Renewable Energy Trends & Opportunities in Sussex County

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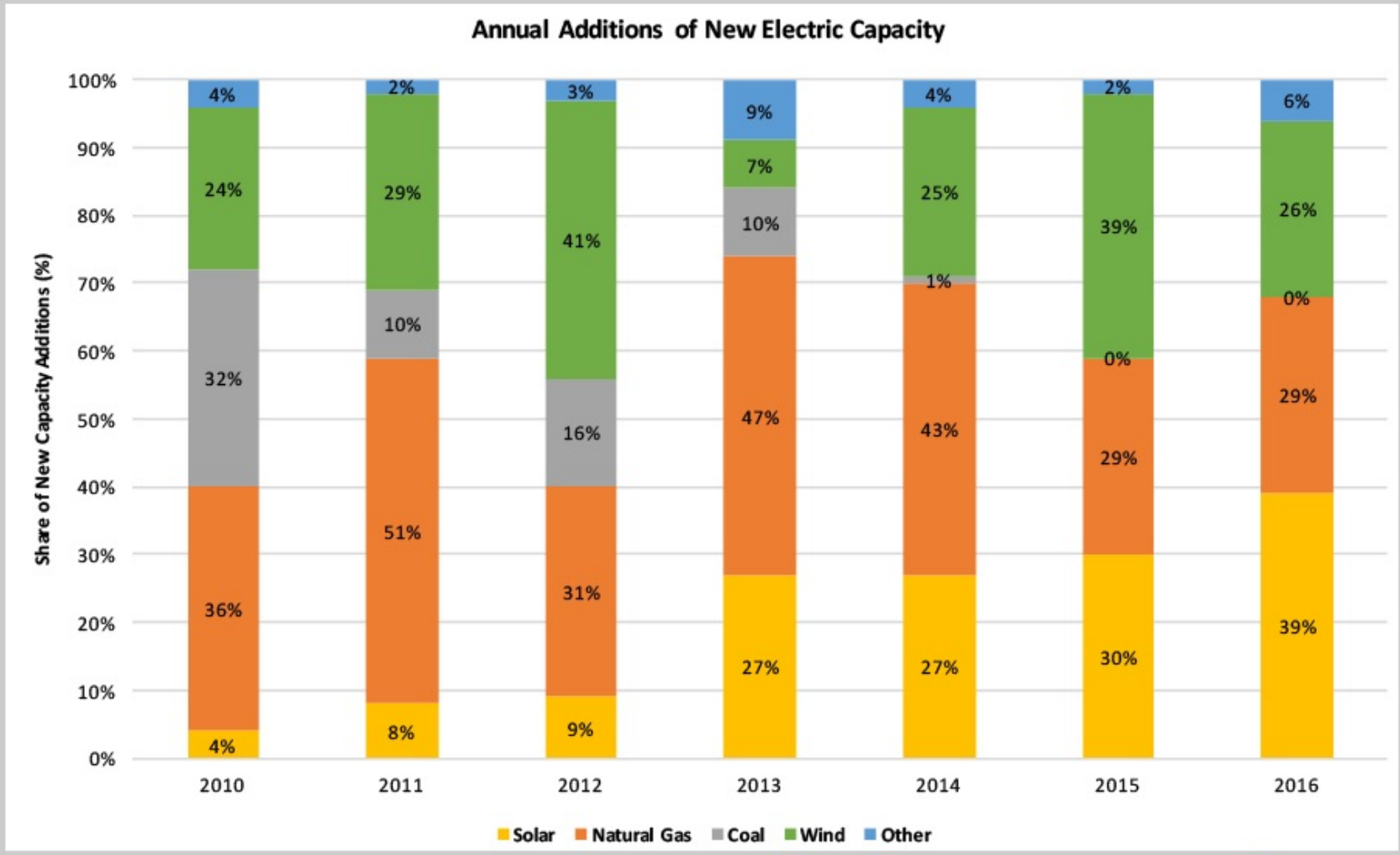
Presentation Outline

- Who we are
- Goals of our research
- Snapshot of the fastest growing industries/jobs in the US
- RPS in DE
- Current state of affairs
- Solar
- Wind
  - Land based wind
  - Offshore
- Wrap-up and discussion

Research Goals

- Sussex County Comprehensive Plan – include renewable energy (RE) developments
  - Explore possible RE technologies appropriate for SC
  - Link to economic development
- Identify and engage decision makers, planners, developers, and energy providers
  - Explore how to bring investment opportunities into the state/county
  - Assess knowledge base and gauge interest
- Identify and engage citizen groups
  - Exchange information
  - Educational institutions and training
- Identify barriers and opportunities for expanding domestic, renewable energies
  - Success stories in the region
  - Articulate benefits
- Facilitate discussions, tailor information, and communicate potential strategies to create economic development ideas around RE

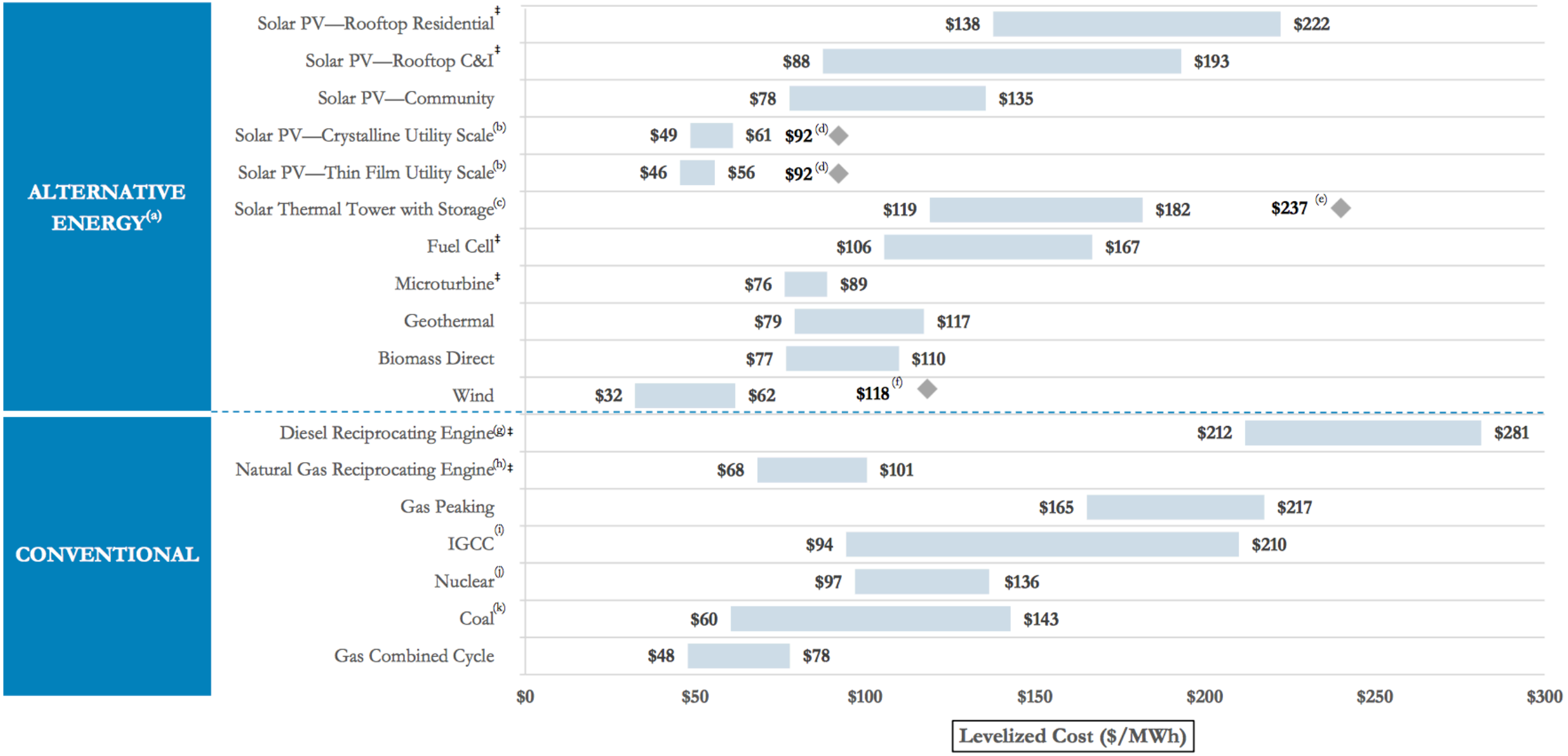
Annual additions of new electric capacity



gtmresearch SEIA Solar Energy Industries Association®

Lazard Unsubsidized Cost of Energy (Dec 2016)

https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf



Source: *Lazard estimates.*

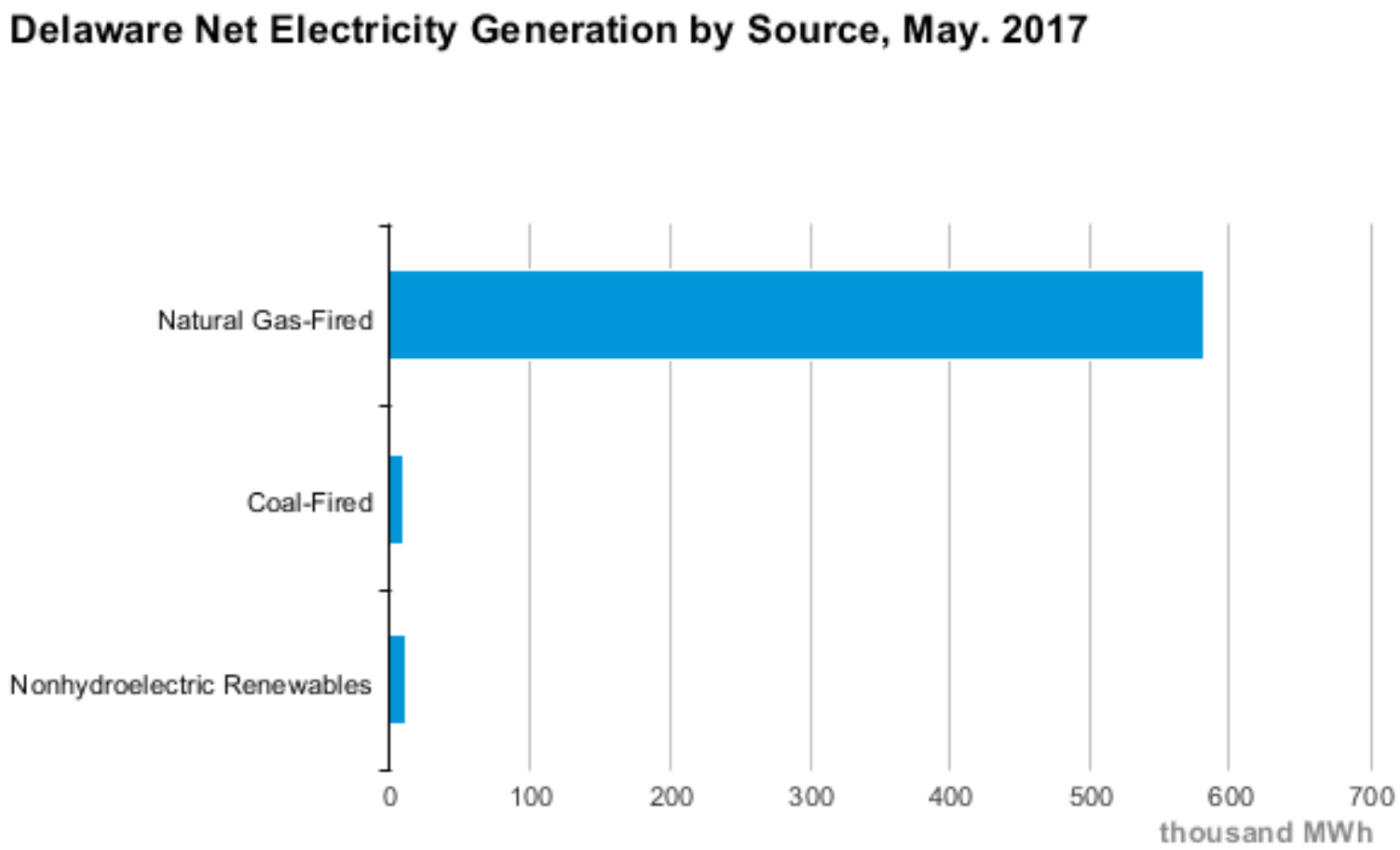
Energy System Transformation 1980 -> 2005 in Delmarva

- In 2016**, Delaware** generated 89% of its electricity from natural gas,
- Up 7% from what it had been two years before
- Generation from coal fell to 5.5%, less than half of what it had been two years before.
- Solar generates 1.61 % of the total electricity now
- **5% reduction in CO_2**
- RPS in place
  - Purchase of Renewable Energy Credits
- Average Retail Price of Electricity to Residential Sector (14.77 cents/kWh)

https://www.eia.gov/state/?sid=DE

Delmarva.com

EIA State Electricity Data (2017)



Source: Energy Information Administration, Electric Power Monthly

DE Renewable Portfolio Standards

- The state wants retail electricity suppliers to purchase (generate) 25 percent of power from renewable sources by 2025
  - with 3.5 percent carve out for solar
  - Passed in 2005 and then increased again 2010

- Source: http://programs.dsireusa.org/system/program/detail/1231

DE joins US Climate Alliance

- "Delaware is the country's lowest-lying state and with 381 miles of coastline, climate change is a very real threat to our future," **Delaware Gov. John Carney** said. "As sea levels rise, more than 17,000 Delaware homes, nearly 500 miles of roadway and thousands of acres of wildlife habitat including our critical wetlands are at risk of permanent inundation. Rising average temperatures and an increase in extreme weather events also pose health risks to Delawareans, and threaten our economy. The U.S. should lead in the global fight against climate change. Delaware is proud to join this coalition of states providing that necessary leadership."

Defining Market Conditions & Policies

- RPS – state requirements
- Federal tax credits
- Wholesale price of electricity
- Policies in place
- Codes, ordinances & land-use
- Education and training
- Site-specific resource assessments for RE
  - Wind (land and ocean), Solar, geothermal, methane, etc.

Benefits to the county and its citizens

- Bring new investments
- New, higher paying jobs
- County tax revenues
- Regional environmental benefits quantified now
  - “In 2015, combined air quality and climate benefits equaled 14.3 ¢/kwh-of-wind in the Mid-Atlantic region.” (LBNL 2017)
  - Less emissions, Cleaner air
  - Public health
  - Less water use

- Increase domestic energy supplies in Delmarva
  - Price suppression effects
  - Less congestion and transmission costs

SOLAR JOBS--- National

- Employment increased by over 51,000 workers, or 25 percent, since 2015.
- The number of jobs in the sector nearly tripling since 2010.
- Larger companies have entered the DE market.
  - Solar City, a San Mateo California, solar panel vendor with operations centers in Seaford and Newark, employs 80 people within the state.
- Nationwide, the solar industry employs about 174,000, and employment in that industry gas grown 10 percent faster than in any other in the last few years.

- http://www.delawareonline.com/story/money/business/2015/09/03/solar-energy-spurs-creation-thousands-jobs-delaware/71666202/

SOLAR- National Market Trends

- "Utility solar is on the cusp of another boom in procurement," said Cory Honeyman, GTM Research's associate director of U.S. solar. "The majority of utility solicitations are focused on maximizing the number of projects that can come online with a 30 percent federal Investment Tax Credit in 2019, or later by leveraging commence construction rules."
- The non-residential solar market—which includes commercial, industrial and community solar installations—grew 29 percent year-over-year, but was down 39 percent from a record high fourth quarter 2016.

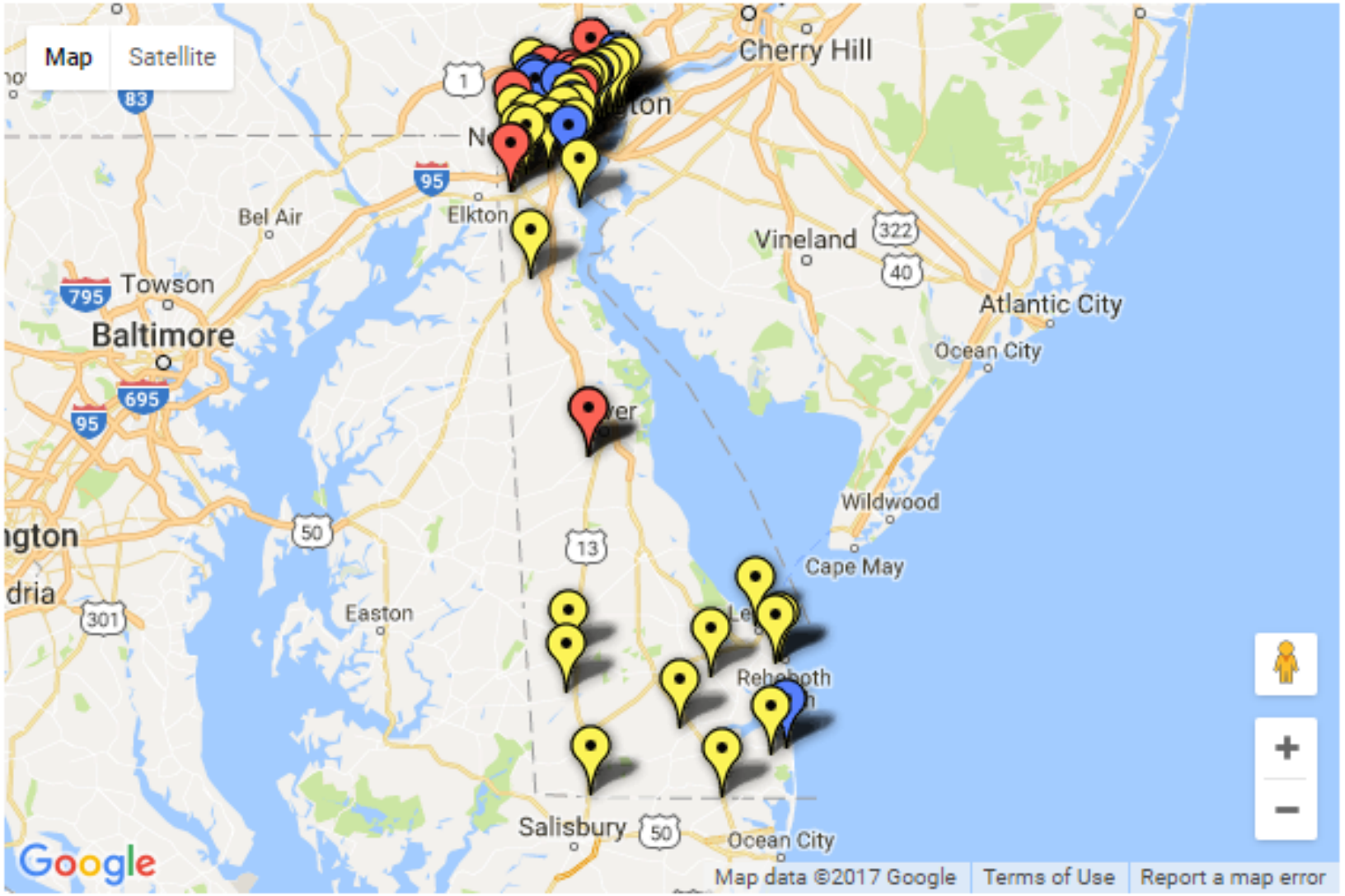
- http://mdvseia.org/solar-industry-news-mid-atlantic/?rkey=20170608DC11610&filter=9187

Key findings ---Solar Energy Insight Report (2017)

- In Q1, 2,044 megawatts of new capacity
- In Q1, solar was the second largest source of new electric generating capacity additions brought on-line, responsible for 30% of new generation, second only to natural gas.
- Community solar continues to be a bright spot for non-residential PV with deployments in Minnesota
  - This segment grow more than 30% over Q1 2016.
- Installed system prices continue to drop across all market segments, with fixed-tilt utility-scale systems dipping under the $1/watt barrier for the first time.
- GTM Research forecasts that 12.6 GW of new PV installations will come on-line in 2017,
  - Down 10% from a record-breaking 2016.
- Total installed U.S. solar PV capacity is expected to nearly triple over the next five years. By 2022, more than 18 GW of solar PV capacity will be installed annually.

- Source: http://mdvseia.org/solar-industry-news-mid-atlantic/?rkey=20170608DC11610&filter=9187

Solar Companies in Delaware



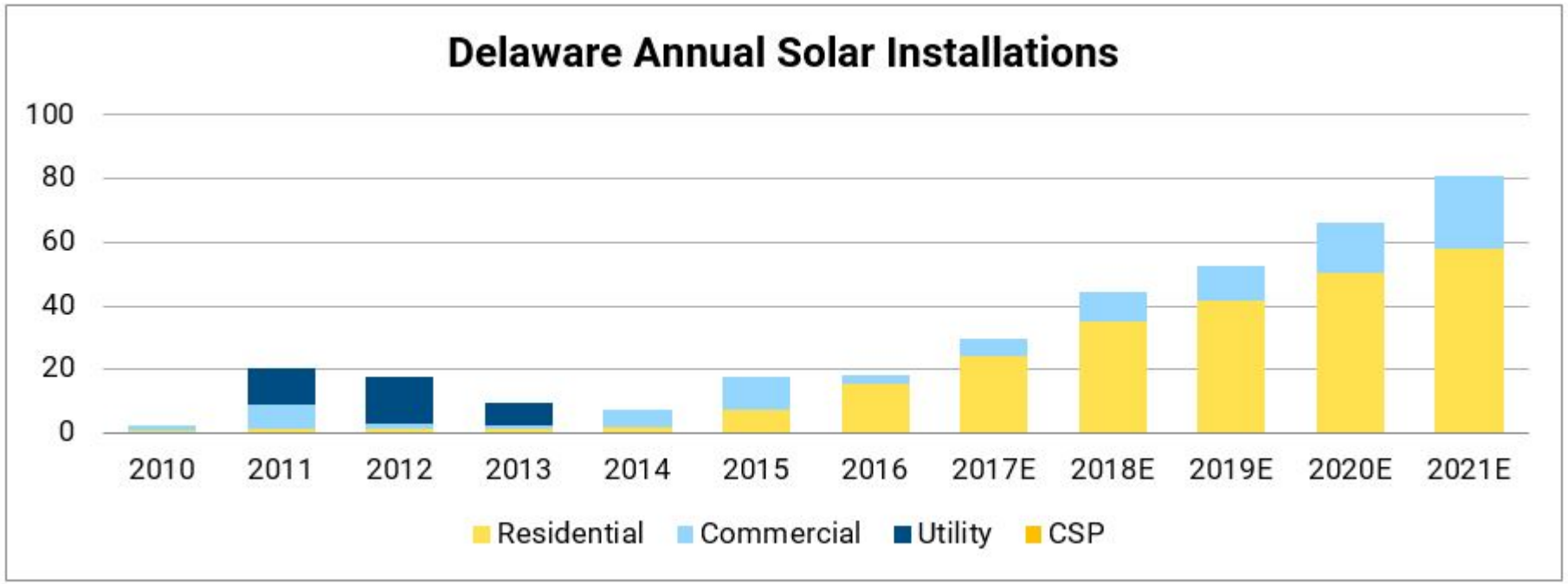
Key: Manufacturer Installer Other

Facts on the Delaware solar industry:

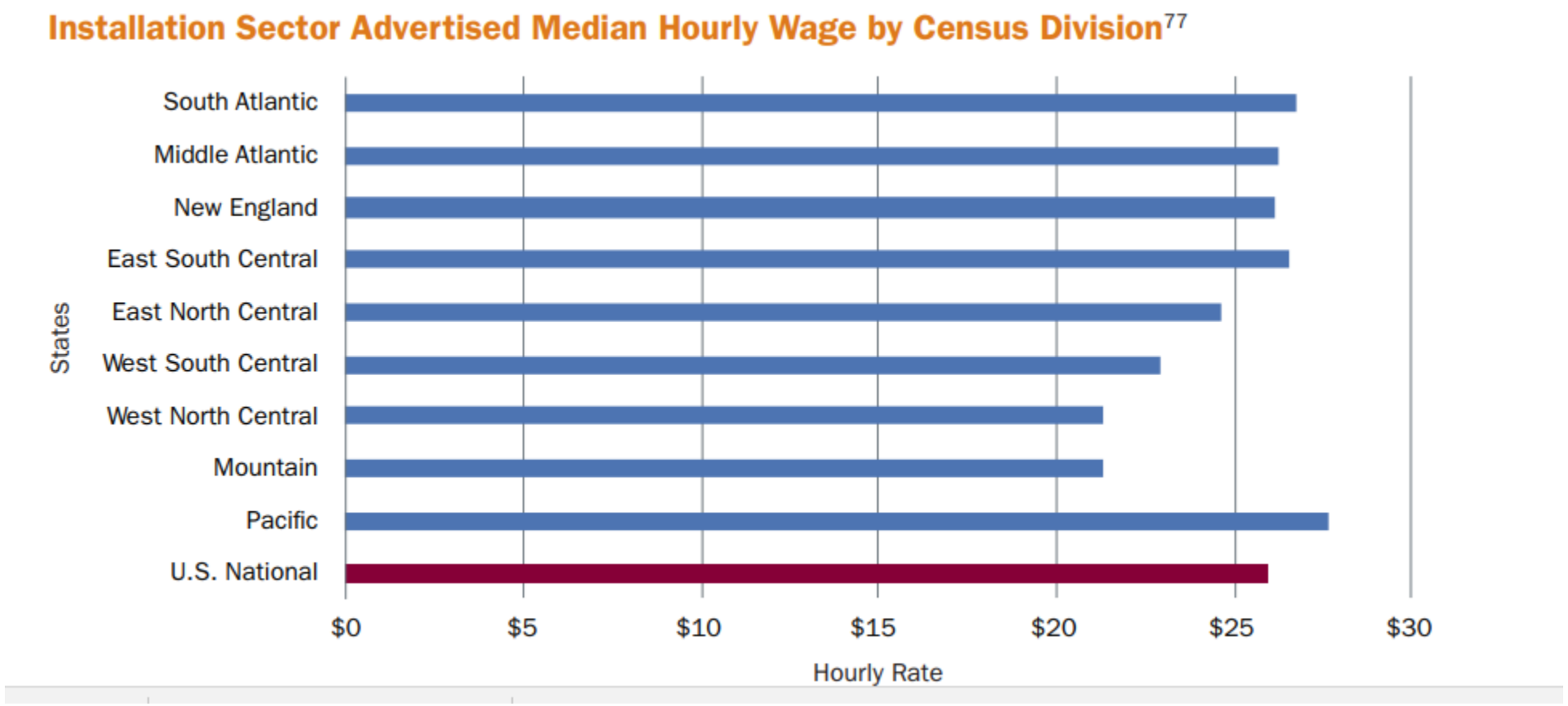
- Total solar installed: 99.4 megawatts (16.9 MW installed in 2016)
- State homes powered by solar: 11,000
- Percentage of state's electricity from solar: 1.61 percent
- Solar jobs and ranking: 363 (46th in 2016)
- Solar companies in state: 53 companies total; 8 manufacturers, 31 installers/ developers, 11 others
- Total solar investment in state: $323.38 million ($48.78 million in 2016)
- Price declines: 64 percent over past five years
- Growth projections and ranking: 271 megawatts over next 5 years (ranks 32nd)
- >$55 million in grants have been given to Delaware residents and businesses to help install solar power.

- http://www.delawareonline.com/story/news/2017/06/27/delaware-techs-solar-project-degree-programs-booming/423675001/

Delaware Solar Installations

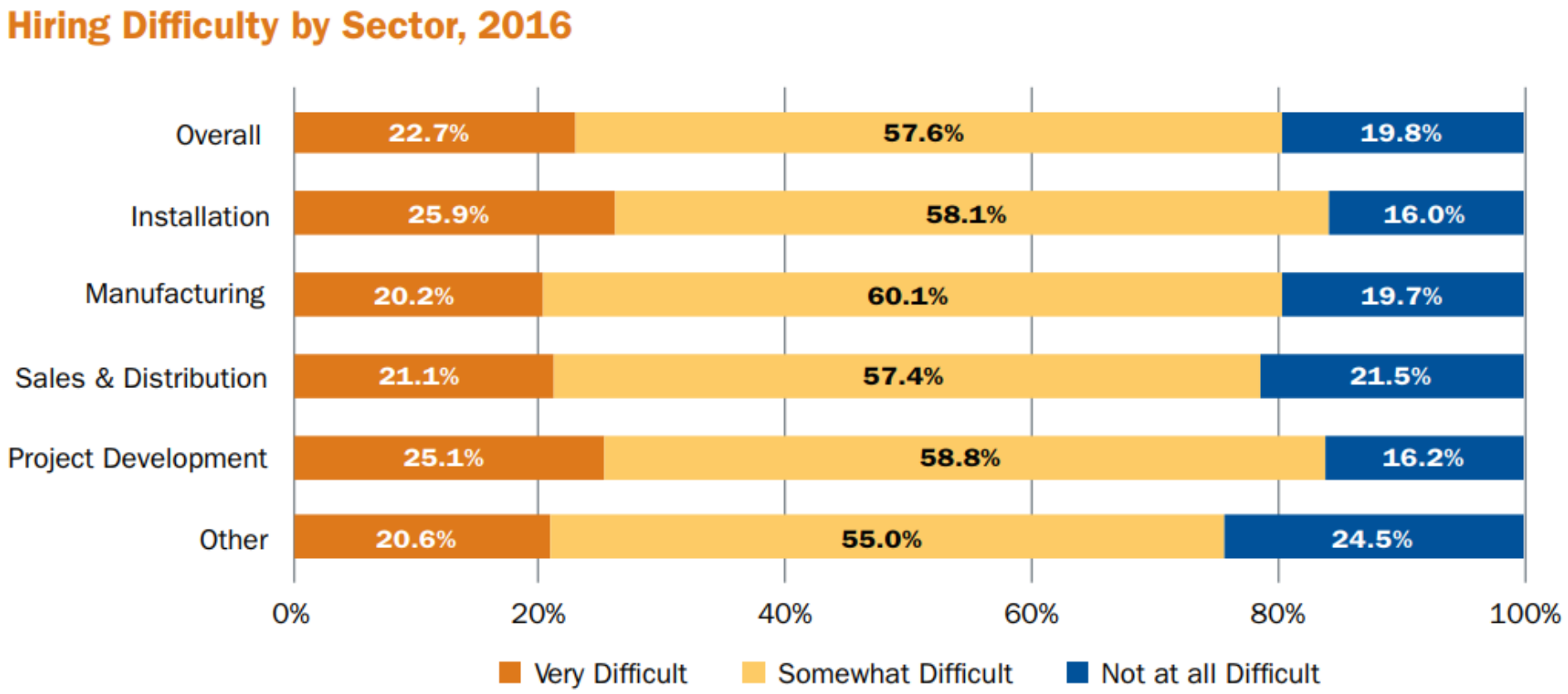


363 Solar Jobs in DE



SEIA website. US solar market insight. http://www.seia.org/research-resources/us-solar-market-insight

Solar Jobs > 260,000 Americans employed
25 % growth from 2015



SEIA website. US solar market insight. http://www.seia.org/research-resources/us-solar-market-insight

Education and Training

- DelTech programs included Energy Management, Renewable Energy Solar and Building Automation Systems (2 year program)
- The University of Delaware (UD) Wind Power Program (2003) conducts research, education, and outreach on wind power, with emphasis on coastal and offshore wind.
- The Graduate Certificate in Wind Power Science Engineering and Policy

LAND-BASED WIND ENERGY IN DELAWARE

- One utility-scale turbine (2MW) at UD campus
  - $6 million investment installed in 2010
  - Funds from federal gov't, UD, and Gamesa corporation
  - Tower height = 256 feet
  - Blade length = 144 feet
  - Until recently, not economically feasible
    - Except along the coast and in the ocean
    - Mainly due to the estimated low wind speeds

- Now manufacturers designed turbines to be deployed at higher hub heights (100m and higher) where wind speeds are greater.
  - Larger rotor diameters allows the turbines to produce significantly more energy at lower wind speeds.

Farming the wind

- Large wind turbines typically use less than half an acre of land, including access roads
- Farmers can continue to plant crops and graze livestock right up to the base of the turbines.

- How can farmers benefit?
  - farmers can lease land to wind developers
  - use the wind to generate power for their farms, or
  - become wind power producers themselves.
- Revenue Options:
  - a fixed annual lease payment,
  - a single up-front payment,
  - a share of revenues from a wind project, or
  - some combination of these.

Farmers and land rental rates

- Farmers can negotiate land rental rates with the developers or turbine companies (compensation varies)
- Typically, farmers are paid between $8,000 and $10,000 per turbine (assuming a 2MW size turbine)
- Another payment option is for leasees to be paid a royalty ($/MWh)
- Payments provide a stable supplement to a farmer's income, helping to counteract swings in commodity prices.

Source: Personal communication with developer. August 2017

Comparison of Summary Results

(based on their individual cashflow model outcomes)

Sussex County Sites	1A	1B	2A	2B	6
Number of Turbines	9	29	23	28	51
IRR (%)	8.92%	9.13%	8.39%	8.11%	3.22%
Payback Period (year of operation)	10	10	11	11	18

Reference: Firestone et. al (2017) In Press. Table 5.

Costs of Land-Based Wind (estimated)	IRR (%)	Pay-back Period (Yrs. of operation)
Base Case (25 year PPA, 100% down payment, 7% discount rate)	8.92	10
15 year PPA	6.79	10
Discount rate 10%	8.88	10
Discount rate 5%	8.95	10
O&M at $70/kW/year	7.87	11
Electricity at $.05/kWh	3.70	17
Electricity at $.10/kWh	11.27	9
REC price at $0	7.36	12
No price (electricity or REC) escalators	6.56	11
No price or cost escalators	7.18	11
REC price at $0; no escalators	5.44	13
50% debt, 15 years @ 6%, 25 year PPA	8.66	15
50% debt, 15 years @ 6%, 15 year PPA	4.65	15
Transmission at 3x national average	8.59	10
Power Production 25% greater	12.58	8

Reference: Firestone et. al (2017) In Press.

Table 6. Sensitivity Analysis Around Assumption in Cash-Flow Models for Site 1A.

Table 7. Levelized Cost of Electricity (LCOE) under differing assumptions

Case: Base Case and Variations	$/MWh
Base Case (25 year PPA, 100% down payment, 7% discount rate)	$69.95
20 year PPA	$74.83*
15 year PPA	$83.91*
10% discount rate	$82.74
5% discount rate	$61.90
O&M at $70/kW/year	$75.68
25% more production	$55.96
50% Debt Finance Case @ 6% interest rate	$76.25
50% Debt Finance Case @ 5% interest rate	$73.63

Reference: Firestone et. al (2017) In Press.

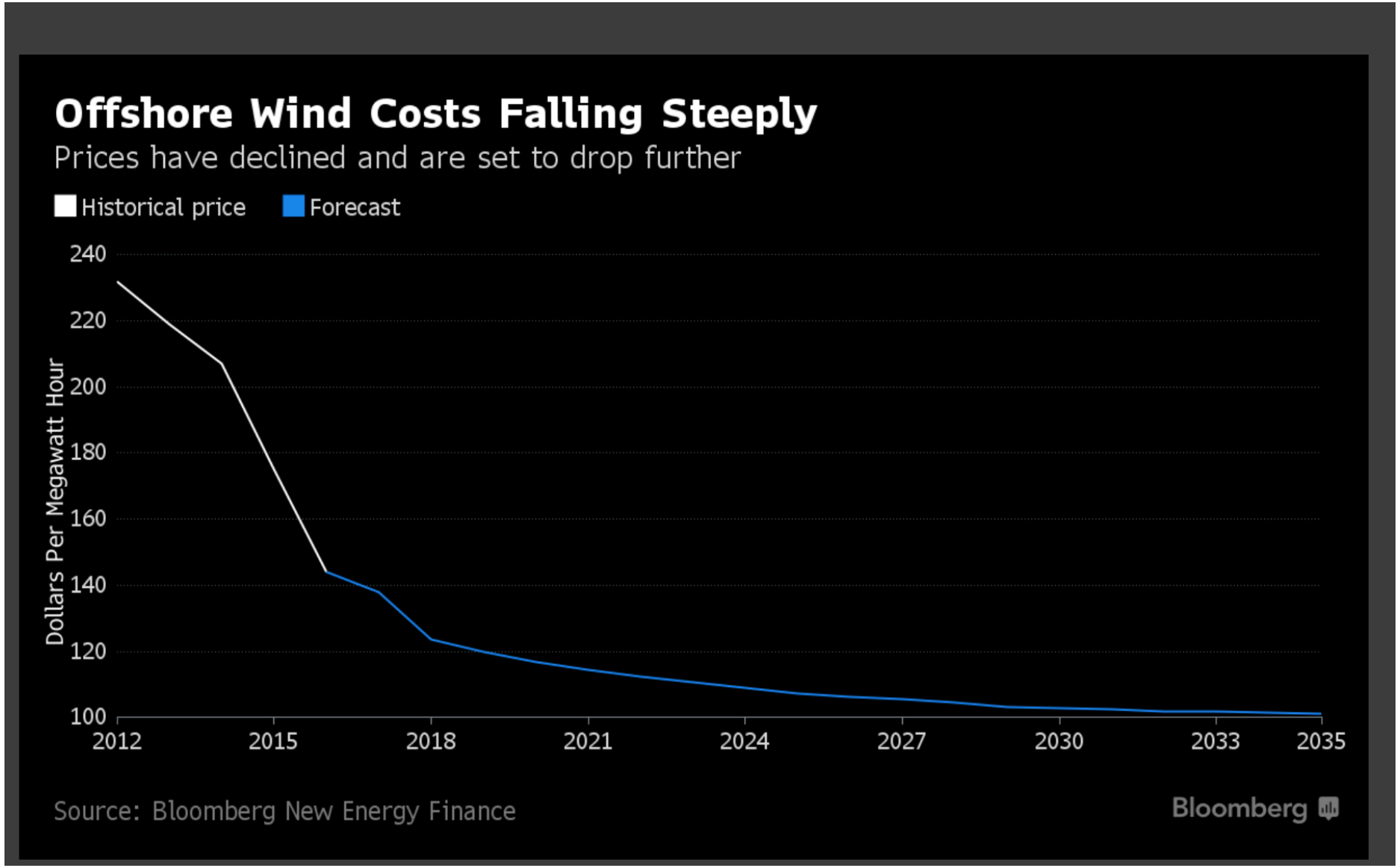
Table . Table 7. Levelized Cost of Electricity (LCOE) at site 1A under differing assumptions.

*Assumes project ceases operation after PPA term

What is needed to move forward with land-based wind

- Develop a wind map
  - Install equipment on existing tall tower or structure
  - Get 1-2 years of site specific wind resource assessment
- Discuss ideas with farmers and land owners
- Examine zoning and ordinances
- Assess environmental constraints/ conservation zones
- Involve the community – early and often

Offshore wind costs rapidly declining



Offshore wind costs

- First project installed in 2016 – Block Island (RI) 5 - 6MW GE turbines
- Across Europe, the price of building an offshore wind farm has fallen 46 percent in the last five years -- 22 percent last year alone.
- Offshore wind generation also tends to correlate with peak times for power demand – late afternoon and early evening – which helps grid operators balance declining solar output after sunset while weaning utilities off fossil fuel generation.

Maryland PSC Decision – May 2017 - Approves Offshore Renewable Energy Credits (ORECs) for two projects

- Deepwater Skipjack –120 MW in the DE WEA
  - Closest point est. 17 miles
  - Coming ashore in Ocean City in Nov 2022
  - Fifteen 8 MW turbines
  - 114 meter hub height and ~670 feet to tip of blade at apex
    - UD Lewes turbine is 404 feet to tip of blade)

- Deepwater Price: 20 year contract @ 2023 Price is $171.30/MWh rising 1%/year to $206.95 in 2042.
  - Levelized cost of $131.93 in 2012$

http://webapp.psc.state.md.us/newIntranet/casenum/CaseAction_new.cfm?CaseNumber=9431

Maryland PSC Decision (cont.)

- US Wind -248 MW in Maryland WEA
  - As far north as Fenwick Island)
  - **coming ashore in Indian River** (Jan 2020).
  - 4 or 6 MW turbines
- Utilities to buy ORECs per the state law

- Ratepayer Bill increase by 1.4% or $1.40/month.

http://webapp.psc.state.md.us/newIntranet/casenum/CaseAction_new.cfm?CaseNumber=9431

How can DE reap some of the potential benefits of this new energy?

- State actions related to Deepwater Wind Project (Skipjack)
  - Explore utility interest in purchasing offshore wind
  - Cable connect into DE grid
  - Restore 350% adder on RPS (expired in May 2017)
  - Potential port re-development in Wilmington
  - O&M support potential from coast

Possible next steps to spark economic development opportunities

- Assessing the market potential for new technologies in Sussex County
  - Establish a site specific wind resource assessment for agricultural lands
- Educate citizens and businesses about RE
- Understand and make available low interest loans to interested businesses and residences
- Understand better the availability of funds
  - state green energy funds available to the county
  - Low interest loans
  - RGGI funds
- Collaborate with utilities deploying RE
- Support state policies requiring installation of renewable energy

Proposed Action Items to Consider

- Land-Based Wind
  - Explore state funds for R&D to support wind measurement campaign
  - Work with UD extension service to identify interested farmers
  - Understand success stories in the region
- Offshore Wind off of DE Coast
  - State legislator action on RPS
  - Explore local benefits from constructions and operation
  - Consider tourism benefits and tradeoffs
- Solar
  - Evaluate municipal/community solar initiatives in the county

EXTRA SLIDES

Local Government action items

SOFT COSTS: WHAT LOCAL GOVERNMENTS CAN DO

LOCAL GOVERNMENTS

Example of actions that local governments can take to reduce soft costs include:

- Updating/Enforcing Rules & Regulations
  - Streamline the solar permitting and inspection processes
  - Implement solar-ready building codes
  - Enact or revise local solar access and solar rights provisions
- Leading By Example
  - Install solar on government buildings and schools; use these installations as educational tools
  - Incorporate solar into an energy savings performance contract
- Making Solar Affordable
  - Engage local lenders to offer low-interest loans for solar
  - Support community bulk purchasing programs
- Organizing Local Solar Efforts
  - Include solar in city, county, and regional planning efforts
  - Establish targets for local solar development
- Leading Customer Outreach & Education
  - Educate citizens about the benefits of solar energy and the options available to them

MUNICIPAL UTILITIES

Examples of effective actions municipal utilities may take include:

- Improving Utility Policies
  - Adopt net metering and interconnection policy best practices
  - Limit rate designs that provide a disincentive for solar; consider rate reform to institute rates that fairly value solar
- Offering Community Solar
  - Provide community solar as an option to customers, whether through a subscription or purchase program
- Provide Customers with Options
  - Consider offering a "value of solar" tariff alongside net metering
- Harmonizing Government & Utility Procedures
  - Update and coordinate processes across departments, such as permitting, inspection, and interconnection (PII)

To learn more about actions that local governments and municipal utilities can take to cut soft costs, check out the U.S. DOE's Solar Powering Your Community guide for local governments (http://www4.eere.energy.gov/solar/sunshot/resource_center/sites/default/files/solar-powering-your-community-guide-for-local-governments.pdf).

DEC rates

- To help gauge changes in our rates, from 2000 to 2008, DEC averaged an annual rate increase of about two-percent. From 2008 to the present, our rates have fallen one-percent. Our overall cost for power, including energy and distribution charges averages 11 cents per kilowatt-hour.

- https://www.delaware.coop/energy-saving-programs/solar-grants

Delaware
Sustainable Communities Planning Grant

- Planning Commission Chairman Dick Oliver presented information regarding the Delaware Sustainable Communities Planning Grant. Chairman Oliver asked Council to consider pledging the $8,000 or $10,000 match requirement in order for the Planning Commission to apply for the grant which would support the Phase 2 Sea Level Rise Study.
- After discussion, Mayor Voveris said that maybe this is something the Council should take a pass on at this time. No Councilmember made a motion in support of the commitment of an $8,000 or $10,000 match.

- From TOWN OF SOUTH BETHANY. TOWN COUNCIL . REGULAR MEETING MINUTES, MAY 12, 2017

Benefits from LBNL study (2017)

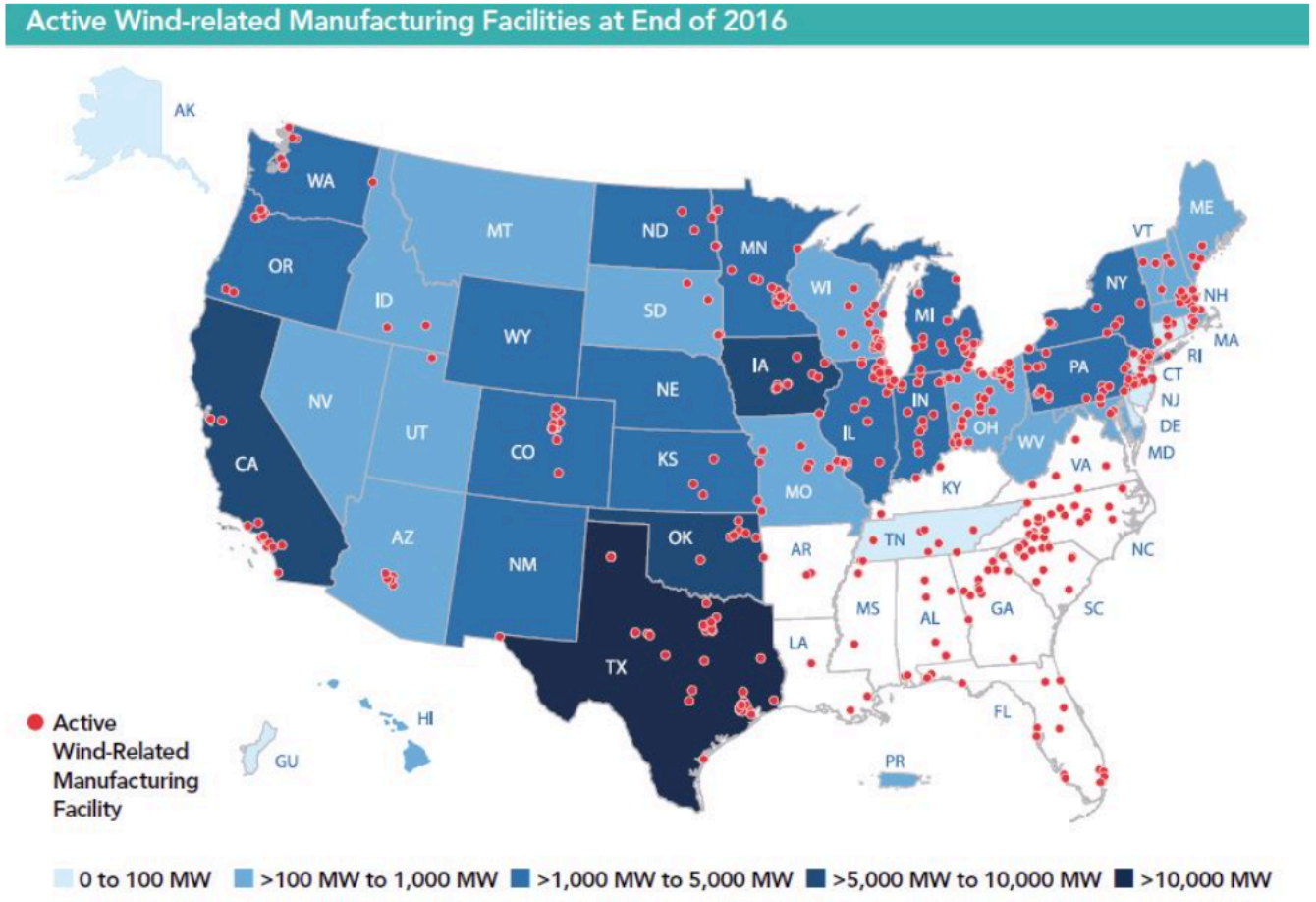
- Wind and solar energy provide air-quality, public health and greenhouse gas (GHG) emission benefits as they reduce the reliance on combustion-based electricity generation. In the United States these benefits vary dramatically by region and over time. In the last decade, wind and solar deployment has increased more rapidly than any other non-combustion-based electricity-generating technology; at the same time, regulatory changes and fossil fuel price changes have led to steep cuts in overall power-sector emissions of criteria air pollutants and CO 2 . These changes prompt the question: have wind and solar energy benefits changed over time?

- “In 2015, combined air quality and climate benefits equaled 14.3 ¢/kwh-of-wind in the Mid-Atlantic region.”

American Wind Energy Association (AWEA) 2016 Wind Business

- According AWEA, at the end of 2016 more than 18,300 MW of wind capacity are under construction or in advanced development. In 2017, uncertainty lingers around implementation of the federal Clean Power Plan, the wider role of energy in addressing climate change, state renewable portfolio standards, net metering, and other state-based incentives.

Manufacturing facilities in the USA



Source: AWEA U.S. Wind Industry Annual Market Report 2016

Europe adds 6.1 GW of wind energy capacity in Q1 2017

- 6.1 GW of extra wind energy capacity was installed in Europe in the first half of 2017, according to figures released today by Wind Europe. The figure puts Europe on course for a bumper year for installations, although hides some worrying trends.
- A total of 4.8 GW of onshore wind capacity was installed in the first half of 2017, although it was heavily concentrated in Germany (2.2 GW), UK (1.2 GW) and France (492 MW).
- There has also been a flurry of activity in offshore wind: 18 projects in four EU Member States (Germany, UK, Belgium and Finland), which saw a total of 1.3 GW installed

Solar Installations

- DelTech Community College celebrated the end of its $7 million energy project
- Milford Solar Farm, completed in 2013 with the capacity to generate 15 megawatts of electricity, enough to power nearly 1,600 Delaware homes.
- That photovoltaic project run by Delaware Municipal Electric Corp. is the biggest solar installation in the state, according to the Solar Energy Industries Association.

LEWES BATTERY STORAGE

- The coastal city will get an eight-megawatt energy storage system produced by Alevo Group, a Swiss energy storage provider that opened a manufacturing plant in North Carolina in 2014. Alevo Group announced the installation, with Lewes as the young company's first announced customer for its GridBanks batteries.
- "The Lewes Board of Public Works has high expectations for the Alevo batteries," Lewes's mayor, Ted Becker, said in a statement. "The installation of the 8 megawatt battery will provide a significant tool to manage our capacity charges, our peak demands and transmission charges, and we anticipate it to be a boon for the citizens of Lewes."
- http://www.delawareonline.com/story/news/local/2016/03/22/lewes-adds-energy-storage-grid/82113674/