

314: FUELS

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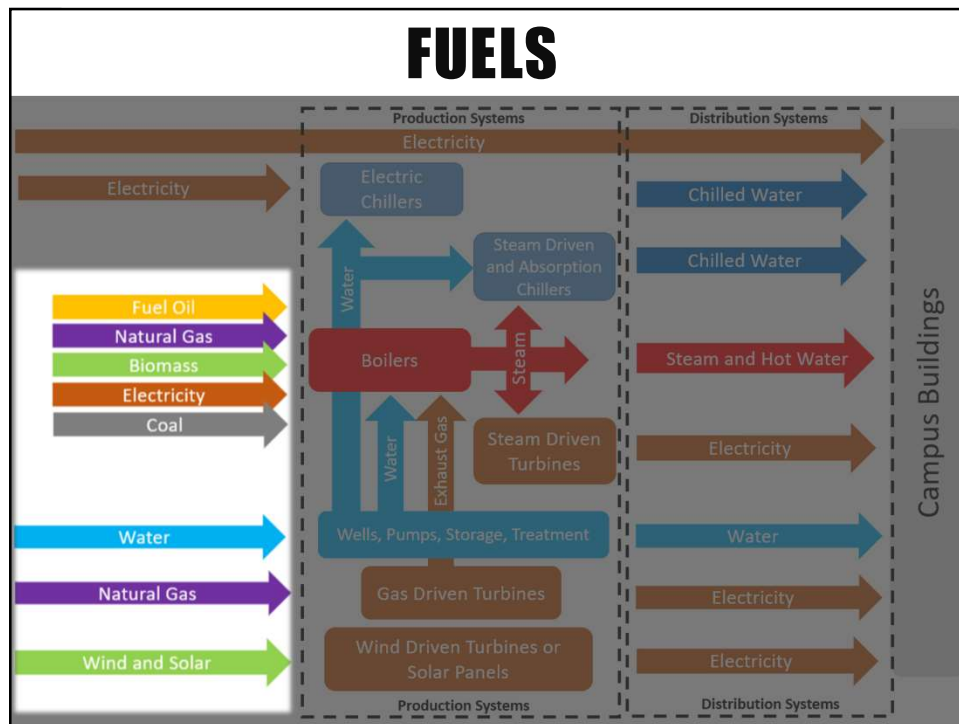
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COURSE OVERVIEW

- Fuel terms and concepts
- Primary fuels
 - Natural Gas
 - Coal
 - Oil
 - Renewables (sun, wind, & biofuels)

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COURSE OVERVIEW

Common issues for each fuel type:

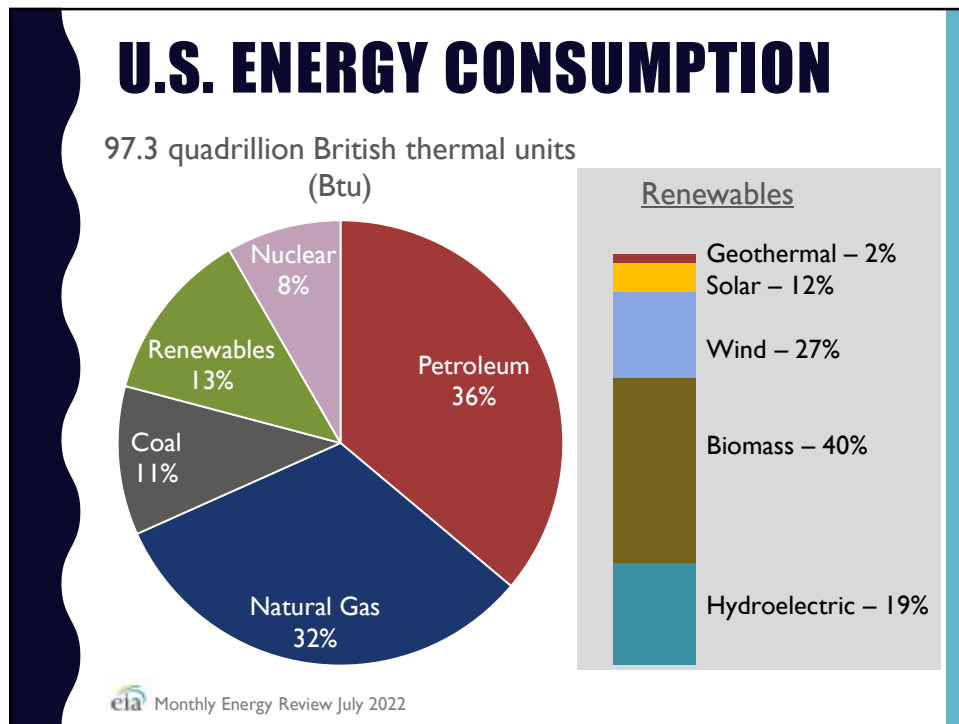
- Emissions
- Reliability
- Flexibility
- Costs – capital and O&M
 - Volatility/risk
 - Purchasing Strategies

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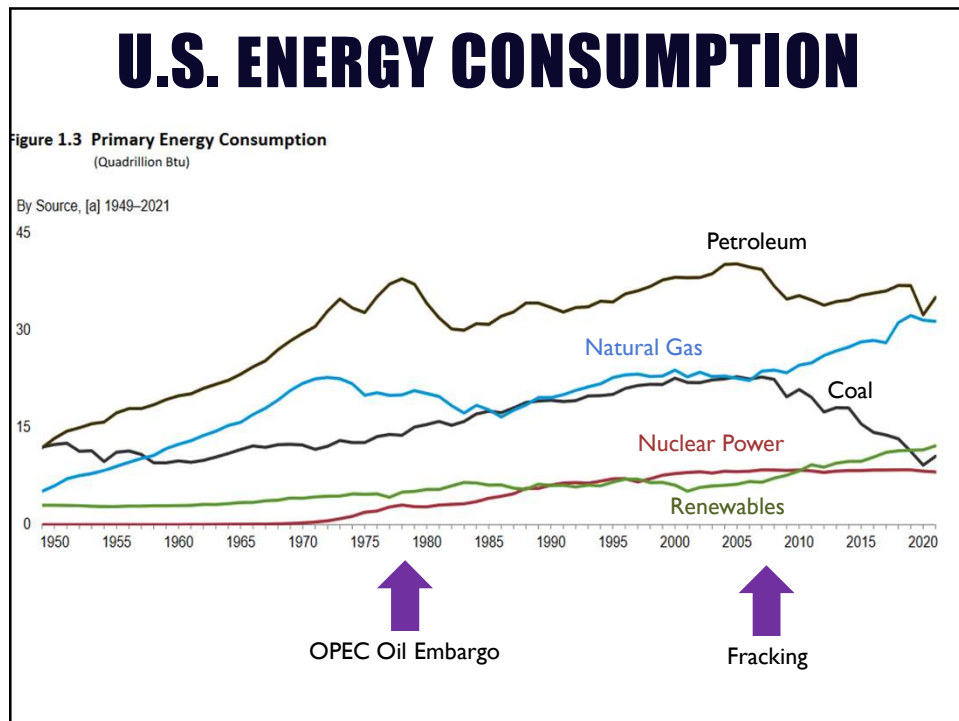
CAMPUS FUEL USE

- Space heating
- Autoclaves, sterilization
- Domestic hot water
- Cooking
- Other processes
- Generate electricity (Cogeneration)
- Absorption Chillers

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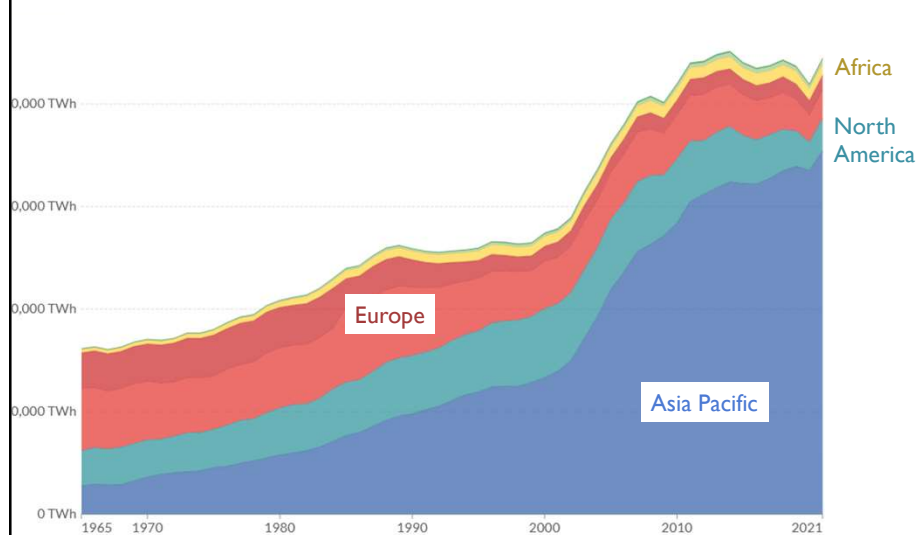
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GLOBAL COAL CONSUMPTION

Coal Consumption by Region



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Colorless and odorless gas



NATURAL GAS

94% - Methane (CH_4)

4% Ethane (C_2H_6)

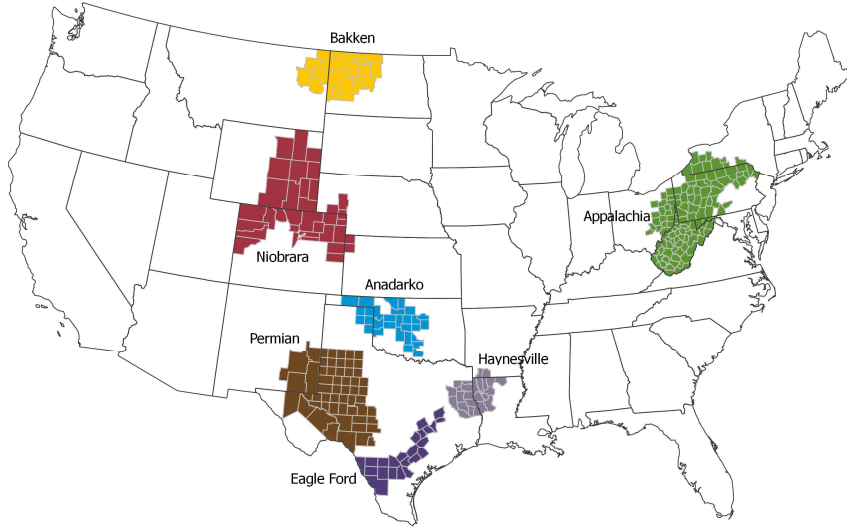
1% - Propane (C_3H_8)

1% - Nitrogen

Transported via
pipeline and ship

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WHERE IS THE NATURAL GAS?



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Solid – fossilized plant matter

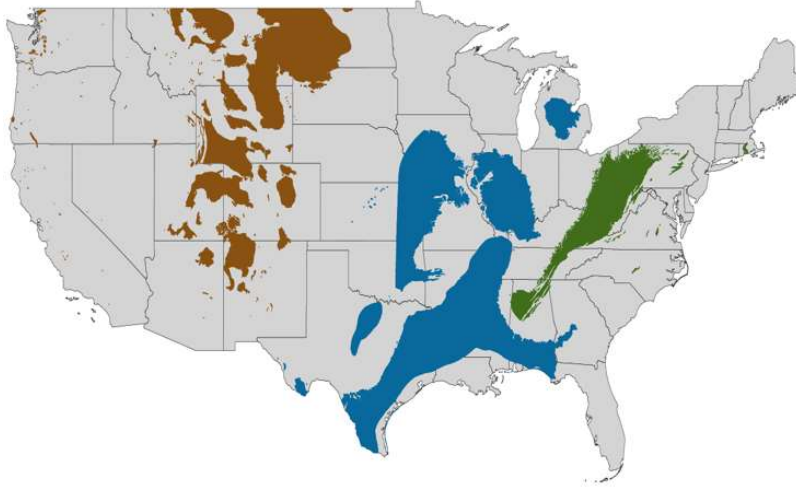


COAL

- Carbon
- sulfur
- hydrogen
- nitrogen
- oxygen
- Transported via rail or truck

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COAL BASINS



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Liquid – fossilized plants and animals



FUEL OIL

Distilled from Crude Oil

86% - carbon

12% - hydrogen

1% - sulfur

0.5% - nitrogen

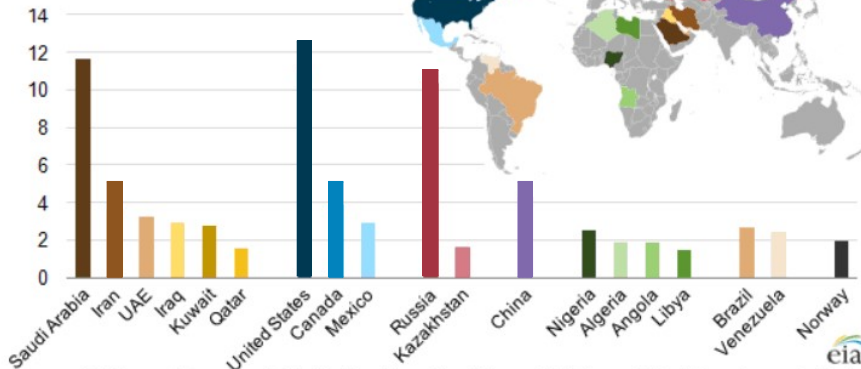
0.5% - oxygen

Transported via rail,
pipeline, or truck

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WHERE IS THE OIL?

Total liquids production
million barrels per day



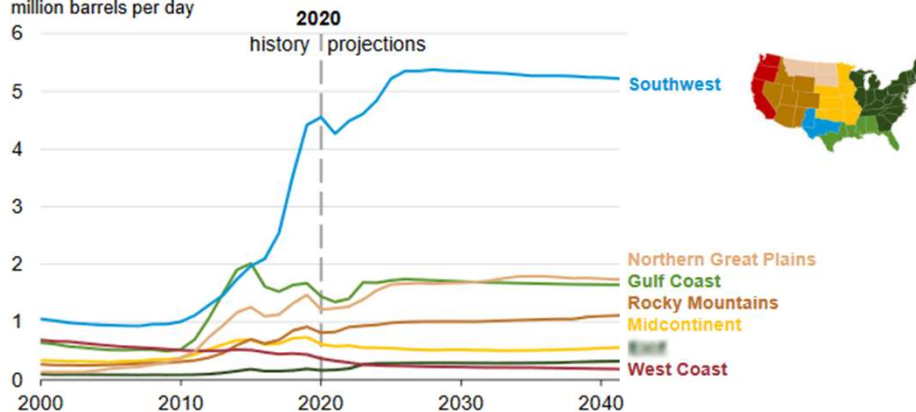
Source: U.S. Energy Information Administration, International Energy Statistics and Short-Term Energy Outlook.
Note: Total petroleum production includes crude oil, natural gas liquids, condensates, refinery processing gain, and other liquids including biofuels.

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US TOTAL CRUDE OIL PRODUCTION

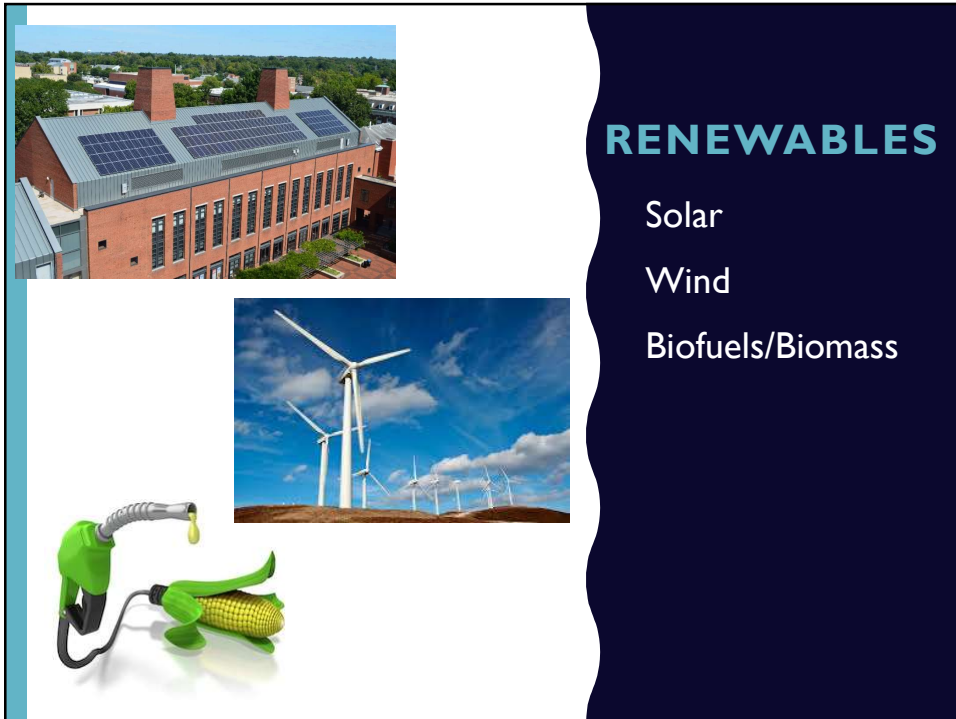
Onshore crude oil production in the Lower 48 states by region
AEO2021 Reference case

million barrels per day

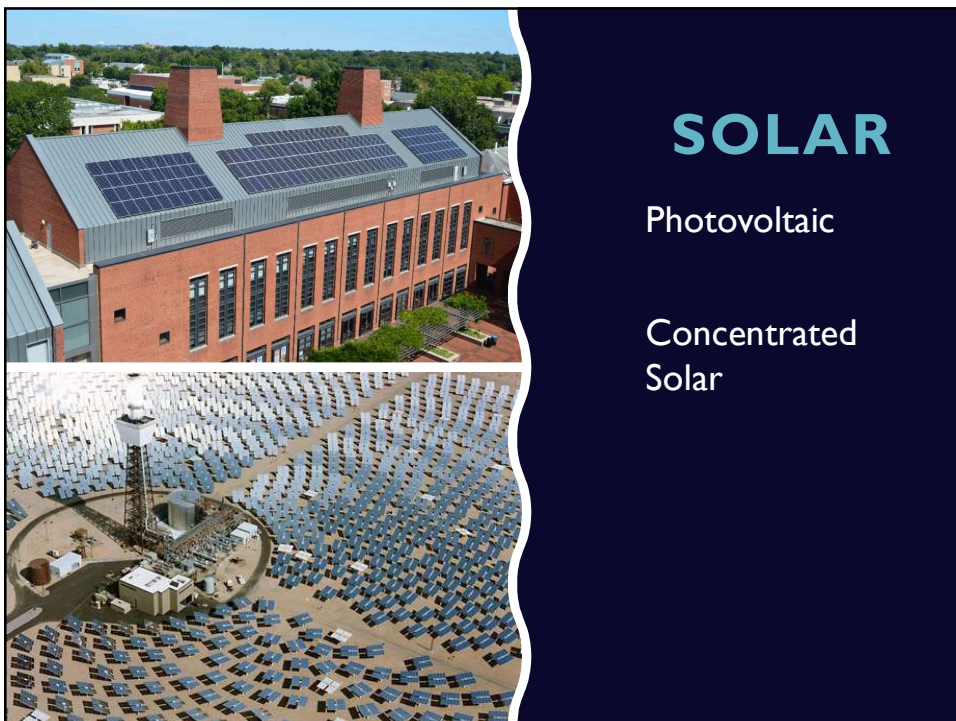


Source: U.S. Energy Information Administration, Annual Energy Outlook 2021

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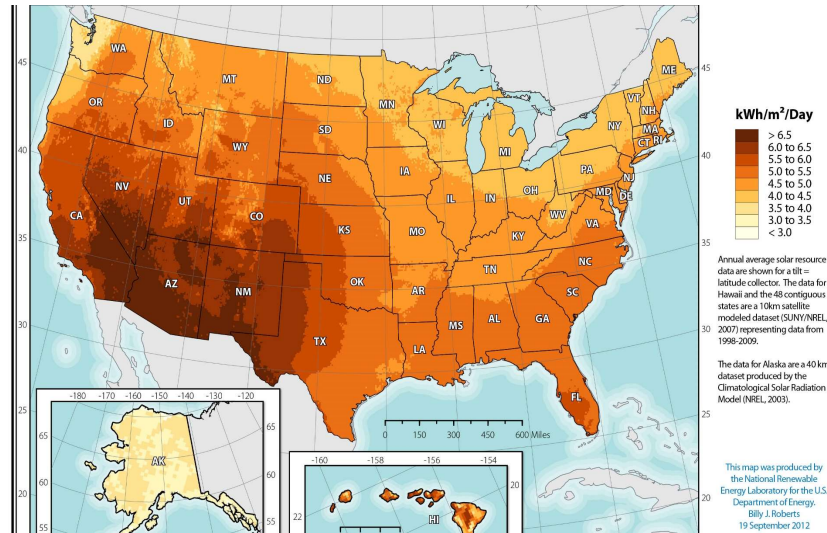


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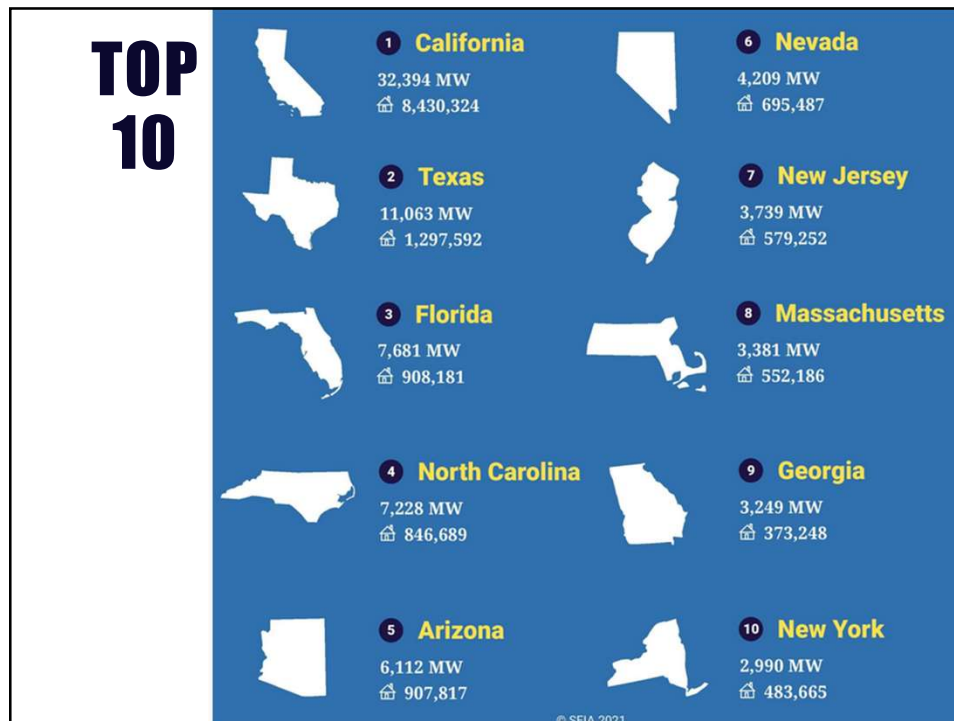


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POTENTIAL SOLAR ENERGY

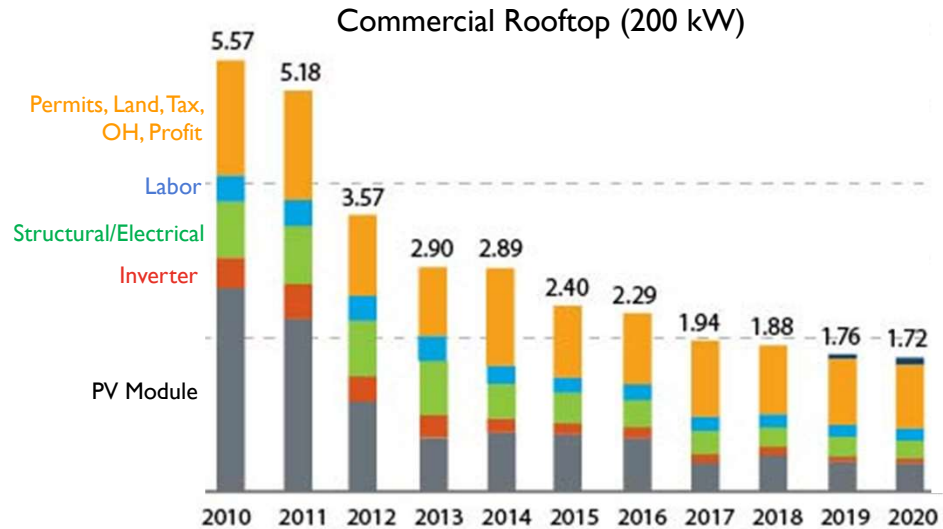


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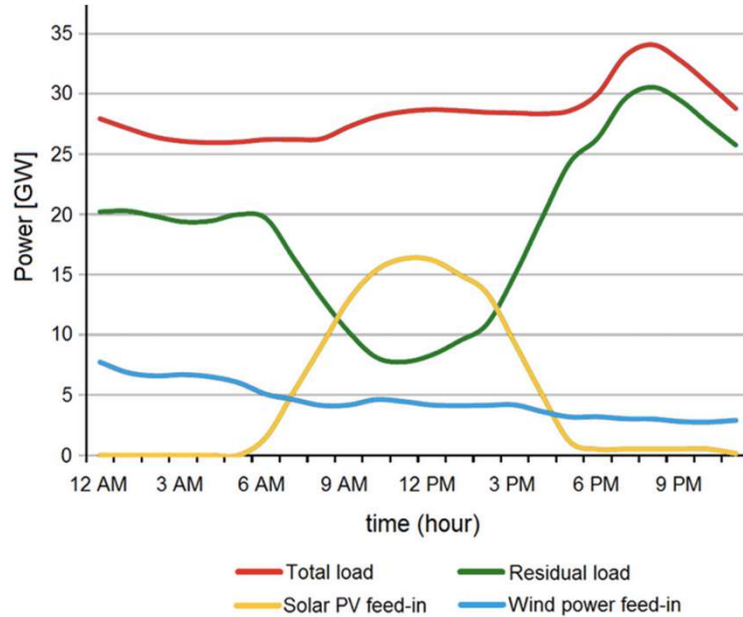
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SOLAR PV COST



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“DUCK CURVE”



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“DUCK CURVE”

Vox

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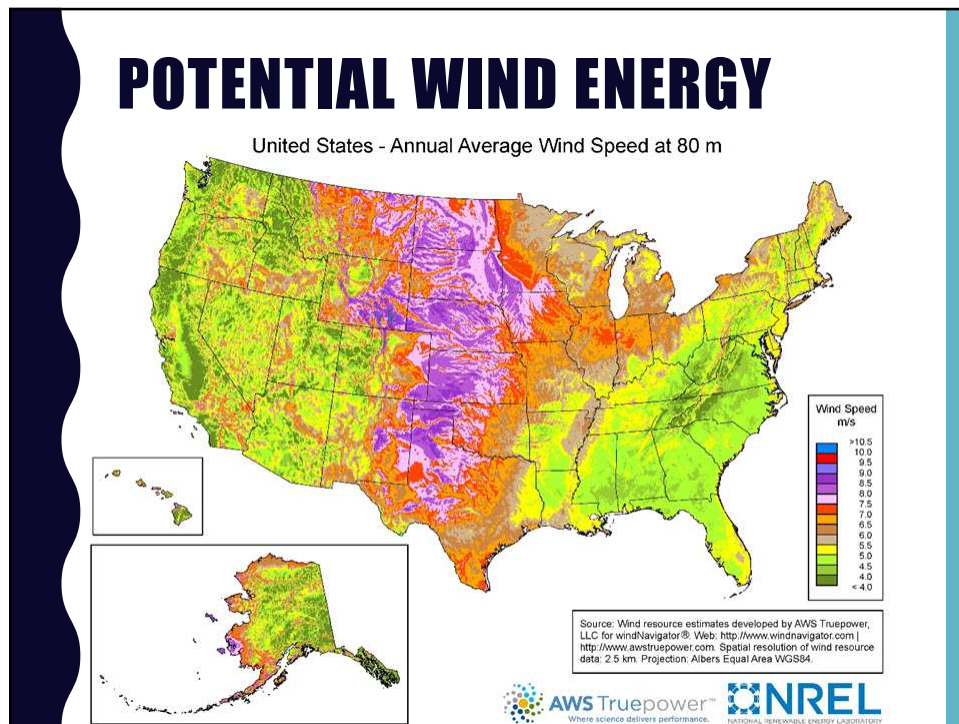


WIND

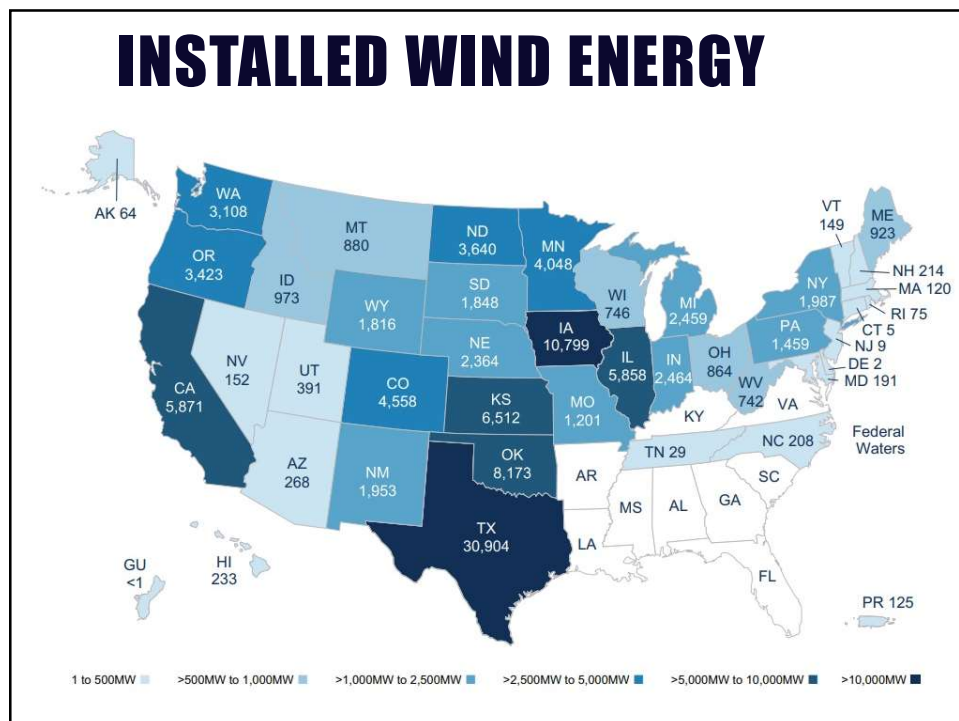
Wind Farm - PPA

On Campus

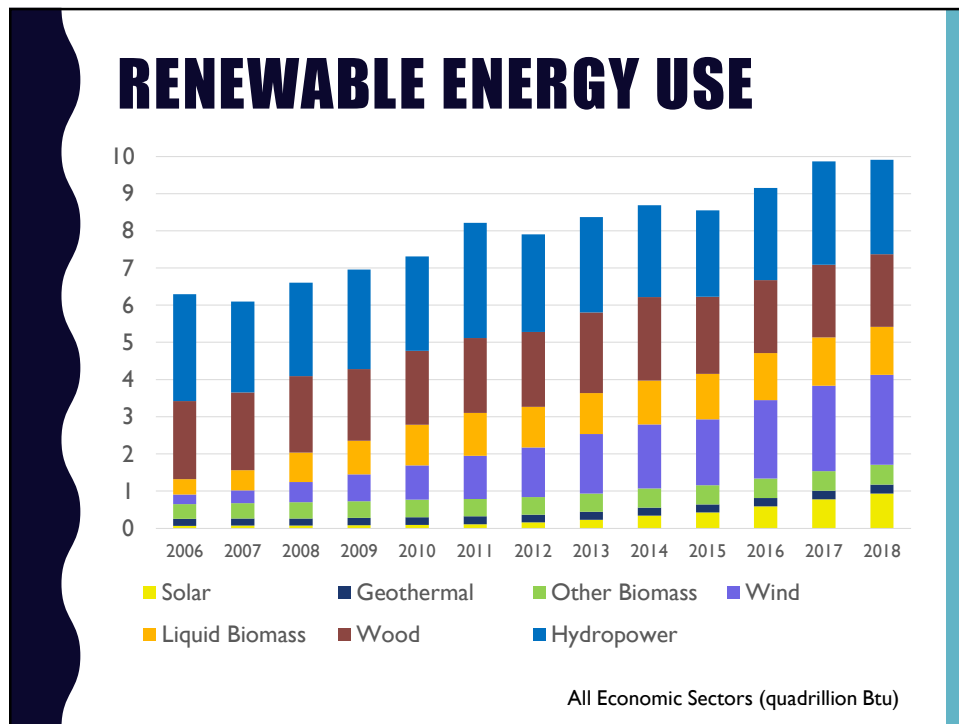
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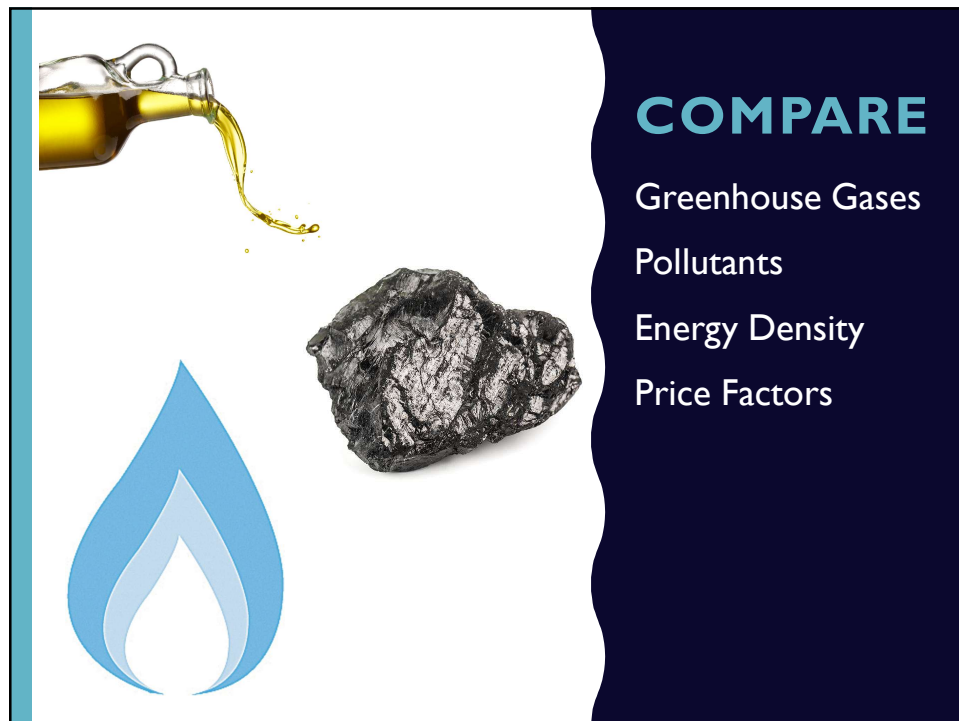
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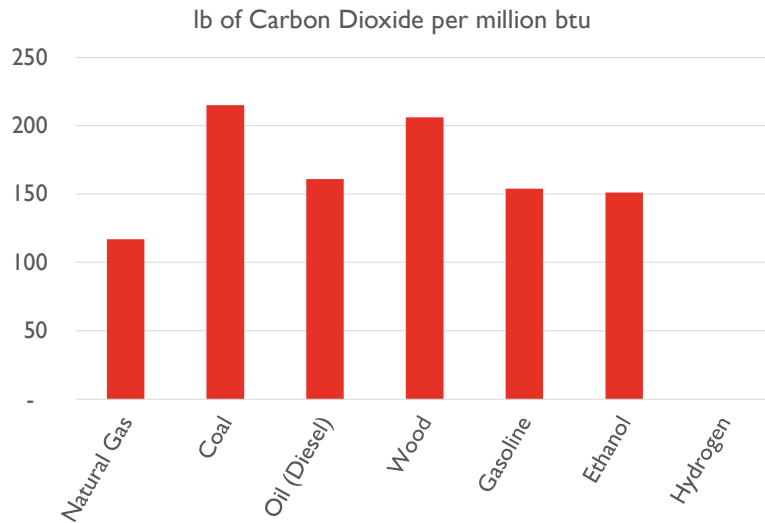


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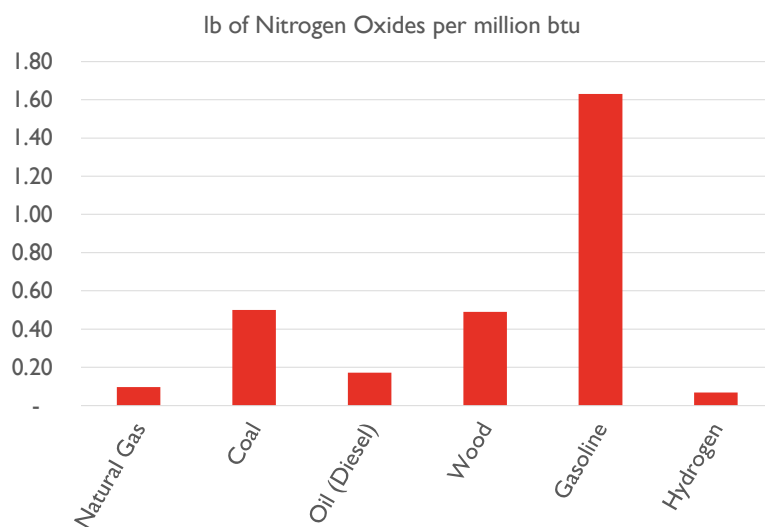
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EMISSIONS – CARBON



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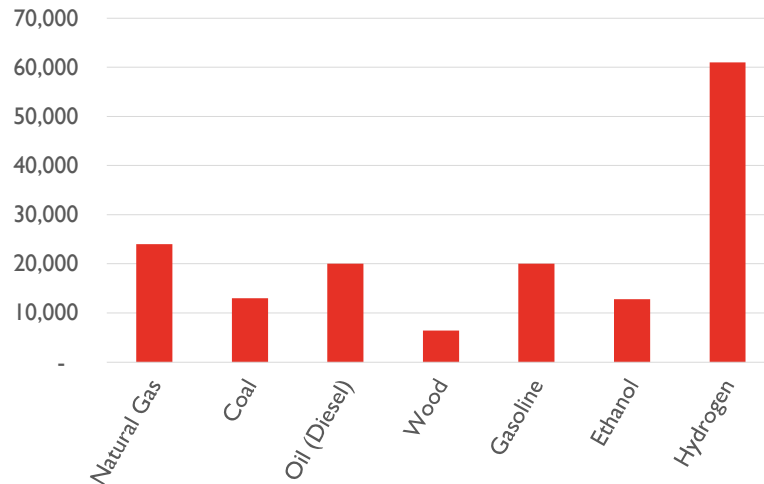
EMISSIONS – NO_x



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ENERGY DENSITY

Energy Density, Btu per lb



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NATURAL GAS PRICE FACTORS

- Distance from wells
- Pipeline proximity and capacity
- Load profile
- Local costs - distribution, taxes, other
- State regulations
- Competing suppliers

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COAL PRICE FACTORS

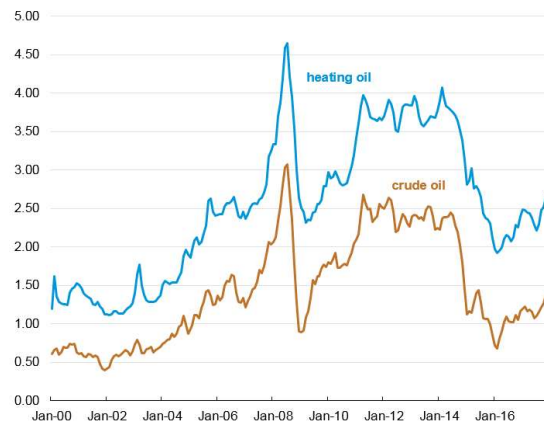
- Transportation - train, barge, truck
- Sulfur content
 - Sulfur dioxide causes “acid rain”
- Surface coal is cheaper than underground coal
- Government regulations

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FUEL OIL PRICE FACTORS

U.S. average monthly heating oil and crude oil prices, 2000 – 2017
Dollars per gallon

- Crude oil price
- Storage space
- Delivery costs
- Demand



Note: Heating oil price is the retail price including taxes. Crude oil price is the composite refiner acquisition cost of crude oil.
Source: U.S. Energy Information Administration, *Short Term Energy Outlook and Petroleum Marketing Monthly*, March 2018



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SOLAR/WIND VALUE FACTORS

- “Transportation” – geographical
- Linked to local cost of electricity
- Availability varies based on local laws/regulations
- Requires connection to local utility

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VOLATILITY AND RISK

- Commodity Markets
 - Natural Gas
 - Coal
 - Crude Oil
- Transportation and Storage
 - Increases volatility and risk
- Procurement/Contracting Process
 - Take or pay requirements
 - Balancing issues

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COST/RISK MANAGEMENT STRATEGIES

- Hedging or Futures Options
- Ability to Switch Fuels
- Demand Management/Peak Shaving
- Thermal Energy Storage
- Combined Heat & Power
- Customer Incentives
- Renewables

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MORE INFORMATION

- U.S. Energy Information Administration
www.eia.gov
- National Renewable Energy Laboratory
www.nrel.gov

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