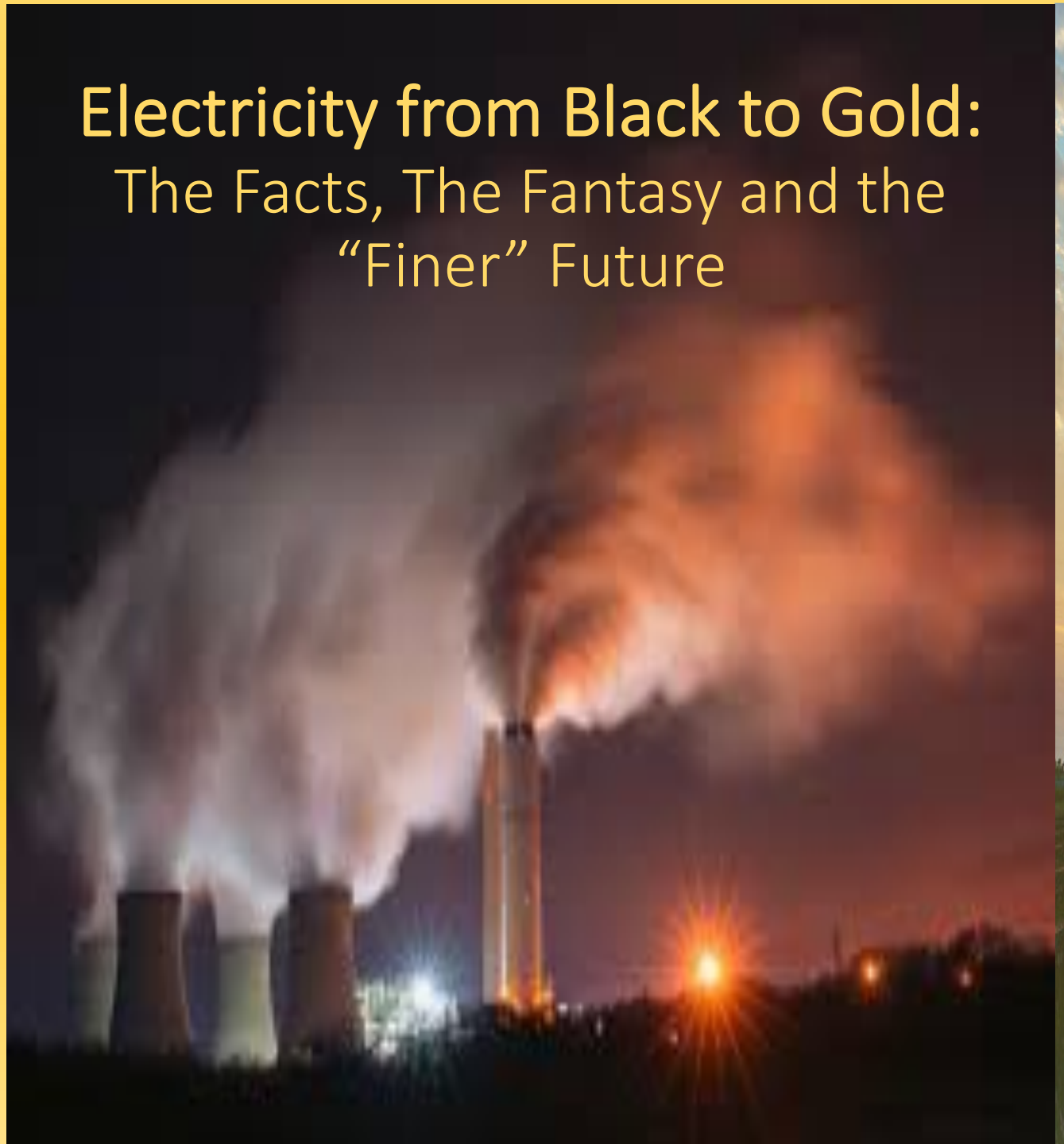
Electricity from Black to Gold:

The Facts, The Fantasy and the "Finer" Future



GND Discussion Group

February 23, 2020

1 Smithfield Street, Pittsburgh

Patricia M. DeMarco

Existential Crises of the 21st Century

"We face a climate emergency!"

Climate Change

https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature

Global Pollution

https://w.gov/news/blog/index.cfm/2012/10/24/Discarded-plaww.fwsstics-distress-albatross-chicks

Earth - Our Life Support System

Fueled by Solar Power

Clean Water

Fresh air

Fertile Ground

Biodiversity of Species

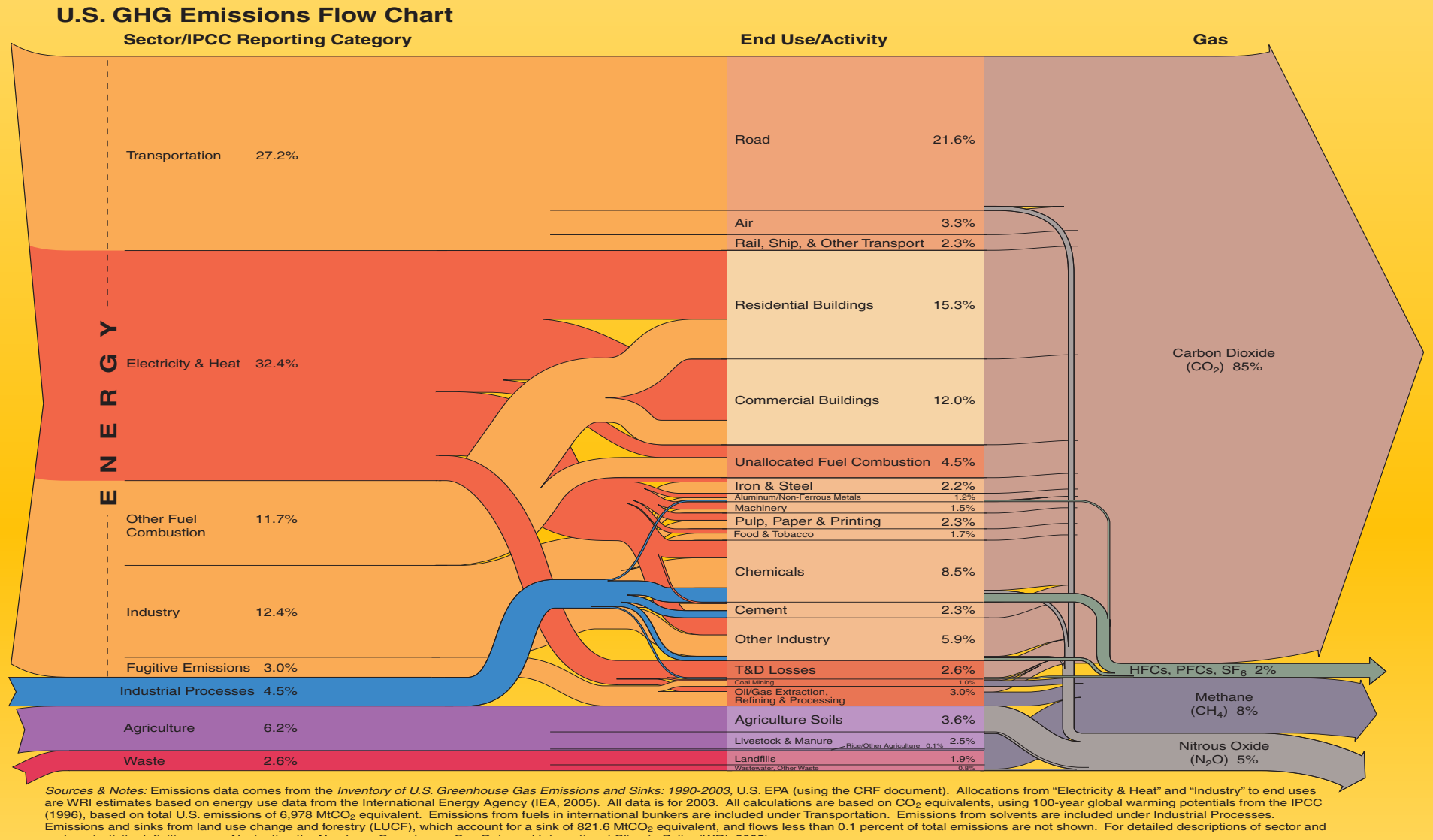
Our Life Support System is Under Stress:

Fossil Fuel Combustion

Increasing Population

Resource Extraction

Hyper-consumption

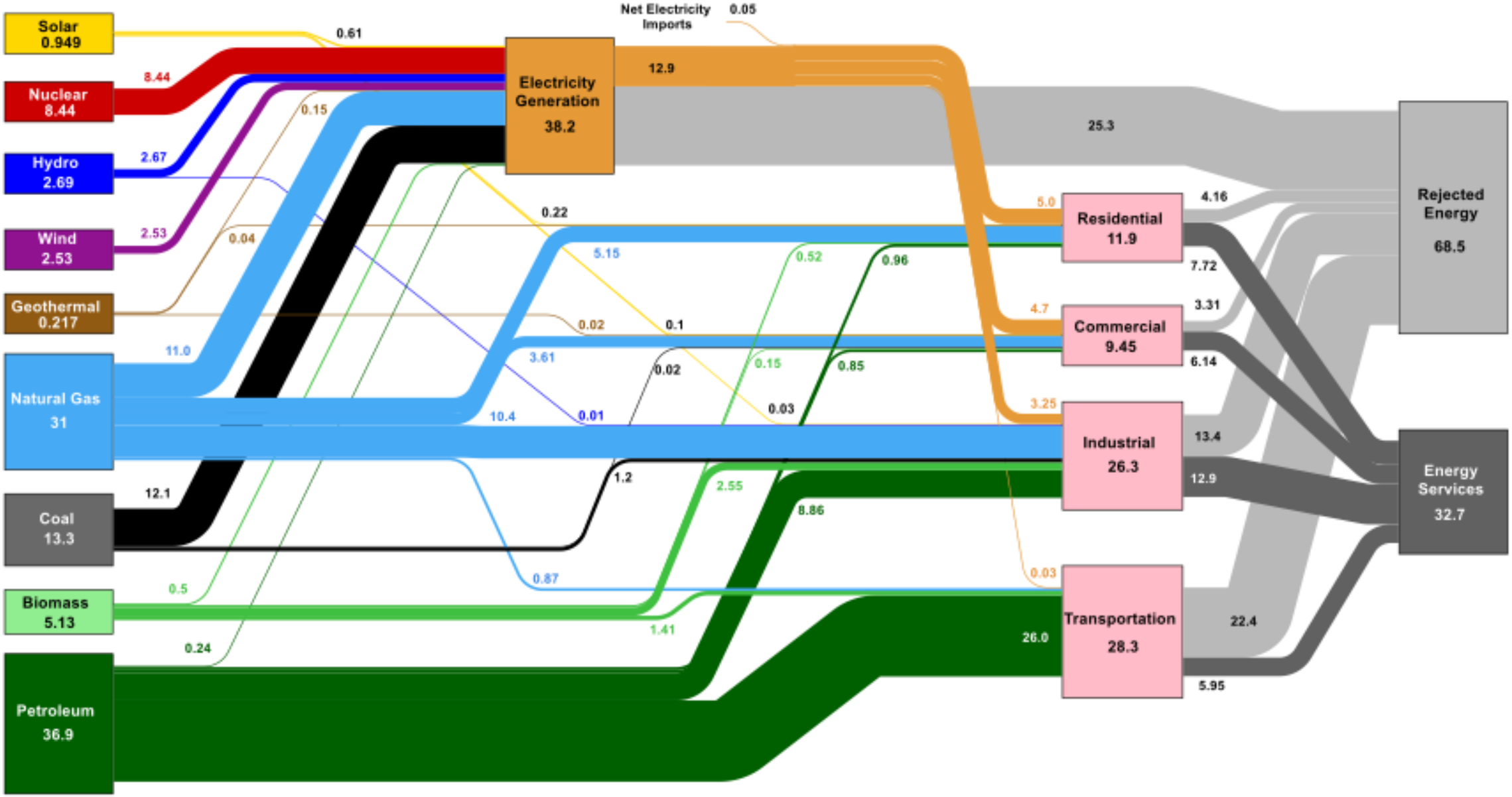


Sources & Notes: Emissions data comes from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2003*, U.S. EPA (using the CRF document). Allocations from "Electricity & Heat" and "Industry" to end uses are WRI estimates based on energy use data from the International Energy Agency (IEA, 2005). All data is for 2003. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on total U.S. emissions of 6,978 $MtCO_2$ equivalent. Emissions from fuels in international bunkers are included under Transportation. Emissions from solvents are included under Industrial Processes. Emissions and sinks from land use change and forestry (LUCF), which account for a sink of 821.6 $MtCO_2$ equivalent, and flows less than 0.1 percent of total emissions are not shown. For detailed descriptions of sector and

Total Emissions in 2015 = 6,587 Million Metric Tons of CO_2 equivalent

https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

Estimated U.S. Energy Consumption in 2018: 101.2 Quads



Source: LLNL March, 2019. Data is based on DOE/EIA MER (2018). 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

The Fantasy

Marcellus shale natural gas as a bridge fuel

Shell Petrochemical complex

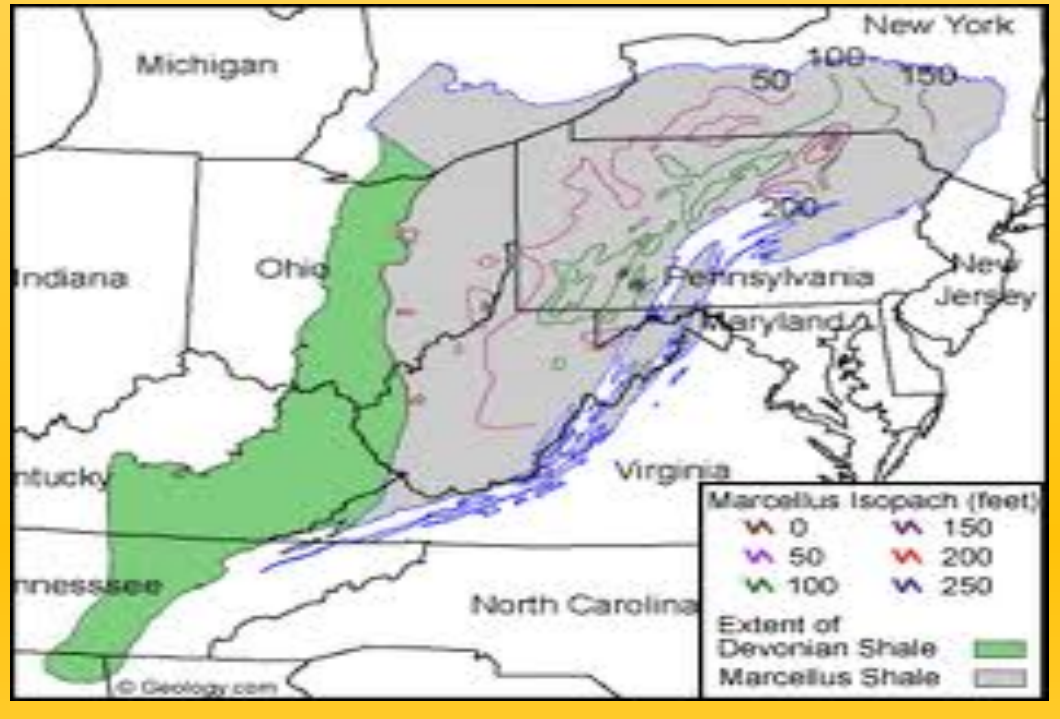
Plastics

HB 1100 subsidies for 30 years to 2050

Andrew Rush/Post-Gazette. August 13, 2019

The Bridge Fuel….

- Marcellus Shale is promoted as the “Bridge fuel”
- The energy “Game Changer” internationally
- “Only the Beginning” in restoring manufacturing, national security,
- Energy independence



- U.S. Geological Survey (USGS) estimated a mean undiscovered natural gas resource of **84,198 billion cubic feet** and a mean undiscovered natural gas liquids resource of **3,379 million barrels** in the Devonian Marcellus Shale within the Appalachian Basin Province.

An Industry Founded on “Special Exemptions”

- **Energy Policy Act of 2005, “Haliburton Loophole”**
- **Removed EPA Authority** to regulate hydraulic fracturing
- Exempt from Safe Drinking Water Act
- Exempt from Clean Air Act
- Exempt from Superfund Act
- Exempt from OSHA Provisions requiring disclosure of chemicals

Renee Lewis Kosnik. “The Oil and Gas Industry’s Exclusions and Exemptions from Major Environmental Statutes.” Earthworks. 2007. https://www.earthworksaction.org/files/publications/PetroleumExemptions1c.pdf

The Promise of Jobs, Jobs, Jobs

- construction at Shell's ethane cracker will eventually provide jobs for 1,500 steamfitters, some of whom will make more than $100,000 a year.
- Natural gas is going to be bigger than the steel industry back 30 or 40 years ago.
- "There's 50 years to 100 years of natural gas in this tri-state region. This thing is not going away."

"Employment in western Pennsylvania has never been better"

Kenneth Broadbent

Steamfitters Local 449

Hydraulic Fracturing Across the US

- **39 States** have shale gas deposits
- **15 Million people** live within a mile of a fracking operation between 2000 and 2017
- **172,100 Oil and Gas industry non-supervisory employees**
- **Only 6.5% represented by unions**

The Precautionary Principle

- *" Underlying all these problems of introducing contamination into our world is the question of moral responsibility -* ***responsibility not to our own generation, but to those of the future****"*
- Rachel Carson

Matt Kelso. A Hazy Future- Pennsylvania's Energy Landscape in 2045. FrackTracker Alliance Issue Paper. January 10, 2018.

Plastic has become a global pollutant:

- 250 ocean species known to be killed or entangled in plastic debris
- 10 to 20 million tons of plastic refuse ends up in the oceans each year
- US discards 35 billion plastic water bottles per year
- Over 40% of plastic is used in packaging
- Plastics account for 8% of world's oil production

Fracking Air Pollution Paths

- **Gas well** drilling, production and completion
- **Surface spills**
- **Evaporation pits** for produced water
- **Gas flaring**
- **Surface transfers**
- **Compression stations**
- **Processing facilities** (eg. Cracker plants)
- **Diesel truck traffic**

Evaporation pit- Easton PA

Frack Water Pollutants

- **Carcinogens:** benzene, toluene, butoxyethanol, zylene
- **Toxic chemicals**: boric acid, methanol, methane
- **Endocrine disruptors**: 120 EDCs (eg. Naphthalene)
- Radioactive Radon, Boron, uranium and Thorium

https://www.epa.gov/radiation/tenorm-oil-and-gas-production-wastes

Environ. Sci. Technol. 2016,
DOI: 10.1021/acs.est.5b06349)

Approximately 1,000 chemical “Products”
Used in hydraulic fracturing process
58% are soluble in water.

Fracking Health Effects

https://www.ecowatch.com/leukemia-oil-gas-wells-2280665249.html

- **Environmental Degradation**
  - Watershed functions compromised
  - Habitat destroyed and fragmented leading to loss of biodiversity
- **Short-term Health Effects -649 chemicals used in fracking process:**
  - **Acute effects include**:
  - 75% skin, eye and respiratory irritants
  - 40-50% affect brain, nervous, immune, and cardiovascular systems and kidneys
  - 37% affect the endocrine system
- **Long-term Health Effects - 25% of fracking chemicals are carcinogens and mutagens:**
  - **Cancers** associated include silicosis, liver cancer, lung cancer, leukemia, Hodgkins Lymphoma
  - **Reproductive effects** including low fertility, birth defects and low birth weight, reproductive disorders, miscarriages and stillbirth.
- **Workers Health & Safety**
  - **Silicosis, lung cancer** from inhalation while handling frack sand propant – 47% of workers at 111 sites exposed to levels 10 times NIOSH REL
  - **Fatal injury 7 X higher** than rate of general industry (large number from trucking accidents)

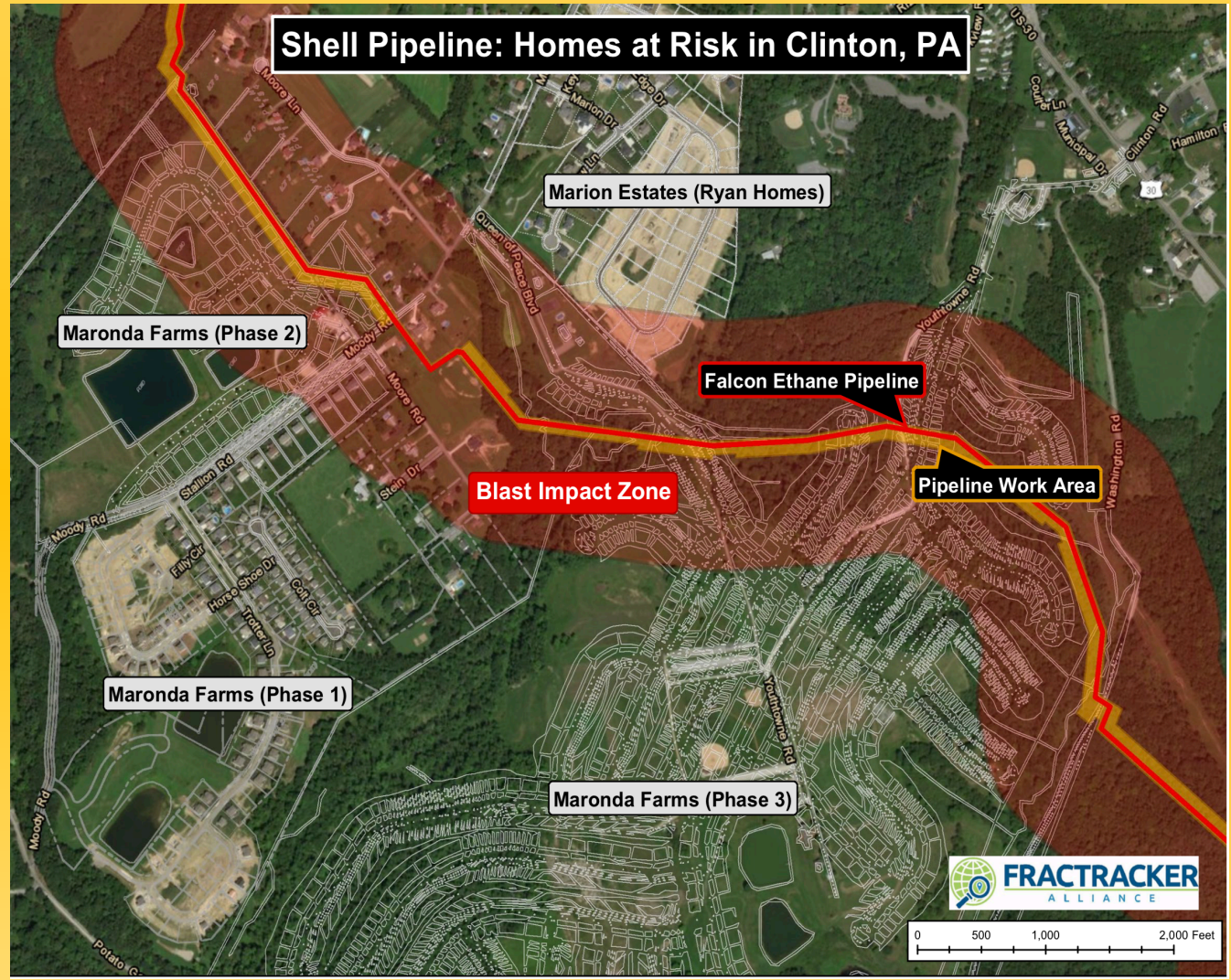
PA Subsidies for ONE Petrochemical Plant- Shell Appalachia

- $1.65 Billion in tax forgiveness over 25 years
- Shell can use the tax credits to reduce up to 20 percent of its tax bill
- The company must invest at least $1 billion in Pennsylvania and
- create at least 2,500 construction jobs.
- Shell was able to claim a state sales tax exemption beginning Jan. 1, 2014
- Shell received $10 million from the Pennsylvania First Program for site development and infrastructure costs

Construction of Shell Chemical Appalachia's ethane cracker facility in Monaca, Pennsylvania in February.
NICK CUNNINGHAM / YALE E360

Property Value Risks:

- "We calculate the **average annual loss** for groundwater -dependent homes within 1.5 km of a well to be $30,167." (avg. **13.9% dec**rease)
- "...**average annual gain** for piped-water properties within 1.5 km of a well is $4802" (avg **2.2% increase**)
- "...These forces are beginning to show up in the way housing markets located on shale plays operate–
- e.g. major national mortgage lenders are refusing to make loans to properties in close proximity to gas wells
- insurance providers are refusing to issue policies on those houses."



The Housing Market Impacts of Shale Gas Development†

By Lucija Muehlenbachs, Elisheba Spiller, and Christopher Timmins*

American Economic Review 2015, 105(12): 3633–3659
http://dx.doi.org/10.1257/aer.20140079

Re-Framing the Problem – What Is the Result?
1. Profits go to a few multinational corporations

- ”Today we have a temporary aberration called “industrial capitalism” which is inadvertently eliminating its two most important sources of capital:
  - The natural world and
  - Properly functioning societies.
- It is incapable of meeting the challenge of these times to **prevent** life on Earth from slipping away.” *Amory Lovins*

Re-Framing the Problem – What Is the Result?

2. Consumers do not see consequences

- Environmental damage to land and ecosystems
- Waste disposal
- Air pollution
- Health effects

These are not reflected in the price.

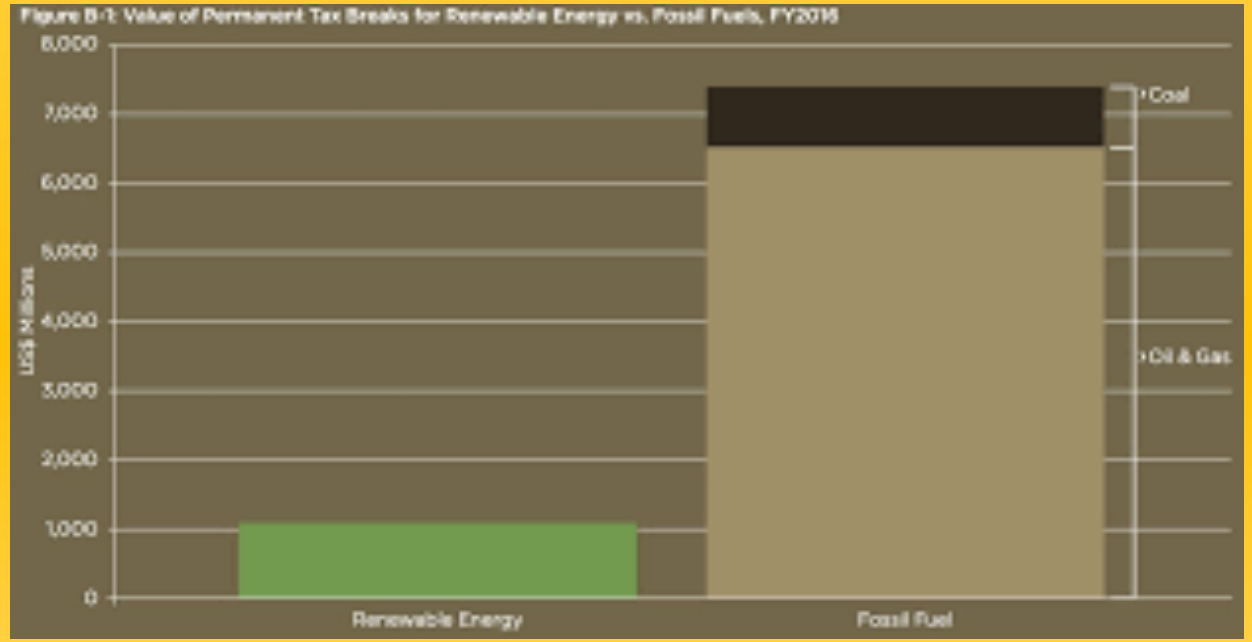
- Policies **support** environmental destruction

Hydraulic fracturing in Hickory PA

Re-Framing the Problem – What Is the Result?
3. The taxpayers pay through subsidies and hidden costs

- **$20.5 Billion/year** in direct production subsidies for oil, gas and coal extraction
- **Permanent** Investment Tax Credits for oil, gas, coal of $7.4 Billion/year
- (compared to $1.3 billion for renewables, ending in five years)
- **Cost to each taxpayer = $142/YR**

  $20 Billion /141 Million taxpayers



Renewable energy subsidies vs oil, gas, coal

Fossil Fuel Subsidy Study ODI 2018

Tax credits and loopholes = Additional $10 billion/yr

- Intangible drilling oil & gas deduction **($2.3 billion)**
- Excess of percentage over cost depletion **($1.5 billion)**
- Master Limited Partnerships tax exemption **($1.6 billion)**
- Last-in, first-out (LIFO) accounting **($1.7 billion)**
- Lost royalties from onshore and offshore drilling **($1.2 billion)**
- Low-cost leasing of coal-production in the Powder River Basin **($963 million)**

https://www.nature.com/articles/s41560-017-0009-8
http://priceofoil.org/2017/10/03/dirty-energy-dominance-us-subsidies/

The Status Quo- “Just the way it is”? Subsidies matter!

- 98% of all operating coal plants are unprofitable if environmental controls are updated and enforced.
- 50% of yet-to-be-drilled oil and gas wells are not profitable (at $50/barrel oil price) if they do not have tax preferences

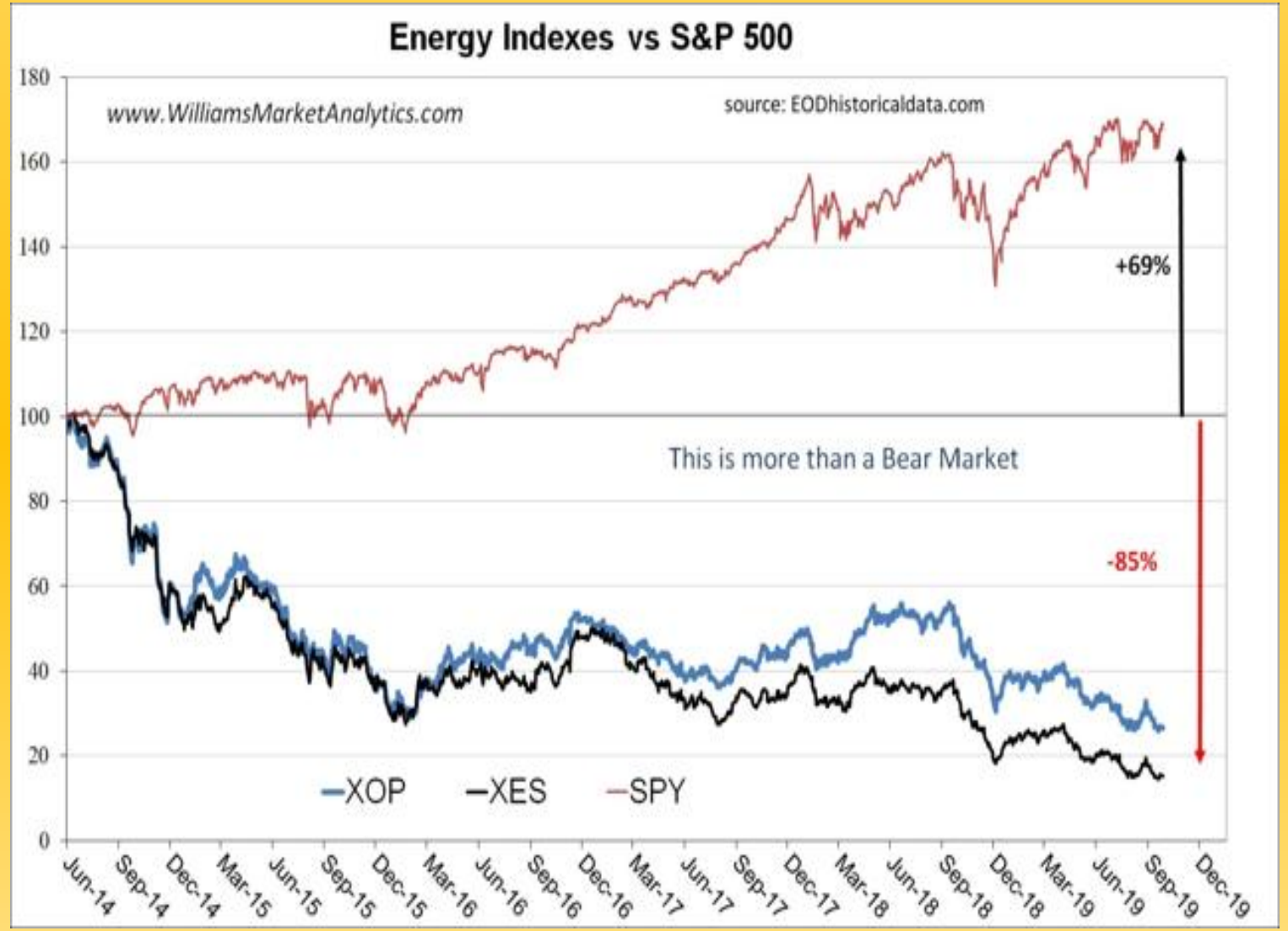
Investment not paying off:

- **The U.S. shale oil industry hailed as a “revolution” has burned through a quarter trillion dollars more than it has brought in over the last decade. It has been a money losing endeavor of epic proportions.**

https://www.icis.com/resources/news/2018/04/12/10211170/risk-to-us-pe-exports-escalates/?redirect=English

Failing Prospects for Fossil Industries:

- S&P 500 growing 69%
- Oil & Gas Production and Oil and Gas Services falling 85%
- “Most oil and gas companies will go out of business or get bought out. Successful oil and gas companies will be those whose managers embrace the clean energy revolution and develop alternative energy products.”



www.WilliwamsMarketAnalytics.com

Bridge to what? ……

From Extraction

To A Circular Supply Chain

Kelp

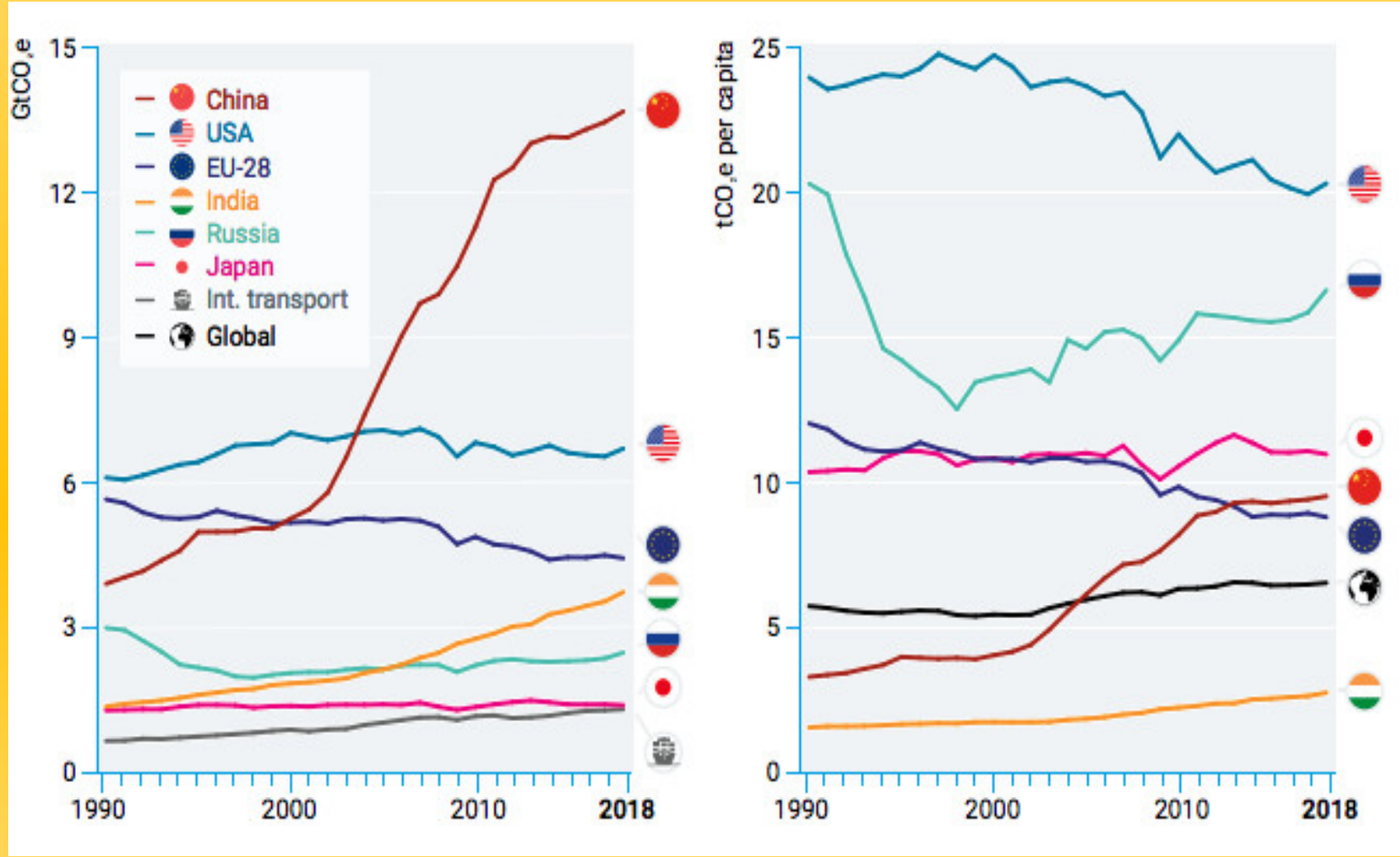
Hemp

Our “Finer” Future

- Millvlale Community Library New Sun Rising https://www.solarunitedneighbors.org/news/national-solar-tour-connects-pennsylvania-solar-homeowners-with-their-community/

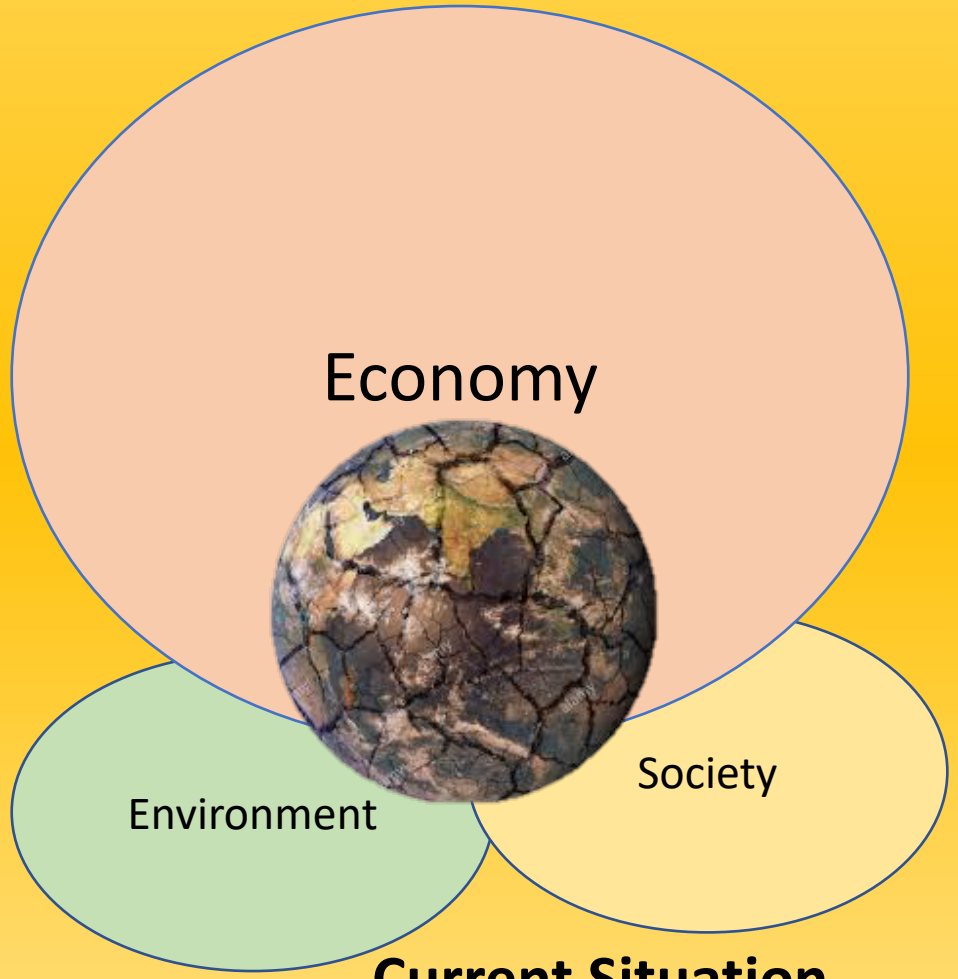
UN Emissions Gap Report 2019

- "Countries collectively failed to stop the growth in global GHG emissions, meaning that deeper and faster cuts are now required."
- Technologies for rapid and cost-effective emission reductions have improved significantly.

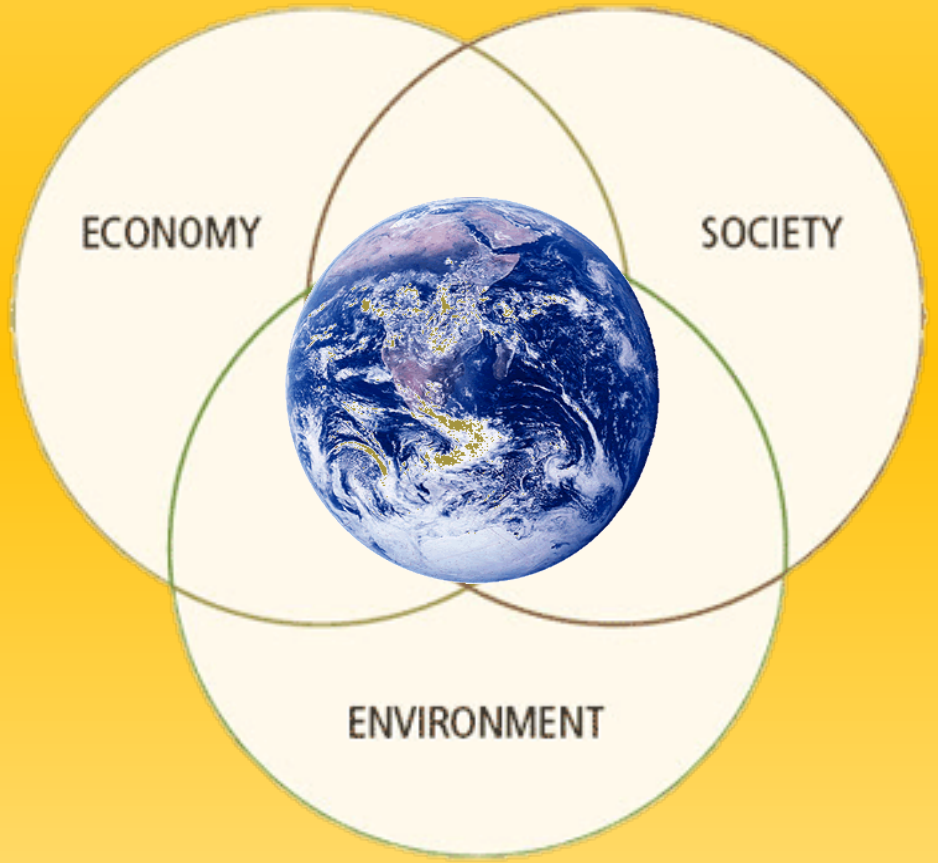


https://wedocs.unep.org/bitstream/handle/20.500.11822/30798/EGR19ESEN.pdf?sequence=13

Sustainability as a Goal



Current Situation



Sustainable Situation

A **Metamorphosis**- not a simple transition

Sustainable Development

Meeting the **needs** of today's generation without compromising

the ability of **future generations**

to meet

their own needs.

United Nations Bruntdland Commission Report

Re-define the Problem:

- We receive from the sun over 10,000 times more energy per year than we are projected to use worldwide
- Solar (renewable) energy sources are FLOWS
- Solar energy is already distributed
- Solar energy is reliable (the sun comes up every day…)
- We have the technology to use it NOW!
- Solar energy does not pollute and it is safe

Solar systems leased on roof-tops

Replace **Fear** With >>>>>>

Demonstrations in Pittsburgh at Clean Power Plan EPA hearing 2015

A **Plan** for a Sustainable Economy

"A just transition of the workforce that creates decent work and quality jobs."

AFL-CIO Climate statement at Copenhagen https://www.scribd.com/document/96838350/Final-Report-from-the-AFL-CIO-and-International-Trade-Union-Confederation-on-the-Copenhagen-Accord-on-Climate-Change

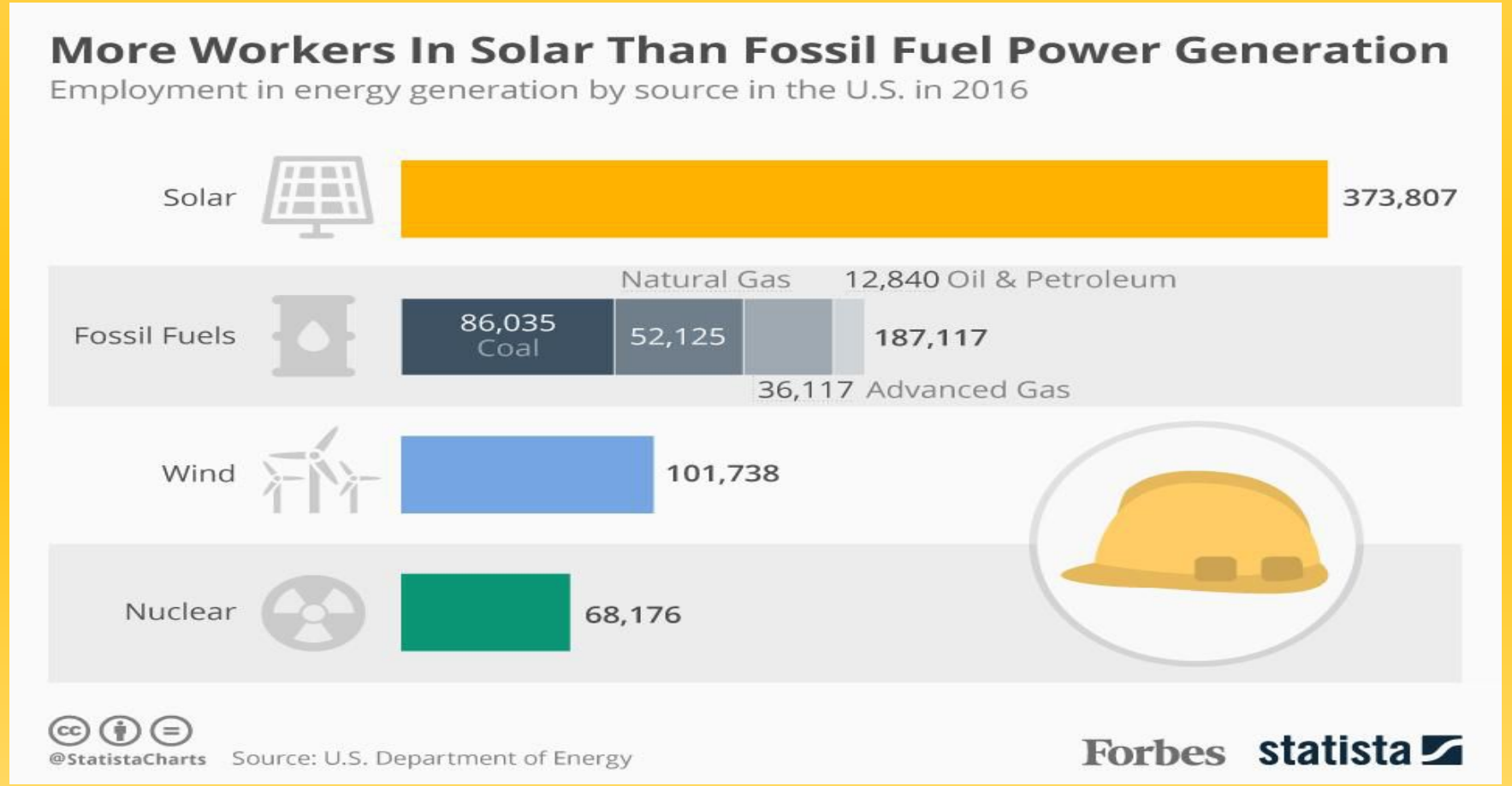
Better Choices: The Green Jobs Economy

- What is a “Green Job”
- “Jobs in businesses that produce goods and services that benefit the environment and conserve natural resources.”

- U.S. Bureau of Labor Statistics

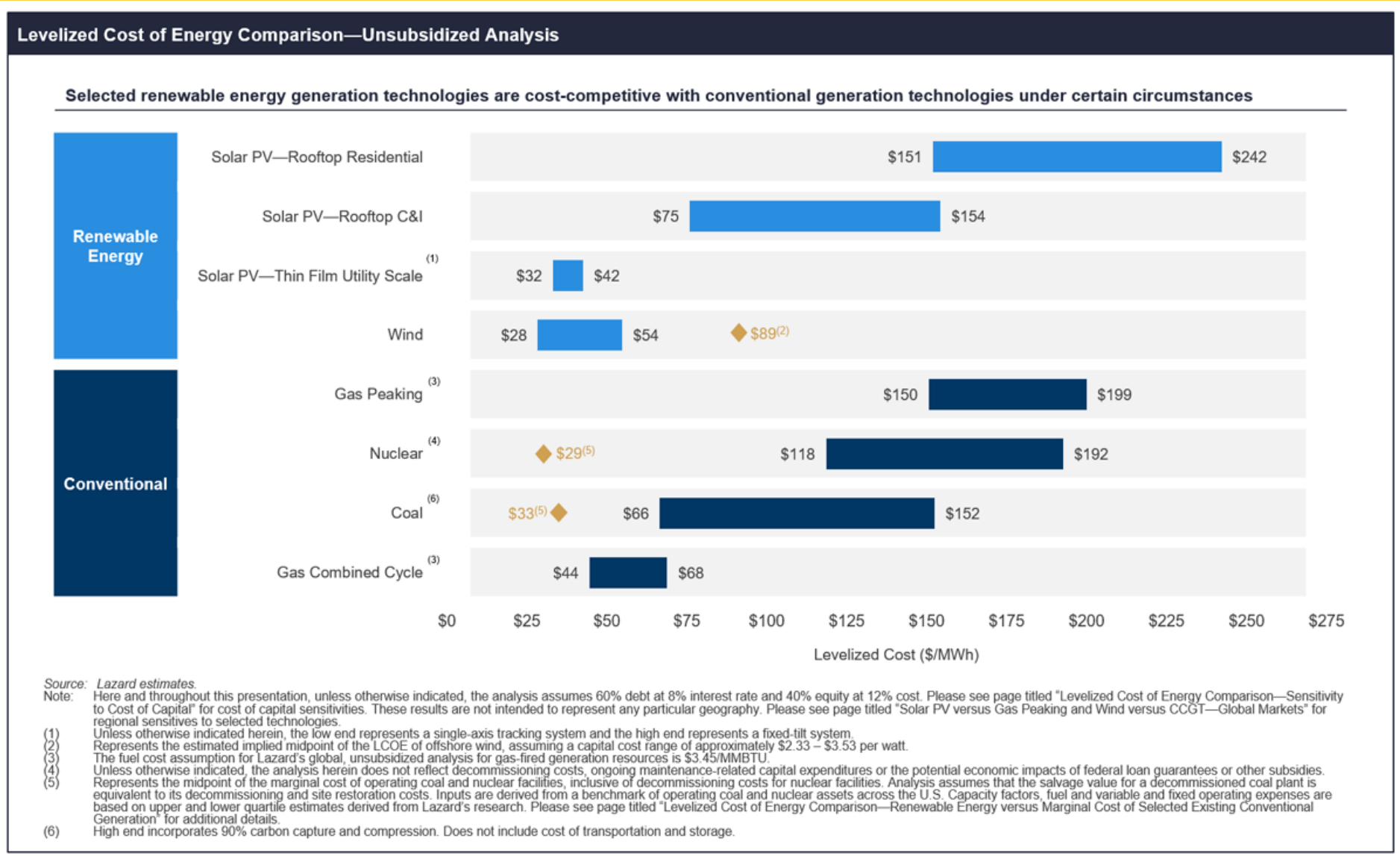
THE INSTITUTE FOR GREEN SCIENCE

Better Choices: The Green Jobs Economy



https://www.forbes.com/sites/niallmccarthy/2017/01/25/u-s-solar-energy-employs-more-people-than-oil-coal-and-gas-combined-infographic/#7cc2b7228000

Cost of Energy Comparison



Source: *Lazard estimates.*

Note: Here and throughout this presentation, unless otherwise indicated, the analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital" for cost of capital sensitivities. These results are not intended to represent any particular geography. Please see page titled "Solar PV versus Gas Peaking and Wind versus CCGT—Global Markets" for regional sensitives to selected technologies.

(1) Unless otherwise indicated herein, the low end represents a single-axis tracking system and the high end represents a fixed-tilt system.

(2) Represents the estimated implied midpoint of the LCOE of offshore wind, assuming a capital cost range of approximately $2.33 – $3.53 per watt.

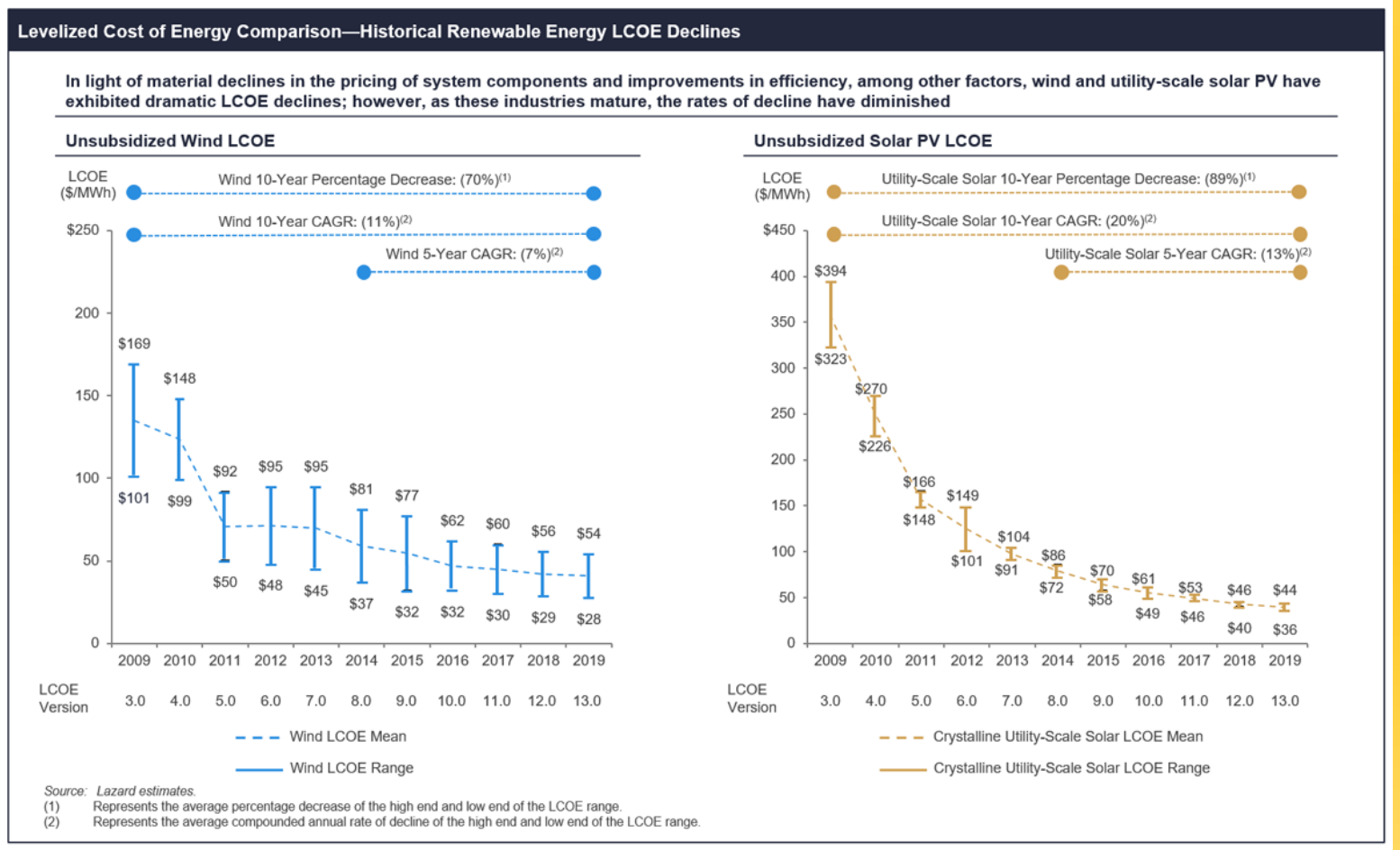
(3) The fuel cost assumption for Lazard's global, unsubsidized analysis for gas-fired generation resources is $3.45/MMBTU.

(4) Unless otherwise indicated, the analysis herein does not reflect decommissioning costs, ongoing maintenance-related capital expenditures or the potential economic impacts of federal loan guarantees or other subsidies.

(5) Represents the midpoint of the marginal cost of operating coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark of operating coal and nuclear assets across the U.S. Capacity factors, fuel and variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research. Please see page titled "Levelized Cost of Energy Comparison—Renewable Energy versus Marginal Cost of Selected Existing Conventional Generation" for additional details.

(6) High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

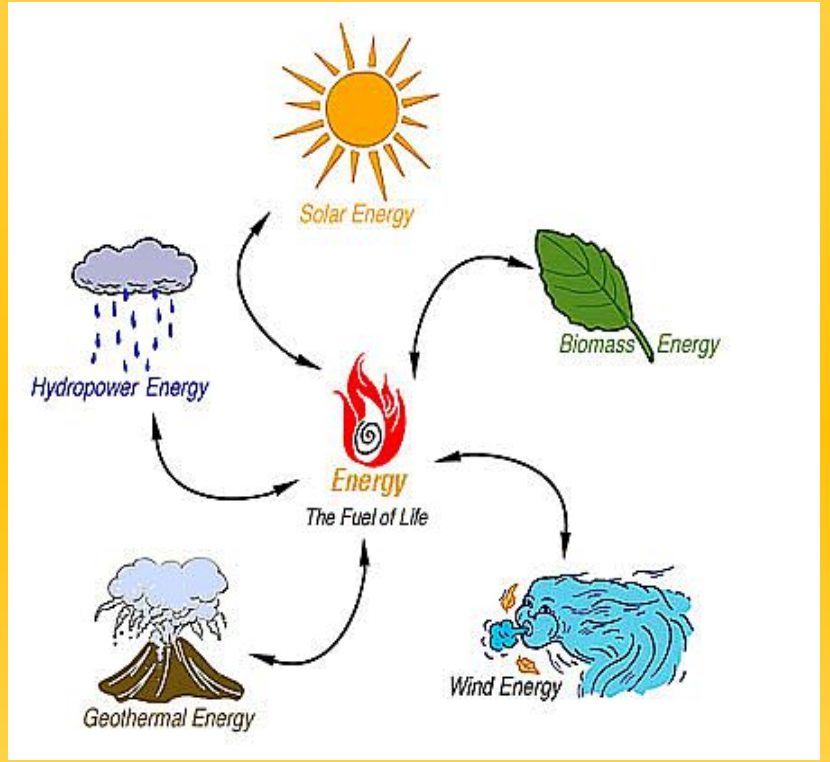
Cost Competitive and Better!



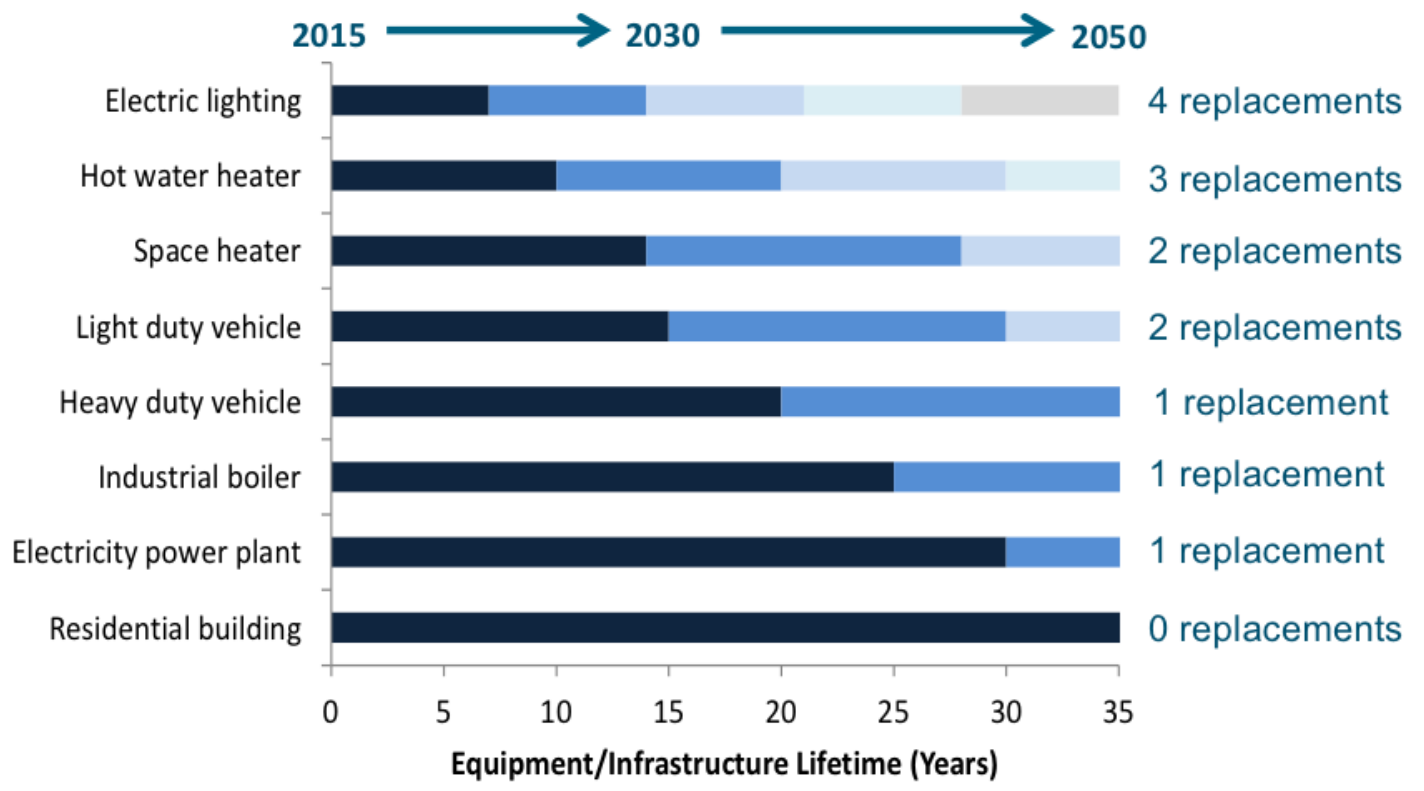
https://www.lazard.com/perspective/lcoe2019

Renewable Energy Systems

- Replace the 1800's technologies with renewable and sustainable energy **systems**
- Focus on meeting the **need for work,** not just replacing fuel sources.



Transition issues



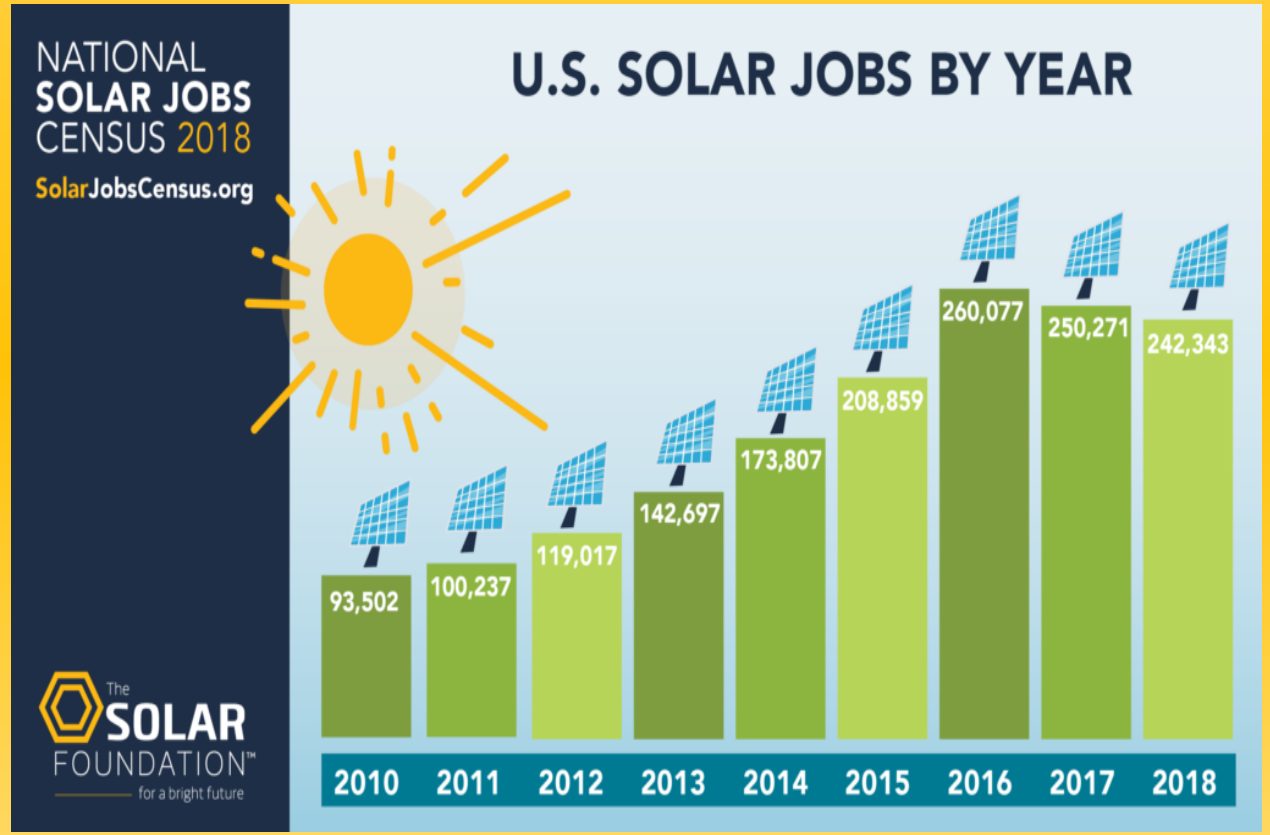
- Increase electrification
- Shift electricity generation to renewables
- Add distributed and customer-generated sources
- Increase efficiency of built infrastructure

Better Choices: The Green Energy Field

What are the sectors of clean energy?

- Renewable energy- solar, wind
- 777,000 jobs in 2016
- Solar increased by 25.5%
- Wind increased by 16%

- Tariffs against China have hurt the industry, as well as uncertainty in the policy arena since 2017



Better Choices: The Green Energy Field

What are the sectors of clean energy?

- Energy Storage and Advanced Electric Grid
- **235% surge in growth 2016-2017**
- 98,800 jobs in storage
- 55,000 jobs in advanced electric grid

Workers at a battery storage facility in Escondido.
Credit Coley Brown for The New York Times

Better Choices: The Green Energy Field

What are the sectors of clean energy?

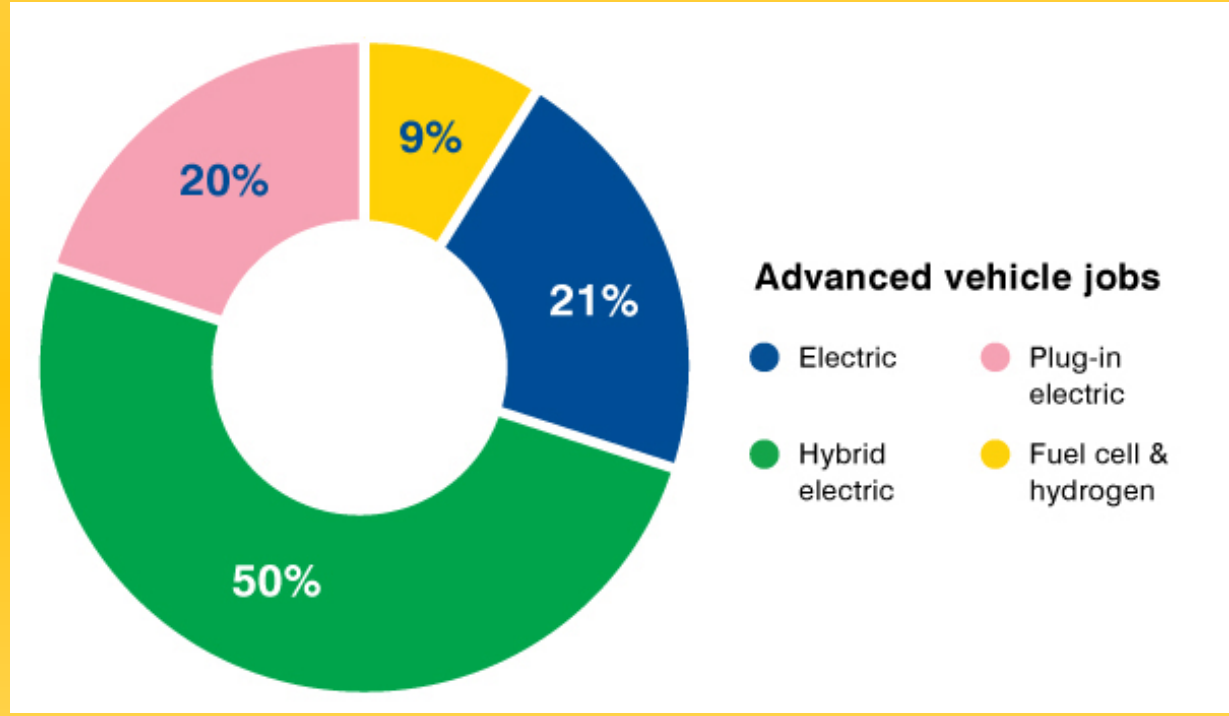
- **Energy Efficiency** –includes diagnostics, engineering modifications, retrofitting, adapting and installing energy efficiency improvements to commercial and residential buildings
- **2.2 million workers** , mostly in construction trades

Midwest Energy Efficiency Alliance

Better Choices: The Green Energy Field

What are the sectors of clean energy?

- **Advanced Vehicles and Transportation**
- Develop and manufacture electric vehicles and hybrid vehicles
- 174,000 jobs in 2016-2017
- $11 Billion in investment announced by Ford for 40 EV and Hybrid vehicles on the market by 2022

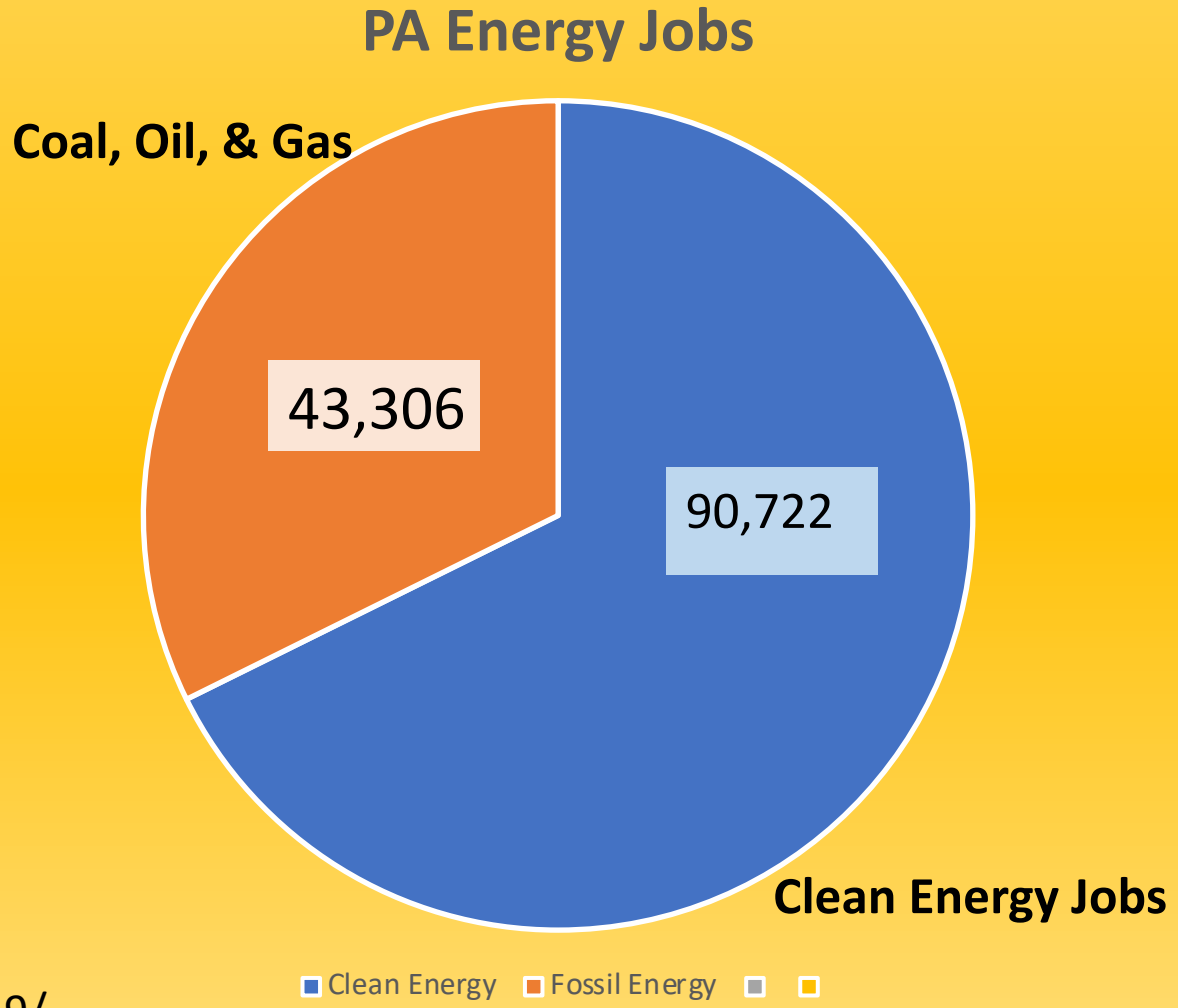


https://www.forbes.com/sites/niallmccarthy/2017/01/25/u-s-solar-energy-employs-more-people-than-oil-coal-and-gas-combined-infographic/#7cc2b7228000

Pennsylvania Energy Sector Jobs

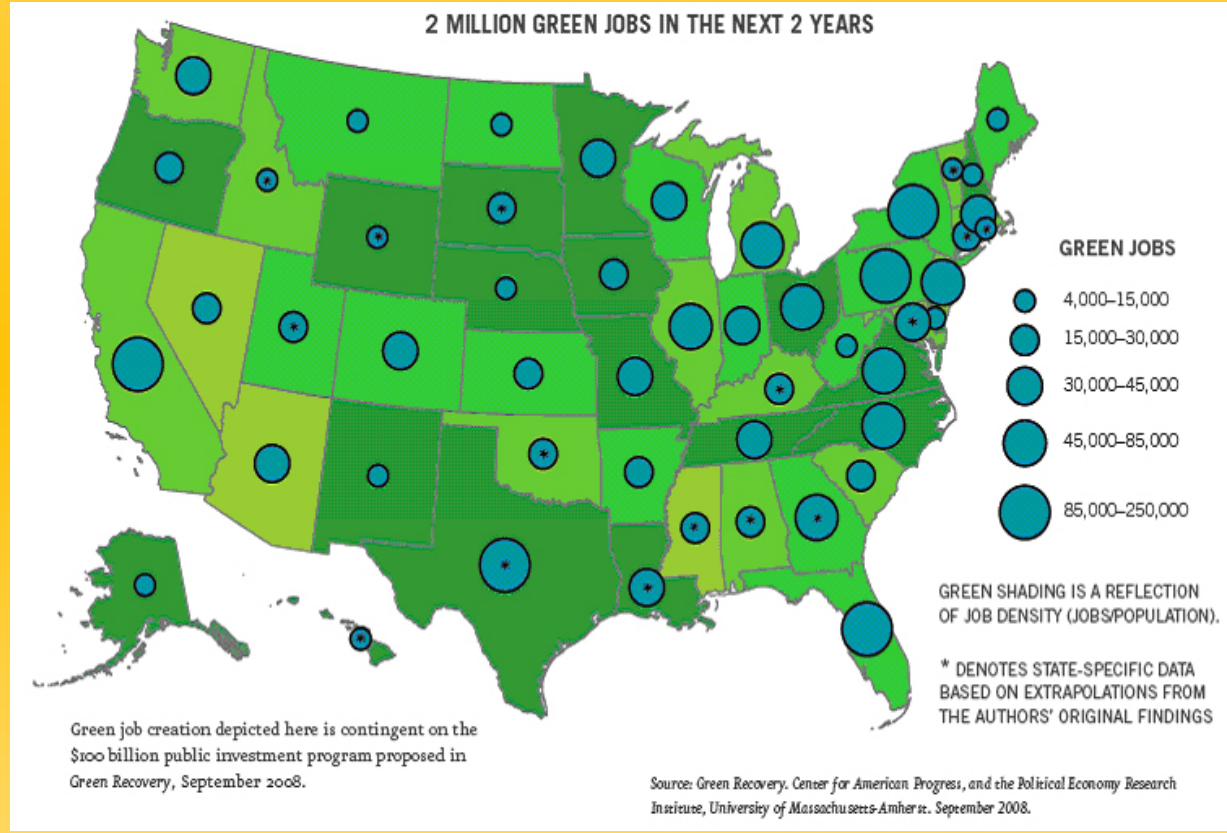
- Energy Efficiency – **68,820 jobs**
- Renewable Energy – **9,209 jobs**
- Clean Vehicles – **7,788 jobs**
- Solar Energy – **4,846 jobs**
- Wind Energy – **2,815 jobs**
- Energy Storage – **1,692 jobs**
- Grid Modernization – **1,861 jobs**
- **ALL Clean Energy Sectors – 90,772 jobs**

https://www.e2.org/reports/clean-jobs-pennsylvania-2019/

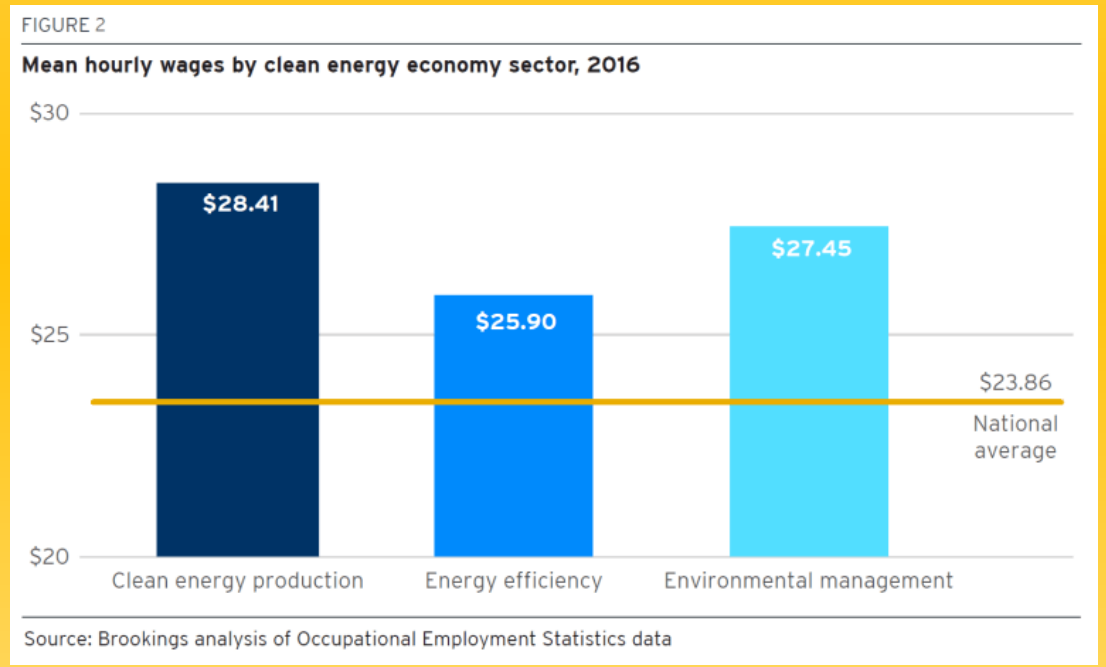


Better Choices: The Green Energy Field

- Technology costs in renewables are dropping sharply
- Demand increasing for efficiency and clean energy solutions
- More supportive policies emerging (state level mostly)
- Investment in renewable infrastructure increasing



Nature of Work in the Clean Energy Economy Wages and Skills



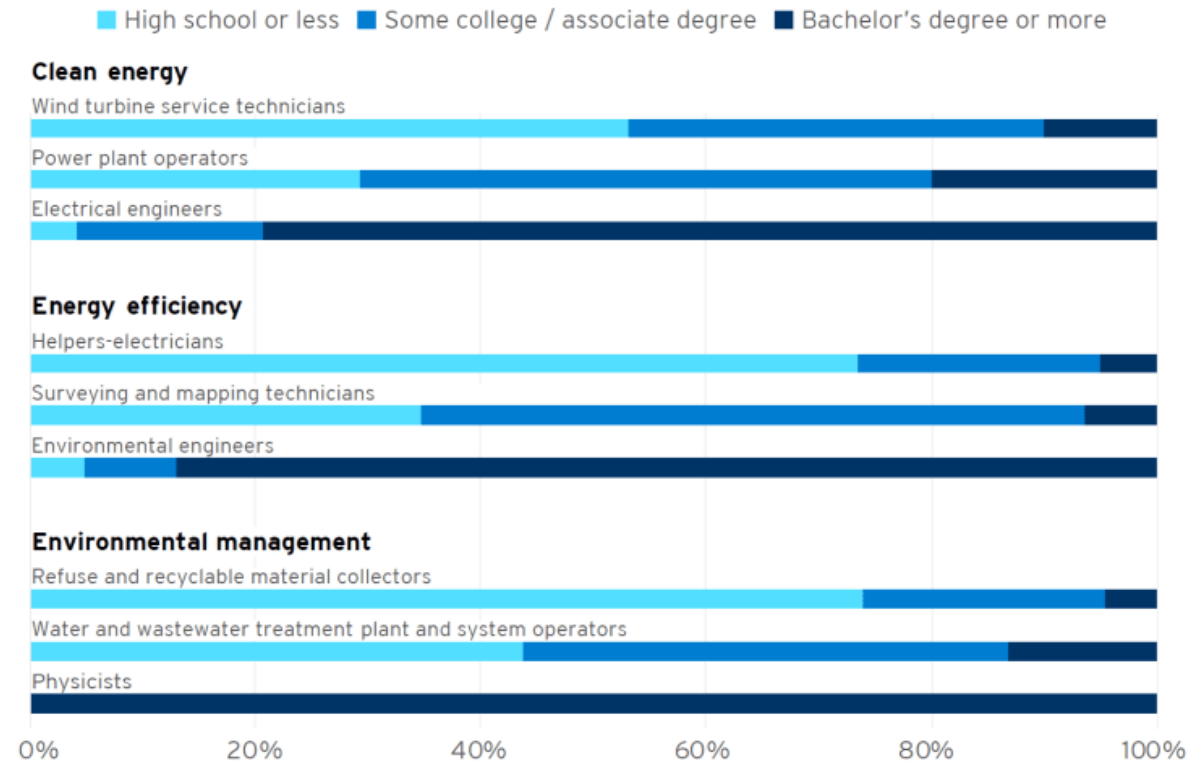
- Wages in all three clean energy sectors are above the National Average = $23.86/hr
- Clean Energy Production= $28.41/hr
- Energy Efficiency = $25.90/hr
- Environmental Management = $27.45/hr

Nature of Work in the Clean Energy Economy

- 1. Clean energy production
- 2. Energy Efficiency
- 3. Environmental Management

FIGURE 3

Educational attainment, by share of employment in selected occupations, 2016



Source: Brookings analysis of Occupational Employment Statistics and Employment Projections data

A Just Transition:

“Economic transformation can not be left to the “invisible hand” of the market. ”

International Trade Union Confederation
Fourth International Congress in Copenhagen 2018

https://www.labor4sustainability.org/post/green-jobs-in-a-global-green-new-deal/

Corporations are not PEOPLE!

- The plan for a just transition MUST include a plan for taking care of the workers
- Protecting pensions and benefits
- Meaningful re-training
- Community re-investment

Status Quo – Bought and paid for!

- Oil, gas and coal campaign contributions and lobbying spent $354 million in 2015-2016 election cycle (all offices)
- Received $29.4 billion in total subsidies

- That is an 8,200% RETURN on the Investment!

Dave Bernhardt, Former oil & gas lobbyist, confirmed to run Department of Interior. April 11, 2019

Pathways for Our Sustainable Future

- **Renewable Energy Systems** that conserve and restore resources
- **Regenerative Agriculture** for a non-toxic food system that captures carbon in fertile ground
- **Green Chemistry** and A Circular Economy for materials designed for re-use from benign materials

- **All** contribute to reducing carbon emissions

Forest Hills Borough Building
Net Zero Energy solution

A Call to Action:
The laws of Nature are NOT negotiable-

- Climate change **will happen** as a consequence of human actions.

- OUR Laws must change to **enable and promote "Green Jobs"** instead of protecting fossil industries

"***American policy is looking backward to a world that no longer exists."***

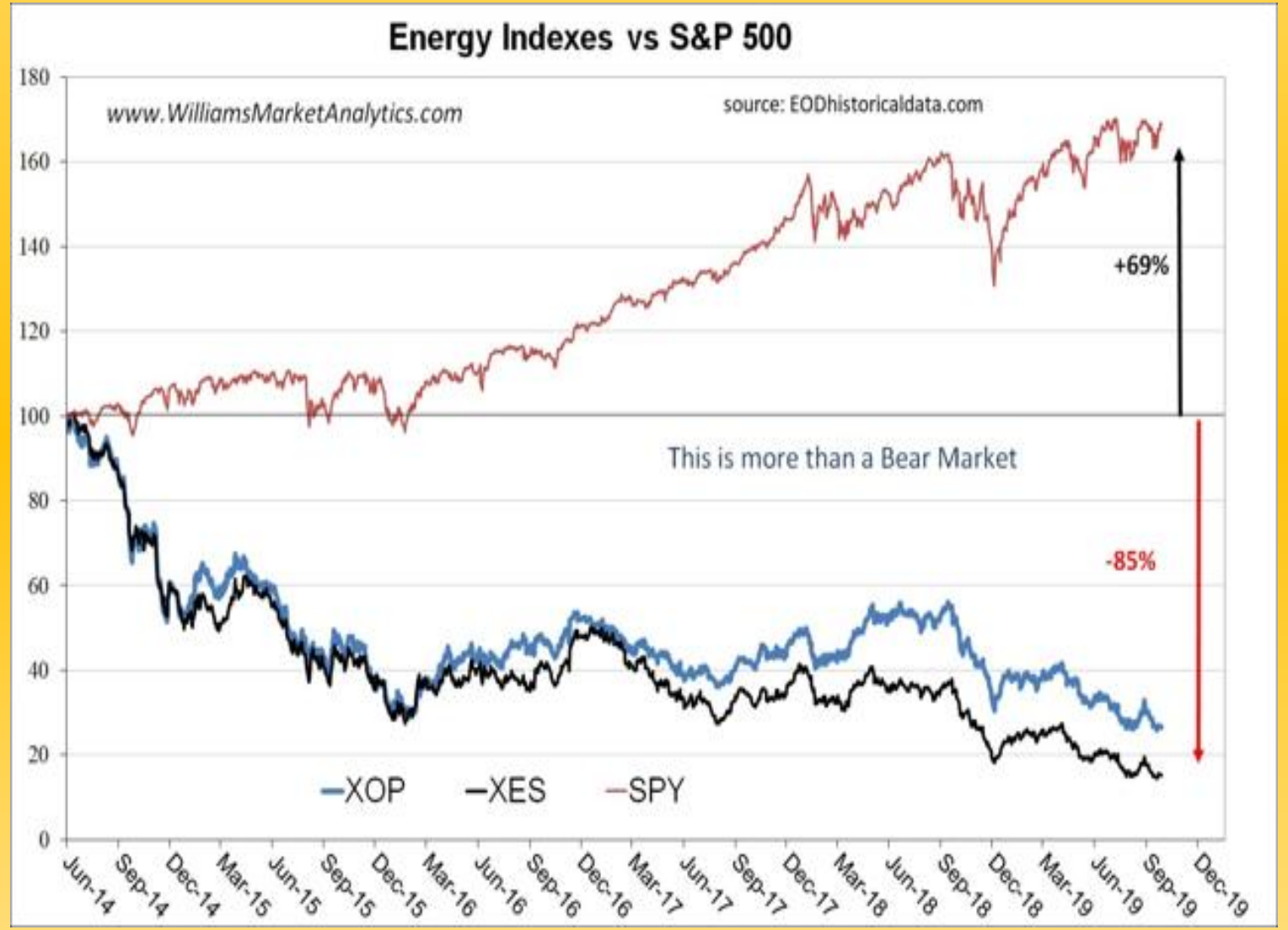
UNEP Executive Director Achim Steiner

2050 Is not so far off:

- My niece Anne will be 28
- My grandchildren Quinn and Lia and niece Julia will be 41 and 45 years old
- My son and daughter will be looking toward retirement at 77 and 79 years old

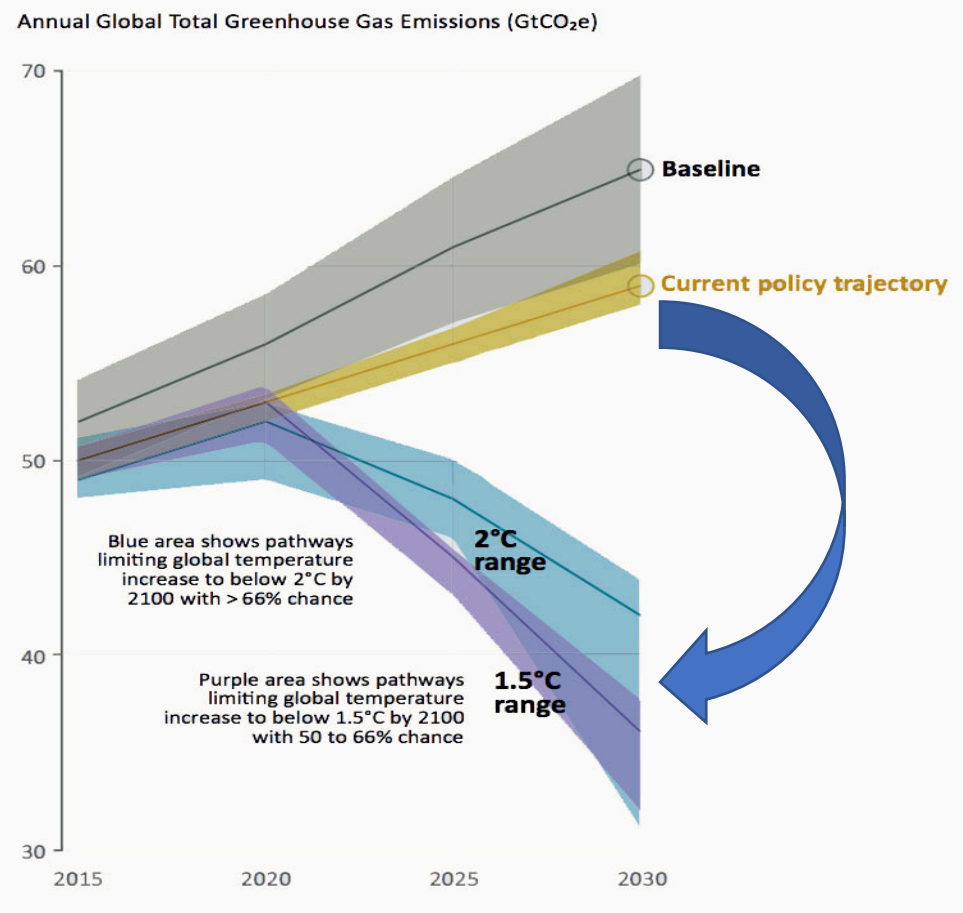
Failing Prospects for Fossil Industries:

- S&P 500 growing 69%
- Oil & Gas Production and Oil and Gas Services falling 85%
- “Most oil and gas companies will go out of business or get bought out. Successful oil and gas companies will be those whose managers embrace the clean energy revolution and develop alternative energy products.”



www.WilliwamsMarketAnalytics.com

How do we make a Policy U-Turn?



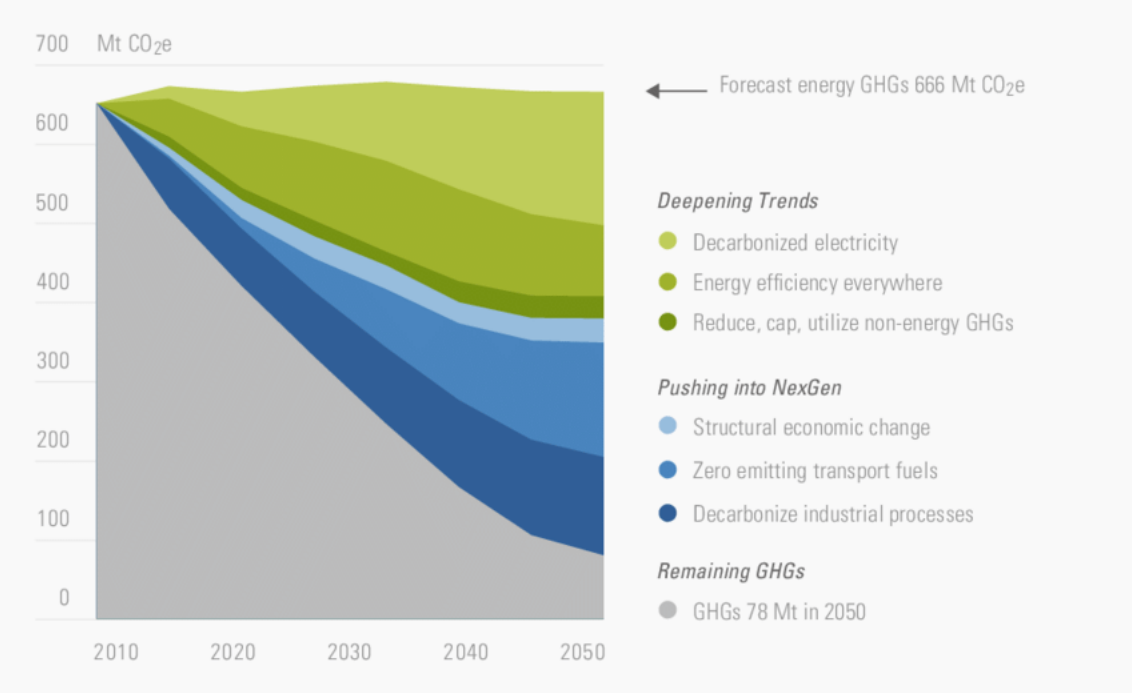
https://e360.yale.edu/features/why-post-paris-climate-challenge-is-even-harder-than-we-thought

Move awareness → **OUTRAGE**!

- Articulate Policy actions
- Build support for action
- Increase political pressure
- Increase social pressure
- Mainstream change

UN Emissions Gap Report Recommendations:

- "Decarbonizing the global economy will require fundamental structural changes, which should be designed to bring **multiple co-benefits** for humanity and planetary support systems. "



Recommendations for US for 2030:

- Introduce regulations on power plants, clean energy standards and carbon pricing for 100% carbon-free electricity
- Implement carbon pricing for industrial emissions
- Strengthen fuel economy standards for all vehicles
- Implement net zero energy standards for all new buildings

Bataille, Chris & Sawyer, David & Melton, Noel. (2015). Pathways to deep decarbonization in Canada.

The Laws of Nature are NOT Negotiable

- Solving the climate crisis is not a technology problem- **it is a moral and ethical problem**

- **Do we preserve the living planet for our children and their great-grandchildren…or not?**