100% Clean Renewable Electricity for New Mexico

FIGHTING CLIMATE CHANGE
350
NEW MEXICO

Sept 1, 2017

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Clean Renewable Energy Means Economic Growth for New Mexico

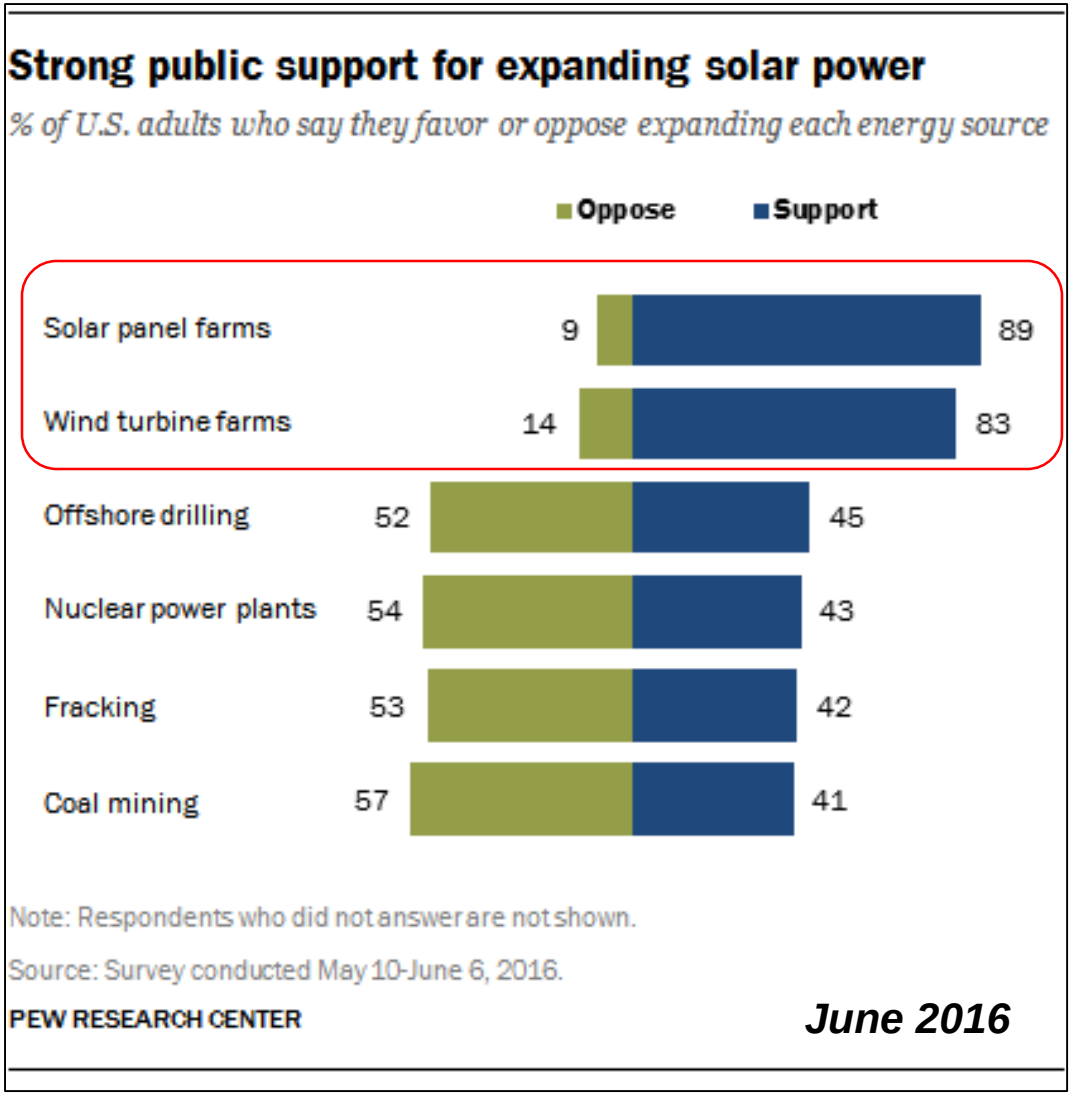
- New Mexico needs to **revive our economy**, help preserve a **livable climate** and make the state a **healthier** place to live.
- How? A bold new Renewable Portfolio Standard (**RPS**) for electricity.
  - Current RPS maxes at 20% by 2020. Extend to 100%
- The electricity RPS has **NO IMPACT on oil** jobs or oil revenue, since **oil is not used** in NM to generate electricity. <7% NM nat. gas for electricity.

Why

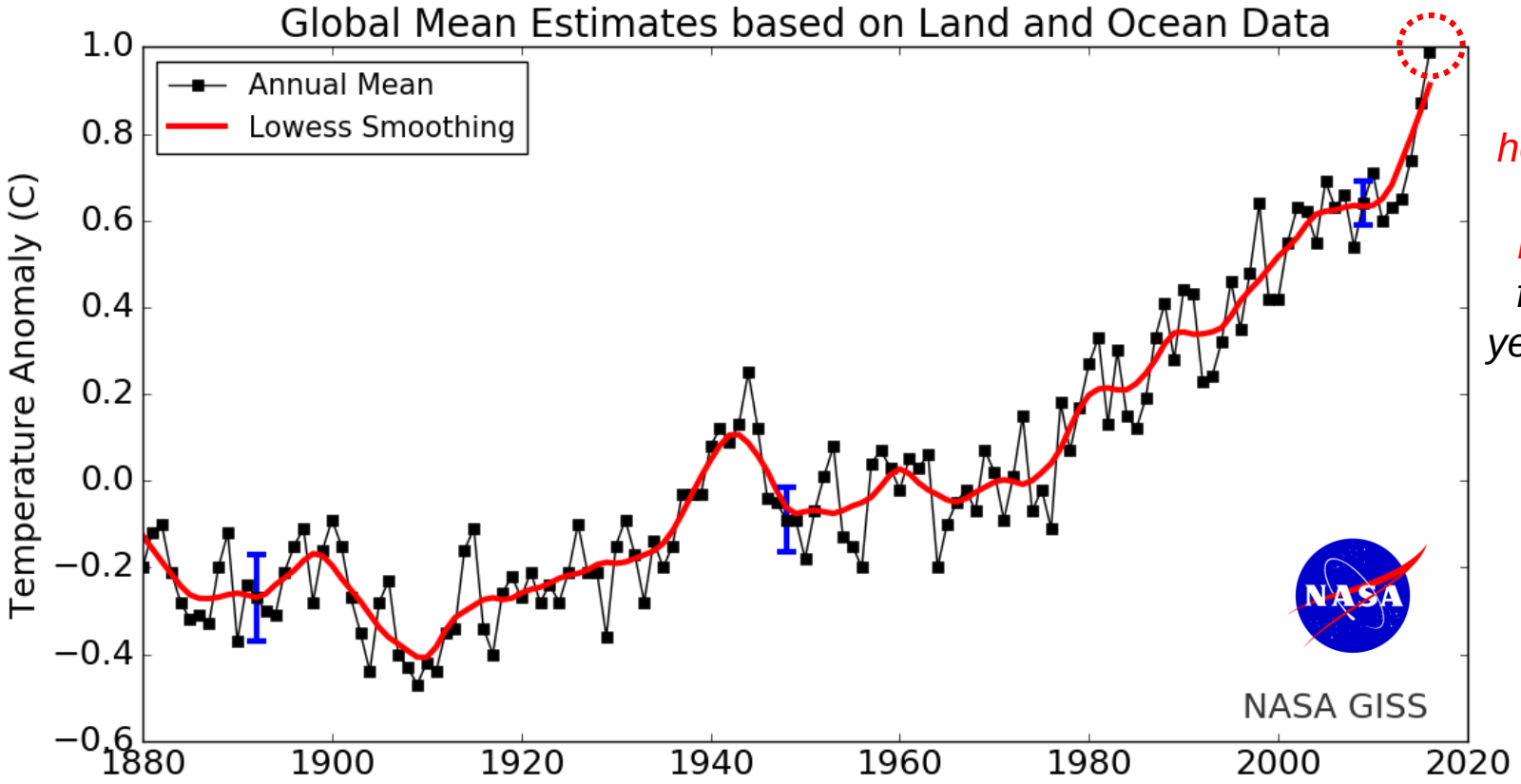
100% Clean Renewable Energy?

86% Support More Clean Energy

- **HUGE** majorities support expanding Solar and Wind energy, **by 7:1**
  - Bipartisan support includes 75% of Trump voters
- And strong majorities <u>oppose</u> expanding fossil fuel and nuclear energy.



Warming is Happening Now



2016:

The new hottest year ever recorded, for the 3rd year in a row

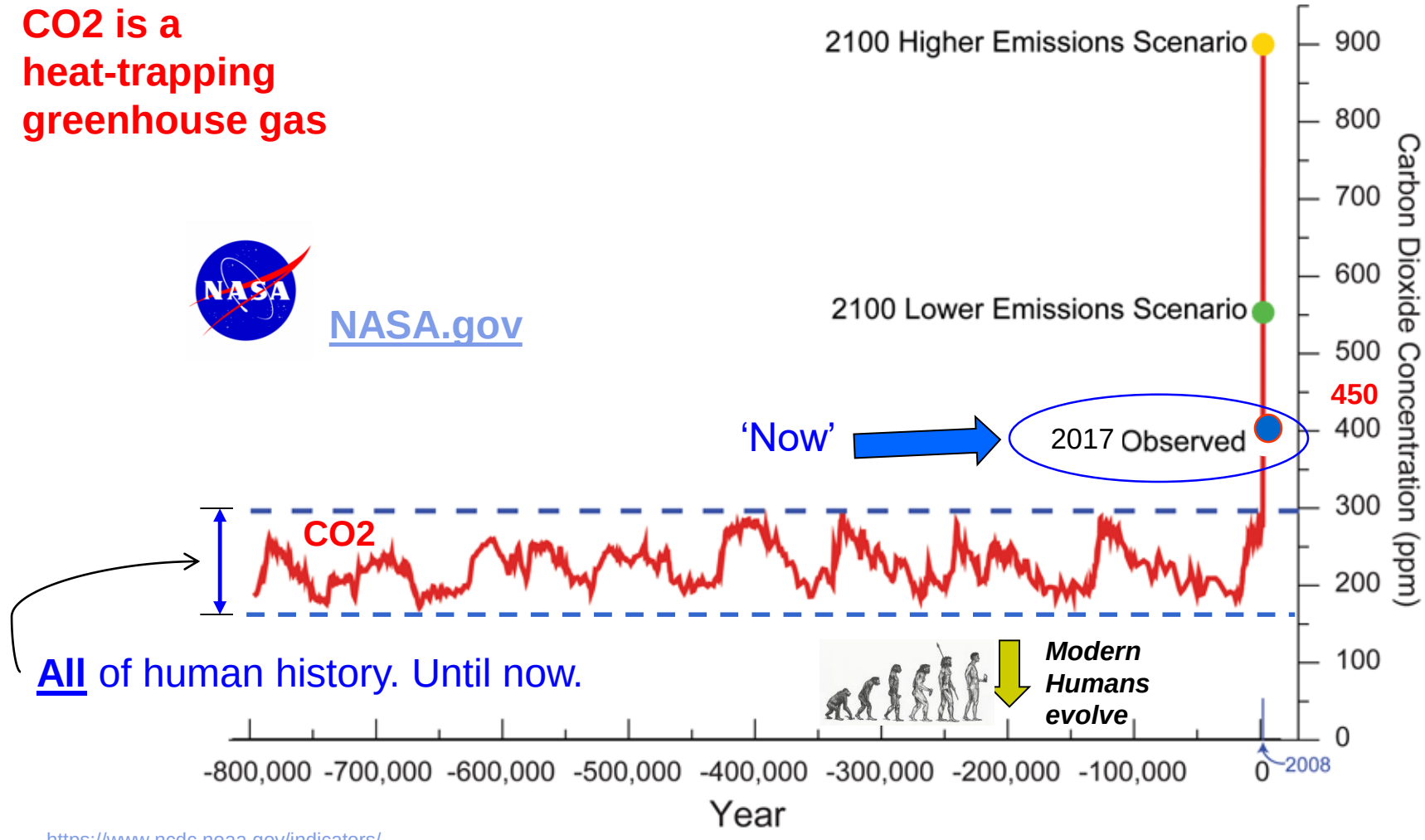
- **2016 – The warmest year on record, by far**
  - https://www.sciencedaily.com/releases/2017/01/170118112554.htm/

http://data.giss.nasa.gov/gistemp/graphs/

CO2 Levels: Higher Now Than Any Time in Human History

CO2 is a heat-trapping greenhouse gas

NASA.gov



https://www.ncdc.noaa.gov/indicators/

http://climate.nasa.gov/key_indicators
https://scripps.ucsd.edu/programs/keelingcurve/

Our Current Path: 450ppm by ~2035

450ppm CO2 is cited as driving dangerous 2.0C warming

450

450

Ice–core data before 1958. Mauna Loa data after 1958.

CO2

Latest CO_2 reading
May 02, 2017

408.50 ppm

Dr. Hansen's limit

CO_2 Concentration (ppm)

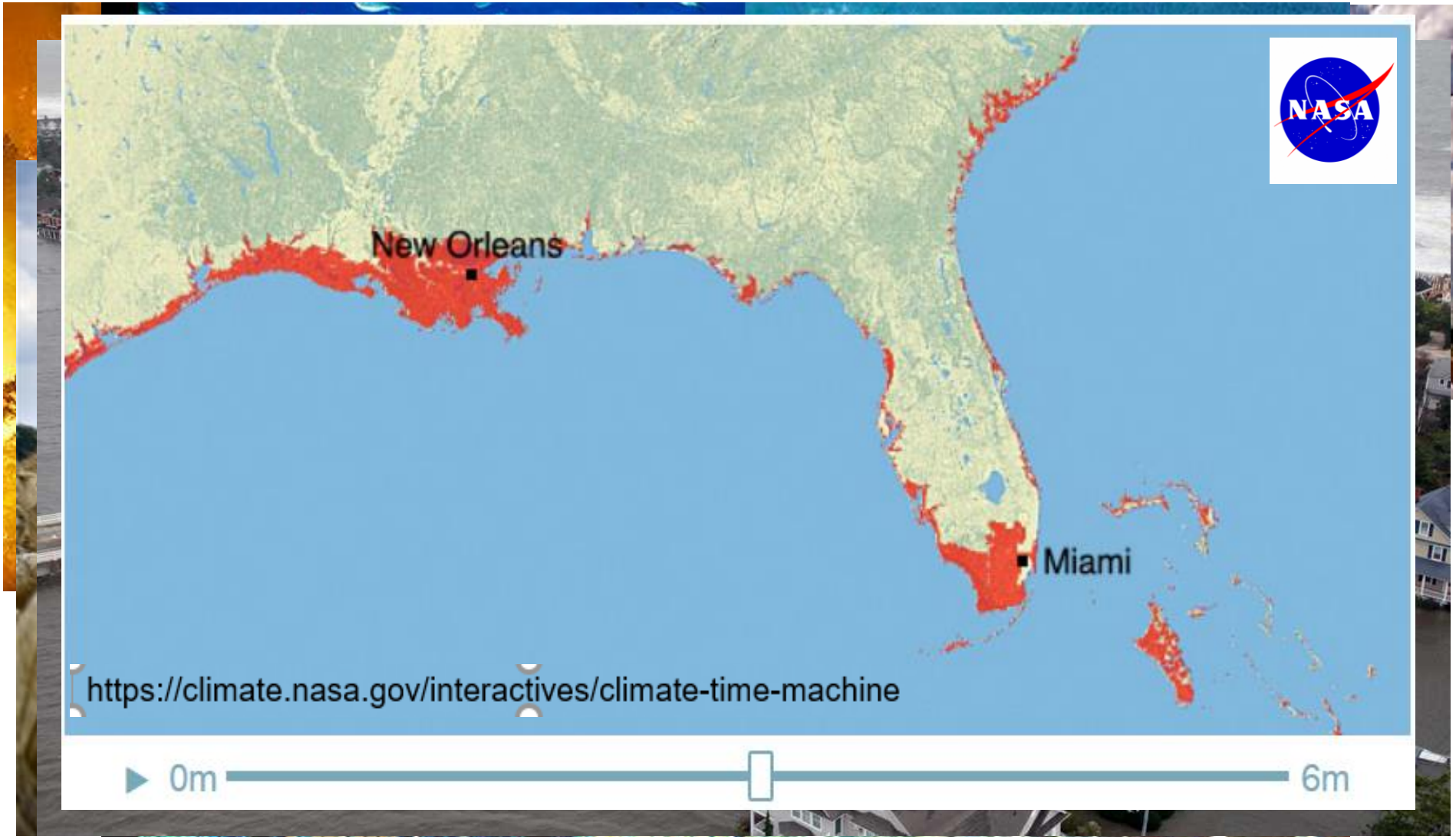
400
350
300
250
200

1750 1800 1850 1900 1950 2000 2035

Dr. Charles Keeling 1928-2005

SCRIPPS INSTITUTION OF OCEANOGRAPHY
The Keeling Curve

Impacts Are Being Felt Now



http://climate.nasa.gov/interactives/climate-time-machine

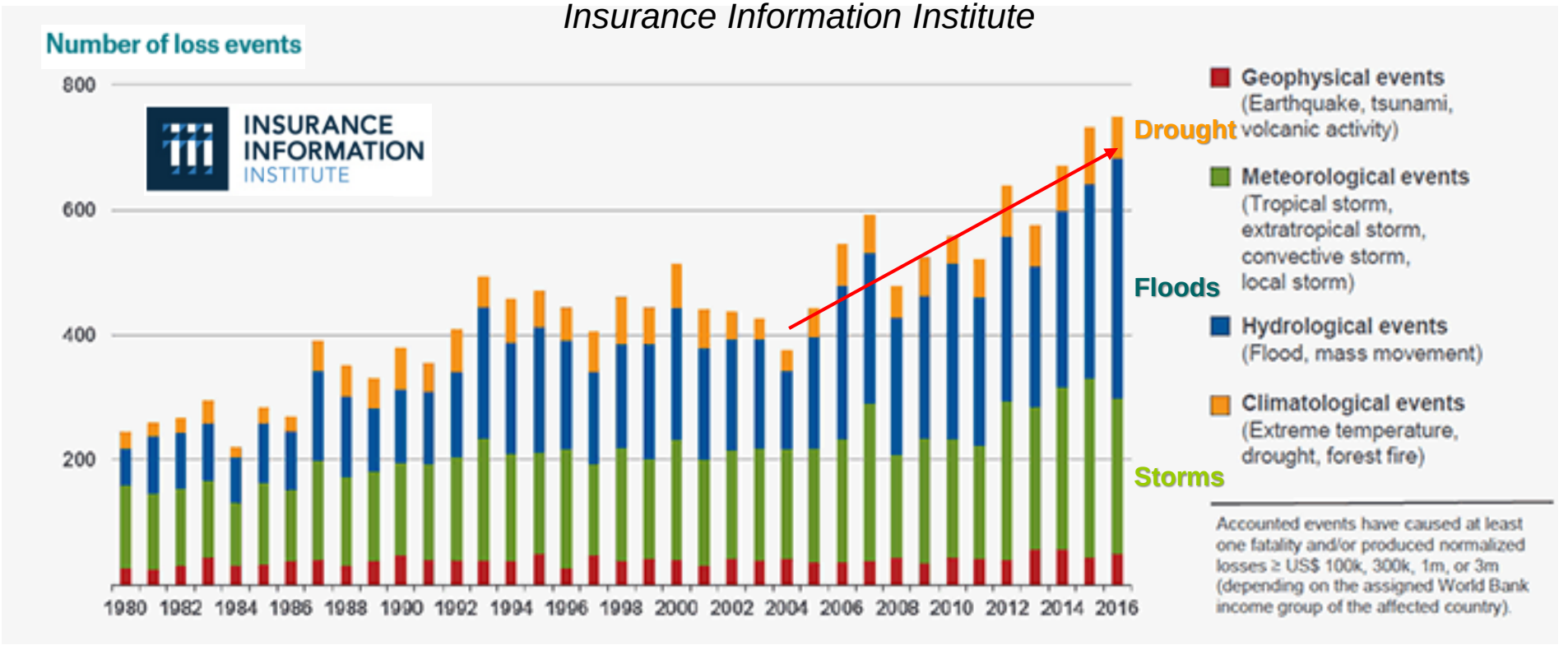
Superstorm Harvey Aug 2017

Houston, TX

Climate Disasters Up 3X Since 1980

Number Of World Natural Catastrophes, 1980-2016

Insurance Information Institute



Source: © 2017 Munich Re, Geo Risks Research, NatCatSERVICE.
Insurance Information Institute *http://www.iii.org/fact-statistic/catastrophes-global*

Global Food Shortages, Then Famine

Worst Case Timing

Year / °C warming	% Loss in Crop Yields
2020's / 1°C	-10%
2040's / 2°C	-30%
2050's / 3°C	-40%
2060's / 4°C	-60%

Tyndal says 4C by 2050

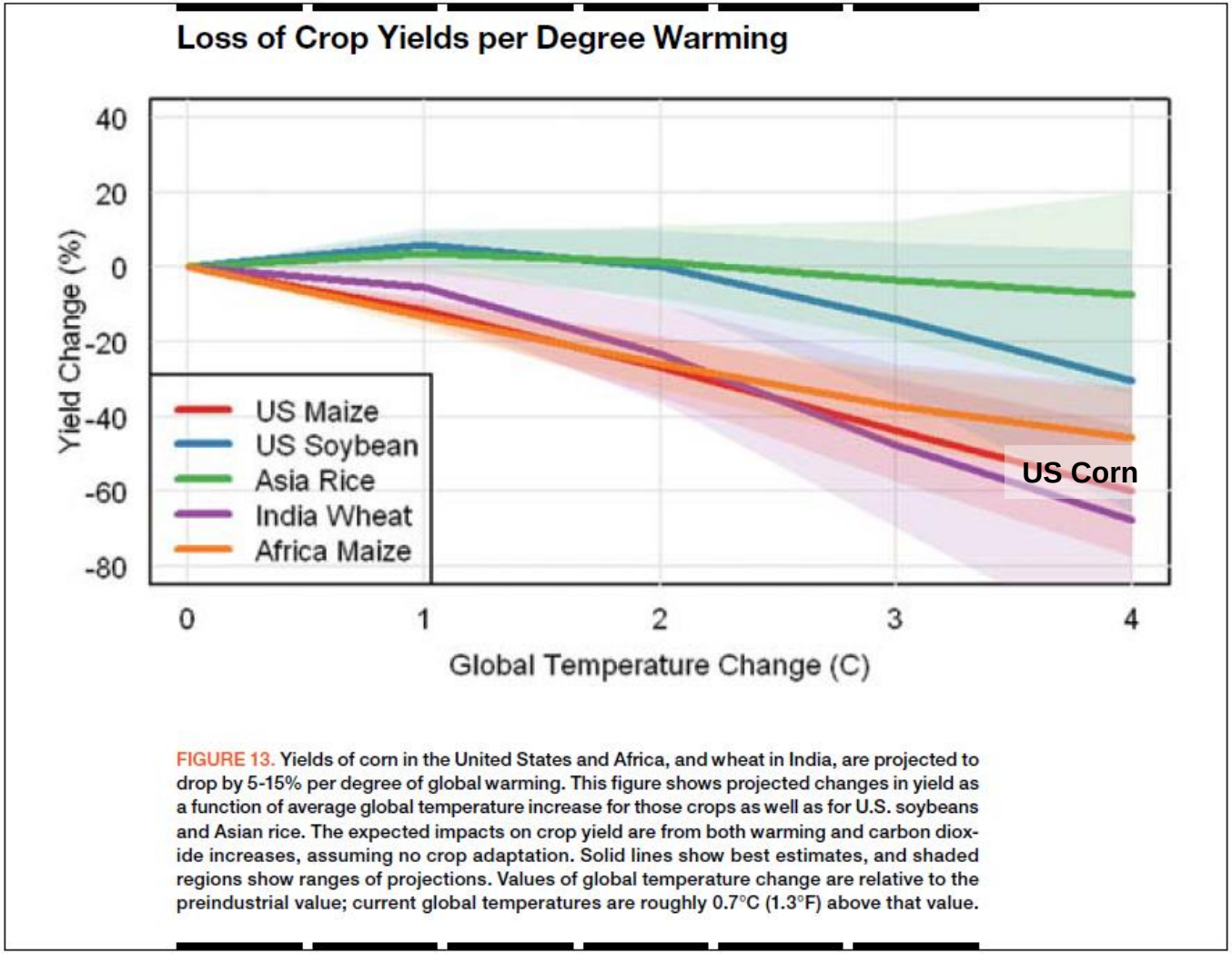


FIGURE 13. Yields of corn in the United States and Africa, and wheat in India, are projected to drop by 5-15% per degree of global warming. This figure shows projected changes in yield as a function of average global temperature increase for those crops as well as for U.S. soybeans and Asian rice. The expected impacts on crop yield are from both warming and carbon dioxide increases, assuming no crop adaptation. Solid lines show best estimates, and shaded regions show ranges of projections. Values of global temperature change are relative to the preindustrial value; current global temperatures are roughly 0.7°C (1.3°F) above that value.

***Source*: The National Academy of Sciences –**

Warming World: Impacts by Degree 2011

Future Warming, by Degree

Worst case, if we don't rapidly change course

Decade	Warm-ing °C	% Loss in Crop Yields	Commentary
2020's	**+1°C**	-10%	2x-4x worse wildfires, drought in SW, coastal flooding
2030's	**+1-2°C**	-20%	Major food shortages (corn, wheat); coral reefs dying; increasing extreme weather. **Miami 1m underwater.**
2040's	**+2°C**	-30%	Most summers hotter than 2003 EU **heat wave**. 30% species risk extinction. Mountain **ecosystems dying**. 4x-8x worse **wildfires**. Pervasive drought in sub-tropics. **Extensive starvation**.
2050's	**+3°C**	**-40%**	40%-70% species extinction. Amazon & boreal forest dieback. Decline in all cereal crop yields in Africa. Release of CO2 and methane from permafrost, tripling from 1.5C. **Wars. Mass starvation.**
2060's	**+4°C**	**-60%**	**Game over**. Ecosystem supports <1 billion people. Climate likely past tipping points for further warming.

Read more in New York Magazine, July 9, 2017. **The Uninhabitable Earth**

From: National Academy of Sciences, 2011, the US National Climate Assessment, 2014 & UK Met office

http://dels.nas.edu/resources/static-assets/materials-based-on-reports/booklets/warming_world_final.pdf (2011)
* http://news.nationalgeographic.com/2015/07/150721-james-hansen-sea-level-rise-climate-change-global-warming-science/

What Must We Do Instead?

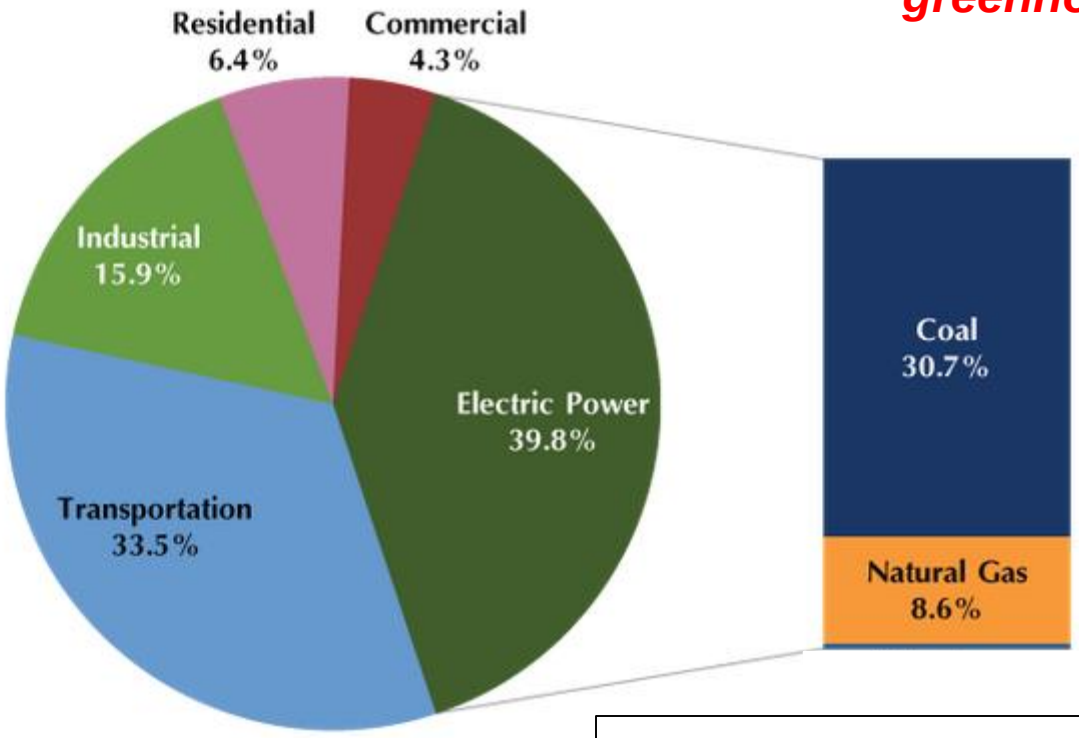
Urgently **mobilize**
to **convert** our energy system
from **fossil fuels** to
carbon-free renewables.

Priority 1: Renewable Electricity

CO2 Emissions in the US

CO2 is a heat-trapping greenhouse gas

Figure 1: 2013 U.S. CO2 Emissions

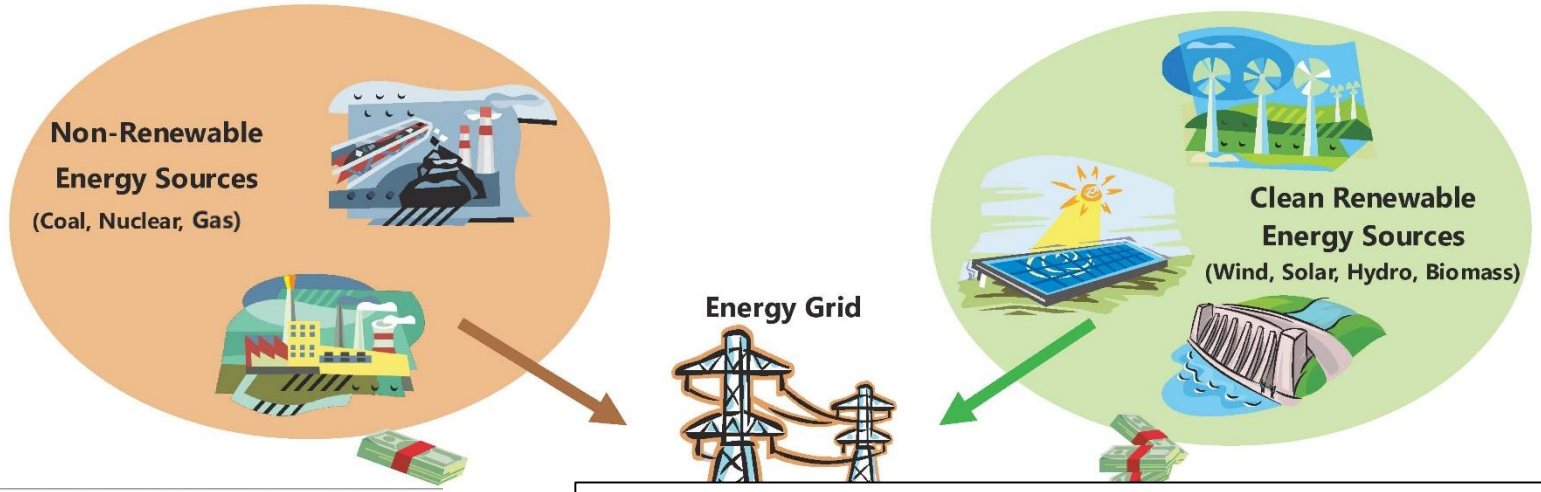


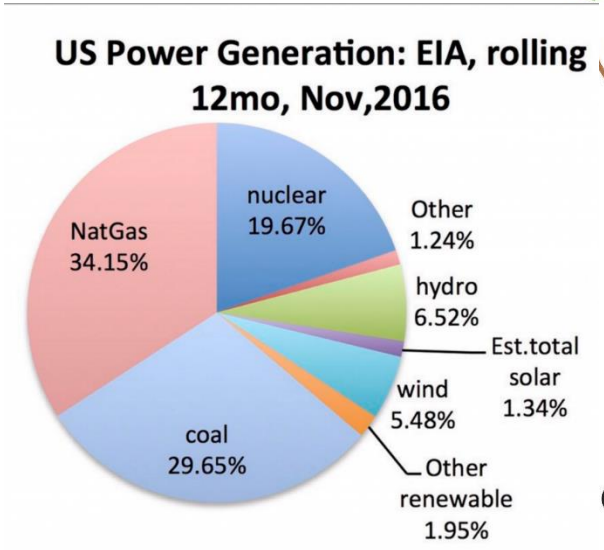
Source:
US Energy Information Administration

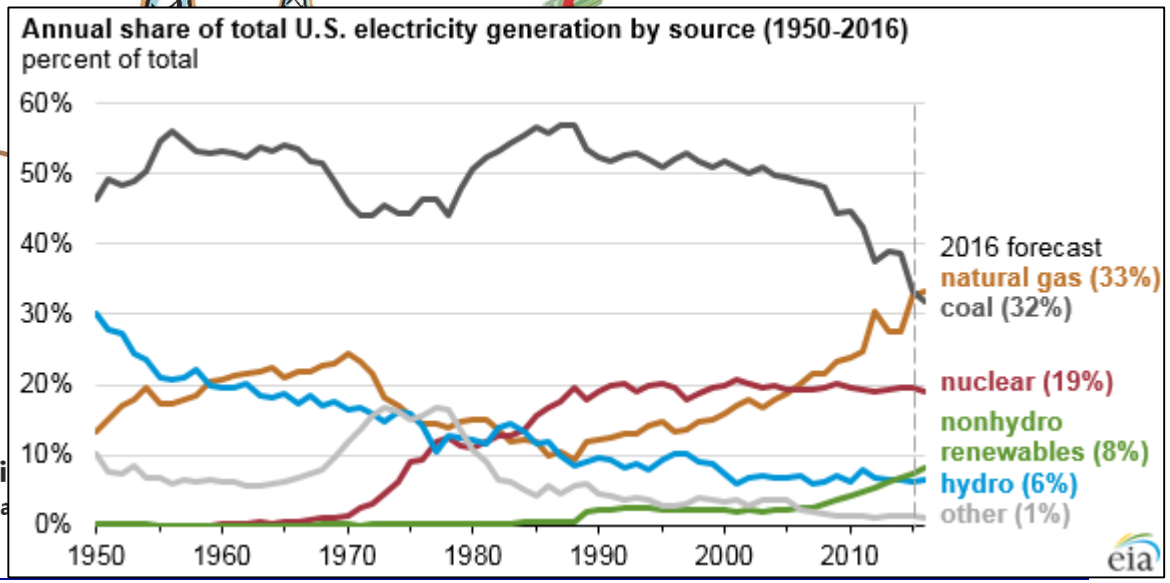
- CO2 emissions from fossil fuels must **cease worldwide** by 2050 if we hope to avoid catastrophic global warming of 1.5-2.0°C.
- The #1 source of CO2 emissions is **burning coal and natural gas** to generate electricity.

http://www.c2es.org/federal/executive/epa/ghg-standards-for-new-power-plants

Where Does Electricity Come From?

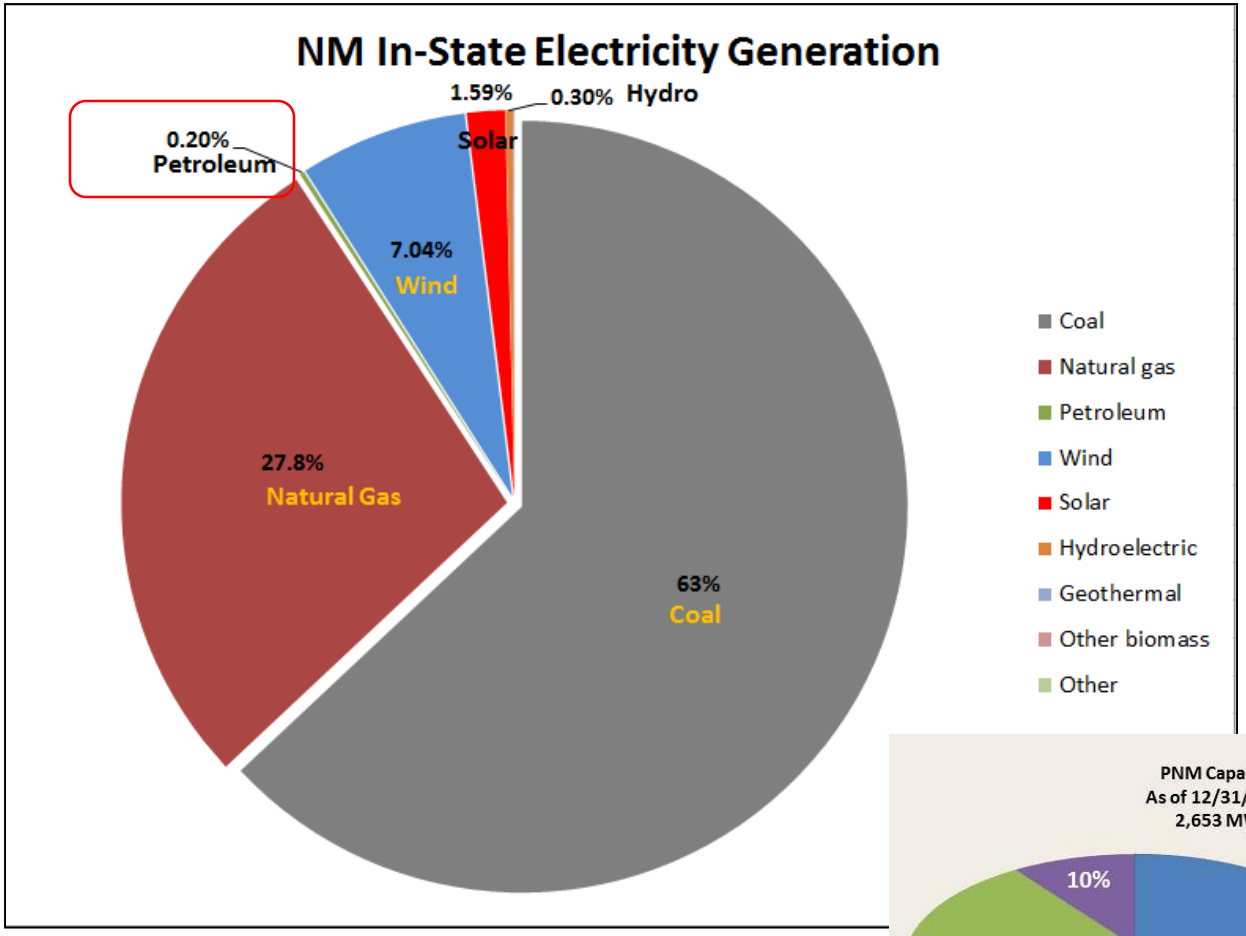


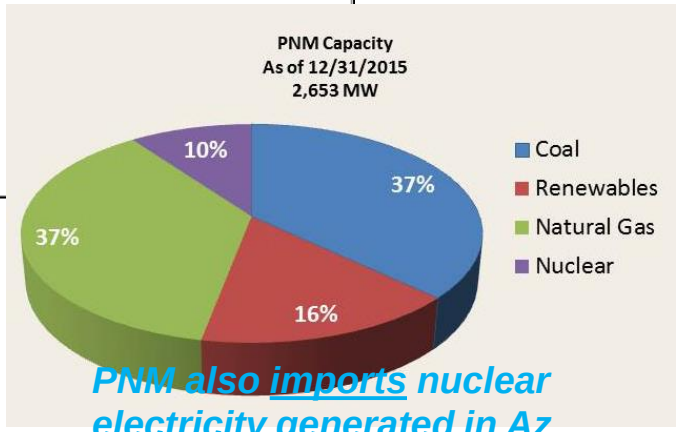




https://www.eia.gov/tools/faqs/faq.php?id=427&t=3

NM Electricity Generation by Source





- **63% coal**, **28% natural gas**.
- 0.20% from petroleum

PNM also imports nuclear electricity generated in Az

Amend the NM 'Renewable Energy Act' for 100% RPS

- Current RPS requirements peak & hold in 2020 at 20%
- The proposed schedule keeps the RPS increasing to reach 50% by 2030, towards 100% by 2050.

Current law

Year	RPS
2020	20%
2025	35%
2030	**50%**
2035	65%
2040	**80%**

3% per year

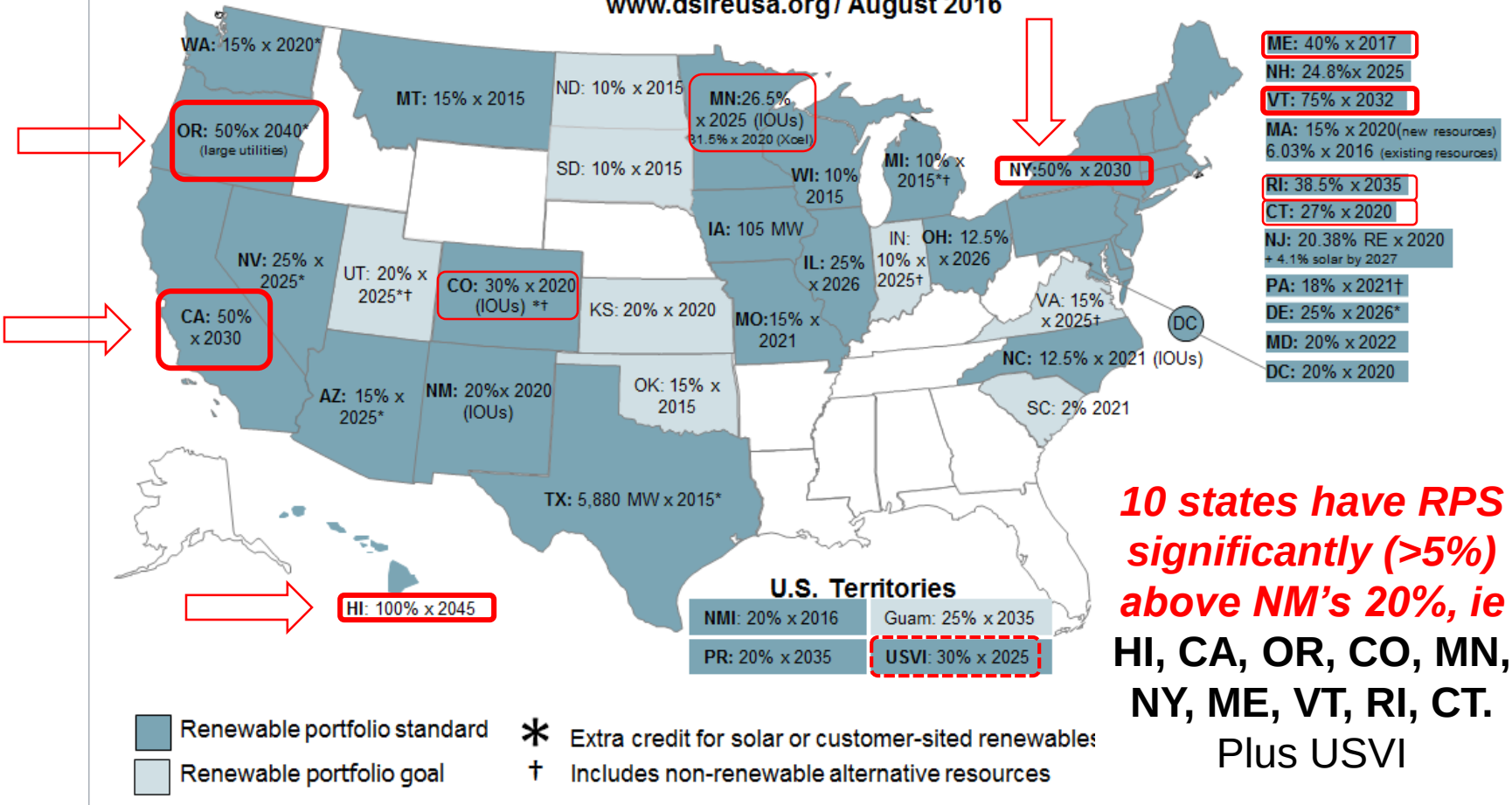
- Then 2% per year 2040 to 2050
- SB312 was a 2017 bill for 80% by 2040. It passed the Senate Conservation comm.

Ten States Have Better RPS Policy Than NM

DSIRE® | NC CLEAN ENERGY TECHNOLOGY CENTER | U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Renewable Portfolio Standard Policies

www.dsireusa.org / August 2016

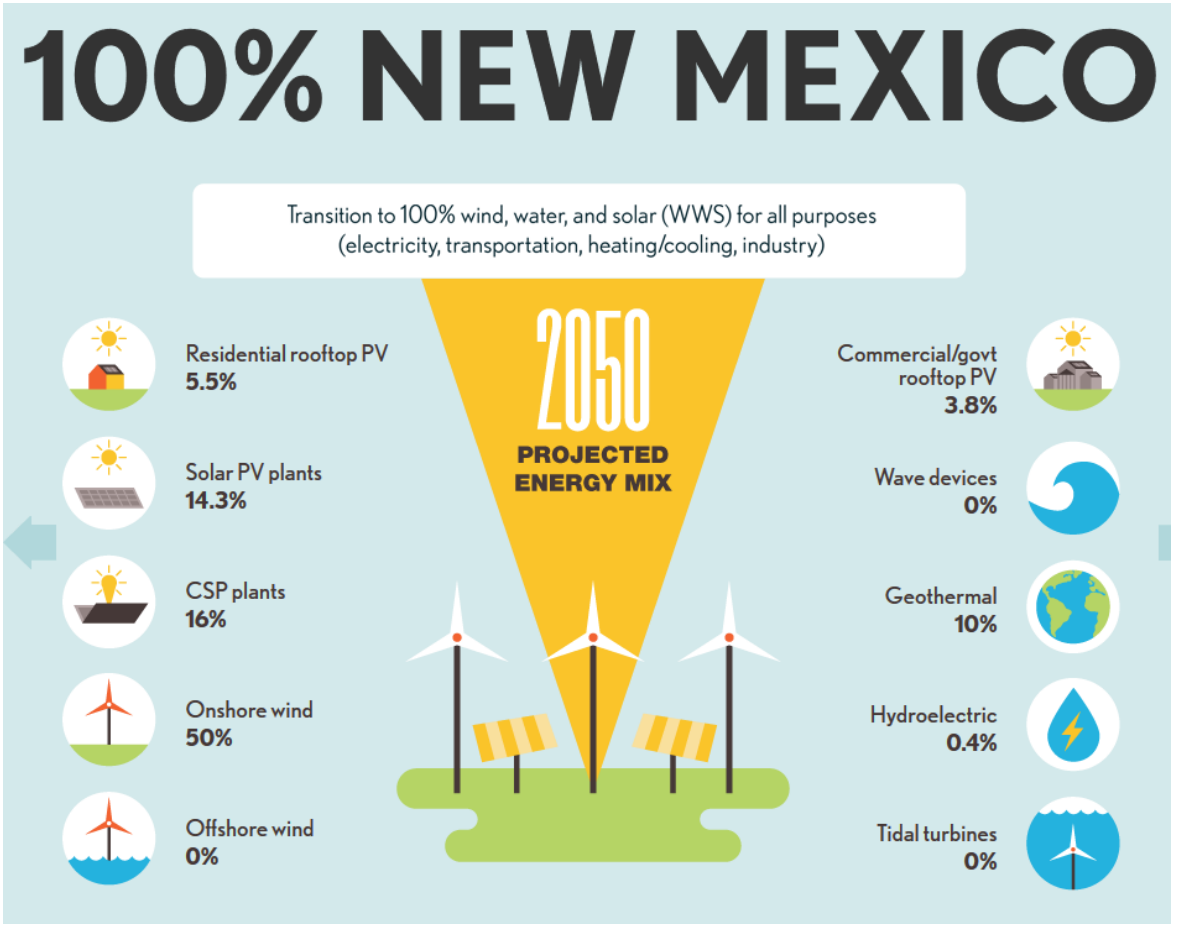


10 states have RPS significantly (>5%) above NM's 20%, ie **HI, CA, OR, CO, MN, NY, ME, VT, RI, CT.** Plus USVI

Energy Mix: 100% Renewables

A 100% Renewable Energy Mix for NM:

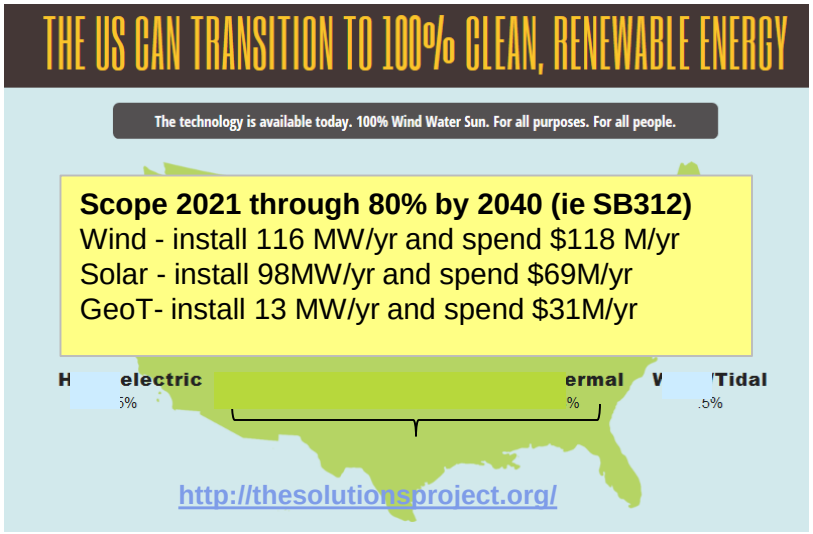
- **50% Wind**
- **40% Solar** (39.6%)
  - 30.3% utility scale
  - 5.5% residential
  - 3.8% comm / govt
- **10% Geothermal**
- Recommended by Stanford University based each state's native resources.



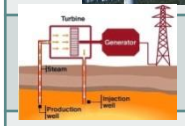
Energy mix for NM as recommended by published analysis for all US States, from ***Stanford University*** *www.thesolutionsproject.org.*

Summary:

What to Build to Reach 100% RPS



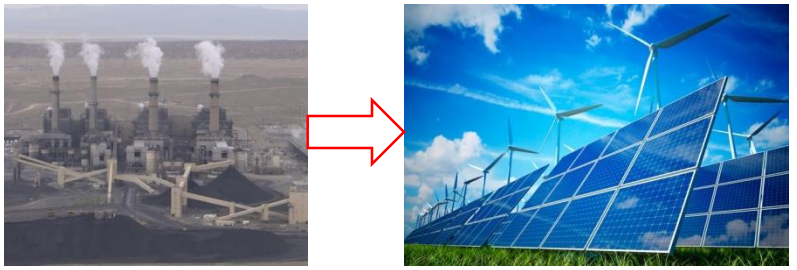
For **30 years**, (2021-2050), NM would **install** on <u>avg</u> **200 MW/year**:

Clean Renewable Energy	# MW /yr	Cost /yr	Power / unit
 Solar Panels	103 MW	$51 M	300 W
 Wind Turbines	87 MW	$101 M	5 MW
 Geothermal Plants	<u>10 MW</u>	<u>$26 M</u>	10 MW
Yearly Total:	200 MW	$178 M	

- This will supply the 23M MWh consumed within our state

2016 electricity revenue was $1.9B for Utilities + Co-ops. $178M is 9%

Why it will work



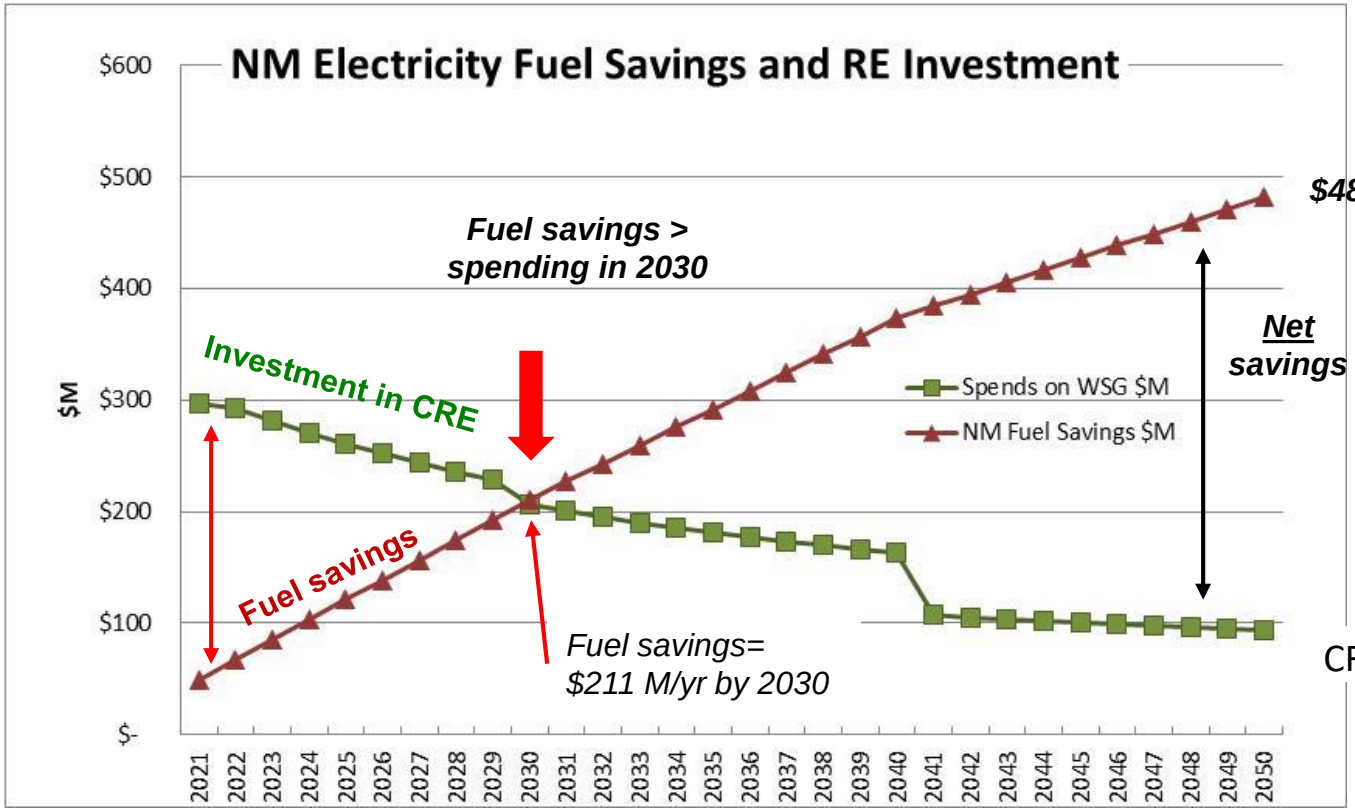
- Old power plants must be replaced as they age. NM's aging coal plants average **40 yrs old**. The RPS helps NM be pro-active, replacing them with clean renewables at zero fuel cost
- Utilities will do the major investment, plus cities, businesses & homeowners. Renters too, if we pass 'community solar'.
- Electricity costs will ultimately drop as we convert to zero-fuel electricity
- Known & **predictable fixed costs** for electricity reduce investment risk for companies moving into NM.
  (no fuel = no fuel price increases)
- We leverage NM's **natural advantages**: available **land, wind, sun, geothermal**, and an underemployed **workforce**

NM Fuel Savings Pay for Investment

Net CRE costs avg $127M thru 2030.

But consider: the SJGS maintenance budget in 2013 was $40M. Plus $10 /yr for capex. Plus costs of pollution controls, etc

2016 electricity revenue was $1.9B



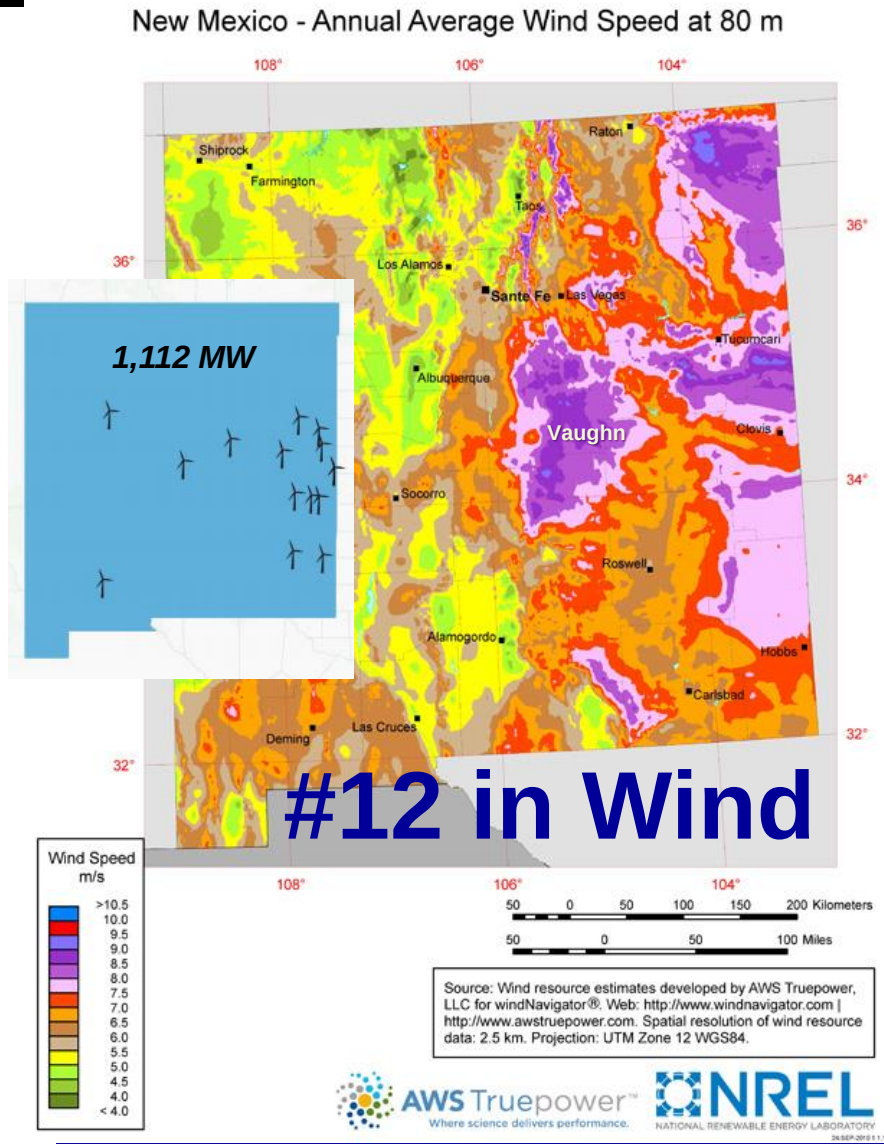
- New Mexico spends $482M/year on coal & gas **fuel** to generate electricity
- For every **10%** we add to CR Energy, we **save $48M**/year on fuel.
- **Fuel savings pay for all investment after 2030.** Until then, net CRE investments average $127M/yr. And savings increase every year.
- So after we reach 50% by 2030, fuel savings pay for all new RE investment.

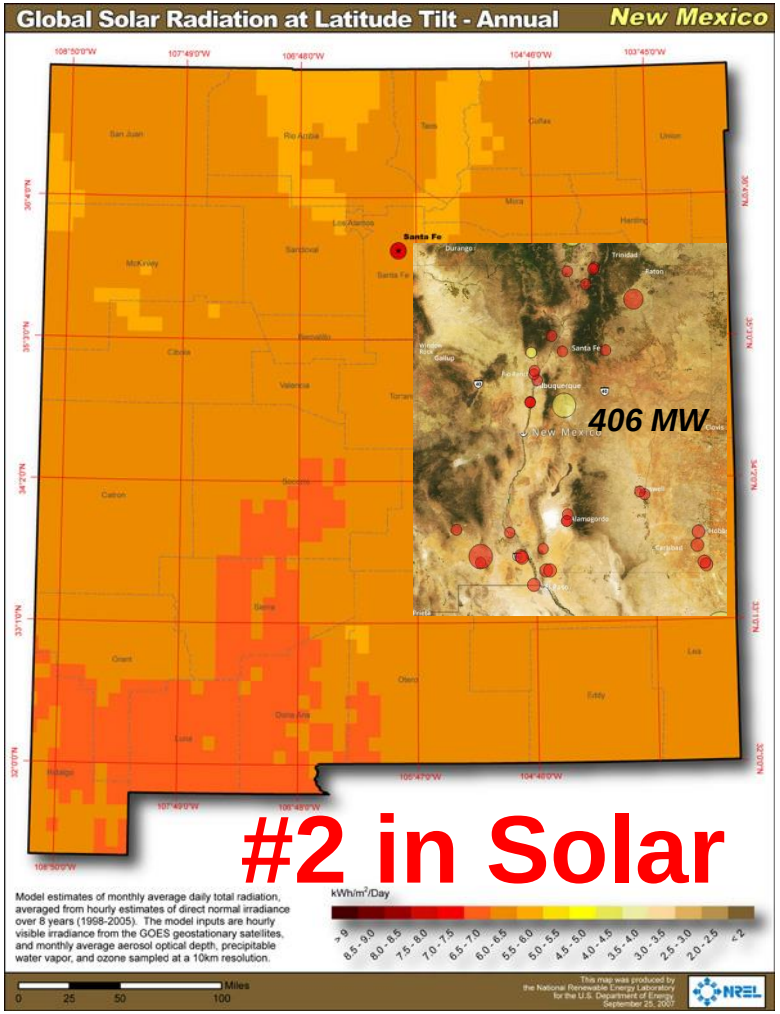
**WSG= wind, solar & geothermal*

The Benefits It Will Bring

- **Jobs of the future** in a growing economic sector, replacing jobs of the past.
- Plus:
  - Cleaner air & water
  - Less water consumption
  - Healthier New Mexicans (less emphysema, asthma, etc), with fewer deaths and lower health care spending. Medicaid is ~31% of the NM state budget
  - Helps stop climate change

New Mexico's Great Wind & Solar





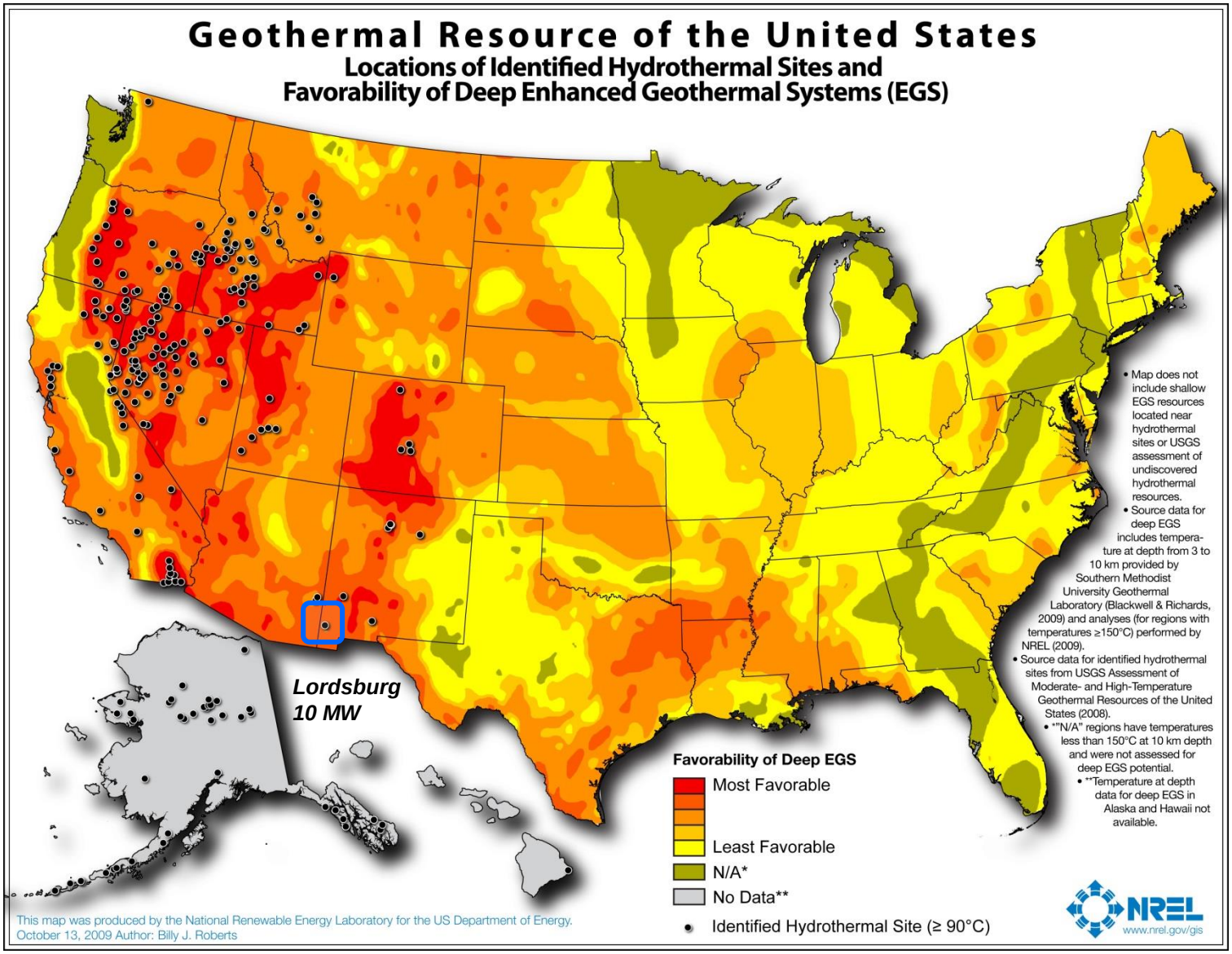
http://www.seia.org/map/majorprojectsmap.php
http://www.seia.org/state-solar-policy/new-mexico

US Geothermal Resource Map

Per the USGS: Geothermal power plants are currently generating 2,500MW in six states: Alaska, California, Hawaii, Idaho, Nevada, and Utah. The electric power generation **potential** from identified geothermal systems is **9,057 Megawatts-electric (MWe), over 13 states.**

The mean estimated power production potential from undiscovered geothermal resources is **30,033 MWe**.

Additionally, another estimated **517,800 MWe** could be generated through implementation of technology for creating geothermal reservoirs in regions characterized by high temperature, but low permeability, rock formations.

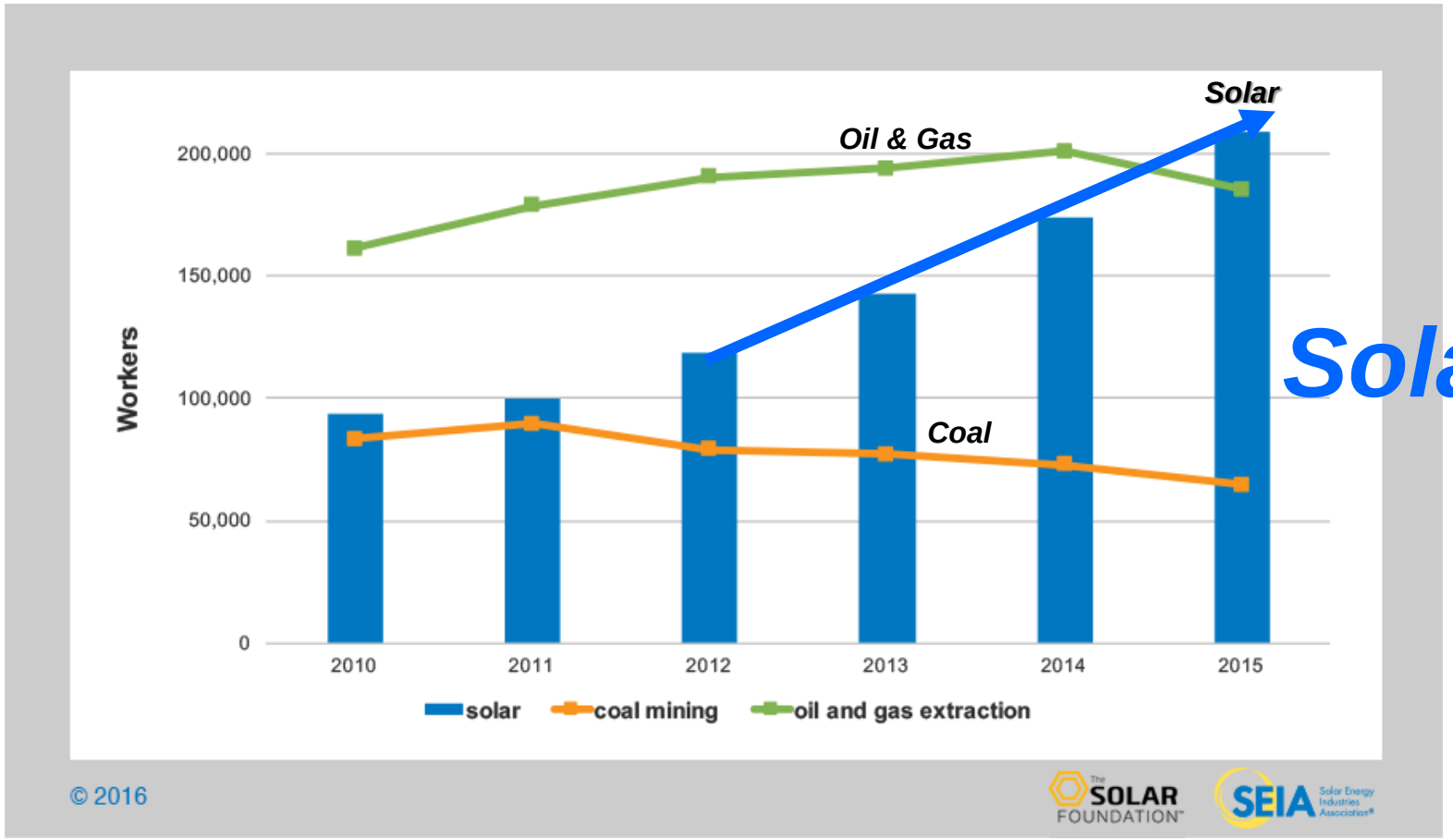


http://www.nrel.gov/gis/geothermal.html

http://pubs.usgs.gov/fs/2008/3082/

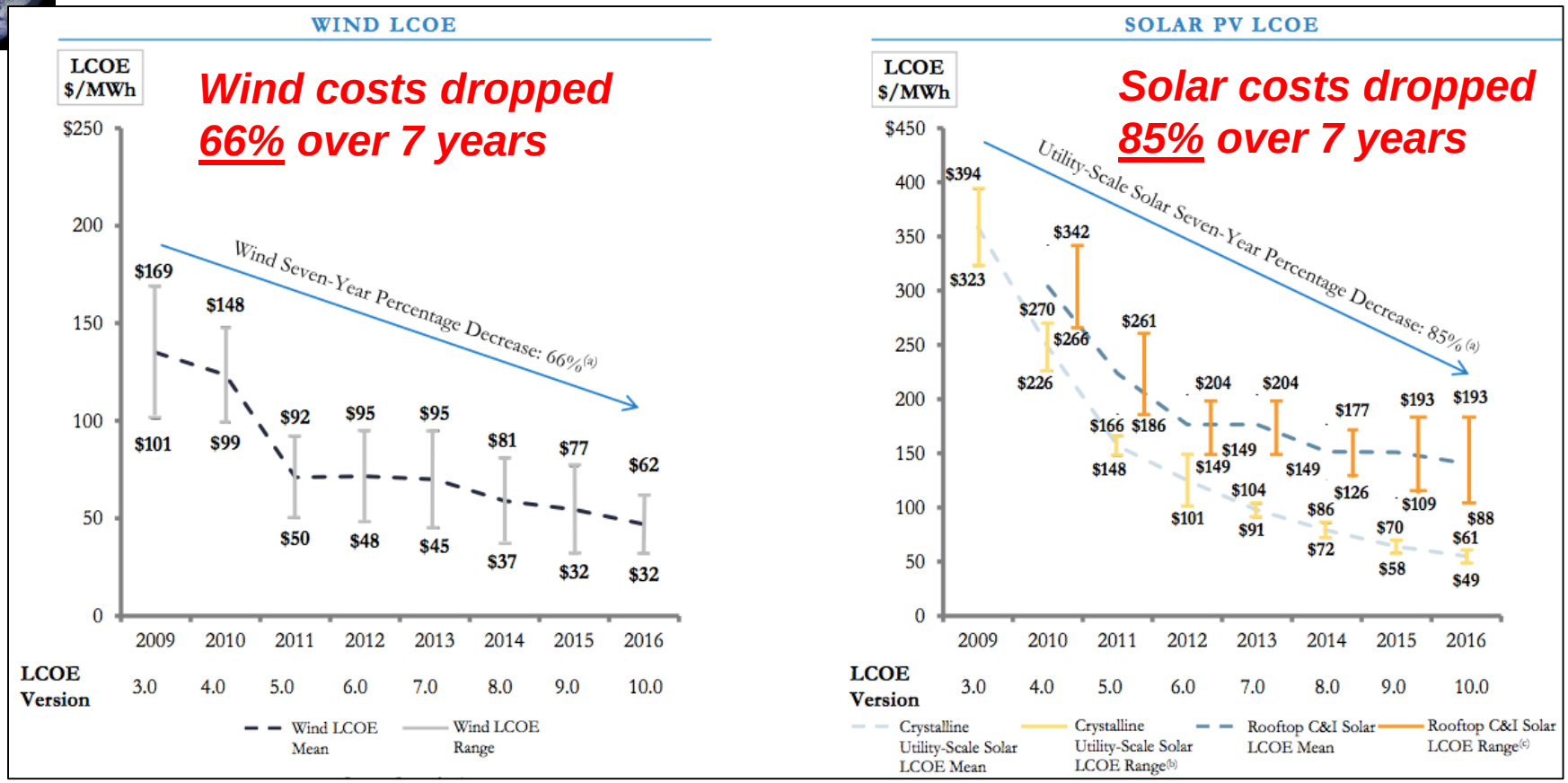
US Solar Jobs Are Booming

Nearly 209,000 Americans work in solar >double the number in 2010, at more than 9,000 companies in every U.S. state.
By 2020, that number will double to more than 420,000 workers.



http://www.seia.org/research-resources/solar-industry-data

Wind & Solar Costs Dropping



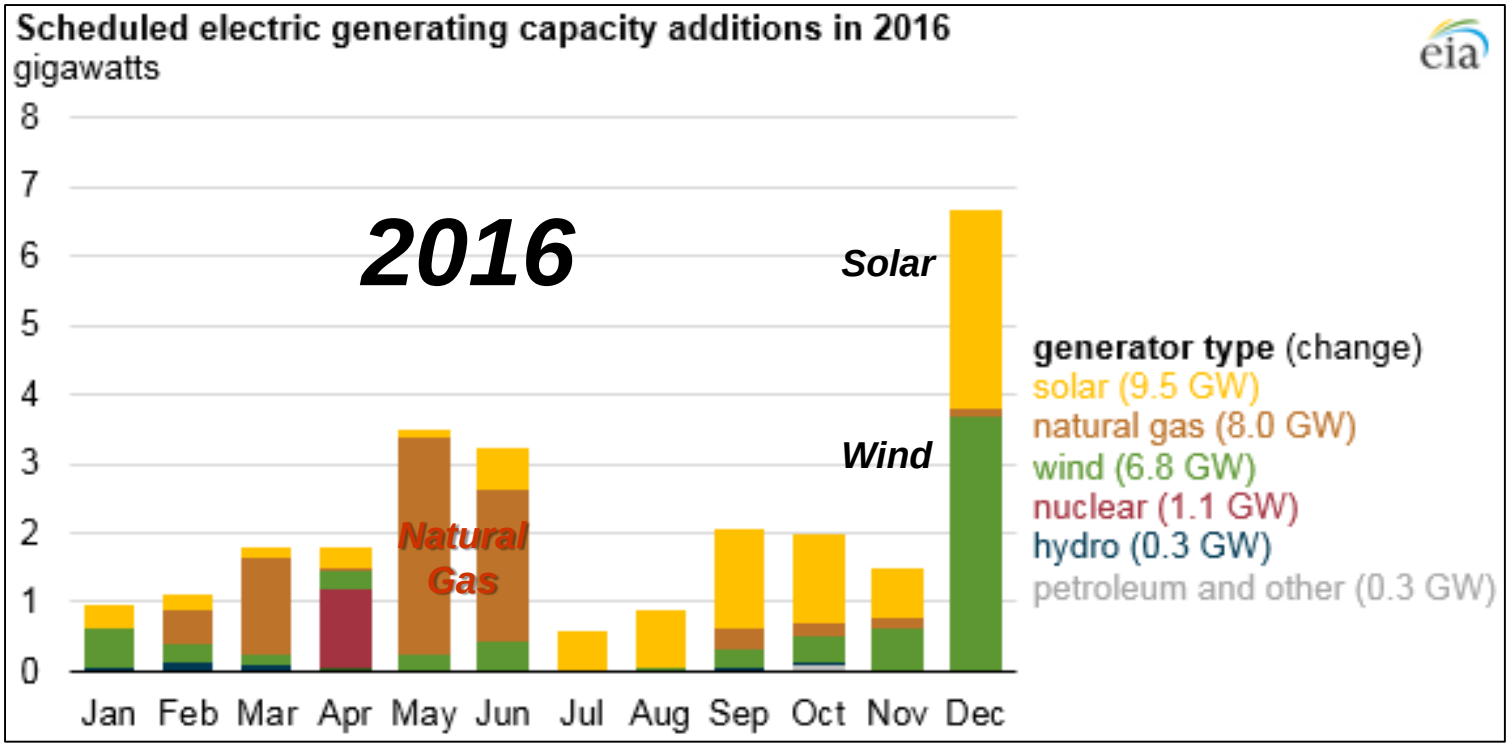
Source: Lazard

- "On an LCOE* basis, onshore wind is the cheapest form of electricity; utility-scale thin-film solar PV is the second cheapest." – *Lazard Investments & Banking*

https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-100/

*LCOE = levelized cost of energy

63% of New US Power from Solar & Wind



- The EIA reported the US added 26 GW of electric generating capacity in 2016. **63% from Solar + Wind**.
  - 9.5GW Solar + 6.8GW wind
- 2016 will be the first year in which utility-scale solar additions exceed additions from any other single energy source.

https://cleantechnica.com/2016/12/19/solar-wind-natural-gas-account-2016-electricity-generation-additions/

NM Solar Industry Has 2,929 Jobs

CNN Money

American Opportunity

Solar jobs growing 17 times faster than US economy

by Matt Egan @mattmegan5

May 25, 2017: 4:20 PM ET

Recommend 19K

- The Solar Foundation reported that in 2016, New Mexico:
  - Has **2,929** solar industry jobs, a growth rate of **54%** in one year.
  - Installers have a median wage of **$20** per hr*
  - Has **102** solar companies*

New Mexico

Download the State Report for New Mexico

30.4%	Installation
20.9%	Manufacturing
18.2%	Sales and Distribution
13.2%	Project Development
17.4%	Other

9th	Solar jobs per capita rank	9/51
102	Total solar companies	28/51
26	Solar patents (2010 - 2015)	18/51
4th	Solar resource rank	4/51
85,838	Homes powered by solar	10/51

** 2015 data*

http://www.thesolarfoundation.org/solar-jobs-census/

http://money.cnn.com/2017/05/24/news/economy/solar-jobs-us-coal/index.html

By Extending RPS, NM Should Add >1000 Solar Jobs

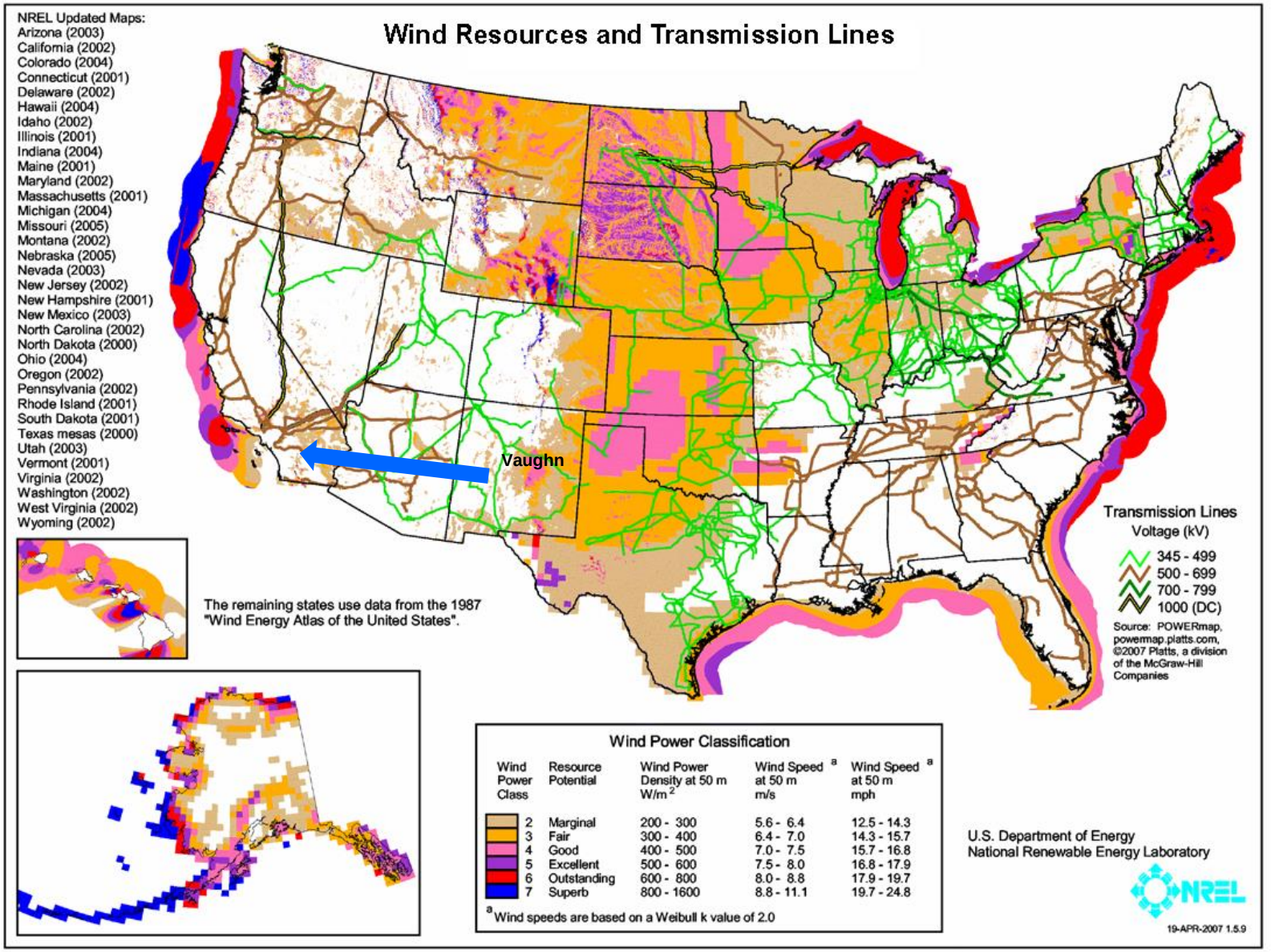
- In 2015 New Mexico had 1,899 solar workers, supporting that year's installation of **56 MW/yr**.
  - That's 34 workers per MW/yr.
- The new RPS should double that install rate to **116 MW/year**. So the NM solar workforce must double from 2015, to about 3,900.
- This **adds 1,000 jobs** just for solar. We'll need these workers by 2021.
  - Then **add even more jobs** by installing more solar for **export**. And more still, with a solar **Gigafactory**.

http://www.thesolarfoundation.org/wp-content/uploads/2016/01/TSF-2015-National-Solar-Jobs-Census.pdf

US Wind Power Resource Map

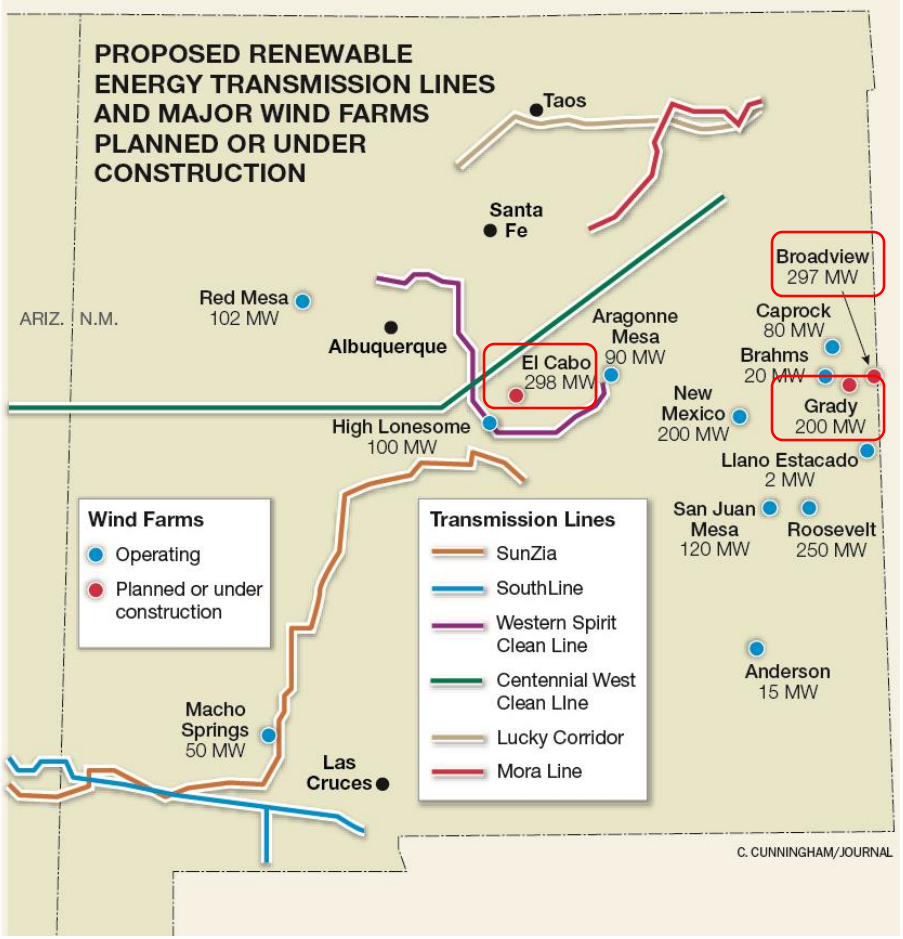
NM is the closest windy state to California

CA needs more wind but will have to import it.



New Wind Projects 2016-2017 And New Transmission

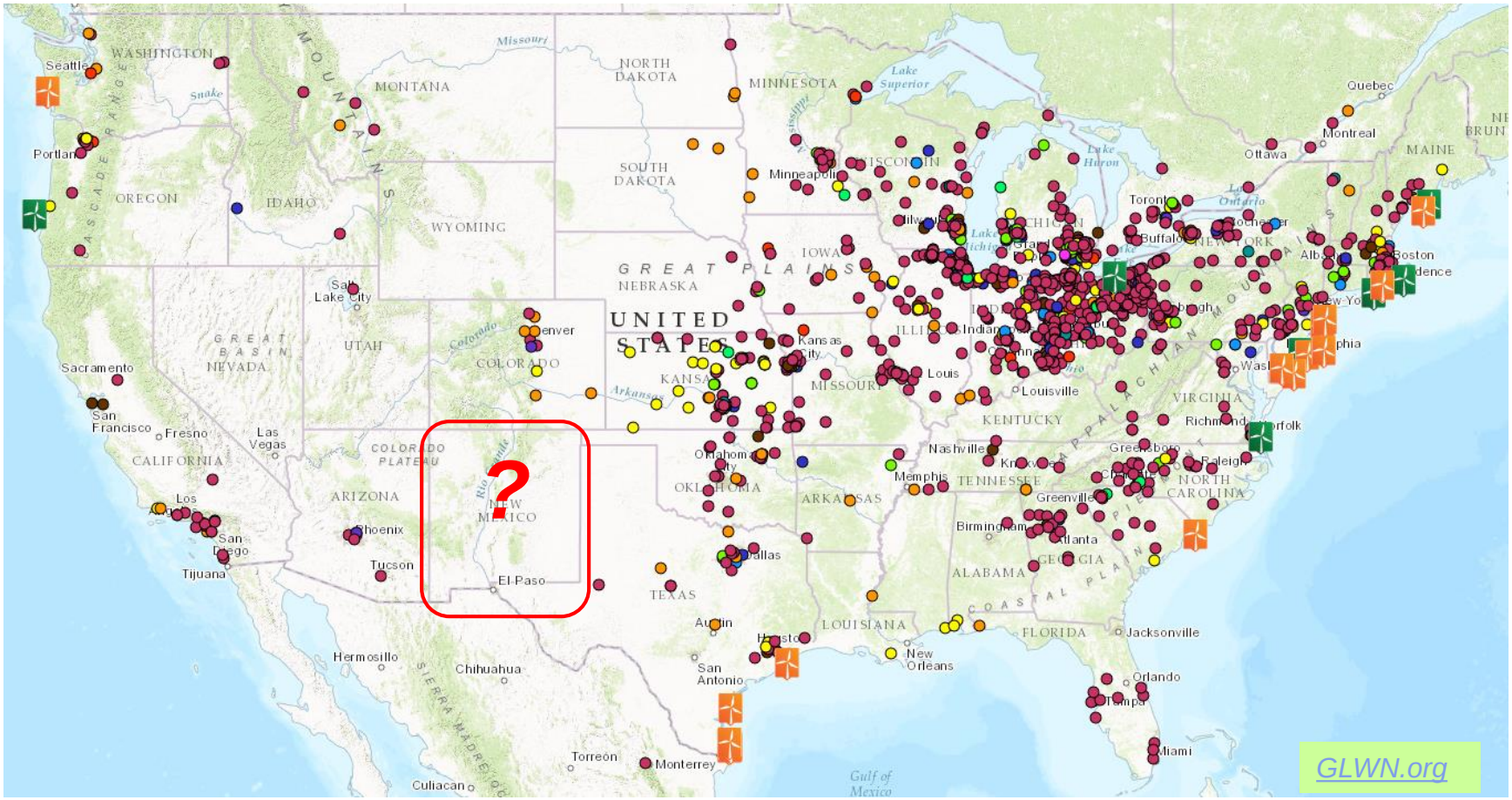
- **Big wind new projects:**
  - El Cabo 298 MW
  - Broadview 297 MW
  - Grady 200 MW
- **Three major export transmission lines:**
  - Centennial West Clean Line
  - SunZia
  - SouthLine



Dec 27 2016 https://www.abqjournal.com/915514/gust-of-windgenerated-energy-sweeping-toward-nm.html

US Wind Turbine Manufacturing

But New Mexico is <u>one of only three states</u>
with <u>no</u> wind turbine manufacturing.



Building: towers, blades, generators, gearboxes, hubs, nacelles, etc

http://energy.gov/eere/wind/wind-manufacturing-and-supply-chain
http://energy.gov/sites/prod/files/2014/09/f18/U.S.%20Wind%20Energy%20Manufacturing%20and%20Supply%20Chain%20Competitiveness%20Analysis_0.pdf

Kit Carson: Renewables Save $50M

Seeking more renewables, Kit Carson Co-op exits relationship with Tri-State G&T

Renewable Taos Study

June 2016 **"30% Solar by 2022"**

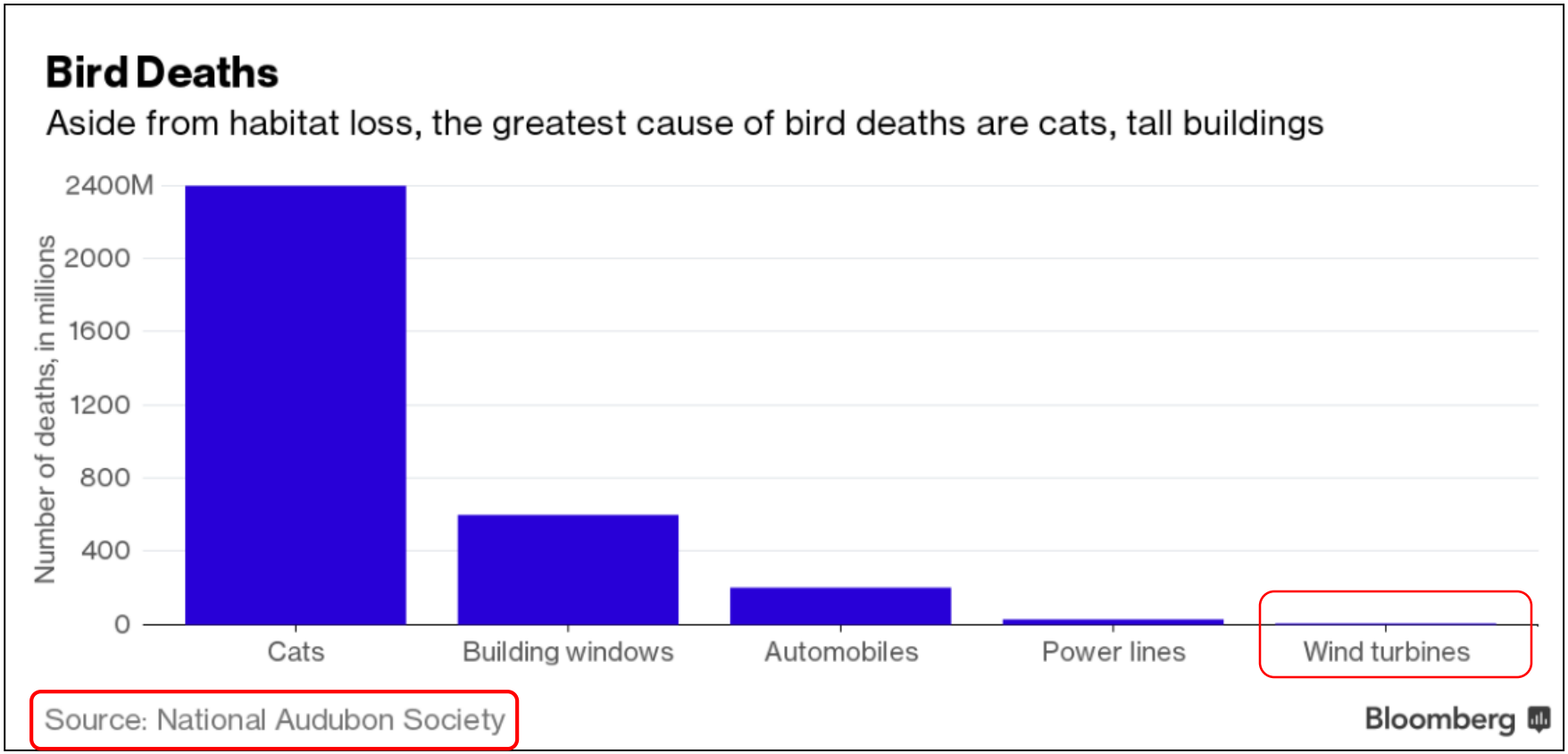
- Kit Carson Electric Cooperative in New Mexico has **exited its agreement with the Tri-State Generation** and Transmission Association and is entering a long-term deal w **Guzman Renewable Energy Partners** of Florida.
- Kit Carson Electric says the switch will **save its 30,000 customers $50 million** over the term of the 10-year agreement.
- 30 MW of solar arrays to be built from May 2017-**2022**, when locally generated solar energy will supply around **30 percent of Kit Carson's total electricity demand**, and 100 percent of its needs during daylight hours on sunny days. Solar production will exceed electricity demand during peak hours. Land is also being set aside for battery storage.

http://www.kitcarson.com/content/kcec-solar-initiative

Summary

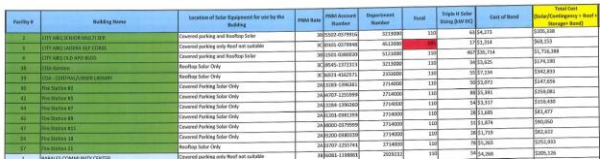
- The clean energy sector is booming worldwide as costs have dropped to make solar and wind the **cheapest sources of new energy**.
- NM has **world-class** Solar, Wind & Geothermal resources ready to develop – but to win, **we must strengthen NM's RPS policy**.
- **Let's spark a NM investment boom in clean energy**, bringing **thousands of good jobs –** by committing our state to clean renewable electricity: 50% by 2030 & 100% by 2050.
  - And remember - electricity RPS has **NO IMPACT on oil** jobs or oil revenue. Oil is **not used** in NM to generate electricity; <7% uses nat. gas.

Cats Kill 10,000x More Birds Than Wind



- Study: fossil fuel power plants **kill 35 times more birds** per GWh than wind turbines

Abq 25% Solar by 2025



- The Abq City Council approved 25% Solar electricity for city buildings ‘by 2025’. After analysis, vote was 9-0. O-17-42
  - Financed w $52M in CREB low interest bonds
  - Funding for first 50% of projects (12 for $25M & 998KW) was approved June 2017, now in RFP. All projects cash positive from year 1. R-17-207
  - Saves the city money. 6 yr payback
  - Project completion expected within two years
- Sen. Heinrich’s office: city toolkit on-line Q3’17
  - Contact Katie Richardson