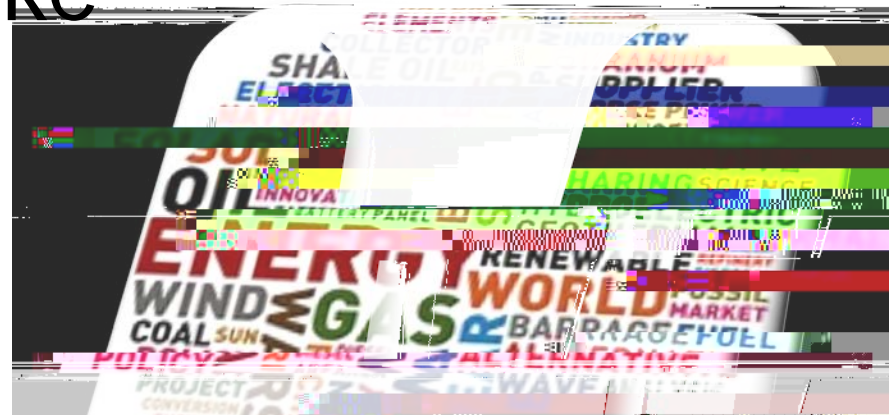
95 QBTU



106 QBTU



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

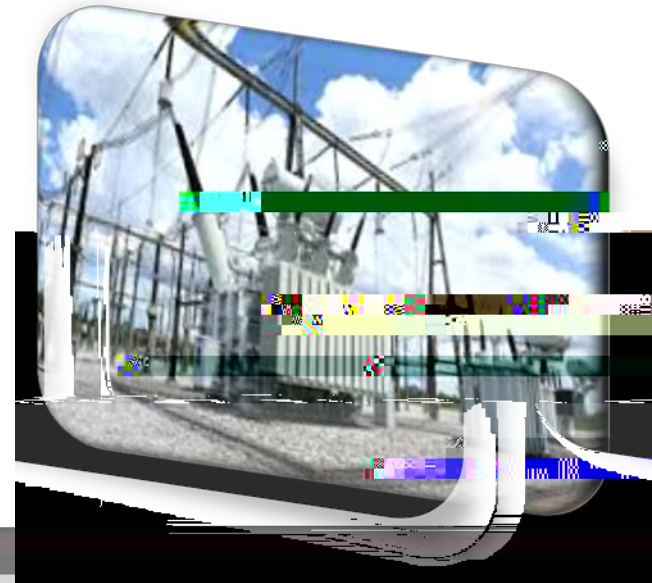


- ▶ Federal Regulation (...uncertainty)
- ▶ Regional/Local Pressures
- ▶

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
Reliability



Reliability

World crude oil prices

World Crude Oil Prices (USD per barrel)

160

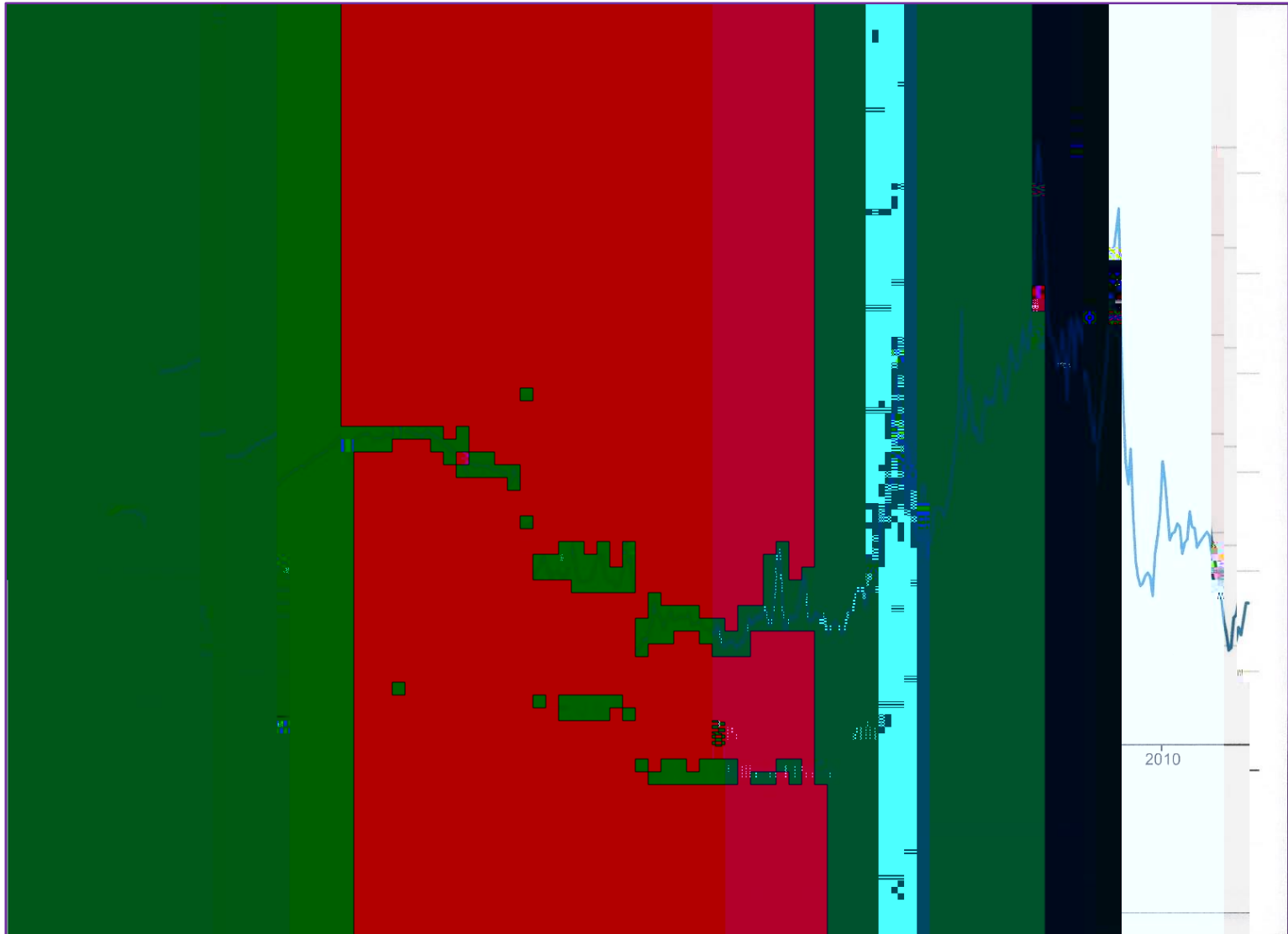
140

120

100



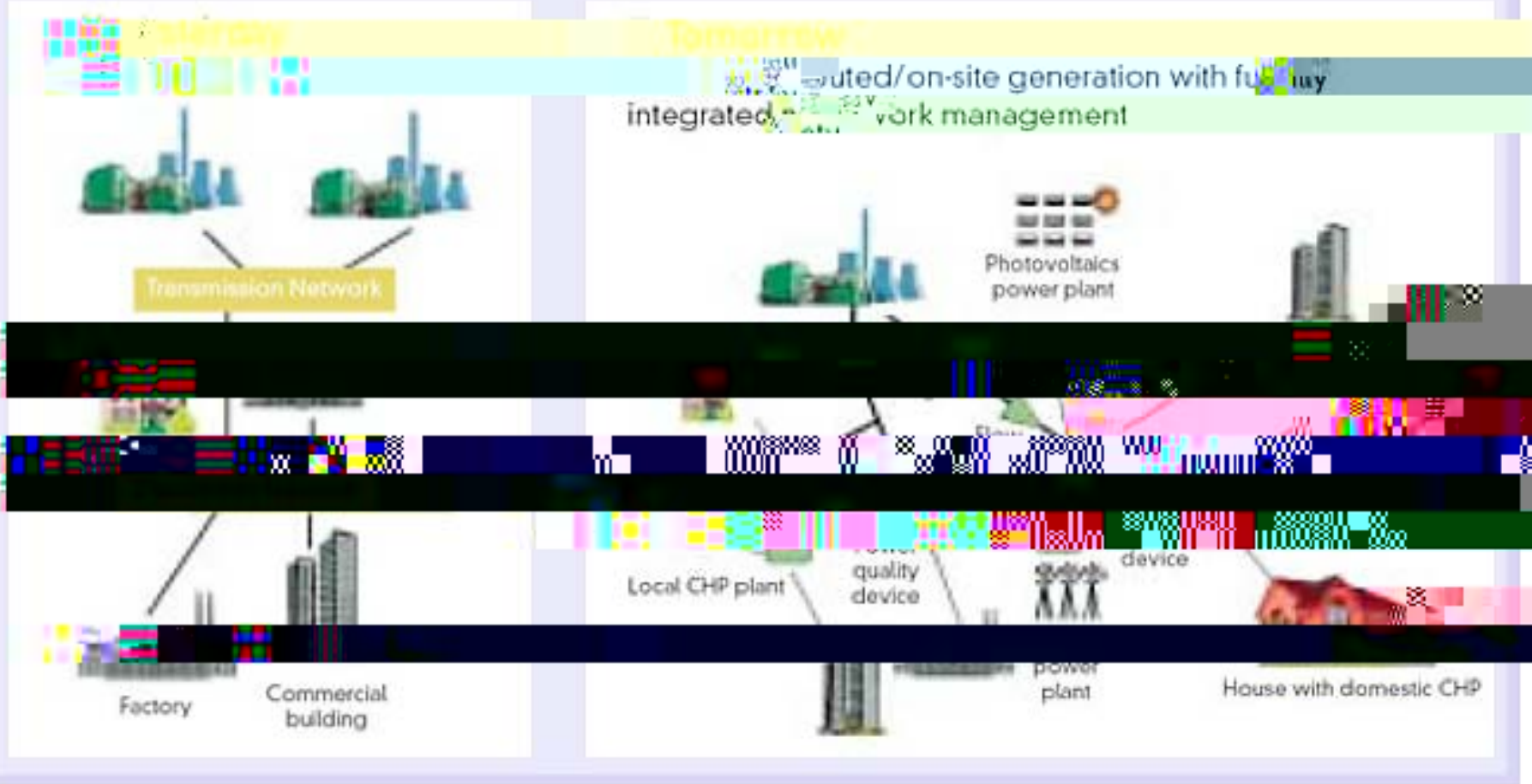
Natural Gas Price History



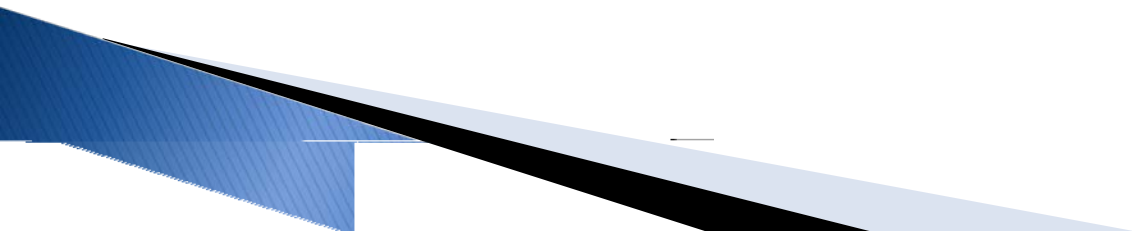


- ▶ “Levelized ” Global Economy for Energy
- ▶ Meeting Global Growth Demands
- ▶ Efficient Transportation Systems
- ▶ Continued Reliance on Fossil Fuels
- ▶ Environmental Impact of Fracking
- ▶ Storage to Support Electricity
- ▶ Security of the Electric System
- ▶ Safe Integration of Technology

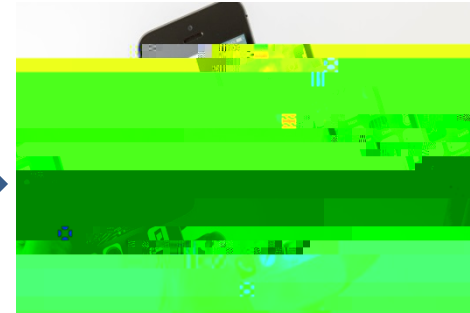
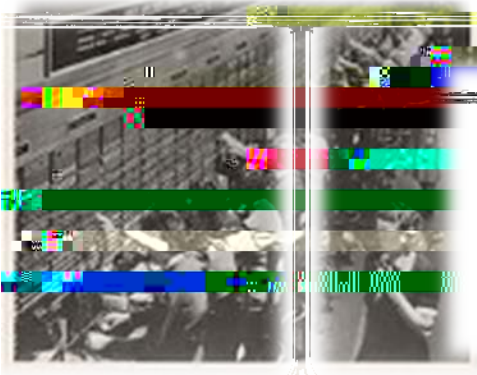
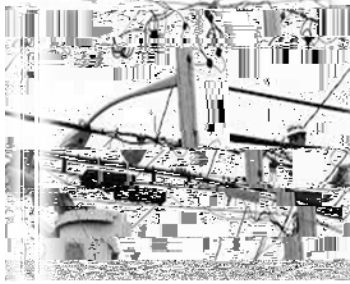
The Past and Future Electricity System



What challenges do you see ahead to advance electricity ?



A Final Thought ...



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

COMPUTERS AND THE ENVIRONMENT



