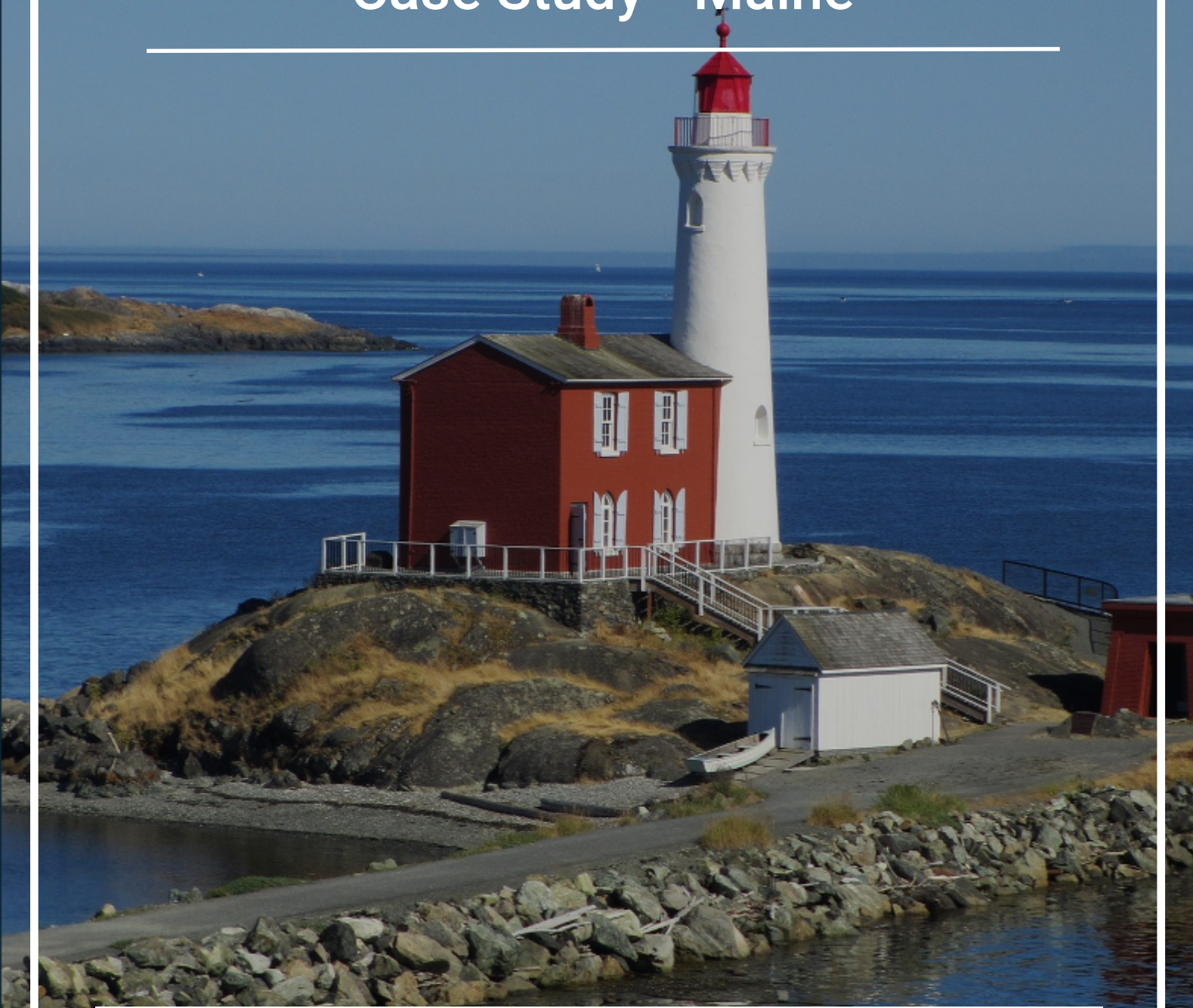
US Green Economy Report Series

Case Study - Maine



UK Government

CLIMATE ADVISERS

UNIVERSITY OF MARYLAND 1856

SCHOOL OF PUBLIC POLICY

CENTER FOR GLOBAL SUSTAINABILITY

Maine State Profile

Maine has increased renewables penetration for more than two decades and has significantly increased its ambition on climate change in the past couple of years. Based on legislation Governor Janet Mills signed into law in 2019, Maine is targeting 80 percent renewables in its electricity sector by 2030, with a goal of 100 percent by 2050. Also in 2019, Governor Mills signed legislation that established the Maine Climate Council, a group of a wide variety of stakeholders that put together a plan, released in December 2020 and to be updated every four years, to meet the state's emissions-reduction targets of 45 percent under 1990 levels by 2030 and 80 percent by 2050. According to an executive order signed by Governor Mills, the state is aiming to be carbon neutral by 2045. Governor Mills has been the leader in pushing for climate action, and she has been helped by the Democratic-run legislature, along with bipartisan support, which bodes well for implementation of the state's climate plan. The vulnerability of the state's coast to climate change threats has also contributed to the urgency for climate action. Maine is a member of the US Climate Alliance and the Regional Greenhouse Gas Initiative (RGGI), a market-based programme to reduce emissions in the power sector.

MAINE STATE GOALS

100%

of renewable electricity by 2050

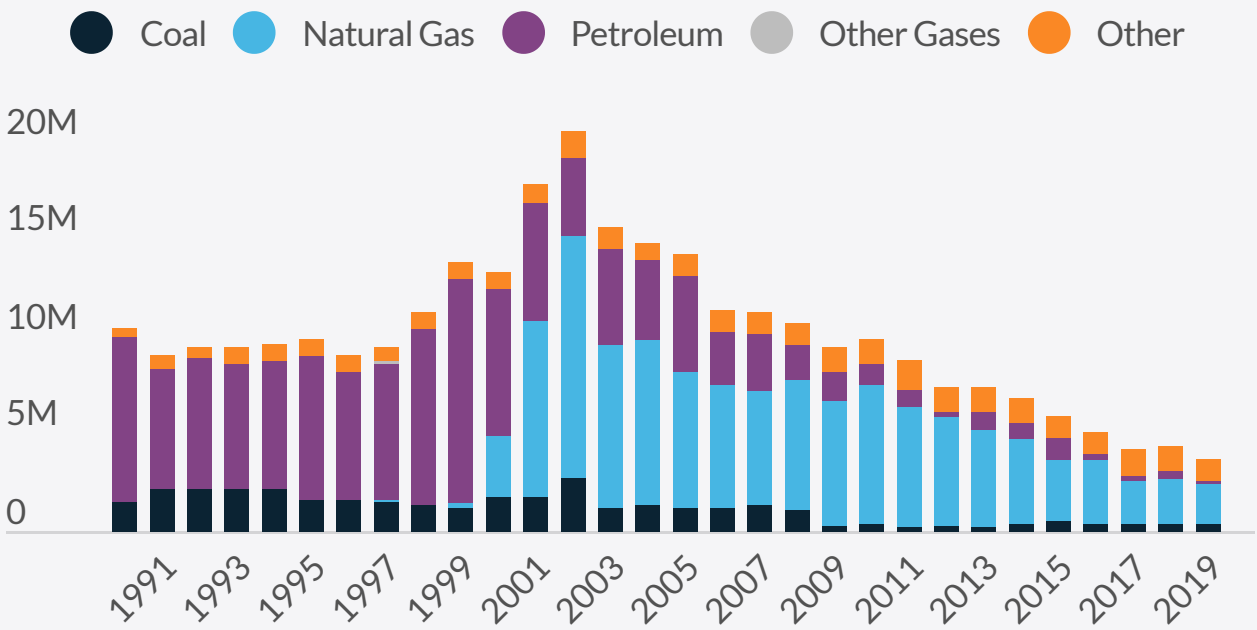
5,000 MW

of wind power from offshore and coastal by 2030

45%

of greenhouse gas emissions below 1990 levels by 2030 and 80% by 2050

ENERGY-RELATED GREENHOUSE GAS EMISSIONS



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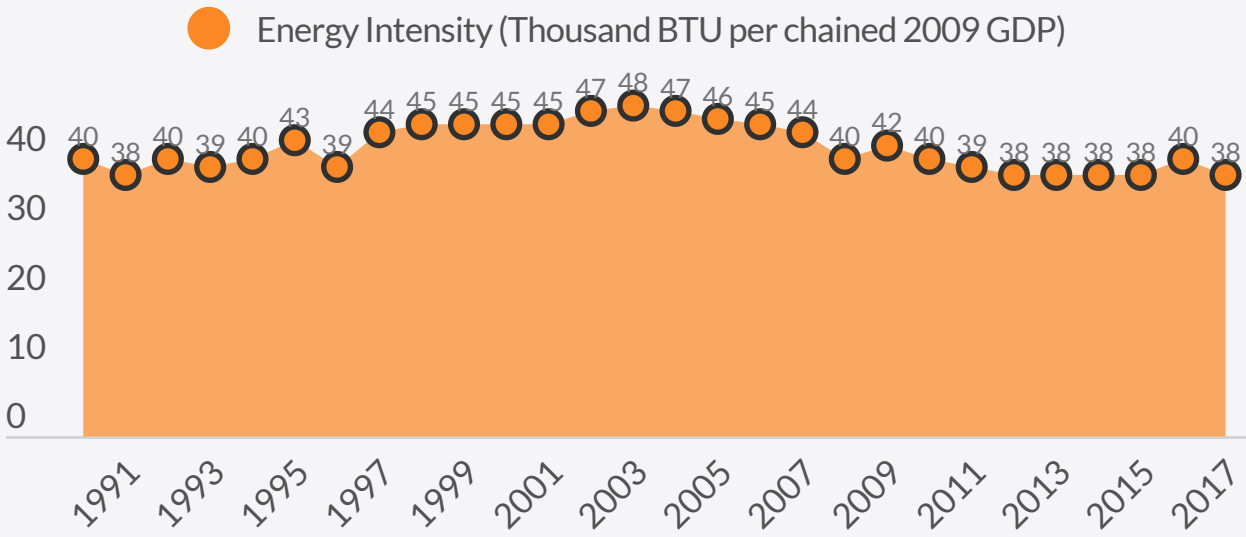
Carbon Dioxide emissions over time by energy generation source, according to the Energy Information Administration. Note: other includes non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies; other Gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

ENERGY INTENSITY OVER TIME



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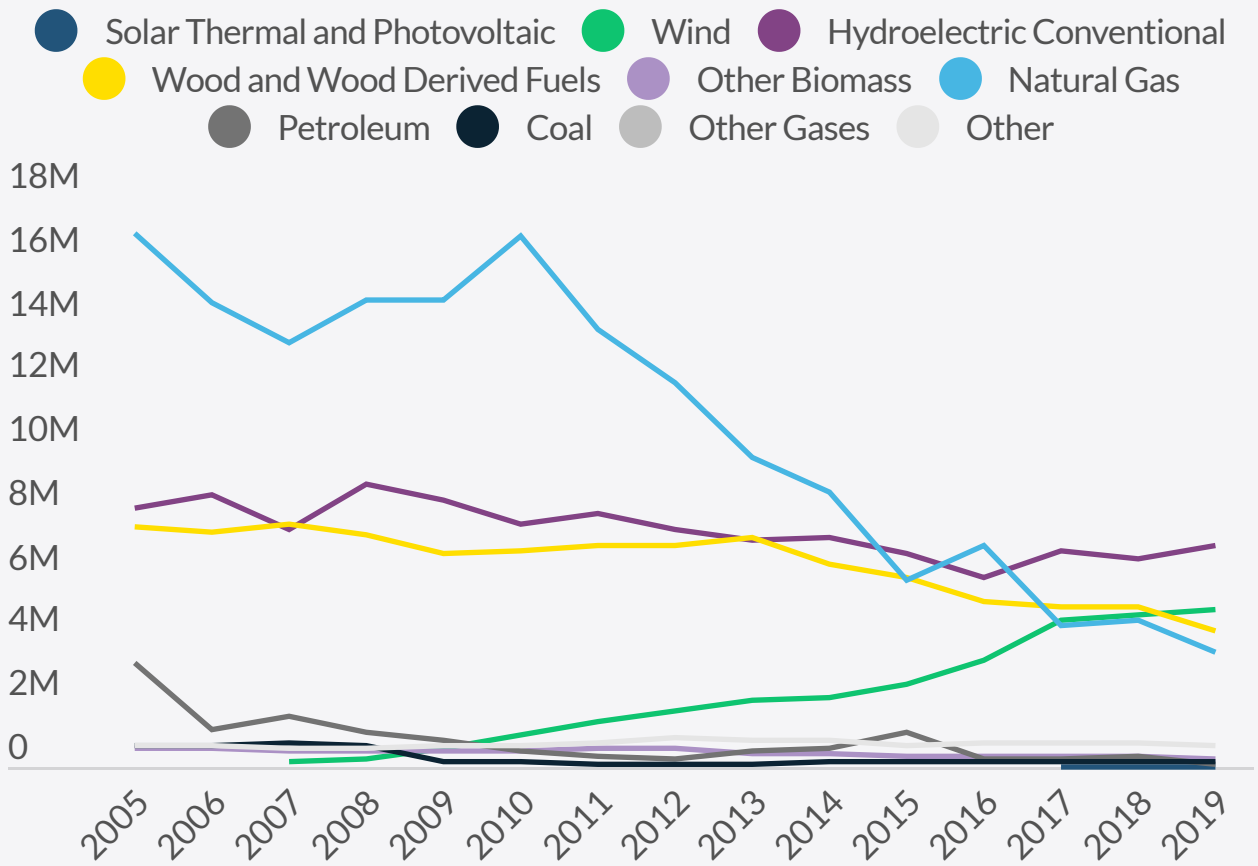
Source: Energy Information Administration

ELECTRICITY GENERATION BY SOURCE



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Generation over time, according to the Energy Information Administration. Note: other includes non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies; other Gases includes blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

ENERGY FACTS AND FIGURES

ENERGY LOSSES	64,143	BBTU
ELECTRICITY PRICES	39.38	USD per MBTU
ENERGY PER GDP	6.82	Thousand BTU per 2012 USD
CONSUMPTION PER CAPITA	292.80	MBTU
NET-INTERSTATE FLOW	3,721	BBTU

Facts and figures, according to the Energy Information Administration. Note: negative net interstate flow of electricity and associated losses indicates flow out of state.

MAINE'S LARGEST GENERATING PLANTS

Largest generation facilities by capacity, according to the Energy Information Administration

827 MW

Petroleum: William F Wyman Hybrid

254 MW

Natural gas: Rumford Power LLC

538 MW

Natural gas: Westbrook Energy Center Power Plant

186 MW

Wind: Bingham Wind

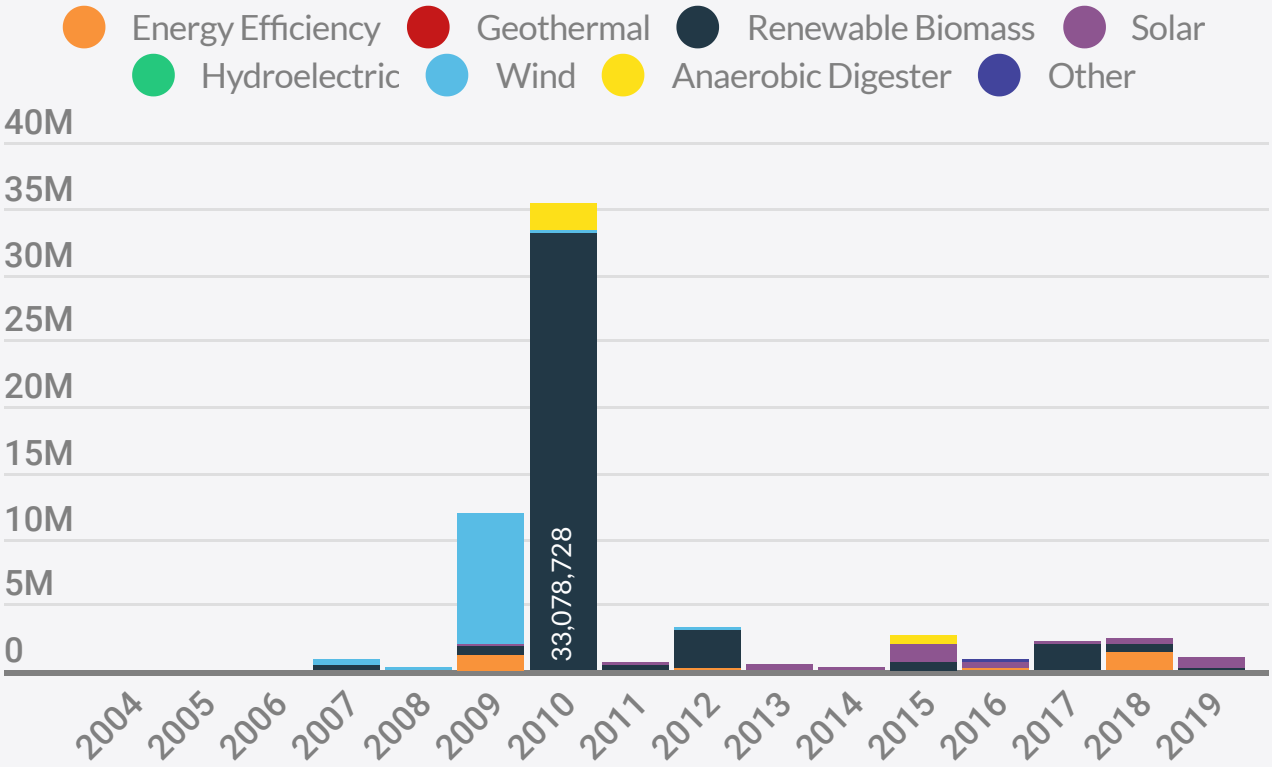
490 MW

Natural gas: Casco Bay Energy Co LLC

178 MW

Natural gas: Bucksport Generation LLC

PUBLIC INVESTMENT BY GENERATION TYPE (DOA)



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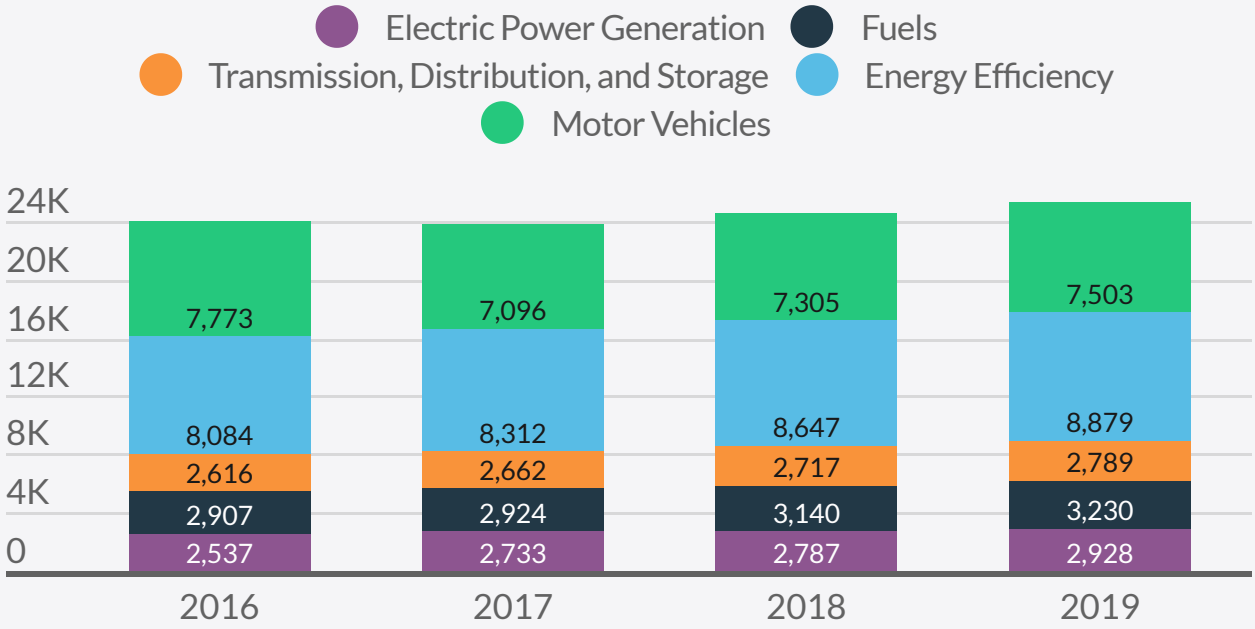
Public investment by energy type from 2002 to 2020, according to the United States Department of Agriculture. Data includes all investments made through Department of Agriculture programs.

TRADITIONAL ENERGY SECTOR JOBS



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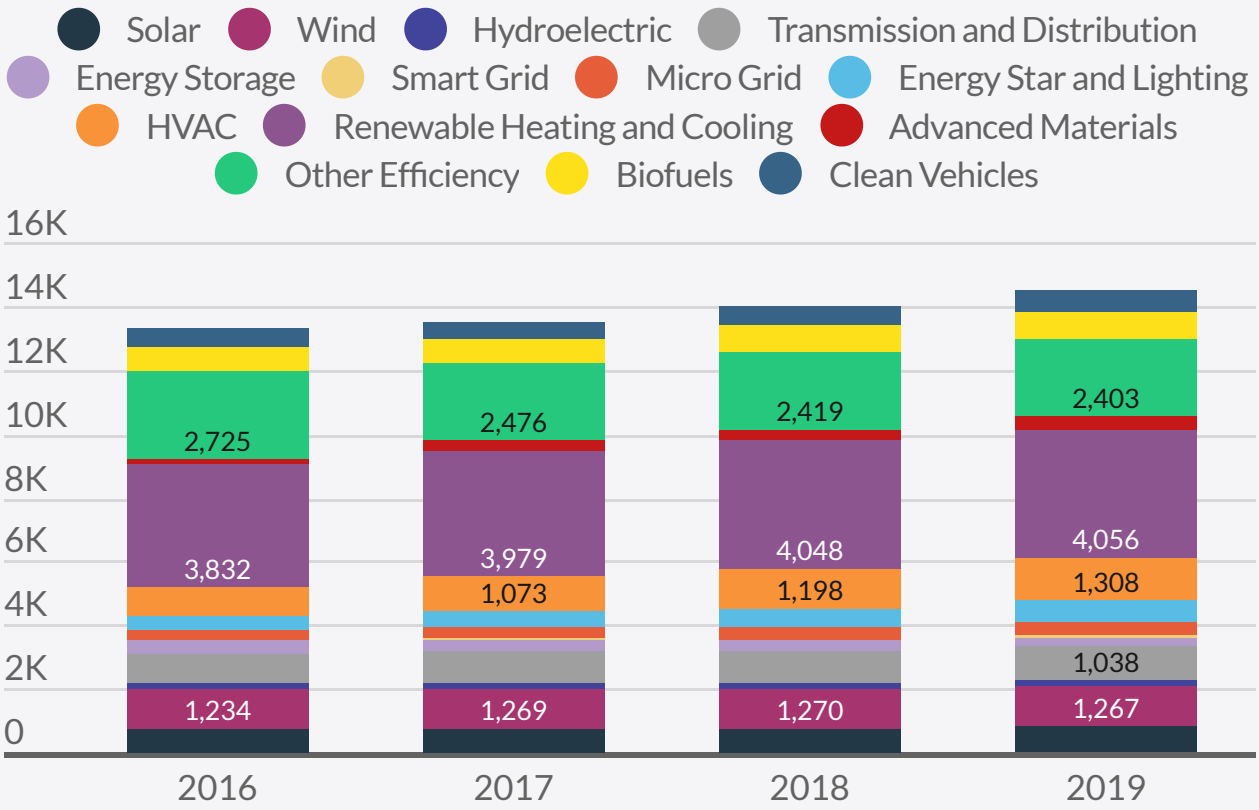
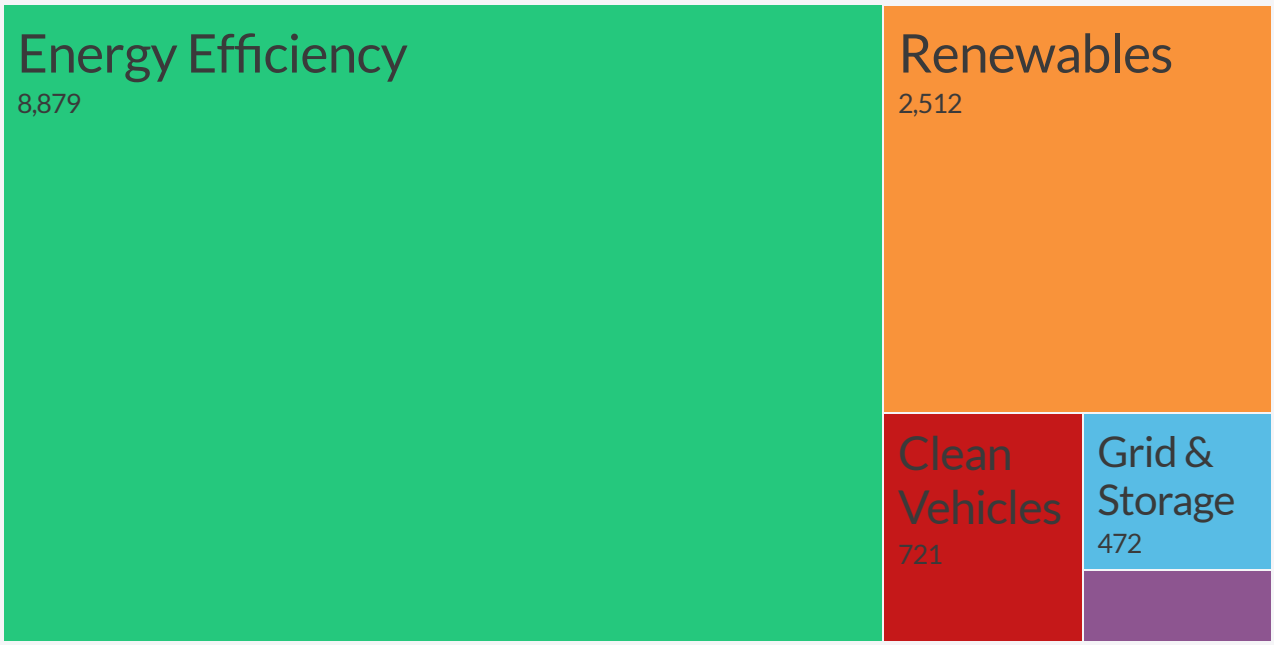
Traditional energy sector jobs over time, according the United States Energy and Employment Report (USEER).

CLEAN ENERGY JOBS BY TYPE



Clean energy jobs over time by type, according to the USEER. See Appendix for definitions and methodology.

OVERVIEW OF CLEAN ENERGY JOBS BY CATEGORY



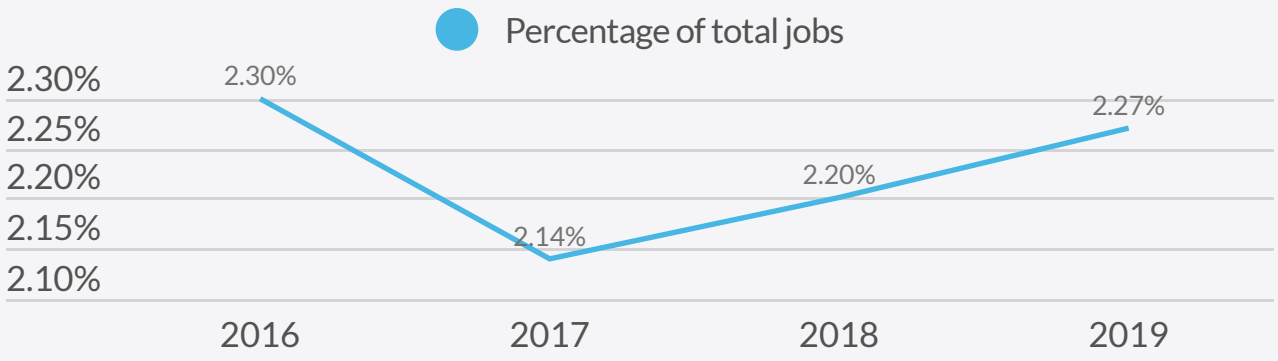
Clean energy jobs over time by technology, according to E2 Clean Jobs America.

CLEAN ENERGY COMPENSATION

Average state clean energy wage	$18.22
Percent above/below median state wage	(1.4)%
#1 most difficult to hire occupation	Technician or mechanical support
#2 most difficult to hire occupation	Electrician/construction workers

Clean energy jobs compensation and hiring, according to E2 Clean Jobs America and the USEER.

CLEAN ENERGY JOBS AS PERCENTAGE OF OVERALL JOBS



Clean energy jobs as a percentage of Bureau of Labor Statistics employment total numbers.

OFFSHORE WIND

With some of the highest sustained wind speeds in the world, the Outer Continental Shelf (OCS) of the Gulf of Maine offers ample opportunities for offshore wind farm siting. Because the OCS drops steeply, wind energy in the Gulf of Maine will likely come from floating offshore wind turbines that do not require fixed installations on the seafloor. In June 2019, Governor Mills announced the state's plan for the 12-MW New England Aqua Ventus (NEAV) floating offshore wind demonstration project, located south of Monhegan Island. NEAV will likely be the first full-scale floating wind project in the nation, if approved by the Bureau of Ocean and Energy Management (BOEM). The data collected and lessons learned from the NEAV project will be applied to a potential 500-MW commercial project. Mitsubishi-owned Diamond Offshore Wind and RWE Renewables have formed a joint venture to own and manage the permitting, construction, deployment and operation of the NEAV project. The project is expected to be worth $100 million, with construction beginning in 2021 and operation by 2022. The University of Maine's Advanced Structures and Composites Center will play a leading role in design and engineering, research and development and post-construction monitoring of the floating turbines.

To balance the development of Maine's offshore wind industry with the state's maritime heritage and existing marine uses, Governor Mills launched the Maine Offshore Wind Initiative in 2019. In October 2020, the US Economic Development Administration (EDA) awarded a $2.166 million grant to the Governor's Energy Office (GEO) to develop a roadmap to advance the offshore wind industry in Maine. The roadmap will examine the economic and environmental impacts of manufacturing processes, supply chains, port facilities, workforce development, power interconnection and transportation systems in establishing a floating offshore wind industry. Maine and the UK have signed a Memorandum of Understanding to cooperate on the development of offshore wind, which aims to increase clean energy jobs and strengthen collaboration on technology and data.

Key Players: Mitsubishi Corporation, RWE Renewables, Central Maine Power, Cianbro Corporation, New England Aqua Ventus, LLC, Maine Offshore Wind Initiative, Bureau of Ocean and Energy Management Gulf of Maine Task Force, University of Maine's Advanced Structures and Composites Center, Island Institute, 25x25 Alliance, Clean Energy States Alliance, Environmental and Energy Technology Council of Maine

913%

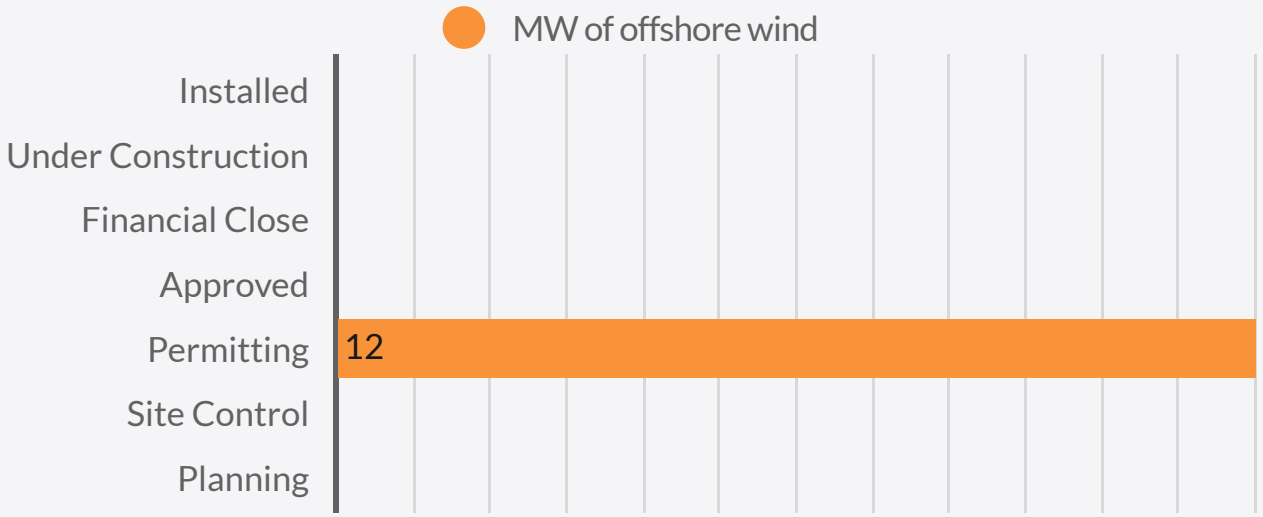
Of electricity generation potentially supplied by wind

38,900 MW

Of offshore wind economically recoverable

Offshore wind potential based on data from Oceana.

OFFSHORE WIND PROJECT PIPELINE STATUS



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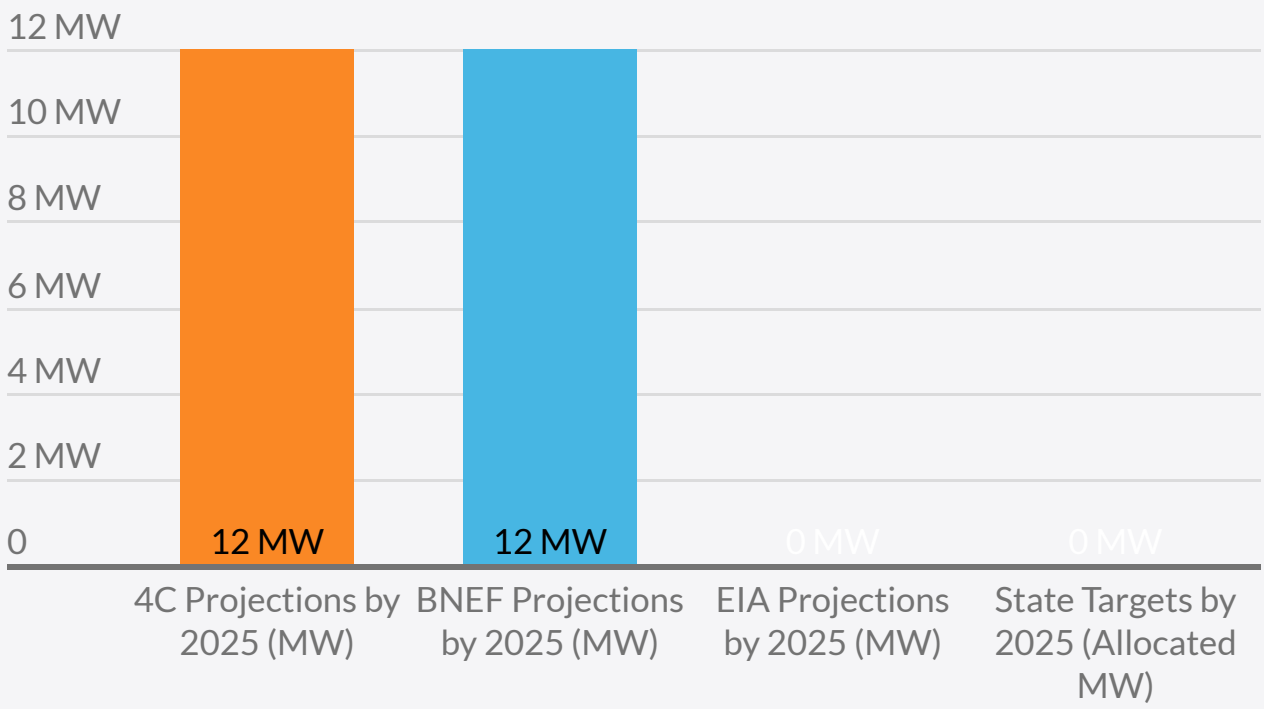
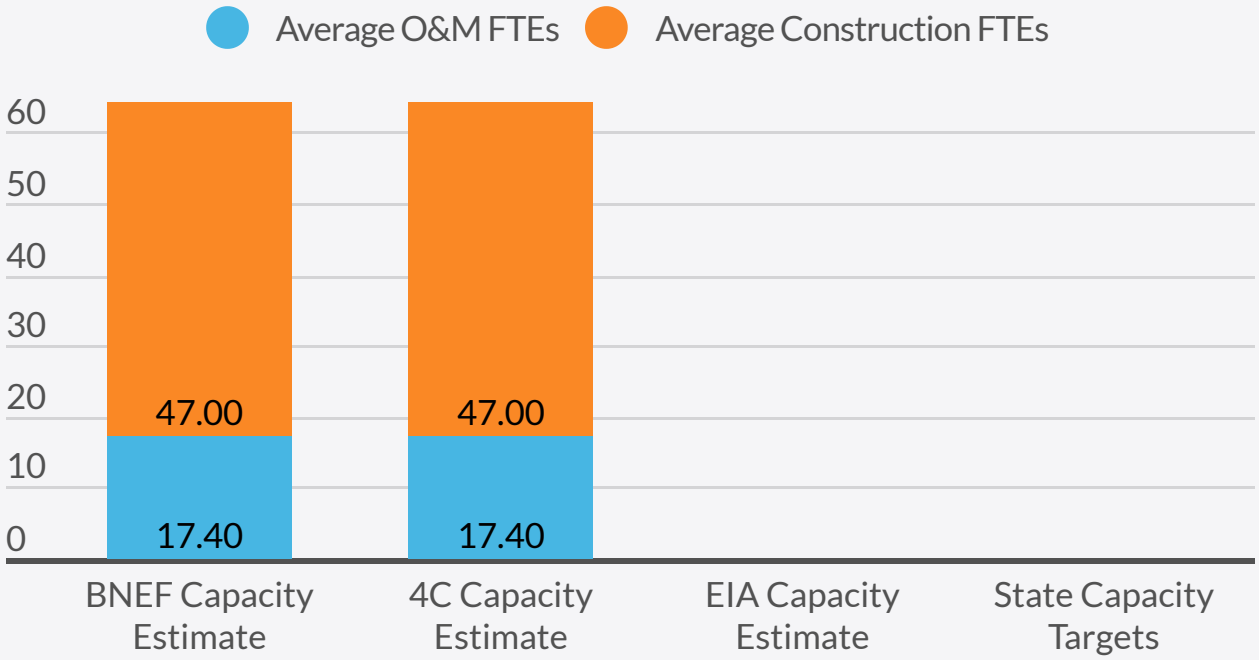
Offshore wind pipeline sourced from the Office of Energy Efficiency and Renewable Energy 2018 Wind Technologies Market Report.

OFFSHORE WIND PROJECTED PROJECT PIPELINE TO 2025



Pipeline based on 4C Offshore , BloombergNEF, the EIA and state procurement target announcements. Data available in the Office of Energy Efficiency and Renewable Energy 2018 Wind Technologies Market Report and the EIA.

PROJECTED OFFSHORE WIND FTE ADDITIONS BY 2025



Methodology: Average FTEs between 2020 and 2020 based on MW estimates per year from BNEF, 4C Offshore, the EIA and announced state targets, along with jobs per MW assumptions from the NREL. Additional details can be found in the Appendix

GREEN CONSULTANCY

In Maine, there are currently 450 environmental consultants employed, earning an average salary of $53,240. Maine’s renewable energy consultancy sector should see growth as a result of the state’s renewable energy potential of 2,152,079 GWh, driven primarily by rural utility-scale PV and offshore wind.

Key proposed projects in the state include a solar PV facility to be run by Three Rivers Solar Power and an onshore wind turbine project proposed by Longroad Energy Services. Given the state’s aggressive policies, particularly in offshore wind, Climate Advisers expects Maine's green consulting sector to grow above the national average of about 11 percent (from 2016 to 2026).

ELECTRIC VEHICLES

Maine is ranked 17th according to the ACEEE EV Scorecard. The state's headline initiative is a rebate of up to $3,000 for the purchase or lease of certain types of EVs, and the backbone of EV policy is the ZEV Sales Requirements, which requires that 22 percent of all vehicles sold in the state be ZEVs by 2025. In addition, Governor Mills has supported the electrification of buses, and a proposed bill in the state legislature, introduced last year, aimed to transition the state's school buses to all-electric by 2040. EVs accounted for 1.13 percent of vehicle sales in Maine in 2018, and there are 750 EVs and 233 charging stations in the state. The outlook for EVs in the state is mixed – despite its initiatives to bolster purchases of EVs, the issue remains politically contentious in Maine. The state's efforts lag behind many of the initiatives and incentives that other states in New England have in place, but the Maine Climate Coalition, which recently advocated for expanding EV uptake through incentives and grants, developing a roadmap and building charging infrastructure in a recent report, has indicated that increasing EV use is a priority in decarbonizing the state's transportation sector.

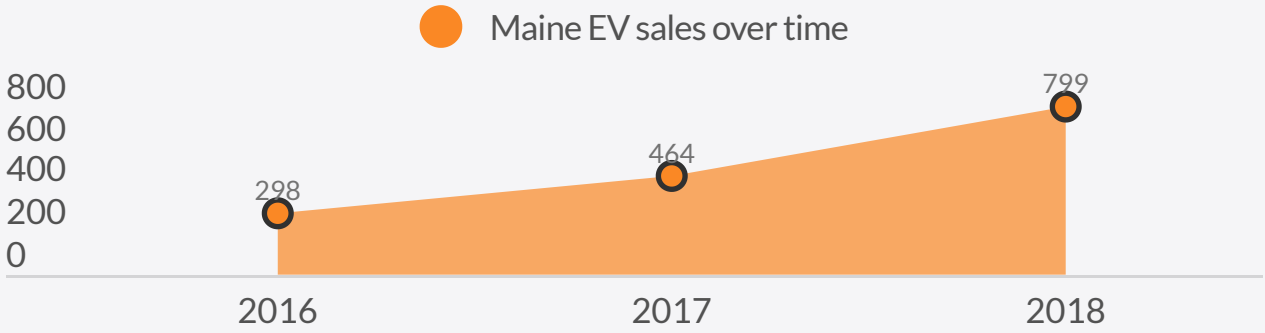
Key Players: Efficiency Maine, ZEV Program Implementation Task Force

ELECTRIC VEHICLE FACTS AND FIGURES

National rank based on EV sales	32
Percentage of national EV sales	0.3%
Market share within state	1.1%
Market share within state (year over year growth)	41%
EV sales as a percentage of motor vehicle sales	0.4%
Number of people per charging station	9,611
Number of people per charging station (rank)	10
EV Fuel Cost per eGallon (2018)	$1.48
EV Fuel Cost per eGallon (% above/below national average)	17%
Fuel cost savings per gallon versus gasoline	$1.38
Most popular EV (search volume)	Chevy Bolt

Electric vehicle quick facts based on data from EVAdoption.

ELECTRIC VEHICLE SALES OVER TIME



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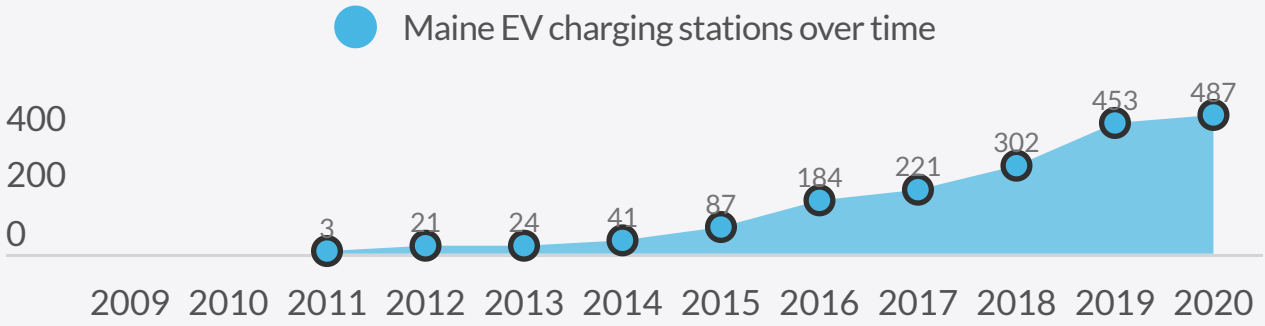
Electric vehicle sales over time, according to EVAdoption.

ELECTRIC VEHICLE CHARGING STATIONS OVER TIME



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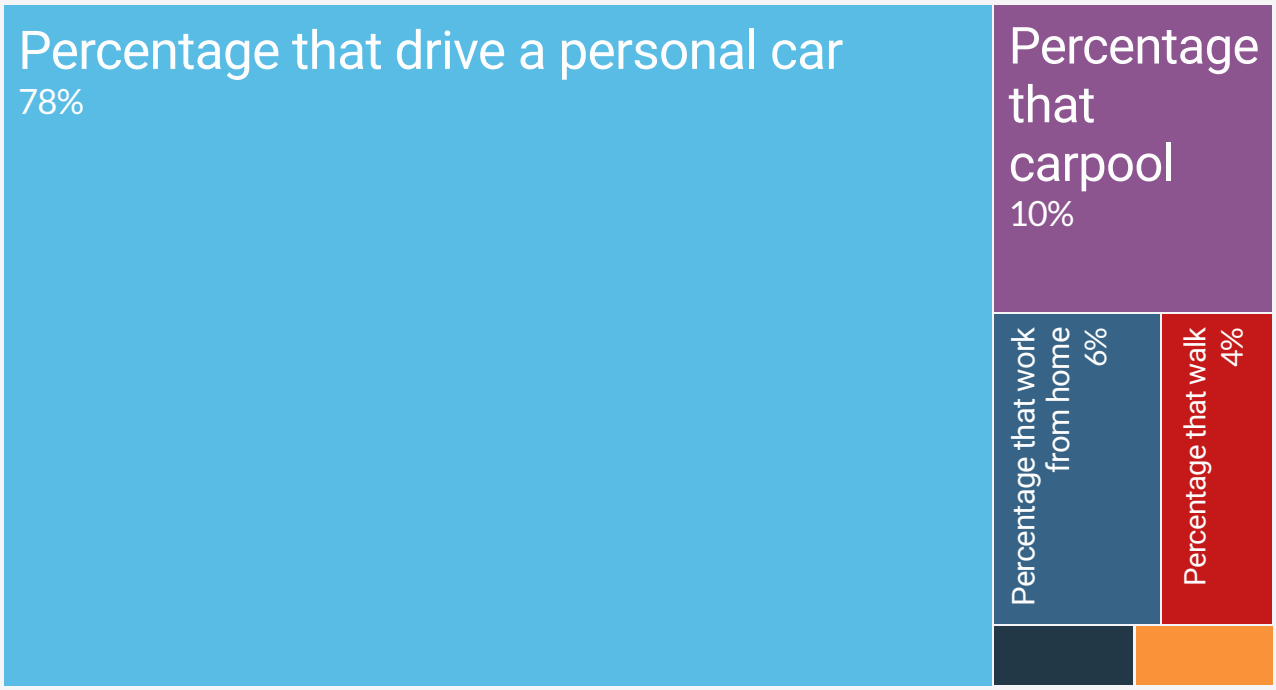
Charging stations over time, according to the United States Department of Energy's Alternative Fuels Data Center.

ELECTRIC VEHICLE LAWS AND INCENTIVES

	Strength	Number	Compared to National Average
Number of EV laws & incentives	Medium	9	-39%
Number of HEV laws & incentives	Low	0	-100%
Number of PHEV laws & incentives	Medium	9	-32%
Number of NEV laws & incentives	High	2	92%
Number of fuel economy/efficiency laws & incentives	High	2	73%

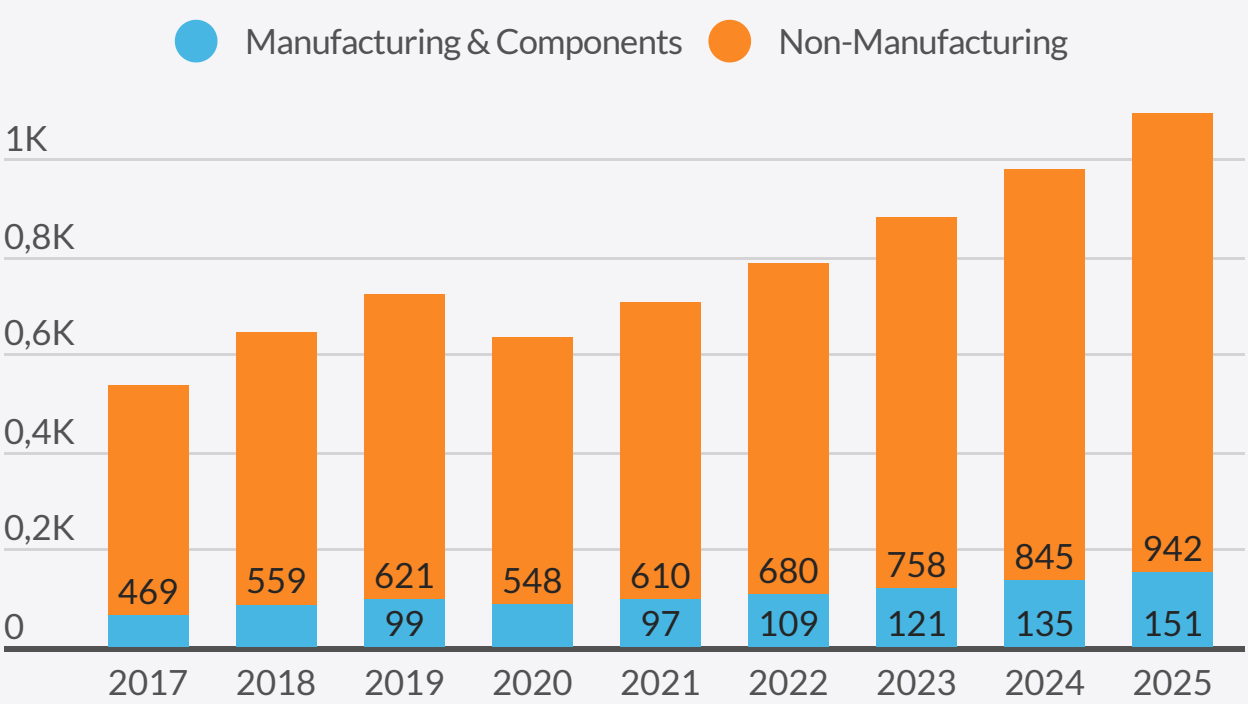
Quantity of state laws and incentives on electric vehicles, in comparison to national average, according to the Alternative Fuels Data Center.

PROFILE OF A MAINE COMMUTER



State commuter dynamics, according to the United States Department of Commerce, Bureau of Census.

PROJECTED CLEAN VEHICLE JOBS (2020-2025)



Methodology: Percentage of manufacturing jobs by state (NAICS codes 3361,3362,3363) of total motor vehicle jobs was applied to total clean vehicle jobs by state (E2) to determine the break down. Forecast based on projected clean vehicles miles travelled. More detail in the Appendix.

ENERGY EFFICIENCY

Maine is ranked 16th on ACEEE's 2020 State Energy Efficiency Scorecard, reflecting the state's prioritisation of improving energy efficiency. The state has 21 financial incentives for energy efficiency, including the Advance Building Program, the Low Income Heat Pump Initiative and the Commercial and Industrial Custom Program. Governor Mills' heat pump initiative, signed into law last year, aims to install 100,000 heat pumps in Maine homes and businesses by 2025. Maine has RGGI-funded energy efficiency programmes, and the state accounts for the avoided costs of carbon of every KWh saved through energy efficiency programmes in its annual RGGI reports. Maine has mandatory building energy disclosure policies for residential rentals, pursuant to H.P. 1468. The state also requires that construction and renovation of state buildings follow green building standards. Executive Order 13, signed in 2019, calls for the creation of a committee for sustainable leadership to establish an energy efficiency and GHG emissions baseline from state operations by February 2021. The state is required to report annual energy usage, sources and GHG emissions to the governor, the legislature and the public every two years thereafter. To promote the advancement of energy efficiency technologies, the Maine Technology Institute (MTI) is investing in R&D projects.

Key Players: Efficiency Maine, Northeast Energy Efficiency Partnerships (NEEP)

ENERGY EFFICIENCY RANKINGS BY CATEGORY

16

Energy Efficiency Rank

16

Utilities Rank

7

Government Rank

11

Transportation Rank

32

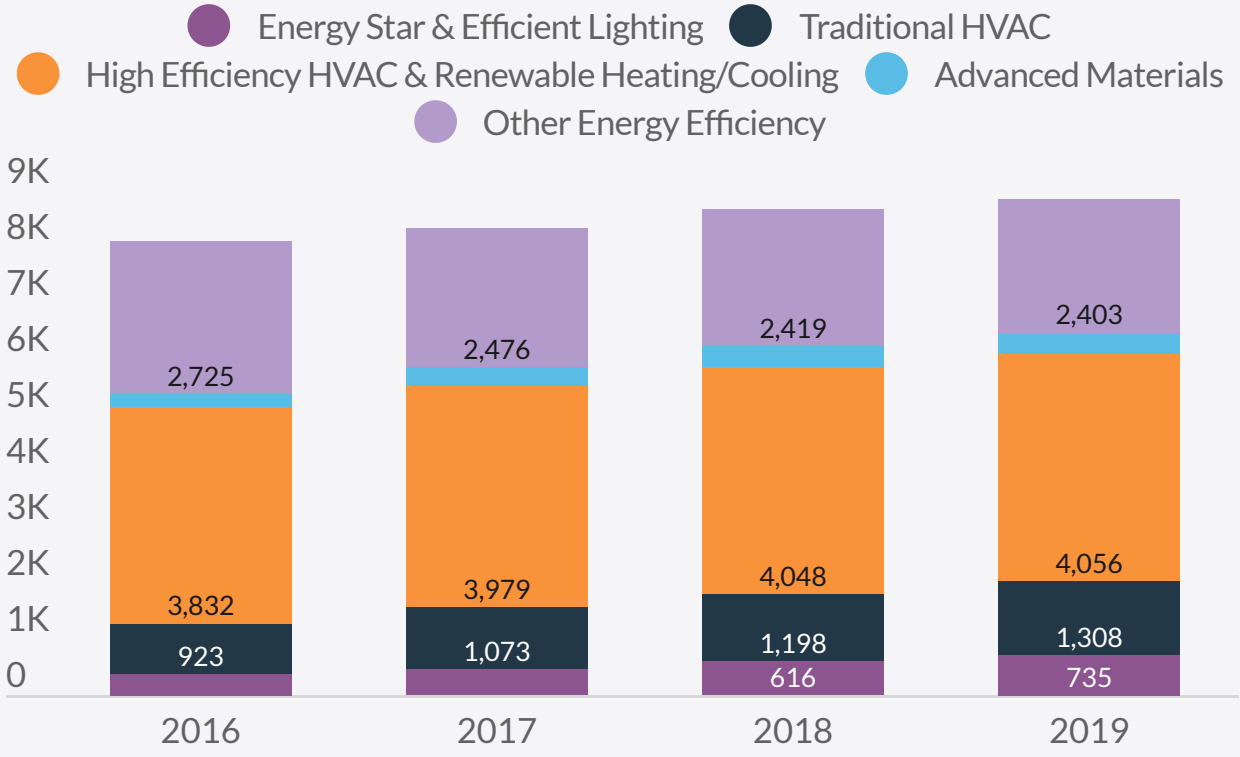
Buildings Rank

8

Appliances Rank

Each component of energy efficiency was evaluated by state by the American Council for an Energy-Efficient Economy, which is the basis for these national rankings. The ACEEE monitors state policies and programs, which feed into an assessment of 32 energy efficiency metrics.

ENERGY EFFICIENCY JOBS BY CATEGORY



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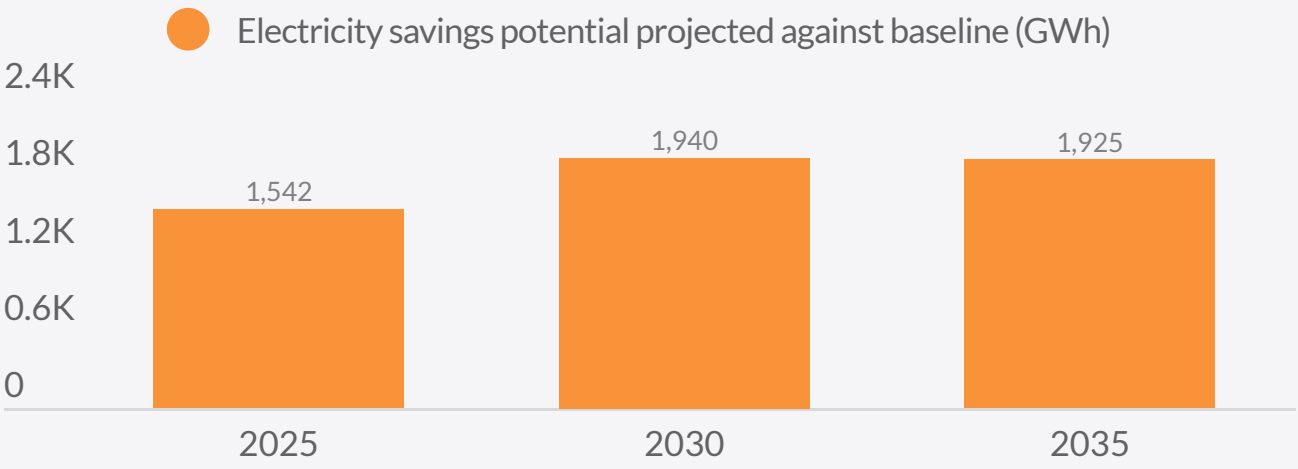
Categories of energy efficiency jobs, according to the United States Energy and Employment Report.

ENERGY EFFICIENCY ELECTRICITY SAVINGS POTENTIAL PROJECTED AGAINST BASELINE



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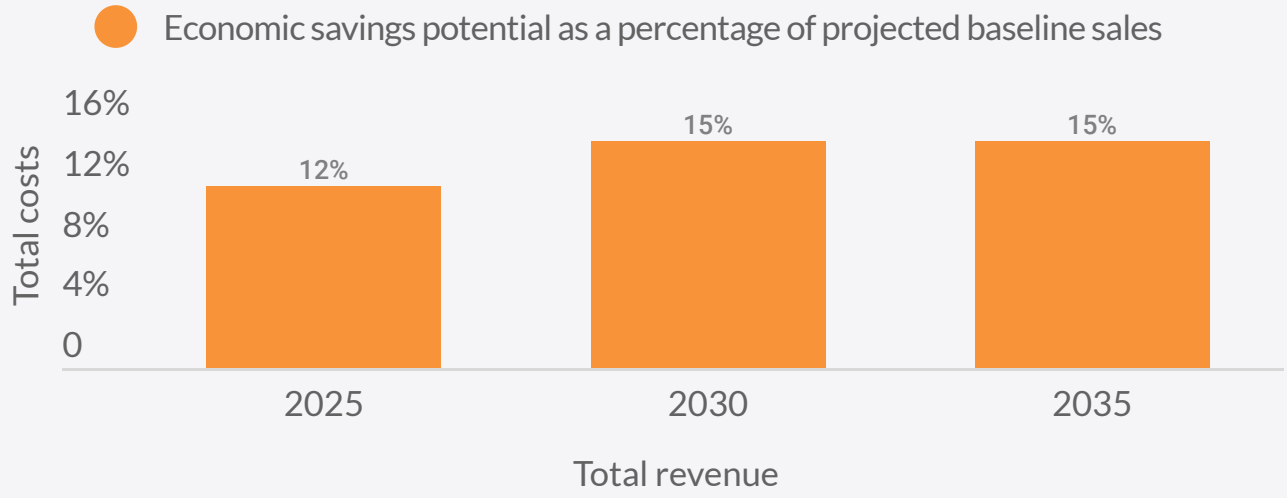
Electricity savings projected by the the United States Office of Energy Efficiency and Renewable Energy.

ENERGY EFFICIENCY ECONOMIC SAVINGS POTENTIAL AS A PERCENTAGE OF BASELINE SALES



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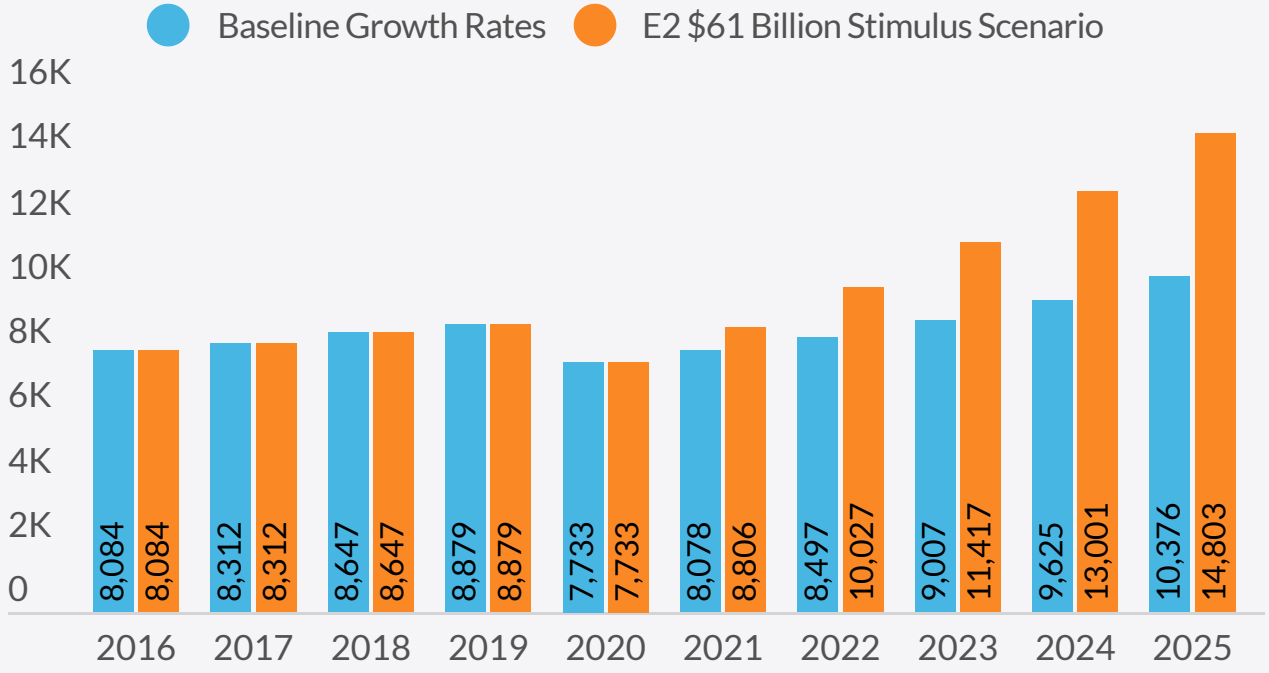
Electricity savings projected by the the United States Office of Energy Efficiency and Renewable Energy.

PROJECTED ENERGY EFFICIENCY EMPLOYMENT



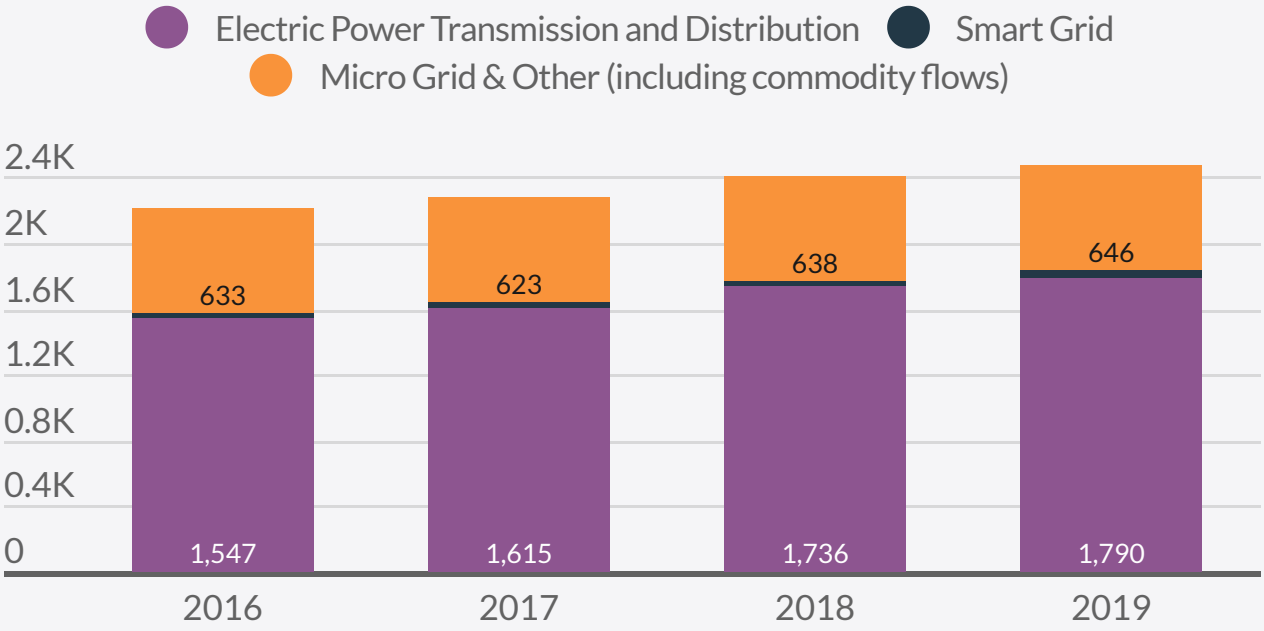
Methodology: US Energy & Employment actuals for ENERGY STAR and efficient lighting, traditional HVAC, high efficiency HVAC and renewable heating and cooling, advanced materials and other energy efficiency. Current growth rates use historic compound annual growth rate, while the E2 $61 Billion stimulus scenario uses growth rates based on projected impacts of a federal stimulus bill. Both cases adjust for COVID-19 job loss actuals in 2020. Additional detail in the Appendix.

GRID MODERNISATION

Maine ranks joint-26th in the 2018 Grid Modernization Index, based on state policy support, customer engagement and degree of grid operations investment. The state focuses on grid modernisation in its energy plan and the state runs an active customer data access programme. Approximately 92 percent of customers use smart meters in Maine, primarily driven by a state-wide policy requiring smart meters. In 2018, Central Maine Power, which supplies power to 77 percent of the state's residential customers, committed to spending $2.5 billion on grid modernisation. The future of electricity management in Maine is currently being debated in the state's legislature. One bill calls for buying out existing infrastructure and creating a publicly owned utility. Representative Seth Berry, the bill's sponsor, additionally estimated that it would take $10 billion to $15 billion to fully upgrade Maine's grid infrastructure. In 2020, 12 bills relating to energy infrastructure and regulations were introduced, of which 1 was enacted, 1 passed one chamber and 3 failed. Maine does not run a demand response programme. As it stands, Climate Advisers anticipates average growth in this sector.

Key Players: Central Maine Power Company, Maine Public Utilities Commission, ISO-NE, Environmental and Energy Technology Council, AVANGRID

GRID JOBS BY CATEGORY OVER TIME



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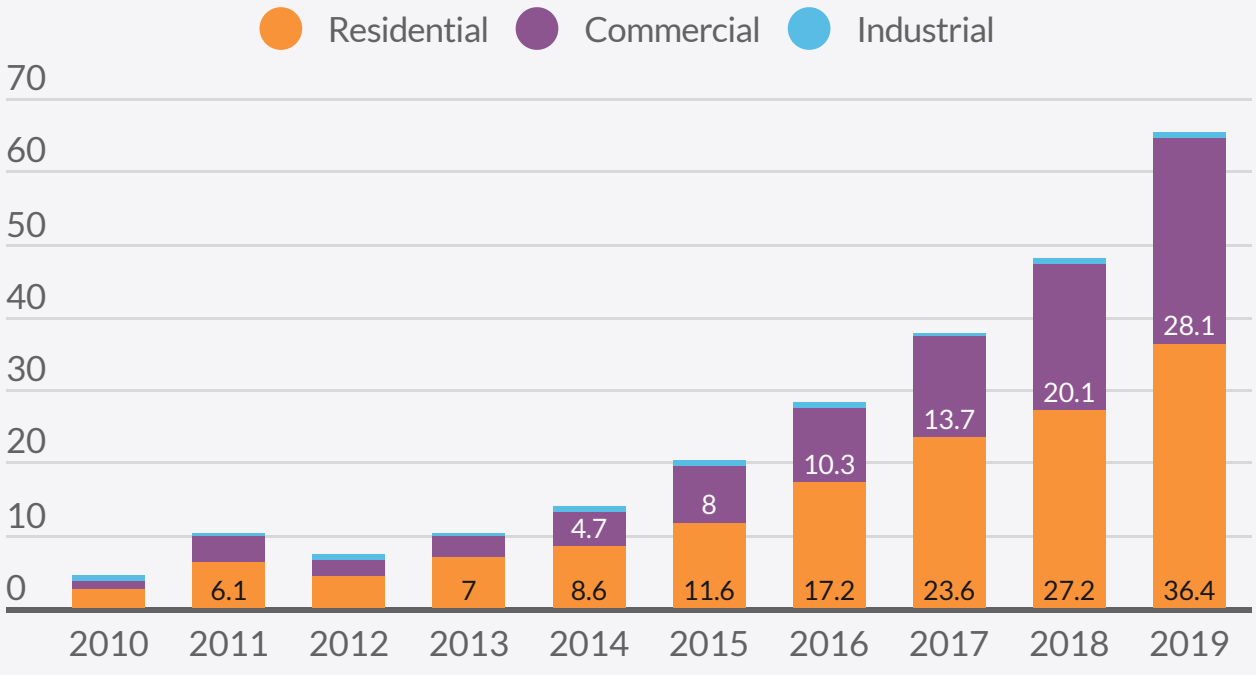
Categories of grid-related jobs, according to the United States Energy and Employment Report.

DISTRIBUTED GENERATION: NET METERING CAPACITY



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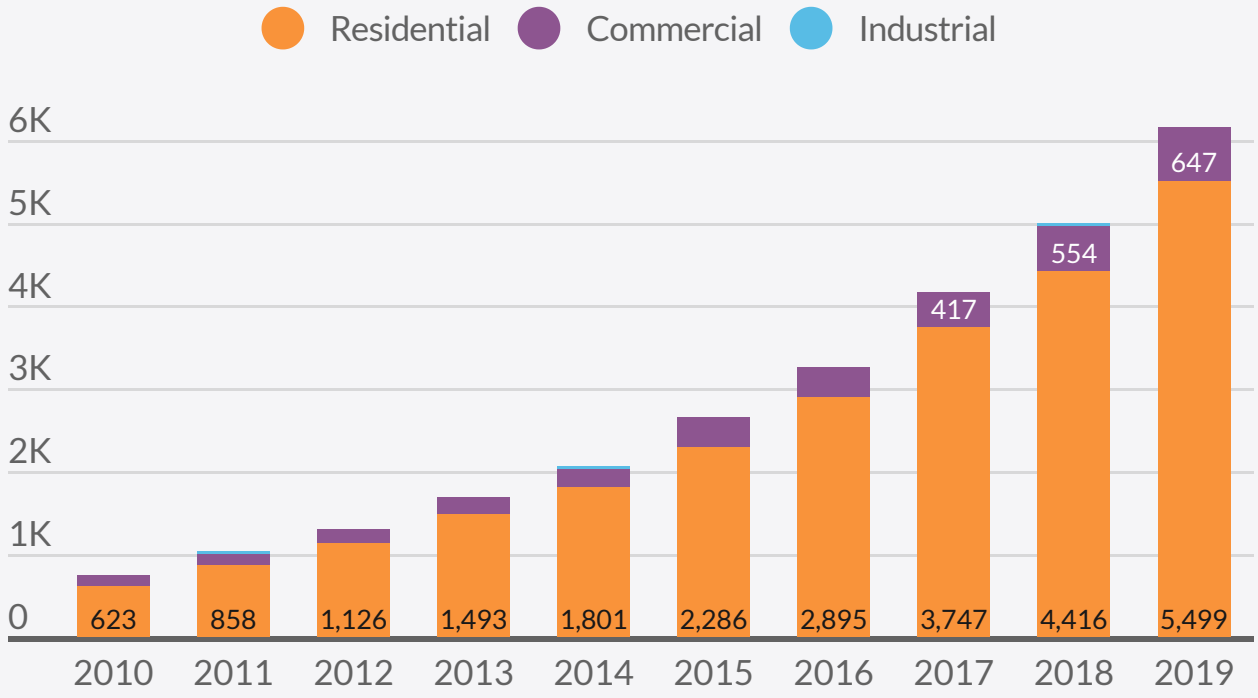
Net metering capacity over time sourced from the Energy Information Administration.

DISTRIBUTED GENERATION: NET METERING CUSTOMERS



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Number of net metering customers sourced from the Energy Information Administration.

ENERGY STORAGE

Installed Capacity: Maine currently has a 16.2-MW battery storage plant operated by FPL Energy Wyman LLC, an independent power producer (IPP), its only storage project.

Policies: Maine has demonstrated some efforts to stimulate energy storage growth in the state. While Maine has no mandatory procurement targets for energy storage, Legislative Document 1711 of 2019 requires the Maine Public Utilities Commission to create incentives to support distributed generation systems that integrate energy storage technologies.

Project Pipeline: Maine has a 2.3-MW battery storage project planned. The project will be owned and operated by Consolidated Edison Development Inc., an independent power producer.

Key Players: FPL Energy Wyman LLC, Maine Public Utilities Commission

ENERGY STORAGE: POLICIES AND CAPACITY INSTALLED

16 MW

Capacity installed

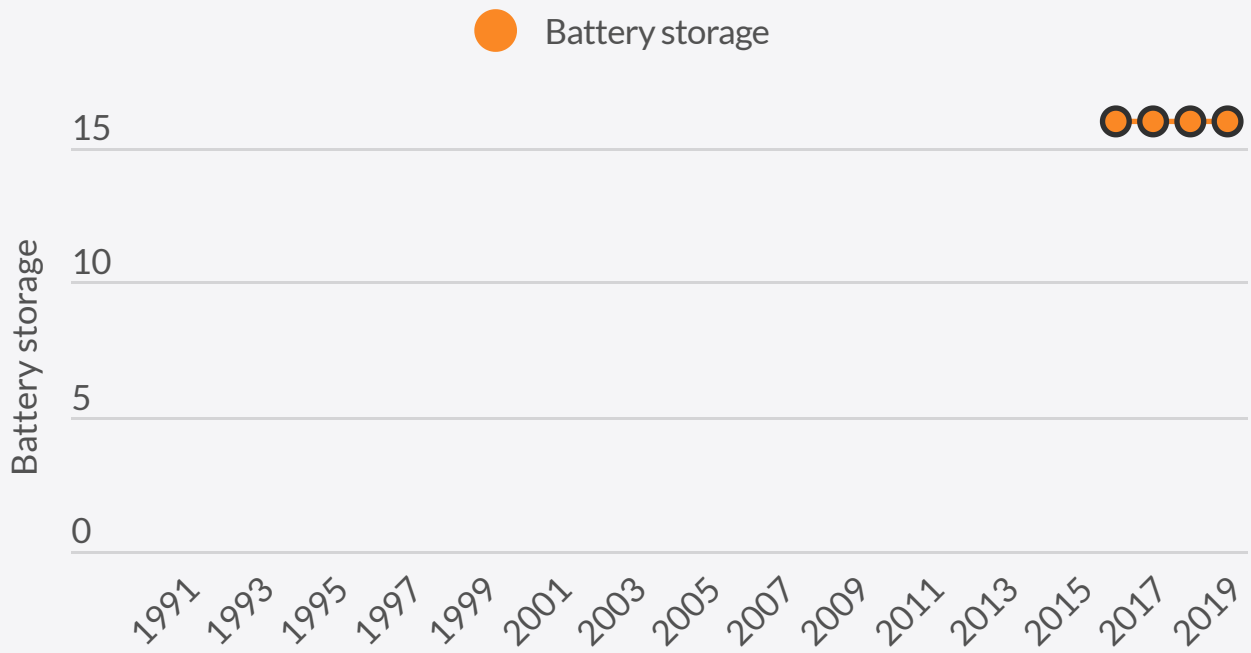
314

Energy storage jobs

	Yes/No
Procurement Targets	No
Regulatory Requirements	Yes
Demonstration Programs	No
Financial Incentives	No
Consumer Protection	No

Targets, policies and incentives maintained by the Pacific Northwest National Laboratory through the United States Department of Energy. Capacity installed sourced from EIA and jobs from USEER.

MAINE CURRENT ENERGY STORAGE CAPACITY



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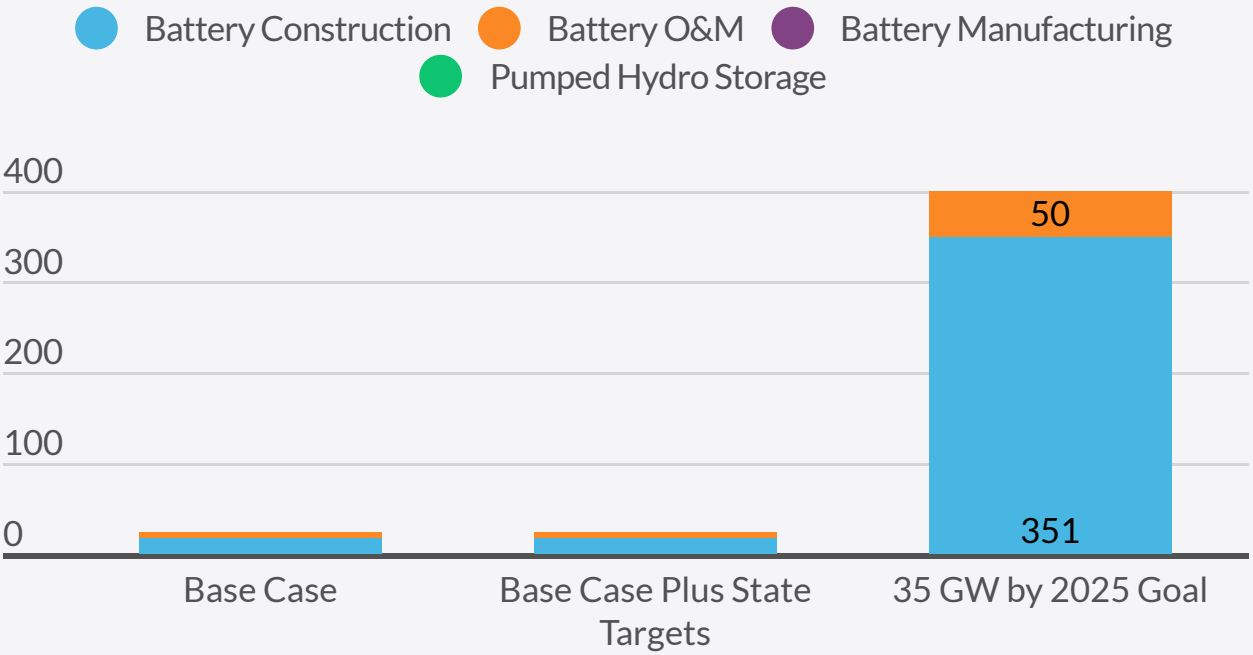
Energy storage generation capacity over time available through the Energy Information Administration.

PROJECTED ENERGY STORAGE FTE ADDITIONS (2021-2025)



Methodology: Battery construction, battery O&M, and Pumped Hydro Storage jobs per MW rates based on historical data and Navigant estimates through 2025; manufacturing based on NAICS 335911 with manual adjustments. Base case capacity forecasts from the EIA pipeline; base case plus state targets includes announced state targets and the 35 GW by 2025 goal is based on an Energy Storage Association vision report. Additional information available in the Appendix.

WASTE TO ENERGY

Biogas: Maine is ranked 43rd for biogas production potential with an estimated 2.69 billion cubic feet of renewable methane per year. The state's potential in biogas is the following: wastewater (51 systems), manure (15 systems), food waste (8 systems) and landfill (1 system). These systems would result in a combined $226 million in capital investments, 1,883 construction jobs and 125 permanent jobs. Furthermore, estimated emissions reductions would be equivalent to having 266,000 cars fewer cars on the road. Maine currently operates 3 food waste systems, 2 landfills, 1 wastewater system and 1 manure biogas system.

Transport: In 2020, the Maine Climate Council's Transportation Working Group highlighted local alternative fuel expansion as a key strategy towards mitigating vehicle emissions. Maine's tax rates are around $0.30 per gallon of motor vehicle fuel bought, while alternative fuels' tax rates are significantly lower. As part of resale purposes, the state requires any changes to the property to be recorded. Insurance companies are also authorised to issue payments to clean energy vehicle owners. Individual biofuel producers are not subject to regulation. Finally, Maine also consumed 8 million gallons of biodiesel in 2018, most of which was imported.

Biomass: 25 percent of the state's net generation comes from biomass sources, the highest share for any state. Approximately 10 percent of Maine's households use wood as their chief heating source. Wood and wood waste are the key biomass sources, with 3 wood pellet manufacturing plants producing a combined 230,000 tonnes annually.

Key Players: Biobased Maine, Professional Logging Contractors of Maine, ReEnergy Holdings, Northeast Regional Biomass Energy Program, Maine Renewable Energy Association

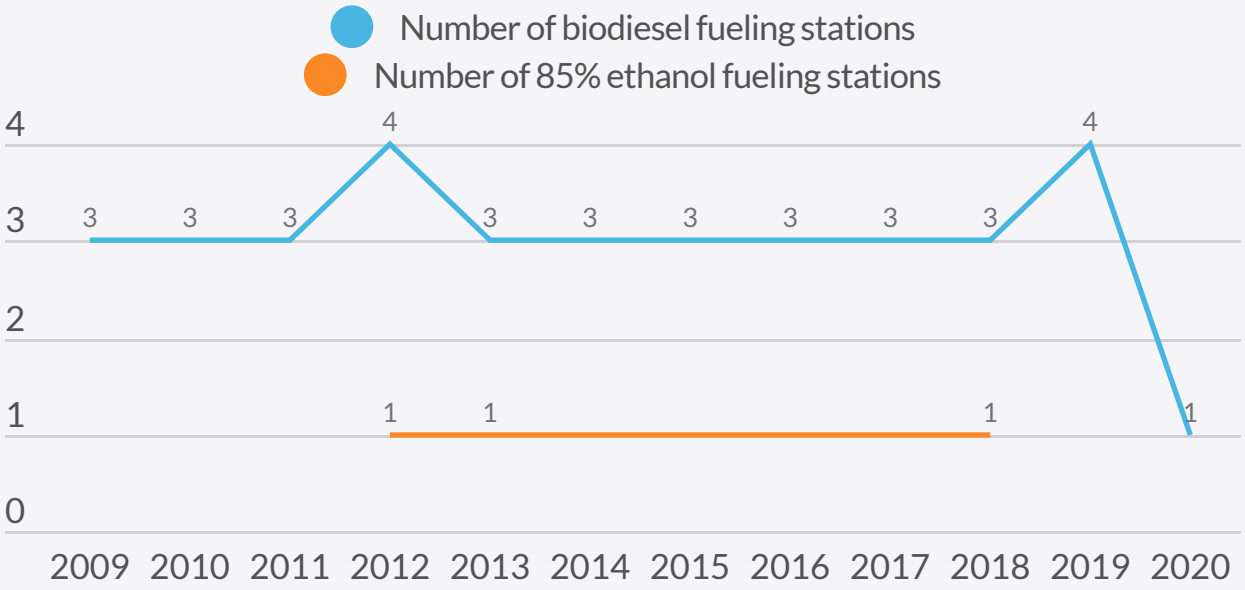
WASTE TO ENERGY: BIOMETHANE POTENTIAL

Biomethane Type	Output (Tonnes/Year)	National Rank
Methane Emissions from Landfills	5,597	41st
Biogas Generation Potential from Wastewater	10,859	40th
Biogas Generation Potential from Industrial, Commercial and Institutional Organic Waste	4,947	40th
Biogas Generation Potential from Animal Waste	562	43rd

Biomethane generation potential and biomass feedstocks, according to the National Renewable Energy Laboratory's Biofuels Atlas..

WASTE TO ENERGY: BIOFUEL LAWS AND INFRASTRUCTURE

	Strength	Number	Compared to National Average
Number of biodiesel laws & incentives	Medium	4	-32%
Number of ethanol laws & incentives	Low	3	-45%



Download data

Fueling stations and applicable laws and incentives, according to the United States Department of Energy's Alternative Fuels Data Center.

WASTE TO ENERGY: CAPACITY BY PLANT TYPE

Biopower Plant Type	Production Capacity (MW)	National rank
Landfill Gas	6	37th
Municipal Solid Waste	35	13th
Wood/Wood Waste Biomass	487	5th
Other Waste Biomass	-	-
Co-Firing Biomass	102	5th

Production capacities, according to the National Renewable Energy Laboratory's Biofuels Atlas.

HYDROGEN

Maine's difficulties onboarding renewable energy to its grid presents opportunities for hydrogen in the state. Against this backdrop, blue hydrogen formed by electrolysis could provide an alternative energy storage option in the state. However, the future remains uncertain, as there are no laws yet incentivising its use in this way and the utility of the technology is dependent on the success of offshore wind projects.

Key Players: Hydrogen Energy Center, Summit Natural Gas

HYDROGEN PRODUCTION POTENTIAL NATIONAL RANKING

38th

Rank of hydrogen production potential in the wind sector

39th

Rank of hydrogen production potential in the solar sector

38th

Hydrogen production potential in the biomass sector

40th

Hydrogen production potential across renewable technologies

Hydrogen potential, according to the National Renewable Energy Laboratory's Hydrogen Demand and Resource Analysis Atlas.

HYDROGEN PRODUCTION COST AND RANK BY PROCESS

Hydrogen Electrolysis Costs	USD/kg	Rank (Low to High)
Commercial	143	11th
Industrial	105	8th
Residential	162	11th

Hydrogen Steam Methane Reforming Costs	USD/kg	Rank (Low to High)
Commercial	80	41st
Industrial	78	40th
Residential	85	41st

Hydrogen costs, according to the National Renewable Energy Laboratory's Hydrogen Demand and Resource Analysis Atlas.

HYDROGEN FUELING STATION POLICY AND INFRASTRUCTURE

	Strength	Number	Compared to National Average
Number of hydrogen fuel laws & incentives	Medium	3	-46%

CARBON CAPTURE, UTILISATION AND STORAGE

Potential for CCUS in Maine is limited as there are no major CCUS policies, incentives or projects in the state and its geography not conducive to carbon storage.