Center for Energy Economics and Public Policy

Understanding Current Energy Changes in the Power Sector

Wyoming's Wind Energy Future

October 2, 2017

Laramie, WY

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Disruptive Trends

1. Loss of coal mining jobs nationally and the politics of this change.
2. Advent of natural gas “fracking”.
3. Explosion of renewable energy in last decade.

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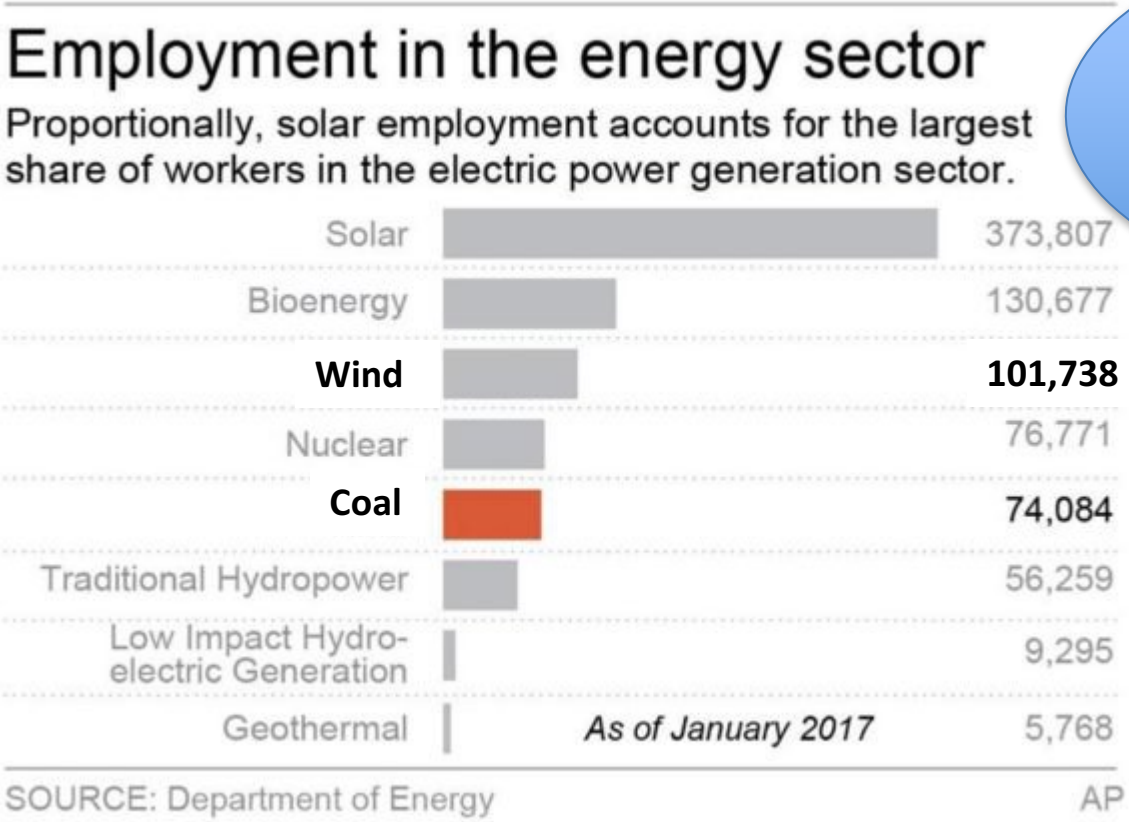
1. Coal vs. Other Generation



US Bureau of Labor Statistics projects the fastest growing job 2014-2024 will be wind technicians with 108% growth.

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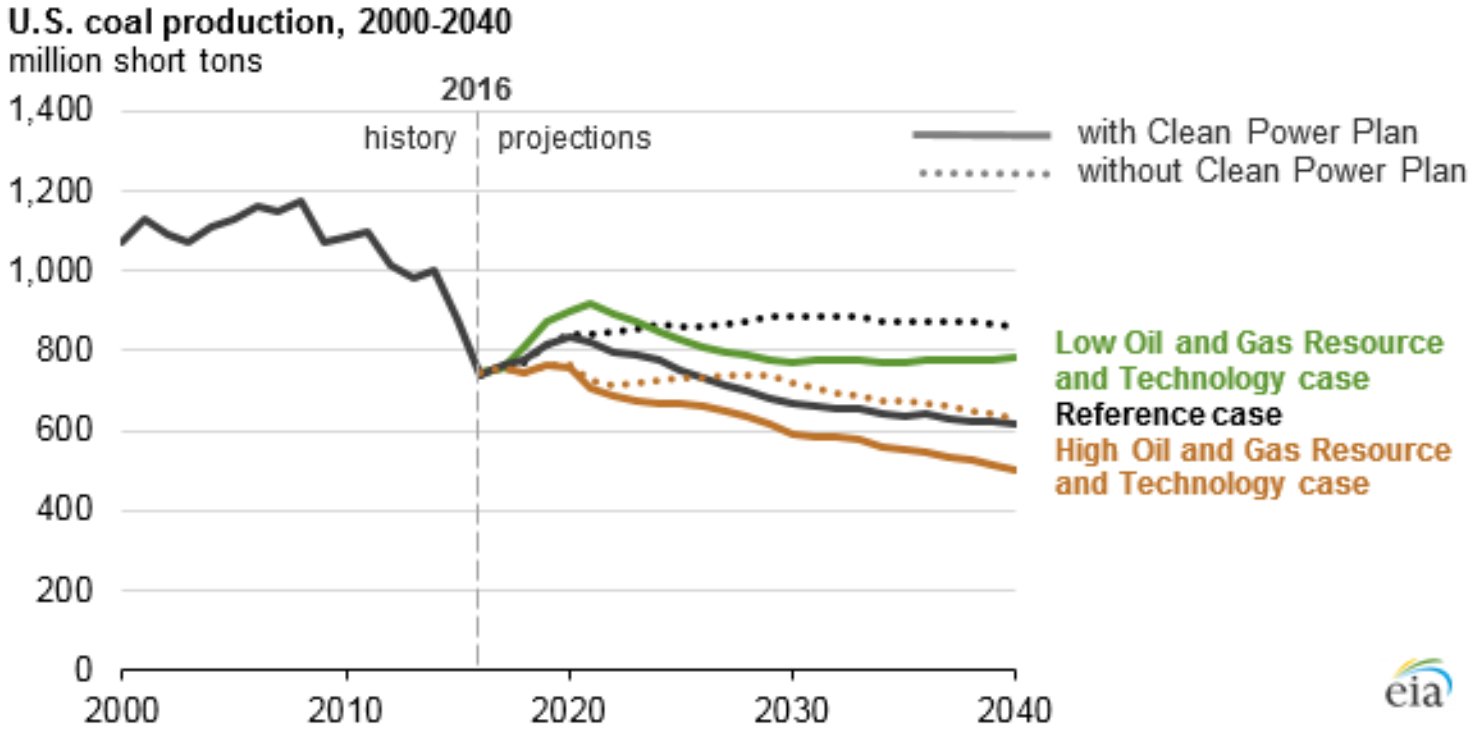
1. Coal Production Forecasts



Source: Energy Information Agency:
https://www.eia.gov/todayinenergy/detail.php?id=31792

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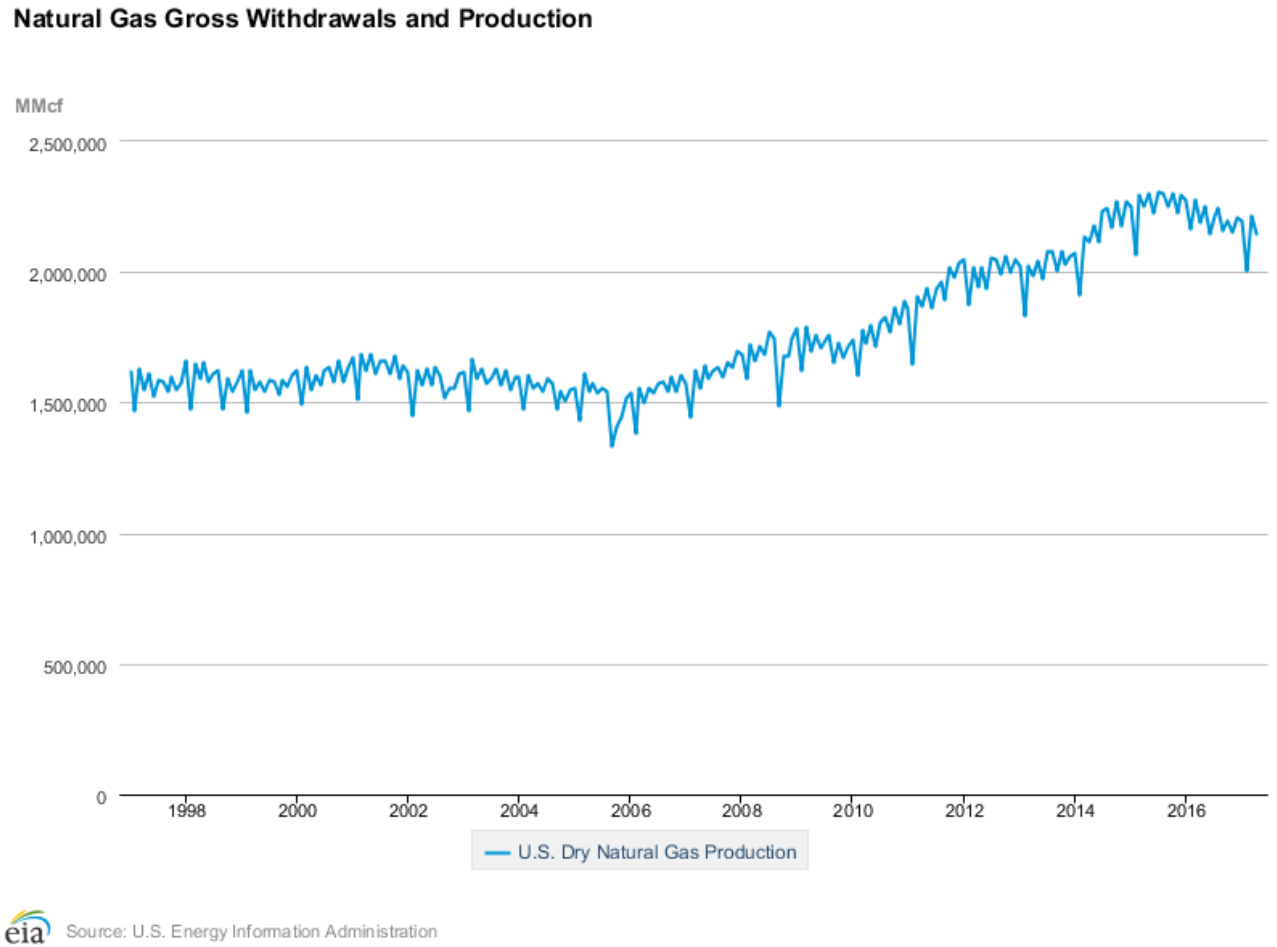
2. Unconventional Natural Gas Production



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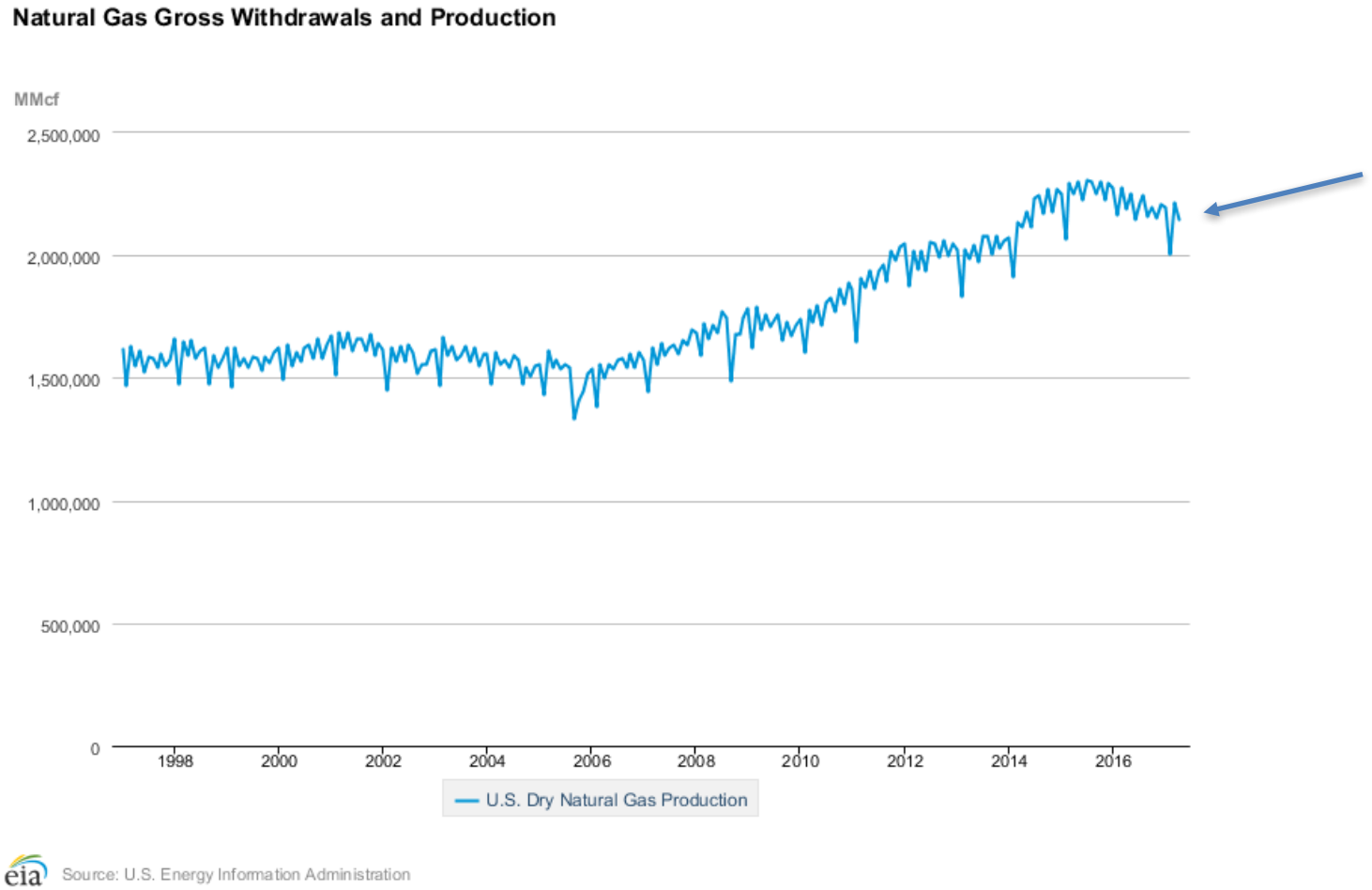

Natural Gas production is 40% higher today than a decade ago.

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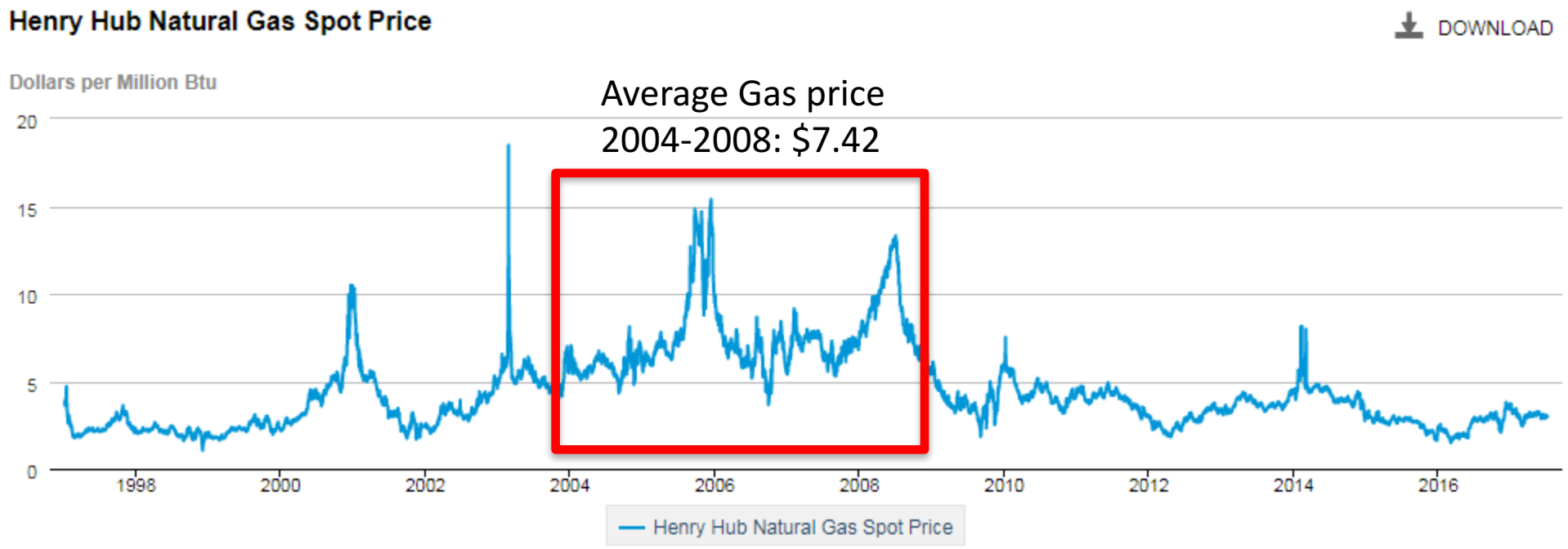

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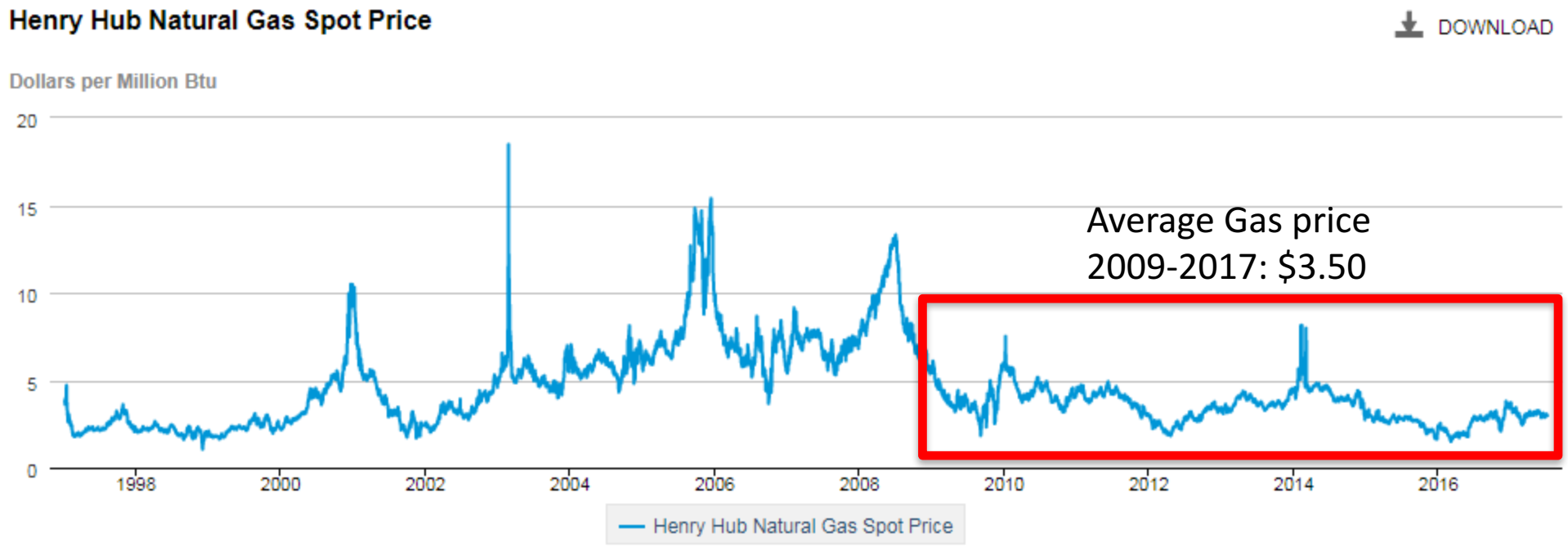

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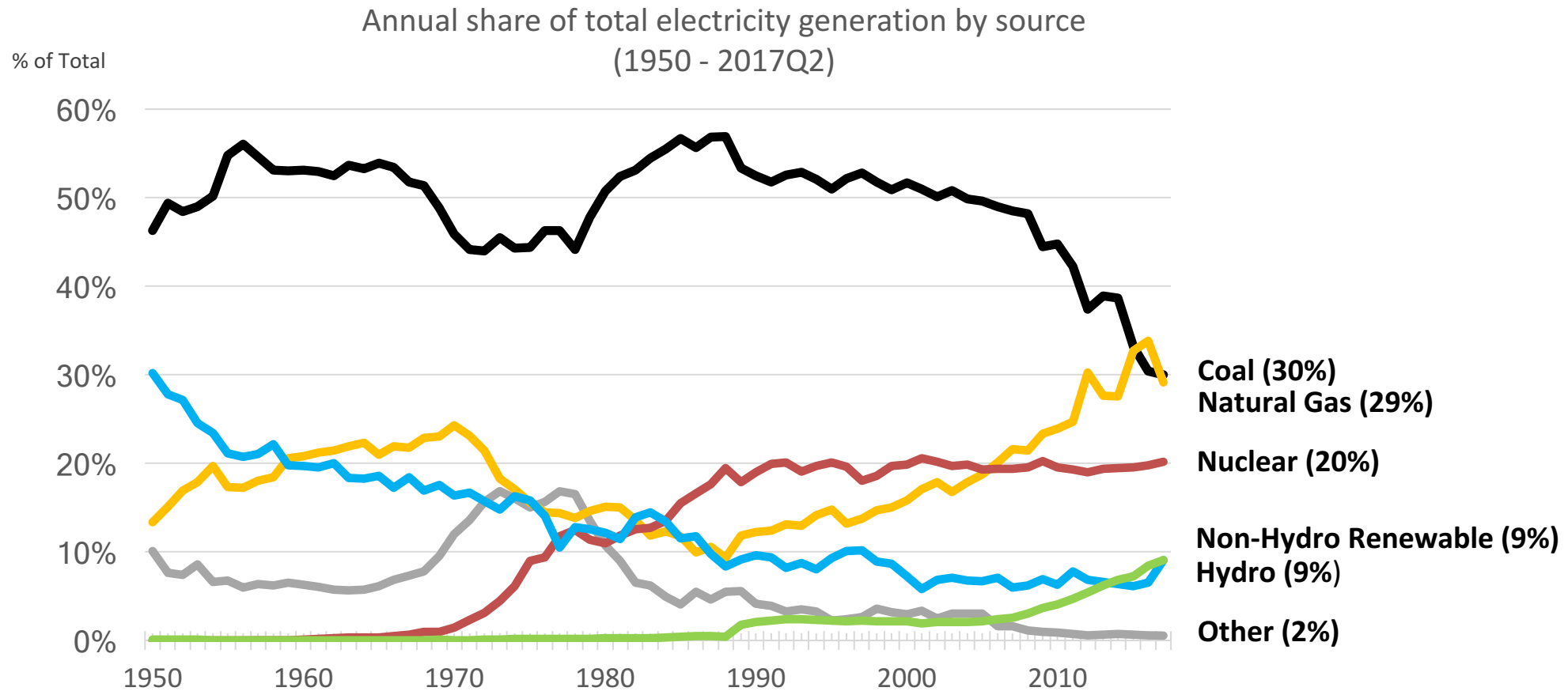
Impact on Electricity Production



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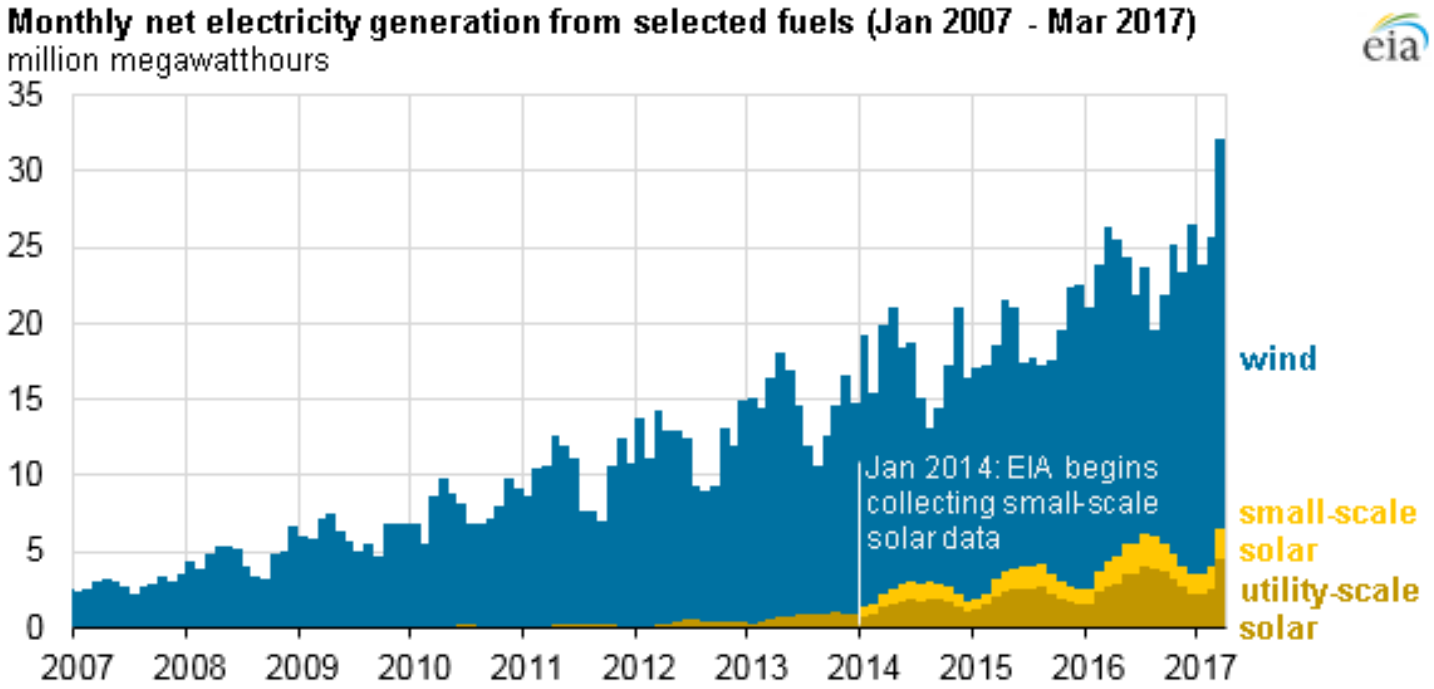
3. Renewable Energy Production



Source: Energy Information Agency:
https://www.eia.gov/todayinenergy/detail.php?id=31632

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Opportunity

- Resource – do you have a good wind resource?
- Markets – can you sell the wind resource?
  - Access – transmission availability.
  - Policy – demand for renewables increased by social choices and incentives?
    - RPS standards or other requirements?
    - Desire to use renewable energy?
- Competitiveness
  - Other competing sources of energy?
  - Where is the resource cheapest to produce and sell?
    - Taxation and operation.
    - Technology enabling competitive production
      - Capacity factor

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Opportunity

- Renewable energy opportunity in the electricity sector driven by three trends

1. Policy: Begun in the 1980s, this has allowed changes to occur in the electricity system that were unforeseen when deregulation began.
2. Consumer preferences/Climate change concerns.
3. Renewable technology development.

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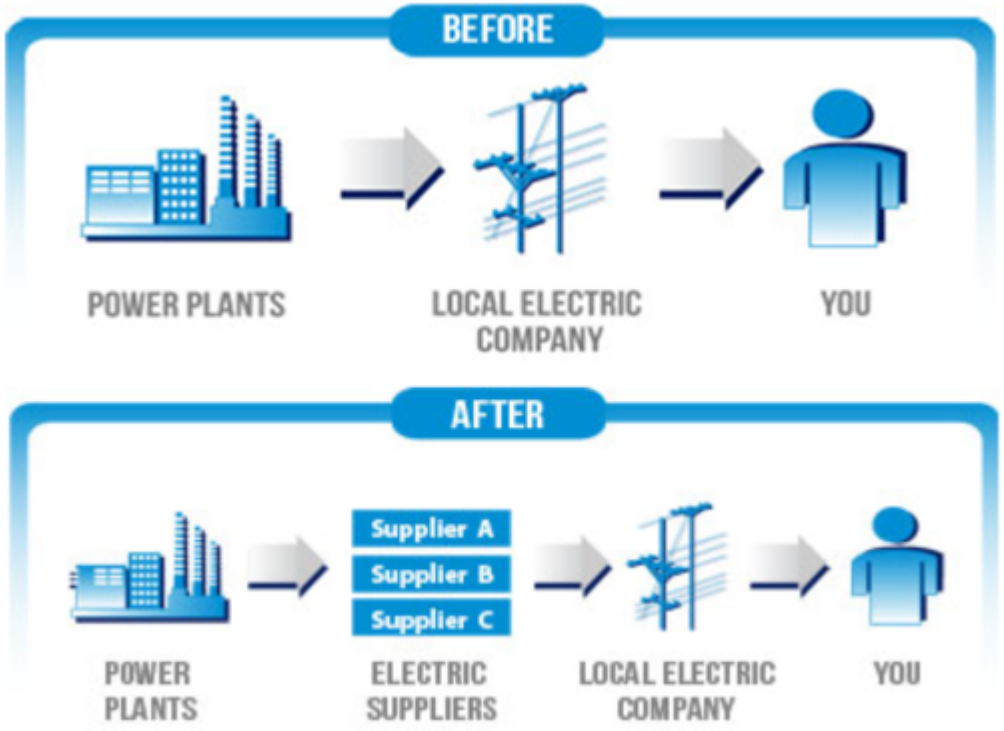
1. Deregulation



- Utilities used to own generation, transmission and distribution.
- Consumers had to use electricity available and produced by the local utility.
- Deregulation opens the generation market to non-utility producers.
- Allows wind and solar production to begin in some areas.

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2. Consumer Preferences

- Consumers care about their power and where it comes from/environmental damage it causes.
  - Deregulation has allowed consumers to express those preferences
    - Can choose suppliers in many states.
  - They have also been expressed at the ballot-box
    - Renewable portfolio standards or renewable targets.
    - Continued bipartisan Congressional support for renewable subsidies.
      - $23/MWh (lasts 10 yrs.) in 2016, declines in 20% increments annually to zero by end of 2020.
- These are also driving current and future power decisions.

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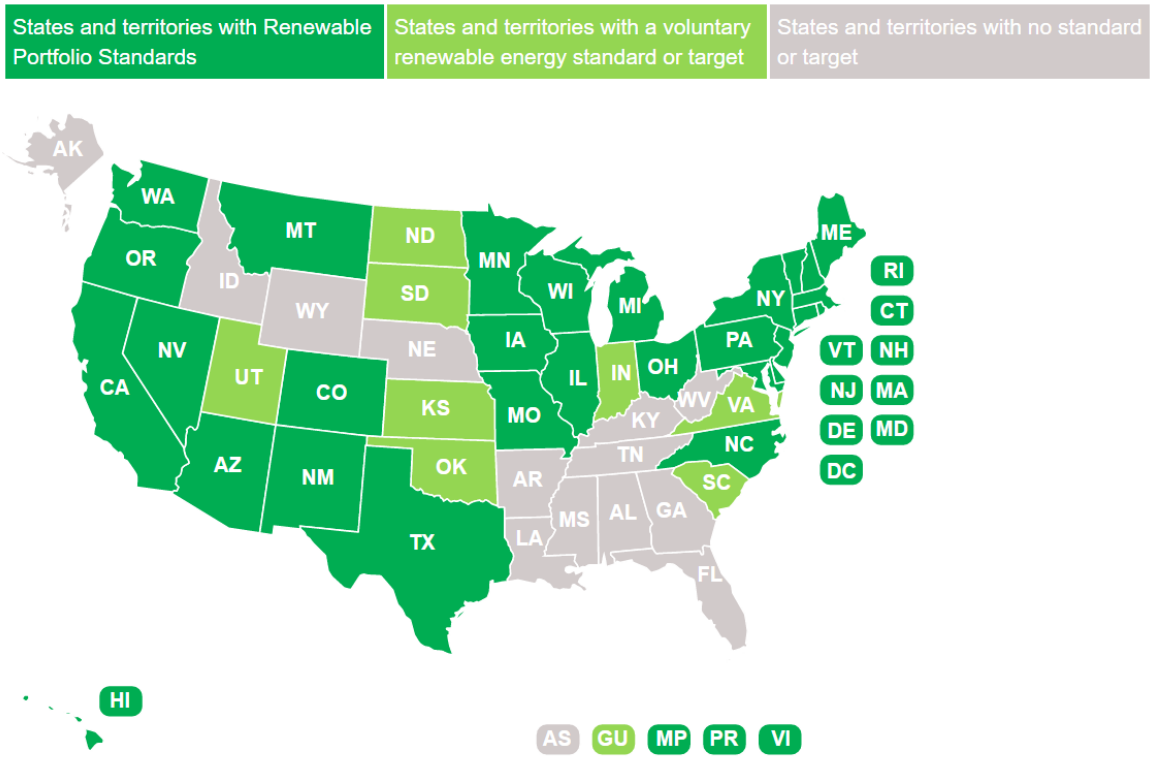
2. Consumer Preferences/Climate Change



- Consumer preferences lead to political decisions.
  - 29 states + DC have renewable portfolio standards.
  - 8 have voluntary standards or renewable targets.

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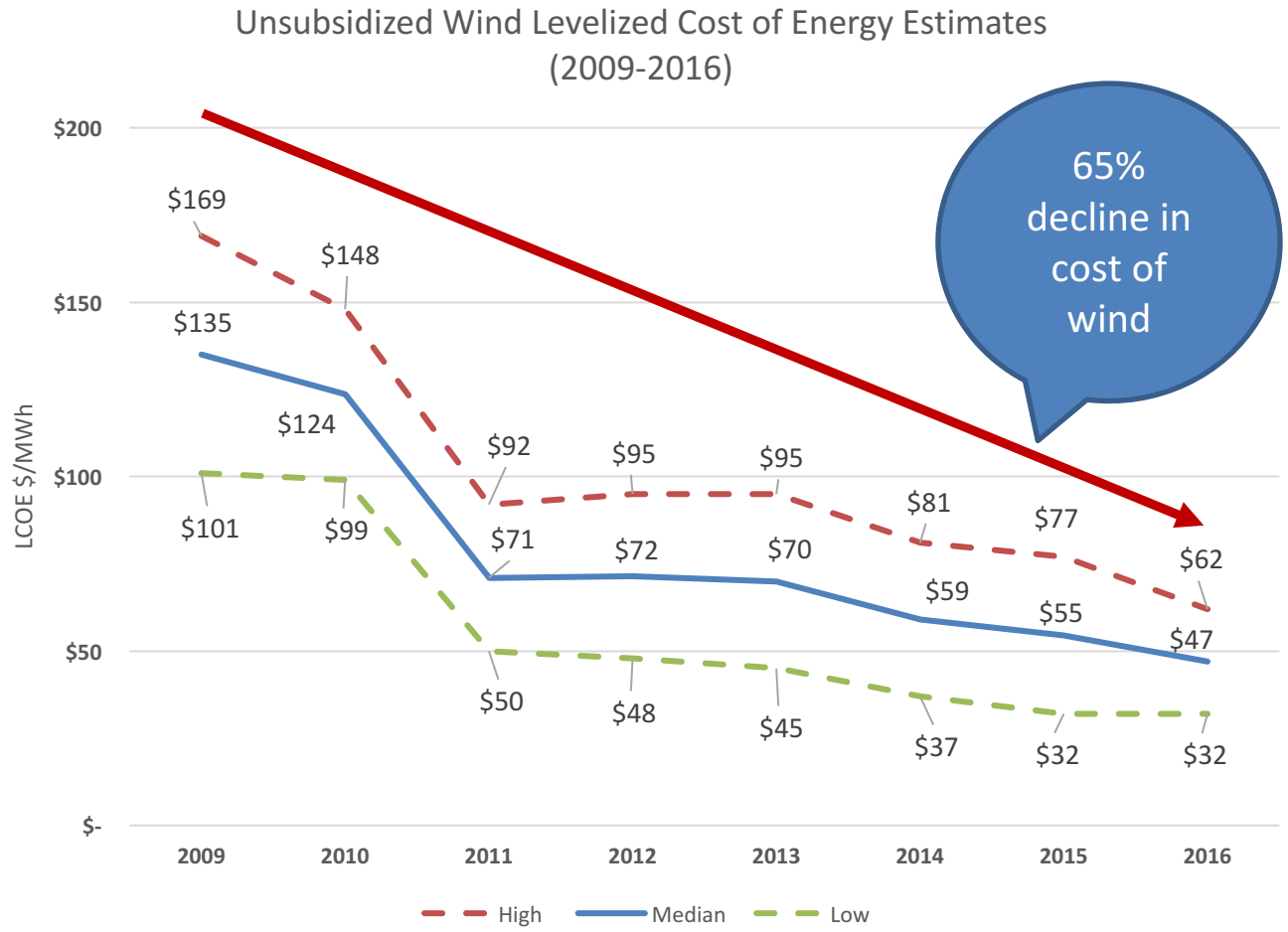
3. Renewable Cost Declines



Source: Lazard LCOE Analyses Versions 2.0-10.0

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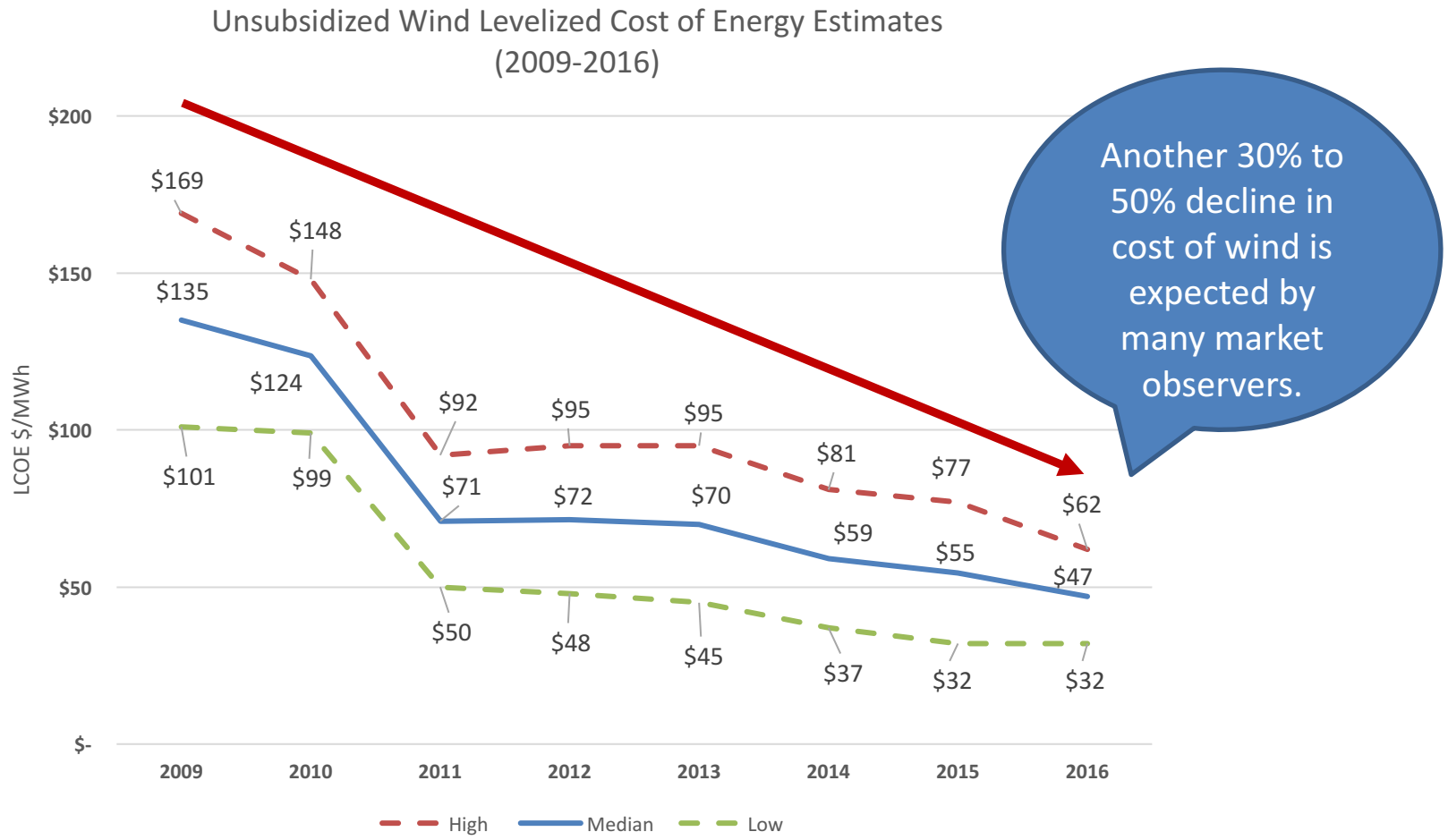

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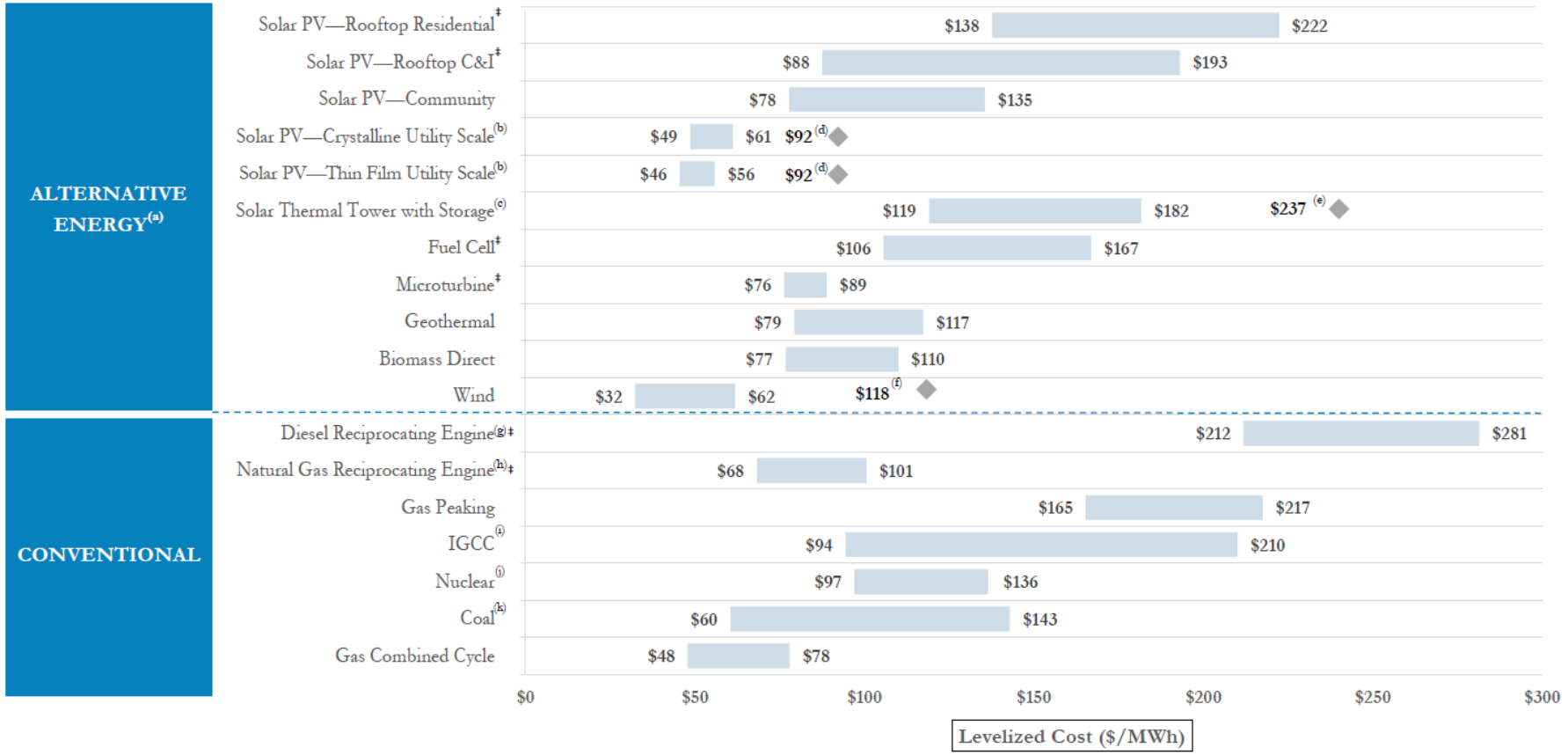
Wind: cheapest source of new generation



These are unsubsidized costs – costs without any tax or investment credits.

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Wind: cheapest source of new generation

These are unsubsidized costs – costs without any tax or investment credits.

Source: Lazard LCOE Analysis v 10.0 (2017)

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Integration Costs: < $10/MWh

- Wind and solar are intermittent sources
- These sources need “backing” for times when they are not available –additional resources to be ready if needed.
  - Also requires additional infrastructure such as transmission to accommodate renewables.
- These “integration costs” however, typically add $3-$5/MWh to the cost of renewables and no more than $10.
- Even including these costs, wind is still the lowest cost form of new generation.

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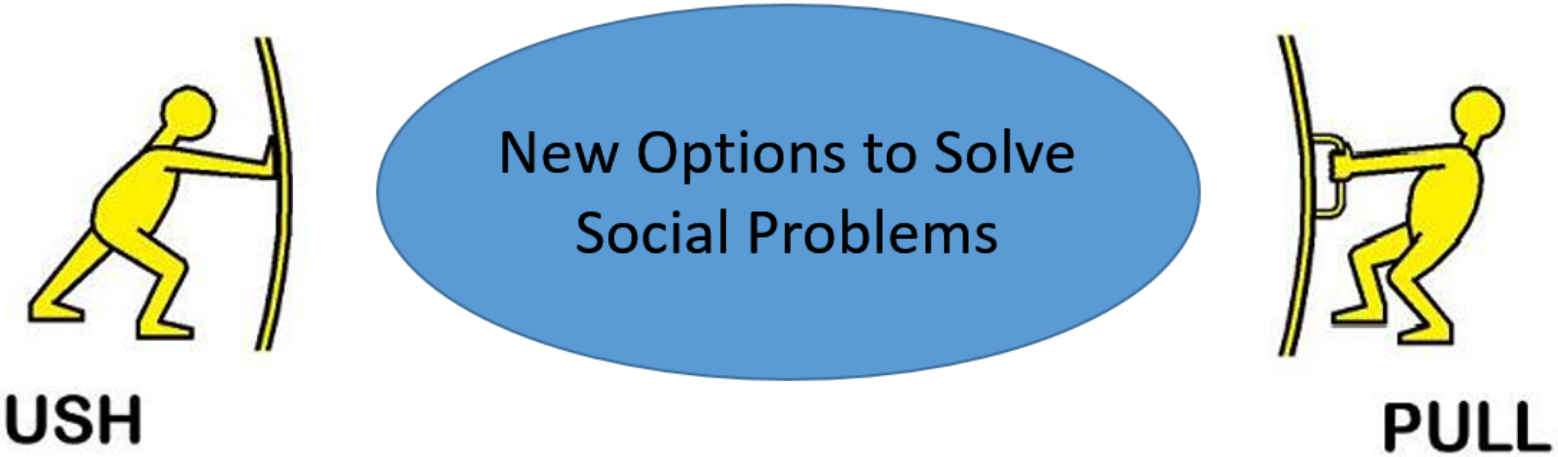
Result: Market Opportunity

Technology **Market Incentives**



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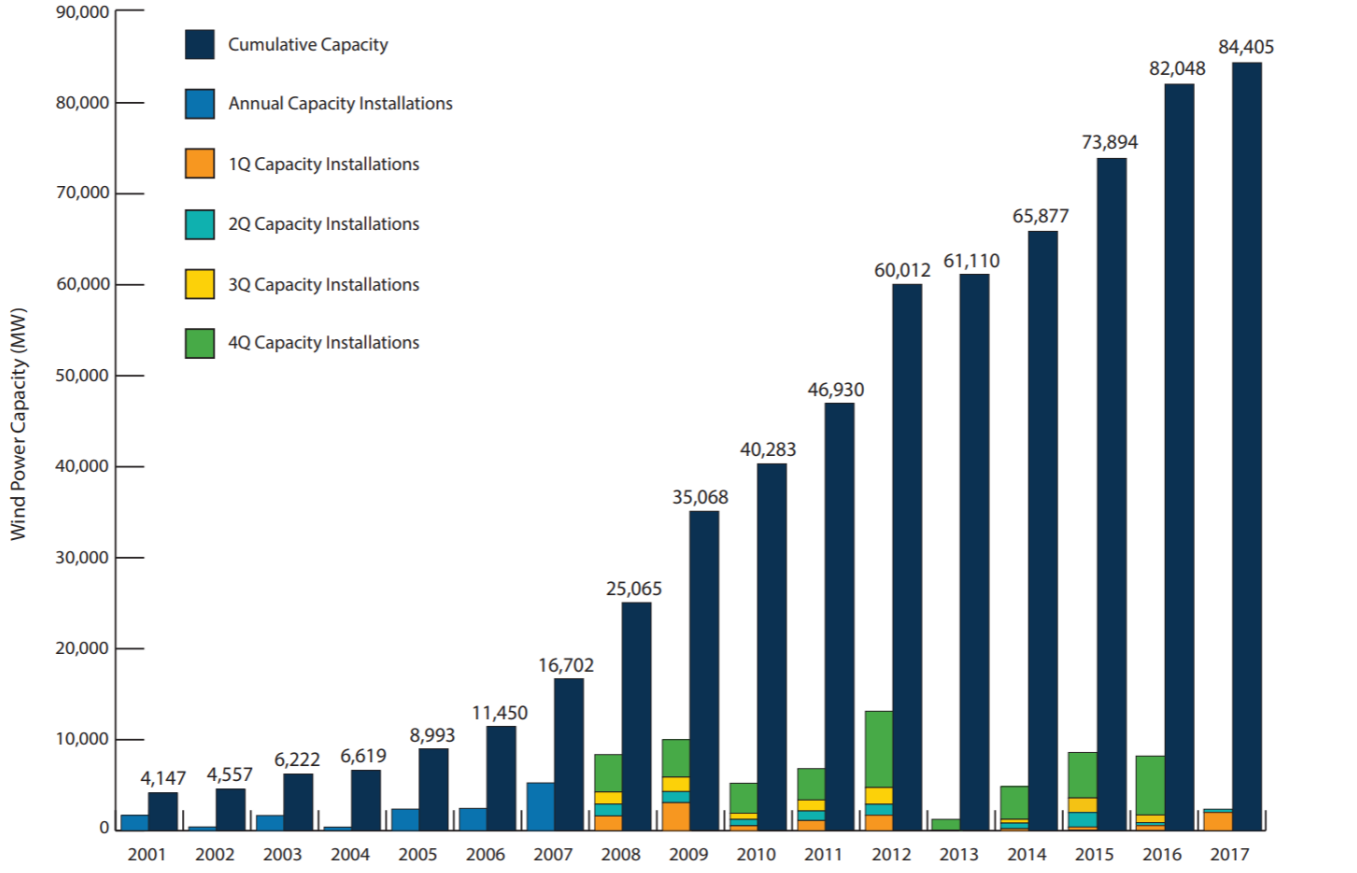
Wind Capacity Increases



Note: Utility-scale wind capacity includes installations of wind turbines larger than 100-kW for the purpose of the AWEA U.S. Wind Industry Quarterly Market Reports. Annual capacity additions and cumulative capacity may not always add up due to decommissioned and repowered wind capacity. Wind capacity data for each year is continuously updated as information changes.

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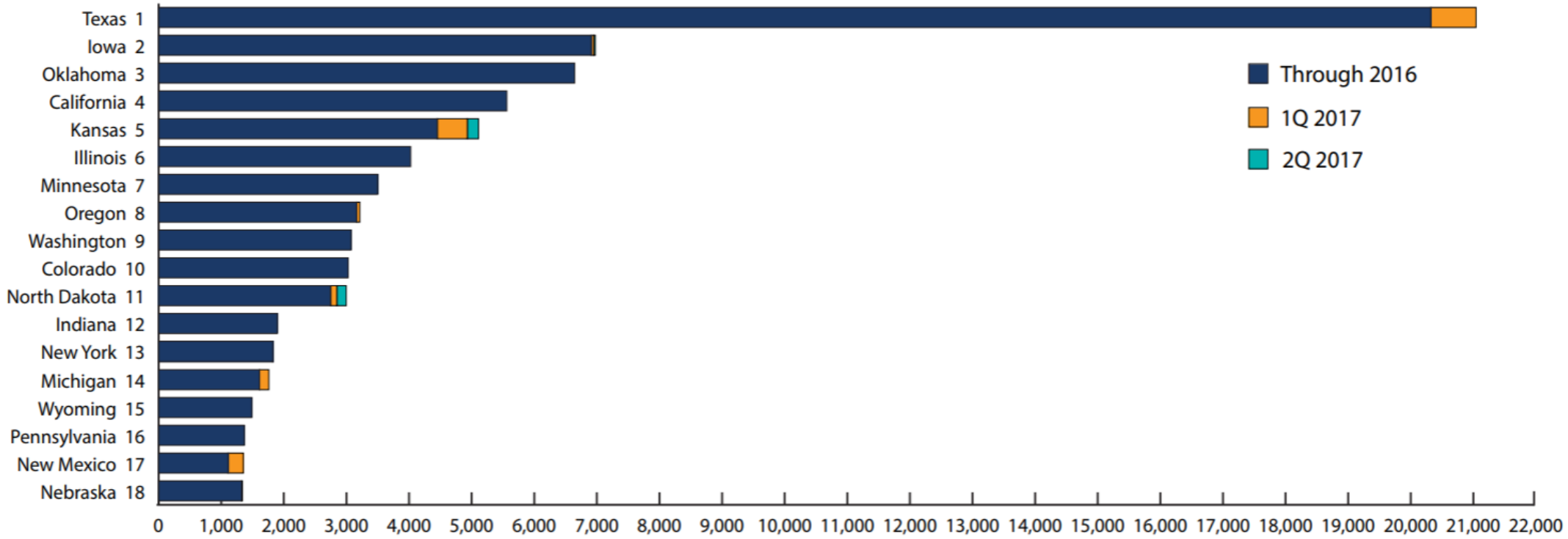
Installed Wind Capacity by State



Source: AWEA Wind Industry Market Report 2017 Q2

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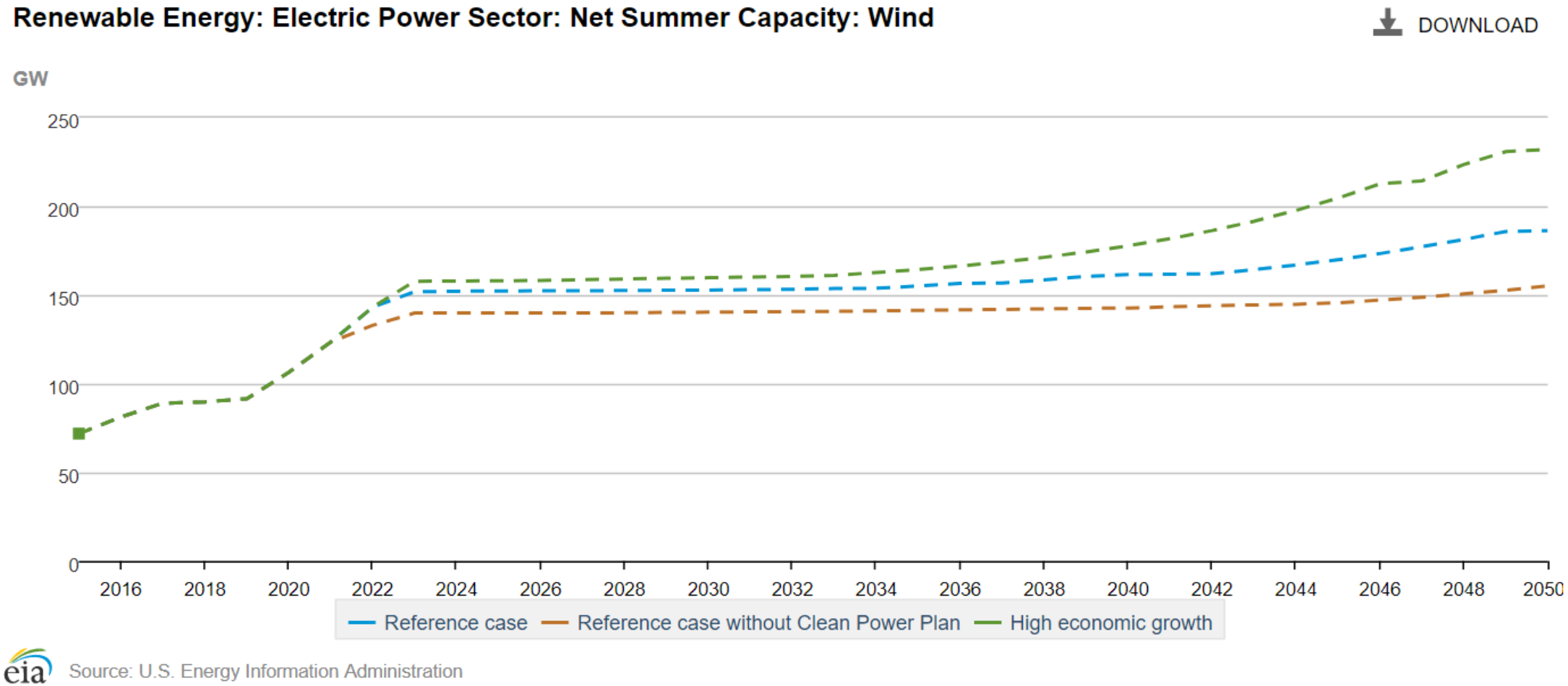
Wind Capacity Forecast



eia Source: U.S. Energy Information Administration

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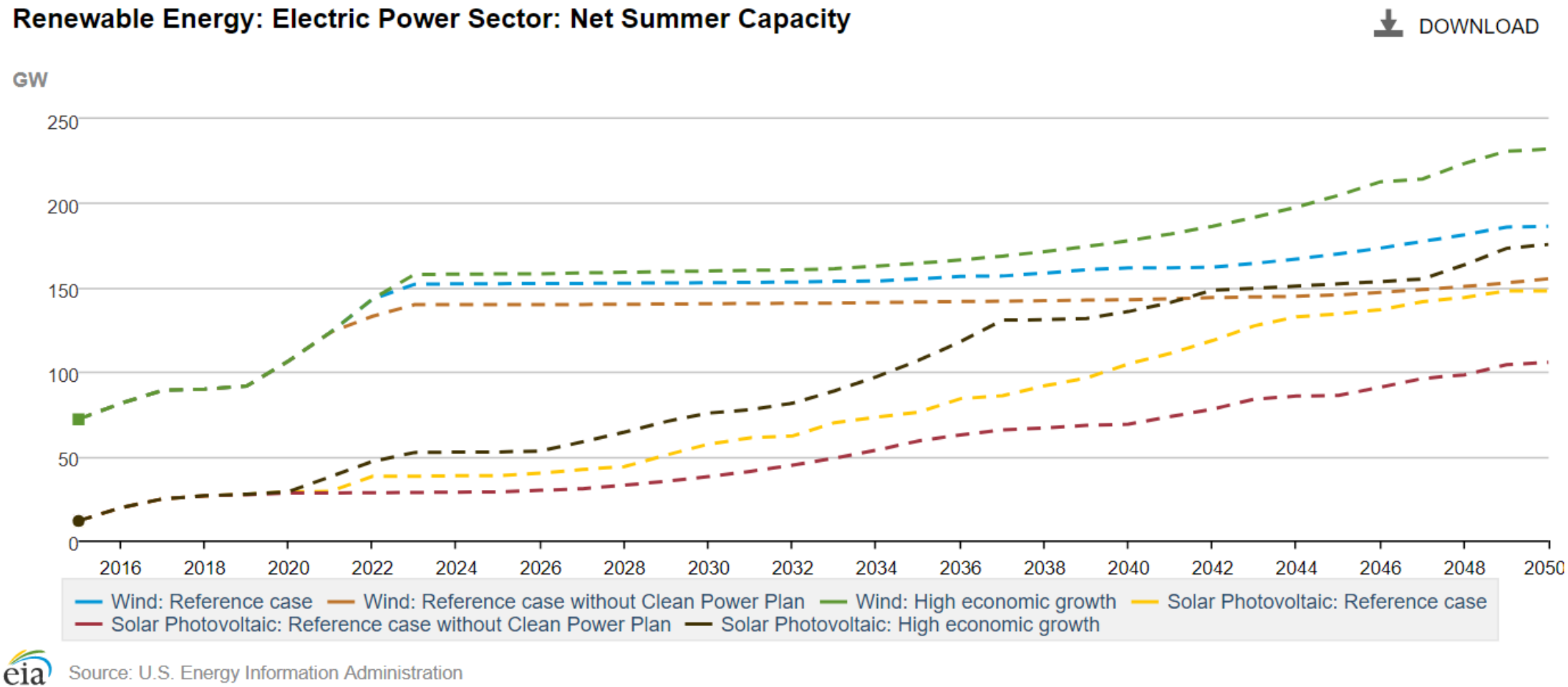
Wind and Solar Capacity Forecast



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Enabling Greater Renewable Penetration

1. Further cost reductions in the technology.
2. Greater transmission development to bring electricity from areas where renewable energy is plentiful to where it is needed.
   - Also allows geographic diversification to be utilized – “the wind is always blowing somewhere”
3. Lower cost storage – battery technologies and other methods.
4. Smarter use of the grid - appliances and devices.

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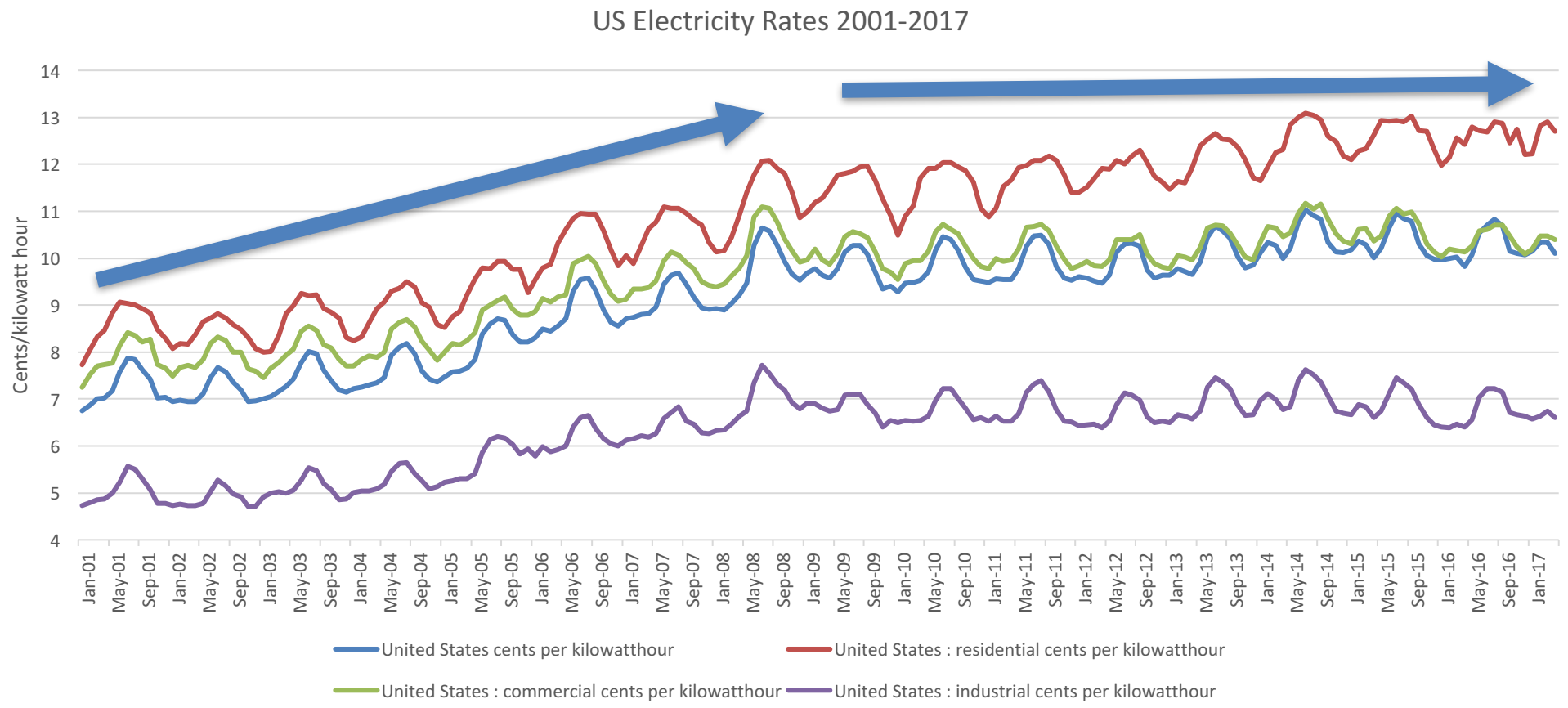
Implications of these Trends: Prices



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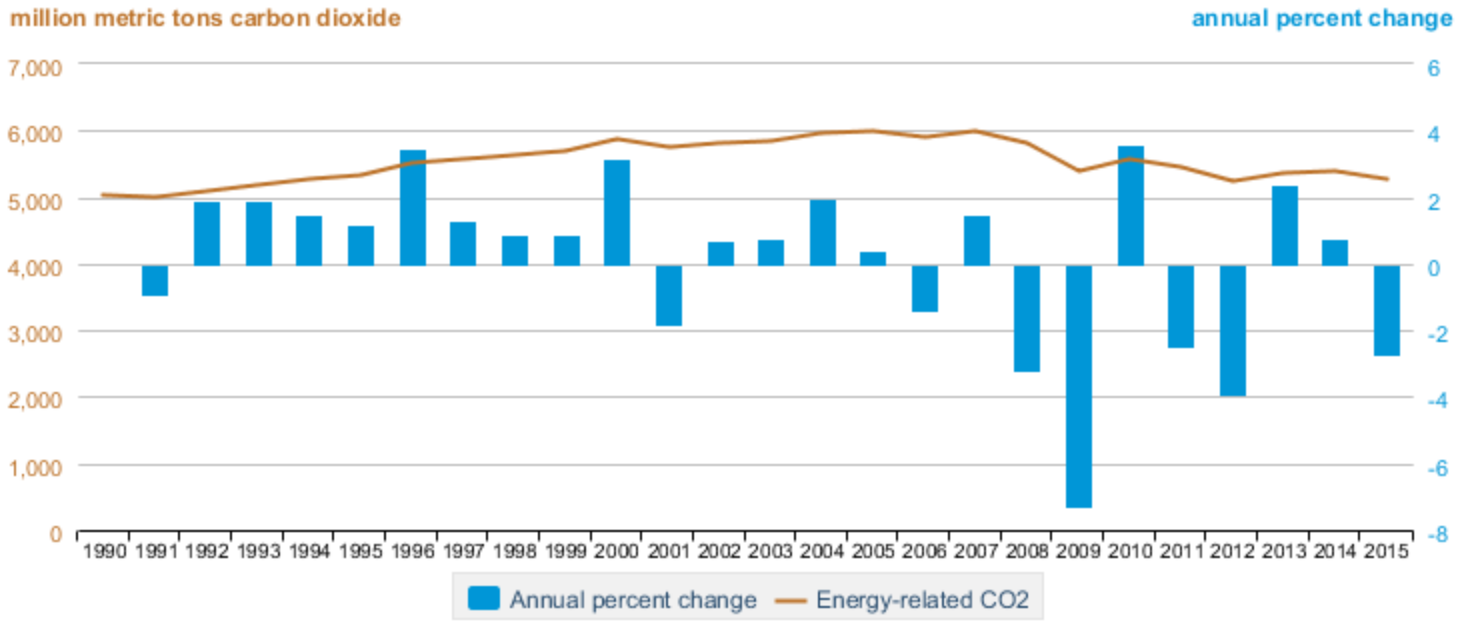
Implications of these Trends: Emissions

Figure 1. Energy-related carbon dioxide emissions, 1990-2015



eia **Source:** U.S. Energy Information Administration, *October 2016 Monthly Energy Review*, Table 12.1 Carbon dioxide emissions from energy consumption by source.

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Challenges

- The energy transition will be challenging, particularly for states that rely on fossil fuel generation/production.
  - Employment in these areas, particularly in the coal sector have been hard hit.
  - State revenues in places like Wyoming have also been hit hard.
- Workforce development will be necessary to accommodate these changes.
- Species, cultural and social impact concerns must be dealt with in areas where renewables developed.

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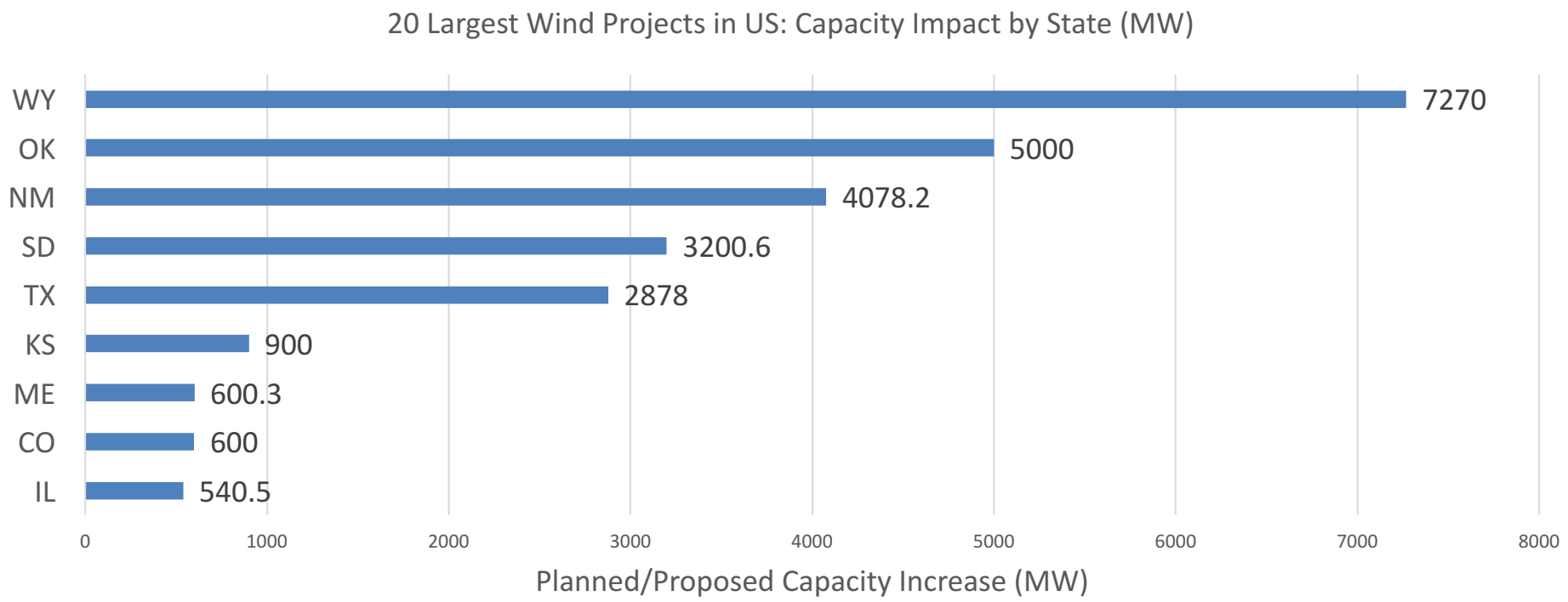
Opportunity in Wyoming



Source: S&P Global Market Intelligence 20 largest wind projects in US (August 2017)

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Implications for Wyoming

- Opportunity:
  - Transition may provide much needed economic development opportunities for states like Wyoming.
- Wyoming currently has 1,489 MW of wind capacity
  - Last major wind boom 2007-2010 when capacity grew by almost 5x (288MW to 1410MW)
  - 80 MW built since then.
- Current proposals could build approx. 8,000+ MW by 2020 (over 5x current capacity) in next decade.

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Implications for Wyoming

- Potential impact of 8,000MW of new wind construction:
  - Over $13 billion in potential investment planned in the state in next 5 years,
  - Over $9 billion in new economic activity in the state,
  - Almost $4 billion in new labor income,
  - Over $2.5 billion in new tax revenues over 20-year lifetime of projects at current tax rates,
  - Almost 68,000 job-years of new employment
    - 28,000 job-years of new employment in the initial 5-year construction phase (average 5,600/year)
    - 40,000 job-years of new employment over 20 years of operation (average 2,000 jobs/year)

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Implications for Wyoming

- Potential tax revenues
  - Wind pays approximately $3.49/MWh from all taxes.
- Of the $2.5 billion in new tax revenues possible if all proposals were developed, benefits accrue both locally and statewide:
  - Approx. 1/3 locally, 2/3's to state.
  - State:
    - Approx. $650 million in taxes for general use in the state
    - Approx. $900 million in taxes for education possible
  - Local: approximately $900 billion.

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Implications for Wyoming

Possible additional economic development possible:

- Supply-chain and logistics benefits
  - Materials
  - Construction and operations services
- Manufacture
  - Wind industry components
- New “green-tech”
  - Consumers who prefer renewable generation (e.g. data-centers, agriculture, etc.)

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Competitiveness?

- Are there policy decisions we can make that will positively or negatively affect potential wind development arriving in the state versus going elsewhere??
  - Taxation/Incentives?
  - Regulation practices and policies?
  - Perceived interest by state officials and legislators?
  - Infrastructure and development and support?

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Challenges

- Protection of cultural values?
  - Landscape
  - Heritage sites
- Species protection?
  - Wildlife/environmental impacts
- Economic impacts?
  - Recreational/Tourism impacts
  - Access/use of lands

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Conclusions

- Energy transition is being driven by market and technological trends in the industry – not regulation requiring renewables.
  - Deregulation of electricity sector, consumer/political preferences and changes in technology development and consumer preferences have .
  - Recent changes have actually lowered prices and emissions.
    - You do not have to be concerned with environmental outcomes to benefit from these changes.
- Growth in renewables will continue.
  - Wind is the lowest cost source of new generation available, and solar will likely also be cheaper than conventional sources by the end of the decade.
- Wyoming can potentially be a large beneficiary of these .

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Pivotal decisions

- How do we address the opportunity?
  - Prediction vs. Intention…
- Wind development will occur whether Wyoming participates or not.
  - How/can we manage wind development to our best advantage?
  - How/can we minimize the challenges wind development poses?
  - Evaluate tradeoffs in managing development – can we avoid too much cost without giving up too much gain?
- Constructive decision-making requires engagement, evaluation and planning.
  - No policy is also bad policy-making.

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Robert Godby

Director, Center for Energy Economics and Public Policy
Department of Economics
University of Wyoming
rgodby@uwyo.edu

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