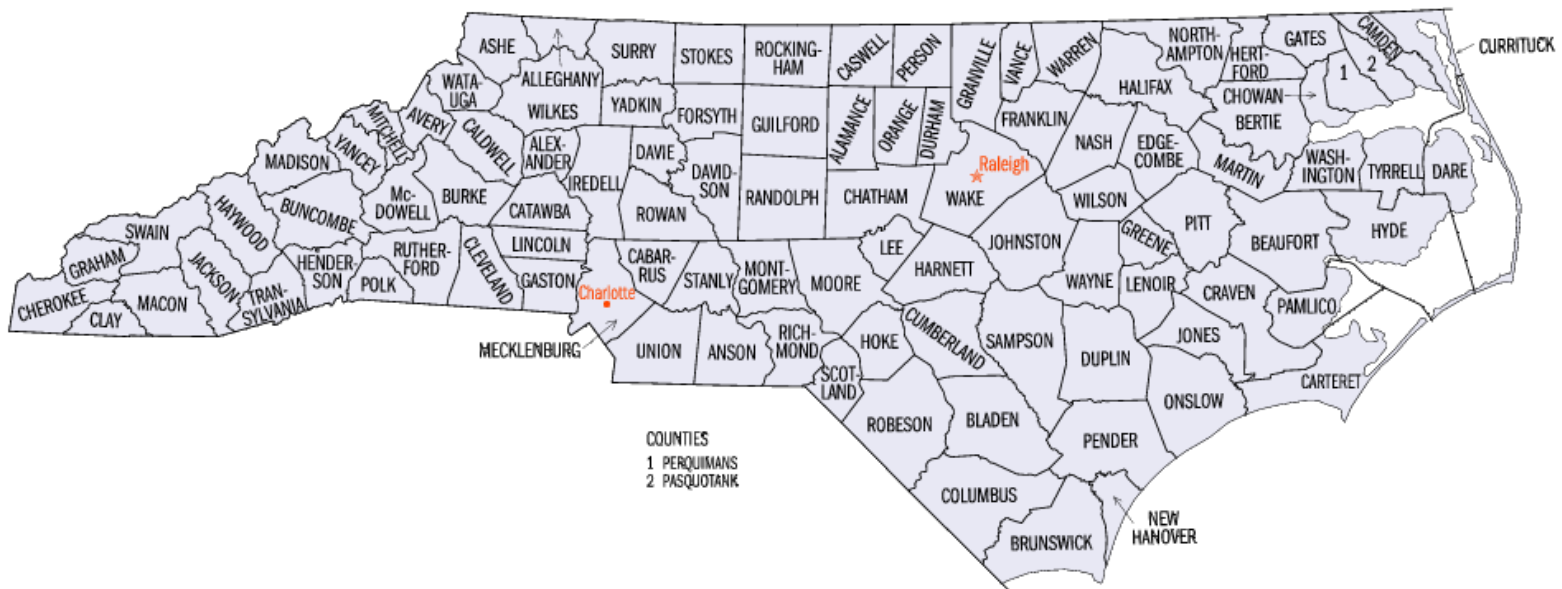
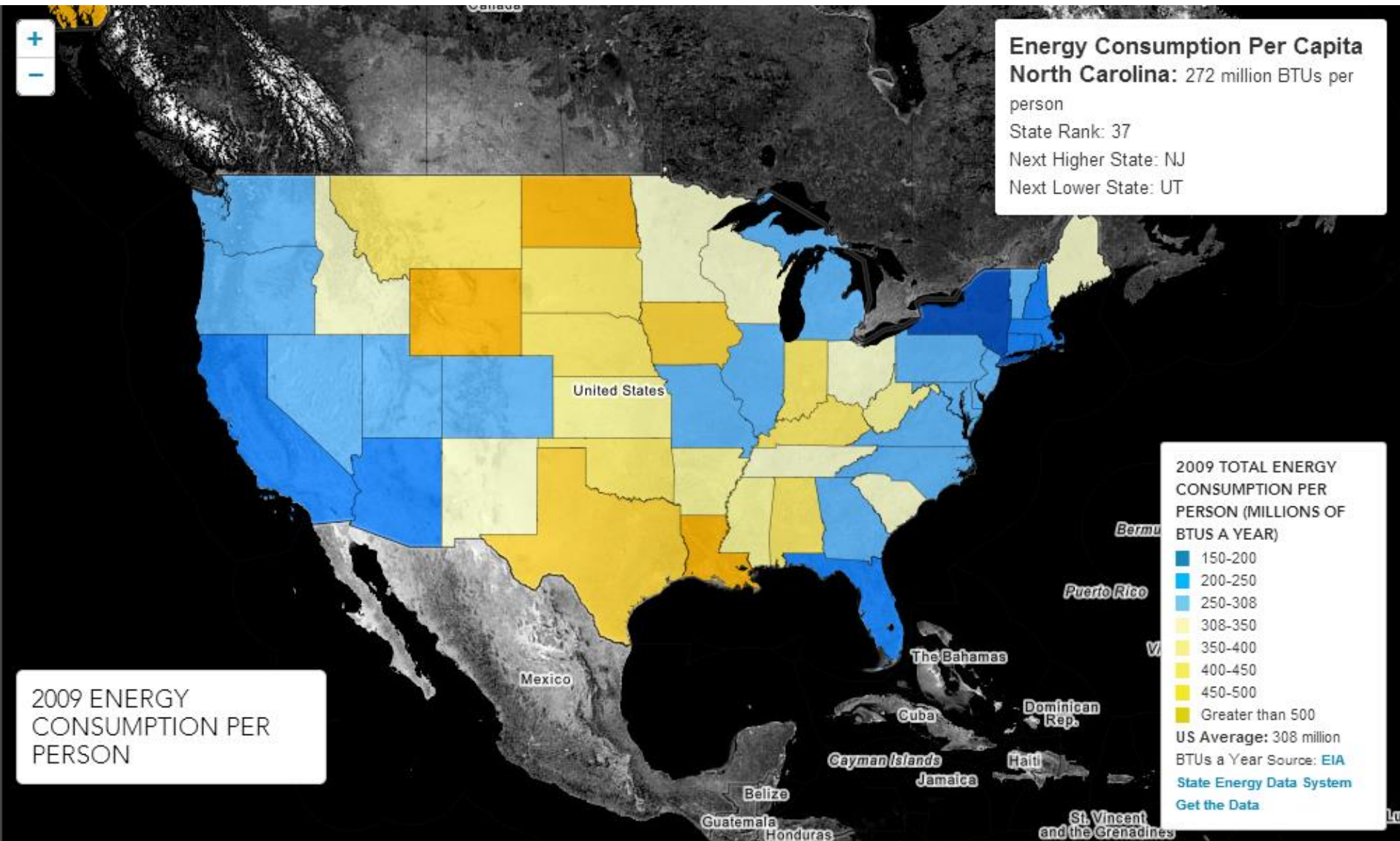


Energy and the Environment in NC

OLLI: May 20, 2013



Our Energy Consumption

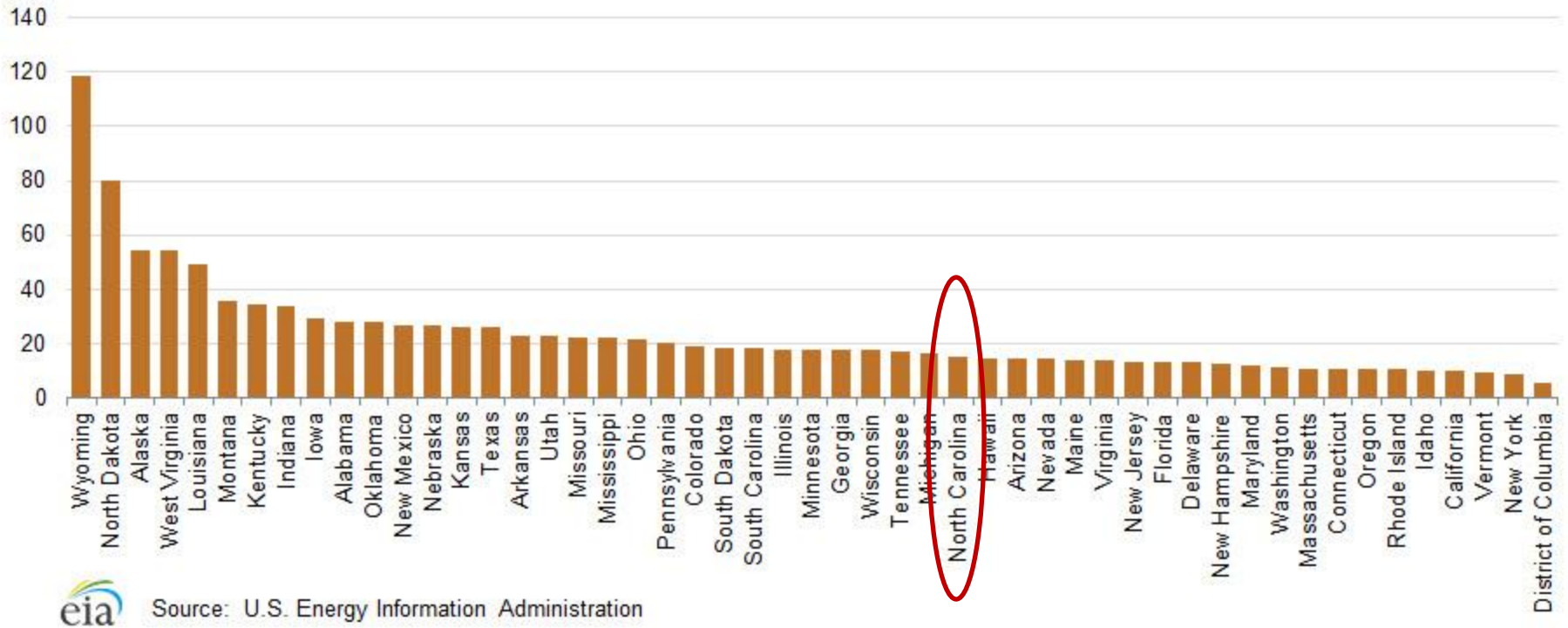


Some Stats...

Category	Nationwide Ranking
Total Energy Consumed per Capita, 2011	38 (267 million BTU)
Electricity Cost, Feb 2014	28 (10.92 cents/kwh)
Total Carbon Dioxide Emissions, 2011	15 (123 million metric tons)

Per-Capita CO₂ emissions

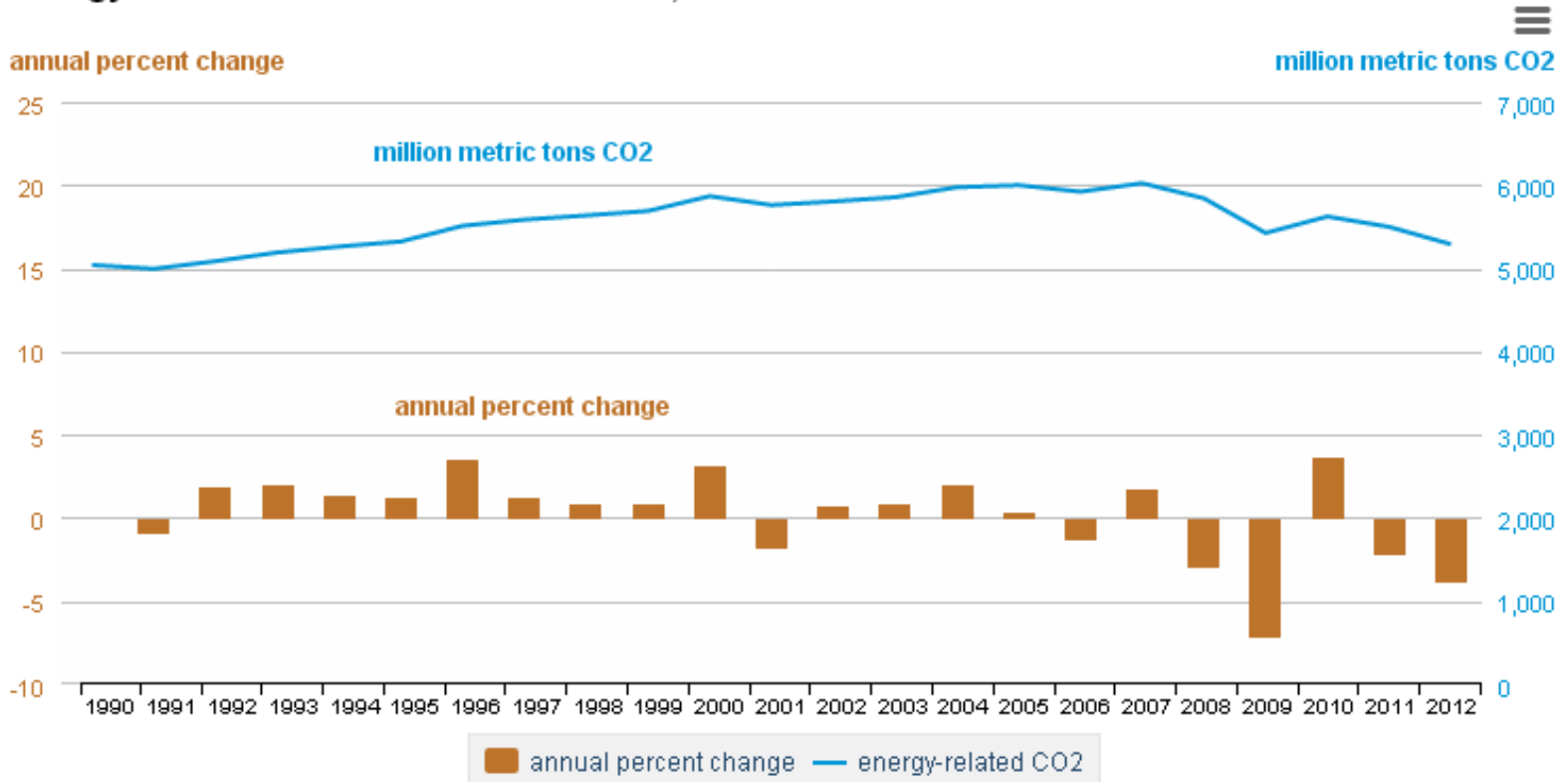
Figure 2. Per-capita energy-related carbon dioxide emissions by state, 2010
metric tons carbon dioxide per person



Source: U.S. Energy Information Administration

U.S. CO₂ emissions

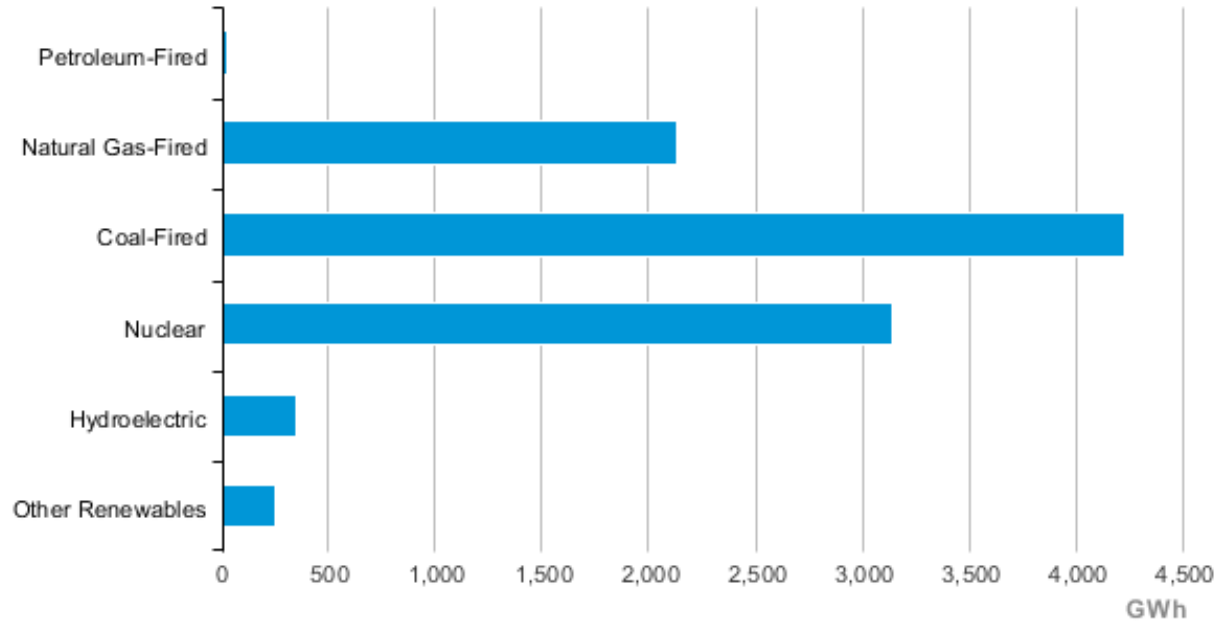
Energy-related carbon dioxide emissions, 1990-2012



Source: U.S. Energy Information Administration, *Monthly Energy Review* (September 2013), Table 12.1.

The Energy Mix in NC

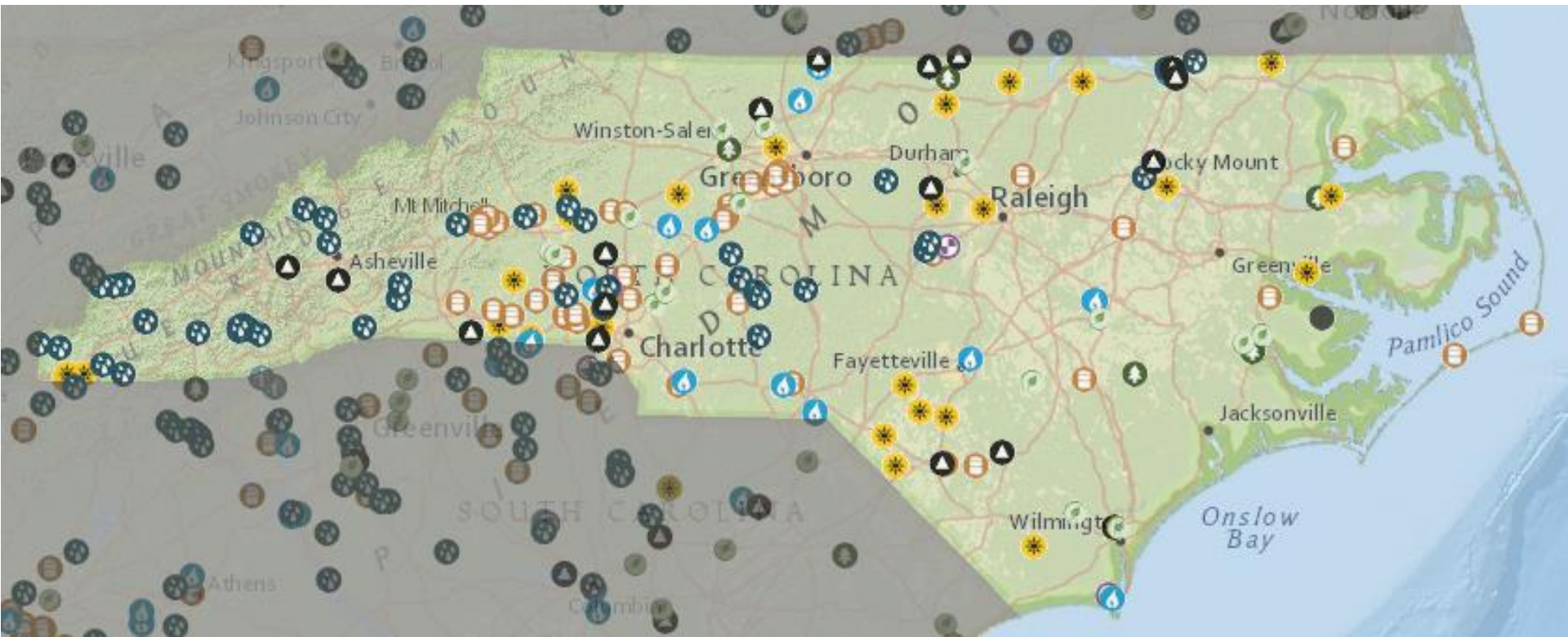
North Carolina Net Electricity Generation by Source, Nov. 2013



 Source: Energy Information Administration, Electric Power Monthly

41.9% Coal
31.2% Nuclear
21.1% Natural Gas
3.4% Hydro
2.4% Other Renewables

Energy Mix in NC



- | | | |
|---------------------------|--------------------------------|----------------------------|
| Biomass Power Plant | Natural Gas Power Plant | Pumped Storage Power Plant |
| Coal Power Plant | Nuclear Power Plant | Solar Power Plant |
| Geothermal Power Plant | Other Power Plant | Wind Power Plant |
| Hydroelectric Power Plant | Other Fossil Gases Power Plant | Wood Power Plant |
| | Petroleum Power Plant | |

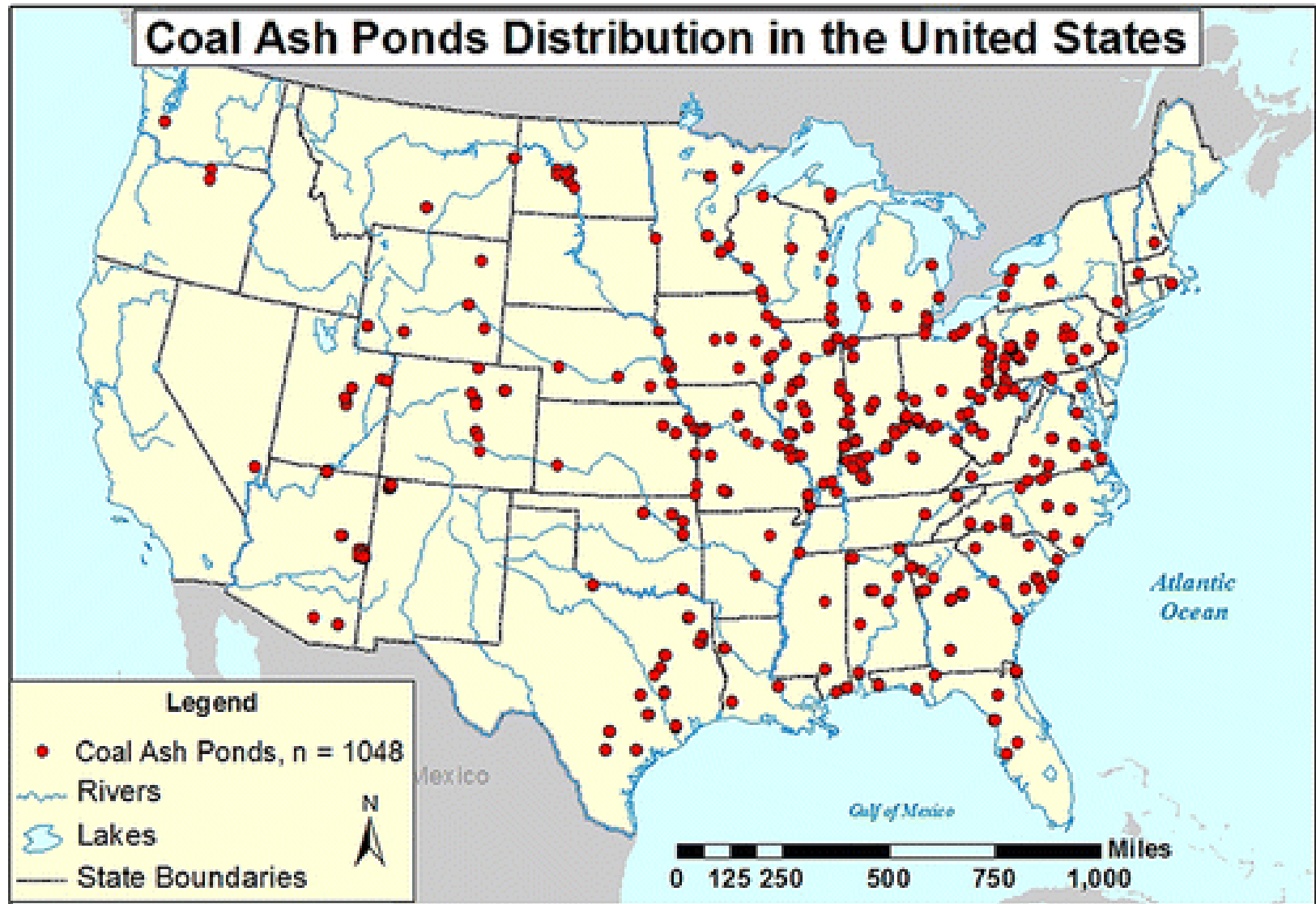
Coal

According to NCDENR, 14 coal-fired power plants (8 active)

- Duke Energy: Retired 4 units and opened one new 825 MW unit at its Cliffside station (powers 600,000 homes)
 - Advanced Clean Coal technology:
 - 99.9% removal of fly ash air emissions, 99% removal of SO₂, 90% NO_x, 90% Mercury



North Carolina has several coal ash ponds



Nuclear in NC

Three Nuclear plants

- Shearon Harris (operational 1987), 1 reactor , 900 MW capacity
- Brunswick (operational 1975), 2 reactors, 1,870 MW capacity
- McGuire (operational 1981), 2 reactors, 2,258 MW capacity

6th in the nation in electricity generation from nuclear power in 2013

- 31% of NC's total electricity generation in 2013
- Run at ~90% capacity



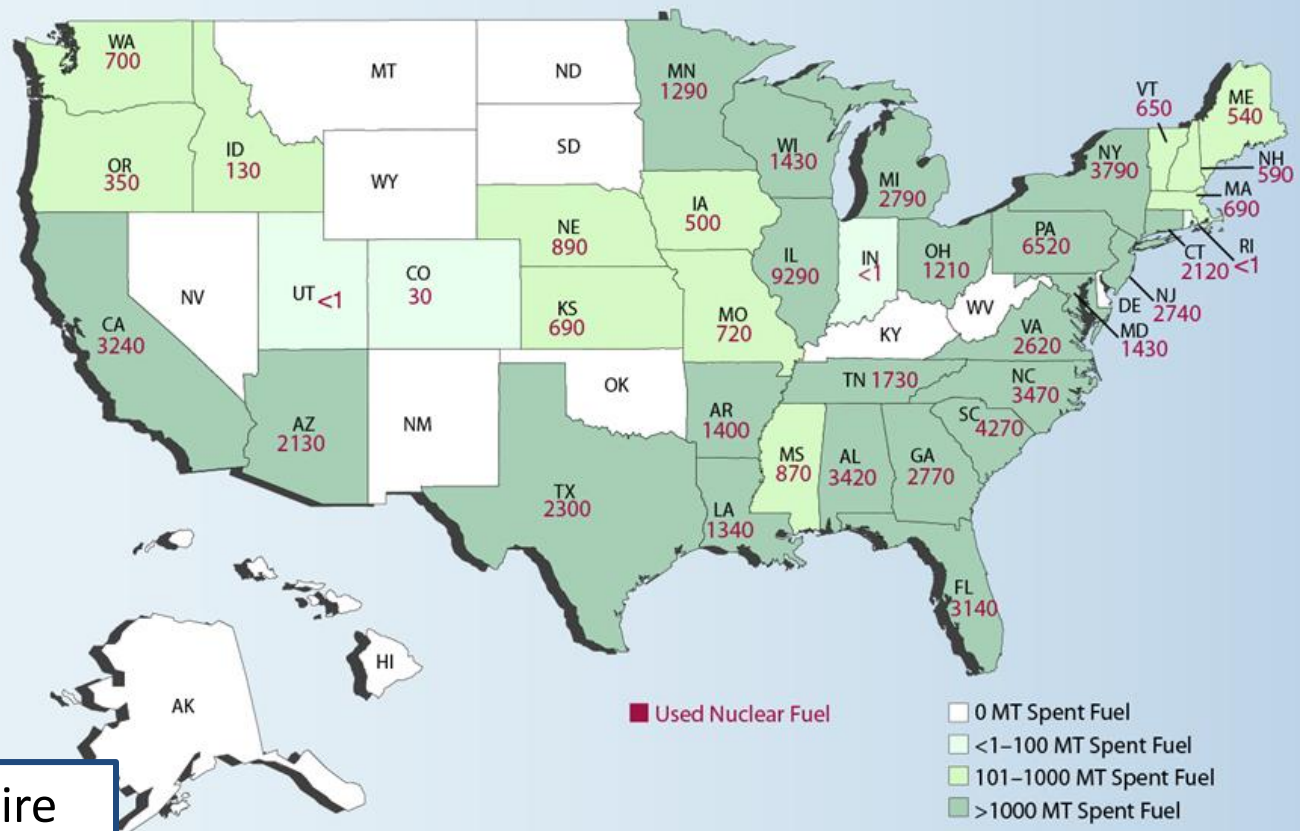
Nuclear Waste

Entire nuclear industry generates about 2,000-2,300 metric tons of used fuel per year

Total = 71,780 metric tons of used nuclear fuel.

Used Nuclear Fuel in Storage

(Metric Tons, End of 2013)



Brunswick and McGuire have dry cask storage as of July 2013

Shale Gas Basins (2011 estimates)

Deep River

Mean estimate = 1660 billion cubic feet of gas

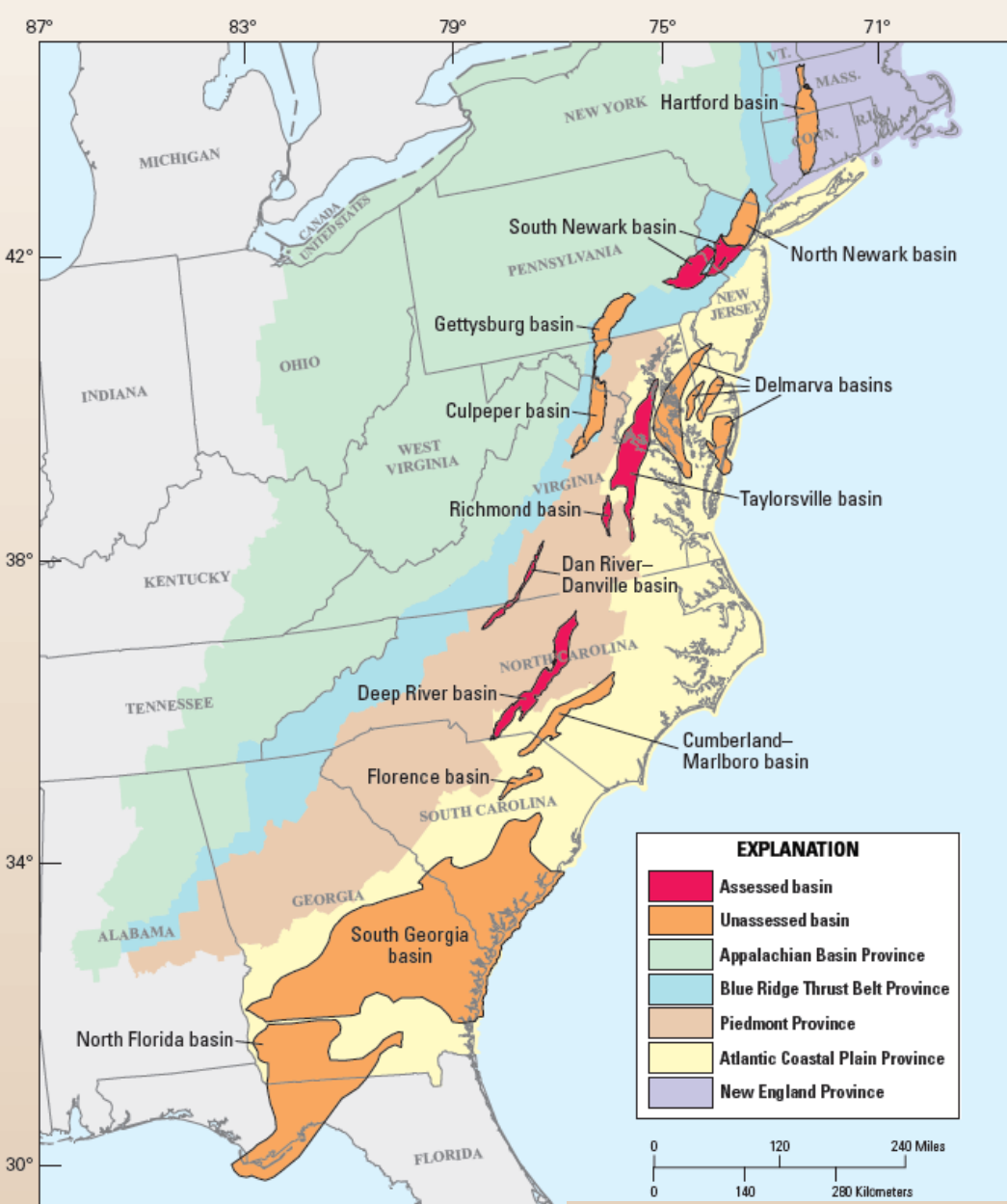
Dan River

Mean estimate = 49 billion cubic feet of gas

vs

Marcellus Shale

Mean estimate = 84 trillion cubic feet of undiscovered, technically recoverable natural gas



Source: USGS

Figure 1. Map of the Eastern United States showing the locations of the five quantitatively (volumetrically) assessed East Coast Mesozoic basins, the nine basins that were not volumetrically assessed, and the U.S. Geological Survey province boundaries. Each basin includes one continuous gas assessment unit (tables 1, 2).

TRIASSIC RIFT BASINS

Shown in blue are the North Carolina shale basins from the Triassic period about 220 million years ago, and a proposed, or unassessed, basin in orange.

DEEP RIVER BASIN

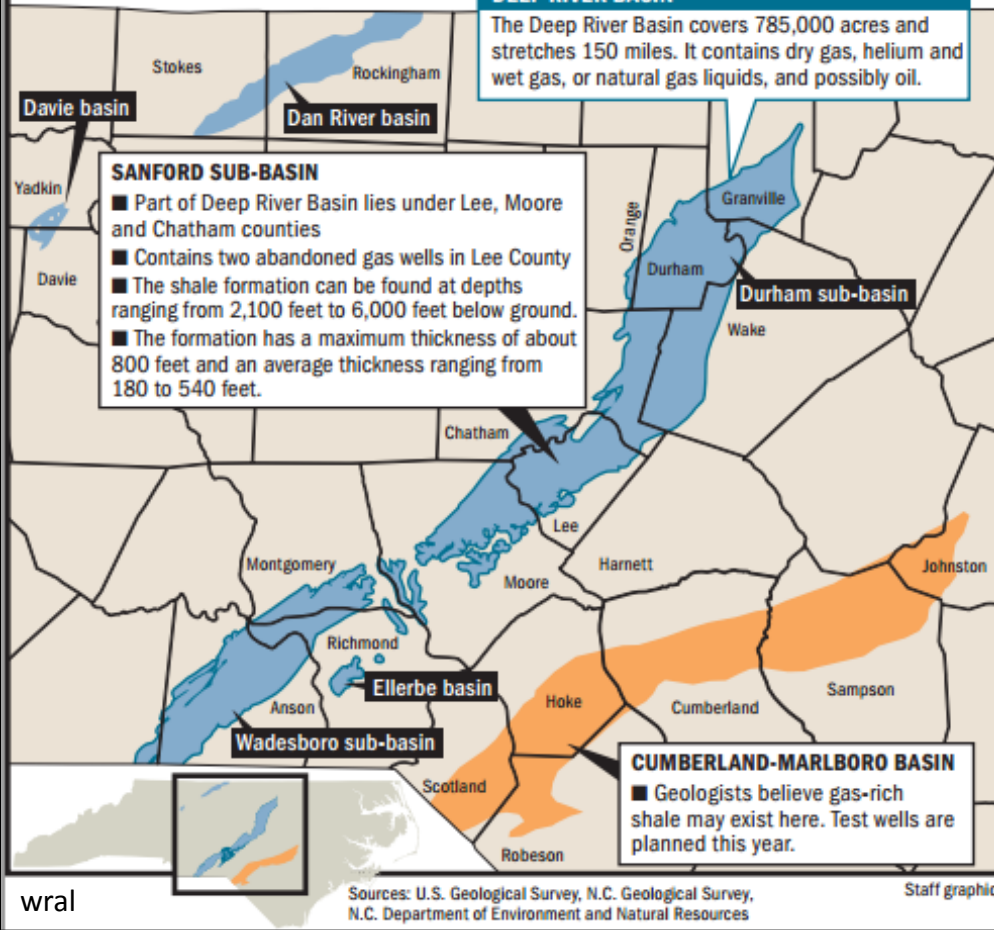
The Deep River Basin covers 785,000 acres and stretches 150 miles. It contains dry gas, helium and wet gas, or natural gas liquids, and possibly oil.

SANFORD SUB-BASIN

- Part of Deep River Basin lies under Lee, Moore and Chatham counties
- Contains two abandoned gas wells in Lee County
- The shale formation can be found at depths ranging from 2,100 feet to 6,000 feet below ground.
- The formation has a maximum thickness of about 800 feet and an average thickness ranging from 180 to 540 feet.

CUMBERLAND-MARLBORO BASIN

- Geologists believe gas-rich shale may exist here. Test wells are planned this year.



According to WRAL—enough natural gas to supply NC’s needs for 5 years at the 2010 consumption rate.

How is NC Adapting?

North Carolina Mining and Energy Commission is formulating regulations, due October 2014

Fracking Fluid

- Allowed non-disclosure of some fracking fluid chemicals
- No injection of diesel fuel, fuel oils, kerosene, petroleum distillates, or crude oil into the subsurface

Baseline Testing

- Water supplies located in the “presumptive liability distance” (5000 ft) of oil and gas wells have to be tested prior to the commencement of drilling activities

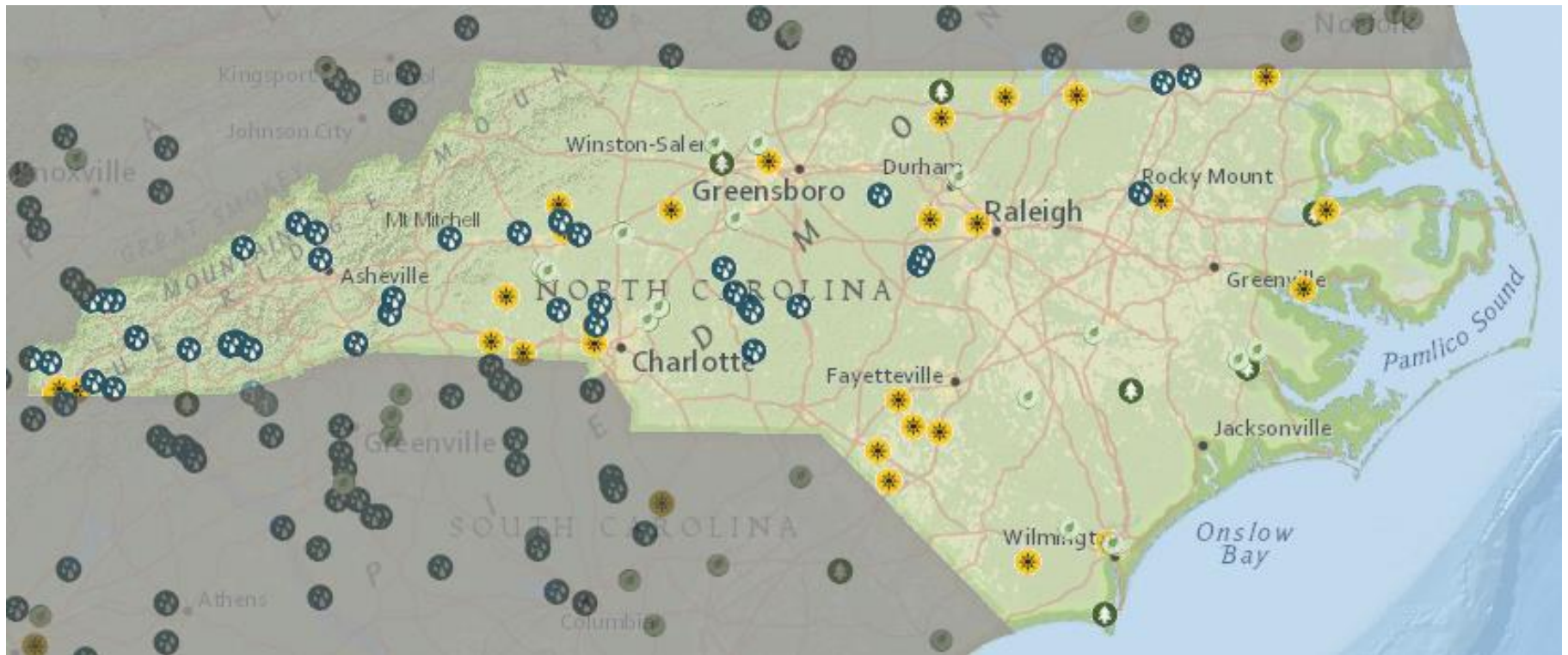
Analytes: pH, specific conductance, total dissolved solids (TDS), turbidity, alkalinity, calcium, chloride, magnesium, potassium, fluoride, sodium, sulfate, arsenic, barium, boron, bromide, chromium, iron, manganese, selenium, strontium, lithium, lead, zinc, uranium, isotopic radium (^{226}Ra and ^{228}Ra), isotopic strontium (^{87}Sr and ^{86}Sr), trihalomethanes, benzene, toluene, ethyl benzene, xylenes (BTEX), diesel range organics (DRO), gasoline range organics (GRO), total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH) (including benzo(a)pyrene), and dissolved methane, propane, and ethane








NC Adaptions continued...

Wastewater Management

- Onsite pits must be lined
- Specified options for flowback water/produced water treatment:
 - Re-use in hydraulic fracturing
 - On-site pretreatments (presumably in pits?)
 - Disposal in plant installed for the purpose of disposing waste and permitted by the state
 - Disposal at an out-of-state plant that is permitted to accept wastewater from oil and gas operations

Renewables in NC



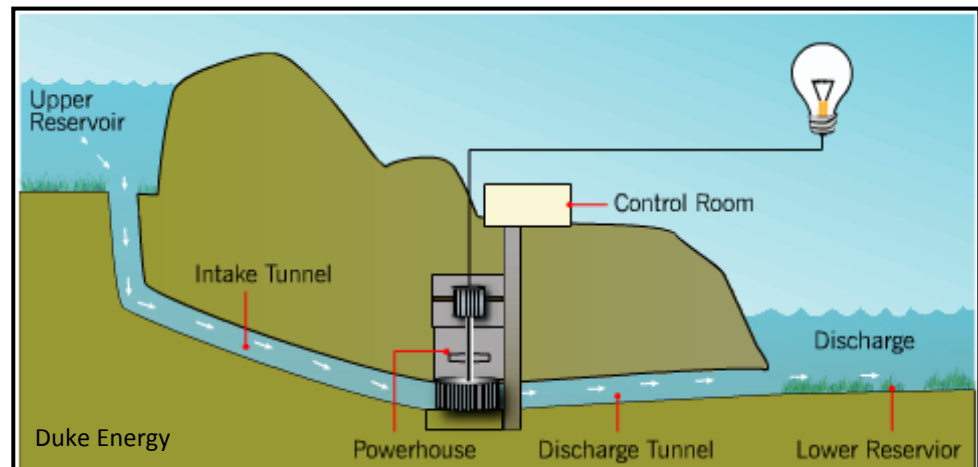
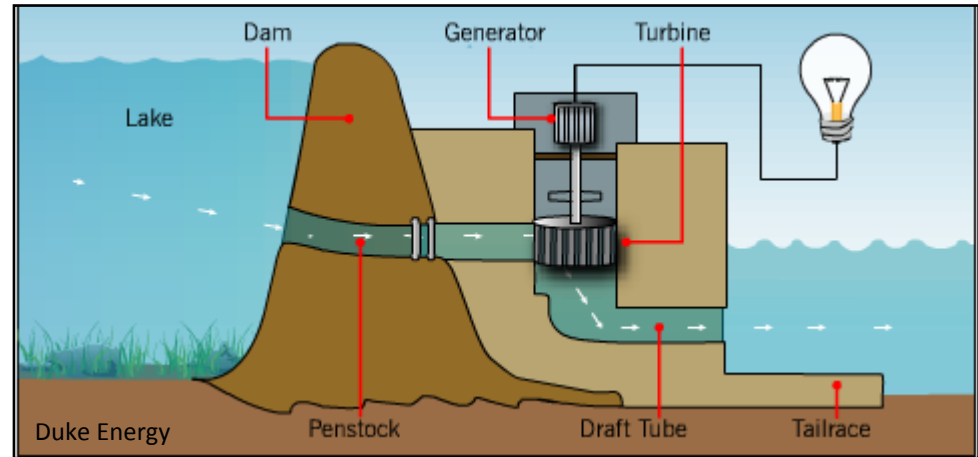
-  Solar Power Plant
-  Biomass Power Plant
-  Geothermal Power Plant
-  Hydroelectric Power Plant
-  Pumped Storage Power Plant
-  Wind Power Plant
-  Wood Power Plant

eia

Hydroelectric

North Carolina:

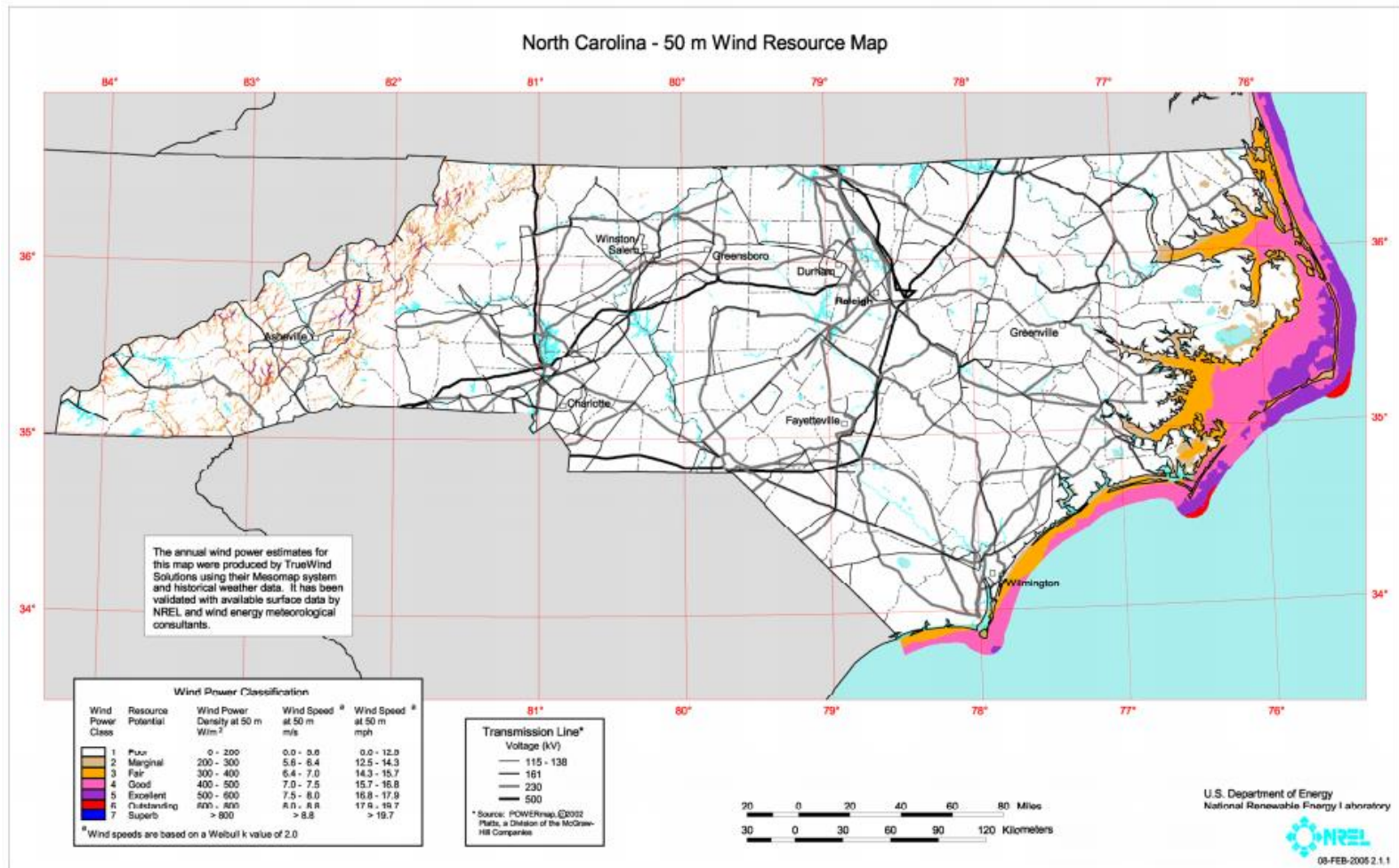
- 3-4% of total energy generation
- ~58% of renewable generation
- Currently used mainly to supply peaking power



Where is the Wind Power?

North Carolina Mountain Ridge Protection Act of 1983

-Intended to prevent unsightly development



Renewable Energy and Energy Efficiency Portfolio Standard

Adopted in 2007 with bipartisan support in the state house and senate

2021: 12.5% (including 0.20% from solar + 0.20% from swine waste + 900,000 MWh from poultry waste)

Who is paying for it?

Utilities may recover the incremental cost of renewable resources and up to \$1 million in alternative energy research expenditures annually from customers.

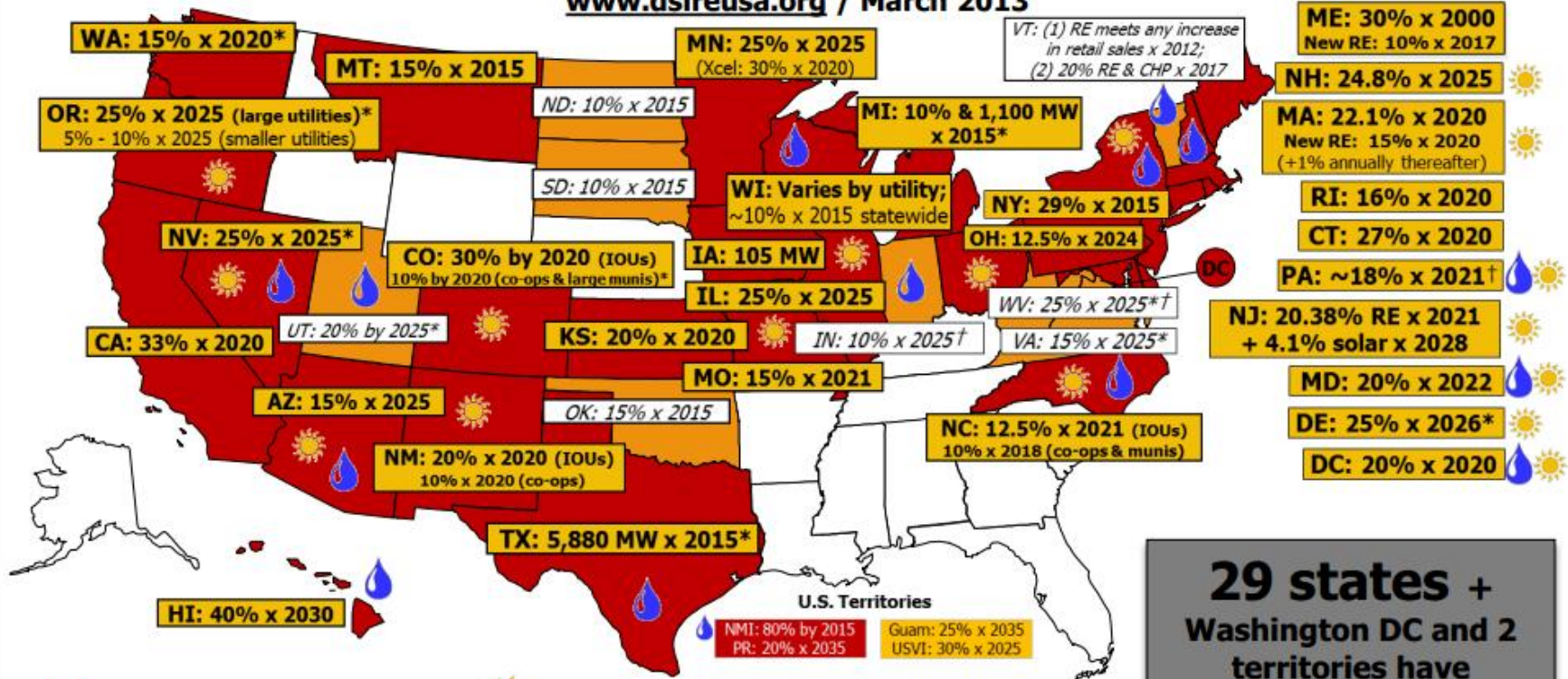
Maximum caps for cost recovery:

Sector	2008	2012	2015
Residential	\$10	\$12	\$34
Commercial	\$50	\$150	\$150
Industrial	\$500	\$1000	\$1000



Renewable Portfolio Standard Policies

www.dsireusa.org / March 2013



- Renewable portfolio standard
- Renewable portfolio goal
- 💧 Solar water heating eligible
- ☀️ Minimum solar or customer-sited requirement
- ✳️ Extra credit for solar or customer-sited renewables
- † Includes non-renewable alternative resources

29 states + Washington DC and 2 territories have Renewable Portfolio Standards
(8 states and 2 territories have renewable portfolio goals)

Solar Energy in NC

Locally

Company puts last panel on Durham County solar farm

May. 12, 2014 @ 06:22 PM



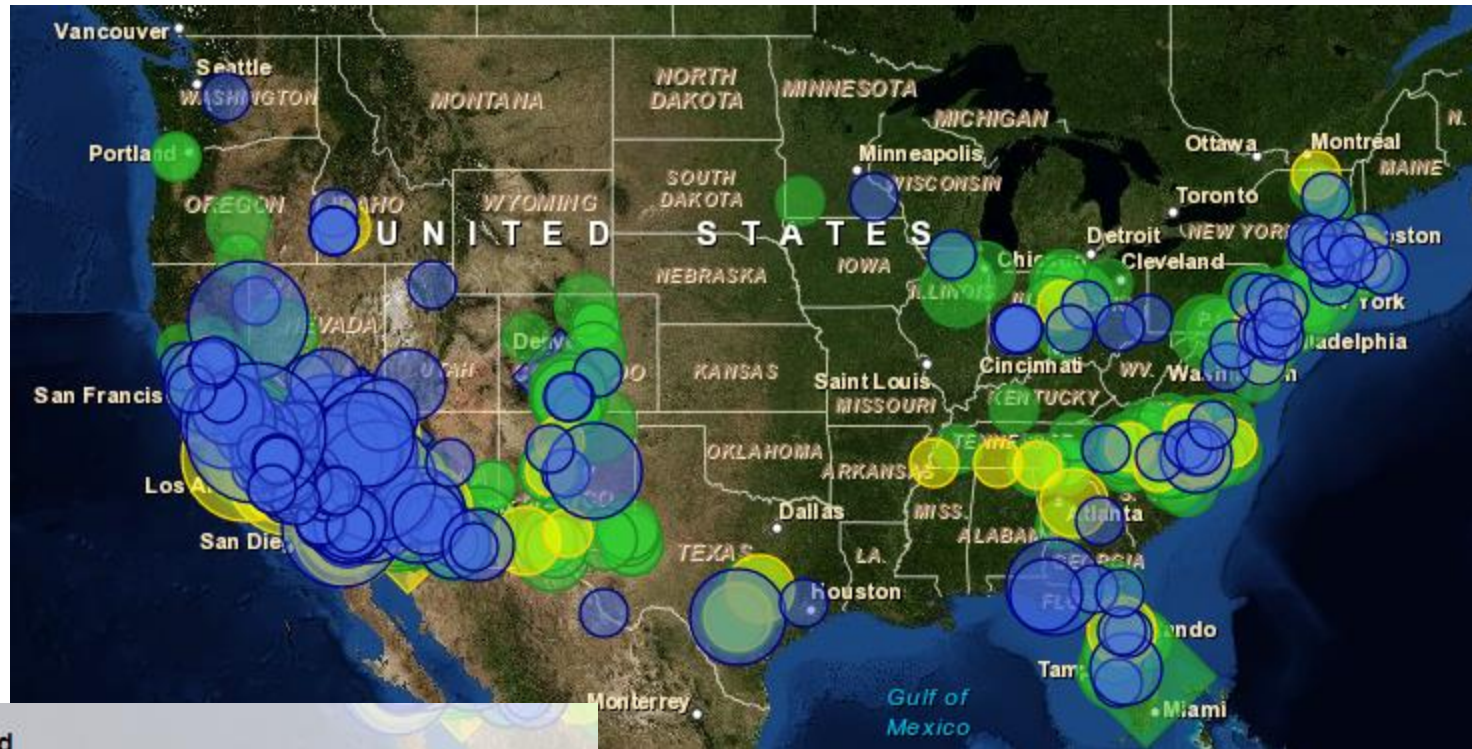
North Durham solar farm (Strata Solar)

- 5 MW (powers 750 homes), 43 acres
- Power will be sold to Duke Energy

State-wide

- North Carolina installed 335 MW of solar electric capacity in 2013
- Solar energy capacity (557 MW) is estimated to power 52,900 homes
- Currently ranked 3rd nationwide in solar electric capacity


Major Solar Projects (1 MW+) in the U.S.





Legend


Photovoltaic projects (PV)


Concentrating Solar Power (CSP)


 PV Operating

 CSP Operating

 PV Under Construction

 CSP Under Construction

 PV Under Development

 CSP Under Development

Sizes indicate the system's power-generating capacity.

Last updated: May 2013

Send additions or corrections to research@seia.org

Biomass Case Study: Pig Poop to Energy



Lloyd Ray Farms System

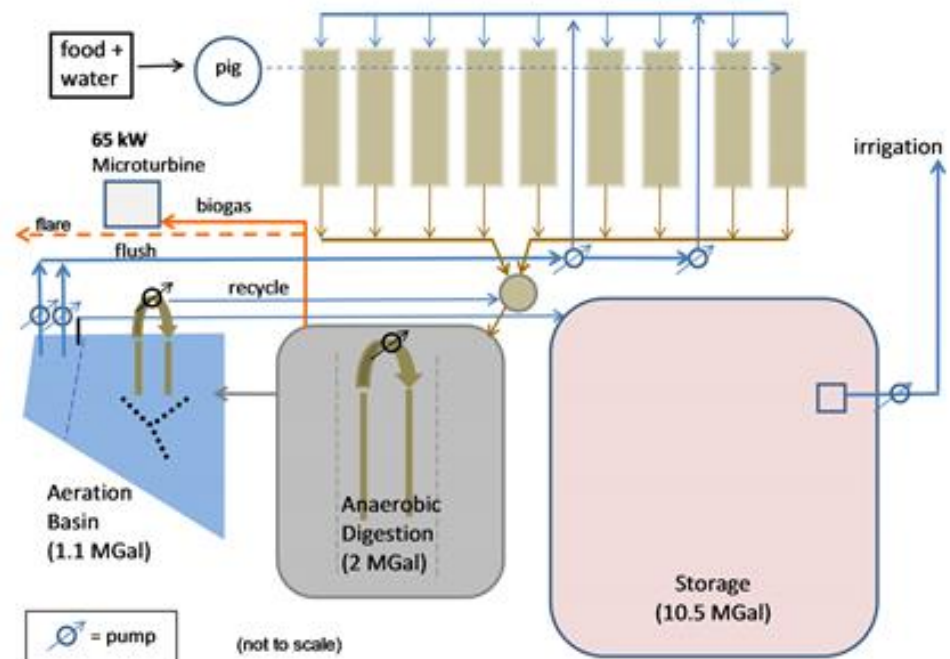
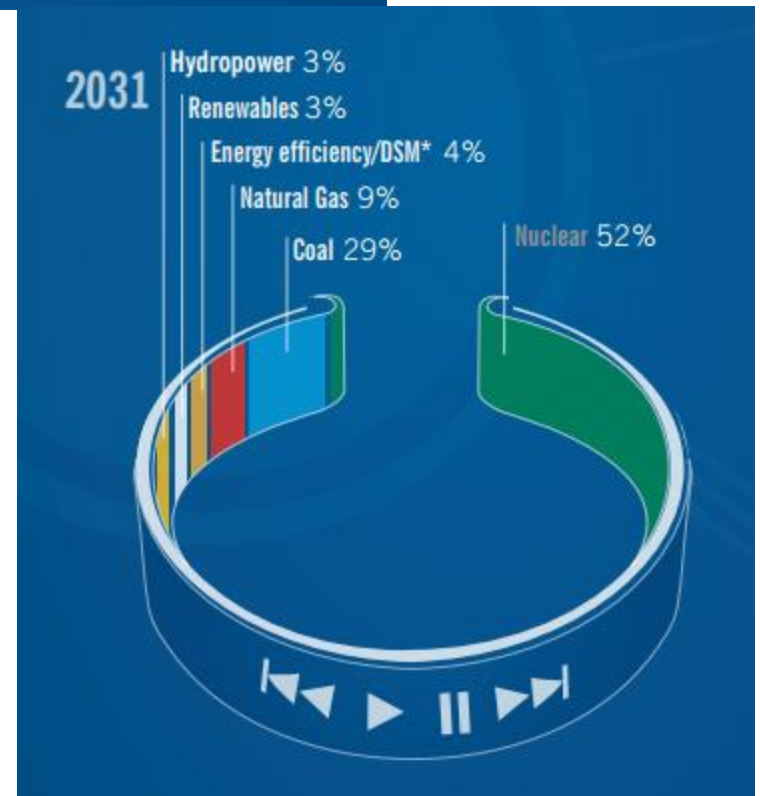
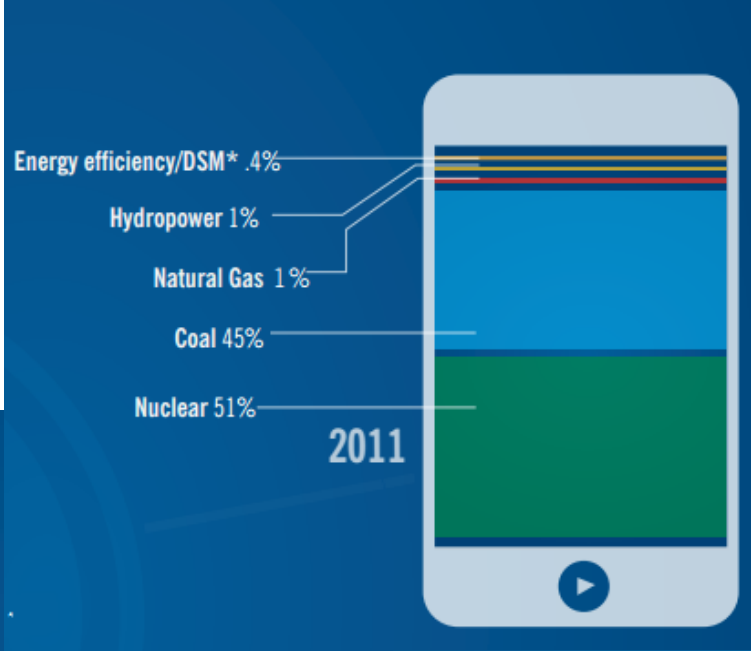
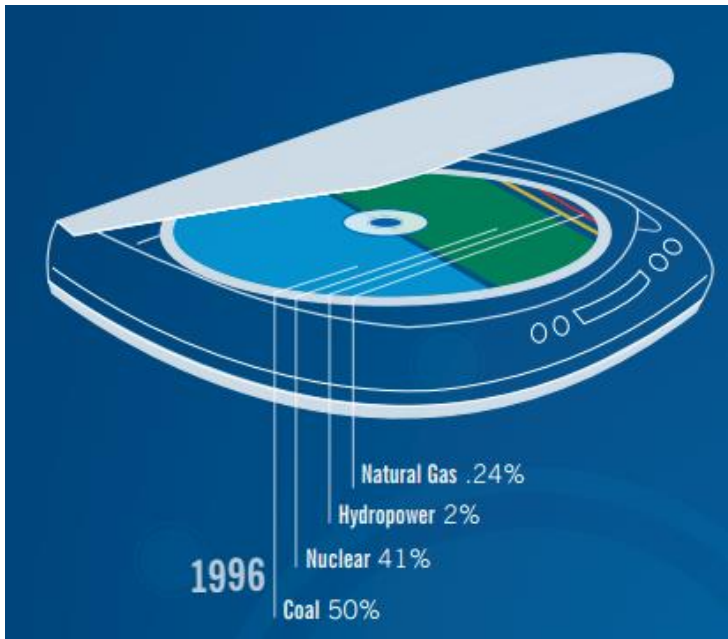


Photo and Diagram Credits: Marc Deshusses, Duke University

Duke Univ., Google, and Duke Energy
Collaboration

Lloyd Ray Farms in Booneville, NC in the
Yadkin Valley

- 8600 pigs
- 400,000 gallons of liquid hog waste treated each week
- Captured methane is used to turn a turbine to generate electricity
- System creates carbon offsets (destruction of methane) that are shared between Duke Univ. and Google



Duke Energy's Changing Energy Mix

Closing thoughts...