# The Reality of an Energy Switch

## Looking back - a decade of Energy Use in the US

A Presentation to CASF on May 20, 2023
by
Bernie McCune

**https://www.youtube.com/watch?v=G6dIvECRfcI**

# US Actual Energy Use from 2011 to 2021

- I plan to show how very little change in estimated energy use among the energy sources bodes poorly for a switch to alternate sources (data based estimates by Lawerence Livermore Labs)

- Predictions into the next decade by LLL & EIA show expected realistic projections for actual energy use that indicate that a transition to “Net Zero” anytime soon is mostly a “fairy tale”

- I would like to see a discussion by experts on both sides of this issue so that the above realities are factored into the debate rather than being continually ignored

- Actually I would like the real climate deniers (human caused $CO_2$ warming advocates) to show me using real data (not models) why there is any need for any dramatic energy switch in the first place (run Patrick Moore’s video)

# Energy Production from 2000

## Snapshot of of two decades ago

### U.S. Energy Production by Energy Source (2000–2011)

| | Coal | Natural Gas* | Petroleum | Nuclear | Renewables | Total Production (Quadrillion Btu) |
|---|---|---|---|---|---|---|
| 2000 | 31.9% | 31.2% | 17.3% | 11.0% | 8.6% | 71.3 |
| 2001 | 32.8% | 31.7% | 17.1% | 11.2% | 7.2% | 71.7 |
| 2002 | 32.1% | 31.0% | 17.2% | 11.5% | 8.1% | 70.7 |
| 2003 | 31.5% | 31.4% | 17.2% | 11.4% | 8.5% | 70.0 |
| 2004 | 32.6% | 30.7% | 16.4% | 11.7% | 8.6% | 70.2 |
| 2005 | 33.4% | 30.1% | 15.8% | 11.8% | 9.0% | 69.4 |
| 2006 | 33.6% | 30.2% | 15.3% | 11.6% | 9.3% | 70.8 |
| 2007 | 32.9% | 31.1% | 15.0% | 11.8% | 9.2% | 71.4 |
| 2008 | 32.6% | 31.6% | 14.4% | 11.5% | 9.9% | 73.1 |
| 2009 | 29.8% | 32.6% | 15.6% | 11.5% | 10.5% | 72.6 |
| 2010 | 29.5% | 32.9% | 15.5% | 11.3% | 10.9% | 74.8 |
| 2011 | 28.4% | 33.9% | 15.4% | 10.6% | 11.7% | 78.0 |

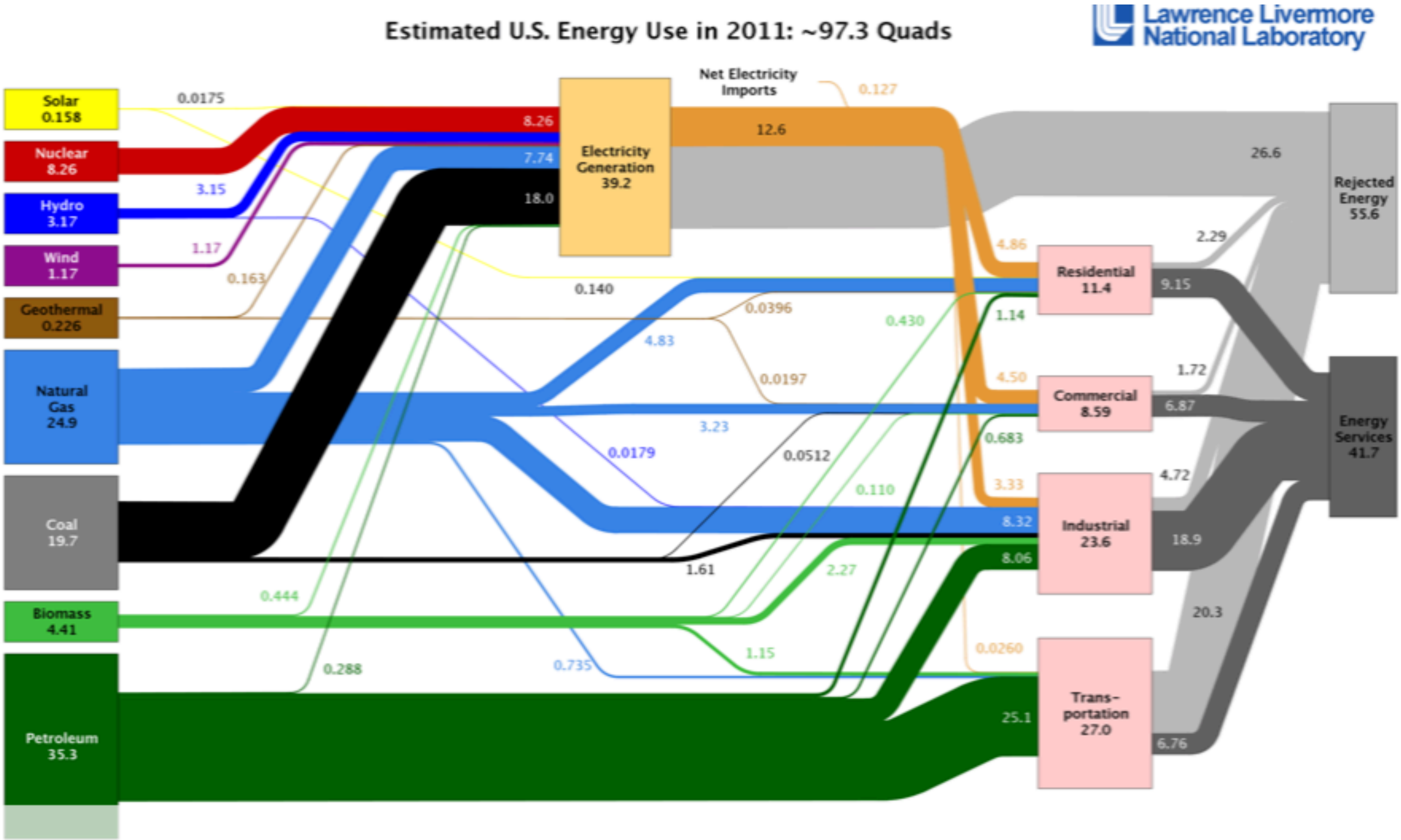
Source: EIA

* Includes natural gas plant liquids.

Note: Annual totals may not equal 100% due to rounding.

# Sankey Energy Flowcharts

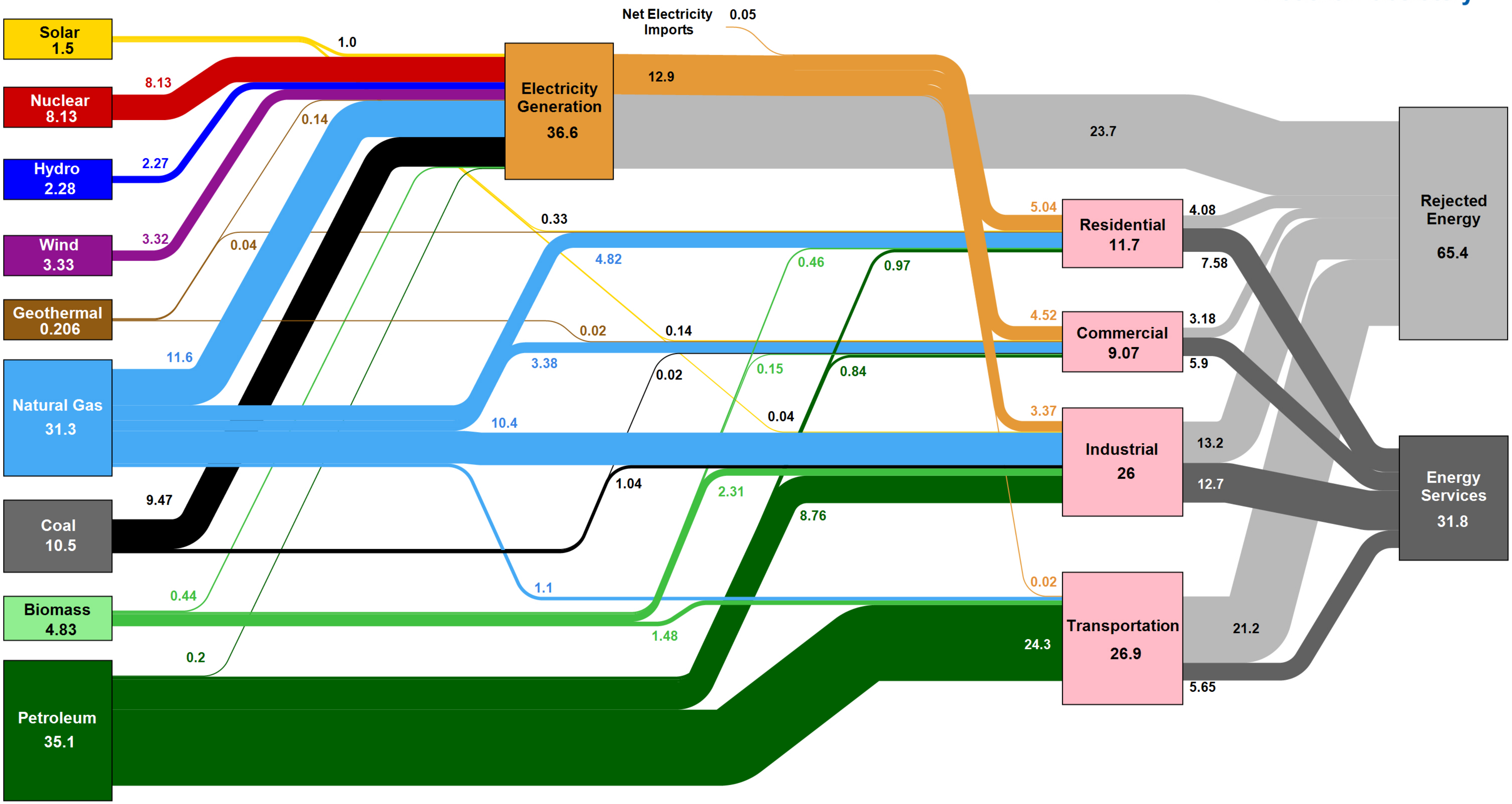
- This is a great graphical view of energy types and volumes using actual data to build annual flows that clearly show changes in those parameters
- An interval of a decade shows clear trends and patterns that can better guide our choices of prime energy movers
- There are dramatic energy losses that are clearly visible in these charts
- Sankey Waterflow Charts can also be found




# Energy 2011 United States

# Estimated U.S. Energy Consumption in 2021: 97.3 Quads

Lawrence Livermore National Laboratory

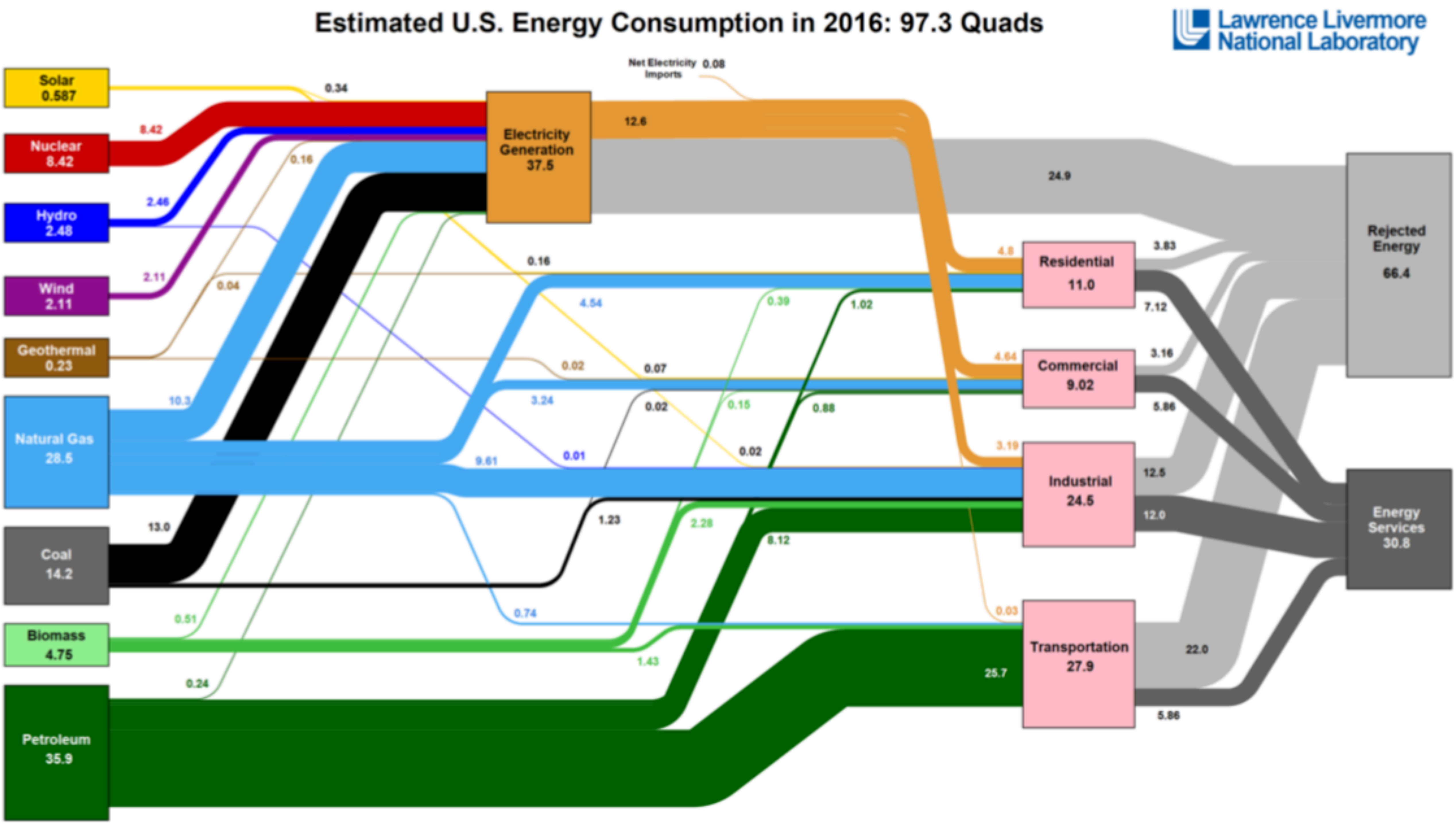



Source: LLNL March, 2022. Data is based on DOE/EIA MER (2021). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 21% for the transportation sector and 49% for the industrial sector, which was updated in 2017 to reflect DOE's analysis of manufacturing. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

# Graphic Take-aways

- Comparing 2011 and 2021 show some very interesting changes
- The dramatic drop in coal use -
  2011 = 19.7 quads        2021= 10.5 quads
- Fossil Fuel fraction (total about 80%) of the mix dropped a couple of quads and Wind and Solar increased 3.5 quads (total 5%) over the past 10 years
- By 2016 not much had changed since 2011 (see next slide)
- Total rejected energy in  2011 was 55.6 quads and
  2021 was 65.4 quads.
- Is there some less visible efficiency in coal versus natural gas use or WUWT?
- Electrical power generation, industrial and transportation processes show very large fractions of rejected power

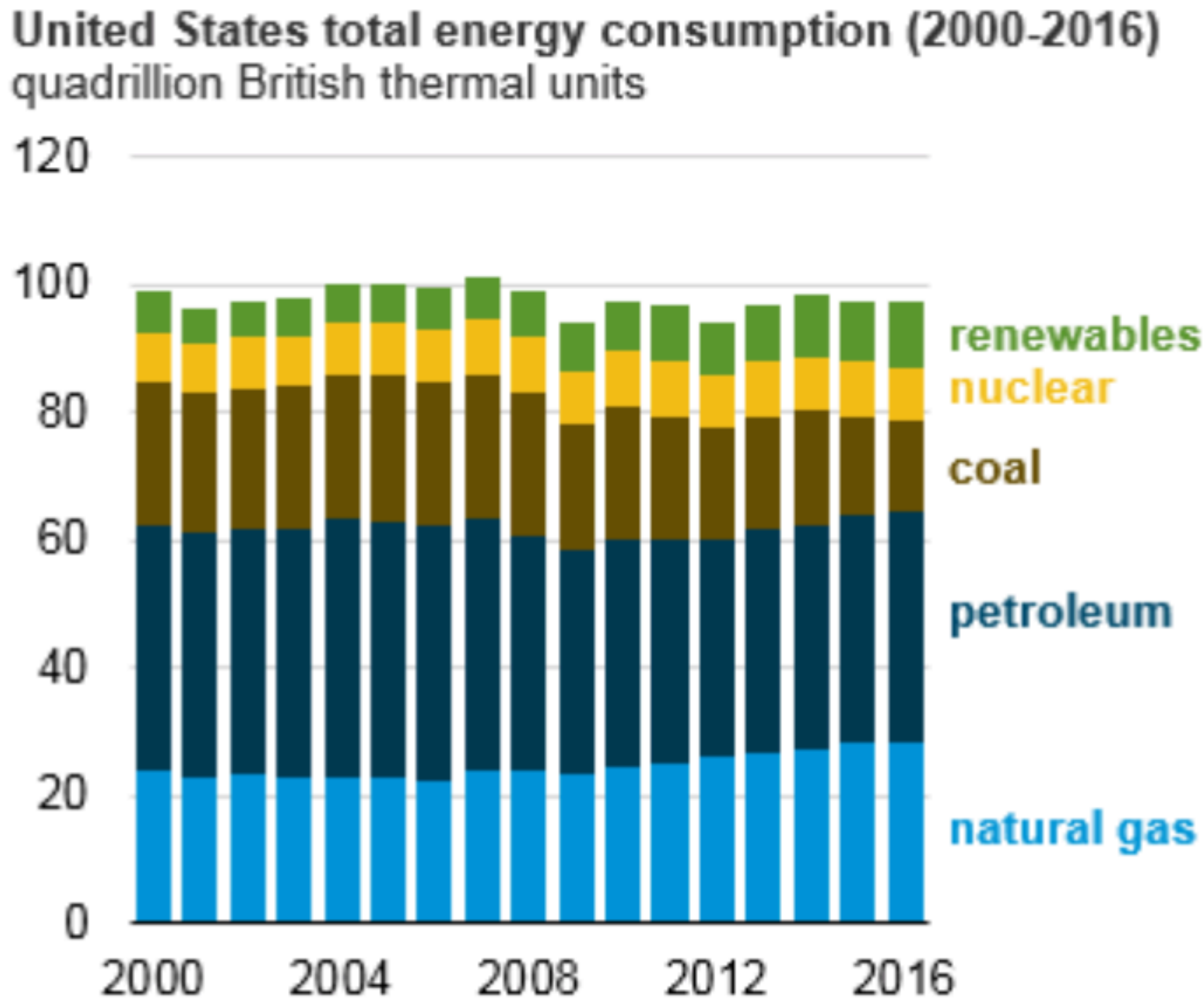
https://www.youtube.com/watch?v=G6dlvECRfcI




Source: LLNL March, 2017. Data is based on DOE/EIA MER (2016). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. This chart was revised in 2017 to reflect changes made in mid-2016 to the Energy Information

Energy 2016 United States

# 16 Years of Energy Trends



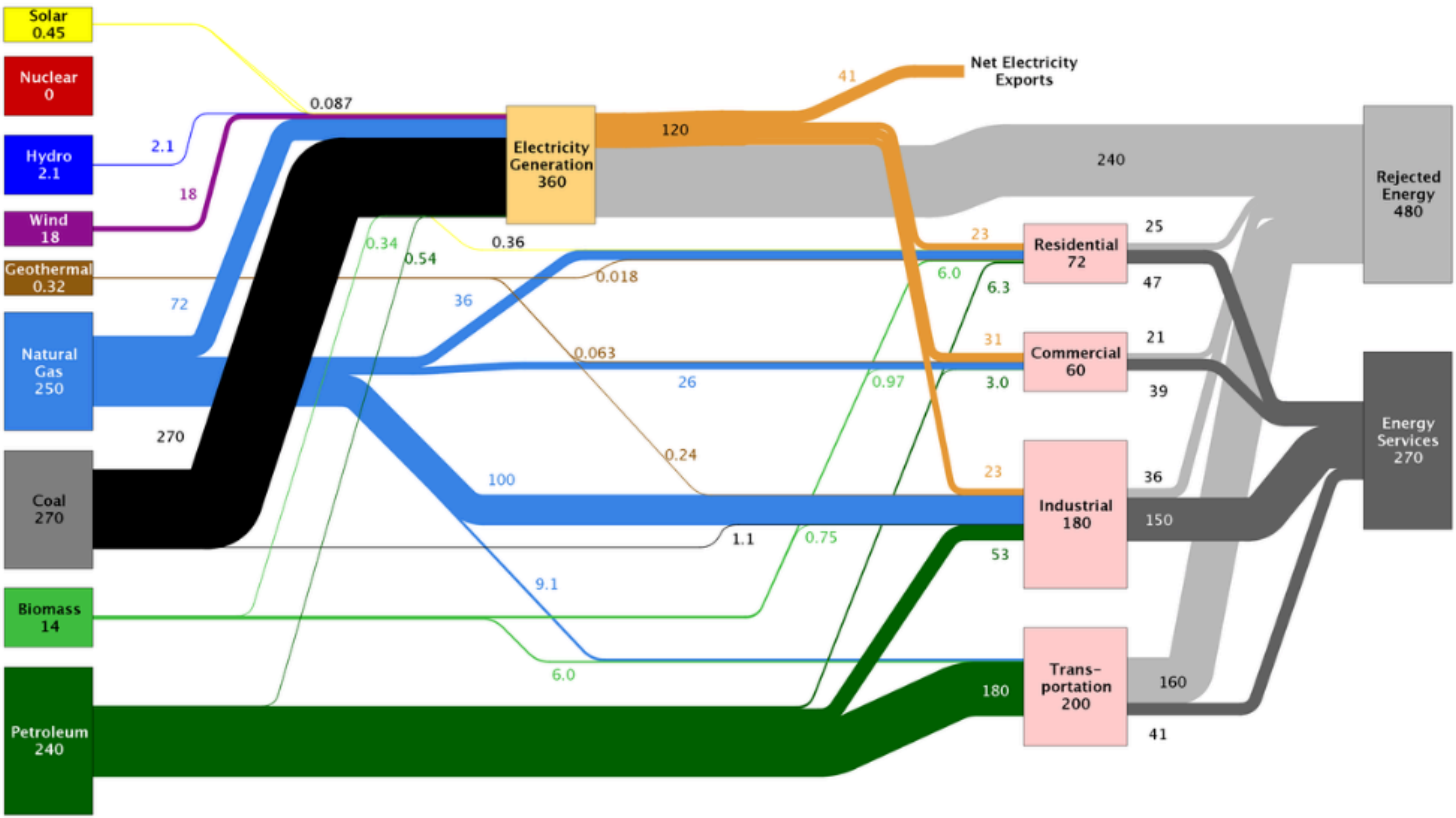

**Source:** U.S. Energy Information Administration, *Monthly Energy Review*

# New Mexico Energy Charts

- NM total energy use is less than a quad and increased by 23 trillion BTUs in the last decade.
- Coal use dropped by 119 trillion BTUs in the last decade
- Oddly NM shows no nuclear consumption for the whole decade while both PNM and EPE (with lots of So.NM customers) had significant imports of power from Palo Verde during the decade (each had a 15% share of Palo Verde total power output at the beginning of the decade)

## Estimated New Mexico Energy Use In 2010
## ~800 Trillion BTU

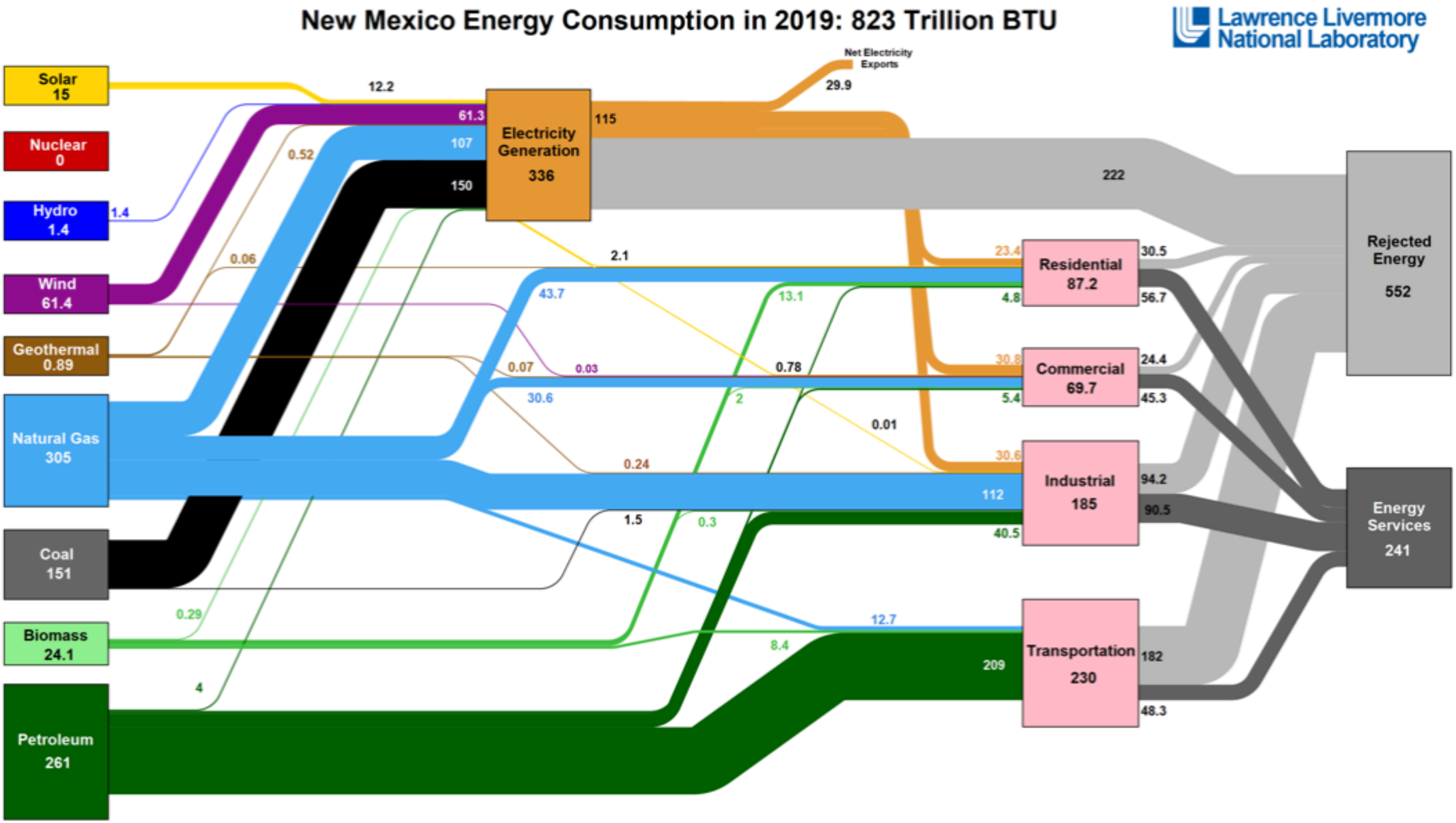
Lawrence Livermore National Laboratory




Source: LLNL 2013. Data is based on DOE/EIA-0214(2011), June 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. Interstate and international electricity trade are lumped into net imports or exports and are calculated using a system-wide generation efficiency. End use efficiency is estimated for each sector as 65% residential, 65% commercial, 80% industrial and 21% transportation. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Energy 2010 United States NM

# New Mexico Energy Consumption in 2019: 823 Trillion BTU

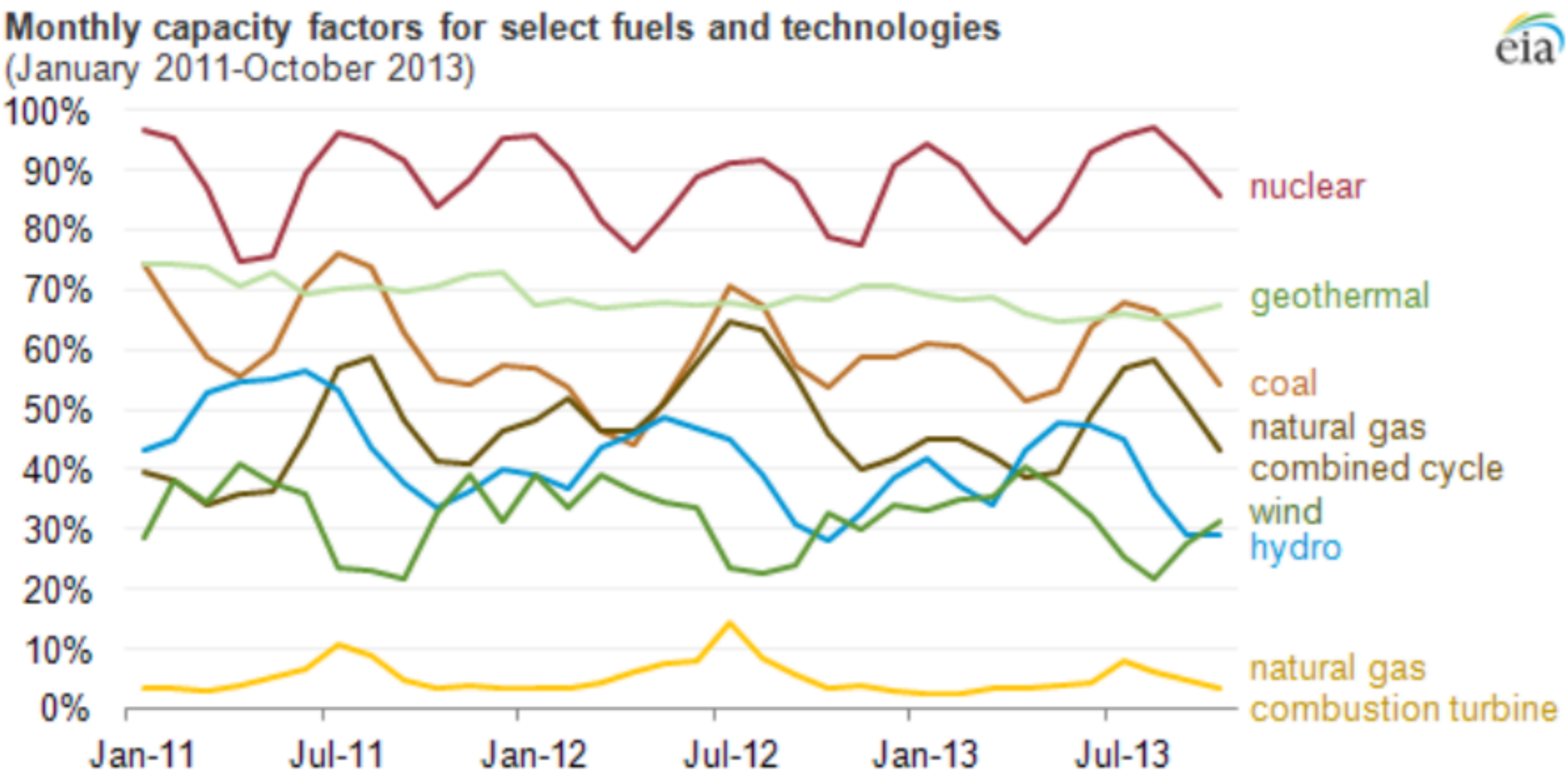



Source: LLNL August, 2021. Data is based on DOE/EIA SEDS (2019). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 0.65% for the residential sector, 0.65%

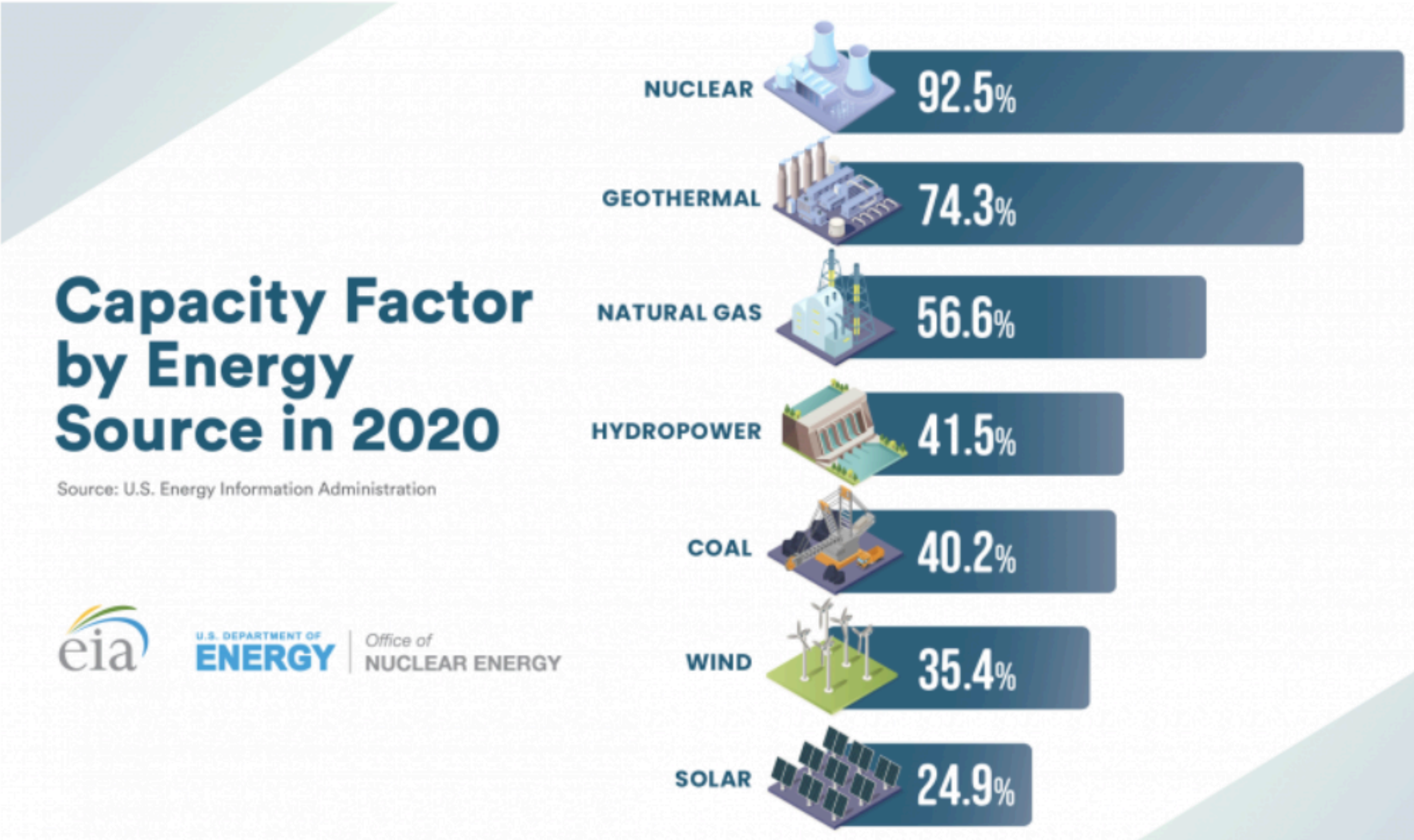
Energy 2019 United States NM

# Capacity Factor

The ratio of the electrical energy produced by a generating unit for the period of time considered to be the electrical energy that could have been produced at continuous full power operation during the same period.  Actual production data is used to produce the chart.



# Nuclear Has The Highest Capacity Factor



# Some General Comments

- Economic and Human activity drives energy use and the reason that 2021 energy use was the same as both 2016 and 2011 was probably due to the year 2021 being in the middle of the pandemic while inflation was rising to new heights

- From 2011 to 2021 coal use dropped by about half (9 quads) and natural gas use increase 6.4 quads to help make up for it

- Wind and solar production in 2013 totaled 1.92 quads and in 2021 totaled 4.83 quads

- With two decades of climate hysteria and portents of doom, the actual data shows very little warming and no trends in extreme weather and barely measurable shifts in energy sources (except for coal)

# Additional Reading and Thoughts on Waste Energy

- Mark Mills Booklet on Energy Reality was sent out early for homework

- https://flowcharts.llnl.gov/commodities/energy (source)

- With modest investments in improving efficiency and reduction of waste energy, we could supply a 2022 energy mix (without alternates) even with population growth and an improving standard of living (that would assume greater energy demand)

- Looking at these charts does focus the issues but this exercise seems to also to bring up a lot of questions

# Efficiency Vs. Alternates

- Increasing efficiency during the past 2 decades by keeping waste low or improving wasted quad loss is probably a better use of our time and money than the frenzied focus of effort on the alternates that we've seen

- The gain in energy production that the alternates showed in the 8 years between 2013 and 2021 was only 2.91 quads

- The total alternate energy production of wind and solar in 2021 as noted in previous charts was 4.83 quads

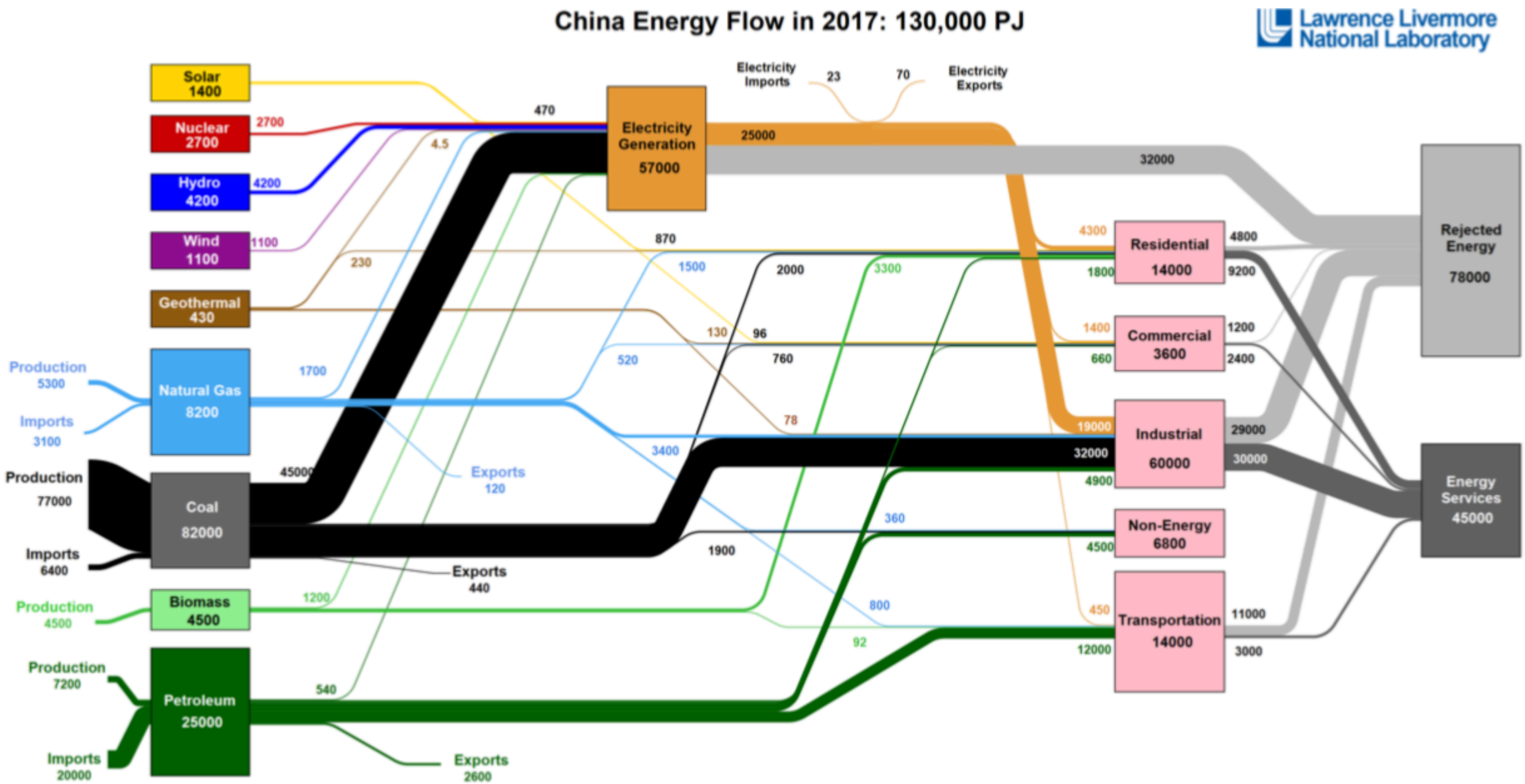
- It is remarkable how large the rejected energy (waste) is - 65.4 quads (about 2/3rds of total energy consumed)

- Much of this inefficiency is based on the laws of physics but there are likely some existing techniques (more insulation) or breakthroughs that might gain some few quads of usable energy

- Oddly 2011 had about 10 quads less rejected energy - Why?

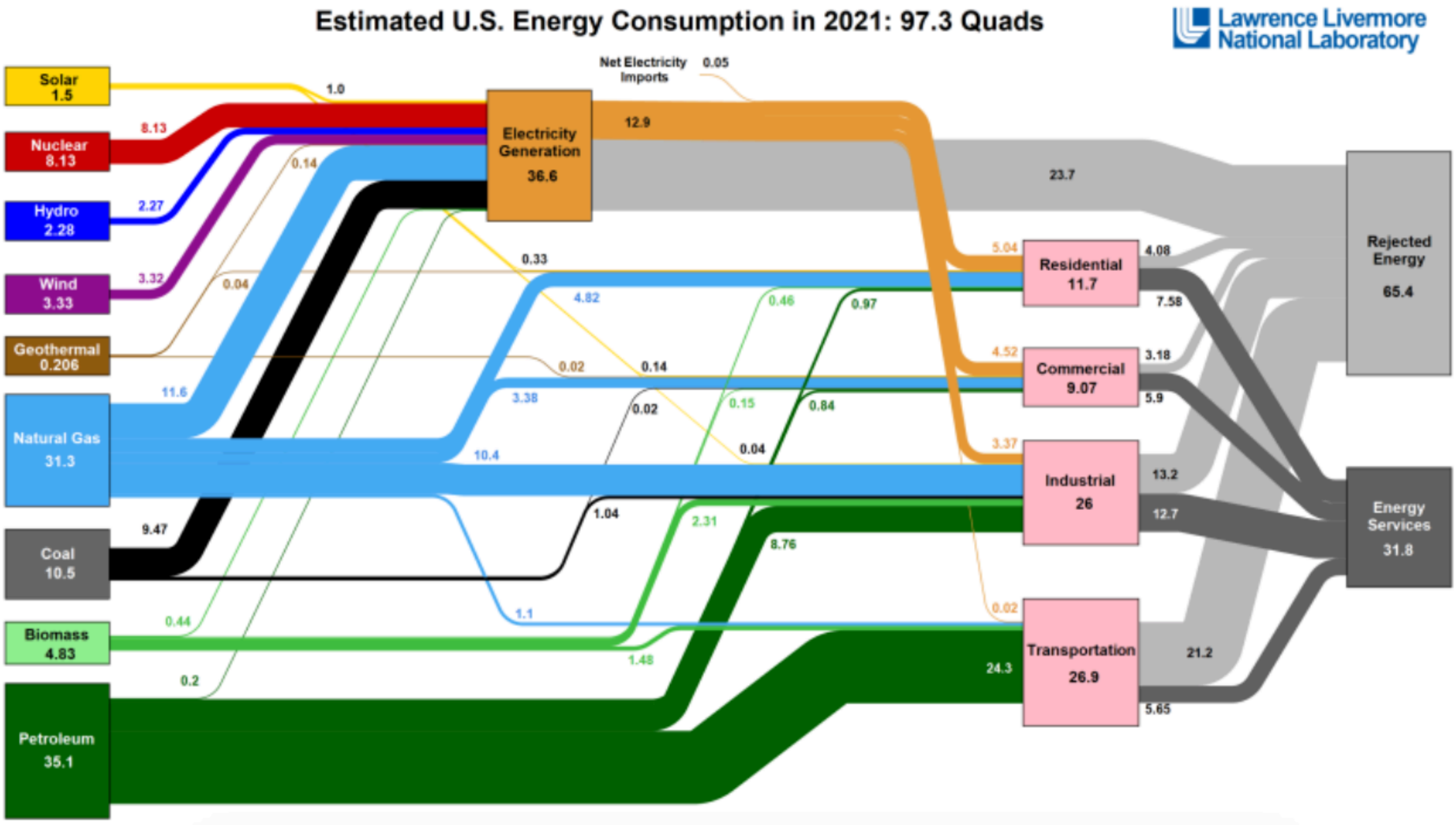
# China Vs. USA

**Roughly 1 Quad = 1000 Peta Joules**
**130,000 PJ ~ about 130 Quads**




Source: LLNL 2021. Data is based on IEAs Detailed World Energy Balances (2019 Edition). If this information, or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the U.S. Department of Energy, under whose auspices this work was performed. All quantities are rounded to 2 significant digits and annual flows of less than 0.10 PJ are not included. Total energy supply (top of chart) and energy resource statistics (left-side boxes) represent national energy use which is the sum of production and imports minus exports. Totals may not equal sum of flows due to independent rounding, stock changes, statistical difference and reporting inconsistencies. Further information can be accessed at https://flowcharts.llnl.gov. LLNL-MI-410527

ENERGY 2017 CHINA



Estimated U.S. Energy Consumption in 2021: 97.3 Quads
Lawrence Livermore National Laboratory
Solar 1.5
Nuclear 8.13
Hydro 2.28
Wind 3.33
Geothermal 0.206
Natural Gas 31.3
Coal 10.5
Biomass 4.83
Petroleum 35.1
Net Electricity Imports 0.05
Electricity Generation 36.6
12.9
23.7
Residential 11.7
Commercial 9.07
Industrial 26
Transportation 26.9
Rejected Energy 65.4
Energy Services 31.8
1.0
8.13
2.27
3.32
0.14
0.04
11.6
9.47
0.44
0.2
0.33
4.82
0.46
0.97
0.02
0.14
3.38
0.02
0.15
0.84
10.4
0.04
1.04
2.31
8.76
1.1
1.48
5.04
4.52
3.37
0.02
24.3
4.08
7.58
3.18
5.9
13.2
12.7
21.2
5.65

# Technical Issues with the Alternates

- Some of the biggest problems with the alternates are their unreliability 24/7 which requires grid level battery back up

- Work on these issues has been extensive and has intensified in the past decade with a large amount of money being spent with only modest improvements (while reaching upper physical limits). Recall Capacity factors for limits.

- Trying to reach unrealistic cost and performance goals defies cost/benefit limits that must soon be faced when planning for our energy future (e-vehicle battery replacement costs because of short life issues is worrisome)

- All energy solutions must also address environmental problems

# Fossil Fuels and Climate Change

- The problem with fossil fuels is they are supposed to cause climate change or more seriously global warming
- A doubling of $CO_2$ in the atmosphere is likely to have some warming effect but so far with an increase of more than 100 ppm of atmospheric $CO_2$ in the past 100 years, it is hard to see more than a fraction of a degree of long term temperature rise (which is effectively in the noise)
- So far the only support of this theory are a number of models. Actual data has already begun to falsify their projections
- Cyclical temperatures do seem to change over short periods by on average $15^0$ C daily, $20^0$ C seasonally, $2^0$ C from UHI effect (and so on) but real data shows long term global average baseline temperature change is only about 1 degree in a century.  GHG saturation indicates doubling $< 0.4^0$ C

# Ignored Environmental Issues

- Both Wind and Solar energy production for Net-Zero levels of energy require huge amounts of land areas that will completely eliminate regional ecosystems of plants and animals all over the planet

- The mining of many of the minerals used in these power systems and the batteries to support their grids will push  global mines that are already needed for our existing modern life style, well beyond their limits

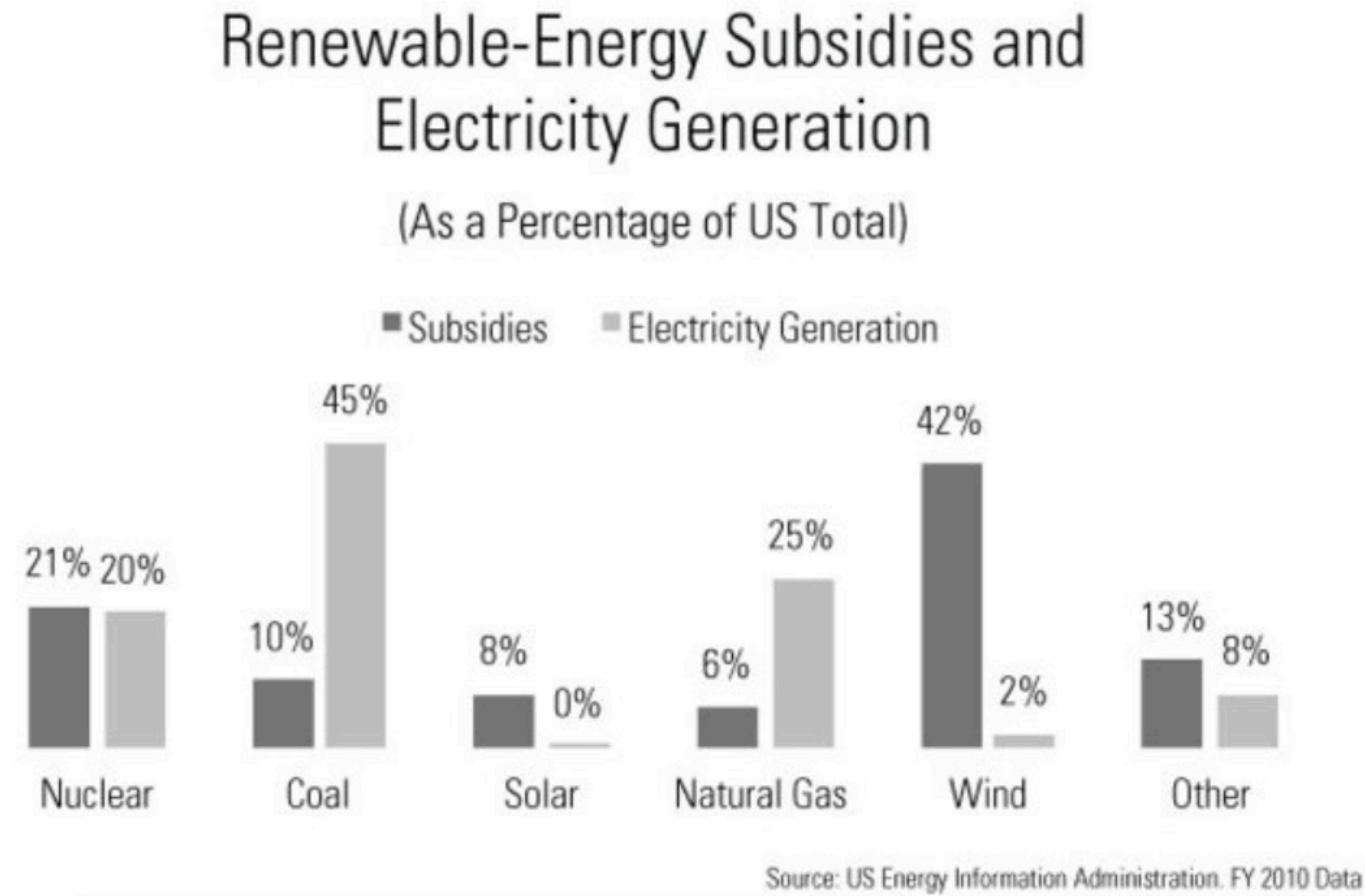
- Mark Mills has documented that many places where mines are found on the planet are already facing shut down due to environmental issues

- Recycling materials from the used up parts of these systems will require even more disruptive land fill

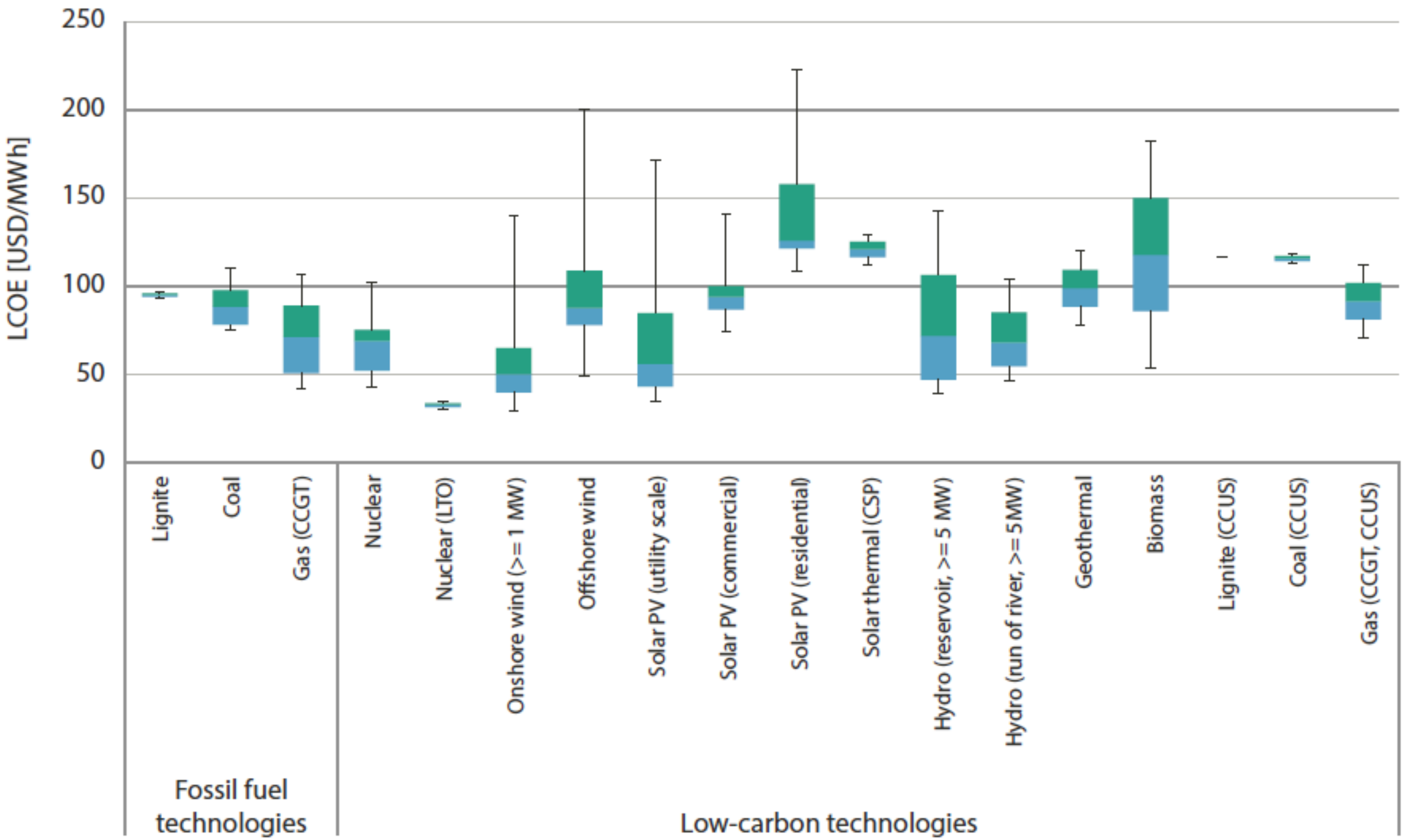
- Safety especially from fires in power plant battery packs and e-vehicles is already becoming an issue

# Some interesting Cost Issues

- In my attempt to determine actual costs for the various energy sources, I ran into some serious problems of finding true costs. Issues of subsidies - see next slide
- It was often assumed that CO2 was a serious threat due to global warming and that cost differences for fossil fuels versus alternate energy could be ignored because of that
- Capacity factor issues seemed to also be ignored
- I ran into distorted Levelized Costs of Energy (LCoE) issues that attempted to factor extreme warming issues into the costs
- There were cost and effectiveness uncertainties that were often ignored (two slides after this)


Renewable-Energy Subsidies and Electricity Generation
(As a Percentage of US Total)
Subsidies
Electricity Generation
21%
20%
10%
45%
8%
0%
6%
25%
42%
2%
13%
8%
Nuclear
Coal
Solar
Natural Gas
Wind
Other
Source: US Energy Information Administration. FY 2010 Data

## Figure ES1: LCOE by technology




Note: Values at 7% discount rate. Box plots indicate maximum, median and minimum values. The boxes indicate the central 50% of values, i.e. the second and the third quartile.

# Energy Use Vs. GDP/purchasing power parity PPP

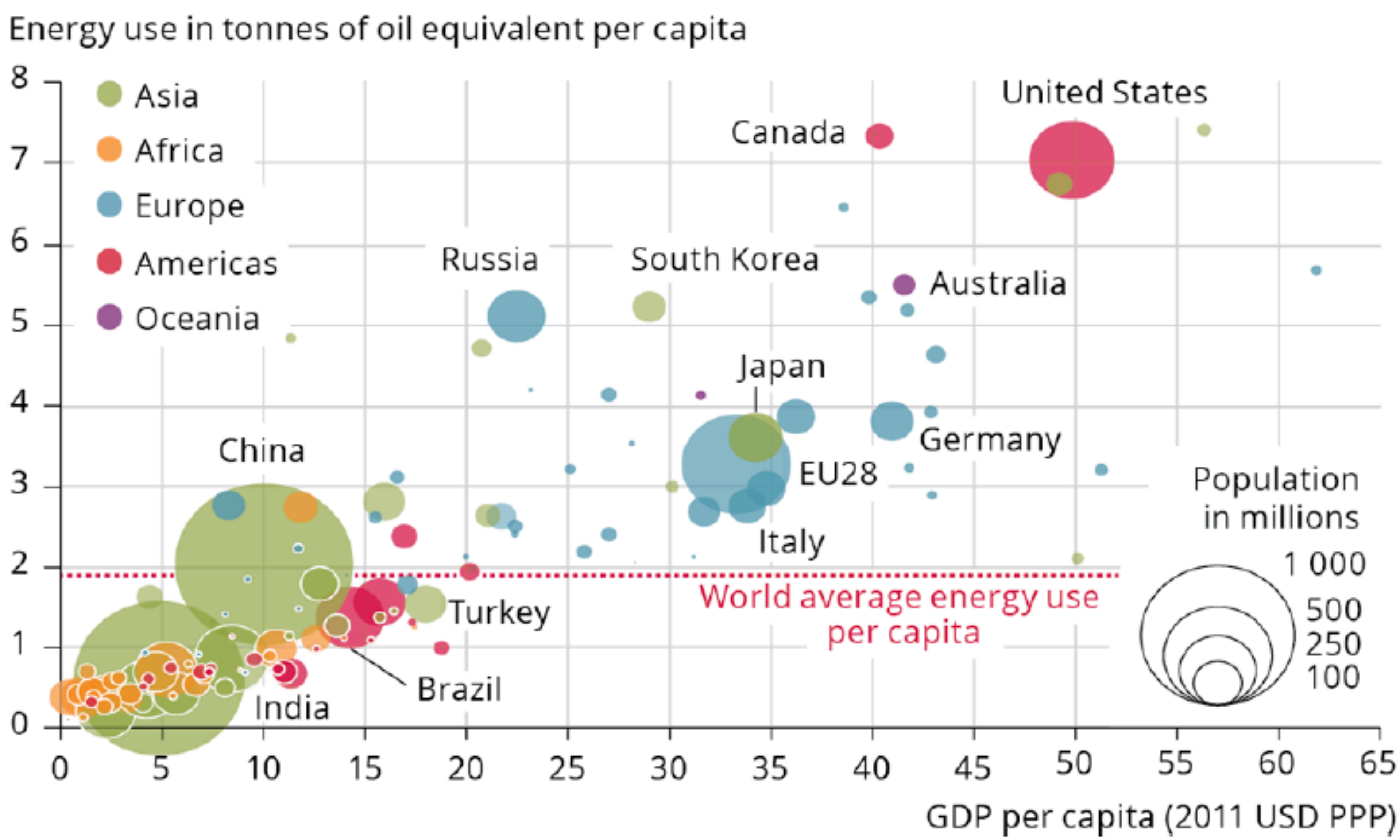



Figure 1.5. Per capita energy consumption (kg oil equivalent) vs. per capita GDP, PPP (2016 $USD). The size of the bubbles denotes total population per country. All values refer to the year 2011.
(Source: European Environment Agency)

# And the Big One

- Net-Zero grid issues will probably require a complete re-do of our existing grid
- This has a potential for being at a very large cost and may not be even possible (enter AI!)
- Are we ready to toss the old out for the new when the new has not even been subjected to any sort of scaled up test?

# But Why Worry?

- Why are we tossing out any possibilities?  Why aren’t we verifying that some of our assumptions are wrong/or right?  Why aren’t we looking for a variety of solutions?
- My family PCP recently suggested that we should probably begin a “Manhattan Like Process” to help us make some tough decisions and perhaps uncover some new technology or energy systems
- Perhaps with some of the alternates we could have a region or a state begin to implement some of the latest “green” plans to see how grounded in real technology they might be
- It would require some funds but probably a lot less than are being predicted to implement an alternate energy switch

# Quick CA and TX comparison Energy Use 2010 & 2019 and Cost (This data might begin to display a sort of test)

- CA increased their production of Solar energy (from 40 to 408 trillion BTUs) while TX increased Wind energy production (from 260 to 745 trillion BTUs)

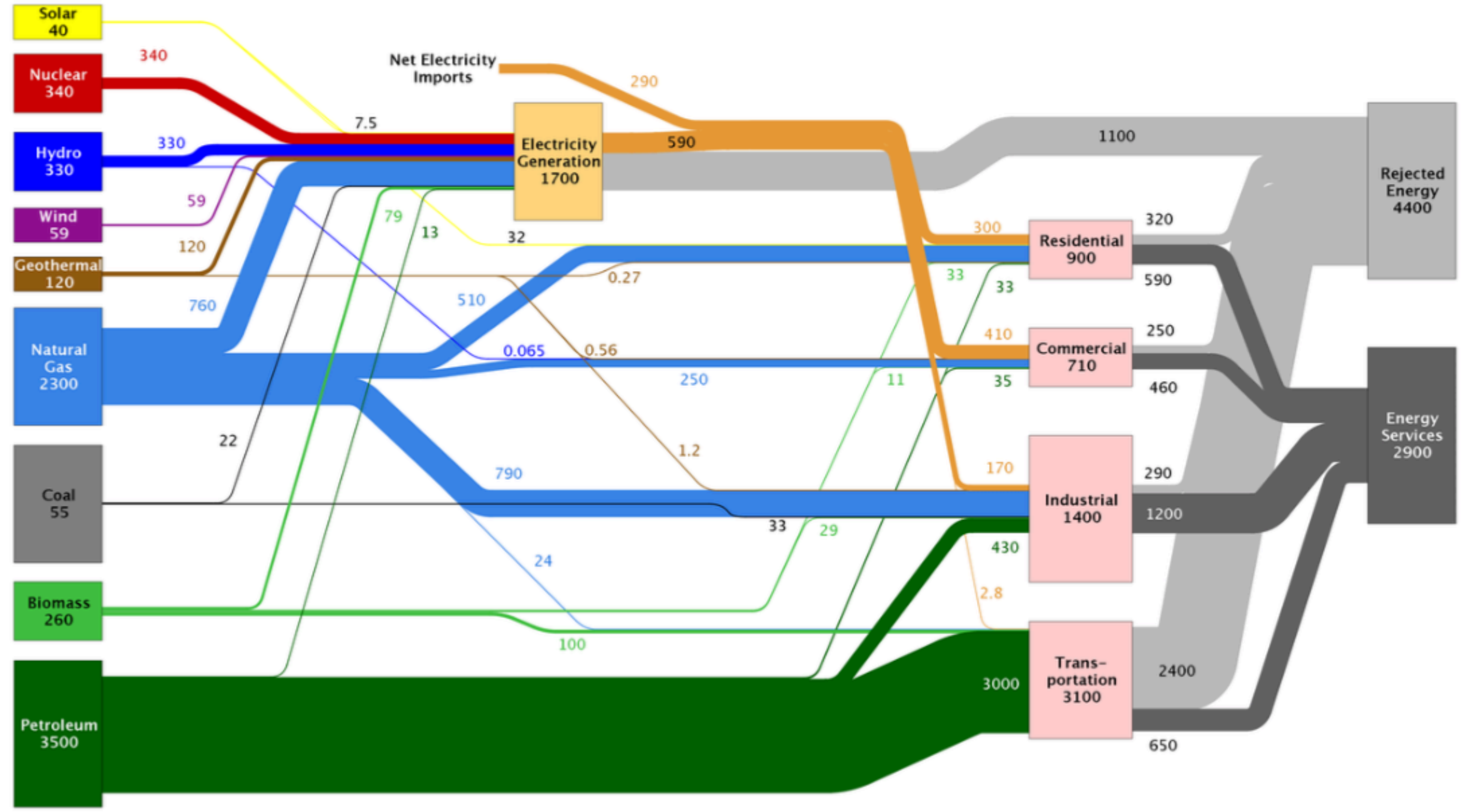
- CA consumption in 2010 was 7300 trillion BTUs and increased very modestly in 2019 to 7352 trillion BTUs

- TX consumption went from 12000 trillion BTUs to 14165 trillion BTUs in that period

- Look at the rates for those two states in the charts following the 2 Sankey chart slides - next 4 slides

## Estimated California Energy Use In 2010
## ~7300 Trillion BTU

Lawrence Livermore National Laboratory

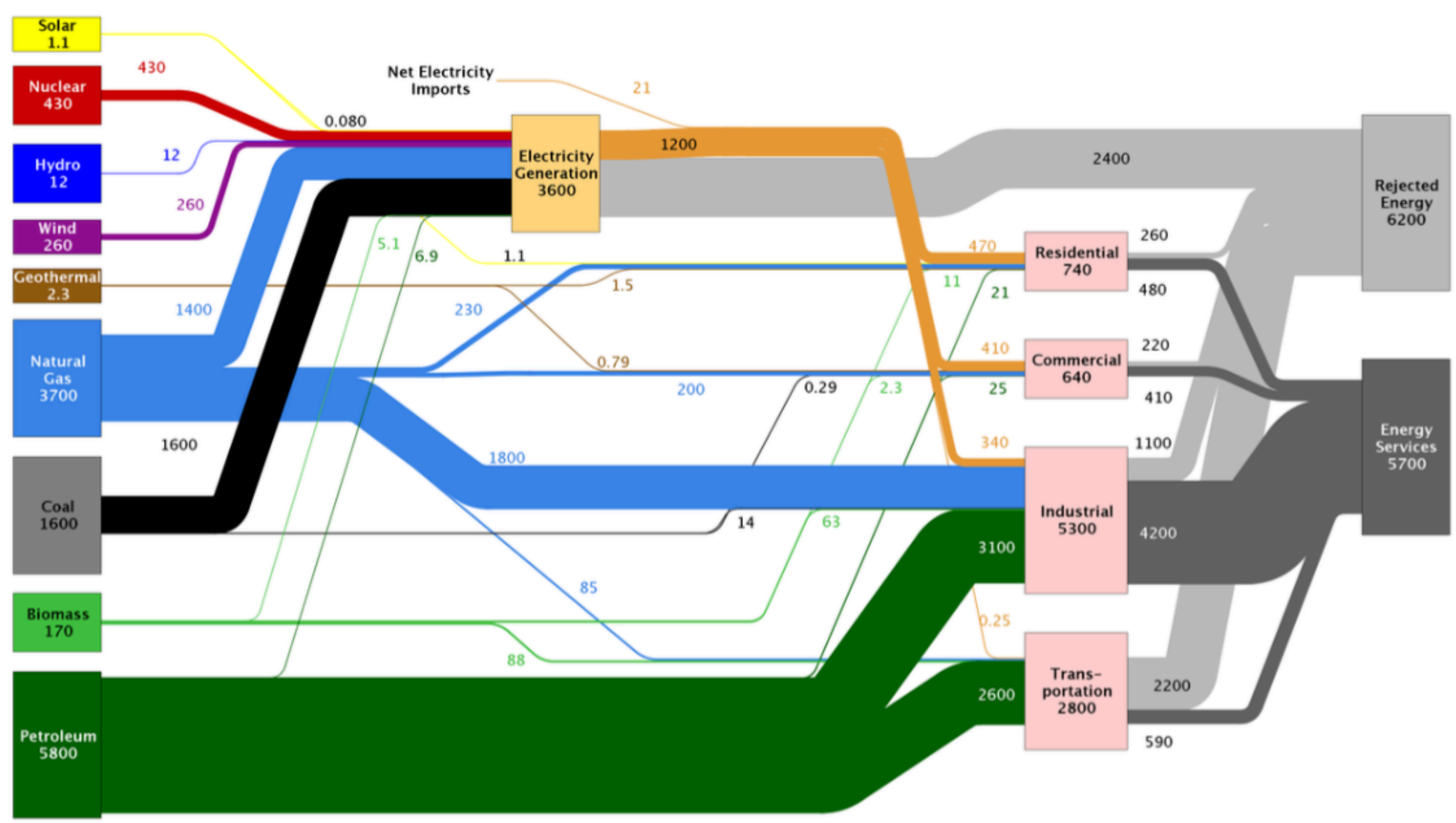



Source: LLNL 2013. Data is based on DOE/EIA-0214(2011), June 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources

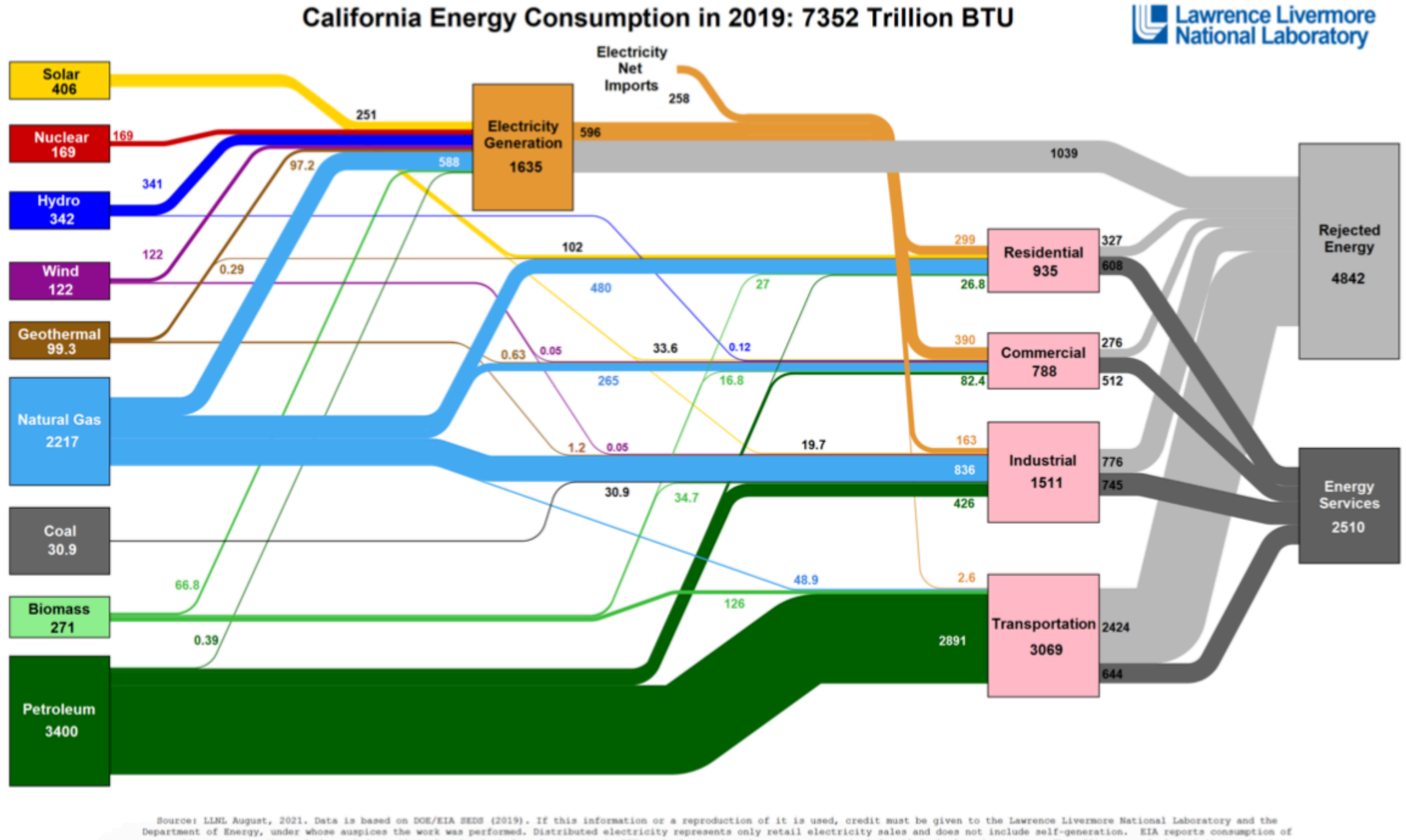
Energy 2010 United States CA

## Estimated Texas Energy Use In 2010
## ~12000 Trillion BTU

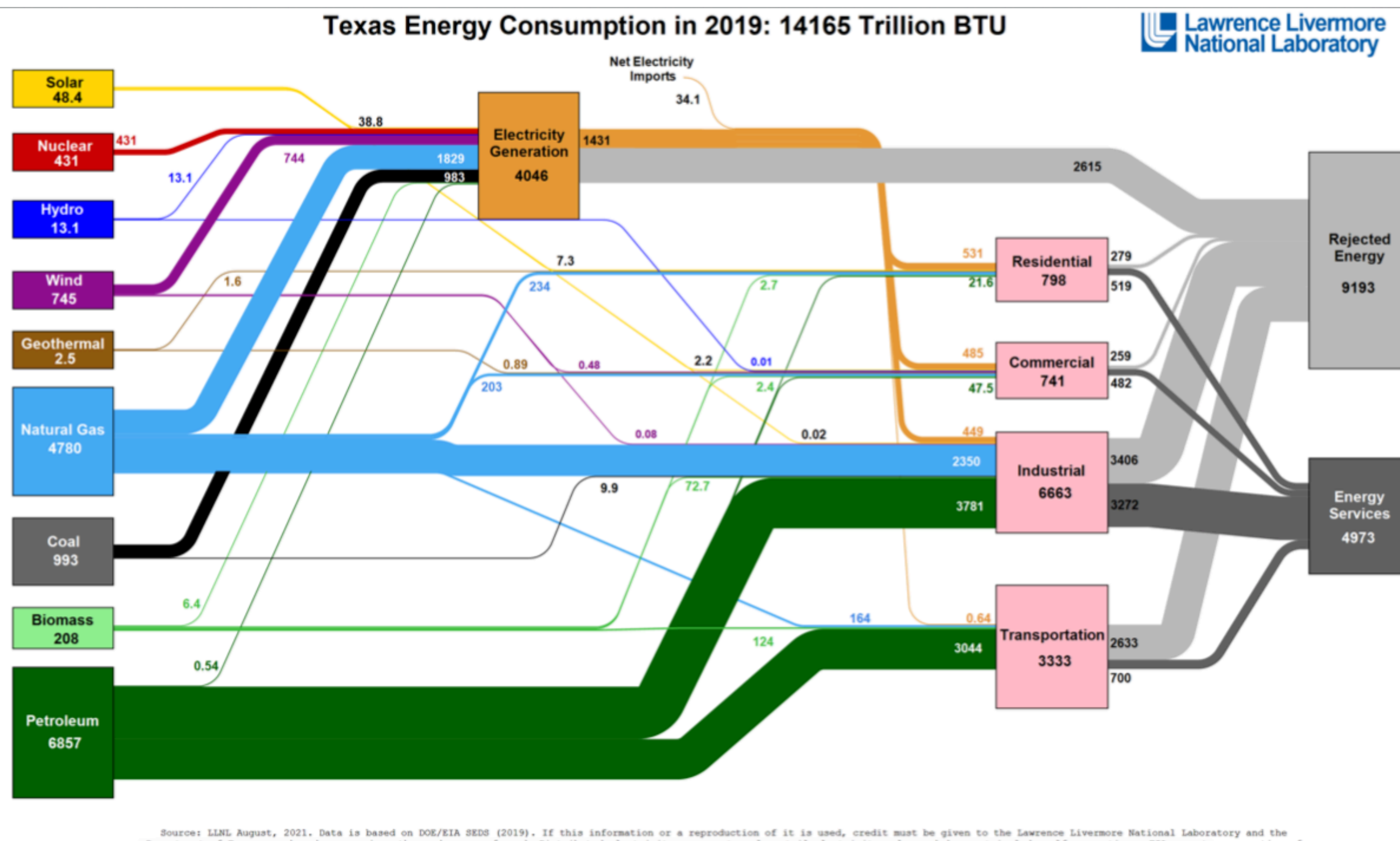
Lawrence Livermore National Laboratory




Source: LLNL 2013. Data is based on DOE/EIA-0214(2011), June 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources




Energy 2019 United States CA




Energy 2019 United States TX

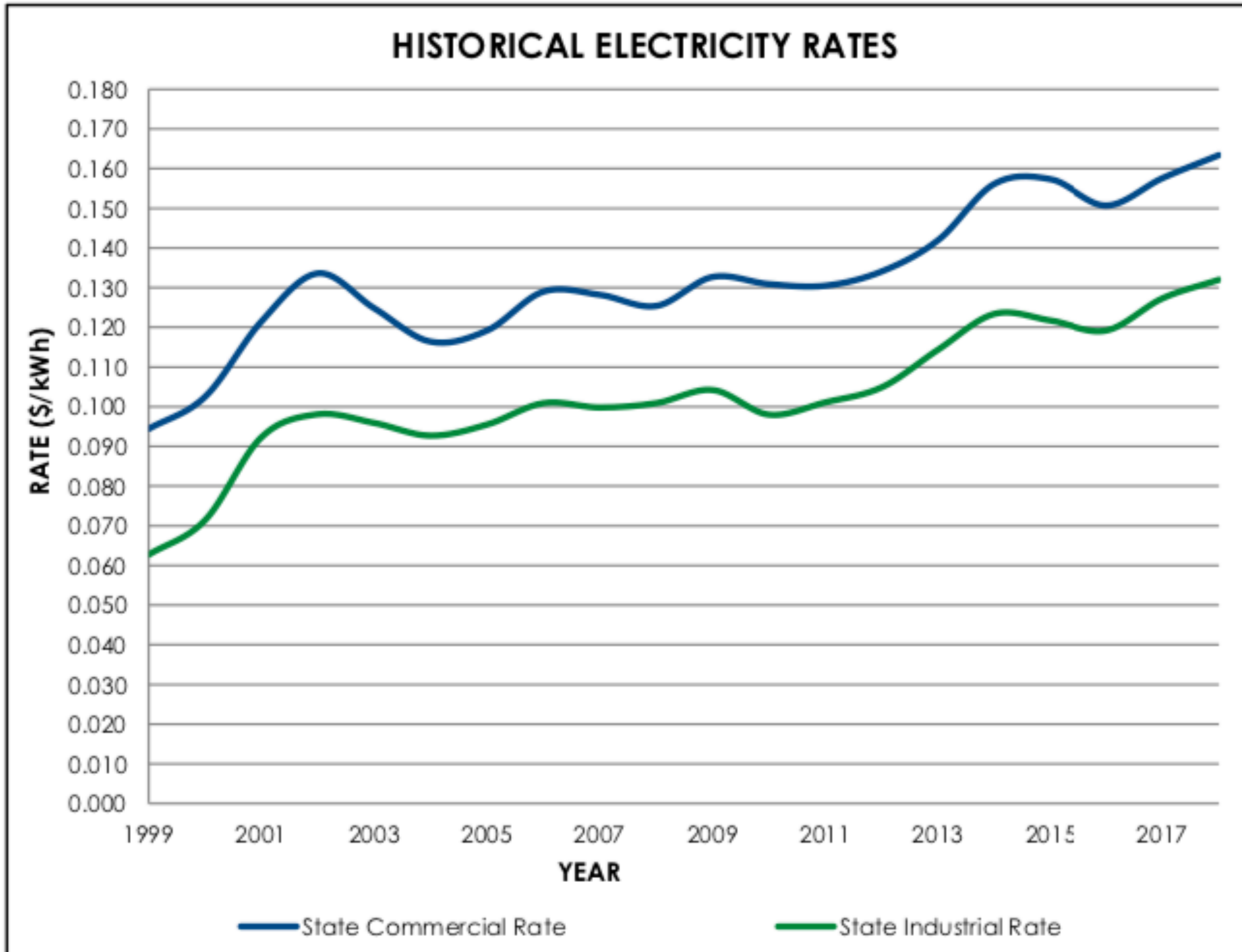
# 20 YEAR HISTORICAL ELECTRICITY RATE ANALYSIS: INDUSTRIAL AND COMMERCIAL BY STATE 1999-2018

ONE ENERGY

## California (CA)

| | ELECTRICITY RATES ($/kWh) | | | |
|---|---|---|---|---|
| | INDUSTRIAL | | COMMERCIAL | |
| Year | Rate | % Change | Rate | % Change |
| 1999 | $ 0.063 | -- | $ 0.094 | -- |
| 2000 | $ 0.071 | +13.9% | $ 0.103 | +8.6% |
| 2001 | $ 0.092 | +29.3% | $ 0.122 | +18.5% |
| 2002 | $ 0.098 | +6.3% | $ 0.134 | +10.0% |
| 2003 | $ 0.096 | -2.2% | $ 0.125 | -6.6% |
| 2004 | $ 0.093 | -3.3% | $ 0.116 | -6.7% |
| 2005 | $ 0.096 | +3.0% | $ 0.119 | +2.4% |
| 2006 | $ 0.101 | +5.7% | $ 0.129 | +8.2% |
| 2007 | $ 0.100 | -1.1% | $ 0.128 | -0.6% |
| 2008 | $ 0.101 | +1.1% | $ 0.125 | -2.2% |
| 2009 | $ 0.104 | +3.3% | $ 0.133 | +5.8% |
| 2010 | $ 0.098 | -6.0% | $ 0.131 | -1.4% |
| 2011 | $ 0.101 | +3.2% | $ 0.131 | -0.3% |
| 2012 | $ 0.105 | +3.8% | $ 0.134 | +2.8% |
| 2013 | $ 0.114 | +9.1% | $ 0.142 | +5.9% |
| 2014 | $ 0.123 | +7.9% | $ 0.156 | +10.0% |
| 2015 | $ 0.122 | -1.4% | $ 0.157 | +0.7% |
| 2016 | $ 0.119 | -2.1% | $ 0.151 | -4.2% |
| 2017 | $ 0.127 | +6.8% | $ 0.158 | +4.6% |
| 2018 | $ 0.132 | +3.7% | $ 0.163 | +3.7% |

**SOURCE:** US EIA Report: 1999-2018 (See methodology page for details)




| ELECTRICITY RATE SUMMARY ($/kWh) | | | | | |
|---|---|---|---|---|---|
| | 1999 RATE | 2018 RATE | AVERAGE ANNUAL INCREASE | TOTAL INCREASE | PREDICTED 2038 RATE |
| INDUSTRIAL | $0.063 | $0.132 | 3.8% | 110.5% | $0.278 |
| COMMERCIAL | $0.094 | $0.163 | 2.8% | 73.1% | $0.283 |

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# 20 YEAR HISTORICAL ELECTRICITY RATE ANALYSIS: INDUSTRIAL AND COMMERCIAL BY STATE 1999-2018

ONE ENERGY

## Texas (TX)

| | ELECTRICITY RATES ($/kWh) | | | |
|---|---|---|---|---|
| | INDUSTRIAL | | COMMERCIAL | |
| Year | Rate | % Change | Rate | % Change |
| 1999 | $ 0.040 | -- | $ 0.065 | -- |
| 2000 | $ 0.044 | +11.3% | $ 0.069 | +5.5% |
| 2001 | $ 0.053 | +19.2% | $ 0.077 | +12.5% |
| 2002 | $ 0.047 | -11.6% | $ 0.070 | -10.2% |
| 2003 | $ 0.053 | +13.1% | $ 0.078 | +12.8% |
| 2004 | $ 0.059 | +11.4% | $ 0.079 | +0.8% |
| 2005 | $ 0.071 | +21.6% | $ 0.089 | +12.0% |
| 2006 | $ 0.078 | +9.5% | $ 0.099 | +11.3% |
| 2007 | $ 0.078 | -0.4% | $ 0.099 | +0.2% |
| 2008 | $ 0.088 | +12.8% | $ 0.108 | +8.9% |
| 2009 | $ 0.067 | -23.3% | $ 0.097 | -10.1% |
| 2010 | $ 0.064 | -4.5% | $ 0.092 | -4.9% |
| 2011 | $ 0.062 | -3.1% | $ 0.088 | -3.9% |
| 2012 | $ 0.056 | -10.7% | $ 0.082 | -7.6% |
| 2013 | $ 0.058 | +4.3% | $ 0.080 | -1.7% |
| 2014 | $ 0.062 | +6.0% | $ 0.082 | +1.7% |
| 2015 | $ 0.056 | -9.3% | $ 0.082 | -0.1% |
| 2016 | $ 0.053 | -4.7% | $ 0.083 | +1.3% |
| 2017 | $ 0.054 | +0.4% | $ 0.083 | 0.0% |
| 2018 | $ 0.054 | +0.7% | $ 0.082 | -1.2% |

**SOURCE:** US EIA Report: 1999-2018 (See methodology page for details)

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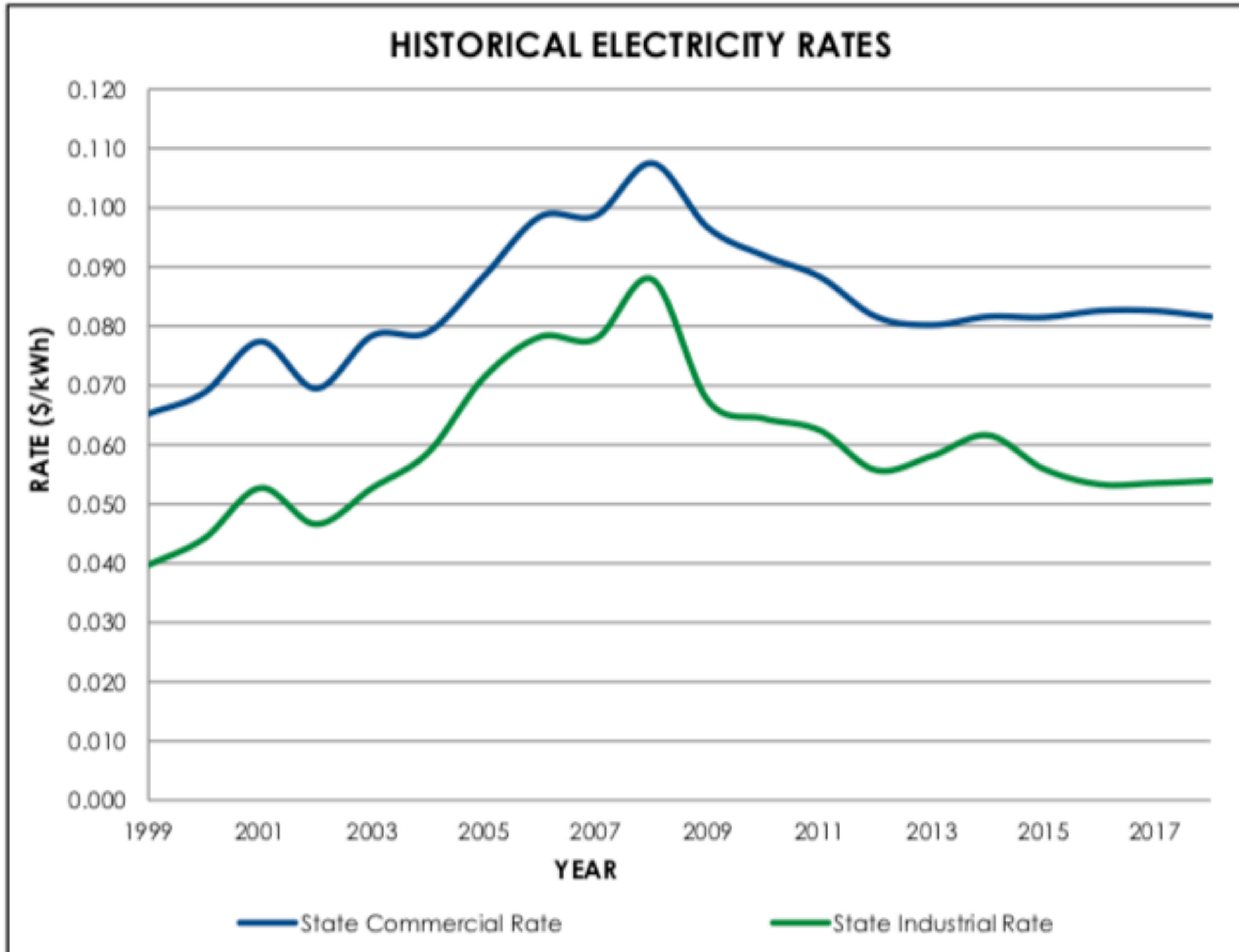



| ELECTRICITY RATE SUMMARY ($/kWh) | | | | | |
|---|---|---|---|---|---|
| | 1999 RATE | 2018 RATE | AVERAGE ANNUAL INCREASE | TOTAL INCREASE | PREDICTED 2038 RATE |
| INDUSTRIAL | $0.040 | $0.054 | 1.5% | 35.8% | $0.073 |
| COMMERCIAL | $0.065 | $0.082 | 1.1% | 25.2% | $0.102 |

# Energy Information Agency (EIA)

- The US Government EIA (DoE) projected numbers for US energy consumption for 2031 is 110.5 quads and they predict that renewable energy production by then will be about 15 quads
- This is 2.8 quads above 2021 levels or about 14% of the total energy used by the year 2031
- Clearly the renewables cannot reach even 25% of the total in that time on the growth curve we now have.  And 50% of alternate energy use by 2050 (growth of 36%) is no where near Net-Zero
- Magical breakthroughs will definitely be needed along with a more aggressive growth curve that so far money has not been able to buy (and probably never will buy)

# Toward a more realistic energy future

- If solar and wind reach only a 25% energy use level in the next few decades, the rest of the electrical base load prime movers will easily be able to sustain the present grid system. There have been a number of studies on this. Predicted energy costs for this are very low (especially if subsidies for the alternates are removed or at least drastically reduced).

- If we start to see improvements in the issues surrounding all the energy prime movers - technical, environmental and financial problems should start to be solved by 2050

- Perhaps by 2050 there will be super batteries and maybe more nukes and coal prime movers will be safer or be run from afar by robots so that no humans will be put at risk

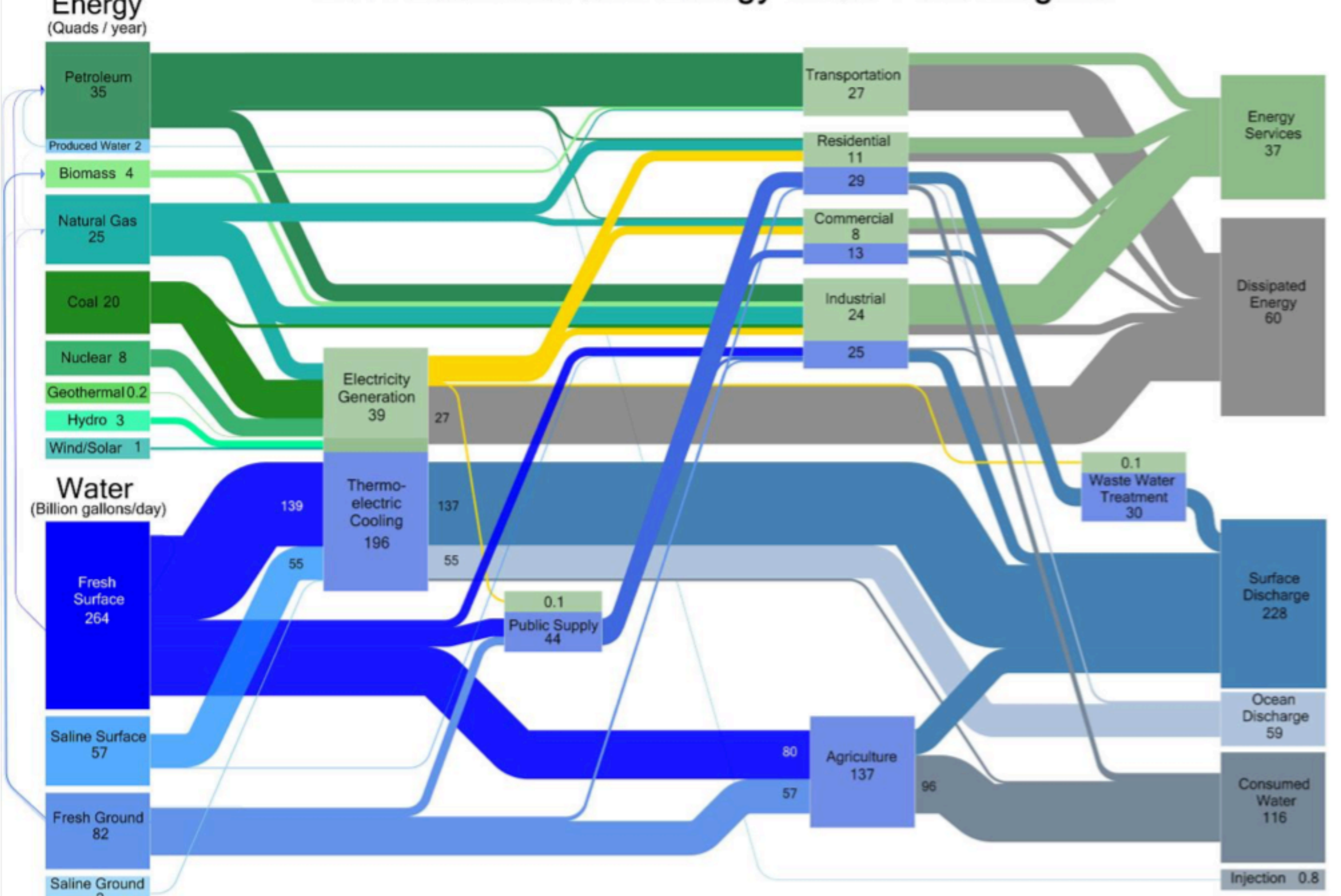
And maybe we can take some good advice into the foreseeable future and "Let's all just Chill"

–*Steve McGee*

# Water Issues using Sankey Diagrams

Bonus Presentation
by
Bernie McCune
May 20, 2023

# 2011 Estimated U.S. Energy-Water Flow Diagram

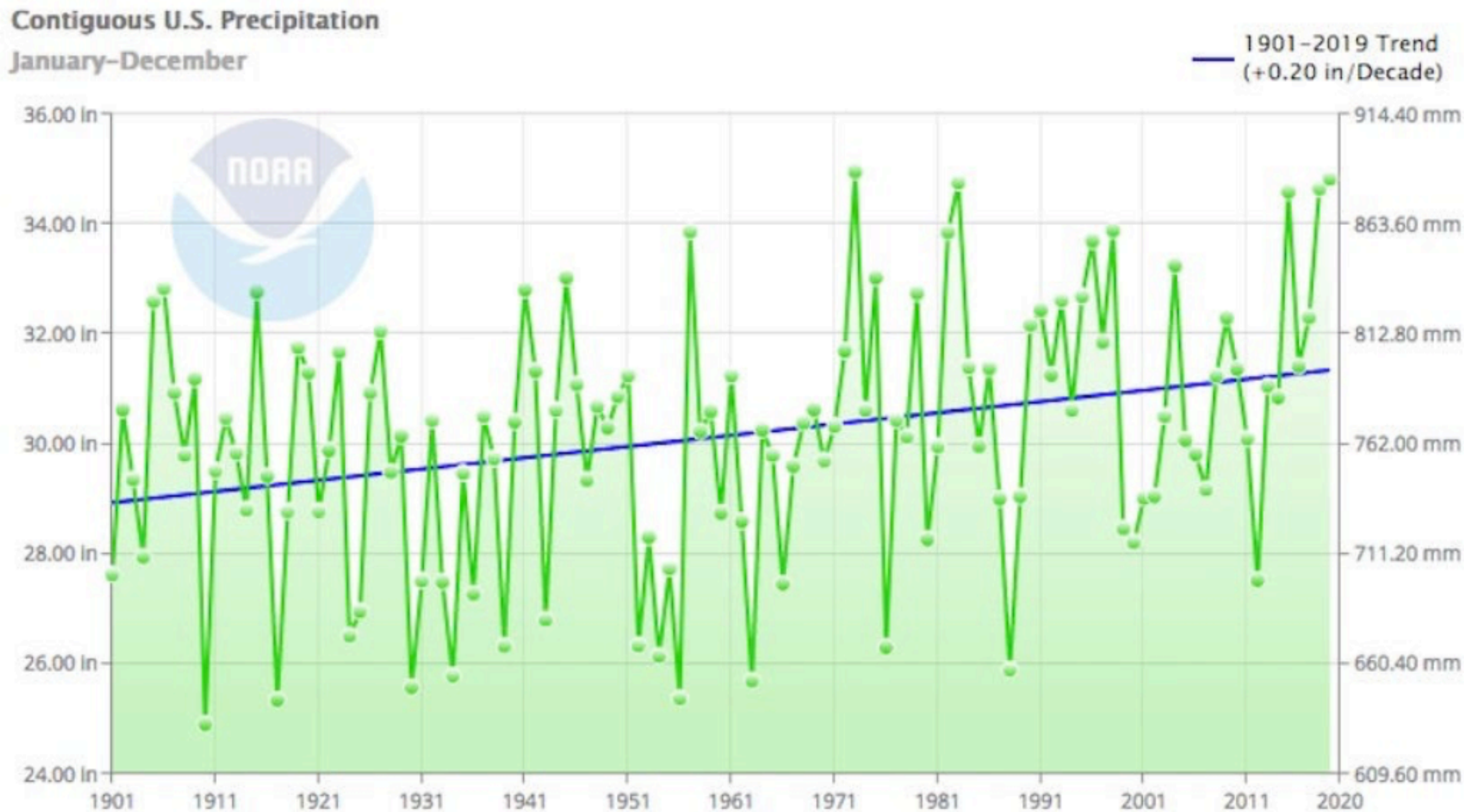



Energy reported in Quads/year. Water reported in Billion Gallons/Day.

# The Ag water consumption caught my eye

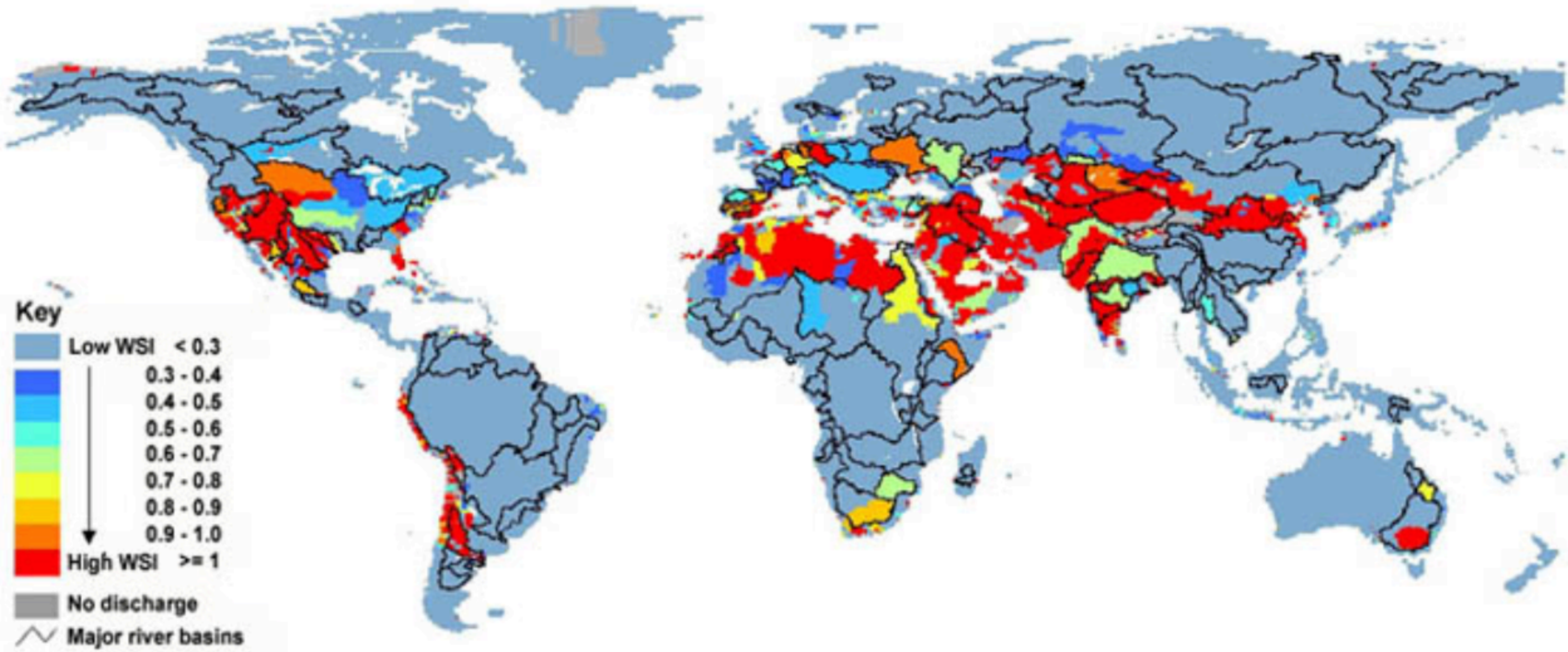
- The water part of the previous chart shows mostly human impacted daily reservoirs, inflows, outflows and consumption
- The direct human consumption of the diagram totals 20 trillion gallons of water a year (which seems quite a lot!)
- Agriculture consumes another 96 trillion gallons/yr
- For the past over 100 years, natural precipitation across the US averaged 30 inches of rain/snow etc falling on each square foot of the US each year = 18.69 gallon/sq ft
- Since the US covers 103,671,742,065,571 sq feet, net natural fresh water input would be about 1,940 trillion gallons every year
- That’s more that 17 times what humans in the US consume (116 trillion gallons/yr)

# Annual Average US Rainfall




Annual precipitation, averaged across the contiguous U.S., for the period 1901-2019. (NOAA/NCEI)

# Water Stress Indicator




**Since the US experiences high water stress mostly in the SW and northern plains. A method to redistribute excess water west and north of the Rockies and NE of the Rockies would dramatically decrease the water stress in the US.**

# Past Ideas of water transfer

- Pipelines of over 1000 miles in length have been proposed to take Mississippi river water especially during flood stages beyond the Rockies to be injected into Colorado river, Rio Grande river and Pecos river basins

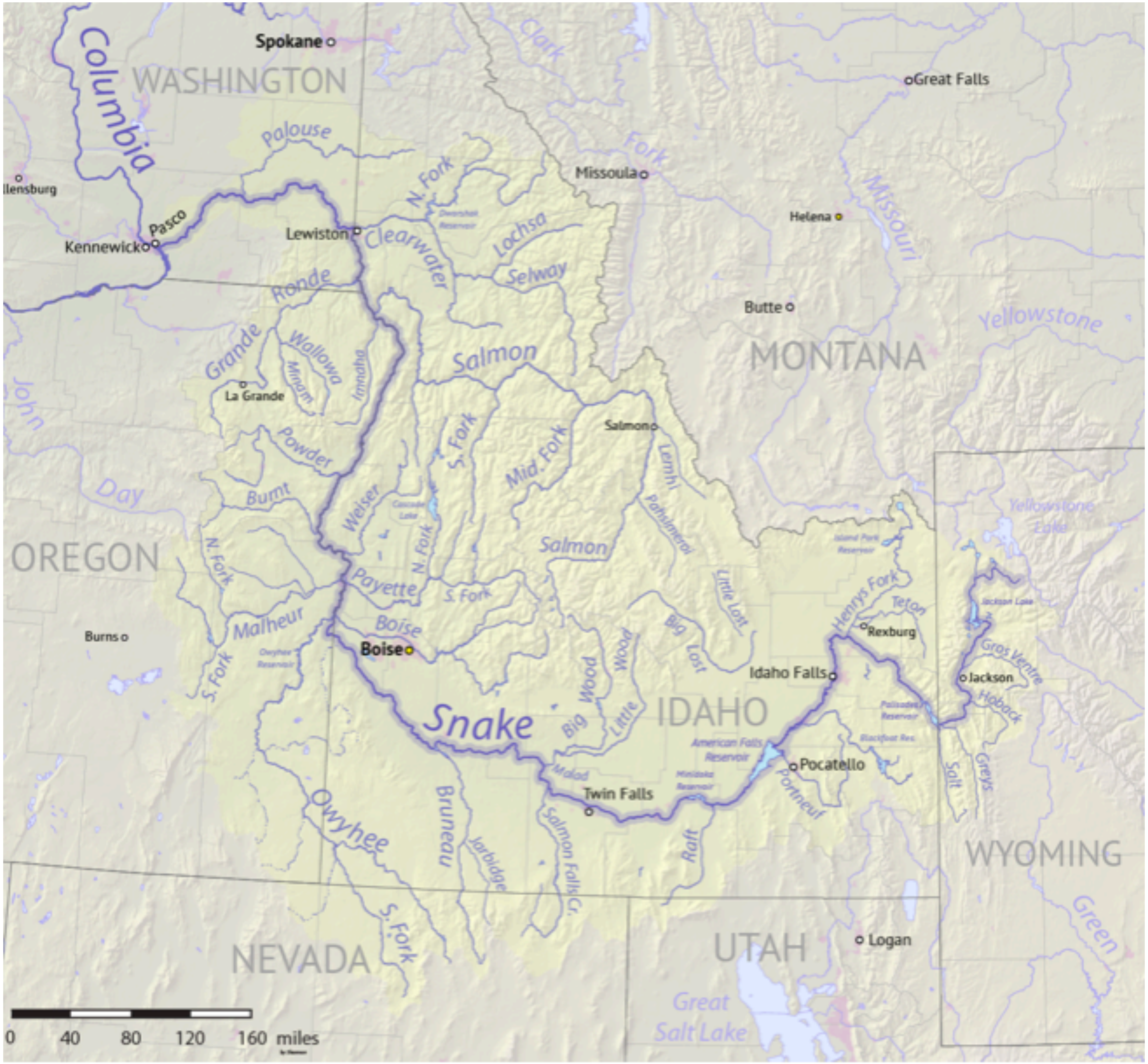
- Another idea was to use the Rocky Mountain Trench that traverses Canada from the Yukon river south into Idaho and Montana and form a huge reservoir to supply water to the Colorado river basin

- These were huge schemes with many dams and pumps to assure that water stressed areas of the SW US would always have plenty of water

- There are probably simpler ways to allow excess water in the RMTrench, the Missouri river and the Colorado river to overflow water into the SW US excess to limit water stress conditions except in very extreme drought conditions (with fewer dams and no reservoirs)

# North American Water Origins

- The corners where Montana, Idaho and Wyoming meet form the origins of most of the beginnings of our largest river basins
- This also is where the southern end of the Rocky Mountain Trench out flows
- The Colombia, Missouri (Mississippi) and the Green River (Colorado) basins form here
- Just south of here in Colorado are the beginnings of the Colorado, Rio Grande, Pecos and Arkansas rivers

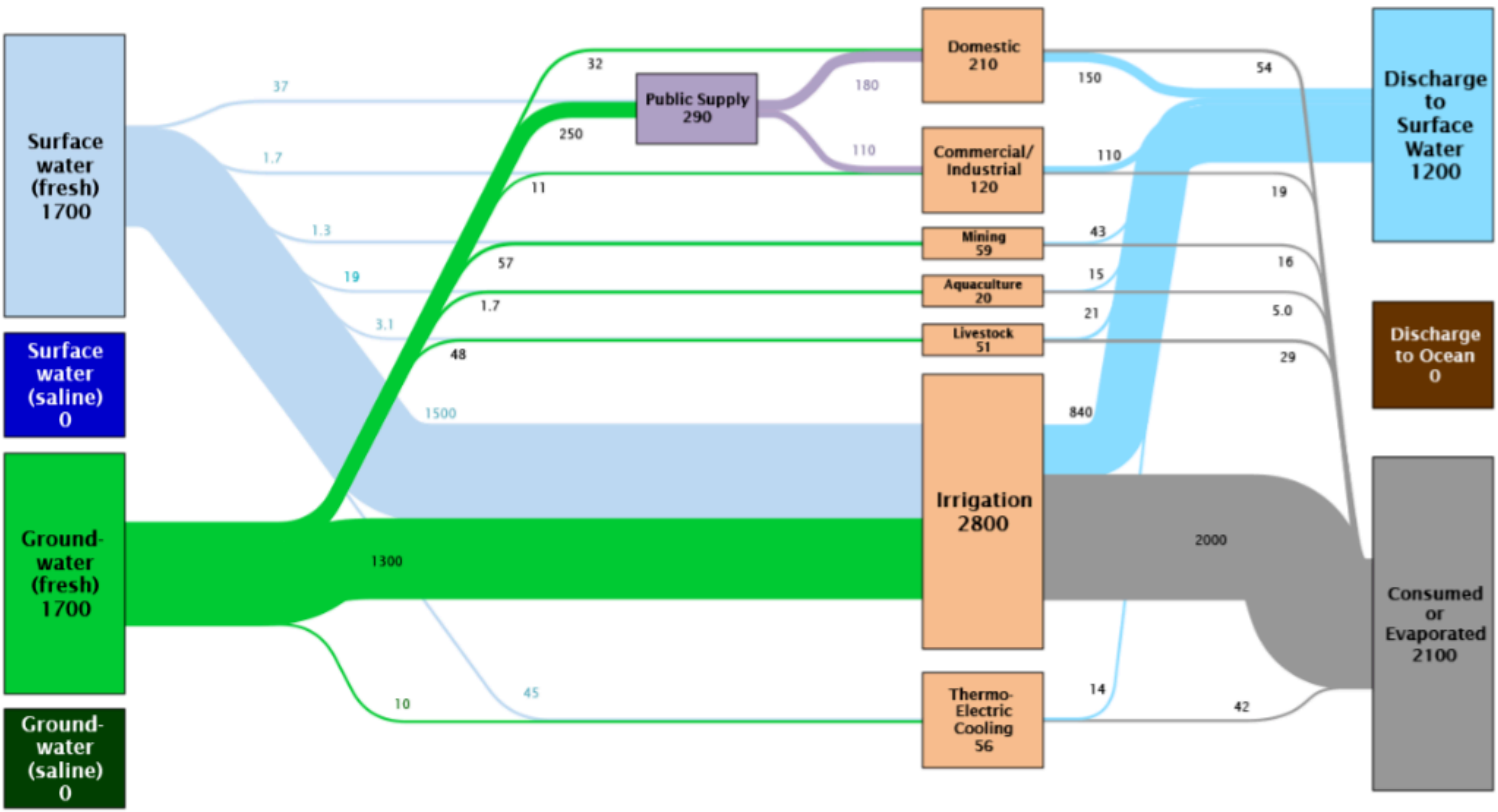


Spokane
WASHINGTON
Columbia
Palouse
Great Falls
Missoula
Clark
Fork
Missouri
Helena
Pasco
Kennewick
Lewiston
Clearwater
N. Fork
Lochsa
Selway
Ronde
Grande
Wallowa
Minam
Imnaha
La Grande
Salmon
Butte
Yellowstone
MONTANA
Salmon
Powder
S. Fork
Mid. Fork
Lemhi
Pahsimeroi
Day
Burnt
Weiser
Salmon
OREGON
N. Fork
N. Fork
Payette
S. Fork
Little Lost
Henrys Fork
Teton
Rexburg
Malheur
Boise
Boise
Burns
Big Lost
Wood
Big Wood
Little
Idaho Falls
Jackson
Gros Ventre
Hoback
S. Fork
Snake
IDAHO
American Falls Reservoir
Pocatello
Malad
Twin Falls
Portneuf
Salt
Greys
Owyhee
Bruneau
Jarbidge
Salmon Falls Cr.
Raft
WYOMING
S. Fork
Green
NEVADA
UTAH
Logan
Great Salt Lake
0
40
80
120
160
miles

# Water Fights

- Past battles with Canada over who owns the boundary water would go away
- Only water presently flowing into the US would be affected with some modification of excess flow from the Rocky Mountain Trench into the Colombia and Mississippi basins being naturally controlled during flood conditions
- The average flow of the river in the Trench is about 98.2 billion gallons/day.  Maximum deficits in Arizona = 3.7 billion gallons/day and in NM = 2.1 billion gallons/day
- Clearly the less than 11 million Canadians in western Canada will have plenty of water even in drought conditions (there never was much question about this)

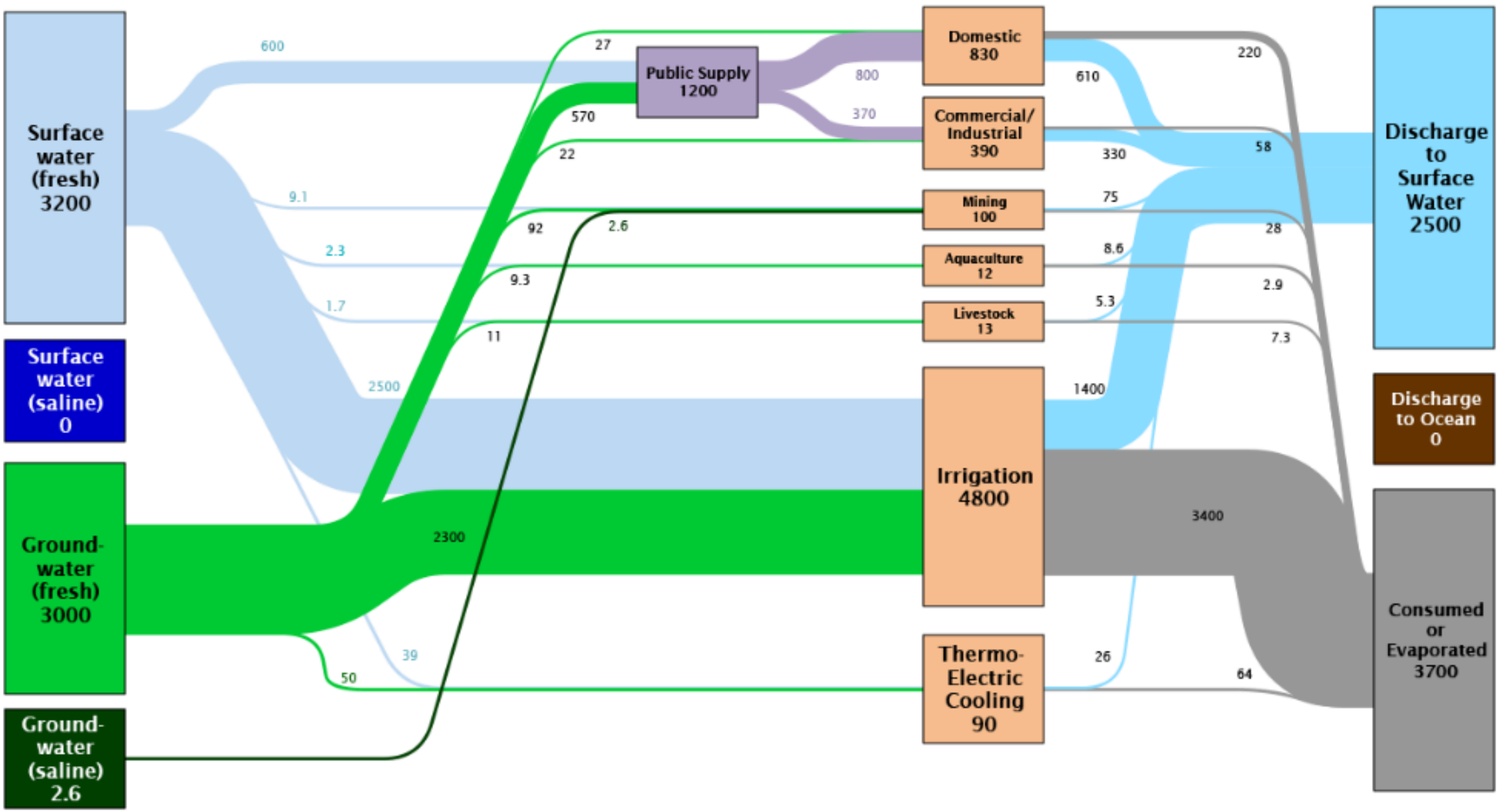
## Estimated New Mexico Water Flow in 2005: 3300 Million Gallons/Day




Source: LLNL 2011. Data is based on USGS Circular 1344, October 2009. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. All quantities are rounded to 2 significant digits and annual flows of less than 0.05 MGal/day are not [illegible]. Totals may not equal sum of flows due to independent rounding. Further detail on how all flows are calculated can be found at http://flowcharts.llnl.gov. LLNL-TR-475772.

Water 2005 United States NM

# Estimated Arizona Water Flow in 2005: 6200 Million Gallons/Day




Source: LLNL 2011. Data is based on USGS Circular 1344, October 2009. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. All quantities are rounded to 2 significant digits and annual flows of less than 0.05 MGal/day are not included. Totals may not equal sum of flows due to independent rounding. Further detail on how all flows are calculated can be found at http://flowcharts.llnl.gov. LLNL-TR-475772.

Water 2005 United States AZ

# This is just a preliminary look

- The devil is in the detail and the main detail that needs to be completely explored is how to siphon off some minimal excess water without affecting the large US basins (primarily the Colombia, Mississippi and Arkansas basins)

- Can this be done without reservoirs and only a very limited number of dams and canals?

- The old methods required a disruption of ecosystems in Canada and the north of the US (many dams and huge reservoirs) and a serious amount of uphill pumping

- This new concept relies primarily on flood stage overflows into the Colorado (Green), Rio Grande and Pecos rivers

- Even for these modest requirements, is this possible?

# NAWAPA

## *Water collection and distribution system*


1. Yukon—The headwaters of the Yukon and Tanana would be dammed to create a reservoir extending from the vicinity of Dawson, Yukon territory, and from Cathedral Rapids, Alaska, southeastward into British Columbia.

2. Peace River—Streams in northern British Columbia would be dammed to form a chain of reservoirs reaching the upper Fraser River near Prince George, and connecting the reservoir behind Portage Mountain Dam on the Peace River.

3. Rocky Mountain Trench—The Rocky Mountain Trench is a gorge containing the upper reaches of the Columbia, Fraser, and Kootenay Rivers. By damming these rivers, a reservoir 500 miles long would be created, extending southerly to Flathead Lake in Montana.

4. Clark-Snake—A supplemental drainage area lies in the Western United States and would draw from the Clark, Clear Water, Bitterroot, Big Hole, Jefferson, Salmon, Little Colorado, Snake and Escalante river basins.

Total drainage areas represent approximately 1,300,000 square miles, enjoying a heavy annual precipitation. Of an average annual runoff of 663,000,000 acre feet of water, approximately 110,000,000 acre feet are withdrawn by NAWAPA for distribution.

5. Clearwater Subsystem—The Clearwater North Fork and Clearwater Rivers, along with the lower reaches of the Salmon and Snake Rivers, would be developed by a series of hydro-power plants in central Idaho and southeastern Washington.

6. Western Desert System—Water to meet the needs of the great North American Desert would be drawn from the outflow of the Rocky Mountain Trench, and combined with conservable flows of numerous mountain streams in the Great Basin Sub-system. Water for irrigation and other uses would be distributed to Idaho, Oregon, Utah, Nevada, California, Arizona and New Mexico in the United States, and to Baja California, Chihuahua and Sonora in Mexico.

The Trout Creek Diversion Aqueduct in Utah would provide good quality water for Southern California and Baja California. The degradation of valuable farm land in these states by the use of Colorado River water with its excessive mineral content could thus be arrested and eventually remedied by leaching.

7. Rocky Mountain East Slope—Water deliveries would be made to the Platte, Arkansas, Canadian, Rio Grande, and Pecos rivers. Aqueducts would deliver water to the Staked Plains area and lower Rio Grande Basin. This water would be drawn upon by New Mexico, Texas, Colorado, Kansas, Nebraska, Oklahoma, and Mexico.

8. Canadian-Great Lakes Canal System—NAWAPA would provide a navigable waterway across the Prairie Provinces, connecting the Fraser River with the Great Lakes, supplying water to the Great Plains. A barge canal branch would connect with the upper Missouri and Minnesota Rivers, permitt flow stabilization in both.

9. Ontario-Quebec Development—The eastern ment of NAWAPA would harness the energies rivers entering James Bay, permit stabilizatio levels in the Great Lakes and St. Lawrence, provide a barge canal across central Quebec.

10. Eastern Diversions—NAWAPA would stabil and control the level of the Great Lakes with annual available supply of 48 million acre f Water deliveries could then be made from the Gr Lakes to water short areas of Vermont, New Har shire, Massachusetts, Rhode Island, Connectic New York, New Jersey, Pennsylvania, Delaw West Virginia, Ohio, Indiana and Illinois, throu a system utilizing rivers, existing canals, and n aqueducts.

# References and Reading List

Mark Mills Energy Transition Delusion

https://media4.manhattan-institute.org/sites/default/files/the-energy-transition-delusion_a-reality-reset.pdf

Patrick Moore on CO2

I will send you a copy of this video if you request it

Simon Michaux Large Paper

https://tupa.gtk.fi/raportti/arkisto/42_2021.pdf

Alex Epstein The FF Big Picture

https://wattsupwiththat.com/2023/04/23/fossil-fuels-the-big-picture/

Lazard LCOE (Energy Costs)?

https://www.netzerowatch.com/lazard-still-unreliable/

Master Resource 2023 Energy Reading List

https://www.masterresource.org/alliance-for-wise-energy-decisions/energy-environmental-review-04-24-2023/

Net Zero = Inflation (Consequences of getting the Science wrong)

https://www.realclearenergy.org/articles/2023/04/27/inflation_net_zero_and_the_bank_of_england_896276.html

Renewables Impact on the Environment

https://www.masterresource.org/energy-density/infrastructure-overload-renewables/

Who hits the Green Energy Wall first?

https://www.manhattancontrarian.com/blog/2023-4-25-south-africa-and-the-green-energy-wall

NYs Energy Future (Unattainable Green Solutions?)

https://www.manhattancontrarian.com/blog/2023-4-22-another-non-reassuring-report-on-new-yorks-energy-future

Profitability of Future Wind

https://climaterealism.com/2023/04/right-oilprice-com-wind-power-is-unprofitable/