



VINEYARD WIND

Vineyard Wind 1

Impact on Jobs and Economic Output

Annual Report #1

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Prepared by:



UMass | Dartmouth



SPRINGLINE
RESEARCH GROUP



Vineyard Wind is currently building the nation's first utility-scale offshore wind energy project over 15 miles off the coast of Massachusetts. The project will generate clean, renewable, affordable energy for over 400,000 homes and businesses across the Commonwealth, while reducing carbon emissions by over 1.6 million tons per year.

The Vineyard Wind parent companies consists of funds managed by Copenhagen Infrastructure Partners (CIP), whose Senior Partners are pioneers with an unparalleled track record in the offshore wind industry, and Avangrid Renewables (AR), the third largest onshore wind developer in the US with operations in more than 20 states, a Lead Market Participant in the ISO-NE market and an affiliate of the Iberdrola Group, the world's largest wind developer with more than 15,000 MW of wind installed.



The University of Massachusetts Dartmouth is a public research university in Dartmouth, Massachusetts. It is the southernmost campus of the University of Massachusetts system. Formerly Southeastern Massachusetts University, it was merged into the University of Massachusetts system in 1991. As a national research university, UMassD opens a world of exploration and discovery. Our students work with world-class faculty researchers and journey into real-world innovation and experiences.



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Executive Summary

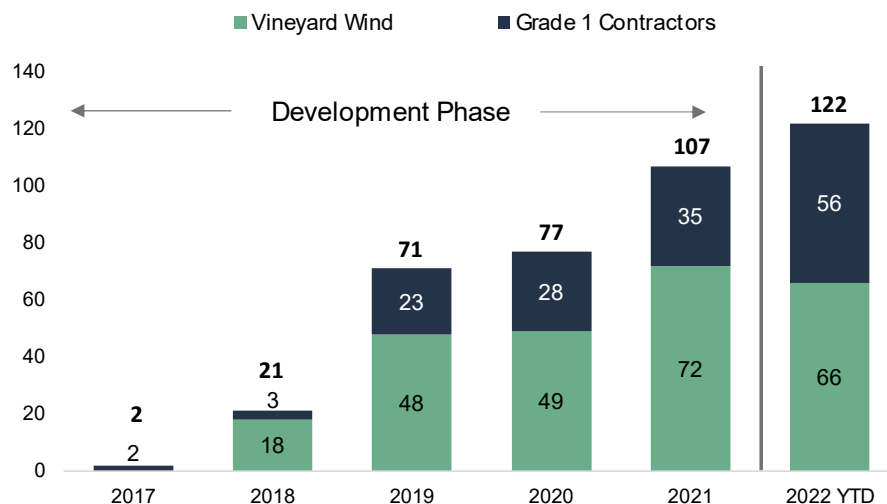
Vineyard Wind's *Offshore Wind Development and Reporting Agreement* (the "*Agreement*") executed with the Massachusetts Department of Energy Resources (DOER) requires Vineyard Wind to deliver written annual progress reports that summarize the company's progress in achieving the goals set forth in Section 1 of the *Agreement*. Accordingly, this analysis utilizes job and expenditure data collected from 2017 through September 2022 to measure Vineyard Wind's progress in meeting the requirements outlined in the *Agreement*, particularly in terms of the extent to which the reported results align with the job and economic output estimates conducted by UMass Dartmouth's Public Policy Center in 2017. Key findings include:

Vineyard Wind Direct Employees

Development Phase: Direct Vineyard Wind employment in Massachusetts over the 2017-2021 Development phase was 278 FTE job years, with the number of FTEs increasing from 2 in 2017 to 107 in 2021 (see Figure 1). This compares to an estimate of 126 FTE job years by UMass Dartmouth in 2017, or a difference of 152 FTE job years. These totals include only Massachusetts residents, which means actual project employment is higher than reported here as it includes an unknown number of out of state workers that supported the project.

FTE Job Years, 2022 Year-to-Date: As of September 2022, Vineyard Wind directly employed 122 full-time workers, including 66 directly employed by Vineyard Wind and 56 Grade 1 contractors (see Figure 1). More than three-quarters (75.8%) of Vineyard Wind employees and 65.2% of Grade 1 contractors are Massachusetts residents.¹ Among Vineyard Wind's Massachusetts-based employees, 38.0% are residents of Southeastern Massachusetts.²

Figure 1. Vineyard Wind Direct FTE Job Years



Source: Vineyard Wind Services Historical and Monthly Tracker Submissions

¹ Grade 1 contractors are working directly with Vineyard Wind staff, have a Vineyard Wind email address, and in most cases work in Vineyard Wind's Boston and New Bedford offices (or telecommute from a Massachusetts address).

² The Massachusetts city/town of residence for Grade 1 contractors is not available.

Massachusetts-Based Subcontractor Employment

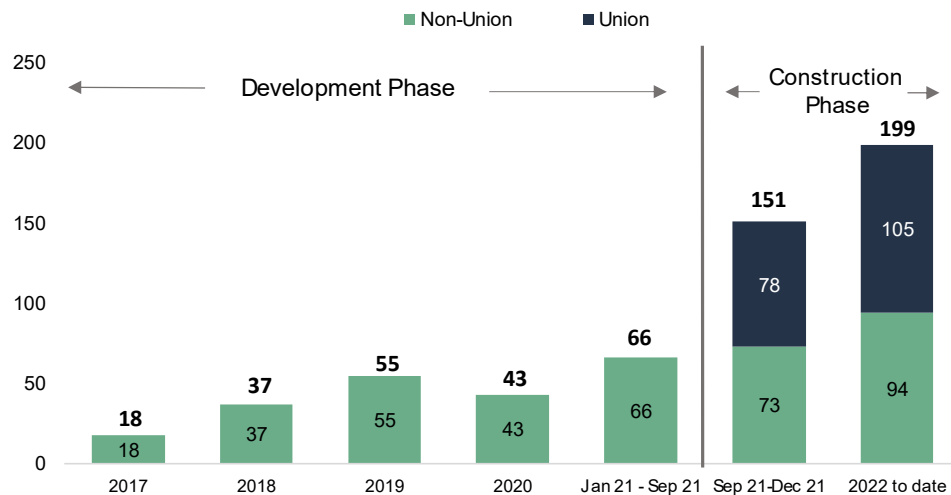
Vineyard Wind Services contracted with 346 individual companies and organizations during the nearly 5-year Development phase. Over twenty-one percent (21.4%) of these subcontractors are based in Southeastern Massachusetts, and they account for 4.1% of the total contracts by value. While modest, these contracts are not insignificant to the region, particularly since many contracts are with small companies or organizations.

Development Phase: Sixty-six workers were employed by Vineyard Wind's subcontractors in the Development phase from January 2022 through September 2022, an increase from eighteen workers in 2017 (see Figure 2). Notably, this is a conservative estimate as it is based on reporting from only 34 of the 48 companies with contracts greater than \$1 million³ and includes only Massachusetts-based employees (contractors did not provide total employment figures that include out-of-state employees).⁴

Construction Phase: Construction phase activities began in September 2021, with 151 union and non-union workers employed at some point during the September through December 2021 period. A total of 199 workers have been employed in 2022 thus far (January 2022 through September 2022), with 105 of those workers being union employees (see Figure 2).

The Development phase data in Figure 2 represent Massachusetts-based workers only. However, the more detailed monthly tracker instituted in late 2021 asked subcontractors to provide employees' ZIP Code. From these data, we estimate that 80.3% of the workers employed during the September through December 2021 period are Massachusetts residents, and 79.3% employed to date in 2022 are Massachusetts residents.

Figure 2. Number of Massachusetts-Based Employees among Subcontractors and Vendors



Source: Vineyard Wind Services Historical and Monthly Tracker Submissions

³ Most of the fourteen companies with contracts of >\$1 million that did not report data are based outside the U.S. and likely have a relatively small number of Massachusetts-based employees.

⁴ Importantly, these totals are not equal to the number of job years, since contractors did not provide the length of time that employees worked (i.e., some employees may have worked less than one year). Also, the totals do not represent unique employees since the same employee may have worked multiple years over the five-year period.

Direct, Indirect, and Induced Employment and Economic Impacts

This section expands on the previous section by examining the broader economic impact of the project in terms of indirect and induced effects.

Development Phase Impacts, 2017-2021

Indirect Impacts: Vineyard Wind's direct payroll and non-payroll expenditures supported an additional 137 indirect jobs during the Development phase. These jobs produced \$11.5 million in labor income, contributed \$16.8 million in added value to the Massachusetts economy, and supported \$27.9 million in new economic output during the Development phase (see Table 1).

Induced Impacts: The direct and indirect impacts induced an additional 251 jobs that generated \$16.8 million in labor income. Development phase activities also contributed over \$28.2 million in added value to the Massachusetts economy and supported \$44.9 million in new economic output (see Table 1).

Total Impacts: In total, Development phase economic activity generated 666 jobs, \$59.3 million in labor income, \$79.1 million in value added, and \$166.6 million in economic output (see Table 1).

Table 1. Direct, Indirect, and Induced Impacts, Development Phase

Massachusetts Impact				
Development Phase (2017 - 2021)				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	278	\$ 31,057,366	\$ 34,085,502	\$ 93,903,244
Indirect Effect	137	\$ 11,505,524	\$ 16,782,238	\$ 27,821,324
Induced Effect	251	\$ 16,759,219	\$ 28,237,439	\$ 44,924,273
Total Effect	666	\$ 59,322,109	\$ 79,105,179	\$ 166,648,841

Source: UMass Dartmouth and Vineyard Wind

Construction Phase Impacts, September 2021 – September 2022

Nearly all of the construction-related activity to this point has been focused on onshore work in the town of Barnstable. Offshore construction is not expected to begin in earnest until Q4 2022, with the majority of the offshore construction impacts expected to occur beginning in Q2 2023. Accordingly, the economic impacts presented below are preliminary and are expected to be much higher once construction of the wind farm is complete.

Indirect Impacts: Vineyard Wind's direct payroll and non-payroll expenditures have supported an additional 64 indirect jobs during the Construction phase to date. These jobs produced \$4.3 million in labor income, contributed \$7.3 million in added value to the Massachusetts economy, and supported \$15.8 million in new economic output (see Table 2).

Induced Impacts: The direct and indirect impacts induced an additional 34 jobs that generated \$2.3 million in labor income. Construction phase activities also contributed over \$3.8 million in added value to the Massachusetts economy and supported \$6.0 million in new economic output (see Table 2).

Total Impacts: In total, Construction phase economic activity to date has generated 190 jobs, \$15.4 million in labor income, \$20.3 million in value added, and \$37.8 million in economic output (see Table 2).

Table 2. Direct, Indirect, and Induced Impacts, Construction Phase

Massachusetts Impact				
Construction Phase (September 2021 - September 2022)				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	92	\$8,804,789	\$9,201,004	\$15,959,847
Indirect Effect	64	\$4,320,315	\$7,259,660	\$15,782,155
Induced Effect	34	\$2,255,580	\$3,802,150	\$6,049,020
Total Effect	190	\$15,380,684	\$20,262,815	\$37,791,023

Comparison to UMass Dartmouth 2017 Estimates

This section compares the extent to which the results reported here compare with the estimates of the project's contributions to employment and economic development contained in the 2017 UMass Dartmouth analysis and included as part of Vineyard Wind's proposal submission to DOER. On every dimension of the economic impact of the project to date, we find that the expected impacts are larger in 2022 than expected in 2017.

Direct Employment Impacts

- The direct number of Development phase FTE job-years is 278. This compares to the 2017 estimate of 126 job years, a difference of 152 jobs (see Table 3).
- In all, the total job impact of Development phase activities 666. This compares to the 2017 estimate of 274 jobs, a difference of 392 jobs (see Table 3).

Indirect and Induced Employment Impacts

- **Indirect Impacts:** Vineyard Wind's direct payroll and non-payroll expenditures generated an additional 137 indirect FTE job years during the Development phase. This compares to the 2017 estimate of 27 jobs, a difference of 110 jobs (see Table 3).⁵
- **Induced Impacts:** The direct and indirect impacts of the Vineyard Wind 1 project induced an additional 251 jobs during the Development phase. This compares to the 2017 estimate of 121 jobs, a difference of 130 jobs (see Table 3).

⁵ IMPLAN does not report jobs as FTEs. Accordingly, the reported jobs for the indirect and induced impacts were converted to FTEs using IMPLAN conversion tables.

Labor Income, Value Added, and Economic Output Impacts

- Labor Income, Value Added, and Economic Output values are also much higher than the 2017 estimates. For example, total economic output (direct + indirect + induced) is estimated to be \$166.6 million, which compares to \$81.1 million in the UMass Dartmouth estimate, a difference of \$85.5 million (see Table 3).

**Table 3. Development Phase, Total Massachusetts Economic Impacts,
UMass Dartmouth Estimate Versus Actual**

Massachusetts Impact								
Development Phase								
Impact Type	Employment		Labor Income		Value Added		Output	
	PPC 2017	Actual	PPC 2017	Actual	PPC 2017	Actual	PPC 2017	Actual
Direct Effect	126	278	\$ 19,734,093	\$ 31,057,366	\$ 26,349,146	\$ 34,085,502	\$ 38,421,815	\$ 93,903,244
Indirect Effect	27	137	\$ 2,166,711	\$ 11,505,524	\$ 3,172,692	\$ 16,782,238	\$ 8,438,925	\$ 27,821,324
Induced Effect	121	251	\$ 7,965,164	\$ 16,759,219	\$ 13,159,673	\$ 28,237,439	\$ 34,225,613	\$ 44,924,273
Total Effect	274	666	\$ 29,865,968	\$ 59,322,109	\$ 42,681,512	\$ 79,105,179	\$ 81,086,353	\$ 166,648,841

Source: Estimate; Dartmouth PPC, 2017 (Base scenario). Current; UMass Dartmouth & Vineyard Wind

A primary reason for the larger impact in 2022 is that the 2017 analysis was conducted very early in the project when not all the project parameters were known, particularly in terms of local content expenditures. In addition, a two-year federal permitting delay and an expanded project envelope unexpectedly extended the Development phase through September 2021, when project financing was finalized or “financially closed”. The economic impact of future projects will likely be closer to initial estimations as project development becomes more streamlined and predictable.

1 Overview

Vineyard Wind is currently building the nation's first utility-scale offshore wind energy project 15 miles south of Martha's Vineyard. The Vineyard Wind 1 (VW1) project will consist of an array of 62 wind turbines, spaced 1 nautical mile apart, that will generate 800 megawatts (MW) of electricity and power over 400,000 homes.

Vineyard Wind's *Offshore Wind Development and Reporting Agreement* executed with the Massachusetts Department of Energy Resources (DOER) requires Vineyard Wind to deliver written annual progress reports that summarize the company's progress in achieving the goals set forth in Section 1 of the *Agreement*. Accordingly, this analysis utilizes job and expenditure data collected from 2017 through September 2022 to measure Vineyard Wind's progress in meeting the following eight requirements outlined in the *Agreement*:

- (a) the total number of employees on Vineyard Wind Services LLC's payroll, as well as the number who reside in the Commonwealth and in which counties
- (b) the total number of workers employed by subcontractors and vendors for Vineyard Wind 1 LLC, as well as the number who reside in the Commonwealth
- (c) an estimate of the direct, indirect, and induced employment and economic impacts to date in Massachusetts from the Project
- (d) the extent to which the reported results align with the estimates of the project's contributions to employment and economic development contained in the project proposal *Request For Proposals For Long-Term Contracts For Offshore Wind Energy Projects*
- (e) any relevant lessons learned that Massachusetts officials can use to improve economic outcomes for Massachusetts and inform future state procurement and programmatic efforts
- (f) the impact of projects supported by the Resiliency and Affordability Fund, specifically focusing on revenue generation and the impacts on the communities in which such projects are located
- (g) how the community in Massachusetts party to a Host Community Agreement with Vineyard Wind has benefitted from the payments it received under such agreement
- (h) the share of the Innovations in Marine Mammals Protection Fund spent in Massachusetts, which institutions received funding, and the projects supported

2 UMass Dartmouth Public Policy Center 2017 Estimates

The Public Policy Center (PPC) at UMass Dartmouth conducted an analysis in 2017 that described the economic contributions to employment and economic output that the proposed 800 MW Vineyard Wind 1 project would have on the Commonwealth of Massachusetts and the regional economy of Southeastern Massachusetts (SEMA).⁶ The analysis was undertaken in response to inquiries contained in the *Request for Proposals for Long-Term Contracts for Offshore Wind Energy Projects (RFP)* issued by the state's four electric distribution companies in coordination with the Massachusetts Department of Energy Resources (DOER).

Vineyard Wind provided the PPC with detailed job creation estimates and expenditures for each project phase for their proposed 800 MW project. These estimates were based on the Vineyard Wind team's extensive experience and knowledge acquired from comparable projects in Europe, as well as information Vineyard Wind directly obtained from their partners and suppliers. The PPC thoroughly reviewed the direct job creation and expenditure estimates, which were informed by data gathered from previous related work, interviews with industry leaders, site visits to European wind farm developments and ports, and a comprehensive literature review.

In its 2017 analysis, PPC estimated that the 800 MW Vineyard Wind 1 project would support an estimated 3,180 direct FTE job years across all phases over the project period under the Base scenario and 3,658 direct FTE job years in the High scenario for Massachusetts. This total includes 126 FTE job years in the Development phase and 974 FTE job years in the Construction phase (Base scenario) (see Table 4).⁷ The report concluded that workers would be drawn from a diverse range of occupations that represent a wide distribution of skill and educational levels, ranging from white collar jobs such as environmental scientists and engineers to blue collar jobs such as iron workers, longshoremen, and machine operators.

Table 4. PPC Estimated Direct FTE Job Years for the Vineyard Wind 1 Project, 2017

Region	Total Direct FTEs	Pre-Construction & Development	Construction	O&M Annual	O&M Lifetime Job Years	Total Job-Years
Massachusetts						
Base Scenario	1,180	126	974	80	2,000	3,180
High Scenario	1,633	126	1,426	81	2,025	3,658
SEMA						
Base Scenario	1,151	119	952	80	2,000	3,151
High Scenario	1,407	119	1,207	81	2,025	3,432

Source: UMass Dartmouth Public Policy Center, 2017

⁶ SEMA is defined as Barnstable County (Cape Cod), Bristol County, Dukes County (Martha's Vineyard), Nantucket County, and Plymouth County.

⁷ The PPC developed a Base and High scenarios that varied by the assumed level of state and regional supply chain expenditures.

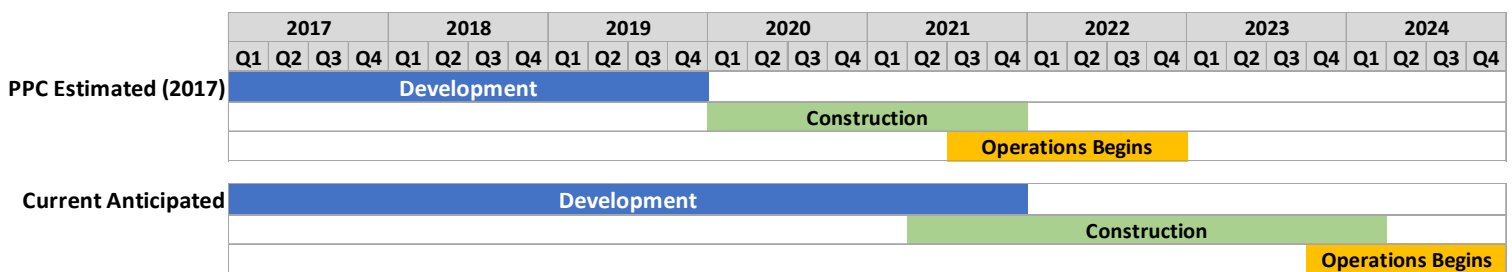
3 Project Schedule and Data Collection Methodology

3.1 Project Schedule

The 2017 PPC analysis assumed that Development phase work would be completed during the 2017-2019 period. It was expected that the Onshore Construction phase would begin in Q1 2020 and the concurrent start of the Operations phase would commence in Q3 2021 (see Figure 3). However, a two-year federal permitting delay and an expanded project envelope unexpectedly extended the Development phase through September 2021, when project financing was finalized or “financially closed”.⁸

Accordingly, the current analysis includes jobs and expenditure estimates for the full Development phase. The analysis also includes estimates related to Construction phase jobs and expenditures, although much of the construction-related activity to this point has been focused on onshore work in the town of Barnstable. Offshore construction is not expected to begin in earnest until Q4 2022, with the majority of the offshore construction impacts expected to occur beginning in Q2 2023.

Figure 3. Project Schedule: Estimated versus Current Anticipated



Source: Vineyard Wind and UMass Dartmouth

3.2 Data Collection

Data collection to obtain job, expenditure, and other information from Vineyard Wind and its subcontractors began in earnest in October 2021, shortly following the project’s financial close. Two primary data collection tools were developed and used to monitor relevant project activity:

- 1) An historical spreadsheet tracker to obtain Development-related job and expenditure data from 2017 to 2021
- 2) A monthly spreadsheet tracker that Tier 1 contractors were required to submit monthly beginning in November 2021

⁸ Some construction activities related to onshore work began in early September prior to the project’s financial close.

Development Phase Expenditures, 2017-2021

Vineyard Wind provided UMass Dartmouth with a database that detailed the company's subcontractors and the amount of each contract during the 2017 to September 2021 period. There were 346 subcontractors with active contracts, with an estimated 26.0% of the contract value executed with Massachusetts companies (see Table 5).⁹

From the outset, conversations with subcontractors made it clear that obtaining accurate historical data from all subcontractors would be difficult, particularly from smaller companies. Consequently, Vineyard Wind focused its efforts on obtaining detailed job and expenditure data from companies with contracts above \$1 million (n=48), which represents 90.3% of the total contract value during the Development phase (see Table 5). These subcontractors were asked to provide their annual Massachusetts expenditures and counts of Massachusetts-based employees over the 2017-2021 period for activities that directly supported the Vineyard Wind 1 project. Thirty-five of the forty-nine subcontractors (69%) complied.¹⁰

Table 5. Vineyard Wind 1 Development Phase Expenditures, 2017-2021

	Number	% Total Spend	% MA Spend of Total Spend
Contracts >\$1M	49	90.3%	26.6%
Contracts <\$1M	298	9.7%	20.7%
All Contracts	347	100.0%	26.0%

Source: Vineyard Wind and UMass Dartmouth

Subcontractors were asked to provide the annual number of jobs but did not specify the number of full-time versus part-time positions. Consequently, the number of full-time equivalent (FTE) contractor employees was estimated by Vineyard Wind based on institutional knowledge, discussions with the contractors, and data collected for Health, Safety and Environmental (HSE) reports. As noted earlier, subcontractors with under \$1 million in contract value were not included. Instead, our estimation of FTEs and Massachusetts-based expenditures began with the geocoding of each company.¹¹ Job estimates were derived from this data by utilizing Implan economic modeling software and assigning the appropriate Implan code to each Massachusetts-based business' expenditure and using the Implan model's regional purchasing coefficients to develop assumptions about in-state and regional spending patterns and economic impacts.

Construction Phase Expenditures, September 2021 through September 2022

Vineyard Wind created a data collection spreadsheet that was completed monthly by the Tier 1 suppliers. The tracking sheet includes inputs for labor—both union and non-union—as well as nonpayroll expenditures by three geographic levels of analysis: The U.S., Massachusetts, and Southeastern Massachusetts. Subcontractor expenditures made by the Tier 1 suppliers, as well as various diversity,

⁹ This does not imply that all these expenditures were made in Massachusetts.

¹⁰ Expenditure estimates for five survey vessel contractors that did not submit data were estimated by applying proportions from data submitted by other survey vessel companies.

¹¹ Fourteen companies did not have enough information to geocode.

equity, and inclusion (DEI) data such as race, gender, tribal affiliation, and veteran status were also tracked. A total of 112 monthly reports have been received to date.

Data collection was not a seamless process, and the inability of some companies to report data from early in the Development phase created some challenges for the analysis. These data collection issues are explored in more detail in Section 7.

3.3 Job Definitions

This analysis reports employment impacts in two ways - the direct number of FTE job years and the number of individual jobs. Each is defined as follows.

FTE Job Years: Refers to the years of FTE employment created by the project, including wage and salary employees and self-employed persons. One FTE is the equivalent of one person working full time for one year (2,080 hours), thus two half-time employees would equal one FTE. Similarly, a full-time person working five years on the project would equal five FTE job years.

Jobs: The actual number of workers on the project, which includes both full-time and part-time workers who may be on the project for several years, one-year, or less. For example, many of the union workers on the project work for only a month or less since individual construction workers frequently move from site-to-site and to other projects, and the number of workers on the project frequently changes based on the status of the construction project.

4 Vineyard Wind Employees

This section highlights the number of FTE workers directly employed by Vineyard Wind from 2017 through September 2022. Importantly, historical employment data for the 2017-2021 Development phase were obtained from the historical tracker reports, which asked contractors to only include the number of Massachusetts workers. Conversely, the more detailed monthly tracker reports instituted in November 2021 at the outset of the Construction phase asked contractors to provide employee residence for all workers.

4.1 Development Phase FTE Job Years in Massachusetts

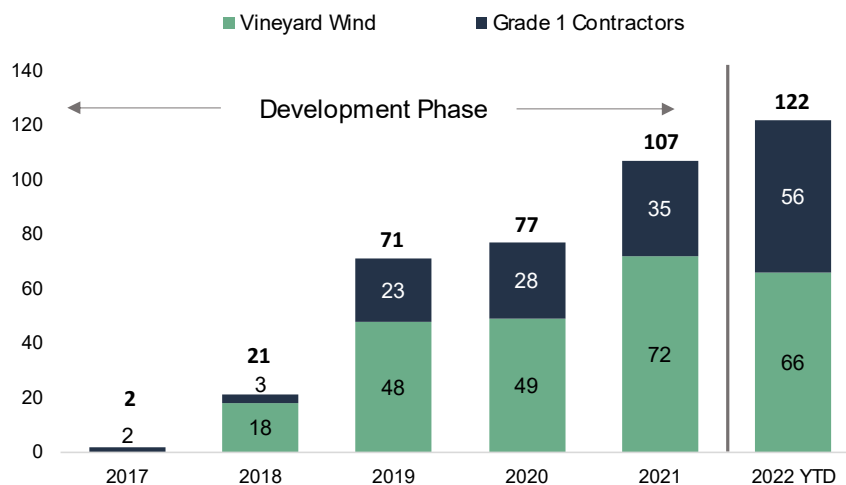
Direct Vineyard Wind employment in Massachusetts over the 2017-2021 Development phase was 278 FTE job years, with the number of FTEs increasing from 2 in 2017 to 107 in 2021 (see Figure 4). This compares to an estimate of 126 FTE job years by the PPC in 2017, or a difference of 152 FTE job years. The total includes workers directly employed by Vineyard Wind and Grade 1 contractors. Grade 1 contractors are working directly with Vineyard Wind staff, have a Vineyard Wind email address, and in most cases work in Vineyard Wind's Boston and New Bedford offices (or telecommute from a Massachusetts address).

As noted, Development phase totals include only Massachusetts residents, which means actual project employment is higher than reported here as it includes an unknown number of out of state workers that supported the project.

4.2 FTE Job Years, 2022 Year-to-Date

As of September 2022, Vineyard Wind directly employed 122 full-time workers, including 66 directly employed by Vineyard Wind and 56 Grade 1 contractors (see Figure 4). More than three-quarters (75.8%) of Vineyard Wind employees and 65.2% of Grade 1 contractors are Massachusetts residents.

Figure 4. Vineyard Wind Direct FTE Job Years



Source: Vineyard Wind Services Historical and Monthly Tracker Submissions

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Among Vineyard Wind's Massachusetts-based employees, 44.0% reside in the Greater Boston area: 24.0% in Suffolk County and 20.0% in Middlesex County. Thirty-eight percent (38.0%) are residents of Southeastern Massachusetts (highlighted in green; see Table 6).¹²

**Table 6. Vineyard Wind Employees
By Massachusetts County, September 2022**

County	Number	Percent
Barnstable	7	14.0%
Bristol	8	16.0%
Essex	5	10.0%
Franklin	1	2.0%
Middlesex	10	20.0%
Norfolk	2	4.0%
Plymouth	4	8.0%
Suffolk	12	24.0%
Worcester	1	2.0%

Source: Vineyard Wind monthly tracker submissions

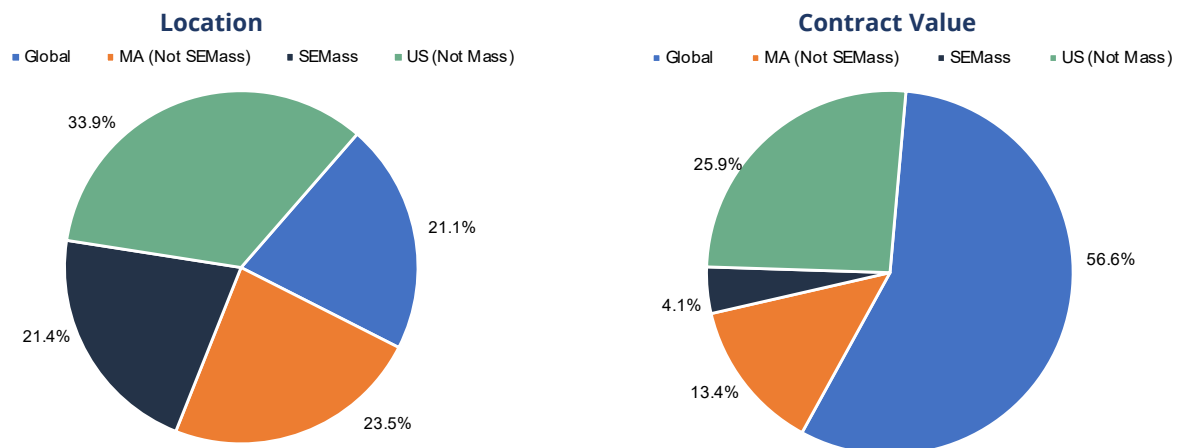
¹² The Massachusetts city/town of residence for Grade 1 contractors is not available.

5 Subcontractor Employment

Vineyard Wind Services contracted with 346 individual companies and organizations during the nearly 5-year Development phase. Over twenty-one percent (21.4%) of these subcontractors are based in Southeastern Massachusetts, and they account for 4.1% of the total contracts by value. While modest, these contracts are not insignificant to the region, particularly since many contracts are with small companies or organizations.

Most of the larger contracts were executed with global companies, which represent 21.1% of the total number of subcontractors but 56.6% of the total expended by Vineyard Wind (see Figure 5). This result is not surprising since offshore wind is a new industry in the U.S. and, as anticipated in the 2017 PPC analysis, most of the development-related work was performed by companies outside the U.S., particularly early on in the Development phase. In addition, the COVID-19 pandemic impacted the ability of non-U.S. contractors to establish a U.S. presence. Despite these obstacles, Vineyard Wind was able to expend approximately 43% of its Development phase contracts with stateside companies.

Figure 5. Primary Location and Contract Value of Vineyard Wind Subcontractors Development Phase



Source: Vineyard Wind and UMass Dartmouth

5.1 Massachusetts-Based Employment

Development Phase

As noted in Section 3, employment data supplied by companies with contract values greater than \$1 million was combined with employment estimates for companies with contract values below \$1 million using the Implan model to arrive at our estimates of total project employment in Massachusetts during the Development phase. From this data, we estimate that 66 workers were employed by Vineyard Wind's subcontractors in the Development phase from January 2022 through September 2022, an increase from 18 workers in 2017 (see Figure 6). Importantly, these totals are not equal to the number of job years, since contractors did not provide the length of time that employees worked (i.e., some employees may have worked less than one year). Also, the totals do not represent unique employees since the same employee may have worked multiple years over the five-year period.

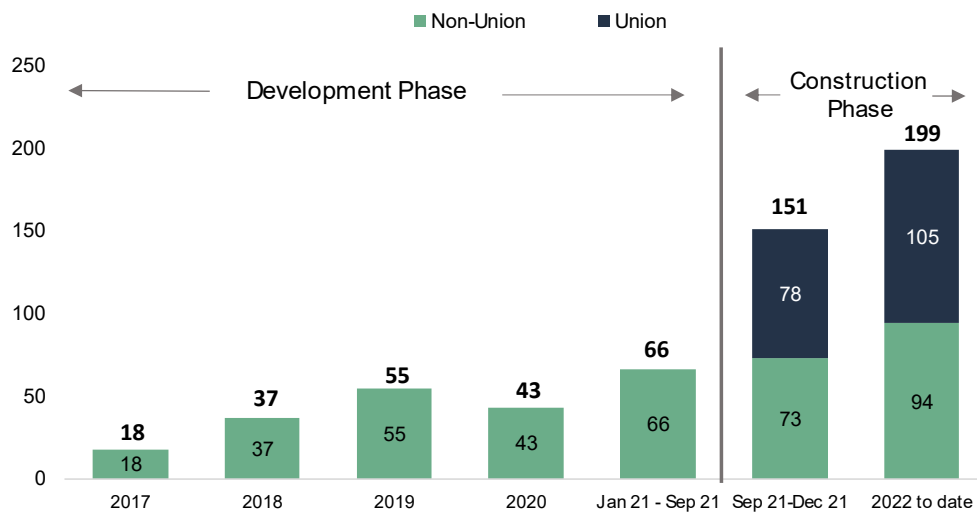
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Notably, this estimate of employees is conservative as it is based on reporting from only 34 of the 48 companies with contracts greater than \$1 million¹³ and includes only Massachusetts-based employees (contractors did not provide total employment figures that included non-Massachusetts employees).

Construction Phase

Construction phase activities began in September 2021, with 151 union and non-union workers employed at some point during the September through December 2021 period.¹⁴ A total of 199 workers have been employed in 2022 thus far (January 2022 through September 2022), with 105 of those workers being union employees (see Figure 6).

Figure 6. Number of Massachusetts-Based Employees among Subcontractors and Vendors



Source: Vineyard Wind Services Historical and Monthly Tracker Submissions

The Development phase data in Figure 6 represent Massachusetts-based workers only. However, the more detailed monthly tracker instituted in late 2021 asked subcontractors to provide employees' ZIP Code. From these data, we estimate that 80.3% of the workers employed during the September through December 2021 period are Massachusetts residents, and 79.3% employed to date in 2022 are Massachusetts residents (see Table 7). The employees represent both full-time and part-time positions.

Table 7. Percent Employees Who Are Massachusetts Residents

Period	Total Employees	MA Employees	Percent MA
Sep 2021 - Dec 2021	188	151	80.3%
2022 Year-to-Date	251	199	79.3%

Source: Vineyard Wind Services Monthly Tracker Submissions

¹³ Most of the fourteen companies with contracts of > \$1 million that did not report data are based outside the U.S. and likely have a relatively small number of Massachusetts-based employees.

¹⁴ As noted in the project schedule presented in Section 3, there was a short overlap of Development and Construction phase activities.

6 Direct, Indirect, and Induced Employment and Economic Impacts

This section expands on the previous section by examining the broader economic impact of the project activities to date. Specifically, we revisit UMass Dartmouth's 2017 economic impact analysis and re-estimate the indirect and induced economic effects of the proposed 800 MW project on the Massachusetts economy for both the Development and Construction phases. To do so we use actual employment data provided by larger contractors and estimated for smaller contractors using actual contract values as the inputs to the Implan model and estimate the economic impact of the project to date using the same method as the 2017 analysis.

Vineyard Wind's direct spending circulates through the state economy and supports additional spending and job creation, that is, the original expenditures and job creation are multiplied. The first set of these ripple effects are **indirect effects**. These effects estimate external economic activity supported from suppliers purchasing goods and services from other businesses as a result of Vineyard Wind's direct spending. Consequently, indirect impacts are often referred to as "supply-chain" impacts.

The second set of effects are **induced effects**, which are the multiplier effects of the direct and indirect effects created when Vineyard Wind employees and employees of its indirect suppliers spend their wages on goods and services statewide. Vineyard Wind pays relatively high wages, and the majority of its employees reside in Massachusetts, thus one would expect the induced economic effect on the Massachusetts economy to be significant relative to the direct effects.

6.1 Development Phase Impacts, 2017-2021

Indirect Impacts: Vineyard Wind's direct payroll and non-payroll expenditures supported an additional 137 indirect jobs during the Development phase. These jobs produced \$11.5 million in labor income, contributed \$16.8 million in added value to the Massachusetts economy, and supported \$27.9 million in new economic output during the Development phase (see Table 8).

Induced Impacts: The direct and indirect impacts induced an additional 251 jobs that generated \$16.8 million in labor income. Development phase activities also contributed over \$28.2 million in added value to the Massachusetts economy and supported \$44.9 million in new economic output (see Table 8).

Total Impacts: In total, Development phase economic activity generated 666 jobs, \$59.3 million in labor income, \$79.1 million in value added, and \$166.6 million in economic output (see Table 8).

Table 8. Direct, Indirect, and Induced Impacts, Development Phase

Massachusetts Impact				
Development Phase (2017 - 2021)				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	278	\$ 31,057,366	\$ 34,085,502	\$ 93,903,244
Indirect Effect	137	\$ 11,505,524	\$ 16,782,238	\$ 27,821,324
Induced Effect	251	\$ 16,759,219	\$ 28,237,439	\$ 44,924,273
Total Effect	666	\$ 59,322,109	\$ 79,105,179	\$ 166,648,841

Source: UMass Dartmouth and Vineyard Wind

6.2 Construction Phase Impacts, September 2021-September 2022

Nearly all of the construction-related activity to this point has been focused on onshore work in the Town of Barnstable. Offshore construction is not expected to begin in earnest until Q4 2022, with the majority of the offshore construction impacts expected to occur beginning in Q2 2023. Accordingly, the economic impacts presented below are preliminary and are expected to be much higher once construction of the wind farm is complete.¹⁵

Indirect Impacts: Vineyard Wind's direct payroll and non-payroll expenditures have supported an additional 64 indirect jobs during the Construction phase to date. These jobs produced \$4.3 million in labor income, contributed \$7.3 million in added value to the Massachusetts economy, and supported \$15.8 million in new economic output during the Construction phase (see Table 9).

Induced Impacts: The direct and indirect impacts induced an additional 34 jobs that generated \$2.3 million in labor income. Construction phase activities also contributed over \$3.8 million in added value to the Massachusetts economy and supported \$6.0 million in new economic output (see Table 9).

Total Impacts: In total, Construction phase economic activity to date has generated 190 jobs, \$15.4 million in labor income, \$20.3 million in value added, and \$37.8 million in economic output (see Table 9).

Table 9. Direct, Indirect, and Induced Impacts, Construction Phase

Massachusetts Impact				
Construction Phase (September 2021 - September 2022)				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	92	\$8,804,789	\$9,201,004	\$15,959,847
Indirect Effect	64	\$4,320,315	\$7,259,660	\$15,782,155
Induced Effect	34	\$2,255,580	\$3,802,150	\$6,049,020
Total Effect	190	\$15,380,684	\$20,262,815	\$37,791,023

Source: UMass Dartmouth and Vineyard Wind

¹⁵ Vineyard Wind expanded the project envelope in December 2019 to include 13 MW wind turbine generators (WTGs) rather than the 8 MW WTGs assessed in the 2017 analysis. This change reduces the number of WTGs in the current approved configuration from 100 to 62. Vineyard Wind conducted a supplemental economic assessment to estimate the effect of this change on employment and economic output and found that the economic benefits associated with the lower WTG scenario do not differ materially from the maximum design scenario of up to 100 WTGs assessed in the 2017 analysis. However, the actual effect of the decrease in the number of WTGs cannot be accurately determined until construction activities are complete.

Union Wage Premium

Much of the construction work is being performed by union labor under a Project Labor Agreement (PLA). A PLA specifies the wages, overtime wages, and fringe benefits to be paid on a project and is usually higher than the prevailing wage required on public projects. The University of California Berkeley's Center for Labor Research and Education recently found that nationally, in 2015, union construction workers were paid wages that were 42% higher (and had total compensation that was 78% higher) than their non-union counterparts.¹⁶

The union wage premium is particularly significant for people of color and women.¹⁷ For example:

- Wages for black union workers are 14.7% higher than those of their nonunion counterparts, while white union workers make 9.6% higher hourly wages than their nonunion peers.¹⁸
- Black union workers are 17.4 percentage points more likely than nonunion workers to have employer-provided health insurance and 18.3 percentage points more likely to have an employer-sponsored retirement plan.¹⁹
- Women represented by labor unions earn an average of 30.9% more per week than women in nonunion jobs (among full-time workers aged 16 and older).²⁰
- Hispanic women represented by labor unions have median weekly earnings that are 42.1 percent higher than those without union representation.²¹

Employing union labor under PLAs not only provides a living wage for construction and trades workers employed on the project, but it also boosts the regional economic impact of a project through higher induced impacts as a result of the higher disposable income of union members working on the project.

¹⁶ See: <https://escholarship.org/content/qt1vg7t2xd/qt1vg7t2xd.pdf?t=r97ho9&v=lg>

¹⁷ These bullets include all workers, not just those employed in the building trades.

¹⁸ See: <https://www.epi.org/publication/how-todays-unions-help-working-people-giving-workers-the-power-to-improve-their-jobs-and-unrig-the-economy/#epi-toc-10>

¹⁹ See: <https://www.cepr.net/images/stories/reports/black-workers-unions-2016-08.pdf?v=2>

²⁰ See: <https://statusofwomendata.org/wp-content/uploads/2015/08/R409-Union-Advantage.pdf>

²¹ Ibid.

7 Comparison to UMass Dartmouth 2017 Estimates

This section compares the extent to which the results reported here compare with the estimates of the project's contributions to employment and economic development contained in the 2017 UMass Dartmouth analysis and included as part of Vineyard Wind's proposal submission to DOER. On every dimension of the economic impact of the project to date, we find that the expected impacts are larger in 2022 than expected in 2017.

As noted, a primary reason for the larger impact in 2022 is the two-year federal permitting delay and expanded project envelope that unexpectedly extended the Development phase. The economic impact of future projects may be closer to initial estimations as project development becomes more streamlined and predictable.

Direct Employment Impacts

- The direct number of Development phase FTE job-years is 278. This compares to the 2017 estimate of 126 job years, a difference of 152 jobs (see Table 10).
- In all, the total job impact of Development phase activities 666. This compares to the 2017 estimate of 274 jobs, a difference of 392 jobs (see Table 10).

Indirect and Induced Employment Impacts

- **Indirect Impacts:** Vineyard Wind's direct payroll and non-payroll expenditures are expected to generate an additional 137 indirect FTE job years during the Development phase. This compares to the 2017 estimate of 27 jobs, a difference of 110 jobs (see Table 10).²²
- **Induced Impacts:** The direct and indirect impacts of the proposed project are expected to induce an additional 251 jobs during the Development phase. This compares to the 2017 estimate of 121 jobs, a difference of 130 jobs (see Table 10).

Labor Income, Value Added, and Economic Output Impacts

- Labor Income, Value Added, and Economic Output values are also much higher than the 2017 estimates. For example, total economic output (direct + indirect + induced) is estimated to be \$166.6 million, which compared to \$81.1 million in the 2017 estimate, a difference of \$85.5 million (see Table 10 and Figure 7).

²² IMPLAN does not report jobs as FTEs. Accordingly, the reported jobs for the indirect and induced impacts were converted to FTEs using IMPLAN conversion tables.

Table 10. Development Phase, Total Massachusetts Economic Impacts, PPC Estimate Versus Actual

Massachusetts Impact								
Development Phase								
Impact Type	Employment		Labor Income		Value Added		Output	
	PPC 2017	Actual	PPC 2017	Actual	PPC 2017	Actual	PPC 2017	Actual
Direct Effect	126	278	\$ 19,734,093	\$ 31,057,366	\$ 26,349,146	\$ 34,085,502	\$ 38,421,815	\$ 93,903,244
Indirect Effect	27	137	\$ 2,166,711	\$ 11,505,524	\$ 3,172,692	\$ 16,782,238	\$ 8,438,925	\$ 27,821,324
Induced Effect	121	251	\$ 7,965,164	\$ 16,759,219	\$ 13,159,673	\$ 28,237,439	\$ 34,225,613	\$ 44,924,273
Total Effect	274	666	\$ 29,865,968	\$ 59,322,109	\$ 42,681,512	\$ 79,105,179	\$ 81,086,353	\$ 166,648,841

Source: Estimate; Dartmouth PPC, 2017 (Base scenario). Current; UMass Dartmouth & Vineyard Wind

Figure 7
Development Phase, Total Massachusetts Economic Impacts
UMass Dartmouth Estimate Versus Actual



Source: Estimate; UMass Dartmouth Public Policy Center (2017). Current; UMass Dartmouth and Vineyard Wind

7.1 Employment Impacts in Other Industry Sectors

Vineyard Wind's project expenditures and the related expenditures of their contractors and subcontractors support employment in other industry sectors through indirect and induced impacts. Table 11 lists the top industry sectors in Massachusetts that benefit from in-state project spending by the number of jobs supported.²³ As noted, about 38% of Vineyard Wind's employees reside in Southeastern Massachusetts, thus it is likely that many of the employment impacts in Table 11 occurred in this region of the state.

Table 11
Top Indirect and Induced Employment Impacts

Industry	Jobs
Employment services	28
Real estate	21
Full-service restaurants	19
Hospitals	16
Other food and drinking places	10
Individual and family services	10
Limited-service restaurants	9
Management consulting services	9
Transit and ground passenger transportation	9
Offices of physicians	8

Source: Implan and UMass Dartmouth

7.2 Why Are the Current Economic Impacts Higher Than the 2017 Estimates?

There are several reasons why the job and other economic impacts presented above are higher than the 2017 analysis estimated.

- The 2017 analysis was conducted very early in the project when not all the project parameters were known, particularly in terms of local content expenditures. Projects of this magnitude evolve over time and estimations are subject to change based on a host of factors outside of a developer's control. For example, the 2017 estimations were based on 8 MW turbines, which were the largest available at the time of the analysis.
- The project's two-year federal permitting delay and resulting expanded project envelope unexpectedly extended the project schedule and resulted in a higher number of direct job-years and direct expenditures. This is the first large-scale offshore wind project in the United States and these delays likely will not be replicated on future projects to this extent.
- The delay not only increased the development and pre-construction job impacts and project costs for Vineyard Wind, but it also increased the level of effort required of the lead permitting consultant team and associated subconsultants. The majority of these jobs require a Massachusetts presence and are held by Massachusetts-based employees.
- Inflation increased much more significantly than anticipated by the 2017 analysis and unexpectedly increased expenditures on goods and services.

²³ Includes full and part-time positions.

8 Lessons Learned to Date and Research-related Recommendations

This section highlights several relevant lessons learned while conducting this research that Massachusetts officials can use to support efforts to improve economic outcomes for Massachusetts and inform future state procurement and related programmatic efforts.

8.1 Data Reporting

There are two primary issues related to data reporting: Compliance and Fidelity.

1. Data Compliance

Issue: Vineyard Wind applied great effort in reaching out to subcontractors to obtain both historical and current monthly data from their contractors. Data collection was undertaken in an environment where the project was ramping up very quickly and the permitting process was uncertain. Historical data was particularly difficult to obtain from some of the large subcontractors. The historical data tracker was purposefully simplified to minimize the burden of reporting and required only a few items of information: the number of Massachusetts-based employees, the total amount spent, the U.S. amount spent, and the amount spent in Massachusetts. Despite these efforts, 14 companies with contract values exceeding \$1 million did not provide the requested data.

In addition, it was decided early on in the project that requiring the 298 subcontractors with contracts below \$1 million to report the same data was infeasible. This decision was informed by conversations with several subcontractors and package managers, who made it clear that compliance would be low and the data reporting imprecise.

Overall, difficulties with compliance were primarily the result of subcontractors contracting with Vineyard Wind before the project's financial close. Accordingly, there was no language built into the contracts that required reporting. In addition, work for many of these contractors was completed over the 2018-2020 period, and these companies did not have much incentive to comply with data requests since they were no longer involved in the project.

Recommendation: As described above, gaps in the available data were addressed by conservative estimates based on actual contract values and empirically derived from an established and widely used input-output model. Going forward, the state should recommend that offshore wind developers include language that requires reporting in all contracts.

2. Data Fidelity

Vineyard Wind and UMass Dartmouth created a monthly data collection tracker after the project's financial close for completion by the Tier 1 suppliers. The initial data collection sheet was quite detailed. However, Vineyard Wind's package managers noted that subcontractors were apprehensive about providing specific spending information because detailed expenditure data would allow Vineyard Wind to obtain proprietary information that could be competitively disadvantageous in future negotiations over the contracted price of goods and services. This is a legitimate concern by the contractors as Vineyard Wind 1 is not a public project and there is tension between Vineyard Wind and its subcontractors about what is an appropriate level of transparency. Furthermore, many of the subcontracts are incredibly complex and the procurement process is very competitive.

Our approach to overcoming this tension with subcontractors was a pragmatic one that was designed to balance the need for detailed information with the level of detail the contractors felt comfortable reporting. The simplified tracker allowed us to strike this balance.

In addition, the data supplied by subcontractors that did comply was at times incomplete, which is partly a result of the data existing across a subcontractor's many departments, such as finance, human resources, and procurement. This challenge was greatest with data designed to capture the diversity of project employees including their race, gender, tribal affiliation, and veteran status. While not a requirement of this report, these missing data make it difficult to accurately measure whether or not the project is meeting various diversity, equity, and inclusion goals, including those contained in the Project Labor Agreement. The downside is that requesting intensely detailed reporting of sensitive or unknown information is cumbersome for subcontractors and may trigger privacy concerns.

Recommendation: In addition to the state recommending that offshore wind developers include reporting language in all contracts as described above, the state should be consistent and clear in standardizing the information that is to be collected to ensure consistency among various offshore wind projects. These requirements should include specific definitions as to how jobs and other data should be defined and collected and how they are reported to ensure accurate and timely reporting.

9 Resiliency and Affordability Fund

Vineyard Wind has established the Resiliency and Affordability Program (RAP) in partnership with Citizens Energy Corporation (Citizens Energy) and Vineyard Power Development Fund, Inc.²⁴ Vineyard Wind will contribute \$15 million in total funding to the RAP with the funding to be used by the program partners to support the development of distributed battery energy storage and solar projects in local host communities as well as to provide credits directly to low-income ratepayers' electric utility bills. The RAP is focused on supporting projects and delivering benefits to low-income ratepayers in New Bedford, Martha's Vineyard, Nantucket, Barnstable, and Somerset as well as to the Mashpee Wampanoag Tribe and Wampanoag Tribe of Gay Head (Aquinnah).

The RAP is in its first year and no projects have been fully developed. However, Citizens Energy has begun enrolling low-income ratepayers in their Joe-4-Sun (J4S) program. The J4S program leverages the Massachusetts SMART program to develop low-income community shared solar projects that generate solar bill credits that are used to lower electricity bills for low-income households. At the time of reporting, 82 participants were enrolled in the J4S program, with another 86 in the process of being enrolled (see Table 12). Each household enrolled in the program will receive about \$600 in electricity bill savings totaling approximately \$100,800 in annual customer savings. Half of the program's savings—\$54,000—is provided by RAP funds.

Table 12. Joe-4-Sun Program Participation

Community	# Participants	# In Process of Enrolling	Total
Barnstable	1	0	1
Martha's Vineyard	9	5	14
Nantucket *	0	0	0
New Bedford	64	53	117
Somerset	2	26	28
Tribes**	6	2	8
Total	82	86	168

* Nantucket is not currently eligible for J4S program due to no Citizens Energy solar projects in Nantucket territory

** Tribes includes Mashpee Wampanoag Tribe and Wampanoag Tribe of Gay Head (Aquinnah)

²⁴ Vineyard Power Development Fund, Inc. is an affiliate entity of Vineyard Power Cooperative, Vineyard Wind's community benefits partner on Martha's Vineyard.

10 Host Community Agreements

Vineyard Wind entered into a Host Community Agreement (HCA) with the Town of Barnstable in 2019. The HCA requires Vineyard Wind to make annual payments to the Town of at least \$1.534 million each year in combined property taxes and Host Community Payments (HCP). The agreement guarantees a total HCP of \$16 million, plus an additional \$60,000 (adjusted for inflation annually), for each year the project is in operation beyond 25 years.

The HCA provided the opportunity for the Town of Barnstable to conduct a detailed review of the specifications for the new substation constructed by Vineyard Wind. Beyond the HCA, Barnstable and Vineyard Wind collaborated on the Town's sewer expansion effort by co-locating sewer infrastructure along the cable route, saving the town millions in project costs, minimizing the need for future road construction, and helping to address the local environmental impact of wastewater and nitrogen loading that degrades the town's bays, estuaries, and ponds. Future annual reports will more fully capture the impacts of the HCA collaboration.

11 Innovation in Marine Mammals and Wind Fund

While still early in the process, there are two programs that Vineyard Wind is supporting under its Wind and Whales Fund. The first is a confirmed project partner and the second is an RFP for \$1.5 million for passive acoustic monitoring (PAM) deployment, which will launch in Q4 2022. Importantly, these projects are in the very early stages and will be reported on in more detail in next year's report in collaboration with MassCEC.

11.1 Innovations for Marine Mammals Protection Initiative Project Plan

Vineyard Wind is allocating approximately \$1 million from the Wind and Whales Fund to the Charles River Analytics (CRA). These funds will be used to test a thermal imaging whale detection system that may offer improved detection for vessel strike avoidance mitigation for marine mammals. This system will be deployed by CRA before and during Vineyard Wind 1 to: (1) compare the performance of a thermal imaging system to that of trained professional protected species observers; (2) conduct a feasibility trial for remote, near real-time verification during Vineyard Wind 1's operations phase to reduce the need for offshore personnel, (3) evaluate the impact of vessel speed on marine mammal detection performance, and (4) compare camera configurations for optimal marine mammal detection.

11.2 Passive Acoustic Monitoring

Vineyard Wind, in collaboration with the MassCEC, is seeking to competitively select and fund an organization or business to provide a real-time PAM and data transmission system with remote alert capabilities that can be deployed at varying locations in advance of transiting vessels during the construction of the Vineyard Wind 1 project. Through this joint initiative, Vineyard Wind and MassCEC are seeking to progress the technology readiness level of real-time PAM technologies as a mitigation tool for vessel strike avoidance and provide better protections for North Atlantic Right Whales (NARW) in the New England region. A second objective is to acoustically record and localize NARW and other mysticete vocalizations to enhance the general understanding of the species' distribution and potentially, abundance. Funds available for the RFP are up to \$1.5 million. The PAM RFP is currently posted on the MassCEC website.