NETL Regional Workforce Initiative (NETL RWFI)

Welcome to the Webinar!

NATIONAL ENERGY TECHNOLOGY LABORATORY

Webinar Logistical Information

- **All participants will be muted for the duration of the webinar**
- **Effort will be made to address questions from the audience after each presenter**
  - In order to ask a question please use the chat to host or private message function
- **Slides will be available after the webinar**
- **Speakers' contact information and slides will be sent in a follow up email after the presentation**

THANK YOU FOR YOUR PARTICIPATION TODAY

Webinar Agenda

Kate Nielsen, NETL RWFI Coordinator

- Welcome Message and Brief Background on the NETL Regional Workforce Initiative

Chris Nichols, Analyst, NETL's Energy Market Analysis Team

- The Role of Energy Market Analysis in Determining Regional Economic Impact
- How multi-discipline analysis is useful in strategic assessments and planning for emerging energy technologies

David Foster, Distinguished Associate with the Energy Futures Initiative

- Results of the 2018 United States Energy and Employment Report (USEER 2018)
- Workforce demand and hiring difficulties for the Pennsylvania, West Virginia, and Ohio regions

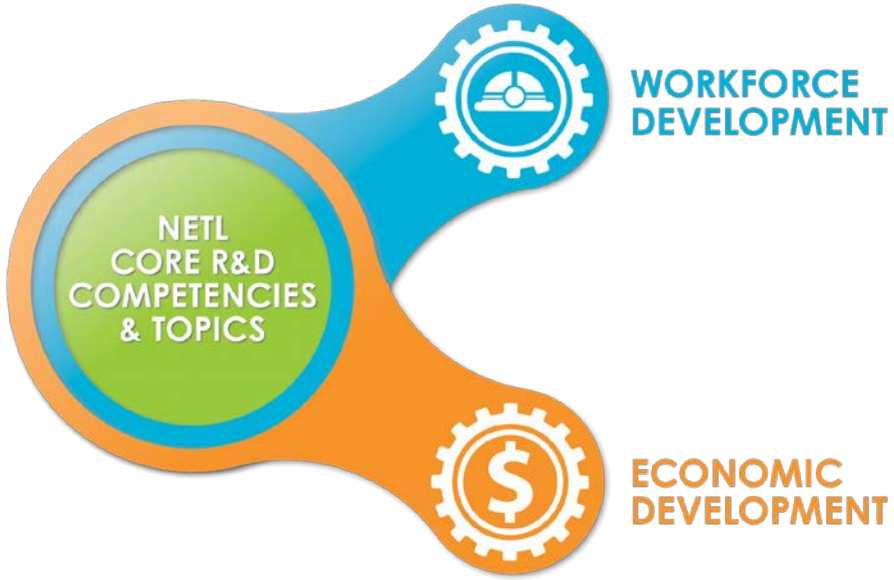
Robert Bozick, Senior Sociologist at RAND Corporation

- Developing a Skilled Workforce for the Oil and Natural Gas Industry Report Results
- Identification of skills and knowledge required by employers in the oil and natural gas industries

NETL Regional Workforce Initiative Mission

A Platform For:

- Communication and collaboration with regional/national stakeholders and partners, federal agency partners, and other DOE national laboratories
- Connecting public investment in energy and advanced manufacturing NETL R&D to national and regional economic development, education, and jobs



How We Engage

- Monthly E-Note Email Bulletin
- On campus engagements
- Webinars and Webcasts
- NETL RWFI Website

Connect with us

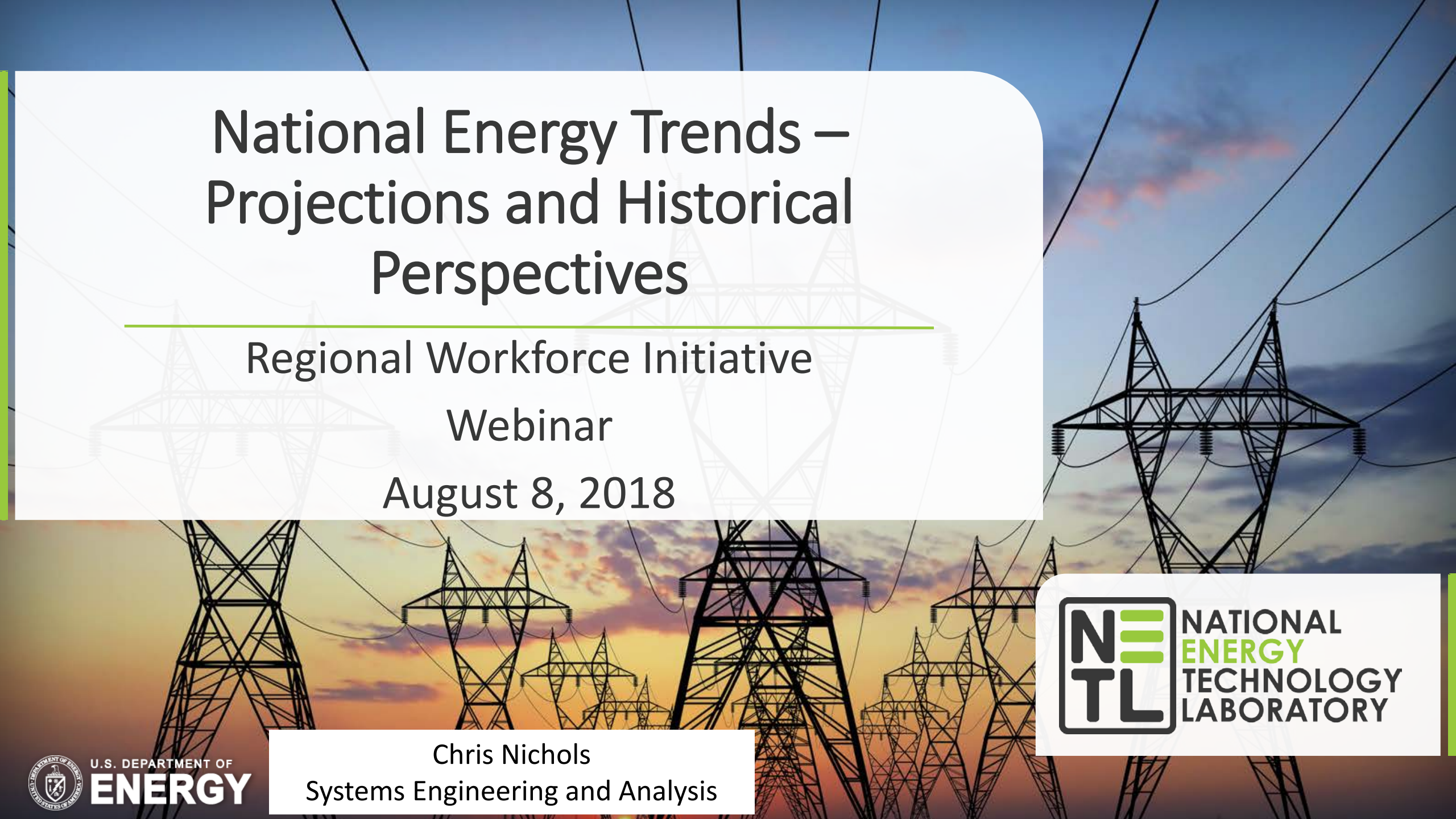
NETL.RWFI@netl.doe.gov
www.netl.doe.gov/RWFI

National Energy Trends – Projections and Historical Perspectives

Regional Workforce Initiative

Webinar

August 8, 2018



Chris Nichols
Systems Engineering and Analysis

U.S. DEPARTMENT OF ENERGY

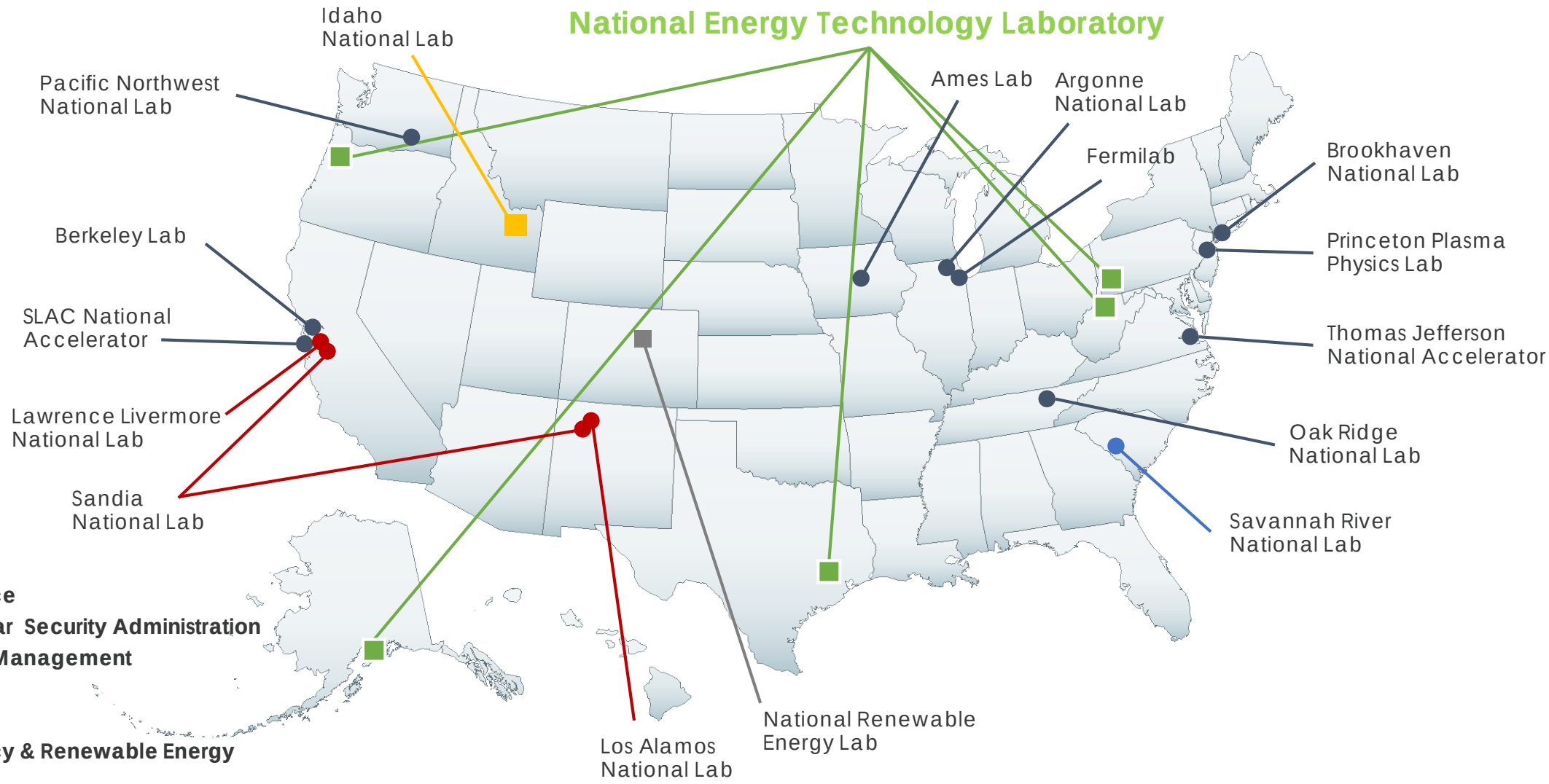
NATIONAL ENERGY TECHNOLOGY LABORATORY

The analysis presented and conclusions drawn herein represent solely those views of the author(s), and do not represent the views of the United States Department of Energy.

Overview of presentation

- **Overview of Department of Energy, NETL and our analysis group**
- **Historical perspectives and current projections of the energy landscape of the U.S. from the Energy Information Administration**
- **What are the job areas that could see growth in these future energy scenarios?**
- **Some "black swans" that could be big game changers**

The National Laboratory System



NETL Core Competencies & Areas of Research

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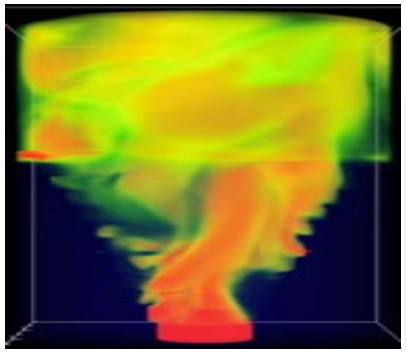
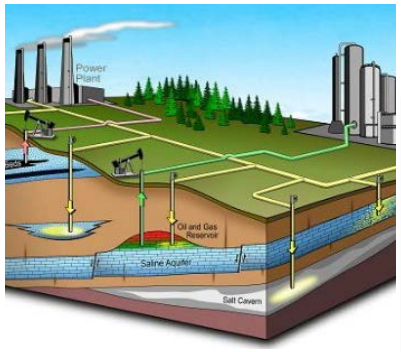


Computational Science & Engineering

Materials Engineering & Manufacturing



Geological & Environmental Systems

Energy Conversion Engineering

Systems Engineering & Analysis

Program Execution & Integration

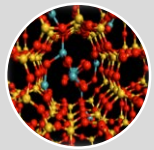
Carbon Storage

Carbon Capture

Sensors & Controls

Advanced Materials

Advanced Computing



Advanced Energy Systems

Water Management

Rare Earth Elements

Enhanced Resource Production

Environmentally Prudent Development

Methane Hydrates

Offshore

Natural Gas Infrastructure

Unconventional

100 years of energy and the economy

The next 40 years could look similar to today's landscape

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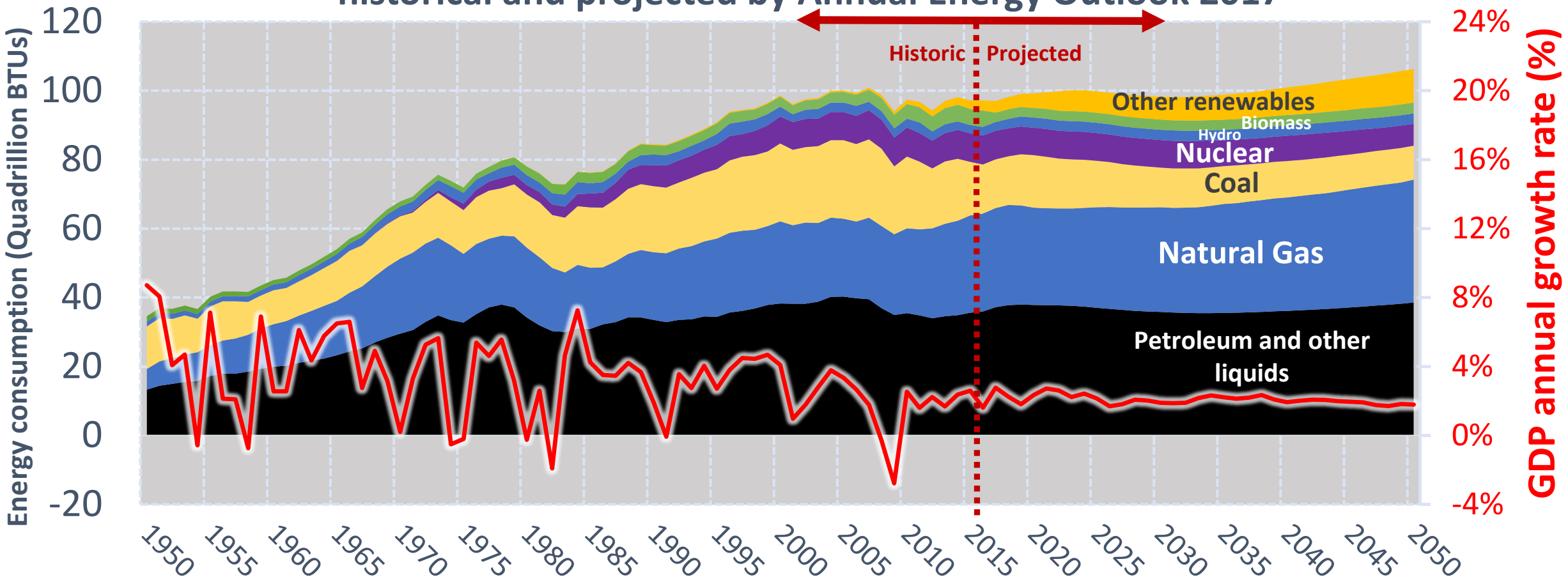
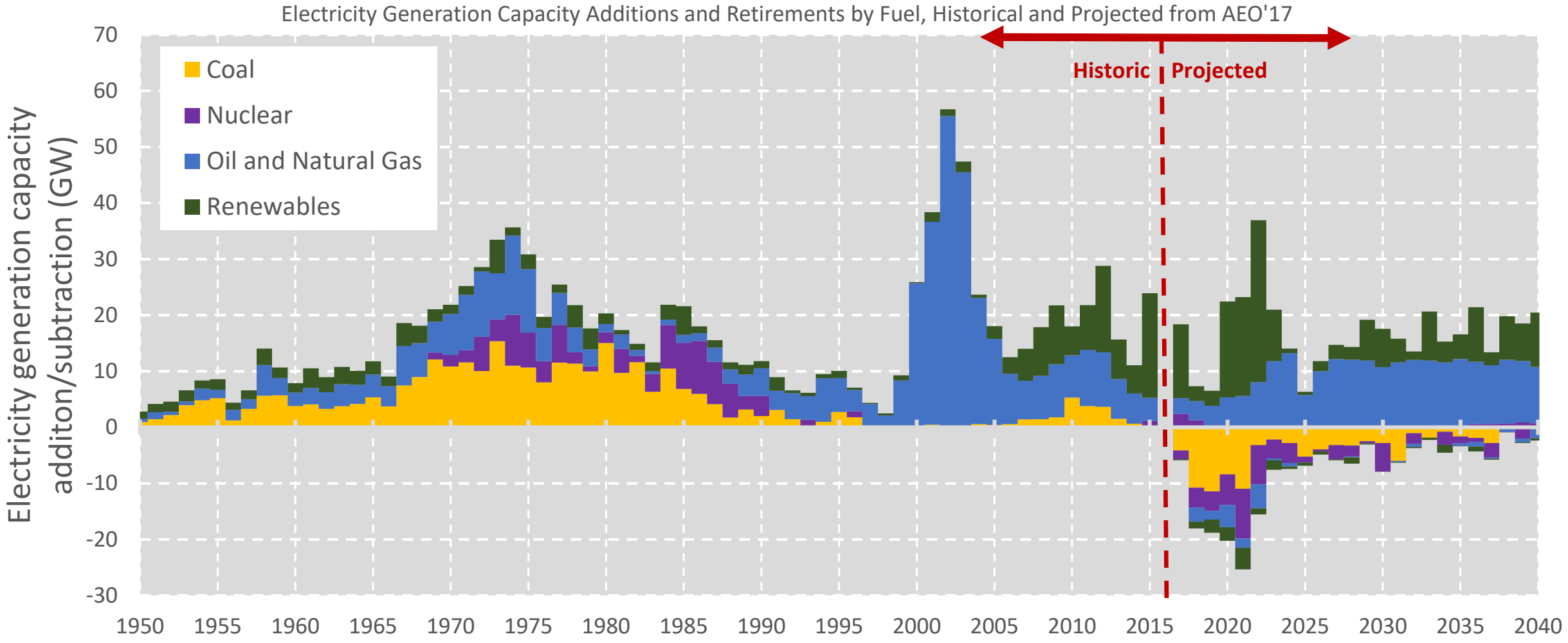
U.S. Energy Consumption by Source and Annual GDP Growth Rate, historical and projected by Annual Energy Outlook 2017



Sources: Energy Information Administration. Historic data from the Annual Energy Review (https://www.eia.gov/totalenergy/data/annual/index.php). Projected data from Annual Energy Outlook 2017 (https://www.eia.gov/analysis/projection-data.cfm#annualproj)

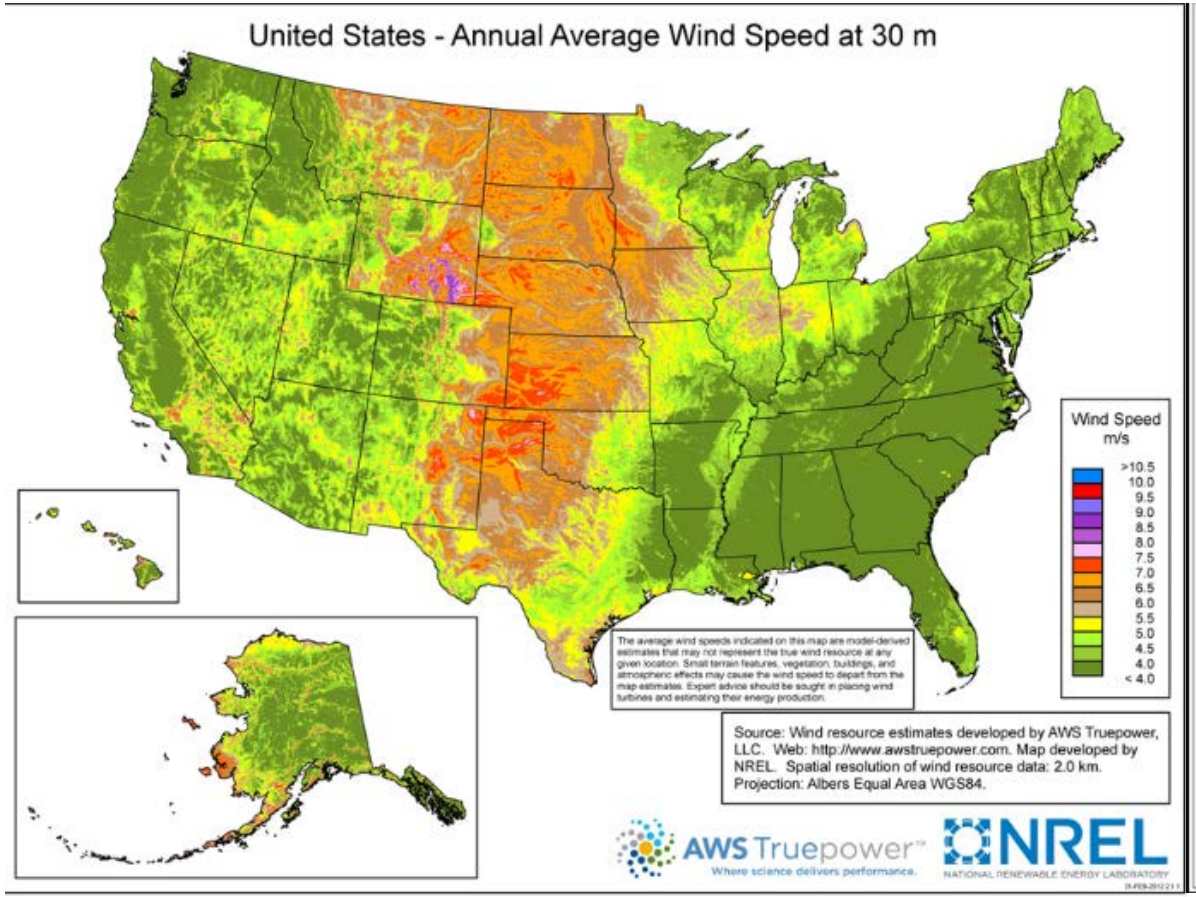
Electricity generation capacity

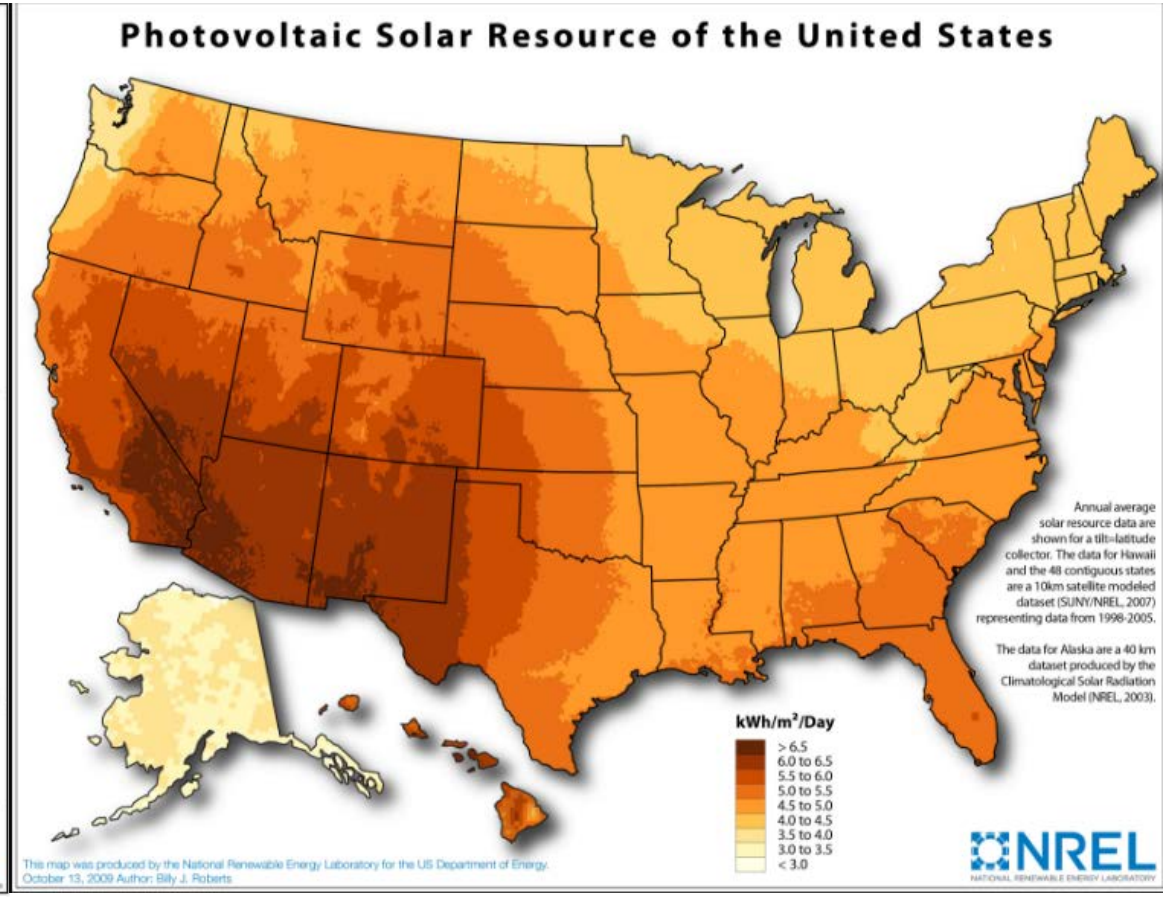
Most new power plants are expected to be natural gas or renewables (wind or solar)



Sources: Energy Information Administration. Historic data from the EIA form 860. Projected data from Annual Energy Outlook 2017 (https://www.eia.gov/analysis/projection-data.cfm#annualproj)

Where will new wind and solar be built?





Energy project developers balance siting new generation in higher resources areas (midWest for wind, Southwest for solar) with getting the electricity to consumers (still concentrated in the east)

Energy project jobs and typical salaries

Design and planning

Type of engineers	Median annual wages
Aerospace engineers	$94,780
Civil engineers	$76,590
Electrical engineers	$83,110
Electronics engineers, except computer	$89,310
Environmental engineers	$77,040

Manufacturing

Occupation	Median annual wages
Machinists	$41,480
Computer-controlled machine tool operators, metal and plastic	$34,790
Team assemblers	$29,320
Welders, cutters, solderers, and brazers	$35,920
Inspectors, testers, sorters, samplers, and weighers	$37,500
Industrial production managers	$87,120

Project construction

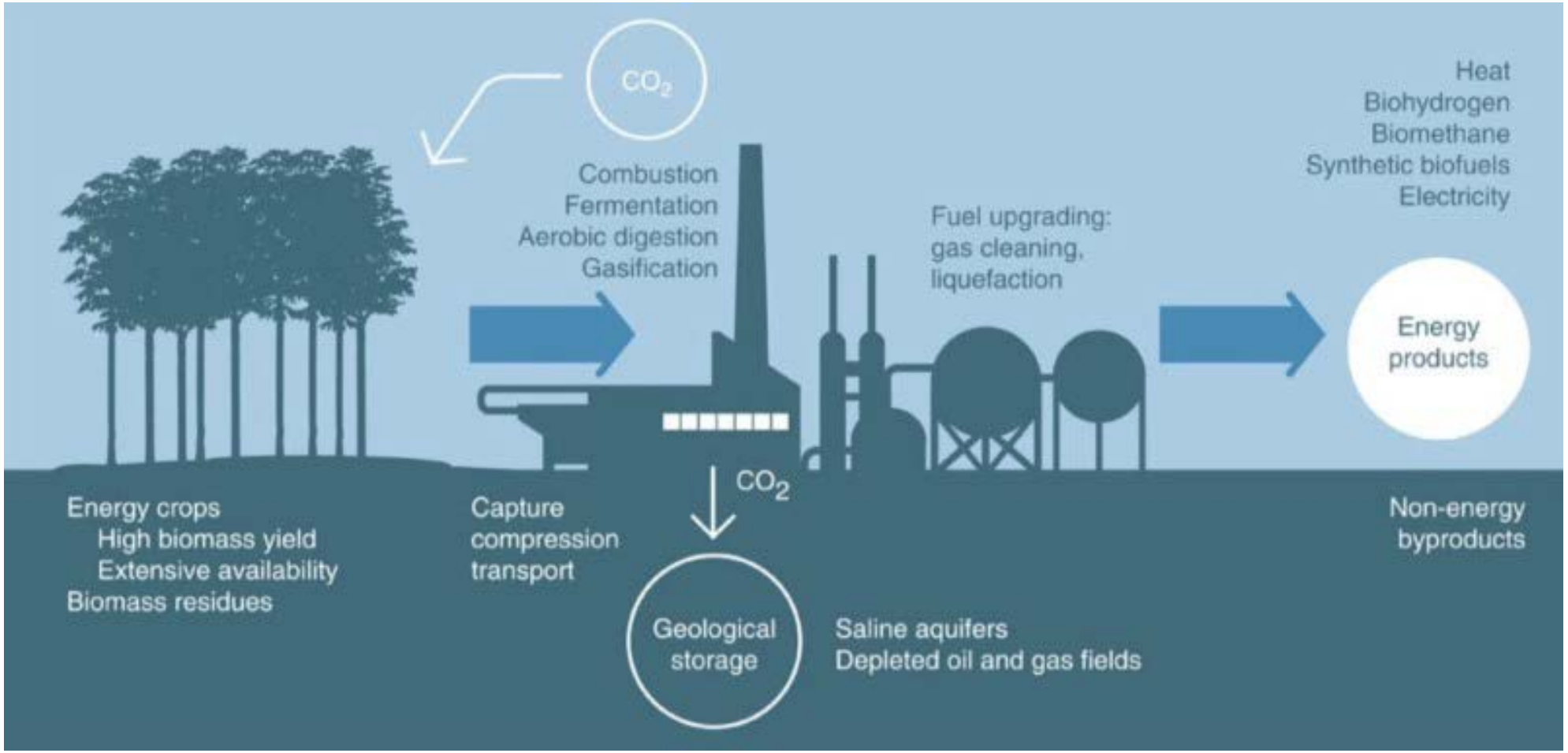
Occupation	Median annual wages
Construction laborers	$29,110
Operating engineers and other construction equipment operators	$39,530
Crane and tower operators	$47,170
Electricians	$49,800

Operations and maintenance

Selected occupations in the electric power generation, transmission, and distribution industry group	Median annual wages
Power plant operators	$64,270
Pump operators, except wellhead pumpers	58,740
Electricians	59,020
Plumbers, pipefitters, and steamfitters	66,080
Electrical and electronics repairers, powerhouse, substation, and relay	66,230

What could change “business as usual”

Very aggressive CO2 reduction plans could use biomass as a major energy source, then capture and store the CO2 emissions underground, resulting in net negative emissions

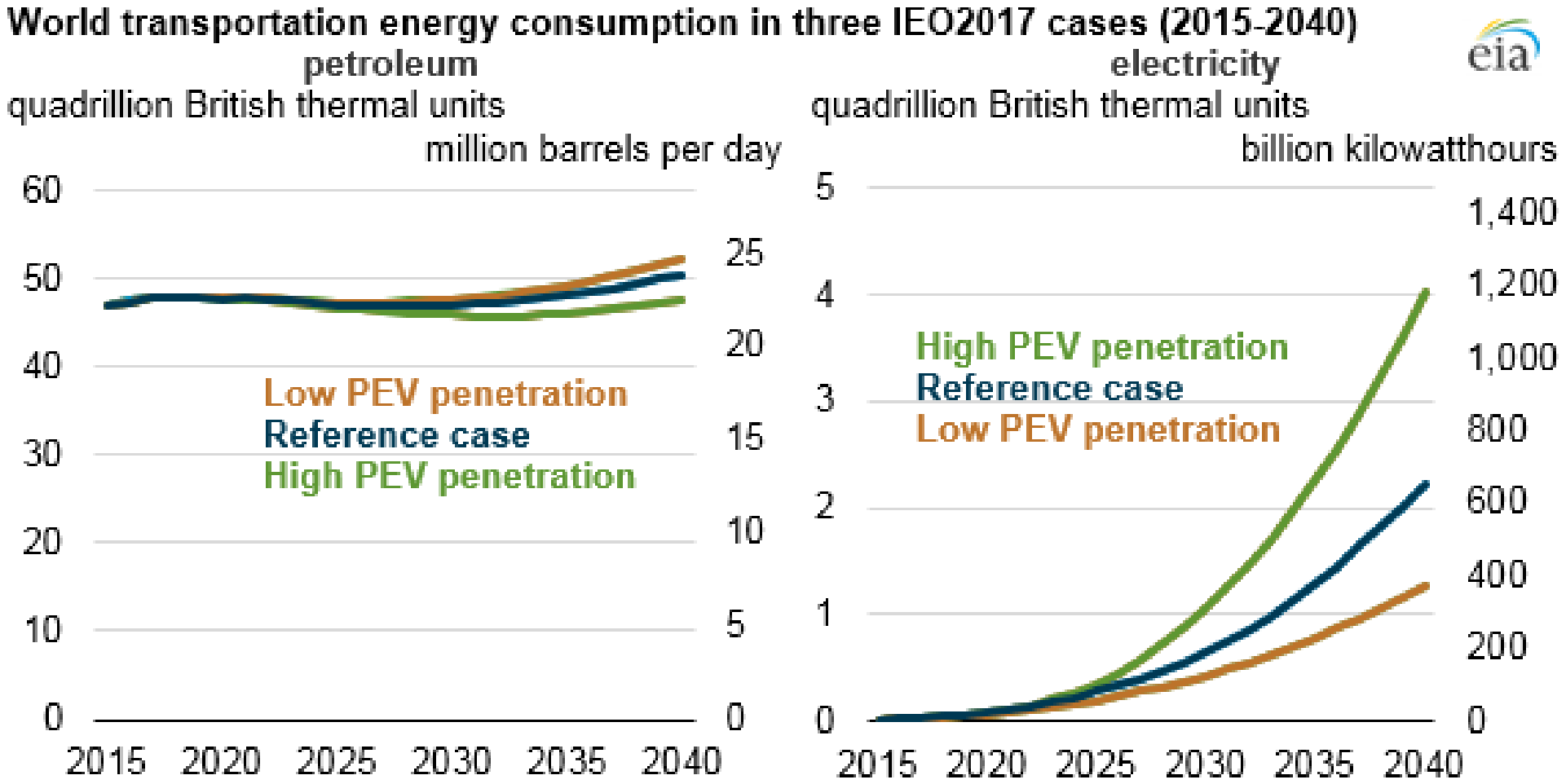


Jobs could result in:

- Biomass production (farming and forestry)
- Chemical engineering
- Geology and subsurface engineering

What could change “business as usual”

More rapid transportation electrification and spread of autonomous vehicles



Source: U.S. Energy Information Administration, *International Energy Outlook 2017*

More jobs as programmers and robotic designers could be required

Trends in energy careers in the future

- **Solid STEM background will become increasingly critical**
- **Technically skilled workers will continue to be vital for the construction and maintenance of energy projects**
  - Smaller, leaner teams will require workers to have some knowledge of more aspects of the project, and understand not only "what" they are doing, but "why"
- **Intellectual and physical automation (artificial intelligence and robotics) are rapidly changing the job market**
  - Those who design the robots (engineers) and program the AIs (coders) will have more job security
- **The energy industry will continue to be a well-paying and rewarding career field**

For more information…

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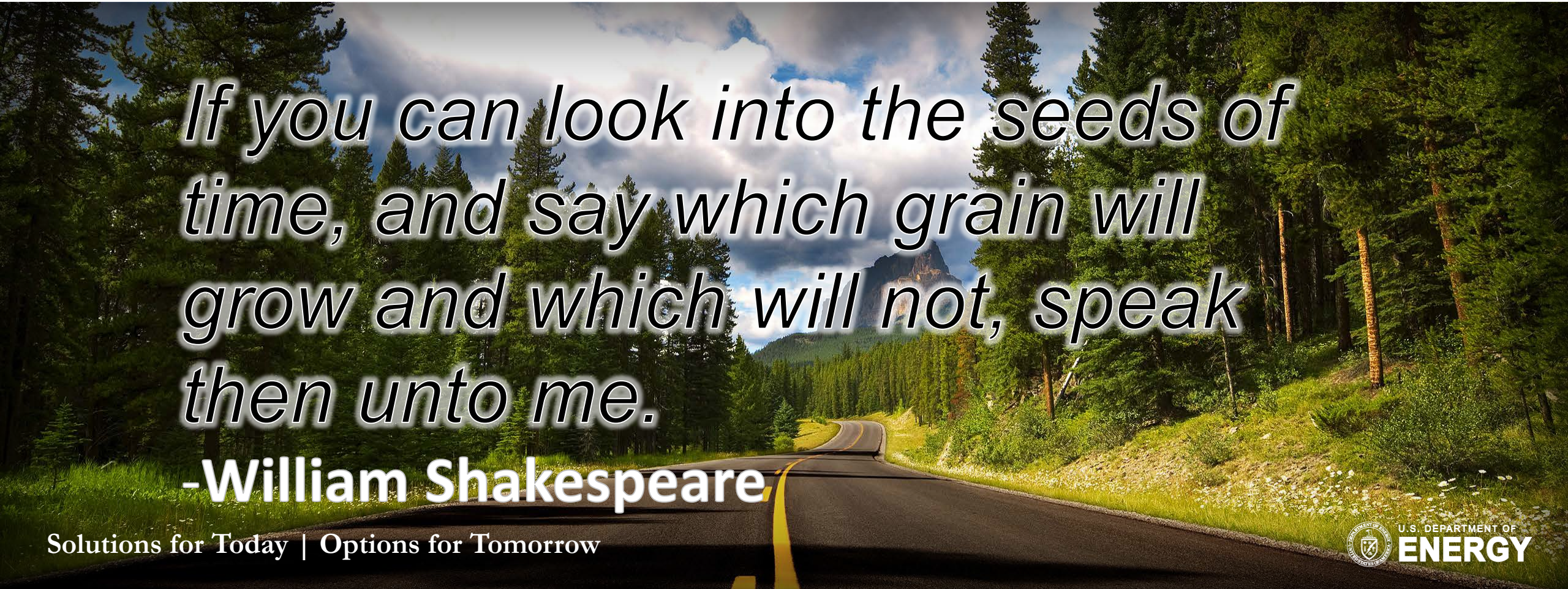
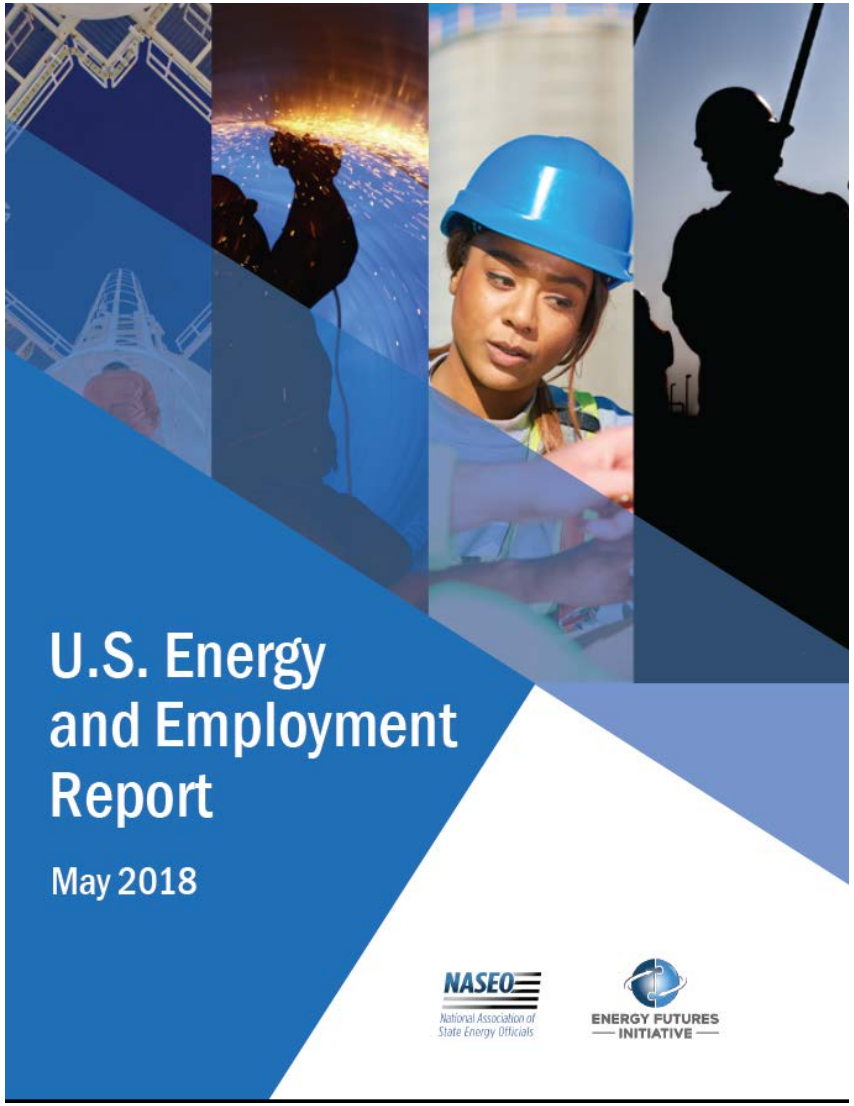


2018 U.S. Energy and Employment Report



--A Joint Project of the National Association of State Energy Officials and the Energy Futures Initiative

Presentation for:

NETL Webinar

August 8, 2018

What Is the USEER?

- The US Energy and Employment Report (USEER) is produced annually from a supplemental survey of employers with energy sector employment.
  - Based on the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW).
  - Developed at the US Department of Energy (DOE) in 2015 with review and approval of BLS and the Energy Information Administration.
  - Issued twice by DOE, in 2016 and 2017, with data collected in the 4th Q of the preceding year.

- In October, 2017, NASEO and EFI announced an effort to raise private funding, hire BW Research (who held the DOE contract), conduct the 4th Q 2017 survey and produce the 2018 USEER.

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How Is the USEER Survey Administered?

- A national supplemental survey that tracks existing BLS QCEW data
  - QCEW is compiled from unemployment records collected at the state level and then aggregated into 1,057 industry sectors using the North American Industrial Classification System (NAICS)
- The survey is administered to a representative sample of 30,000 employers by phone and internet. Results are integrated with QCEW data.
- Analyzes four sectors
  1. Electric Power Generation and Fuels Production
  2. Electric Power and Fuels Transmission, Distribution and Storage
  3. Energy Efficiency
  4. Motor Vehicles

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2018--Some Examples of Undercounting

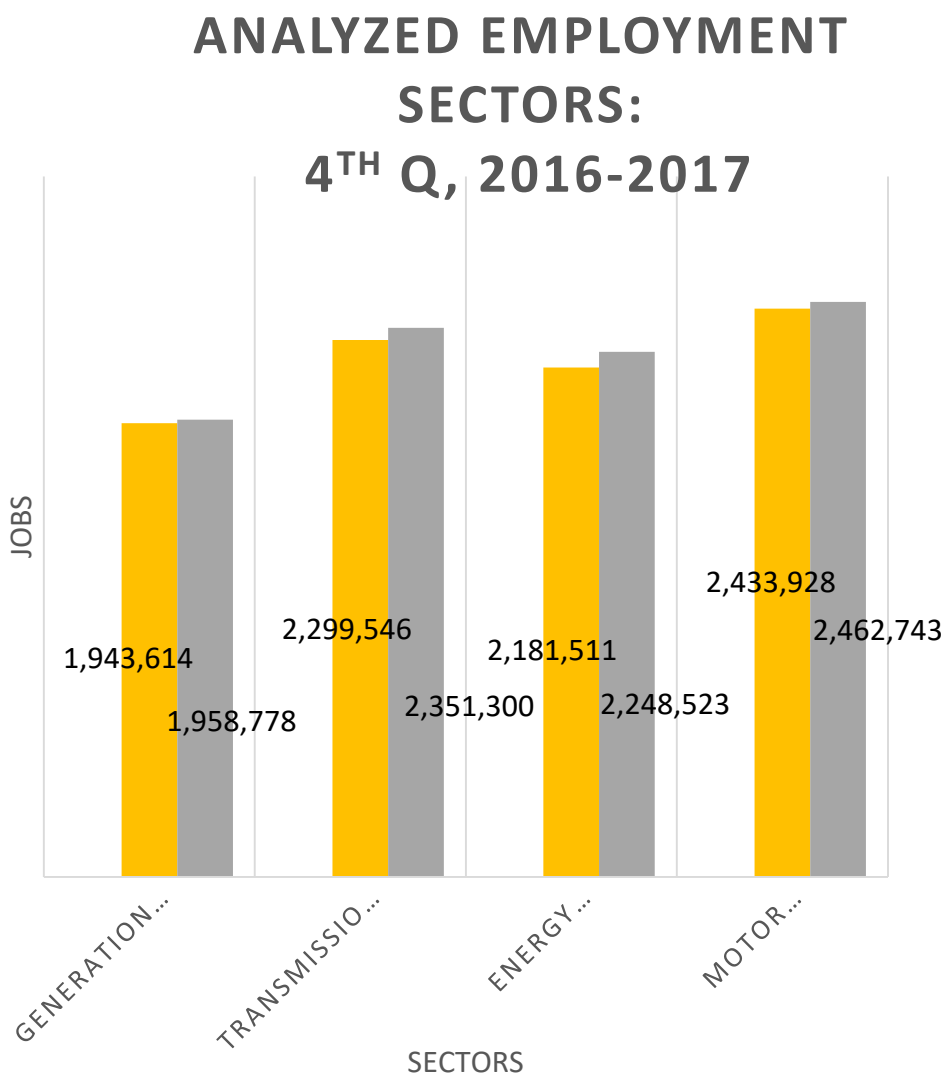
Electric Power Generation: National

Fuel Source	QCEW-BLS	2018 USEER
Fossil fuels	92,817	212,669
Nuclear	44,753	64,743
Wind	6,050	107,444
Solar	2,708	349,725 (250,271)
CHP	1,649	27,239
Hydro	17,501	66,872
Geothermal	1,117	7,927
Biomass	1,693	12,385

Electric Power Generation: Texas

Fuel Source	QCEW-BLS	2018 USEER
Fossil fuels	6,125	12,003
Nuclear	n/a	3,359
Wind	2,355	25,222
Solar	150	11,608
CHP	n/a	n/a
Hydro	1,012	1,418
Geothermal	n/a	n/a
Biomass	n/a	n/a

2018 US Energy and Employment Report



*Traditional Energy sectors include Electric Power Generation and Fuels Production and Transmission, Distribution and Storage.

162,000 New Jobs in 2017 in 4 Sectors

- Traditional Energy and Energy Efficiency add 133,000 jobs in 2017.
  - Energy Efficiency leads the way with 67,000 new jobs.
- Natural gas electric generation adds 19,000 new jobs.
- Overall hiring difficulty declines slightly to 70%
  - But in key growth sectors such as EE construction jobs, worsens, climbing to over 83% difficulty.
- Overall Traditional Energy and Energy Efficiency employers predict 6.1% growth rate for 2018.
- Solar jobs decline for first time since 2010, but wind, CHP, biomass, geothermal and low impact hydro all grow.
- Motor vehicles add 29,000 jobs, but alternative fuel vehicle jobs decline by almost 40,000, in spite of 25% increase in hybrid, plug-in, and electric vehicle sales.

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Jobs in Electric Power Generation and Fuels

2018 USEER Key Results in EPG&F

- Natural gas generation gained 19,000 jobs.
- CHP grew by 9,000 jobs or 51%.
- Biomass generation added 8000 jobs or 55%.
- Wind gained over 5,000 jobs or 6%.
- Hydro added 1300 jobs or 2%
- Coal generation was unchanged.
- Solar lost 24,000 jobs or 6%.
  - 2/3 in CA and MA.
- Nuclear lost 3,400 jobs.
- Oil, gas and coal Fuels grew between 0.1-1.5%.
- Corn ethanol added 6,000 jobs or 12%.

	Electric Power Generation	Fuels	Total
Solar	349,725	-	349,725
Wind	107,444	-	107,444
Geothermal	7,927	-	7,927
CHP	27,239		27,239
Bioenergy	12,385	104,446	116,831
Corn Ethanol	-	34,522	34,522
Other Ethanol/Non-Woody Biomass, incl. Biodiesel	-	20,083	20,083
Woody Biomass Fuel for Energy and Cellulosic Biofuels	-	31,428	31,428
Other Biofuels	-	18,414	18,414
Low Impact Hydroelectric Generation	11,531	-	11,531
Traditional Hydropower	55,341	-	55,341
Nuclear	64,743	8,962	73,705
Coal	92,843	74,180	167,023
Natural Gas	66,385	312,364	378,749
Oil/Petroleum	12,407	510,015	522,422
Advanced Gas	41,034	-	41,034
Other Generation/Other Fuels	34,839	64,968	99,807

Executive Summary—Natural Gas: EPG, Fuels and TDS

- Overall the natural gas industry directly employed 567,535 Americans in 2017.
  - NG Fuels production employs 312,364.
  - NG EPG today employs 107,419 Americans w/41,034 in low emissions technologies.
  - NG TDS employs 118,953
  - NG TDS pipeline transportation employs another 28,799.
- Employers in NG EPG anticipate 5% growth in 2018.
- Hiring difficulty in NG EPG:

32.4%	Very difficult
40.5%	Somewhat difficult
27.0%	Not at all difficult

Nat Gas Generation & Fuels Jobs—Top 15

State	Generation
1. CA	20,309
2. FL	14,512
3. TX	6,105
4. KS	5,024
5. NY	4,986
6. MA	4,553
7. IL	4,483
8. AZ	4,384
9. MI	3,356
10. SC	3,088
11. OH	**3,002**
12. NC	2,663
13. PA	**2,568**
14. UT	2,515
15. AL	1,996

State	Fuels
1. TX	136,101
2. OK	30,102
3. LA	28,101
4. PA	**16,412**
5. CO	12,409
6. FL	10,762
7. CA	8,547
8. WY	7,806
9. NM	7,205
10. WV	**6,805**
11. OH	**6,719**
12. AK	6,004
13. ND	4,579
14. UT	2,562
15. NV	2,557

Executive Summary--Oil: EPG, Fuels and TDS

- Overall the oil industry directly employed 1,558,530 Americans in 2017 (including gas stations).
  - Oil Fuels production employs 510,015.
  - Oil EPG today employs 12,407 Americans.
  - Oil TDS employs 1,016,590 when including retail gas stations.
  - Oil TDS pipeline transportation employs another 19,518*

    *does not include oil pipeline construction.
- Employers in Oil Fuels anticipate 2.7% growth in 2018.
- Hiring difficulty in Oil Fuels:

29.5%	Very difficult
45.5%	Somewhat difficult
25.0%	Not at all difficult

Oil Fuels Jobs—Top 15

1.	TX	176,480
2.	CA	48,644
3.	LA	44,111
4.	OK	33,400
5.	IL	18,481
6.	**PA**	**15,225**
7.	NJ	14,372
8.	CO	13,769
9.	ND	13,547
10.	NM	12,451
11.	**OH**	**11,563**
12.	KS	8,389
13.	AK	7,379
14.	WY	7,336
15.	MN	6,526

Executive Summary--Coal: EPG, Fuels and Transportation

- Overall the coal industry directly employed 203,570 Americans in 2017.
  - Coal Fuels production employs 74,180.
  - Coal EPG today employs 92,843 Americans.
  - Coal transportation employs 36,547.
- Employers in Coal Fuels and EPG anticipate 3.9% and 1.1% growth in 2018.
- Hiring difficulty in Coal Fuels:

30.0%	**Very difficult**
50.0%	Somewhat difficult
20.0%	Not at all difficult

Coal Fuels & EPG Jobs—Top 15

1. OH	**17,429**
2. WV	**16,866**
3. KY	11,695
4. TX	11,650
5. IL	8,386
6. PA	**8,196**
7. WY	7,405
8. IN	6,786
9. AZ	6,296
10. CO	5,524
11. FL	5,043
12. MI	4,190
13. VA	3,835
14. SC	3,790
15. MO	3,036

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Executive Summary—Transmission, Distribution and Storage

- Our energy infrastructure—Transmission, Wholesale Trade and Distribution, and Storage* technologies—employ more than **1.3 million Americans, almost 450,000** more than previously known.
  - When retail sales and distribution in this sector—primarily gasoline stations—are included, an additional 1,017,000 individuals work in this sector, for a total of **2.35 million Americans**.
  - Traditional TD&S added 16,000 jobs while gas stations/fuel dealers grew by 35,000.
  - Utilities and construction added 39,000 jobs, while manufacturing and professional services lost jobs.
  - Battery storage jumped by 6,000, a 12% growth rate for 53,000 total jobs.
  - 38% of employers in TD&S now say a majority of their revenues come from grid modernization or other utility-funded modernization projects.

*TD&S includes both electricity and fuels.

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Executive Summary—Energy Efficiency

- **2.25 million people** work, in whole or part, with Energy Efficiency technologies, a net increase of 67,000.*
  - 1.274 million of these jobs are in construction, a decline of almost 100K.
    - However, the intensity of energy efficiency construction businesses has increased with 80.3% reporting that their employees now spend the majority of their time working with these technologies, up from 74% in 2016.
    - As a result, 1,024,000 construction employees spend a majority of their time on EE than in 2016, an increase of 6,500.
  - 450,000 Americans are employed in Energy Efficiency business and professional services, an increase of 63K.
  - 315,000 Americans manufacture Energy Star products, an increase of 26K.

*This number does not include jobs in retail trade, such as hardware stores, big box appliance stores, etc.

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Executive Summary—Motor Vehicles

- Motor vehicles are included in this report primarily due to their intensive use of energy and contribution to carbon emissions.
  - 28% of domestic energy is used for transportation, and
  - More than 70% of the oil consumed in the U.S. on a daily basis.
- **The Motor Vehicles industry employs 2.46 million** Americans in vehicle assembly, parts manufacturing, automotive repair and maintenance, as well as vehicle, parts, and supplies wholesalers, including air, rail, water, and truck transportation of motor vehicle parts and supplies. (It does not include auto dealers.)
- Of these, **977,000 work in manufacturing**. (Note this does not include the indirect manufacturing jobs in motor vehicles, such as steel, aluminum, glass, etc.)
- **Just under 220,000 employees work with alternative fuels vehicles**, including natural gas, hybrids, plug-in hybrids, all electric, fuel cell and hydrogen vehicles, a **15% decrease from 2016**.
  - **Hybrids, plug-in hybrids, and all electric vehicles** make up 90% of this number, supporting **197,000 employees**.
  - Jobs building hybrids and plug-ins declined, while all electrics rose sharply.
  - Sales of plug-ins and EV's rose by 25% in 2017. U.S. manufacturers lose to Japanese and European imports.

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Executive Summary—West Virginia

- WV's Traditional Energy and Energy Efficiency sectors grew by almost 13% last year more than 7.5 times the national average.
- WV added over 5,600 new jobs in those sectors which now employ over 49,000 people.
- The Traditional Energy sector employs 5.4% of the state's workforce, compared to 2.4% nationally.
- Natural gas alone employs over 6,800 workers, adding more than 3,400 in 2017 alone.
- WV's coal mining sector added another 1,740 jobs, growing to over 14,400, the most in any state.
- WV also employs 1,106 in renewable electricity, a slight increase over 2016.

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Executive Summary—Pennsylvania

- PA's Traditional Energy and Energy Efficiency sectors grew by over 7% last year more than triple the national average.
- PA added almost 12,000 new jobs in those sectors which now employ over 178,000 people.
- PA also employs 5% of the country's fuels' employees, well above the national average.
- Natural gas alone employs over 16,400 workers, adding an impressive 7700 in 2017 alone.
- PA's EE sector added another 2900 jobs, growing to over 65,000.
- PA also employs 12,417 people in zero emissions' electricity.

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Executive Summary—Ohio

- OH's Traditional Energy and Energy Efficiency sectors declined by just under 1% last year while the national average grew by a little over 2%.
- OH lost almost 1,700 jobs in those sectors which now employ just over 176,700 people.
- OH's Traditional Energy employment is 1.8% of the state's total, compared to 2.3% nationally.
- OH is the number one state in the country for coal-fired generation employment at 15,460, down over 900 jobs from 2016.
- OH's EE sector added almost 900 jobs, growing to over 79,600.
- OH employs 11,151 people in zero emissions' electricity.

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Conclusions

- **Energy job growth rates were very high in West Virginia and Pennsylvania, while they slowed in OH.**
- **Job growth in Fuels production was uneven across the three states.**
  - Coal and natural gas employment rose in WV.
  - Natural gas rose in PA, while coal and oil declined.
  - In OH, coal, oil, and natural gas all declined.
- **Energy Efficiency**
  - EE jobs grew in all three states, but most dramatically in PA.
- **Energy Infrastructure**
  - TDS grew in all three states, adding almost 2,100 jobs.

Conclusions—Workforce Hiring Difficulty

Table OH-1.
Hiring Difficulty by Major Technology Application

Technology	Very Difficult (percent)	Somewhat Difficult (percent)	Not at All Difficult (percent)	Don't Know / Not Applicable (percent)
Electric Power Generation	34.4	46.9	18.8	-
Transmission, Distribution and Storage	21.1	63.2	15.8	-
Energy Efficiency	31.0	39.4	29.6	-
Fuels	22.2	33.3	40.7	3.7
Motor Vehicles	41.9	44.2	14.0	-

Table PA-1.
Hiring Difficulty by Major Technology Application

Technology	Very Difficult (percent)	Somewhat Difficult (percent)	Not at All Difficult (percent)	Don't Know / Not Applicable (percent)
Electric Power Generation	25.6	53.8	20.5	-
Transmission, Distribution and Storage	12.5	75.0	12.5	-
Energy Efficiency	21.9	47.9	26.0	4.1
Fuels	23.1	19.2	57.7	-
Motor Vehicles	43.3	20.0	36.7	-

Table WV-1.
Hiring Difficulty by Major Technology Application

Technology	Very Difficult (percent)	Somewhat Difficult (percent)	Not at All Difficult (percent)	Don't Know / Not Applicable (percent)
Electric Power Generation	33.3	25.0	33.3	8.3
Transmission, Distribution and Storage	-	66.7	16.7	16.7
Energy Efficiency	57.1	28.6	14.3	-
Fuels	5.9	47.1	47.1	-
Motor Vehicles	40.0	40.0	20.0	-

Nationally:

- Energy efficiency construction hiring was found to be the single most difficult with 47.3% of employers reporting "very difficult".
- Overall, MV manufacturing hiring reported the most difficult with over 89.5% of employers reporting "very difficult" or "somewhat difficult."

In OH, PA, and WV:

- Energy Efficiency hiring in WV most difficult with 57% of employers, reporting "very difficult", compared to 38.9% nationally.
- Motor Vehicles reporting very difficult in all three states, particularly in OH with large MV workforce, compared to 20.3% "very difficult" nationally.
- Fuels hiring difficulty in WV reported far below the national average of 23.6% "very difficult".

2018 USEER

Thank you!

Questions?

To download the 2018 USEER and State Fact Sheets go to:
www.usenergyjobs.org

For more information, contact:

- David Foster at dafoster@energyfuturesinitiative.org
- Sandy Fazeli at sfazeli@naseo.org
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Developing a Skilled Workforce for the Oil and Natural Gas Industry

August 8, 2018

Robert Bozick & Gabriella Gonzalez

NETL's Energy and Manufacturing Workforce Webinar

Today's Presentation

- Study Overview
- Strengths of the System
- Challenges to the System
- A Cautionary Tale about the Future

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Four Study Components

- Survey of Employers (N = 67)***
- Survey of Department Chairs (N = 87)***
- Survey of College Instructors
- Analysis of Student Data

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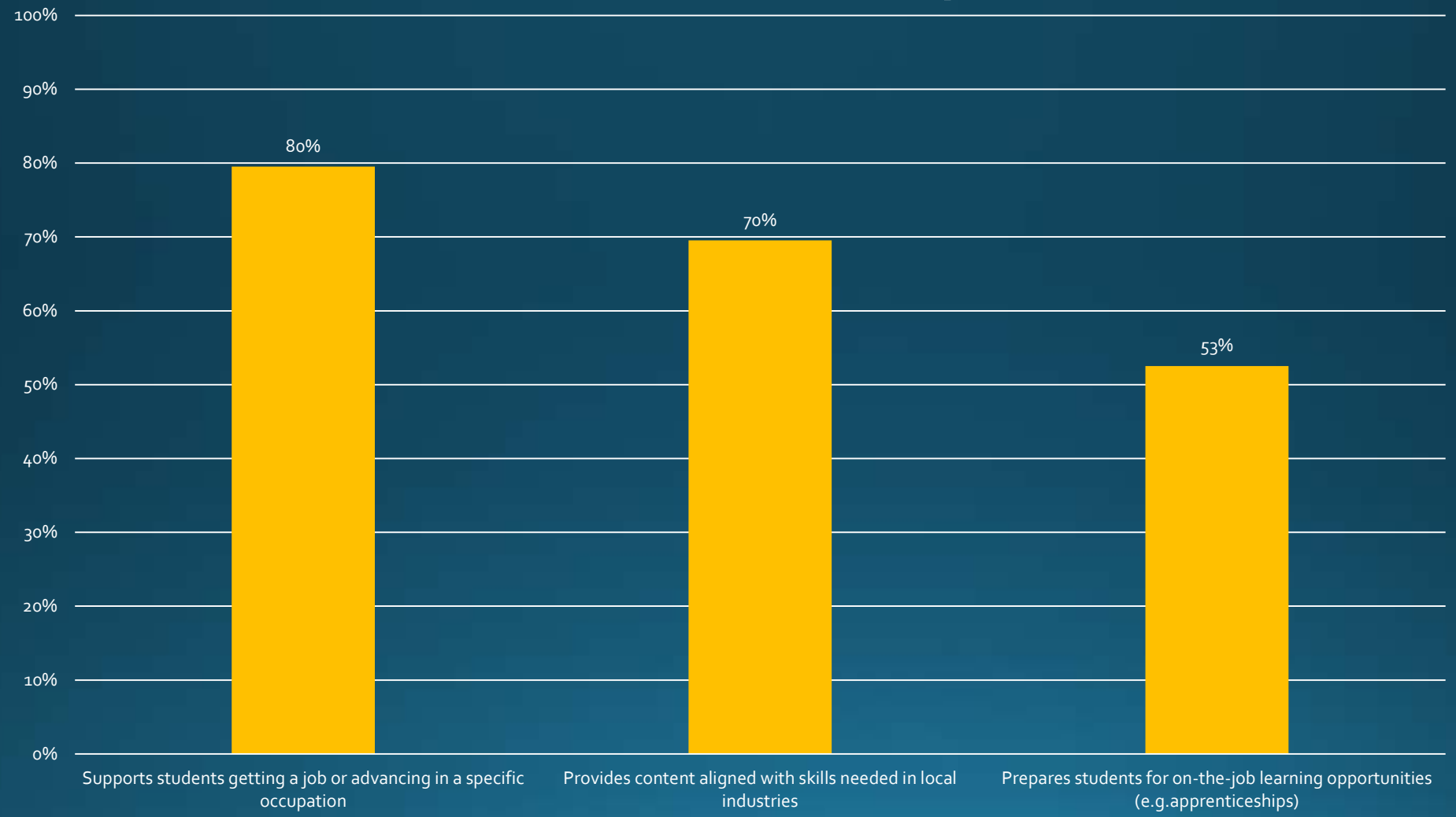
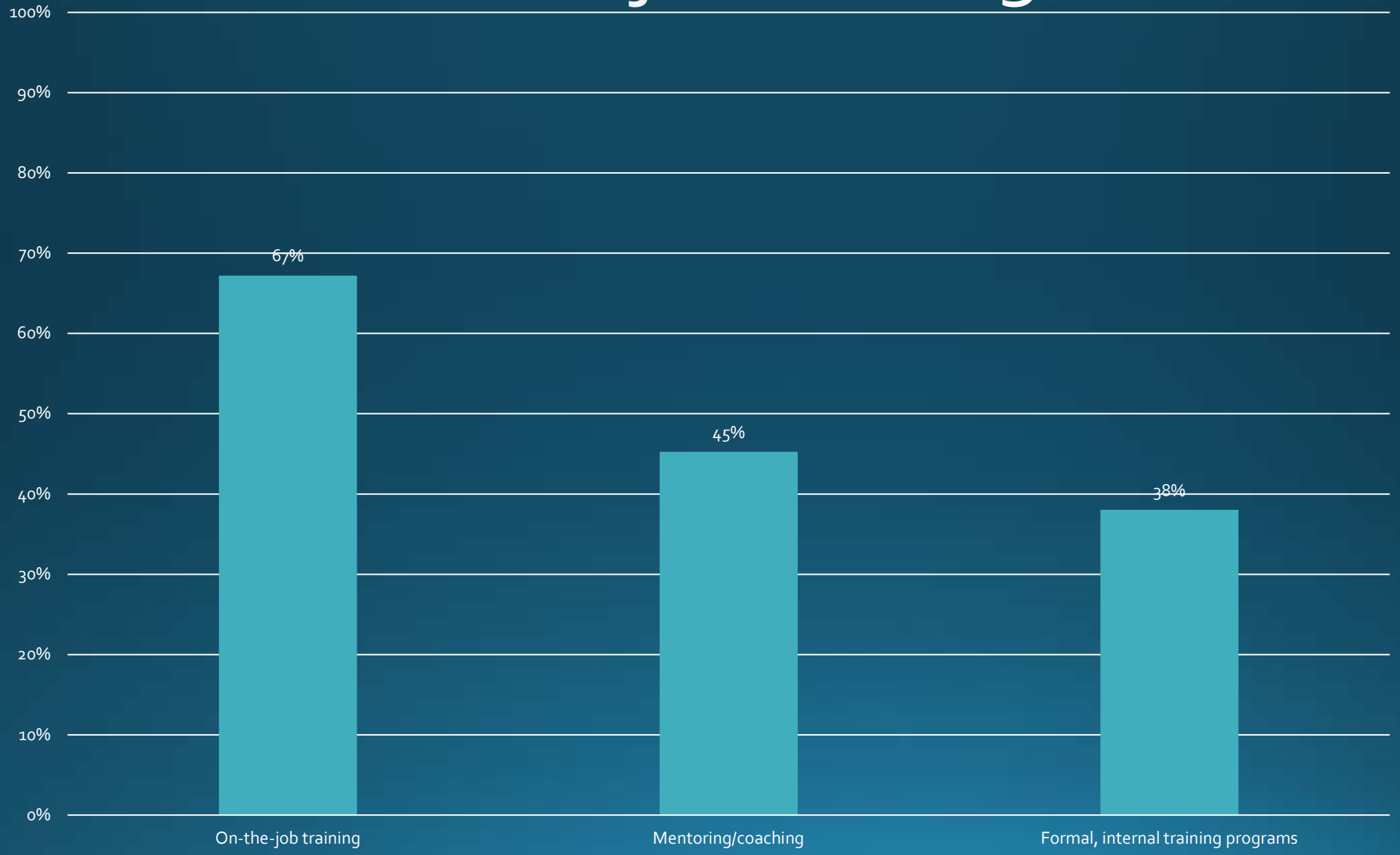
Colleges have programs in place to support workforce development



Most employers in the industry provide on-the-job training



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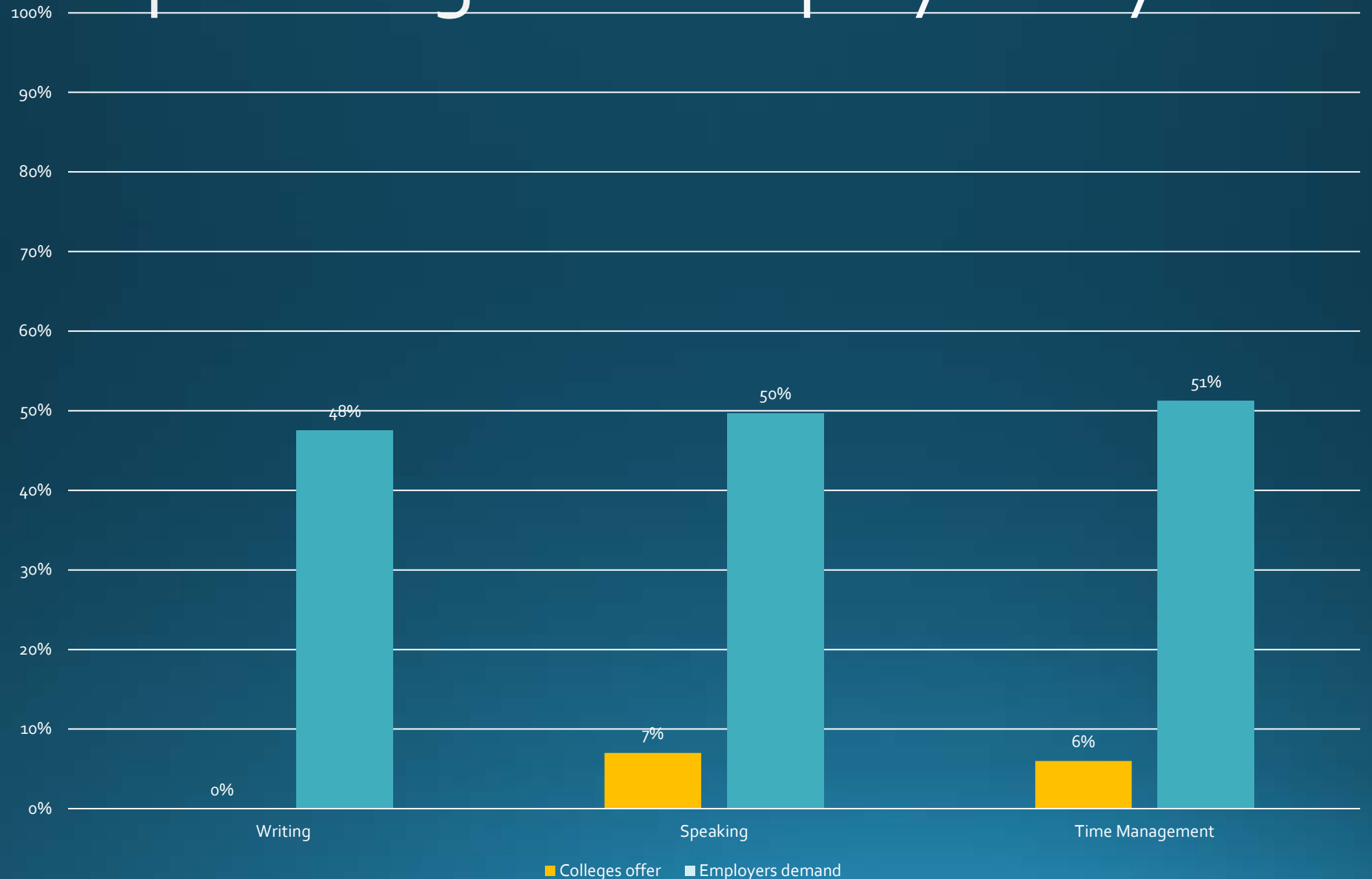
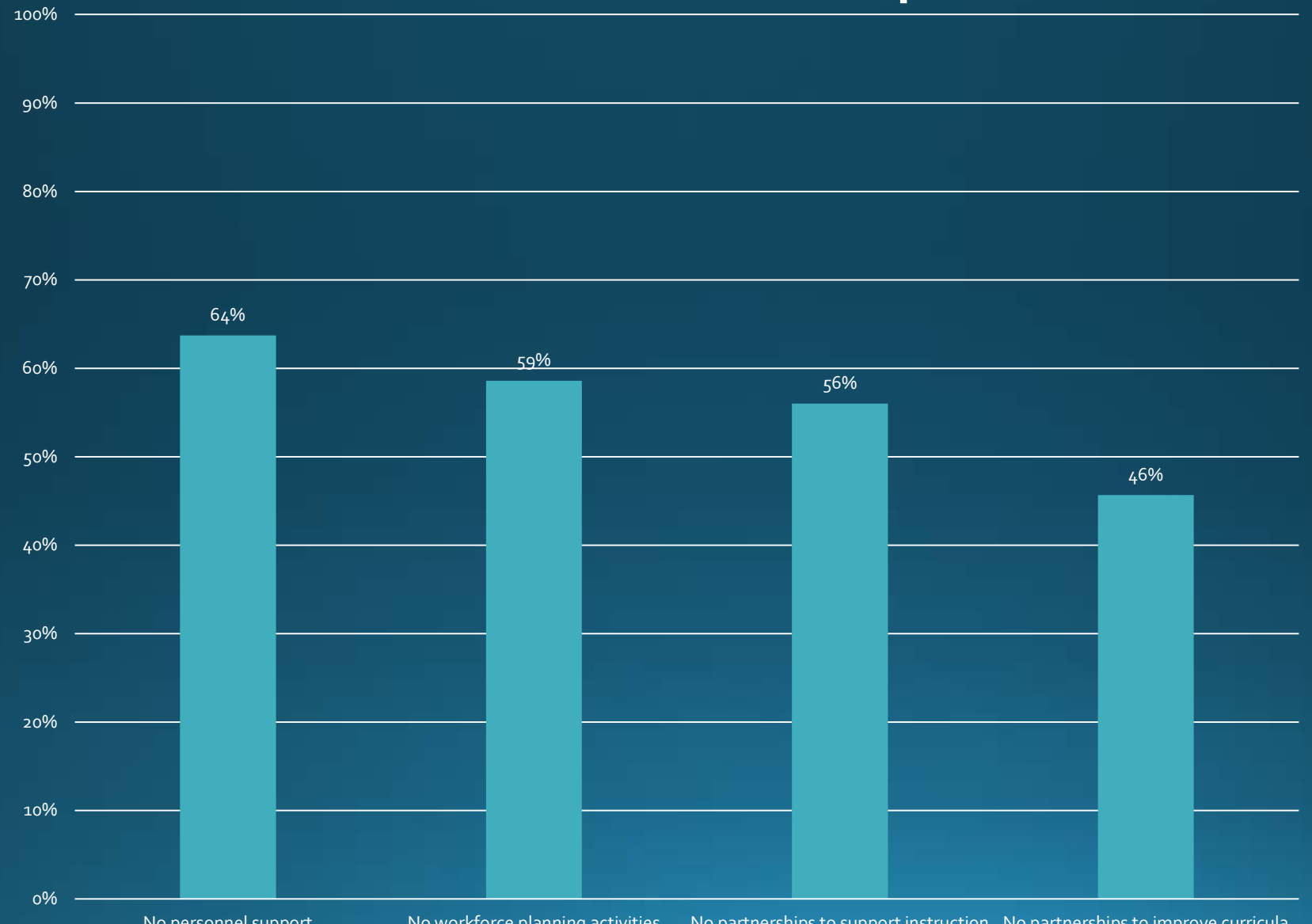
Oil and natural gas programs are not distinctly emphasizing basic employability skills



Employers are engaging with local colleges, but there is room for improvement



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An Analysis of Employers and Colleges in Ohio, Pennsylvania, and West Virginia

Robert Bozick, Gabriella C. Gonzalez, Cordaye Ogletree, Diana Gehlhaus Carew


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