

Kentucky Coal

Past, Present, and Future

Presentation to the
Northern Kentucky University Chase Law School
University of Cincinnati College of Law
Symposium on the Future of Coal
March 27th, 2014

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Kentucky Energy and Environment Cabinet
Department for Energy Development and Independence
502-564-7192

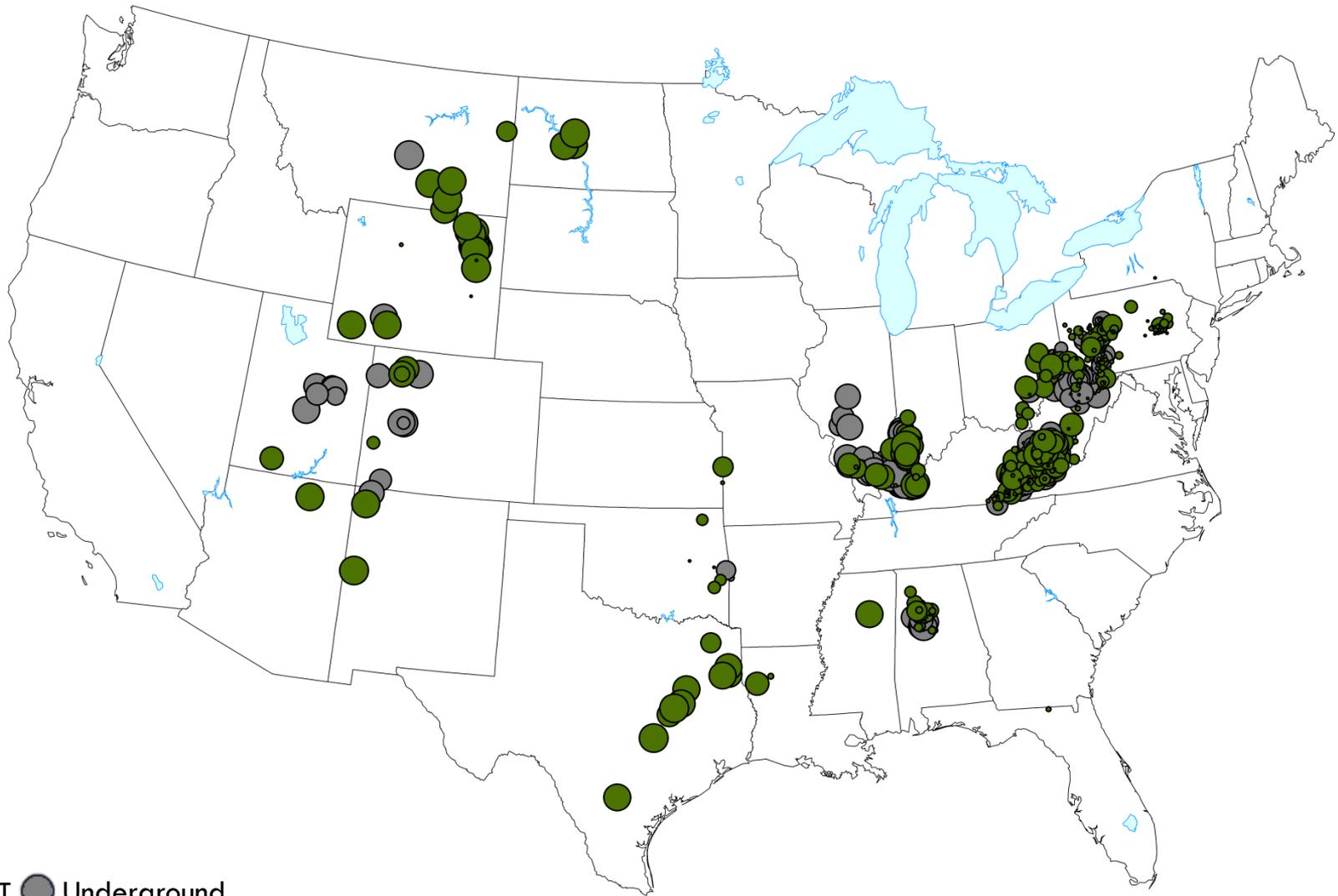
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Website: energy.ky.gov

Overview

- **Trends in Kentucky Coal Production, Markets, & Employment:** *Declining*
- **Kentucky's Electricity Portfolio Today:** *Coal*
- **Kentucky's Future Electricity Portfolio:** *Natural Gas*
- **The Significance of Electricity to Kentucky:** *Manufacturing*

Kentucky Coal Production & Employment

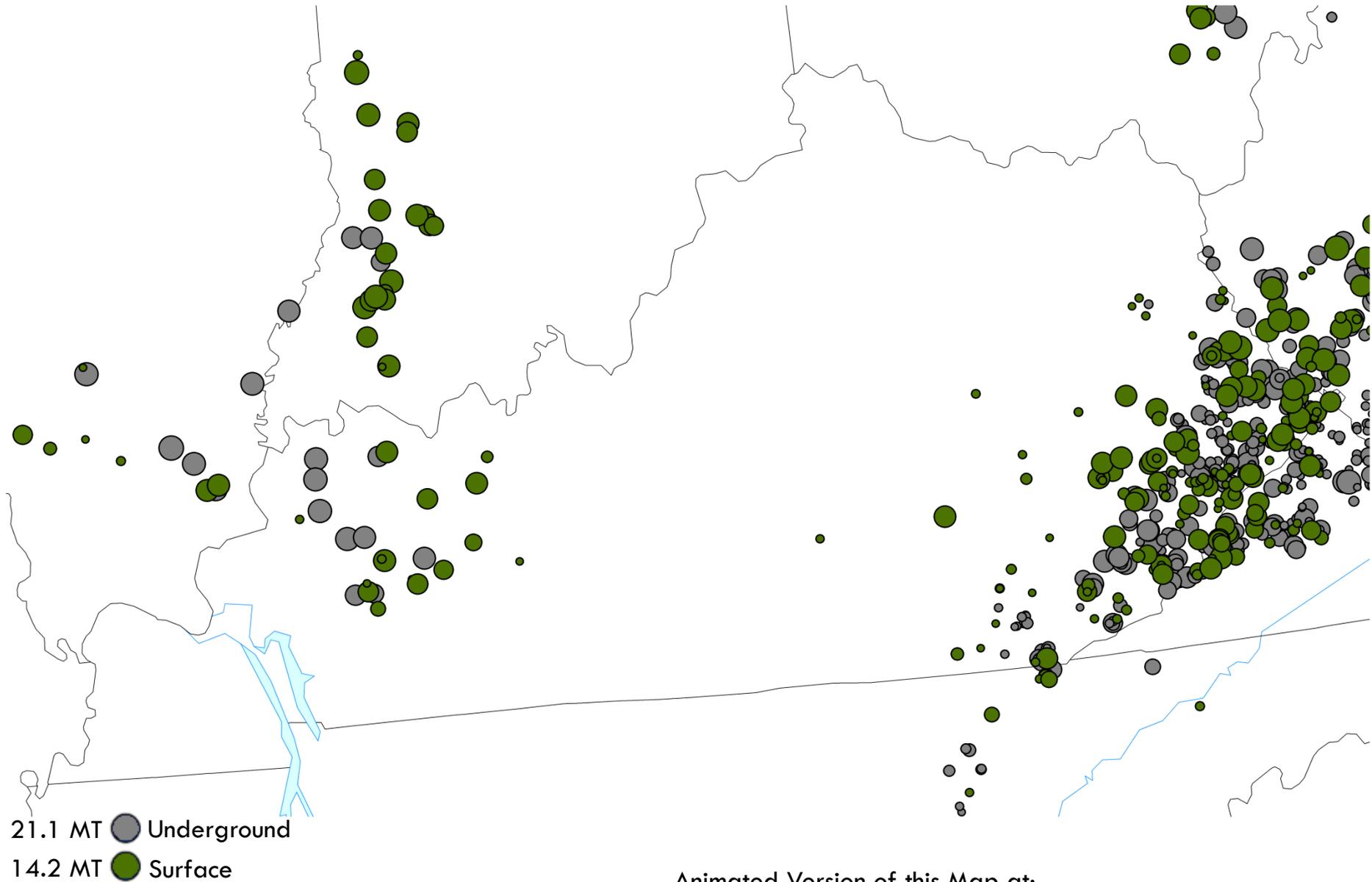
United States Coal Production, Q4-2013



80.2 MT  Underground

157.8 MT  Surface

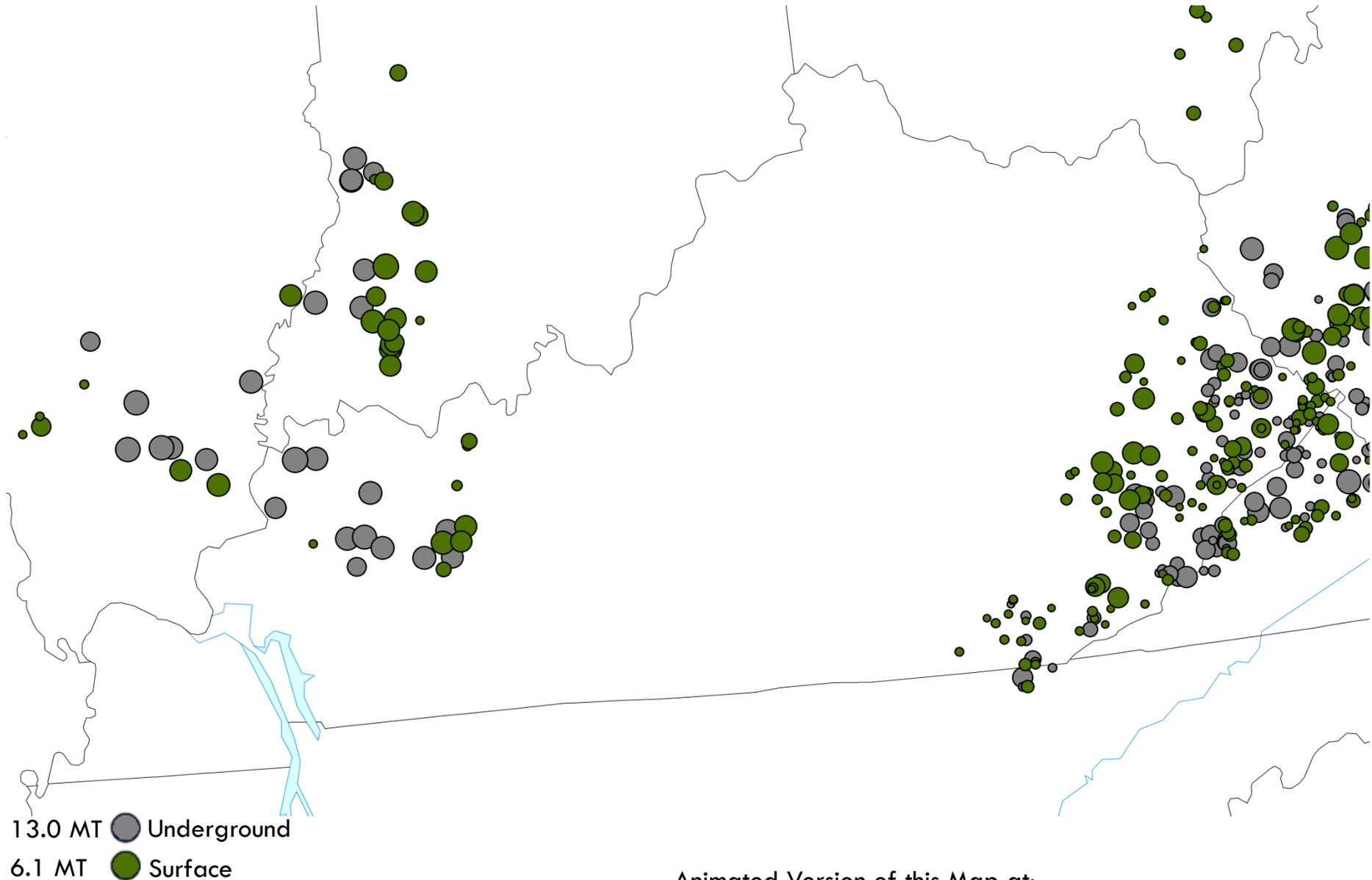
Kentucky Coal Production, Q1-2000



Animated Version of this Map at:

<http://youtu.be/1JckUUTSsA>

Kentucky Coal Production, Q4-2013

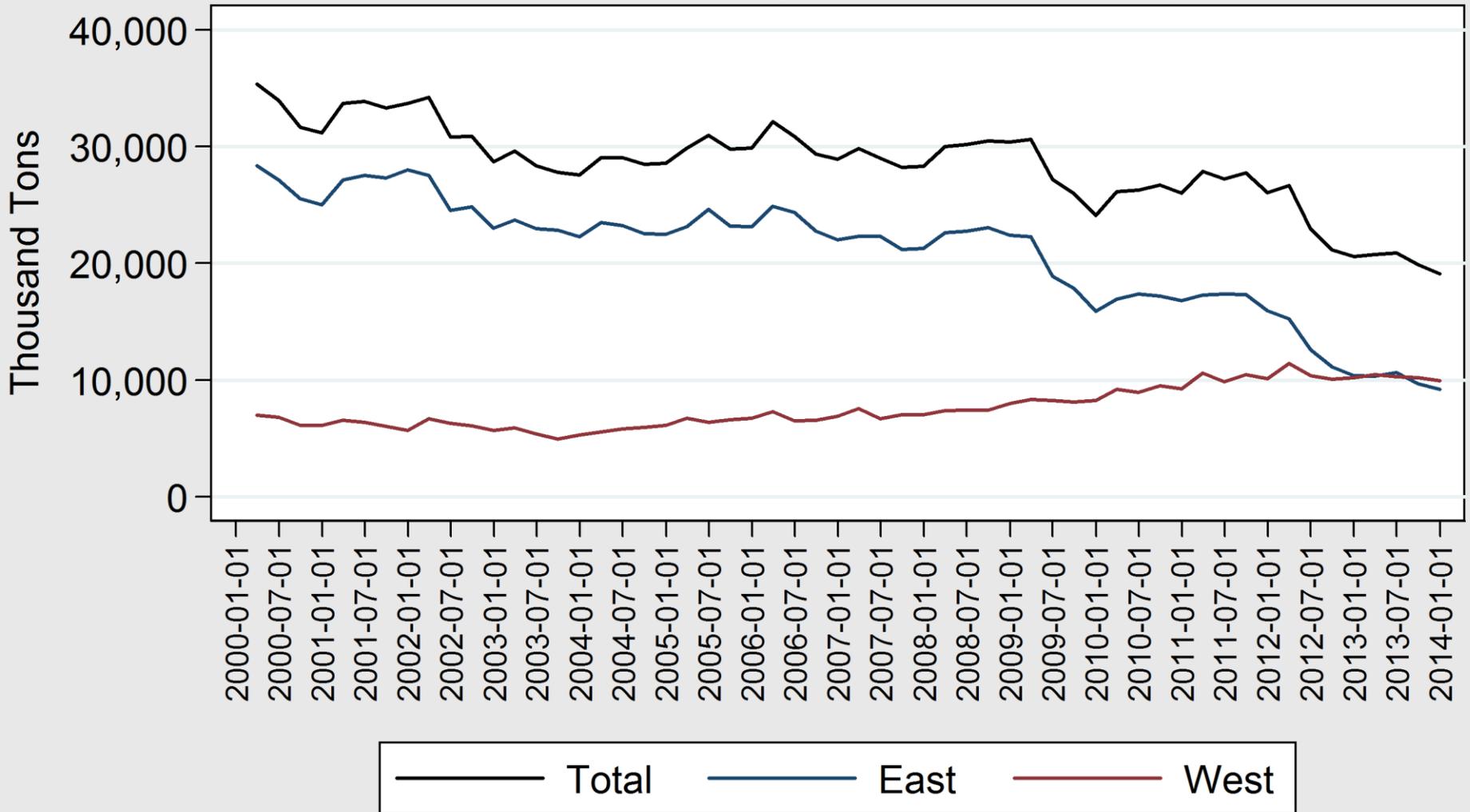


Animated Version of this Map at:

<http://youtu.be/1JckUUTSsA>

Kentucky Quarterly Coal Production, 2000-2013

Eastern Kentucky vs. Western Kentucky

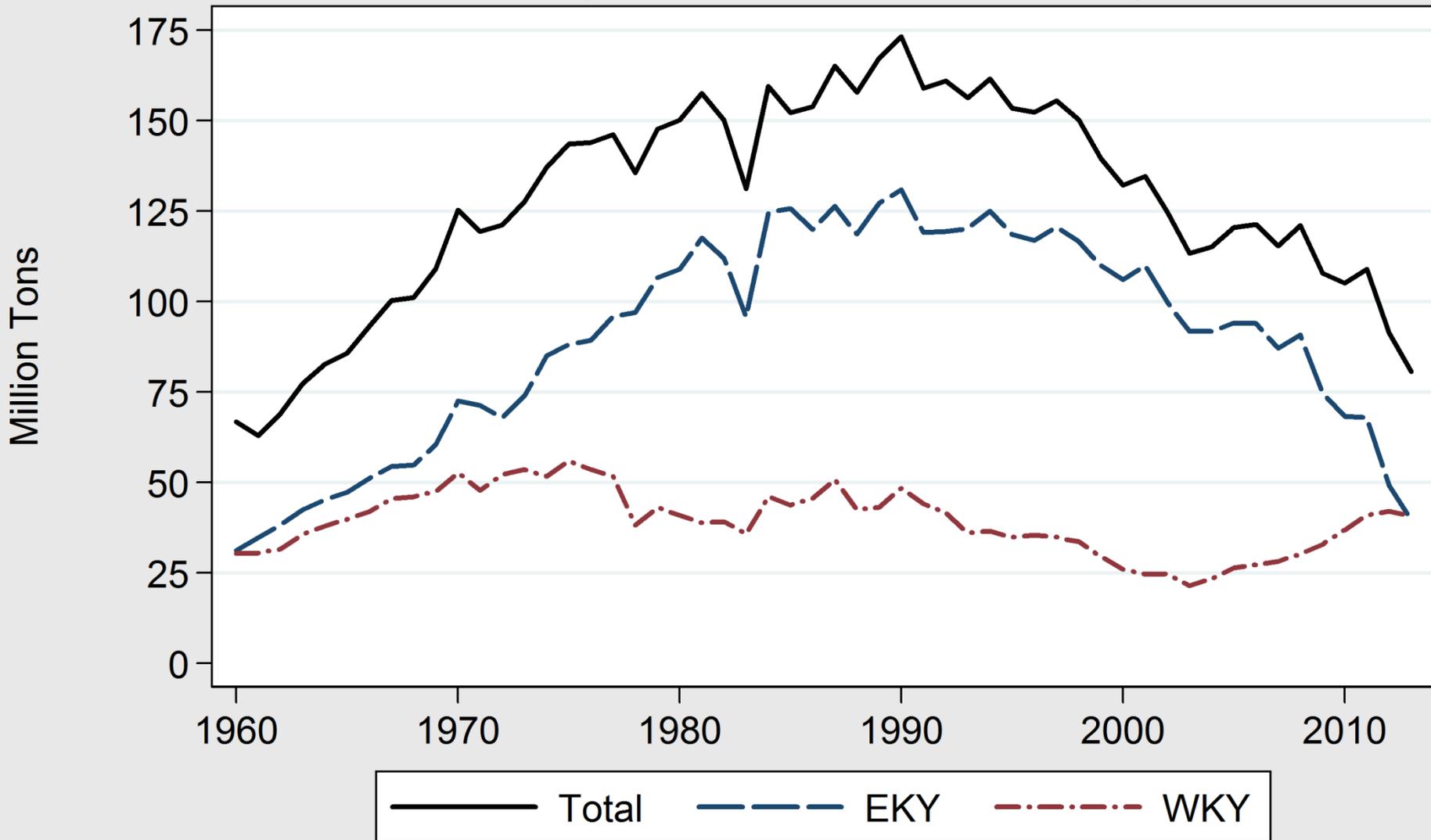


Kentucky Energy Database, EEC-DEDI, 2014

Microdata Source: MSHA-MDRS Queried on: 5 Feb 2014

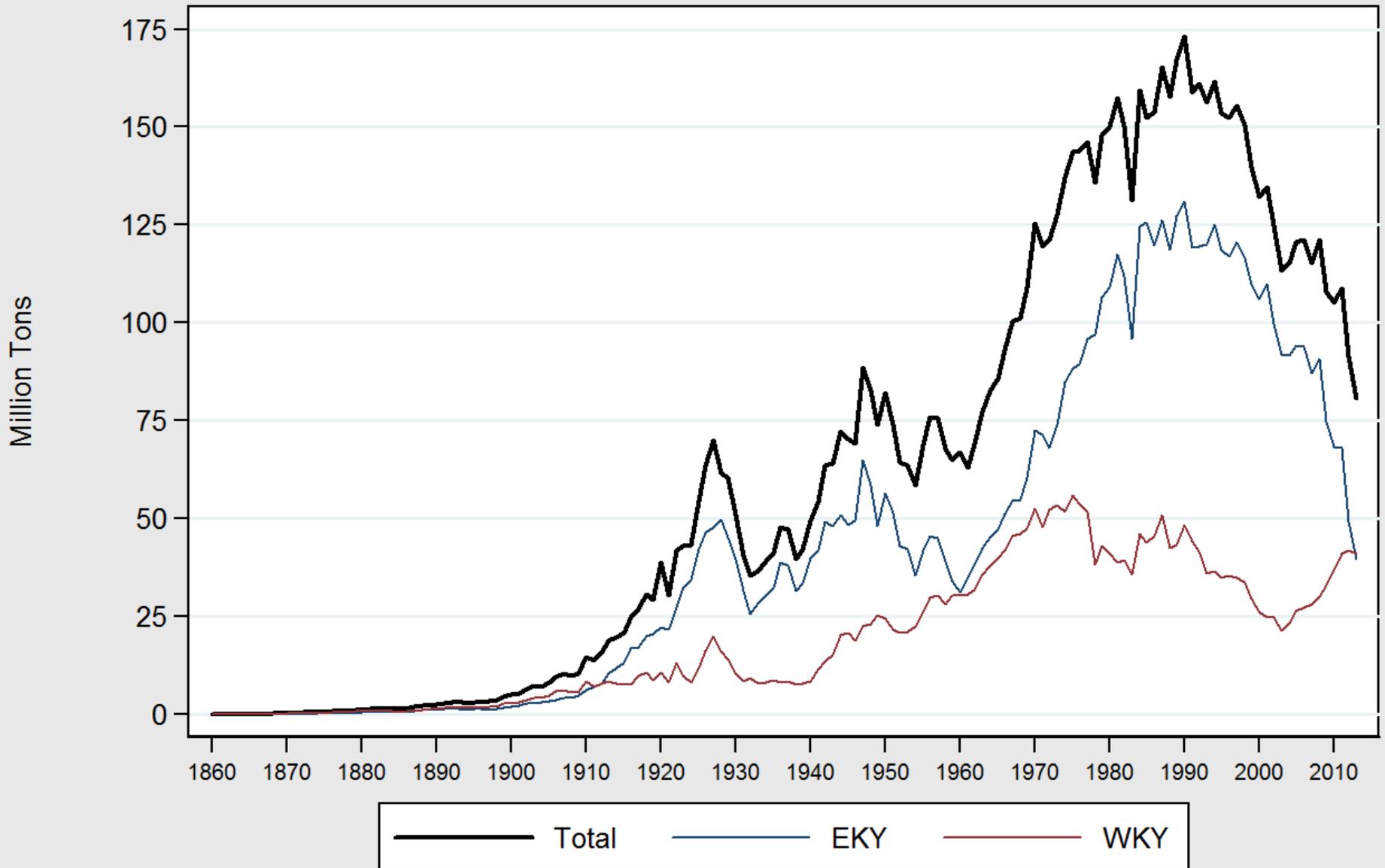
Kentucky Total Coal Production, 1960-2013

Eastern Kentucky Production & Western Kentucky Production



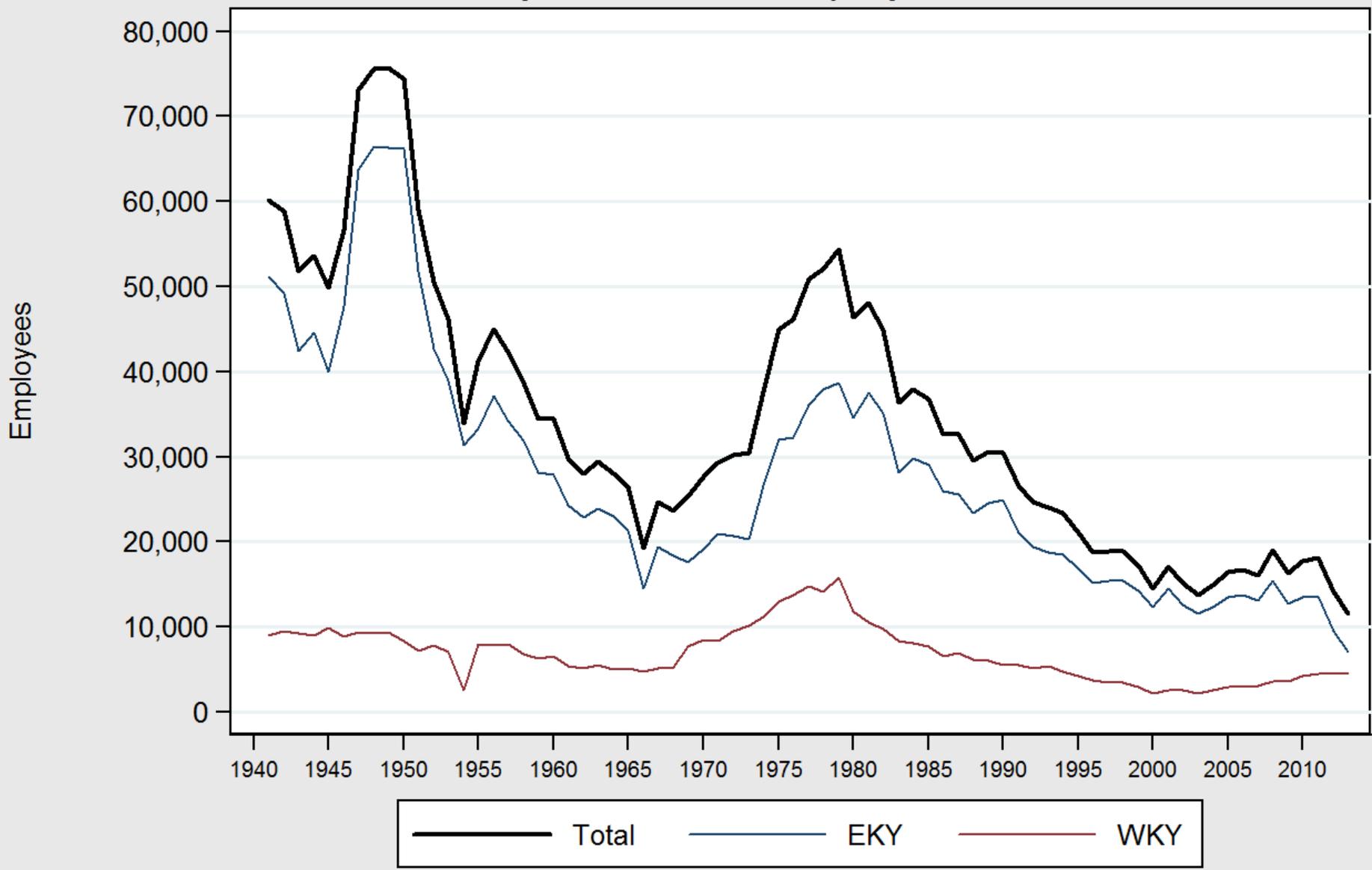
Kentucky Energy Database, EEC-DEDI, 2014

Kentucky Coal Production, 1860-2013



Kentucky Energy Database, EEC-DEDI, 2014

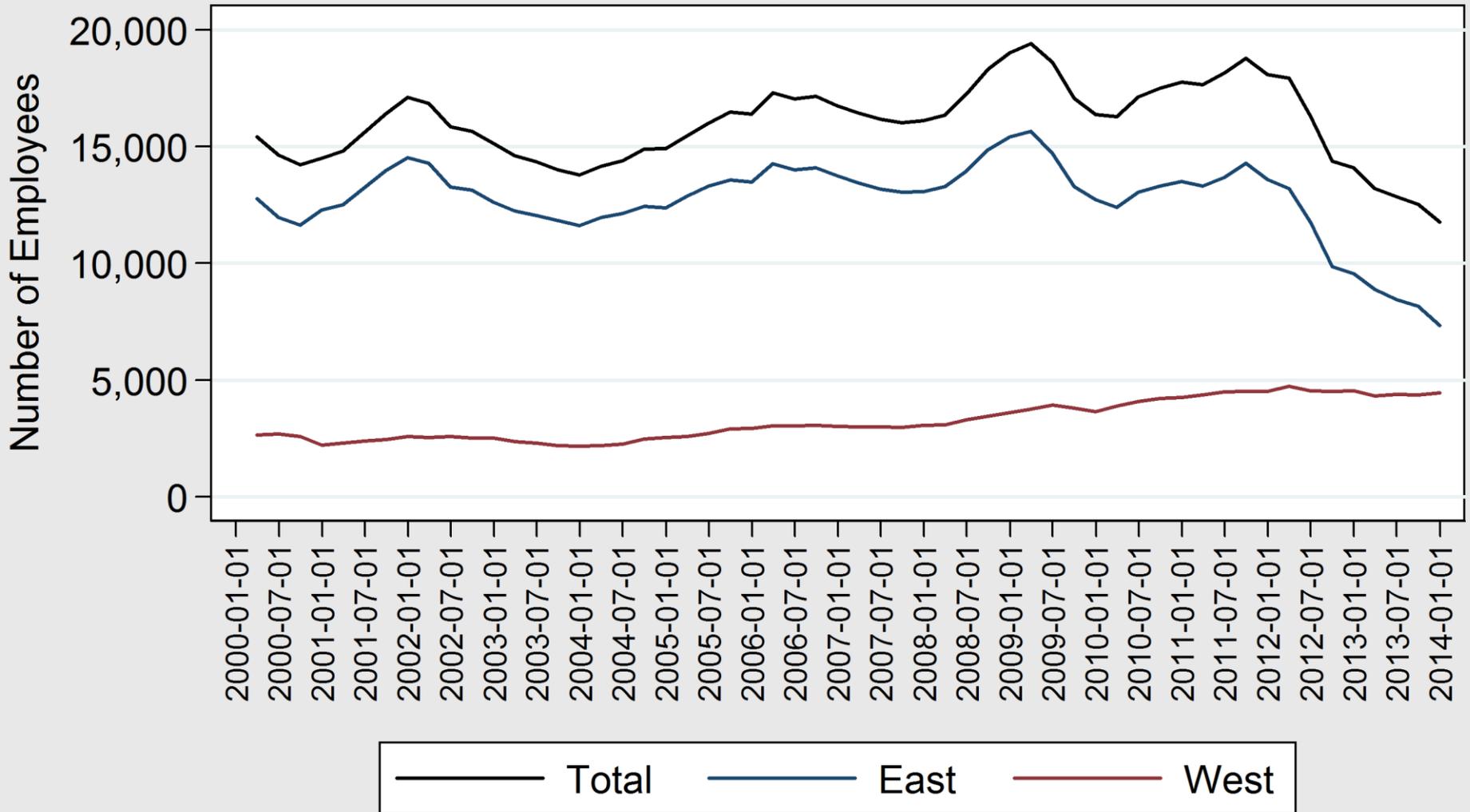
Kentucky Coal Mine Employment, 1940-2013



Kentucky Energy Database, EEC-DEDI, 2014

Kentucky Quarterly Coal Mine Employment, 2000-2013

Eastern Kentucky vs. Western Kentucky

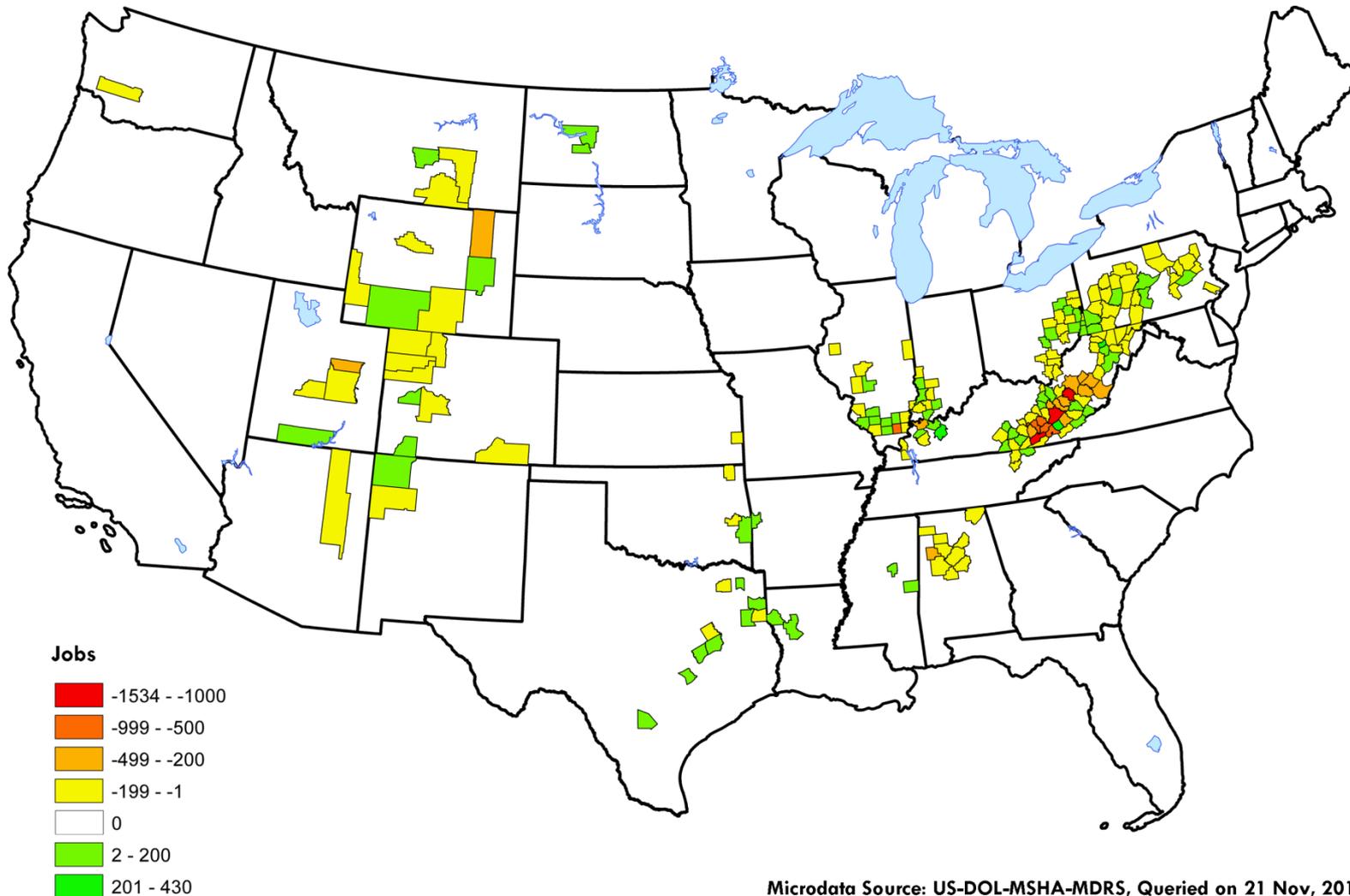


Kentucky Energy Database, EEC-DEDI, 2014

Microdata Source: MSHA-MDRS Queried on: 28 Feb 2014

Change in Coal Mine Employment

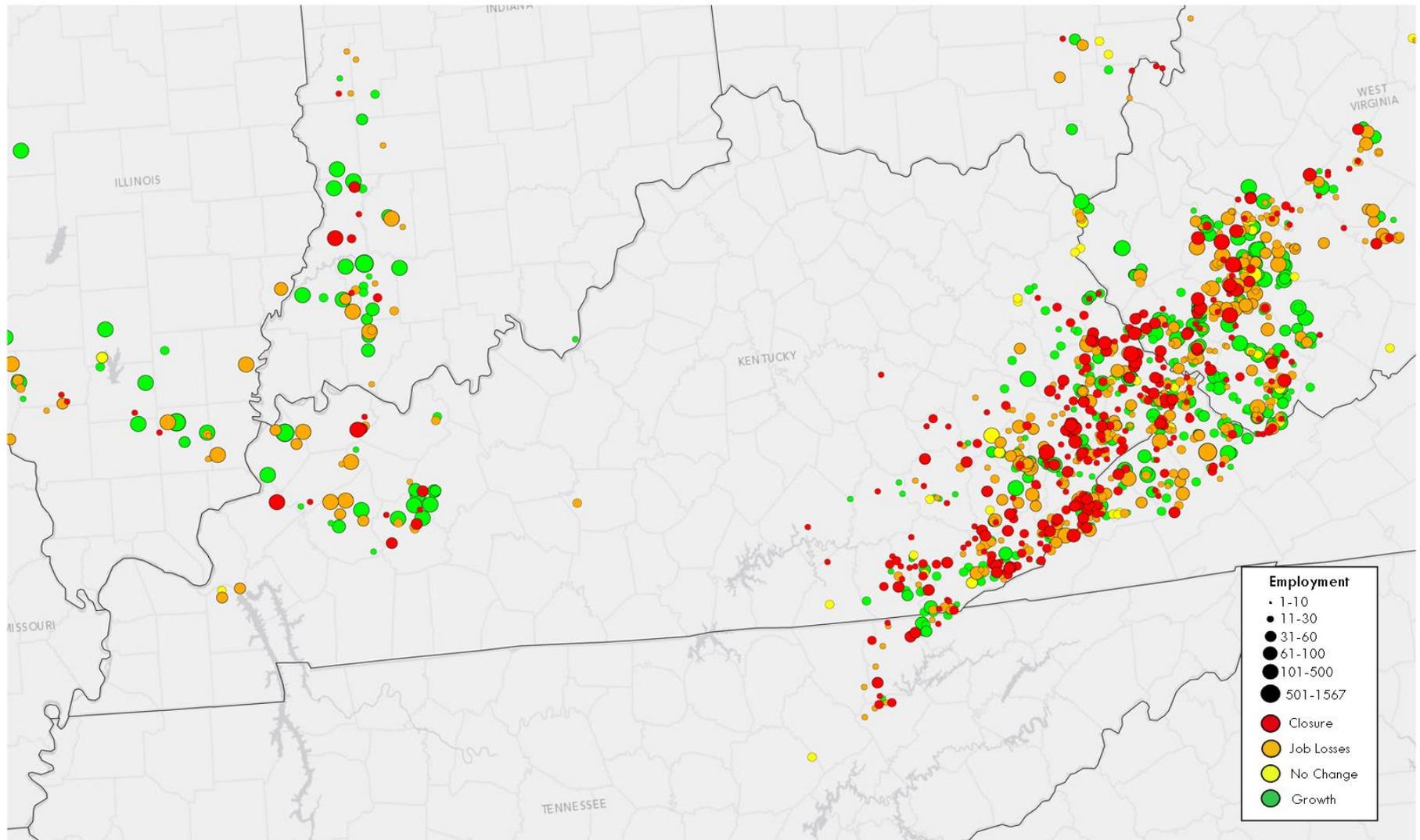
Q3-2011 — Q3-2013



Microdata Source: US-DOL-MSHA-MDRS, Queried on 21 Nov, 2013

Map by the Kentucky Energy and Environment Cabinet, 2013

Change in Coal Production Employment by Mine, Q3-2011 to Q3-2013

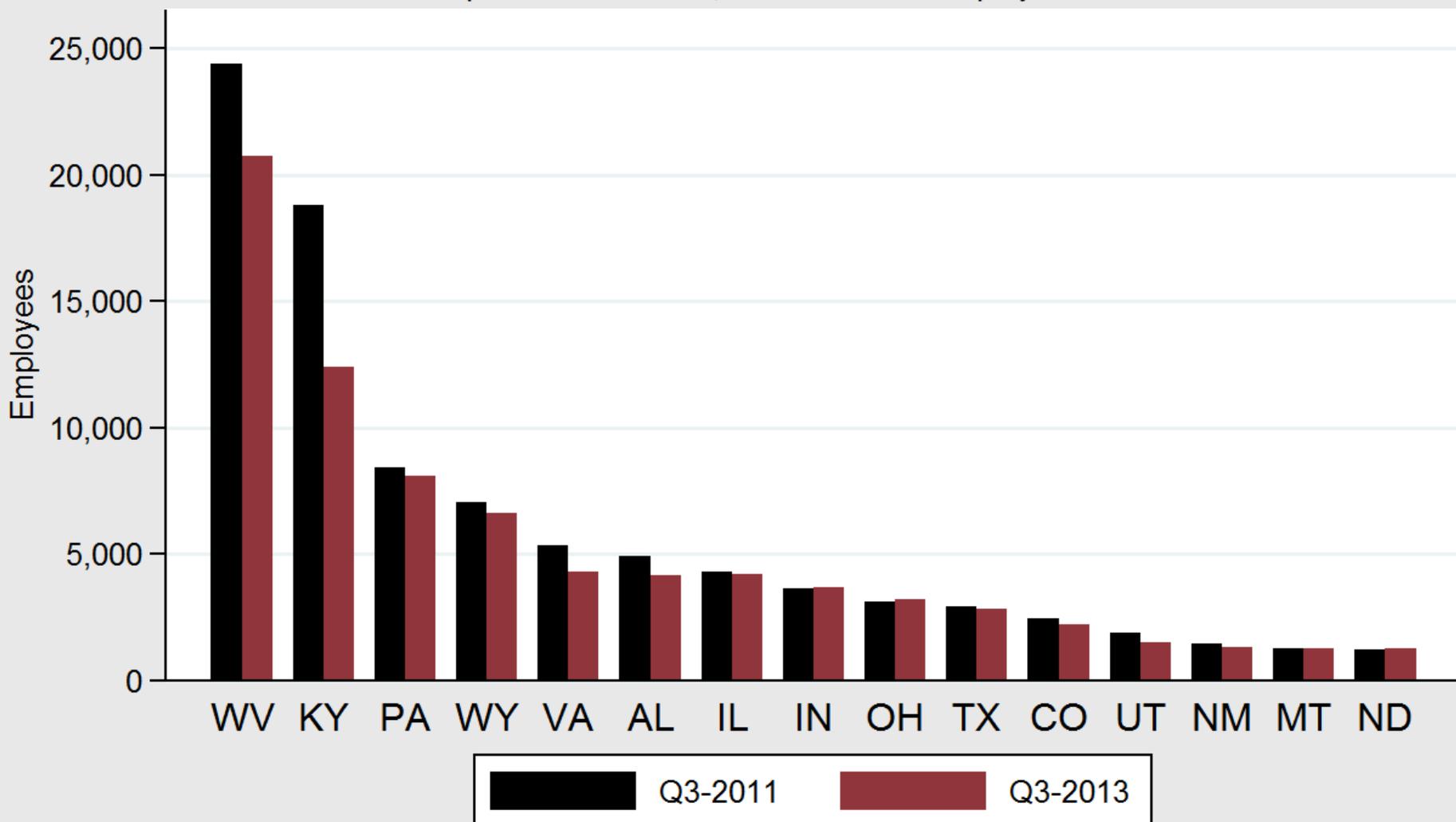


Note: Some coal mines are not visible because of their physical proximity to one-another.

Kentucky Energy Database, EEC-DEDI, 2013
Microdata Source: MSHA-MDRS, Queried 11/15/2013

United States Coal Mine Employment by State, Q3-2011 vs. Q3-2013

Top 15 States with 1,000 Coal Mine Employees or More

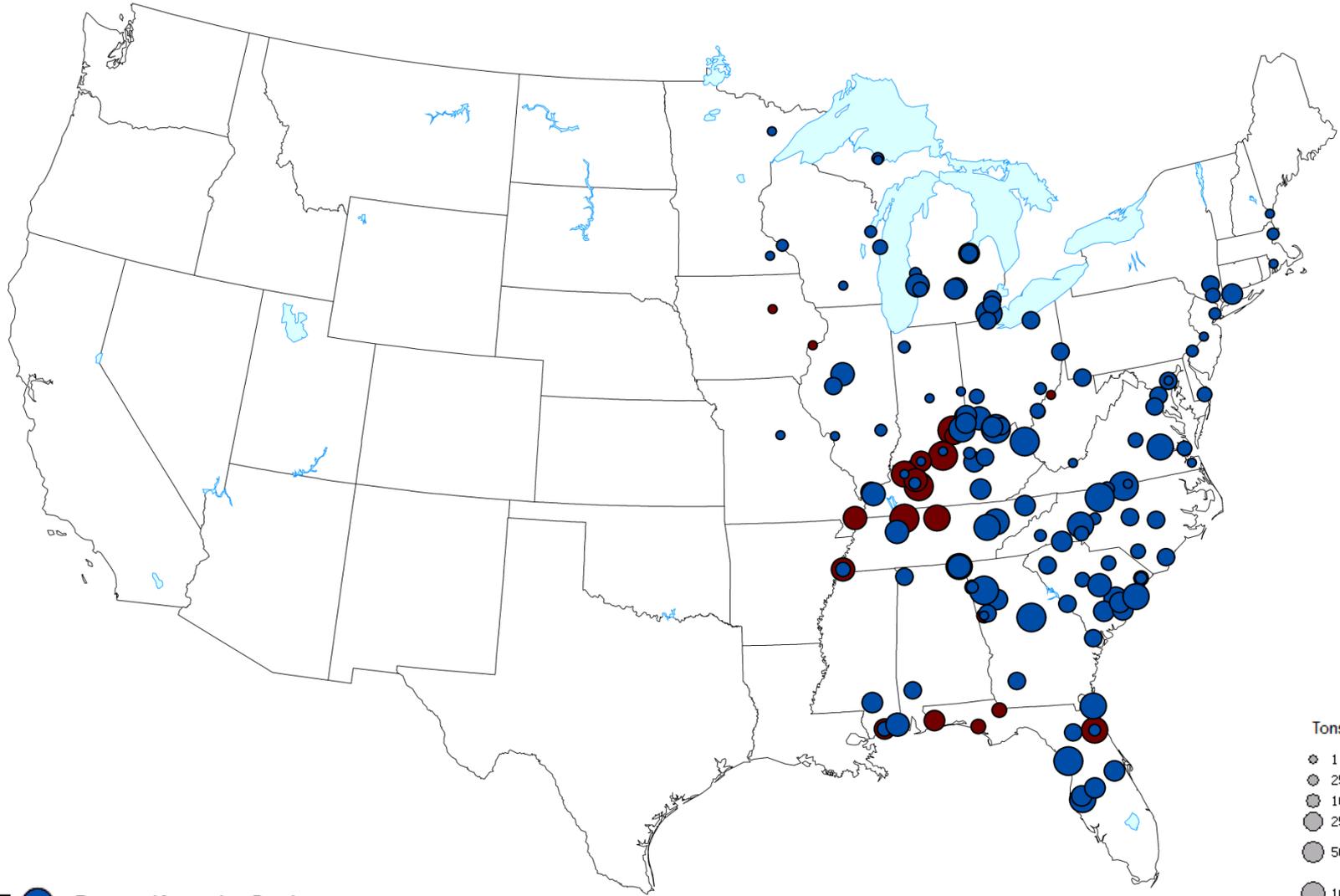


Kentucky Energy Database, EEC-DEDI, 2013

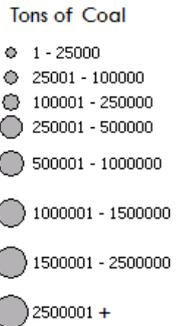
Microdata Source: MSHA-MDRS, Queried on: 21 Nov 2013

Kentucky Coal Markets

Kentucky Coal Deliveries, 1990

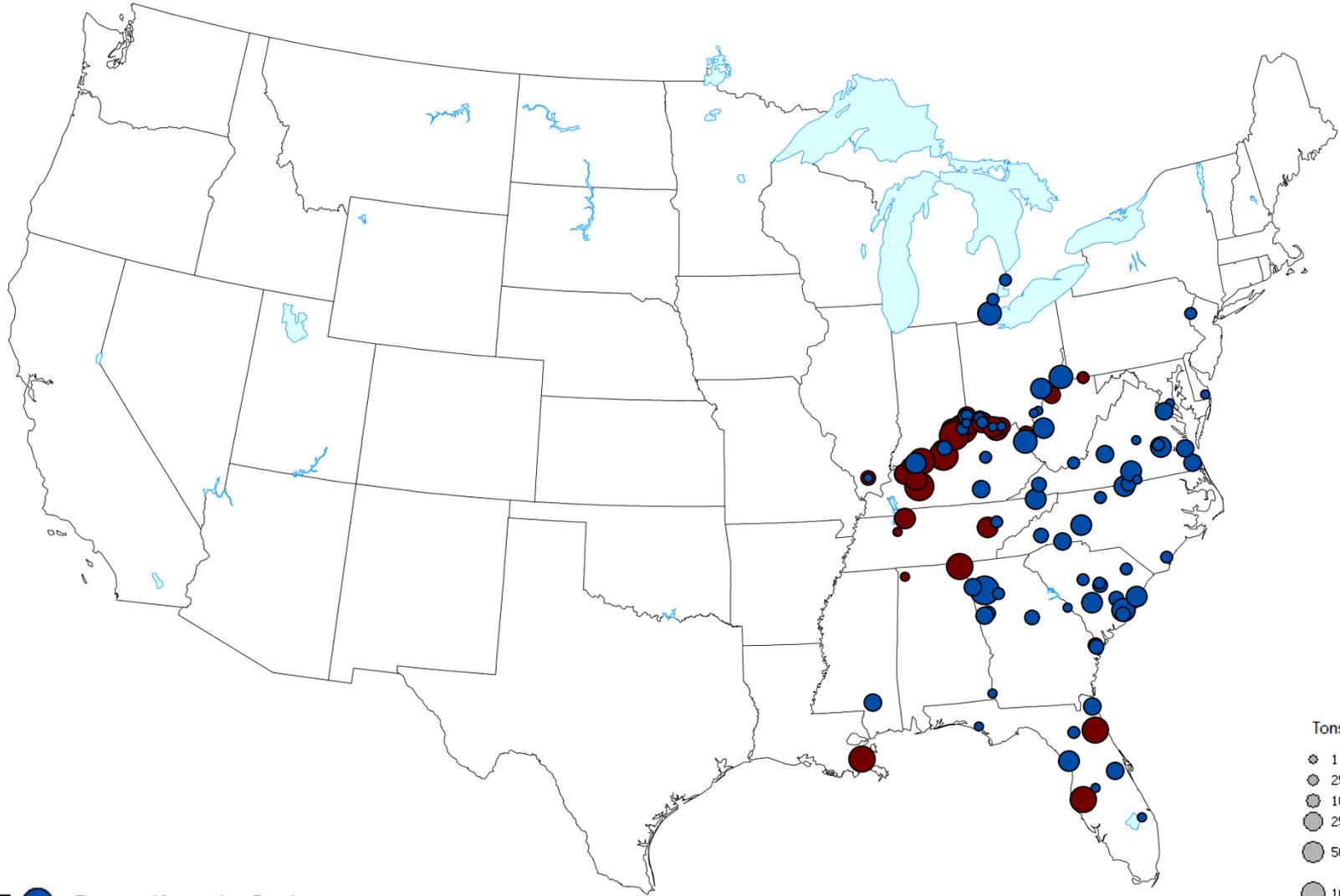


85.2 MT ● Eastern Kentucky Coal
43.6 MT ● Western Kentucky Coal



Animated Version of this Map at:
<http://youtu.be/ofNBO8g9xuo>

Kentucky Coal Deliveries, 2013



23.7 MT  Eastern Kentucky Coal
38.3 MT  Western Kentucky Coal

Tons of Coal

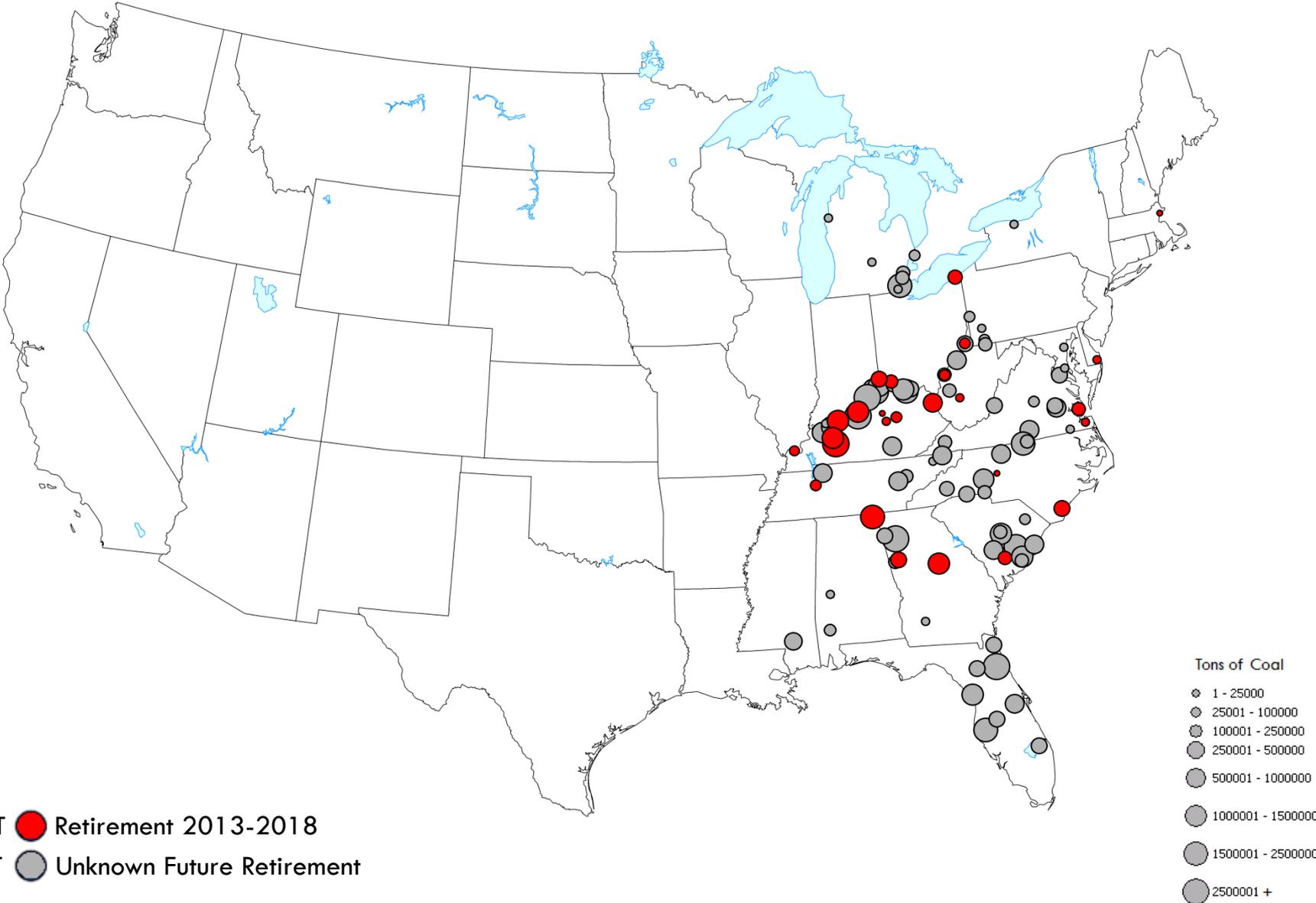
-  1 - 25000
-  25001 - 100000
-  100001 - 250000
-  250001 - 500000
-  500001 - 1000000
-  1000001 - 1500000
-  1500001 - 2500000
-  2500001 +

Animated Version of this Map at:

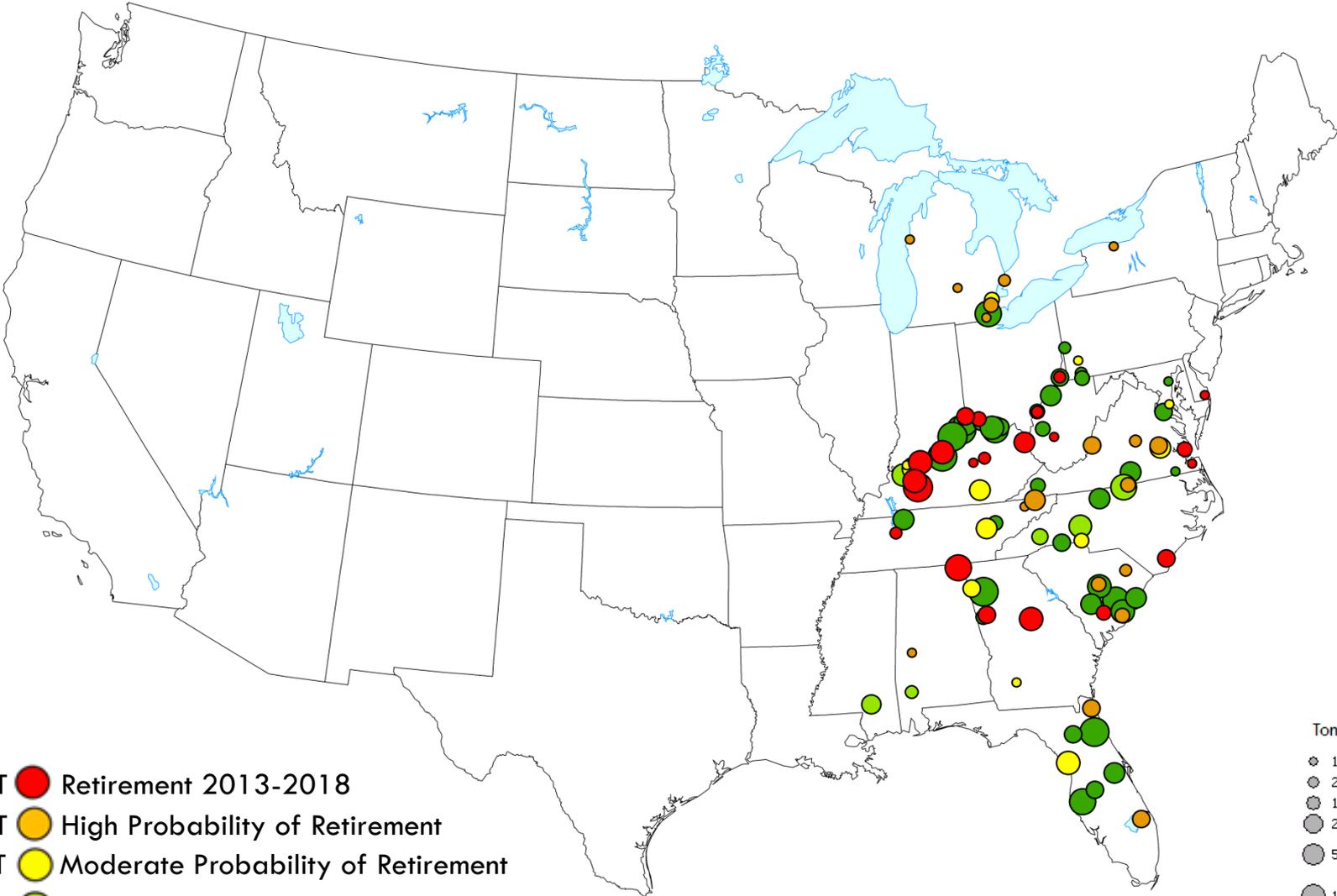
<http://youtu.be/ofNBO8g9xuo>

energy.ky.gov

Kentucky Coal Deliveries & Future Retirements, 2012



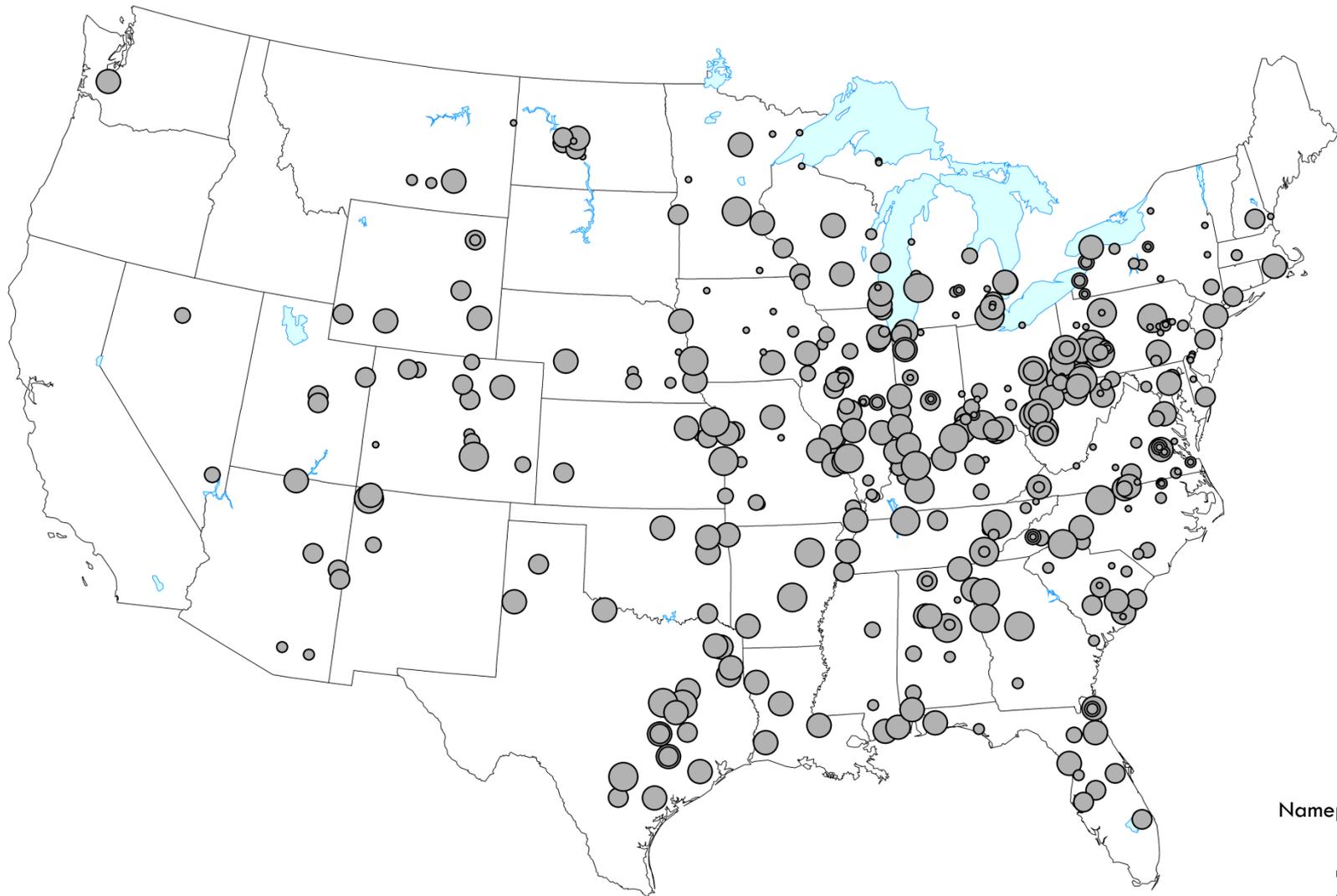
Kentucky Coal Deliveries & Future Retirements, 2012



- 15.4 MT Retirement 2013-2018
- 3.3 MT High Probability of Retirement
- 5.2 MT Moderate Probability of Retirement
- 3.5 MT Retirement Unlikely
- 40+ MT Retirement Highly Unlikely

- Tons of Coal
- 1 - 25000
 - 25001 - 100000
 - 100001 - 250000
 - 250001 - 500000
 - 500001 - 1000000
 - 1000001 - 1500000
 - 1500001 - 2500000
 - 2500001 +

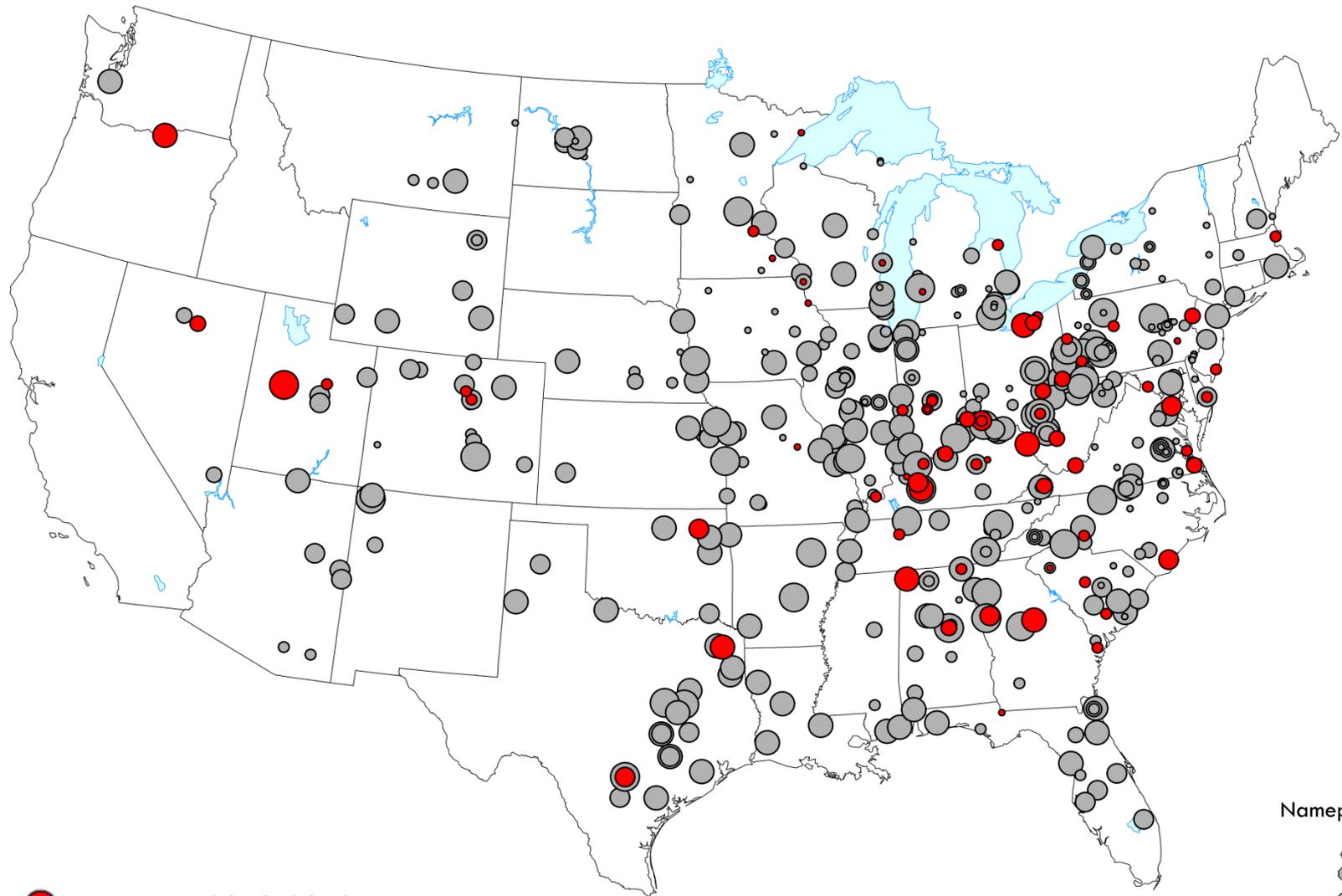
United States Coal-Fired Power Plants, 2012



Nameplate Capacity

- ◇ 2 - 100
- 101 - 200
- 201 - 300
- 301 - 500
- 501 - 800
- 801 - 1300

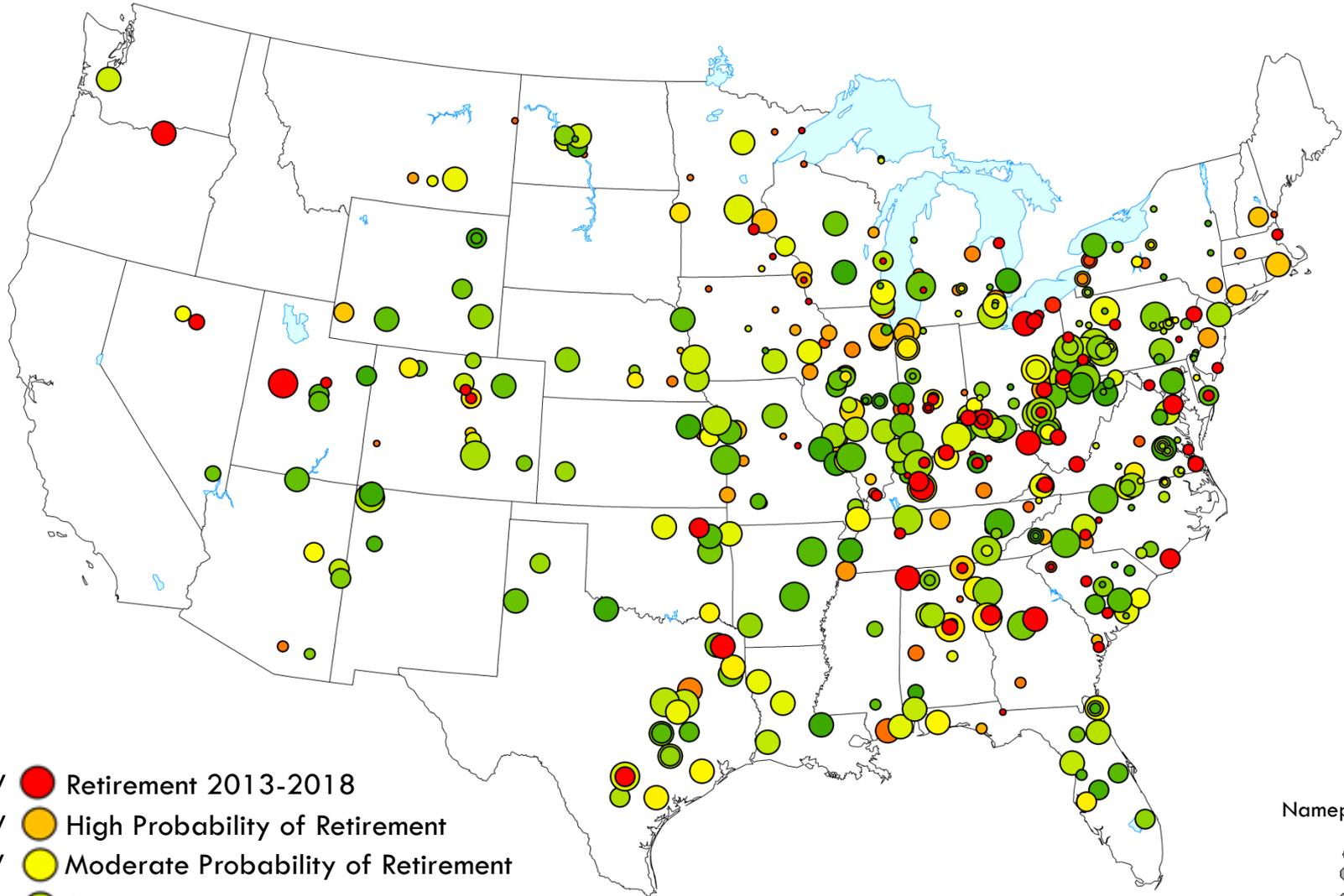
United States Coal-Fired Power Plants, 2012



33 GW ● Retirement 2013-2018
312 GW ● Unknown Future Retirement

Nameplate Capacity
◆ 2 - 100
● 101 - 200
● 201 - 300
● 301 - 500
● 501 - 800
● 801 - 1300

United States Coal-Fired Power Plants, 2012



- 33 GW Retirement 2013-2018
- 18 GW High Probability of Retirement
- 30 GW Moderate Probability of Retirement
- 25 GW Retirement Unlikely
- 237 GW Retirement Highly Unlikely

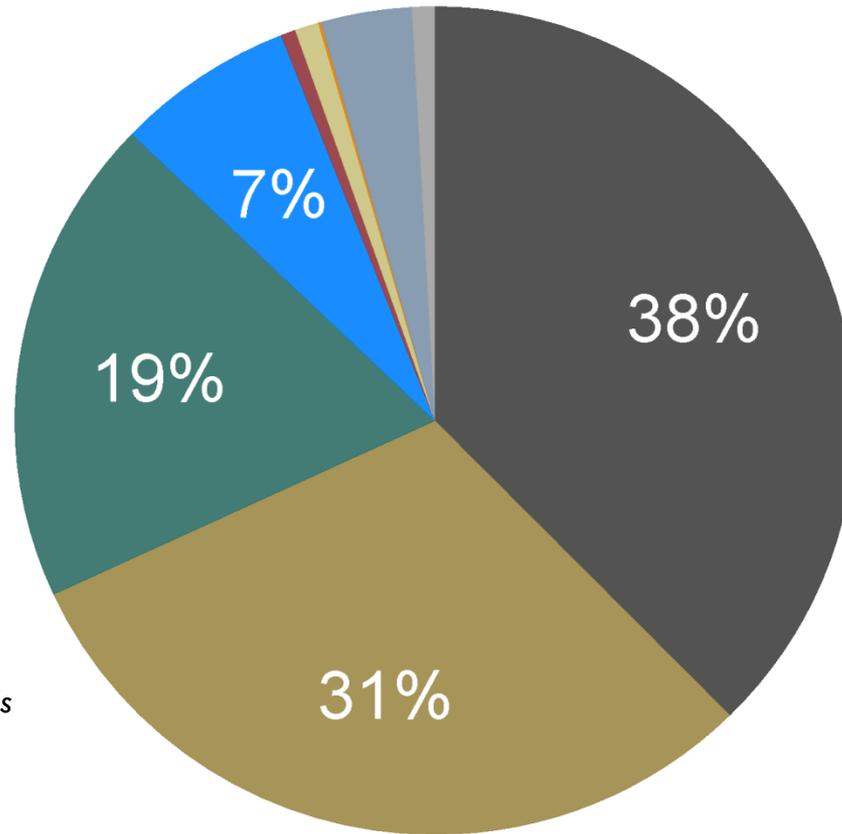
- Nameplate Capacity
- 2 - 100
 - 101 - 200
 - 201 - 300
 - 301 - 500
 - 501 - 800
 - 801 - 1300

A Quick Introduction to

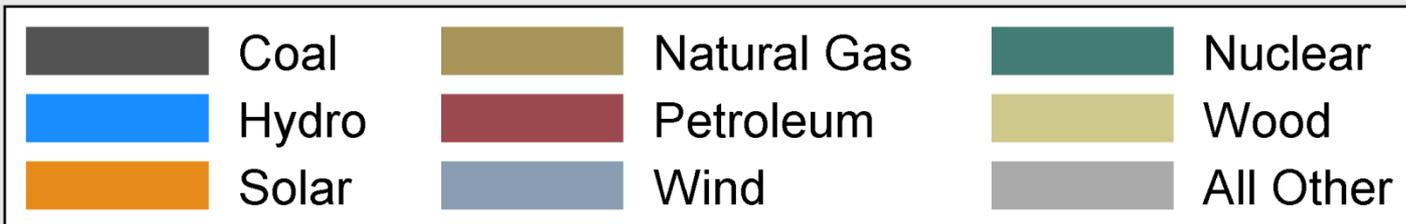
Kentucky's Electricity Portfolio

United States Electricity Generation, 2012

Electricity Generation by Fuel Type (%)

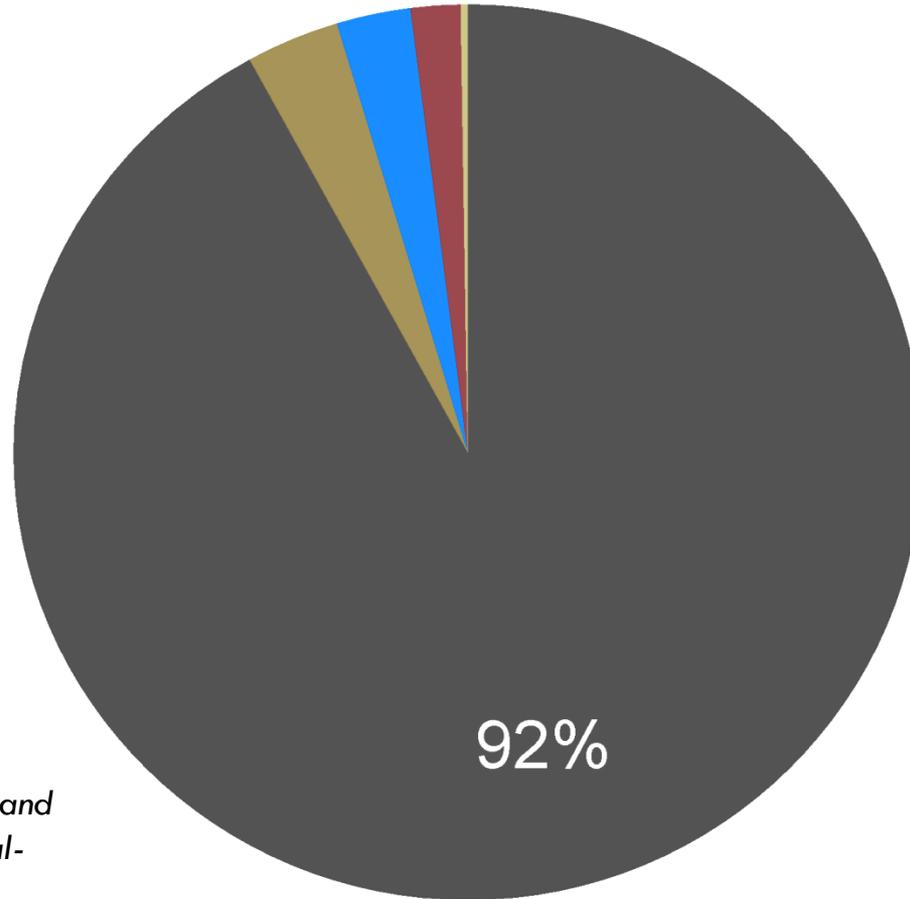


Electricity consumption nationally is relatively balanced between coal, natural gas, nuclear power, hydroelectric, and wind.



Kentucky Electricity Generation, 2012

Electricity Generation by Fuel Type (%)

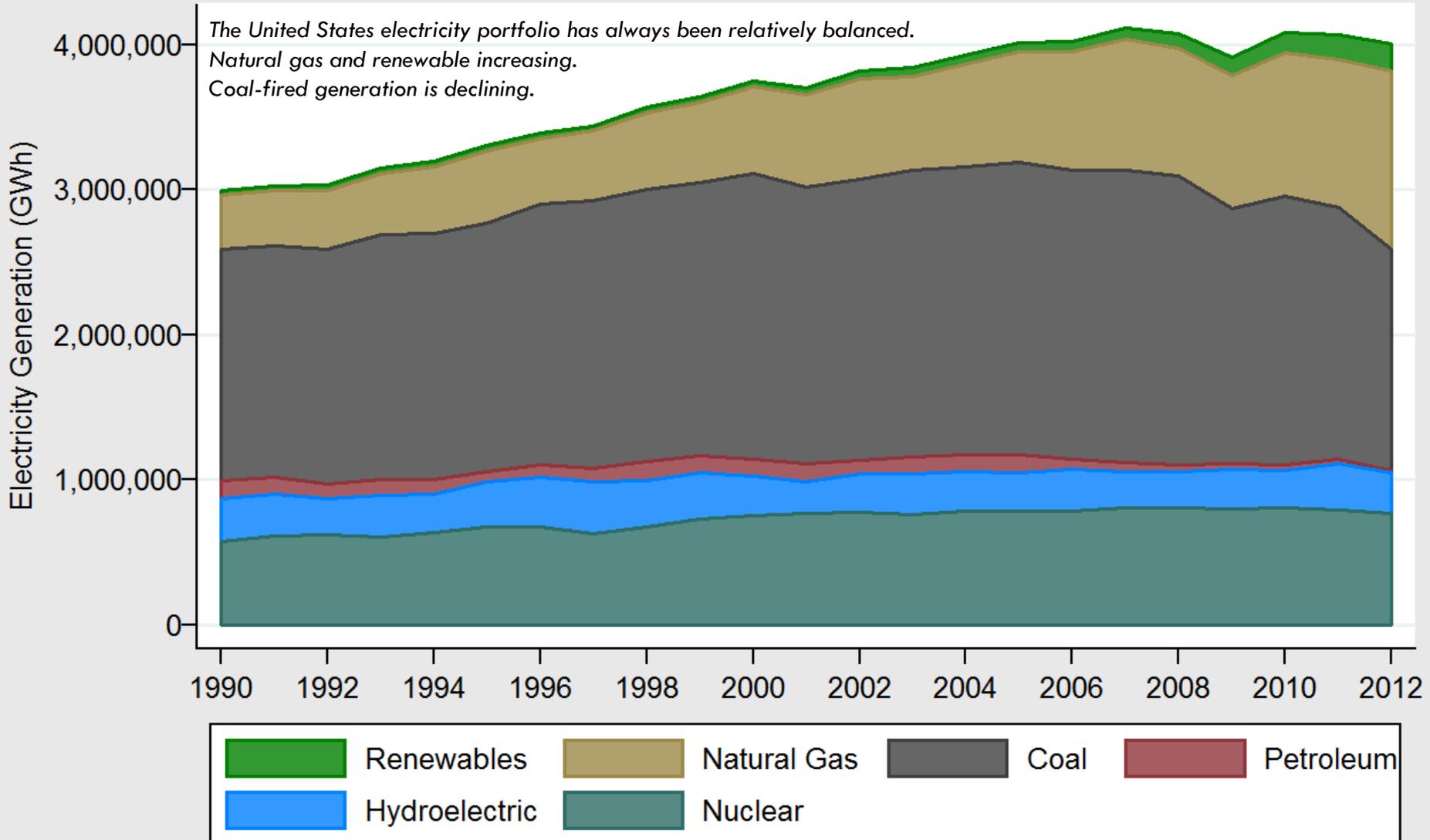


Over 92% of the electricity generated in Kentucky in 2012 and 2013 came from Kentucky's coal-fired power plants.



United States Electricity Generation, 1990-2012

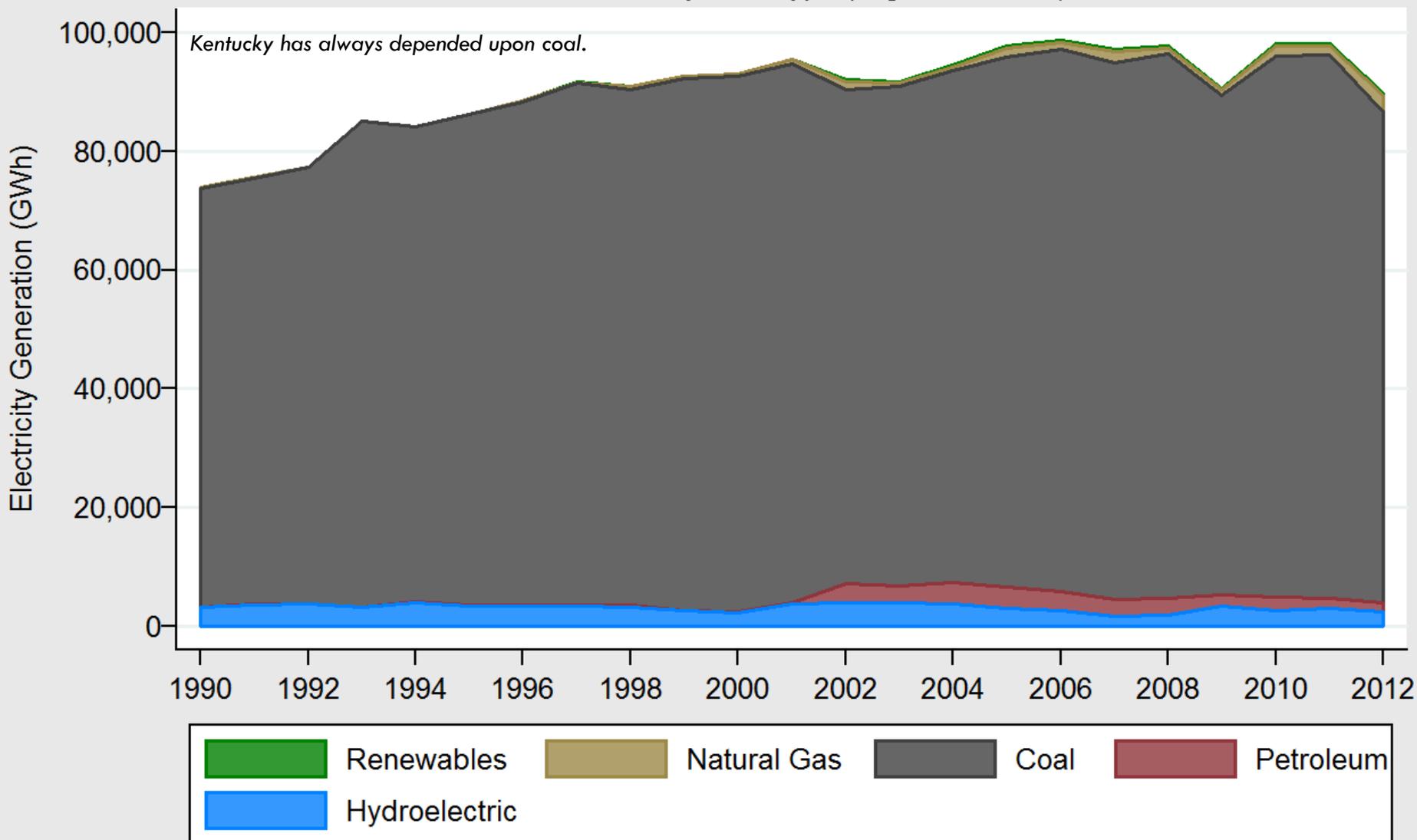
Generation by Fuel Type (Gigawatt Hours)



Kentucky Energy Database, EEC-DEDI, 2013

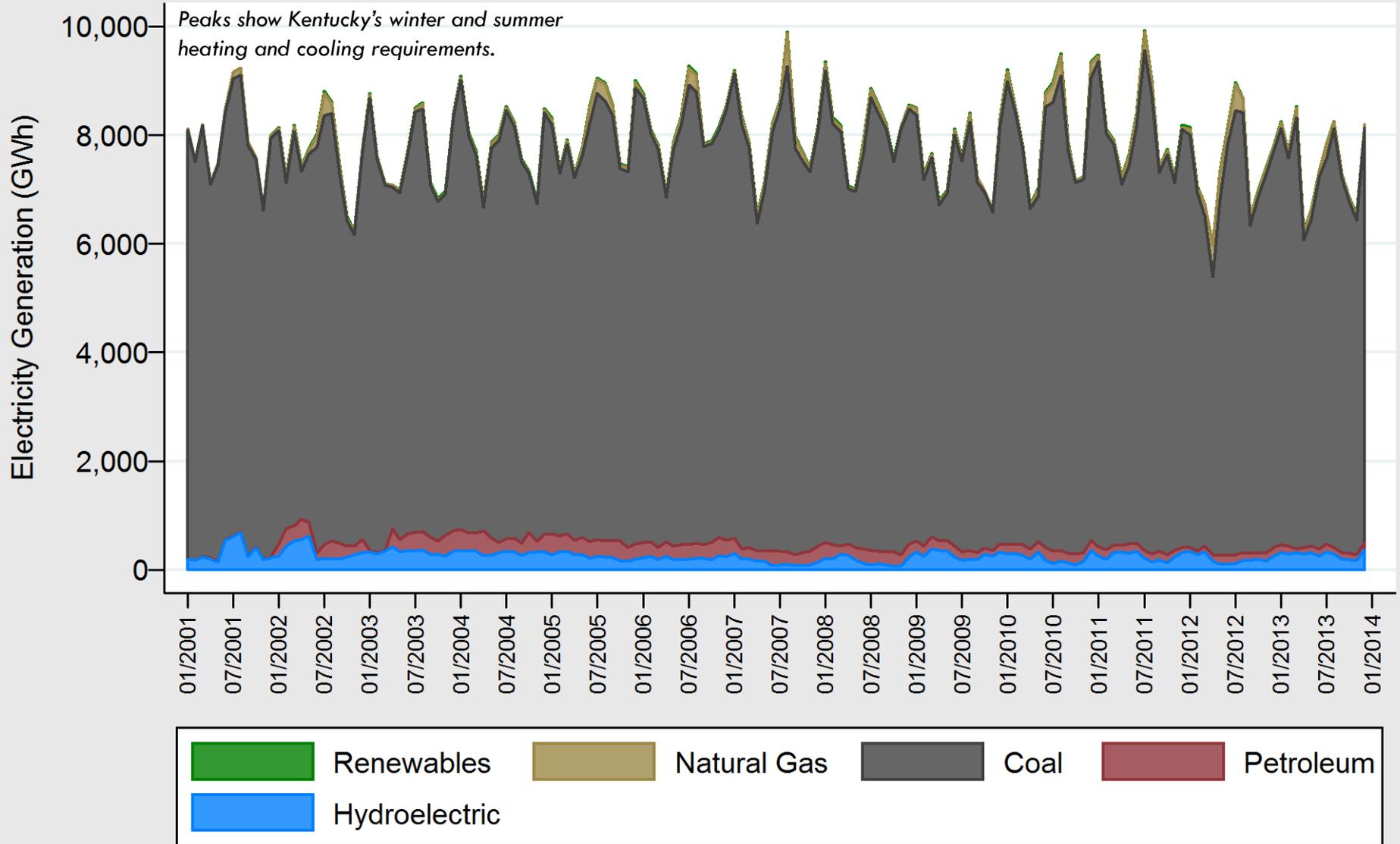
Kentucky Electricity Generation, 1990-2012

Generation by Fuel Type (Gigawatt Hours)



Kentucky Energy Database, EEC-DEDI, 2013

Kentucky Electricity Generation by Fuel Type, 2001-2013



Kentucky Energy Database, EEC-DEDI, February 2014

Data Source: EIA Electric Power Monthly, February 2014

A Quick Introduction to

Kentucky's Future Electricity Portfolio

[Download the Full Report](#)

“Economic Challenges Facing Kentucky’s Electricity Generation Under Greenhouse Gas Constraints”

Changes in Federal Regulation

More numerous and more stringent federal environmental regulations affecting coal-fired generation in ways that differ from the past.

Mercury Air Toxics Standards (MATS)

MATS has accounted for a large portion of recent coal plant retirements.

National Ambient Air Quality Standard (NAAQS)

Much more stringent Ozone (O₃) standards likely to be proposed.

Cross State Air Pollution Rule (CSAPR)

Supreme Court decision expected in June 2014.

Water Intake & and Effluent Limitations

EPA is past deadline to propose rules for water intake structures.

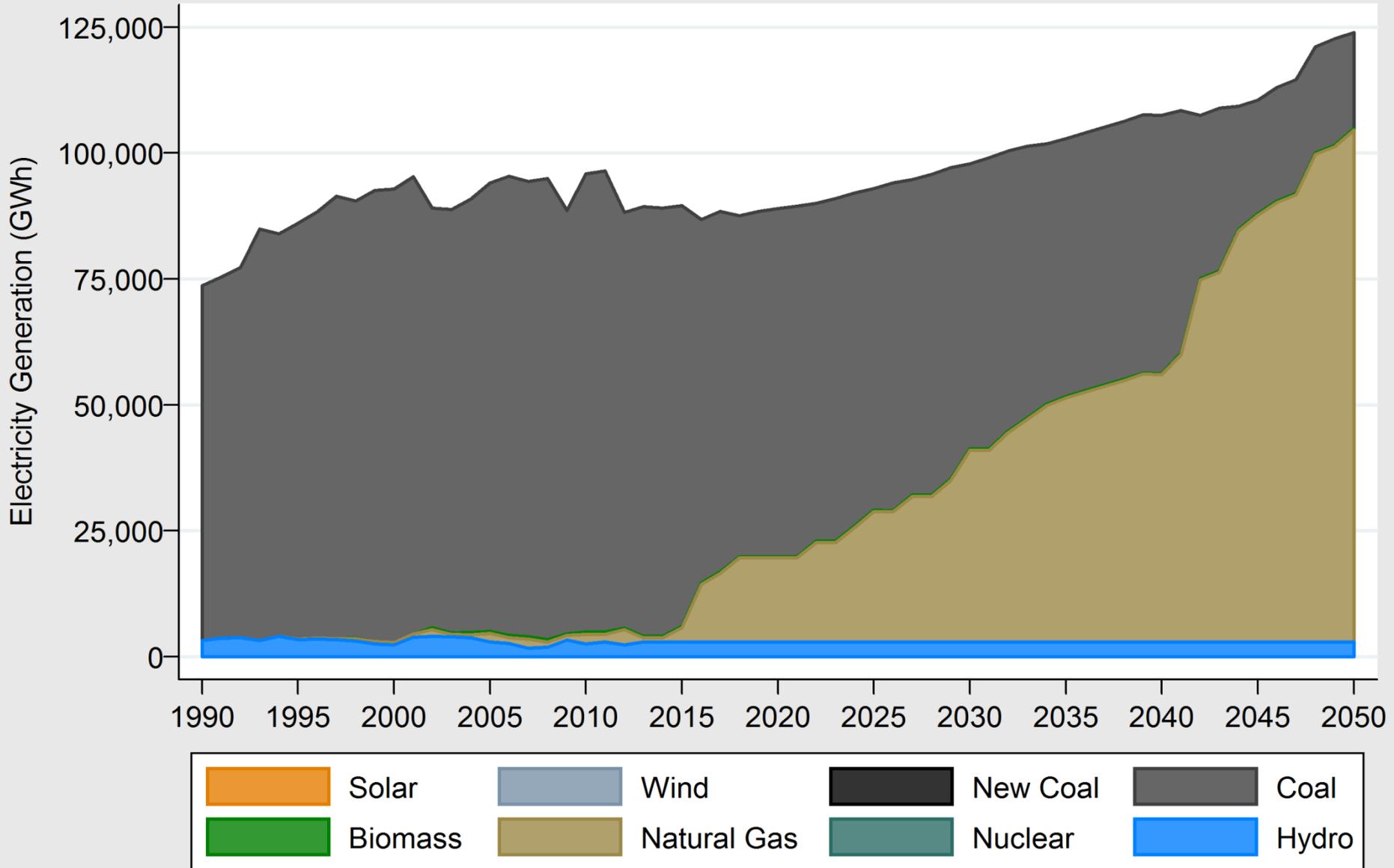
Coal Combustion Residuals (coal ash)

EPA under pressure to act, especially in light of recent spills; depending on approach EPA takes, could require costly compliance for utilities.

President's Climate Agenda

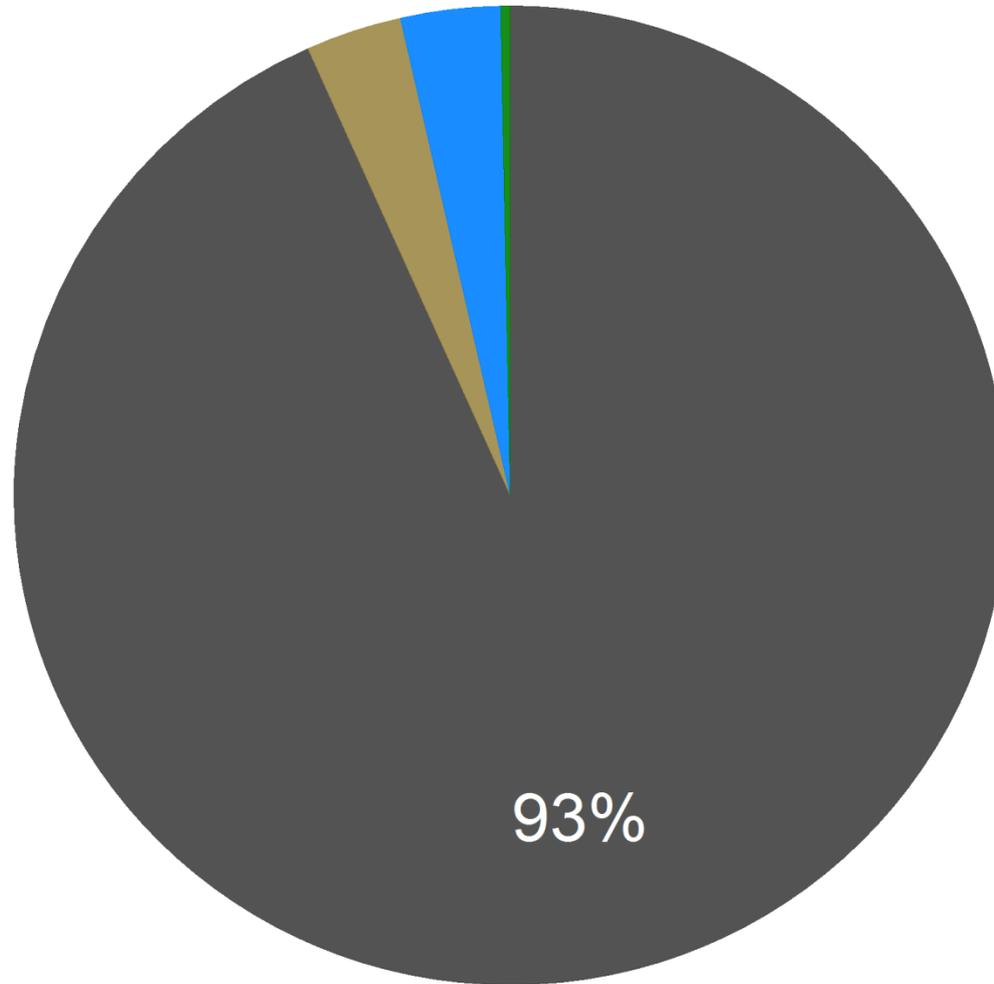
EPA using Clean Air Act 111(b) to set an unachievable 1,100 lbs. of CO₂ per MWh limit for new coal power plants. EPA is considering using Clean Air Act 111(d) to establish CO₂ emission standards for existing coal power plants.

Kentucky Electricity Generation 1990-2050

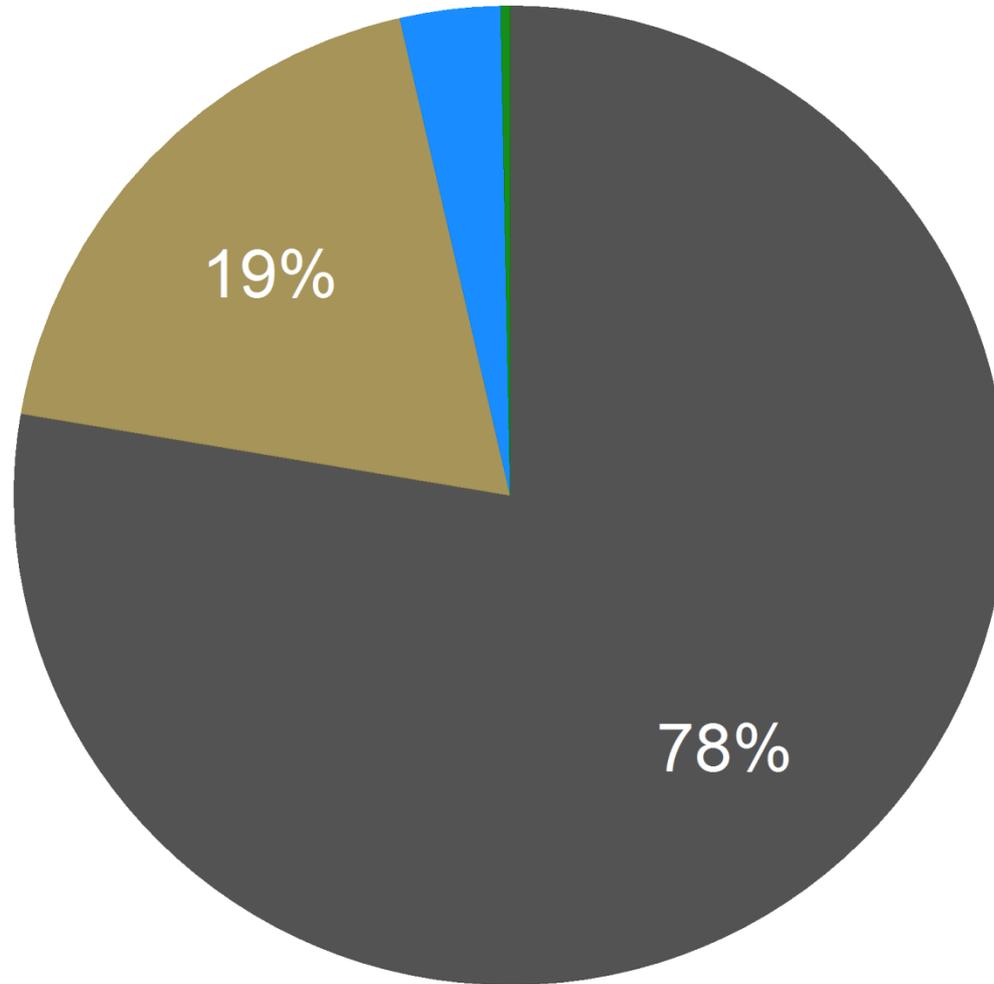


Kentucky Electricity Portfolio Model, EEC-DEDI, 17 Nov 2013 Scenario:1

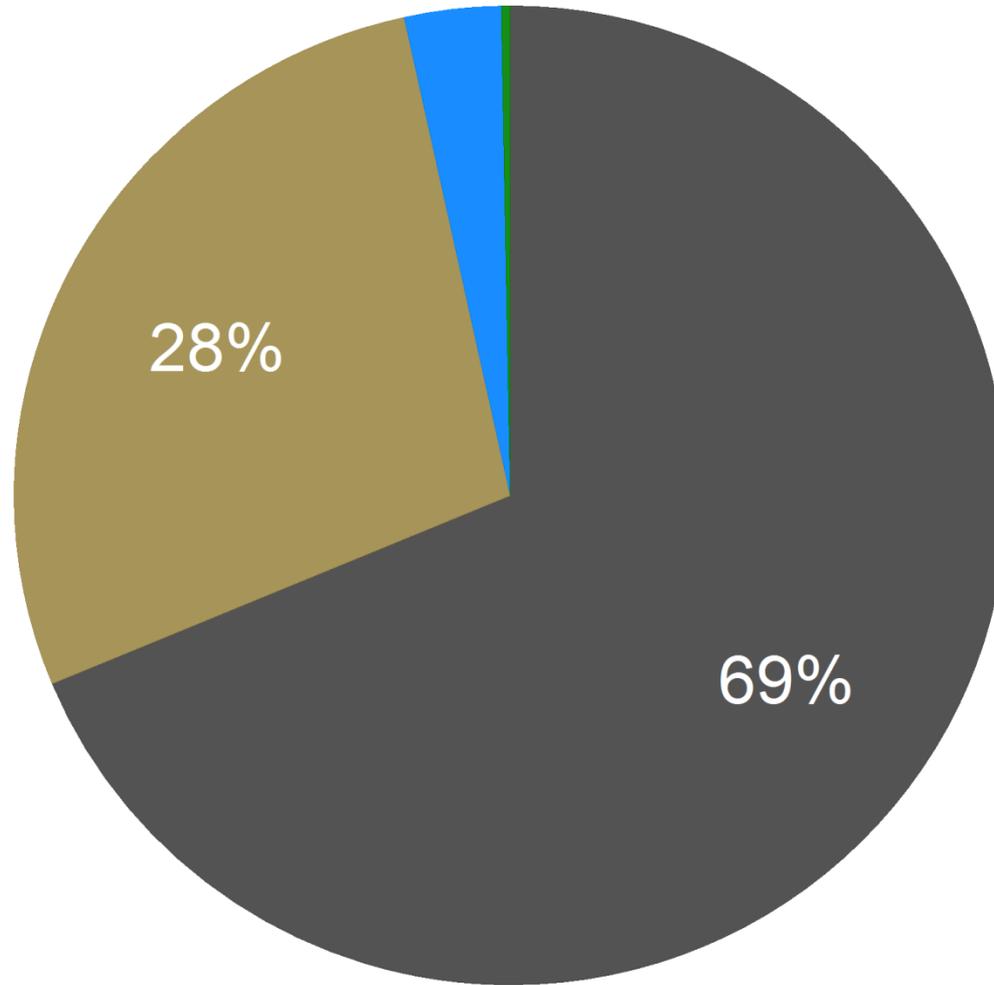
Kentucky Electricity Generation, 2015



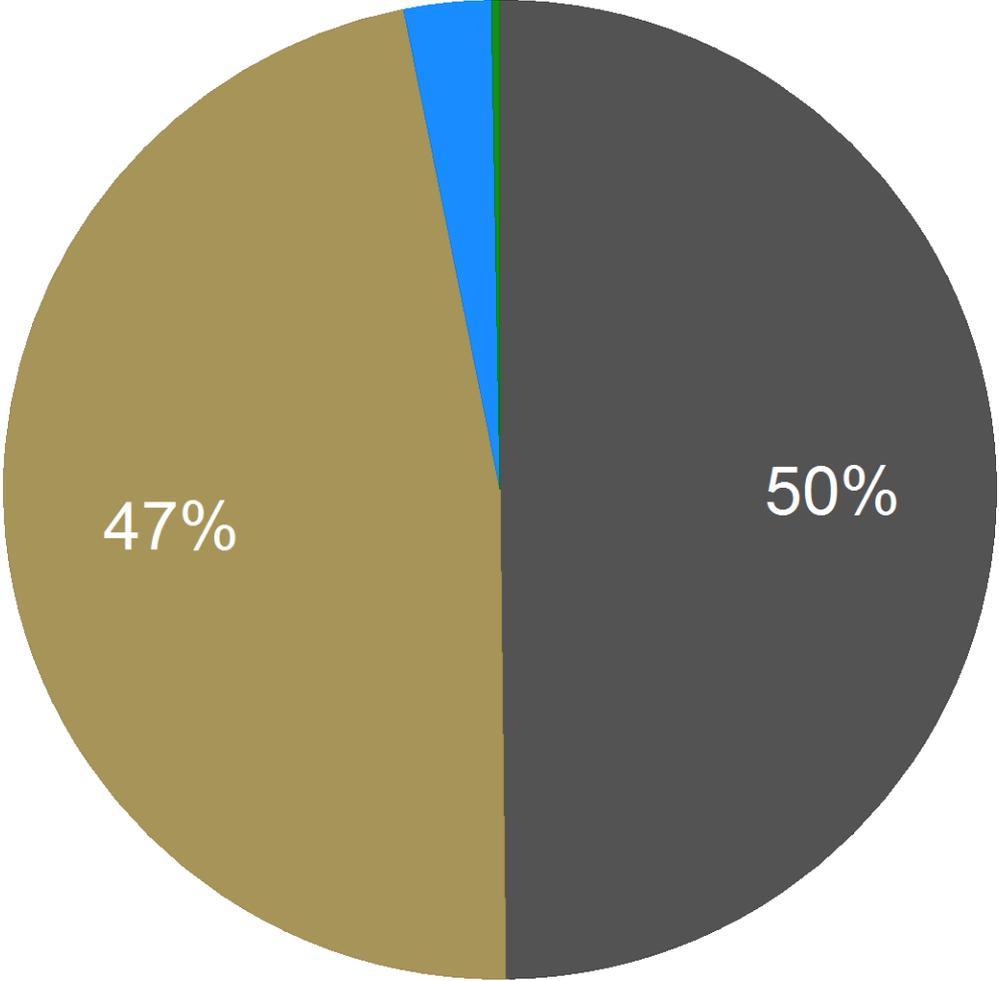
Kentucky Electricity Generation, 2020



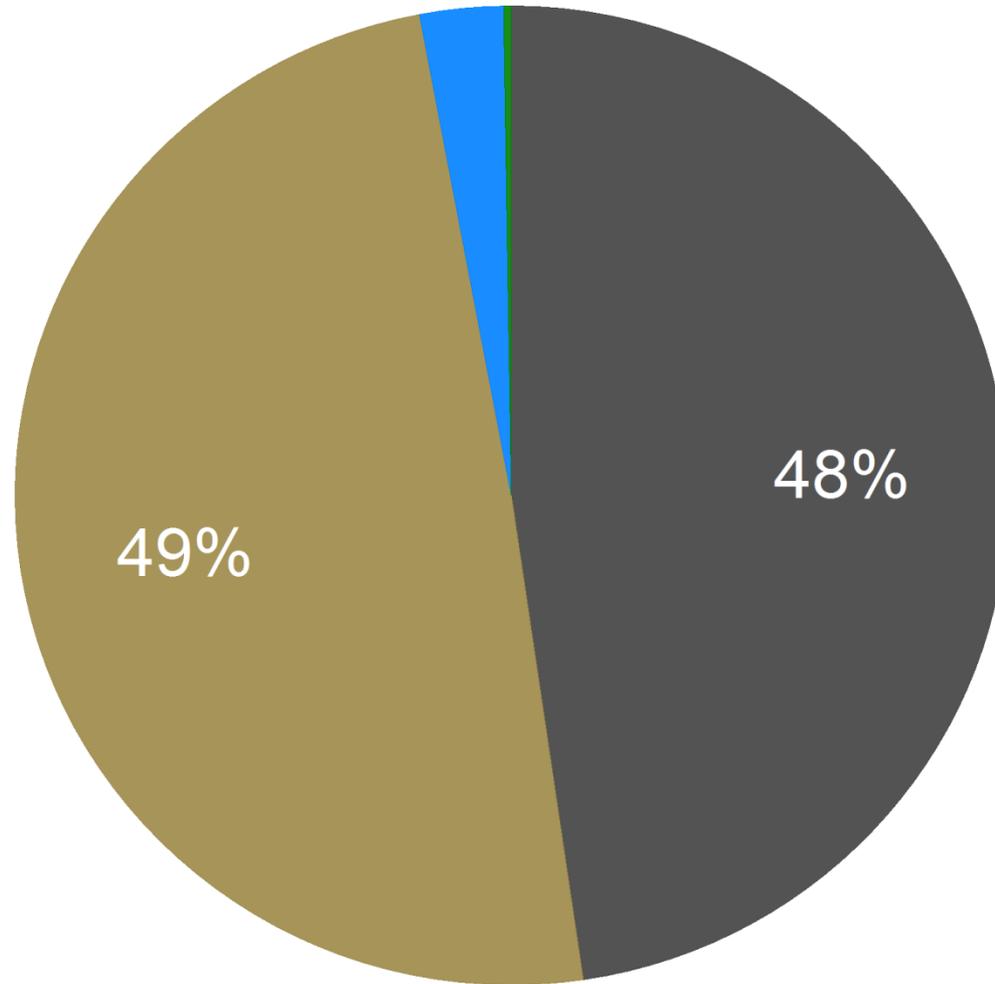
Kentucky Electricity Generation, 2025



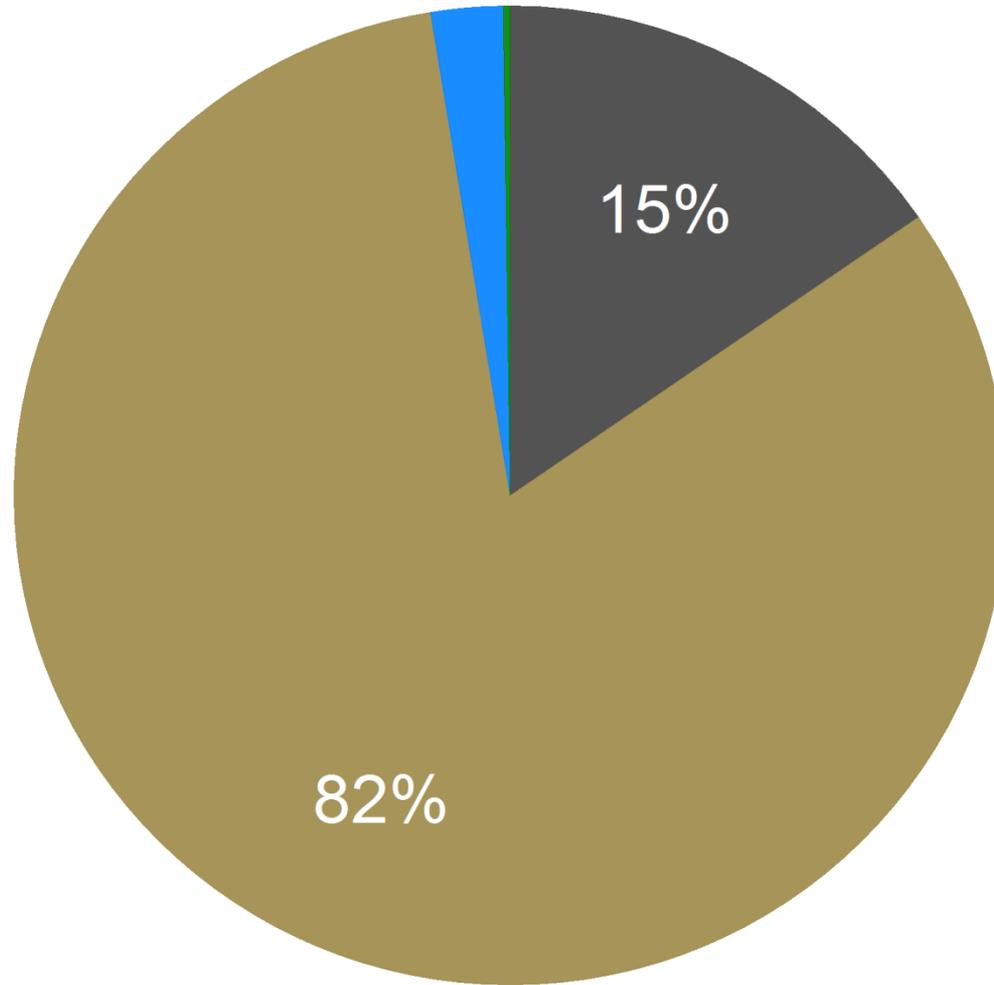
Kentucky Electricity Generation, 2035



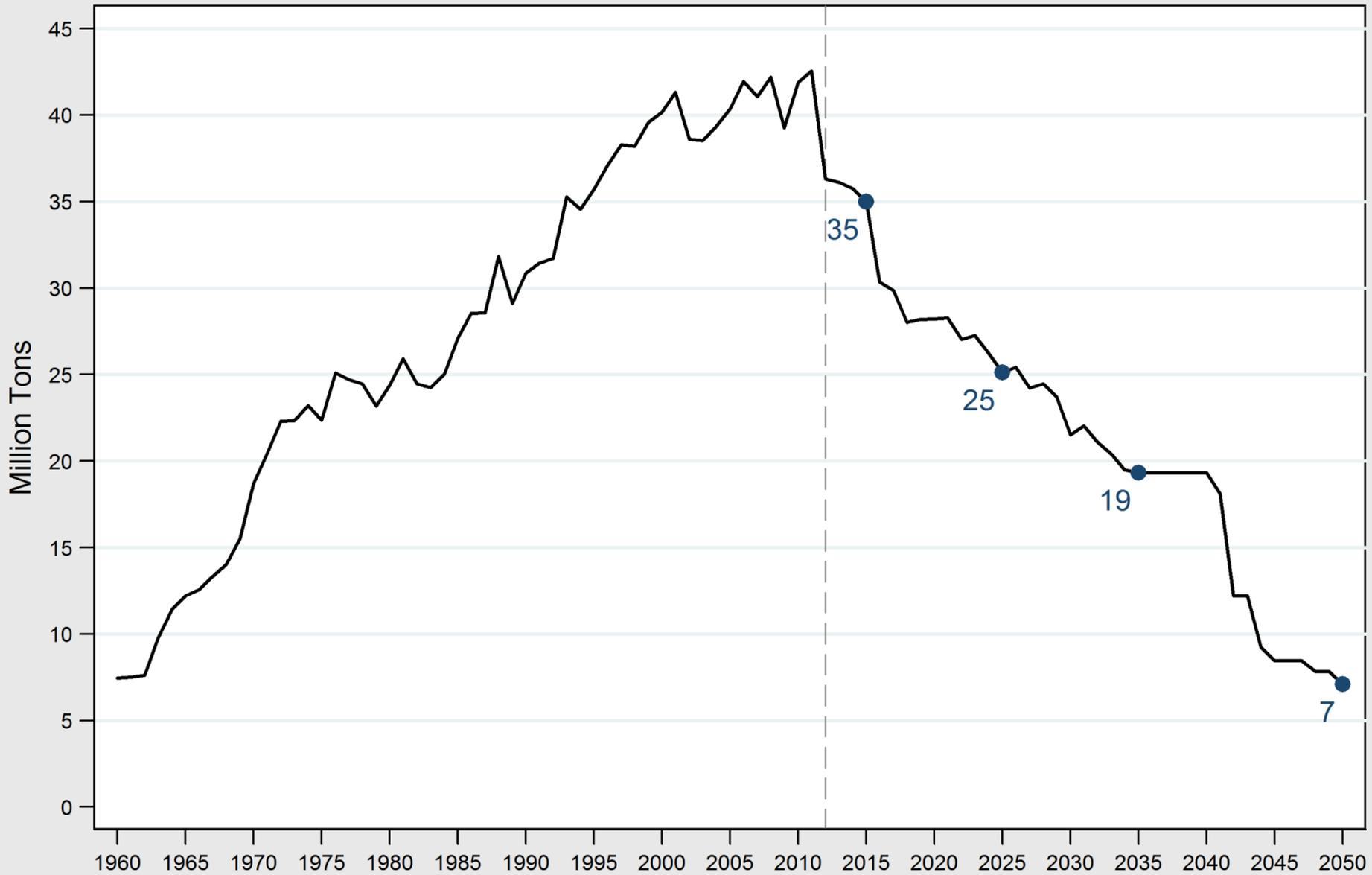
Kentucky Electricity Generation, 2040



Kentucky Electricity Generation, 2050

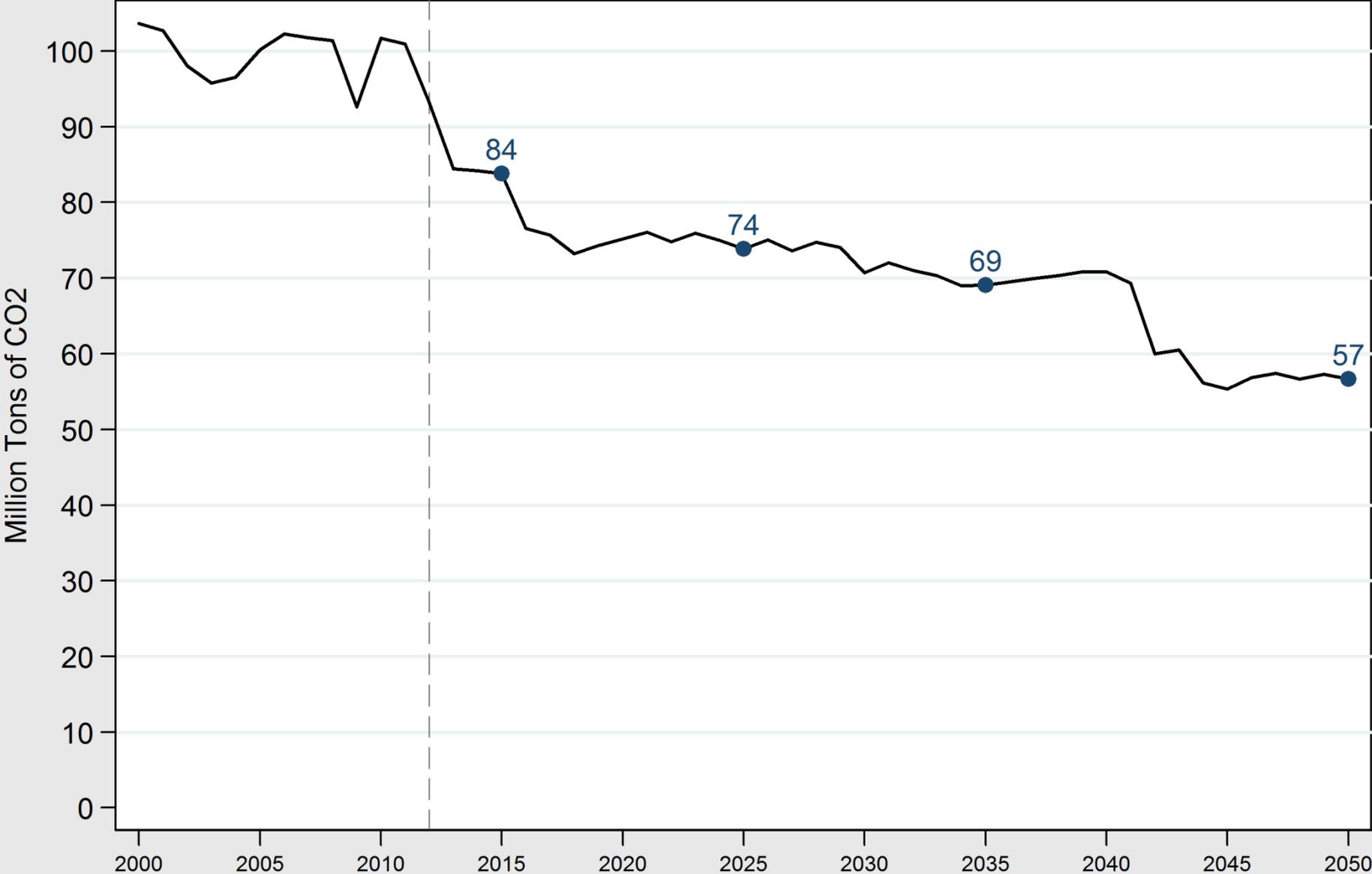


Kentucky Coal Consumption for Electricity Generation, 1960-2050



Kentucky Electricity Portfolio Model, EEC-DEDI, 17 Nov 2013 Scenario: 1

Kentucky Carbon Dioxide Emissions from Electricity Generation, 2000-2050



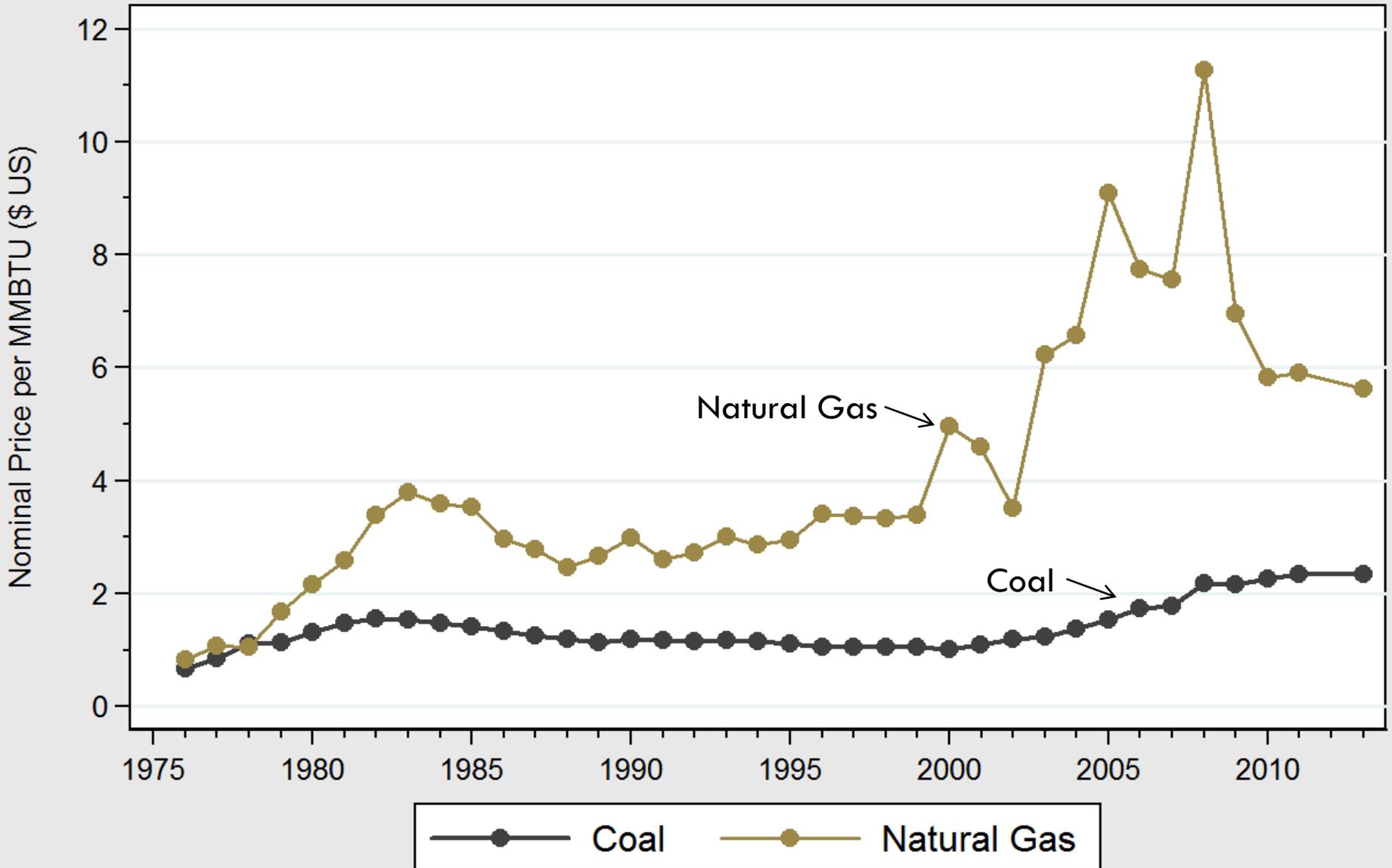
Kentucky Electricity Portfolio Model, EEC-DEDI, 17 Nov 2013 Scenario: 1

Significance of Electricity to Kentucky

[Download the Full Report](#)

“The Vulnerability of Kentucky’s Manufacturing Economy to Increasing Electricity Prices”

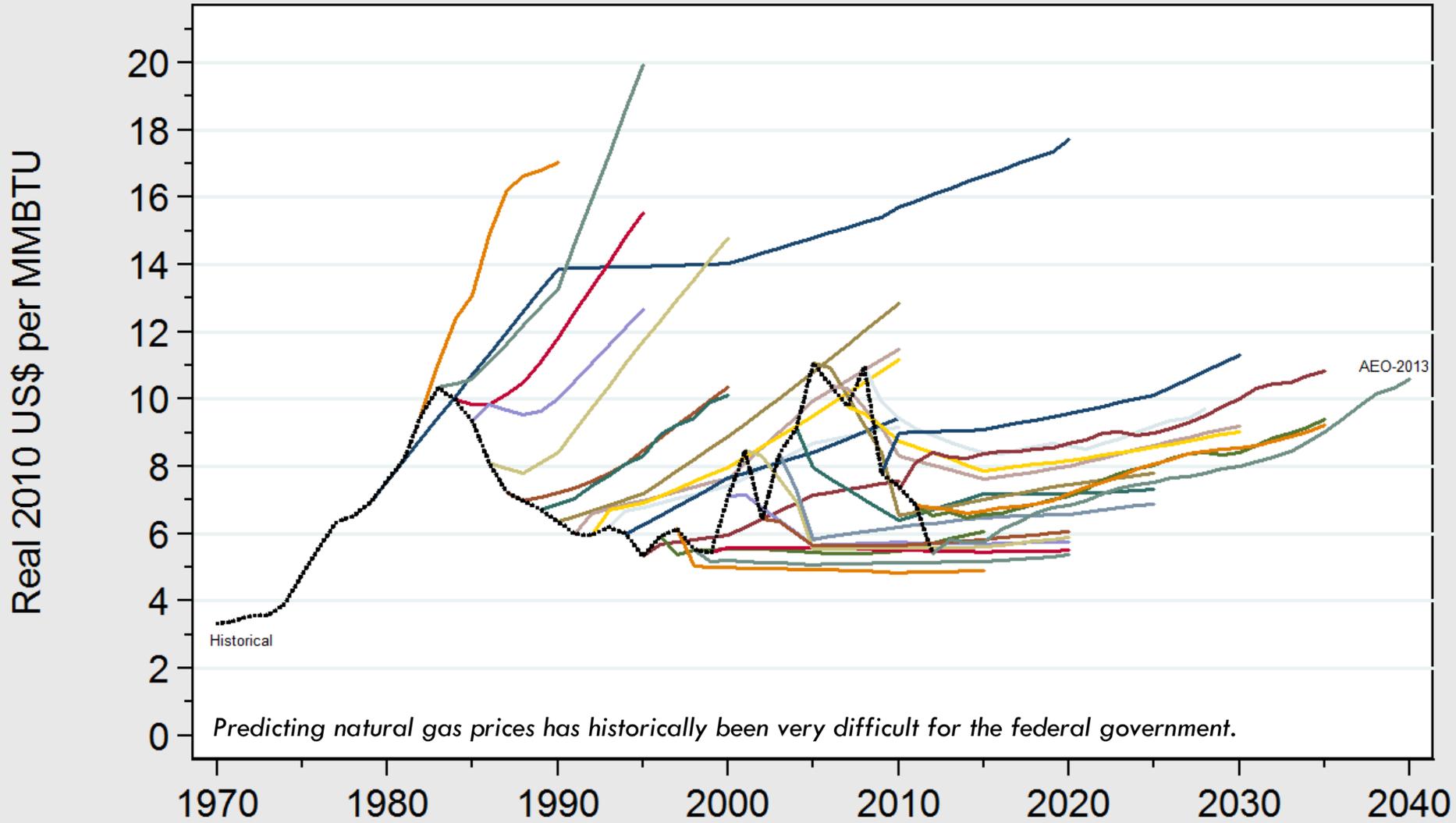
Kentucky Coal & Natural Gas Prices for Electric Power, 1976-2013



Kentucky Energy Database, EEC-DEDI, 2014

EIA Natural Gas Price Forecasts, 1979-2013

Energy Information Administration Annual Energy Outlook Forecasts vs. Actual

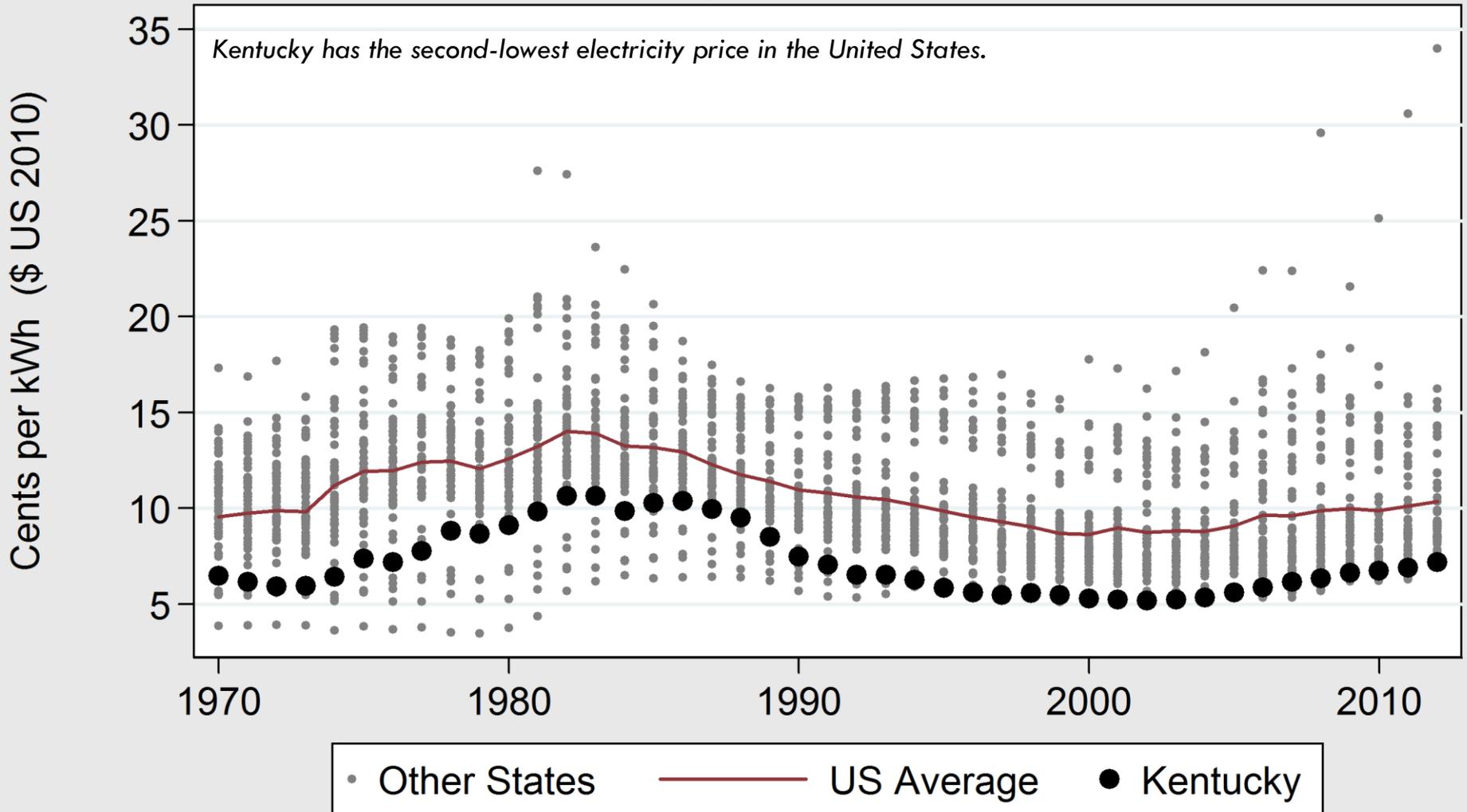


Kentucky Energy Database, EEC-DEDI, 2013

Data Sources: EIA-AEO 1979-2013 - Reference Case Delivered Price - All Sectors & BLS-CPI, 2013

Kentucky Average Real Electricity Price, 1970-2012

Kentucky vs. the United States

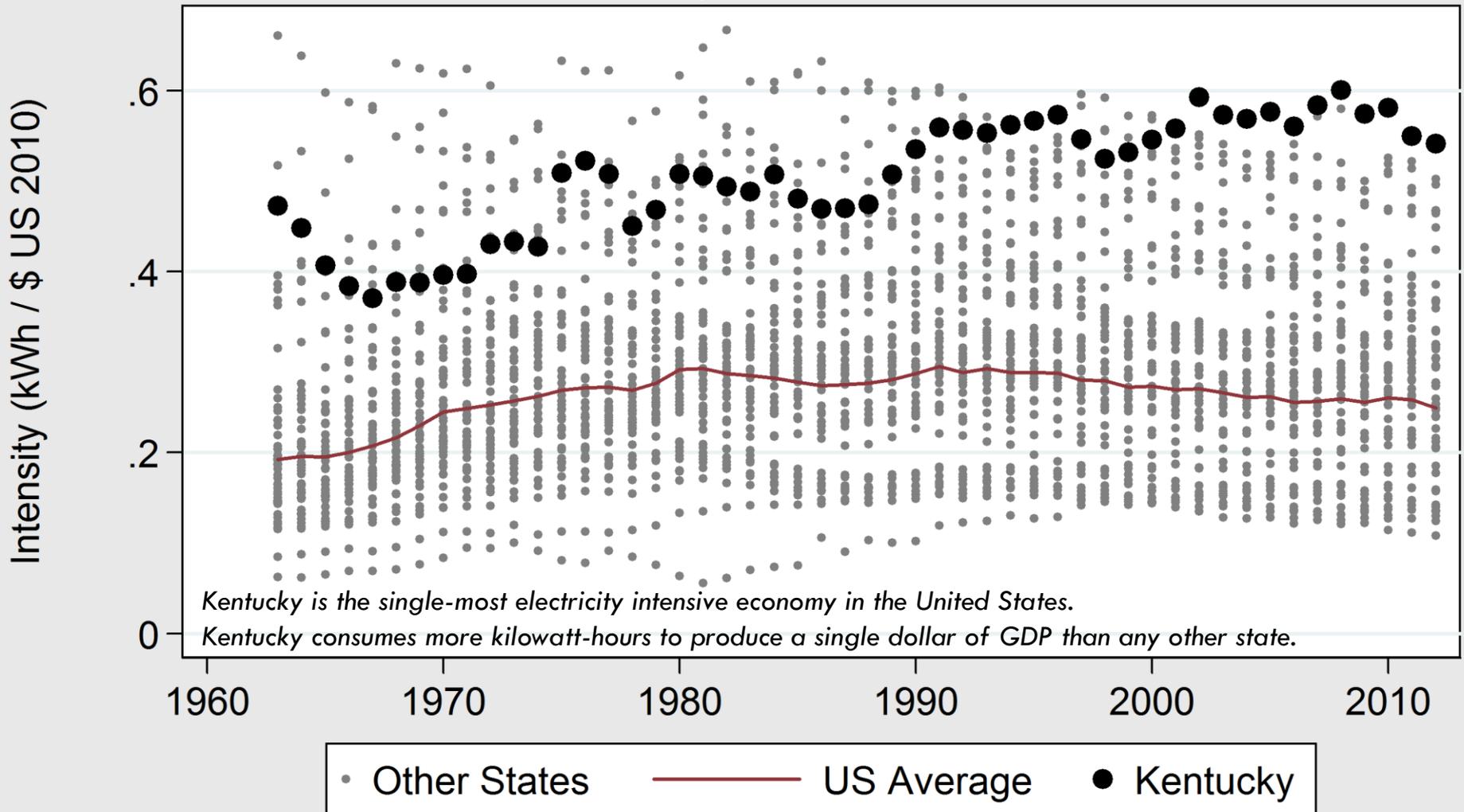


Kentucky Energy Database, EEC-DEDI, 2013

Data Source: EIA Form 861 & 826 & BLS-CPI

Electricity Consumption per State GDP Dollar, 1963-2012

Kentucky vs. the United States

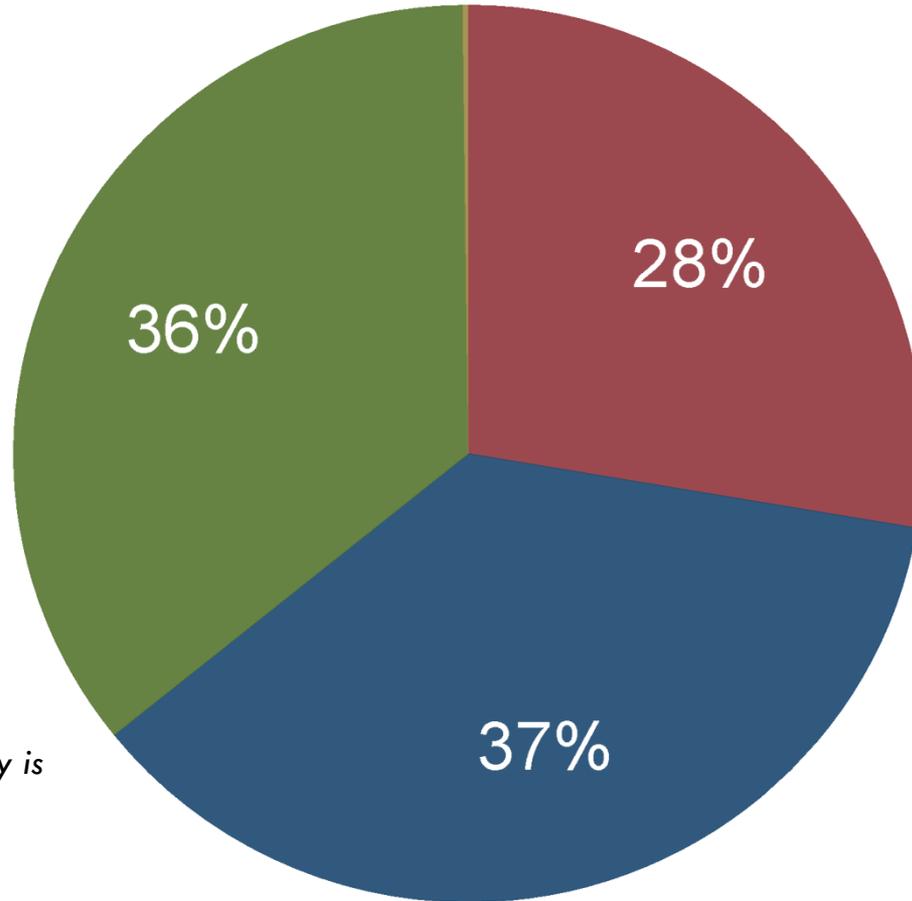


Kentucky Energy Database, EEC-DEDI, 2013

Data Source: EIA Forms 861 & 826 & BEA GDP by State

United States Electricity Consumption, 2012

Consumption by Sector (%)

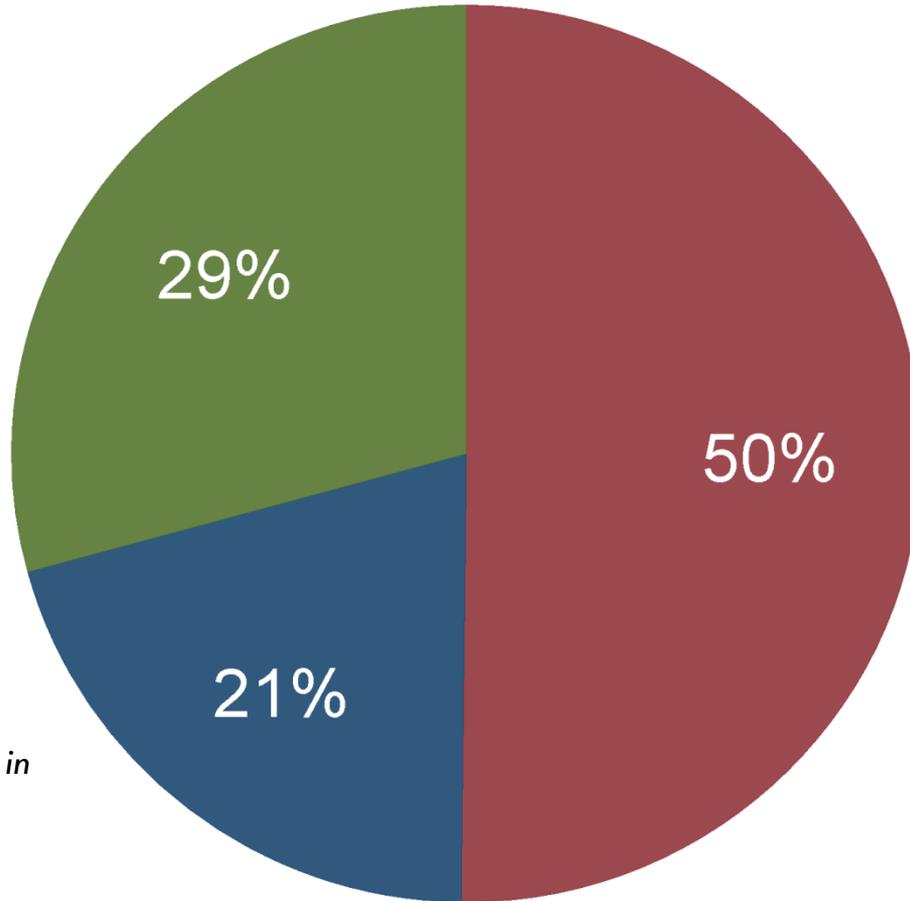


Electricity consumption nationally is split fairly equally between commercial, industrial, and residential consumers.

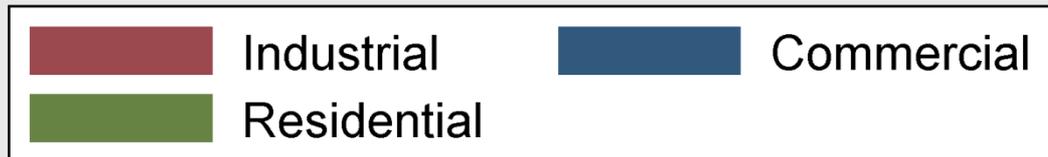


Kentucky Electricity Consumption, 2012

Consumption by Sector (%)

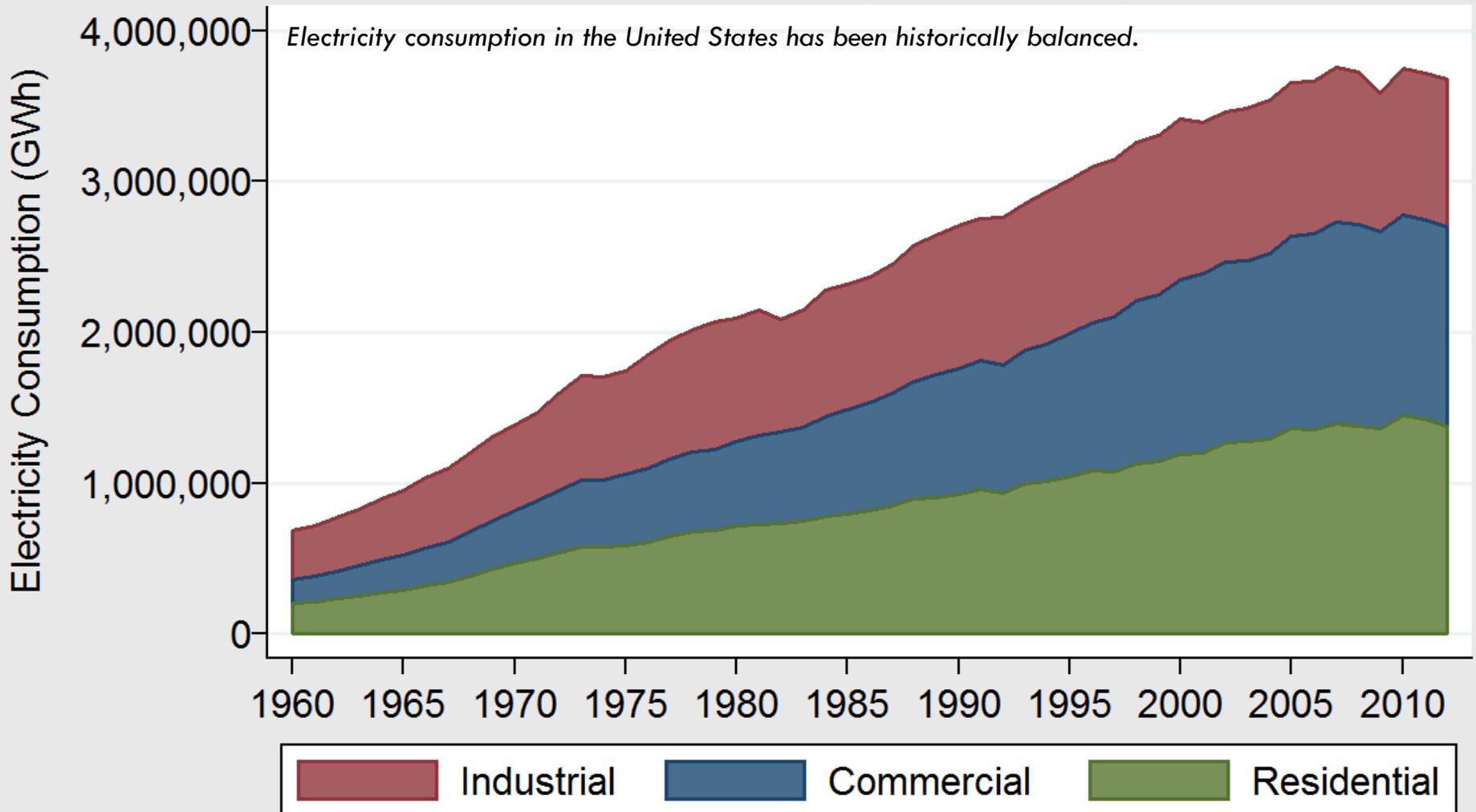


Half of the electricity consumed in Kentucky every year goes to industrial and manufacturing processes.



United States Electricity Consumption, 1960-2012

Consumption by Sector (GWh)

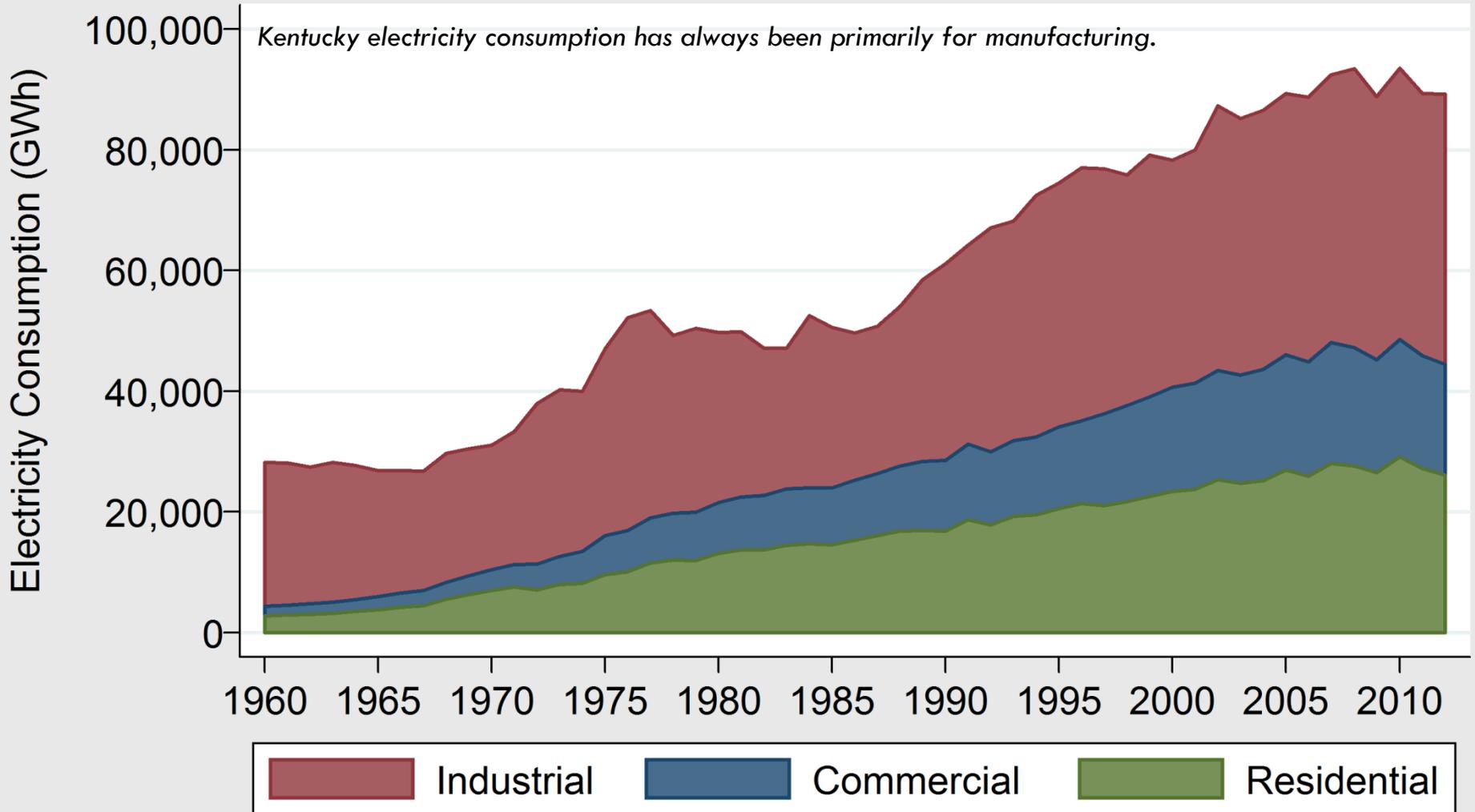


Kentucky Energy Database, EEC-DEDI, 2013

Data Source: EIA Form 861 & 826

Kentucky Electricity Consumption, 1960-2012

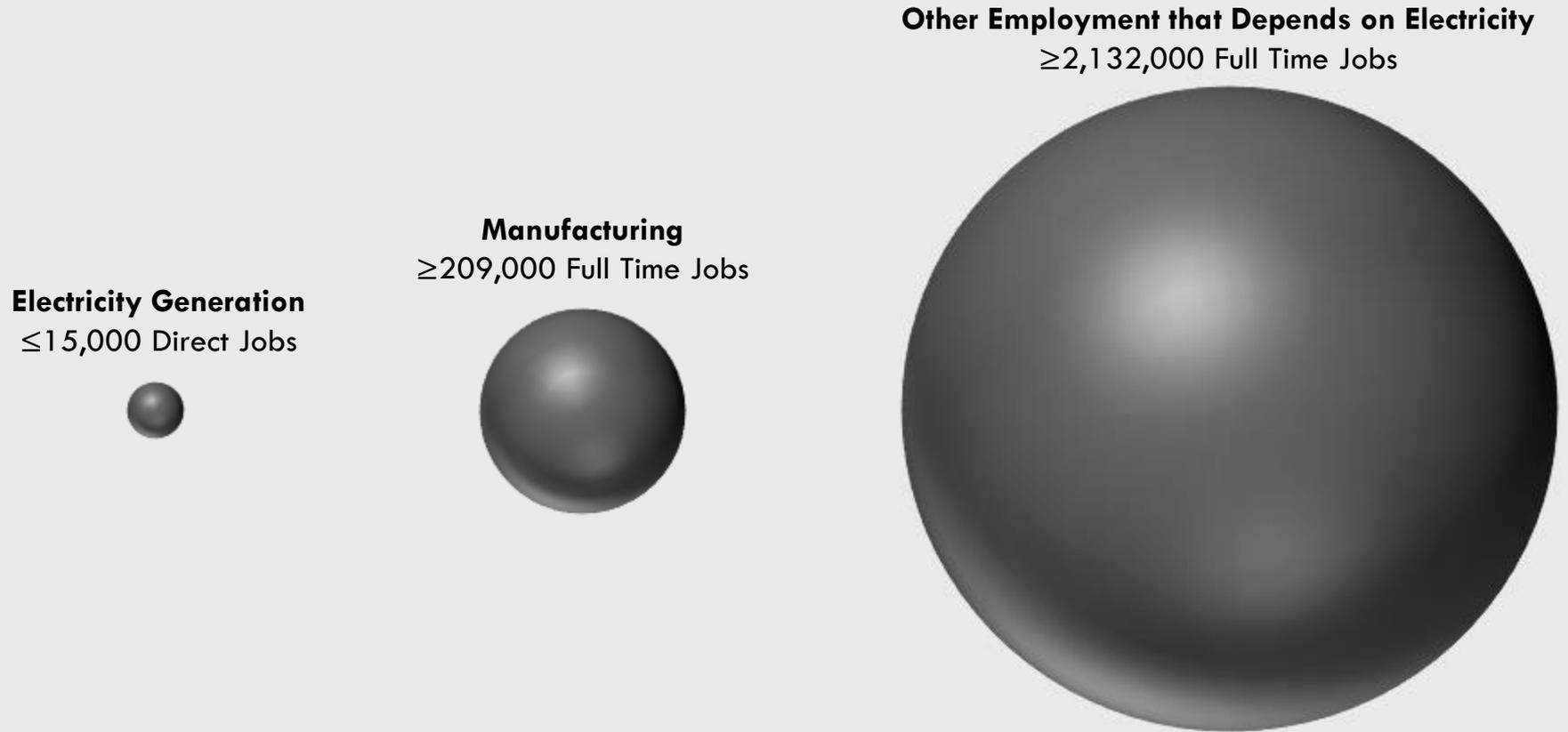
Consumption by Sector (GWh)



Kentucky Energy Database, EEC-DEDI, 2013

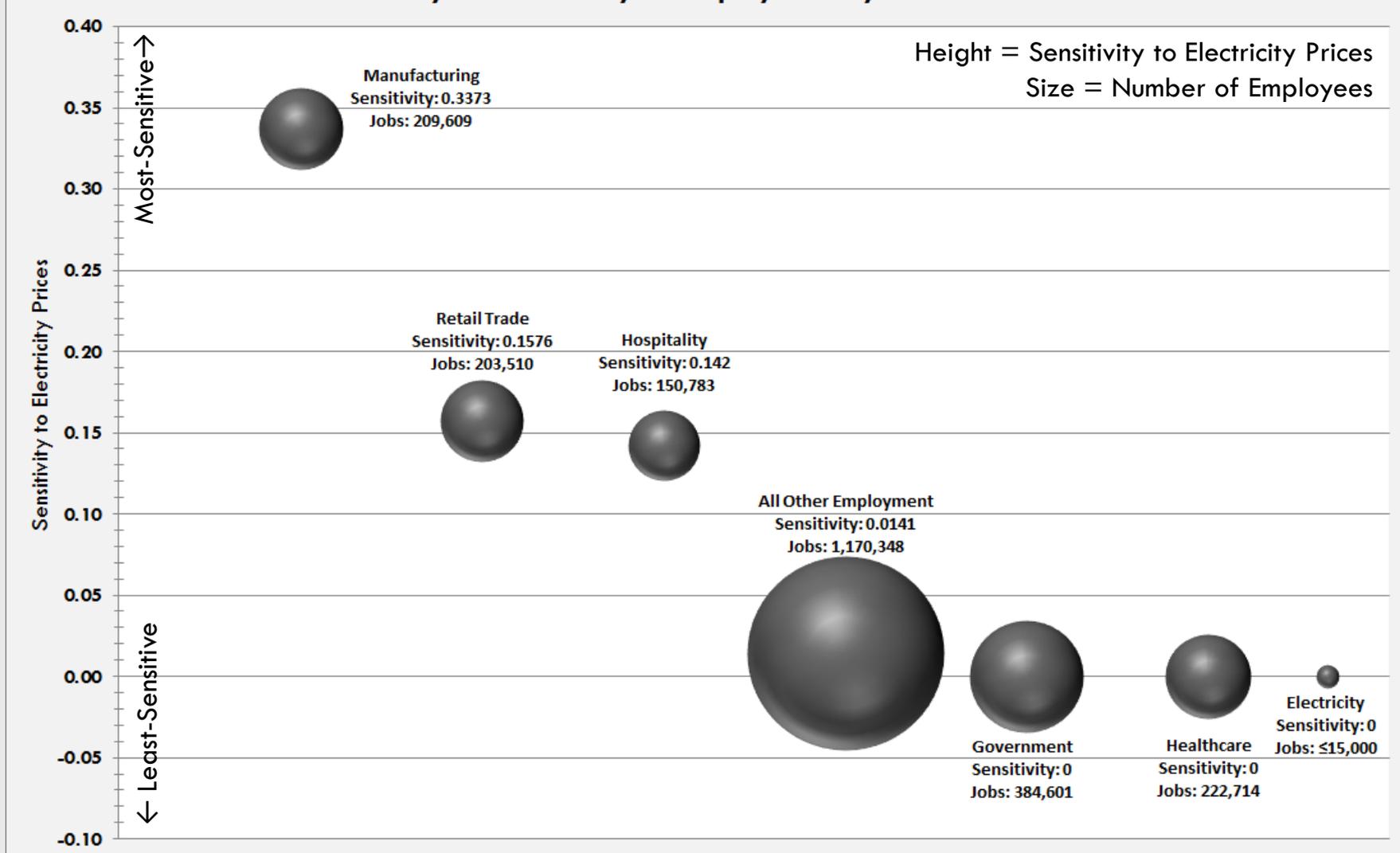
Data Source: EIA Form 861 & 826

Kentucky Electricity Portfolio & Employment



Employment Depends Upon Electricity – Direct employment for electricity generation, such as power plant operators and coal miners, is a relatively smaller portion of total employment in Kentucky compared to the millions of jobs that depend upon the reliable and inexpensive electricity they produce. Electricity-dependent jobs can be modeled with electricity price elasticity of employment coefficients.

Electricity Price Elasticity of Employment by Economic Sector



Sensitivity to Electricity Prices Differs by Industry – This study developed price elasticity of employment coefficients for the top five employment sectors in Kentucky by modeling the historical responsiveness of employment nationally. Manufacturers were the most-responsive. Retail stores, restaurants, and hotels were less than half as responsive. Government and healthcare showed no responsiveness whatsoever.

Kentucky Electricity Portfolio & Employment

Intensity Rank	Manufacturing Sector	Kilowatt-hours per \$ of Product	Kentucky Electricity Cost per \$ of Product	Percentage of Production Costs	Kentucky Workers
1	Aluminum Smelting	4.37313	\$0.236	23.6%	3,482
2	Iron & Steel Mills	1.5764	\$0.085	8.5%	2,954
4	Basic Chemical	0.71269	\$0.039	3.9%	3,043
5	Glass Manufacturing	0.60508	\$0.033	3.3%	2,015
24	Motor Vehicle Parts	0.14747	\$0.008	0.8%	16,660
52	Motor Vehicle Assembly	0.03654	\$0.002	0.2%	11,384

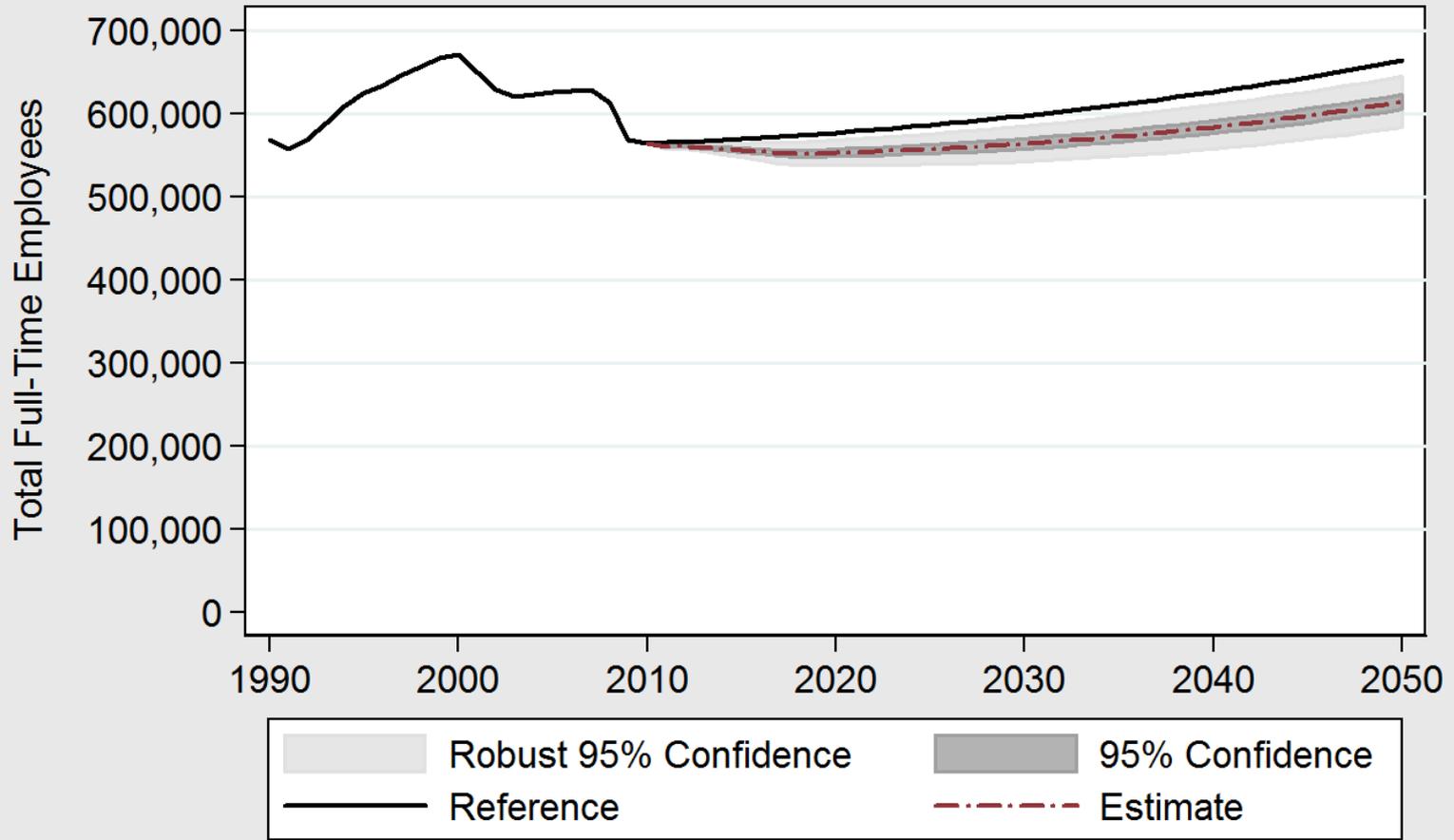
The production of aluminum, iron, steel, chemicals, and glass are some of the most-electricity intensive manufacturing processes, where up to a quarter of total production costs go to electricity expenses.

Other large manufacturing sectors, like motor vehicle assembly, which may be less electricity-intensive, depend upon primary material inputs from more electricity-intensive sectors.

The complete list of all manufacturing sectors is available on page 4 of the associated white paper: <http://energy.ky.gov/Programs/Documents/Vulnerability%20of%20Kentucky's%20Manufacturing%20Economy.pdf>

Kentucky Electricity Intensive Employment Forecast, 1990-2050

Impact of 25% Electricity Price Increase on Energy Intensive Employment (NAICS 31, 32, 33, 44, 72)



Kentucky Energy Database, EEC-DEDI, 2011

Combined Impact of Electricity-Intensive Sectors - Given a 25% increase in real electricity prices by 2025, Kentucky's most electricity-intensive economic sectors, (manufacturing, retail trade, restaurants, and hotels) could be expected to shed a combined total of **30,237** full-time jobs and with 95% confidence and robust standard errors between **12,620** and **50,947**.

Contact Information

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