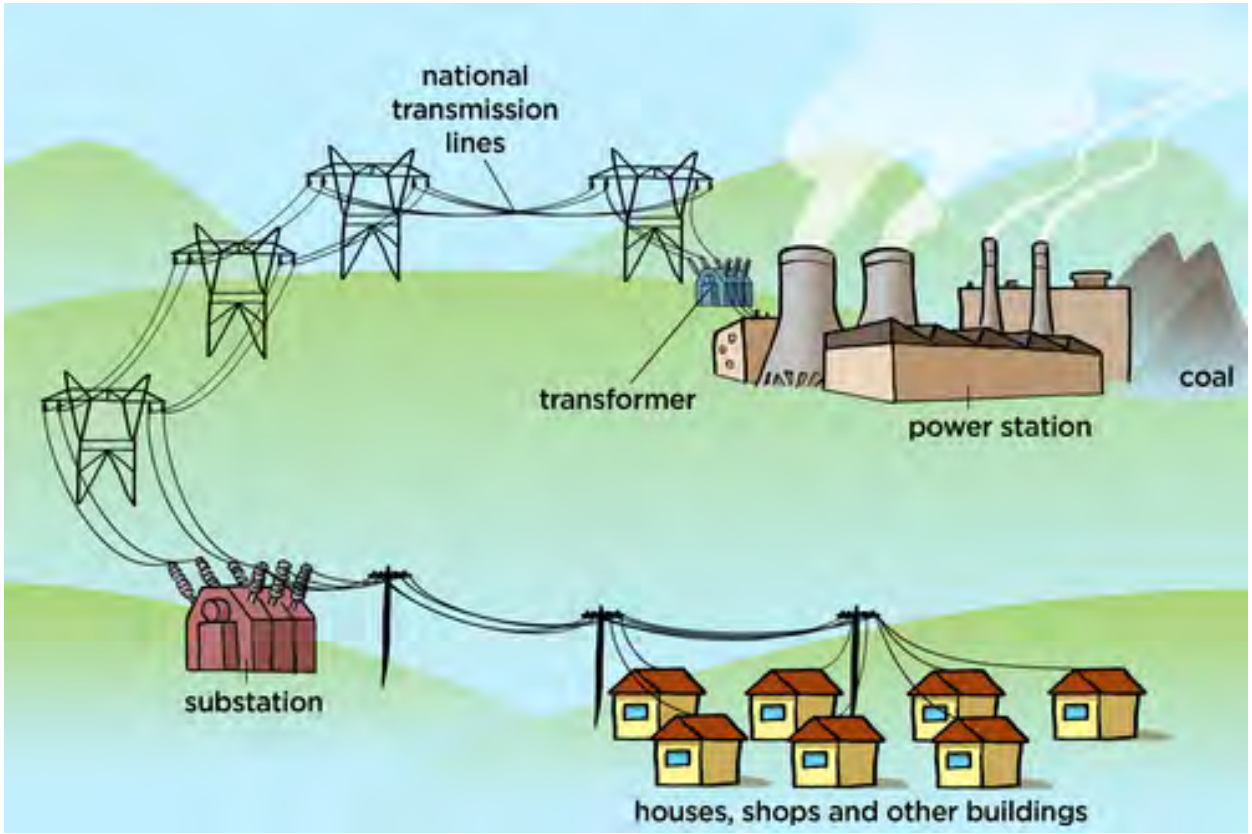

# Adjusting to the Clean Power Plan

# Electricity 101



# Electricity 101

# EPA's Clean Power Plan

- EPA wants to reduce carbon dioxide ($CO_2$) emissions from existing coal power plants.
- EPA used three building blocks to establish the rule:
  1. Better efficiency at existing coal plants
  2. Shift generation from coal to natural gas plants
  3. Increase use of renewables

# What's the Overall Problem?

- Both technical and business hurdles to clear
- Problem: Electric utilities must comply with regulations while also providing reliable, low cost power to their customers
  - How do they accomplish that with the new rule?
  - Each building block has its own unique problems

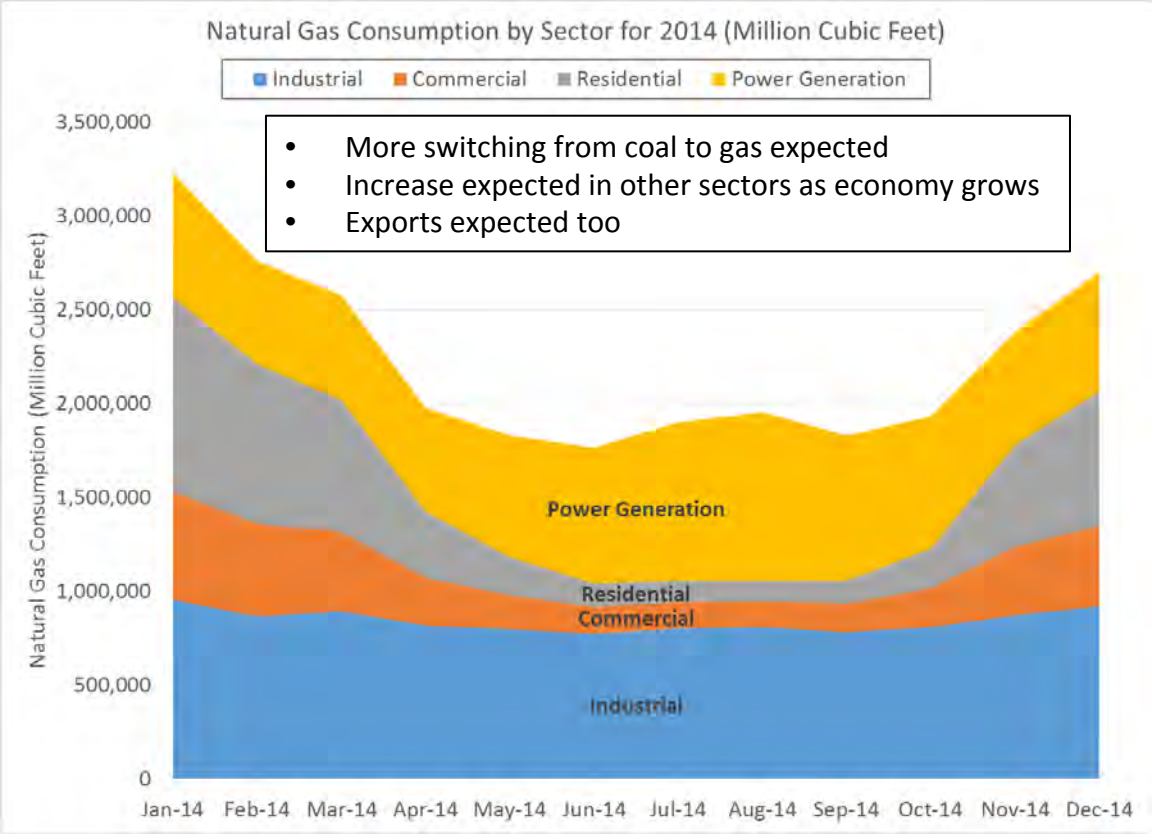
# Building Block 1: Better Efficiency

- EPA wants to increase the efficiency of existing coal plants (i.e. get better “gas mileage”)
- But many of them already have as good efficiency as they can get due to the business environment
- Solution: Help power plants figure out physical or operational improvements to implement
- There’s a fine line; some improvements can trigger other environmental regulations

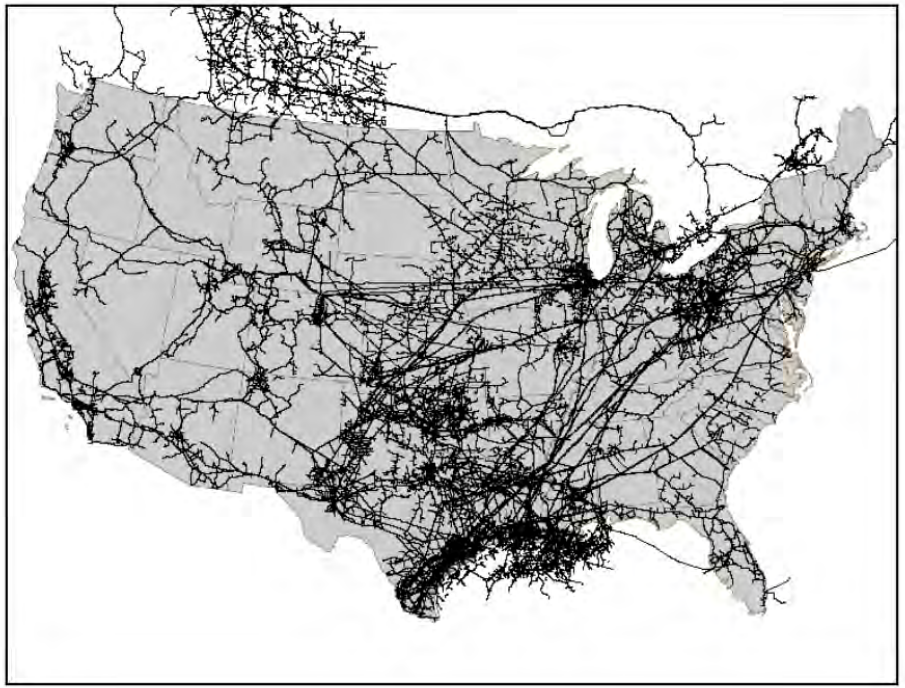
# Building Block 2: Shift to Natural Gas

- When it comes to $CO_2$, natural gas plants get twice the “gas mileage” as coal plants
- Sounds like a great plan, but there are underlying issues
  - Moving away from a “diversified” portfolio
  - On-site natural gas storage is difficult
  - All sectors use gas, especially in the winter

# Natural Gas Consumption Profile



# More Gas Pipelines will be Built

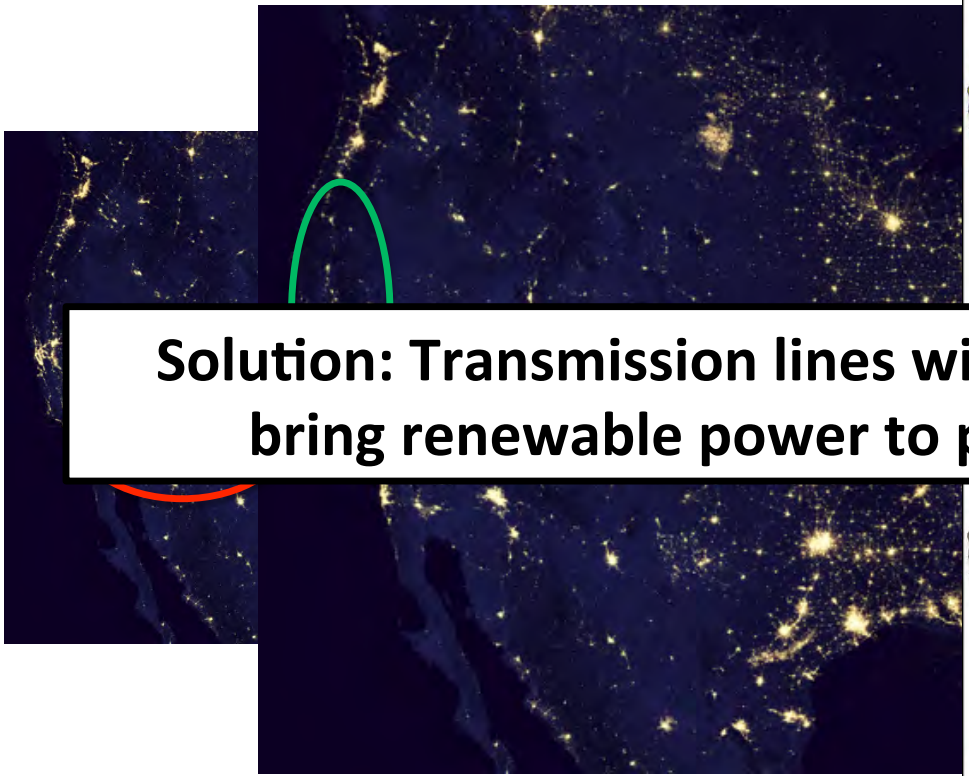


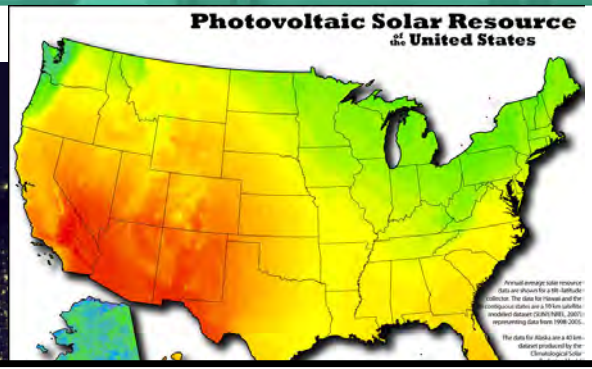
- EPA is projecting power sector to double consumption
- System is typically not built with over-capacity
- Solution: Pipelines will need to be built; big projects will take time.

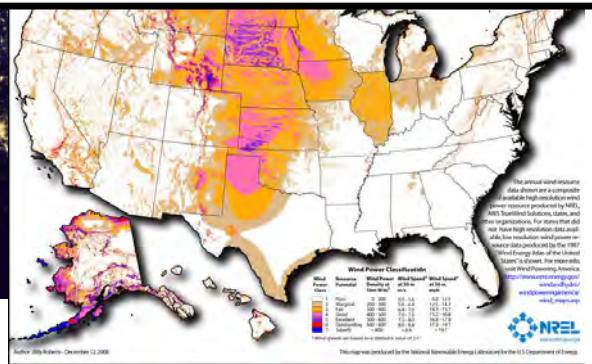
# Building Block 3: Use More Renewables

- Wind and solar provide emission-free energy
- Two major concerns:
  - People do not live where the best renewable resources are located
  - Renewable resources are typically producing when we need it least

# Renewable Resources vs. Population Centers

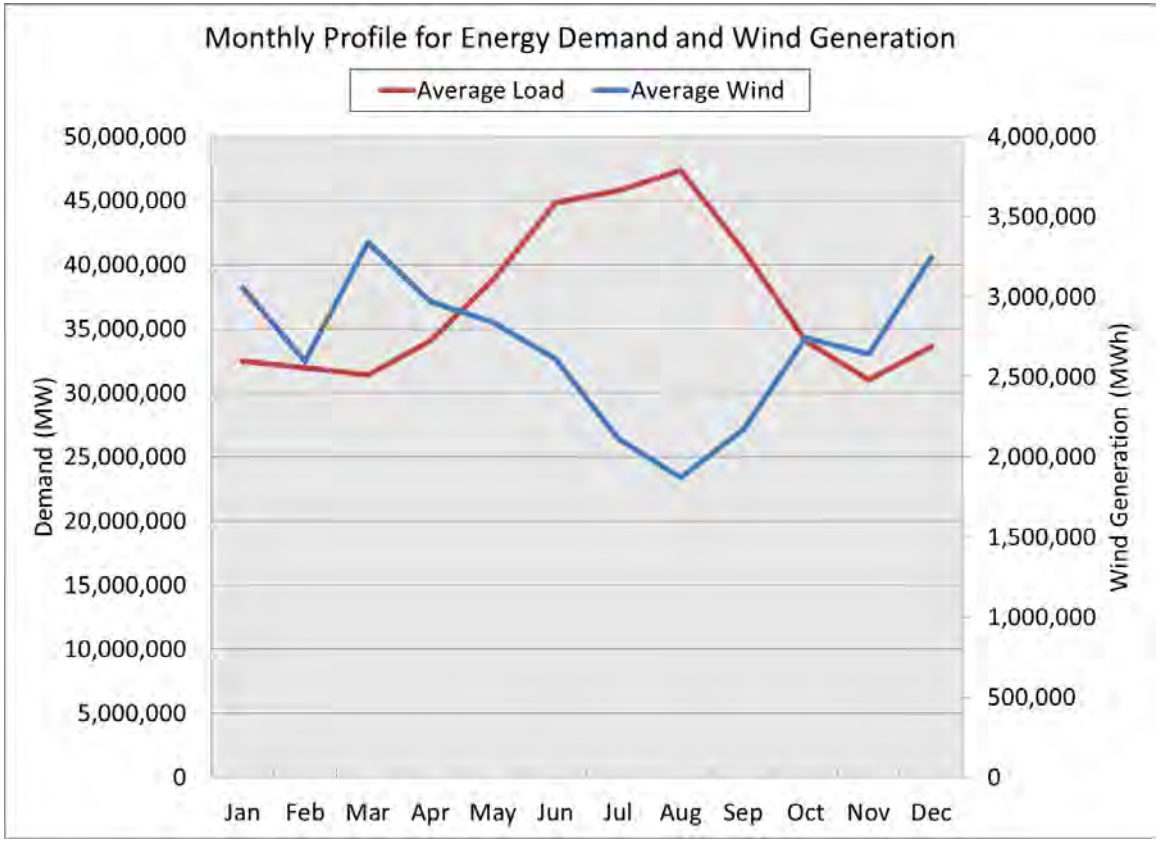




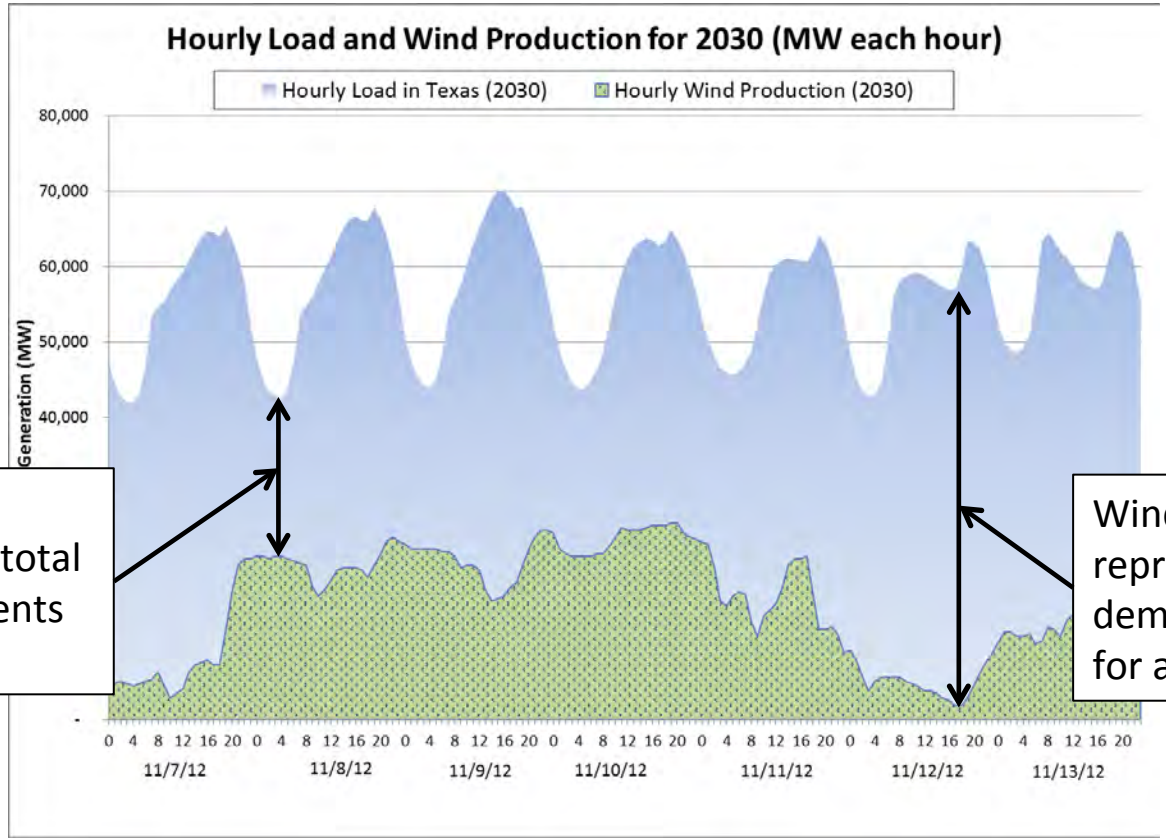



**Solution: Transmission lines will need to be built to bring renewable power to population areas.**

# Annual Profile of Load and Wind



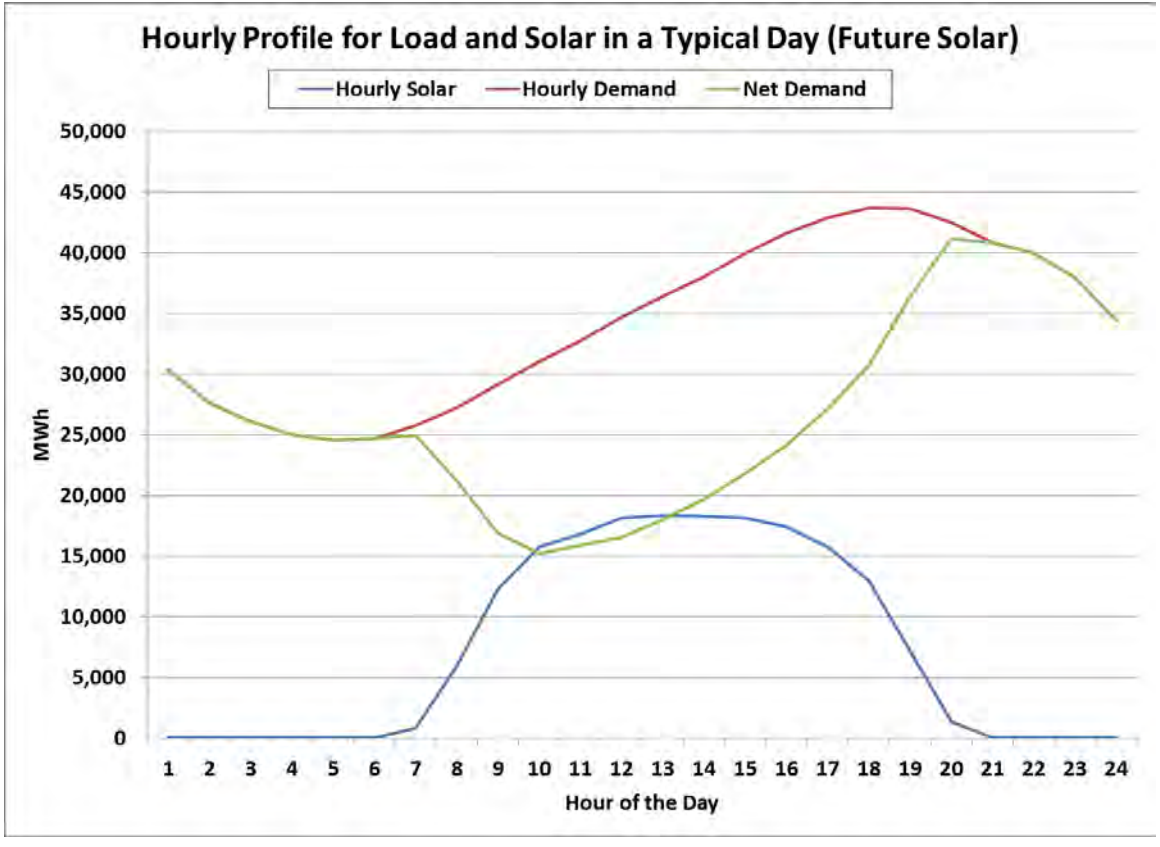
# Hourly Profile of Load and Wind



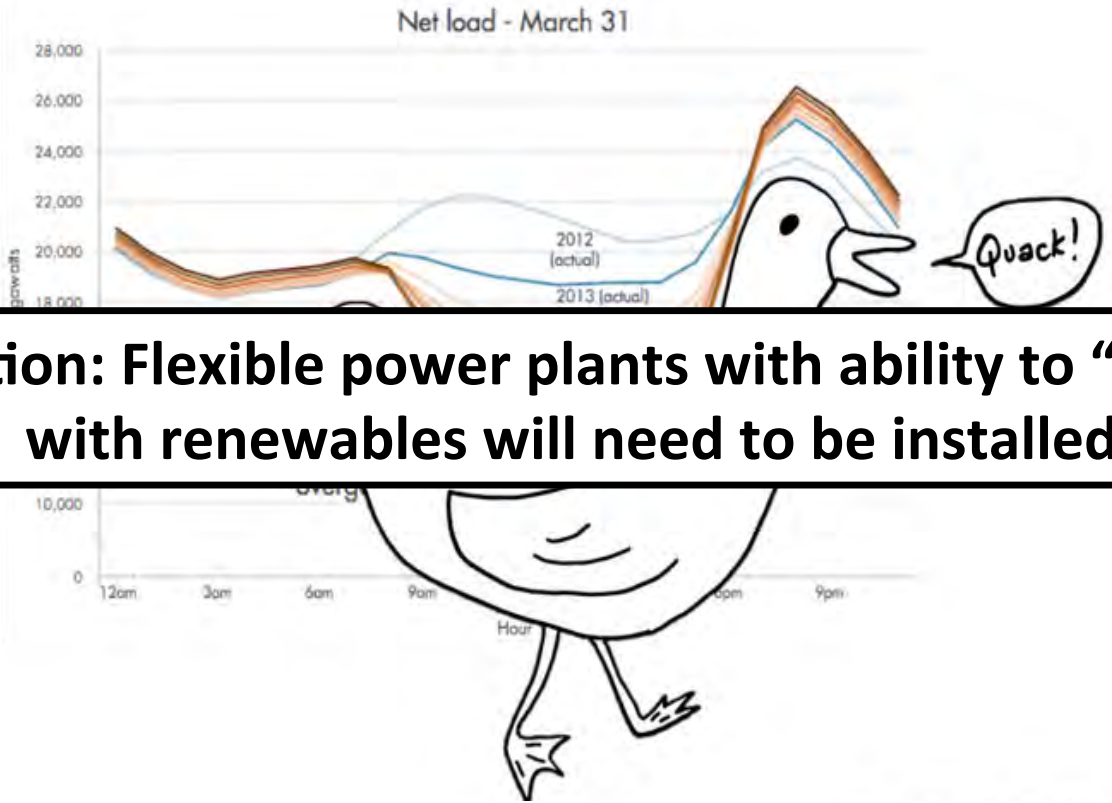

Wind generation represents 51% of total demand requirements for a given hour.

Wind generation represents 3% of total demand requirements for a given hour.

# Load and Solar on a Typical Day



# The “Duck Curve”




**Solution: Flexible power plants with ability to “move” with renewables will need to be installed.**

# What’s the Overall Solution?

- The regulation is a legal mess; the courts will deal with that
- It’s a technical mess as well since the regulation would fundamentally change power supply in the United States
- Nothing that can’t be solved, but a lot more technical evaluations will be required
- In the end, more natural gas pipelines, transmission lines, and flexible power plants are needed

# QUESTIONS?