Outer Continental Shelf Air Regulations Notice of Intent

CAPE WIND ENERGY PROJECT
HORSESHOE SHOAL
NANTUCKET SOUND,
MASSACHUSETTS

PREPARED FOR

Cape Wind Associates, LLC
75 Arlington Street, Suite 704
Boston, MA 02116

PREPARED BY

ESS Group, Inc.
888 Worcester Street, Suite 240
Wellesley, Massachusetts 02482

Project No. E159-502.8

December 7, 2007

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1.0 INTRODUCTION

The following Notice of Intent (NOI) for the proposed Cape Wind Associates' Offshore Renewable Energy Project (the Project) has been prepared by ESS Group, Inc. (ESS) to fulfill the regulatory requirements of the United States Environmental Protection Agency (EPA), as codified under Title 40 Code of Federal Regulations (CFR), Part 55: Outer Continental Shelf Air Regulations. 40 CFR § 55.4(a) specifies that not more than 18 months prior to submitting an application for a preconstruction permit for a source located within 25 miles of State's seaward boundaries, the applicant must submit an NOI to the EPA regional office and to the air pollution control agencies of the Nearest Onshore Area (NOA) and areas adjacent to the NOA.

This NOI acknowledges that the primary emission sources exist only during preconstruction activities and the two-year Project construction period, and assumes the applicability of onshore requirements based on the twenty year useful life of the Project. The NOI assumes the Corresponding Onshore Area (COA) to be the NOA as the Administrator has not made any COA designation pursuant to 40 CFR § 55.5.

2.0 PROJECT APPLICANT

- The Applicant is Cape Wind Associates, LLC.
- The Project name is the Cape Wind Energy Project.
- The Facility is located at Horseshoe Shoal, Nantucket Sound, Massachusetts (Latitude 41-30-31 N, Longitude 70-19-55 W).
- The owner is Cape Wind Associates, LLC.
- The Facility Site Contact is:
  Craig D. Olmsted
  (617) 904-3100 ext 119
- The Project's mailing address is :
  Cape Wind Associates, LLC
  75 Arlington Street, Suite 704
  Boston, Massachusetts 02116
  (617) 904 3100

3.0 PROJECT DESCRIPTION

The Project is fully described in the Draft Environmental Impact Statement (DEIS) prepared by the United States Army Corps of Engineers (USACE). This document was prepared in November 2004 in response to a permit application to fulfill the requirements of the National Environmental Policy Act (NEPA) and the USACE implementing regulations under Title 33 CFR, Parts 320-330. Please refer to Executive Office of Environmental Affairs (EOEA) File No. 12643 and Cape Cod Commission (CCC) File No. JR#20084.

The Project will utilize offshore wind energy as its renewable fuel to generate electric energy for sale. The Standard Industrial Code (SIC) for the project is 4911.

4.0 POTENTIAL EMISSIONS

Air pollutant emissions from the Project will occur during pre-construction and construction activities. While in operation, there will be no emissions sources associated with the generation of electricity by the Facility. During operation of the wind park, sources of emissions will consist of routine maintenance activities, safety, health and emergency drills and actual emergency events. None of these sources meet the definition of an OCS source and therefore are not included in this NOI.

The Project is calculating emissions to include construction emissions as an OCS Source. At the same time, the regulations provide that OCS sources located within 25 miles of a state's seaward boundary should be regulated according to the requirements applicable to a source located in the COA. Those requirements would NOT include quantification or regulation of onshore emissions from construction. Thus, those onshore emissions from construction activities have not been included in this NOI.

The emission sources include the following:

- Crew, supply and tow boat engines
- Offshore installation components (such as cranes, pile drivers, jet plows and winch engines)
- Insignificant sources including paints, coatings, and solvent usage

Table 1 summarizes the potential emissions in tons from OCS sources for each phase of the Project, which will occur inside of 25 miles. Table 1 also shows the expected ton per year emission rates of each pollutant during the two year construction period, based on the assumption that 70% of the emissions occur during the first year of construction. Vessel emission calculation summaries for the OCS sources involved in the Pre-construction and Construction phases of the Project that will occur inside of 25 miles have been included in Appendix A. For each potential OCS emission source associated with the Project, an estimation of its potential–to–emit the following pollutants was made:

- Nitrogen Oxides (NOx)
- Volatile Organic Compounds (VOC)
- Sulfur Dioxide (SO_2)
- Carbon Monoxide (CO)
- Particulate Matter smaller than 10 microns (PM_{10})
- Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Carbon Dioxide (CO_2)
- Hazardous Air Pollutants (HAPS)

The calculation methodology for potential emissions is:

ER= EF x EHP x TM

Where:

ER = emission rate (lbs. per period)
EF = full load pollutant specific emission factor (lb/hp-hr)

EHP = engine maximum rated horsepower (hp)
TM = time in mode (operating hours/period)

- For most of the sources, the emissions factors were compiled from the latest AP-42 references adopted by the U.S. Department of the Interior, Minerals Management Service (MMS). Specifically emission factors as presented in Chapter 3 - Stationary Internal Combustion Sources of AP-42, Table 3.2-2, Table 3.3-1, Table 3.3-2, and Tables 3.4-1 through 3.4-4 were used in the potential emissions calculations.
- For the Zodiac Boats that will be used, emission factors from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", EPA420-R-05-019, Table 10, were used. Worst case emissions factors were selected from carbureted, indirect injection and direct injection emission factors for 50-100 Hp outboard, marine engines. When calculating emissions, the emission factors for HC and PM were used to calculate the potential emissions of VOC and PM_{10}, respectively.

  See Section 8 for additional discussion concerning limitations on source operations and current and proposed non-road engine and marine diesel standards.

5.0 EMISSIONS POINTS

5.1 Crew Boats

Crew Boats will be used for a variety of purposes to support project construction. They will be equipped with diesel–fired IC engines rated at approximately 750 hp. These engines often employ the following measures to minimize the emissions of NOx: four-degree injection timing retard, turbo-charging and enhanced intercooling. Additional diesel-fired engines on these vessels are the auxiliary engines, whose emissions are usually not controlled.

Crew boats will average 1 round trip per day between the wind farm and Falmouth or other piers or ports and will be used for the following activities:

1. Load, transport (receipt, movement and delivery) and unload personnel, supplies, and equipment to and from the wind farm or pier locations for routine construction operations and maintenance.

2. Support operations in conjunction with construction, maintenance and/or repairs in the wind farm, including diving operations.

3. Support/participate in safety, health, and emergency drills and actual incidents, including storm, vessel collision, bomb threat and terrorist and man overboard.

For crew boats, the Emission Point description is as follows:

- Emission rate calculations are explained in Section 4; emission rates and emissions are summarized in Appendix A.
- Stack height should proportionally be about 1/3 of the boat length. For a 750 hp boat of 65 ft length, the stack height is approximated at 22 ft.

5.2 Supply Boats

The supply boats assigned to the Project will be equipped with diesel-fired IC engines. These engines often employ the following measures to minimize the emissions of NOx: four-degree injection timing retard, turbo-charging and enhanced intercooling. Additional diesel-fired engines on these vessels are the auxiliary engines, whose emissions are usually not controlled.

Supply boats identified for the construction phase will be:

- Tow tugs identified for the transport of the barges containing the piles, transition pieces, rock armor, filler material, and ESP deck are rated at 6,000 hp.
- Attendant tugs identified for the transport of the jack up barge and the scour protection installation equipment, and the handling of the pile and transition piece barge, the armor/filler barge, and the ESP crane barge are rated at 3,000 hp.
- The tow and attendant tugs to be used for cable laying are rated at 1,500 hp.

Supply boats will be used frequently during periods of construction and will most likely come from Quonset Point in Rhode Island. Supply boats will be used for the following activities:

1. Load, transport (receipt, movement and delivery) and unload personnel, equipment and supplies to and from the wind farm during construction operations.

2. Support operations in conjunction with construction, including cable installation, mooring buoy, structural supports, and cathodic protection equipment.

3. Support/participate in safety, health, and emergency drills and actual incidents, including storm, vessel collision, bomb threat and terrorist and man overboard.

For supply boats, the Emission Point description is as follows:

- Emission rate calculations are explained in Section 4; emission rates and emissions are summarized in Appendix A.
- Stack height should proportionally be about 1/3 of the boat length.
    - For a 1,500 hp boat of 90 ft length, the stack height is approximated at 30 ft.
    - For a 3,000 hp boat of 105 ft length, the stack height is approximated at 35 ft.
    - For a 6,000 hp boat of 120 ft length, the stack height is approximated at 40 ft.

5.3 Lobster Boats

Re-configured lobster boats will be used for geophysical and geotechnical investigation during the Pre-construction phase of the project. These 42-foot long boats will be equipped with diesel-fired 1,000 Hp IC engines. The lobster boats also include natural gas-fired generators.

For the Lobster boats, the Emission Point description is as follows:

- Emission rate calculations are explained in Section 4; emission rates and emissions are summarized in Appendix A.
- Stack height should proportionally be about 1/3 of the boat length. For a 42-ft long boat, the stack height is 14 ft.

5.4 Zodiac Boats

Zodiac boats will be used for the boring program during the pre-construction phase of the project. During this phase, a number of deep borings will be advanced at selected WTG sites. This effort will provide more site specific data to assist in the final design stage. The Zodiac boats will be equipped with approximately 100-hp gasoline burning outboard motors and will most likely come from Falmouth.

For the Zodiac boats, the Emission Point description is as follows:

- Emission rate calculations are explained in Section 4; emission rates and emissions are summarized in Appendix A.
- The zodiac boats don't have stacks. The emission point is at sea level.

5.5. Cranes

The pedestal cranes on the crane barges are driven engines rated at 400 to 800 hp. The IC engines to be used in the wind farm will not be equipped with diesel fuel flow metering devices. All IC engines will be equipped with non-resettable hour meters. The actual engine usage will be logged each time the engine is fired. The engine emissions will be calculated using the total elapsed run time and the maximum rated engine hp rating as described in Section 4. The emissions from the cranes are summarized in Appendix A.

5.6 Generators on Barges

The generator engines on the crew boats and supply boats provide half of the maximum engine rating. The generator engines will be equipped with non-resettable hour meters. The actual engine usage will be logged each time the engine is fired. The engine emissions will be calculated using the total elapsed run time and the maximum rated engine hp rating as described in Section 4. The emissions from the generators are summarized in Appendix A.

6.0 FUELS AND RAW MATERIALS: QUANTITY AND TYPE

Diesel oil, natural gas and gasoline are the three fuels identified for the Project. Diesel will be used extensively throughout all phases of the Project, while the use of natural gas and gasoline will be limited to the pre-construction phase. During the pre-construction phase, natural gas will be used as the fuel for the electric generators and gasoline will be used in the Zodiac boats.

Fuel usage has been estimated based on the maximum consumption rates and total operating hours of each engine or generator. Each engine or generator was assumed to operate at full load for the duration of its operation to determine its fuel usage. Fuel usages were calculated based on an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr. This is the BSFC value is used to convert power outputs to heat input rates in AP-42, Chapter 3 - Stationary Internal Combustion Sources. The following heating values were assumed for each fuel:

Diesel oil heating value = 138,500 Btu/gal
Gasoline heating value = 125,000 Btu/gal
Natural gas heating value = 1,030 Btu/ft^3

The equation used to determine the fuel usage of each engine or generator was as follows:

Diesel Oil or Gasoline Usage
Fuel Used (gal) = Equipment Size (hp) x Hours of Operation (hr) x BSFC of 7,000 (Btu/hp-hr) / Fuel Heating Value (Btu/gal)

Natural Gas Usage
Fuel Used (ft^3) = Equipment Size (hp) x Hours of Operation (hr) x BSFC of 7,000 (Btu/hp-hr) / Fuel Heating Value (Btu/ft^3)

In accordance with the EPA420-F-04-032 document dated May 2004, fuel sulfur levels in non-road diesel fuel should be limited to a maximum of 500 ppm, starting in 2007. This requirement also applies to marine engines. In accordance with this requirement, the fuel oil for the vessels will be low sulfur diesel with a sulfur content of 0.2 to 0.3% by weight.

7.0 AIR POLLUTION CONTROL EQUIPMENT

The engines and generators will not be equipped with any add-on pollution control equipment.

8.0 SOURCE OPERATIONAL LIMITATIONS / WORK PRACTICES AFFECTING EMISSIONS

The vessels will use low sulfur distillate oil with 0.2 to 0.3% sulfur content by weight. The overall preference is for equipment that meets non-road and marine engine standards as applicable. In the event that EPA's March 2007 Proposed Rule, No. EPA-HQ-OAR-2003-0190 for More Stringent Emission Standards for Locomotives and Marine Compression-Ignition Engines becomes applicable to the Project, the engines used for the Project will meet those standards as promulgated.

9.0 OTHER INFORMATION AFFECTING EMISSIONS

Based on good engineering practice principles and current trends of existing marine vessels, the stack height for each vessel is assumed to be proportionally about 1/3 of the vessel length. Accordingly, for the vessels employed for the Project the stack heights are expected to range from approximately 14 to 40 ft for vessels 42 to 120 ft in length.

10.0 INFORMATION TO DETERMINE THE APPLICABILITY OF ONSHORE REQUIREMENTS

The Massachusetts Department of Environmental Protection (MassDEP) has established Air Pollution Control Regulations (310 CMR 7) for onshore sources of air emissions. 310 CMR 7.02 provides procedures and standards for the issuance of approvals in the Commonwealth of Massachusetts, and establishes emission limitations and restrictions for a facility or emission unit. 310 CMR 7.02(2)(b) specifies changes that may be made at a facility that are exempt from the approval requirements. 310 CMR 7.02(b)(7) exempts facilities that have de minimus emissions, or potential emissions of less than one ton of any air contaminant, from the plan approval requirements. The proposed Cape Wind facility does not have potential emissions of any contaminant of more than one ton per year, and is therefore exempt from the MassDEP's plan approval requirements.

310 CMR 7.00: Appendix A sets forth the Massachusetts preconstruction review programs for stationary sources of air pollution. It applies to major sources of a pollutant for which an area is designated as nonattainment and for all major sources of NO_X or VOC. The proposed Cape Wind facility is not a major source of any pollutant and is therefore exempt from the preconstruction review requirements of 310 CMR 7.00, Appendix A.

310 CMR 7.00: Appendix C sets forth the MassDEP's Operating Permit and Compliance Program. The proposed Cape wind facility does not meet the minimum potential emissions thresholds to be subject to the program. It is also not subject to a New Source Performance Standard (NSPS), a National Emissions Standard for Hazardous Air Pollutants (NESHAP), it is not an acid rain source, and is not in any of the other source categories to be subject to this program.

There are no other onshore requirements that are applicable to the proposed facility.

11.0 INFORMATION TO DETERMINE SOURCE IMPACTS IN ONSHORE AREAS.

Air dispersion modeling is used to estimate the potential ambient impacts from the release of pollutants into the atmosphere from emission sources. EPA has developed computer models to estimate these impacts.

EPA's SCREEN3 model is often used as a first cut screening tool to conservatively estimate the 1-hour ambient impact concentrations resulting from the emissions from a source. The model is applied for a range of meteorological conditions to calculate impacts at various downwind distances, assuming that the wind blows directly towards the modeled locations. The model predicts the maximum 1-hour ambient air impact concentration resulting from the source emissions. Using standard EPA scaling factors, the 1-hour impact is scaled to estimate the maximum impacts for other averaging periods.

The emissions from the vessels, engines and generators within the Cape Wind site will be evaluated to determine the resulting potential ambient impacts in Massachusetts. A simple screening analysis will be performed to evaluate these emissions, with traffic routes modeled as area sources. In the event that the initial modeling yields overly conservative results, AERMOD refined modeling would be employed

using sequential hourly meteorological data, and the ship traffic will be modeled as a series of line sources.

11.1 Construction Emissions

A wide variety of vessels or equipment could be operating within the Cape Wind construction site at any given time. The total potential emissions from these activities are provided in Table 1. Modeling to determine the maximum impact will be based on an estimate of the maximum number of vessels and pieces of construction equipment that would be operating at any given time during the construction period.

11.2 Dispersion Environment

The Cape Wind site is surrounded by water. There are no other land uses within a three-kilometer radius of the site. Therefore, rural dispersion coefficients will be used in the dispersion modeling analysis.

11.3 Model Selected for Use

Screening modeling will be performed with EPA's SCREEN3 (dated 96043) model. The model is appropriate for assessing ground-level concentrations in rural dispersion environments. The SCREEN3 model calculates 1-hour concentrations in simple terrain using the EPA Industrial Source Complex Short-Term (ISCST3) Model algorithms.

11.4 Scaling Factors

The SCREEN3 model calculates 1-hour concentrations at simple terrain locations. NAAQS have been established for various averaging periods. Short-term 1-hour and 8-hour standards have been established for CO. An annual standard has been established for nitrogen dioxide (NO_2). Annual, 3-hour and 24-hour standards have been established for SO_2. A 24-hour standard has been established for PM_{10}. Annual and 24-hour standards have been established for $PM_{2.5}$. In order to estimate simple terrain and cavity concentrations for the other averaging periods, scaling factors of 0.9, 0.7, 0.4 and 0.08 will be applied to the 1-hour impacts to derive 3-hour, 8-hour, 24-hour and annual impacts, respectively.

11.5 Source Parameters

The construction vessel emissions will be modeled as a volume source. Initially, emissions from all construction vessel traffic will be conservatively located at the closest point of the Cape Wind project to Massachusetts land. Emissions will be released throughout the 25 square mile project area. However, initial modeling will be based on the conservative assumption that all construction activity occurs within a 2000-ft by 2000-ft area, located within the project area at the closest point to state waters.

Emissions will be released from a stack on the construction vessel. A release height of 10 meters will be used in the modeling.

11.6 SCREEN3 Model Application

The SCREEN3 dispersion model will be applied to predict the maximum potential ambient air quality impacts that may result from the construction vessel traffic and equipment to be used at the Cape Wind site. SCREEN3 will be applied to determine the maximum concentrations at receptor locations in Massachusetts. This will include both sea-level estimates within 3 miles (or 4.8 kilometers) of the coast and ground-level estimates on shore. The SCREEN3 model will be applied with the following input parameters:

- Rural dispersion parameters,
- Receptors beginning at the closest distance within 3 kilometers of the Massachusetts shore
- Default meteorology,
- Normalized emission rate of 1 gram per second, and
- Terrain elevations at and beyond the Massachusetts shore

The closest distance to state waters is approximately 2200 feet (670 meters). A series of receptor locations will be used to determine the area of maximum impact. Beyond the closest point to state waters, receptors will be placed at 100-meter increments out to three kilometers and at 500-meter increments out to ten kilometers.

If the maximum, modeled concentrations have not been resolved within the 10-kilometer grid, additional distances will be modeled. The locations of the maximum predicted concentrations will be resolved to within 100 meters.

The maximum terrain height found within the immediate area of each on-shore receptor will be selected as the receptor height. The immediate area will be defined by the range of distances between the midpoints of the receptor and the previous receptor, and the receptor and the next receptor, regardless of direction.

11.7 Background Air Quality

Background air quality is defined as the existing air quality in the absence of a proposed source. Background levels can be determined from currently available air quality data, model calculations of nearby emission sources, or a combination of the two. For this analysis, the determination of compliance with NAAQS is based on the combination of the maximum modeled impact concentrations with the background air quality from MassDEP air monitoring stations. Therefore, NAAQS compliance can be demonstrated by comparing the total concentrations to the standards.

Background air quality values for this analysis will be based on the three most recent years (2004-2006) of data available from EPA's Office of Air Quality Planning and Standard's AIRS Data Internet

web site (http://www.epa.gov/airsweb). Short-term background values will be based on the highest of the second-high values in any year. Annual background values are based on the maximum value for any year. Due to a lack of monitoring locations in Cape Cod, the closest Massachusetts or Rhode Island monitor will be used. Background values will be based on:

- CO from East Providence, RI,
- SO_2 from Fall River, MA
- $PM_{2.5}$ from Fall River, MA,
- PM_{10} from Boston, MA, and
- NOx from Truro, MA.

11.8 Analysis of Results

The worst-case modeled concentrations from the proposed construction vessel traffic will be compared to the allowable Prevention of Significant Deterioration (PSD) increments. The modeled construction vessel traffic concentrations will also be added to regional background values to determine the total concentrations. These values will be compared to the NAAQS to demonstrate compliance with the ambient standards. If any of the total concentrations exceed the NAAQS, a protocol for a refined analysis will be submitted at that time.

11.9 References

Auer, A. H., 1978. Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 17: 636-643.

US EPA, 1999. Guideline on Air Quality Models, (Revised) EPA450/12-78-027R, Office of Air Quality Planning and Standards. Research Triangle Park, NC.

Tables

Table 1
Summary of Potential OCS Source Emissions Inside of 25 Miles
Cape Wind Energy Project
Horeshoe Shoal, Nantucket Sound, Massachusetts

Project Phase	Emissions (Tons)							
	NO_X	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPS
Preconstruction	19.6	0.8	2.5	7.6	0.6	0.6	919	0.0
Construction	431.0	13.8	56.3	94.0	13.3	13.3	20,427	0.2
Total	450.6	14.6	58.8	101.6	13.9	13.9	21,346	0.2

Annual Construction Emissions	Emissions (Tons)							
	NO_X	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPS
Construction - Year 1 - 70%	301.7	9.7	39.4	65.8	9.3	9.3	14,299	0.1
Construction - Year 2 - 30%	129.3	4.1	16.9	28.2	4.0	4.0	6,128	0.1
Total	431.0	13.8	56.3	94.0	13.3	13.3	20,427	0.2

Table 2
Summary of OCS Source Fuel Usage
Cape Wind Energy Project
Horeshoe Shoal, Nantucket Sound, Massachusetts

Project Phase	Fuel Usage		
	Diesel Oil gallons	Gasoline gallons	Natural Gas cubic feet
Preconstruction	80,058	1,120	19,959
Construction	1,782,107	0	0
Total	1,862,165	1,120	19,959

Appendix A

OCS Source Emissions Calculation Spreadsheets

Cape Wind Project
Preconstruction G&G Data Gathering Emissions Inside of 25 miles

Emission Factors (g/hp-hr) Diesel Recip. >600 hp Based on AP-42 Vol.1 , Tables 3.4-1 - 3.4-4							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
11.00	0.33	1.47	2.40	0.32	0.32	526.16	0.00474

Emission Factors (g/hp-hr) Diesel Recip. <600 hp Based on AP-42 Vol.1 , Tables 3.3-1 - 3.3-2							
NOx	TOC*	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
14.06	1.14	0.93	3.02	1.00	1.00	521.63	0.00003

* Emission factor for VOC was not available; TOC emission factor is used instead, which will result in a very conservative estimation of VOC emissions.

Emission Factors (lb/MMBtu) Natural Gas 4-Stroke Based on AP-42 Vol.1 , Table 3.2-2							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
0.85	0.12	0.00059	0.56	0.000077	0.000077	110.00	0.072

Emission Factors (g/bhp-hr) for 50-100HP 4-stroke, outboard marine engines. Based on Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition. EPA420-R-05-019, Table 10. Worst case emissions factors were selected from carbureted, indirect injection and direct injection engine types. When calculating emissions, HC and PM were equated with VOC and PM10, respectively.							
NOx	HC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
5.82	5.82		152.25	0.06			

Activity Type	Vessel Type/ Emission Source	Number of Sources	Equipment Size (HP)	Equipment Size (kW)	Activity	Count	Duration	Operating Hours (per unit)	Assumptions	Fuel Use (gal or ft3)	Emissions (tons)							
											NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
Preconstruction Period - Activities within 25 Miles of the Project																		
Geophysical - WTG's	42' Diesel Lobster Boat	1	1,000	746	-Travel b/w Falmouth and WP - 30 miles of transect	6 days	10 hrs/day	60	- 2 hrs. @ 15 knots then 8 hrs. @ 3 knots	3,032	0.7	0.0	0.1	0.2	0.0	0.0	34.8	0.000
Geophysical - 33 kV Inner Array Cable	42' Diesel Lobster Boat	1	1,000	746	-Travel b/w Falmouth and WP - 30 miles of transect	20 days	10 hrs/day	200	- 2 hrs. @ 15 knots then 8 hrs. @ 3 knots	10,108	2.4	0.1	0.3	0.5	0.1	0.1	115.9	0.001
Geophysical - 115 kV Interconnect Cable	42' Diesel Lobster Boat	1	1,000	746	-Travel b/w Falmouth and WP - 30 miles of transect	7 days	10 hrs/day	70	- 2 hrs. @ 15 knots then 8 hrs. @ 3 knots	3,538	0.8	0.0	0.1	0.2	0.0	0.0	40.6	0.000
Electrical Generator	Gas Fired	1	8.7	6.5		30 days	10 hrs/day	300		17,772	0.008	0.001	0.000	0.005	0.000	0.000	1.007	0.001
Borings	Tug Boat	1	1,500	1,119	Travel b/w Falmouth and	30 days	24 hrs/day	720	Full Load @ 1hr/day	54,585	13.1	0.4	1.7	2.9	0.4	0.4	625.8	0.006
Boring Drill Rig	Truck mtd Rig	1	350	261	1 boring/day	20 days	10 hr/day	200	Rig Stays on HSS till done	3,538	1.1	0.1	0.1	0.2	0.1	0.1	40.2	0.0
Vibracore Boat		1	1,000	746	Final Cable Design and Constructability survey	8 days	10 hr/day	80	- 33 kV: 1 core/3 miles of cable, total 22 - 115 kV: 2 /mile of cable, total 26 - 6 /day	4,043	1.0	0.0	0.1	0.2	0.0	0.0	46.4	0.000
Multibeam Survey	26' Boat	1	300	224	Shallow area multibeam survey	8 days	10 hr/day	80		1,213	0.4	0.0	0.0	0.1	0.0	0.0	13.8	0.0
Electrical Generator	Gas Fired	1	4	3		8 days	10 hr/day	80		2,187	0.001	0.000	0.000	0.001	0.000	0.000	0.124	0.000
Crew Movement	Zodiac Boat	1	100	75	1 boring/day	20 days	10 hr/day	200	Zodiac only needed for boring program	1,120	0.1	0.1		3.4	0.001			
Total Preconstruction Emissions											**19.6**	**0.8**	**2.5**	**7.6**	**0.6**	**0.6**	**918.6**	**0.0**

Fuel Use

Fuel Oil	**80,058**
Gasoline	**1,120**
Natural Gas	**19,959**

All operating hours will be metered to track actual emissions.

Cape Wind Project
Construction Emissions Inside of 25 miles

Note: All trips are one-way (not round trips).

Emission Factors (g/hp-hr)Diesel Recip. >600 hp Based on AP-42 Vol.1 , Tables 3.4-1 - 3.4-4							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
11.00	0.33	1.47	2.40	0.32	0.32	526.16	0.00474
Emission Factors (g/hp-hr) Diesel Recip. <600 hp Based on AP-42 Vol.1 , Tables 3.3-1 - 3.3-2							
NOx	TOC*	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
14.06	1.14	0.93	3.02	1.00	1.00	521.63	0.00003

* Emission factor for VOC was not available; TOC emission factor is used instead, which will result in a very conservative estimation of VOC emissions.

Activity Type	Vessel Type/ Emission Source	Number of Sources	Equipment Size (HP)	Equipment Size (kW)	Activity	Count	Duration	Operating Hours (per unit)	Assumptions	Fuel Use (gal)	Emissions (tons)							
											NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
Construction Period - Activities within 25 Miles of the Project																		
Pile Installation																		
Move jack up barge to Wind Park	attendant tug	1	3,000	2,237	Travel b/w 25 mile boundary and WP	4 trips	4 hrs/trip	16	This is done twice (once per year)	2,426	0.6	0.0	0.1	0.1	0.0	0.0	27.8	0.0
Transport piles and transition pieces to wind park	tow tug	1	6,000	4,474	Travel b/w 25 mile boundary and WP	86 trips	4 hrs/trip	344	avg. 3 piles per trip, 130 piles, duration only w/in 25 miles	104,318	25.0	0.8	3.3	5.5	0.7	0.7	1196.0	0.0
Pile barge handling tug @ Wind Park	attendant tug	1	3,000	2,237	Daily activity	130 days	4 hrs/day (load factor.33)	520	3 piles per week, attendant tugs only operate equiv of 1/2 day	78,845	18.9	0.6	2.5	4.1	0.5	0.5	904.0	0.0
Put piles in place	primary 500 ton crane	1	800	597	Set piles	130 days	4 hrs/day	520		21,025	5.0	0.2	0.7	1.1	0.1	0.1	241.1	0.0
Pile driving	Hydraulic ram	1	1,600	1,193	Set piles	130 piles	4 hrs/pile	520	IHC S-1200 hydrohammer	42,051	10.1	0.3	1.3	2.2	0.3	0.3	482.1	0.0
Moving crew in and out	crew boats	2	750	559	daily travel b/w Falmouth and WP	130 days	2 hrs/day	260		19,711	4.7	0.1	0.6	1.0	0.1	0.1	226.0	0.0
Transition piece handling tugs @ Wind Park	attendant tug	1	3,000	2,237	Daily activity	130 days	4 hrs/day (load factor.33)	520	3 pieces per week, attendant tugs only operate equiv of 1/2 day	78,845	18.9	0.6	2.5	4.1	0.5	0.5	904.0	0.0
Set transition pieces	primary 500 ton crane	1	800	597	Set Pieces	130 days	4 hrs/day	520		21,025	5.0	0.2	0.7	1.1	0.1	0.1	241.1	0.0
Installation of scour protection																	0.0	0.0
Move scour protection installation equipment to Wind Park	attendant tug	1	3,000	2,237	Travel b/w 25 mile boundary and WP	4 trips	4 hrs/trip	16	This is done twice (once per year)	2,426	0.6	0.0	0.1	0.1	0.0	0.0	27.8	0.0
Transport rock armor barges	tow tug	1	6,000	4,474	Travel b/w 25 mile boundary and WP	276 trips	4 hrs/trip	1,104	Spd. 8 knts	334,787	80.2	2.4	10.7	17.5	2.3	2.3	3838.5	0.0
Transport filler material barges	tow tug	1	6,000	4,474	Travel b/w 25 mile boundary and WP	370 trips	4 hrs/trip	1,480	Spd. 8 knts	448,809	107.6	3.2	14.4	23.5	3.1	3.1	5145.7	0.0
Install rock armor	crane	1	400	298	Daily activity	65 days	8 hrs/day	520	2 towers per day	10,513	3.2	0.3	0.2	0.7	0.2	0.2	119.5	0.0
Install filler material	crane	1	400	298	Daily activity	65 days	8 hrs/day	520	2 towers per day	10,513	3.2	0.3	0.2	0.7	0.2	0.2	119.5	0.0
Armor/filler barge handling tugs @ Wind Park	attendant tugs	2	3,000	2,237	Daily activity	130 days	4 hrs/day (load factor.33)	520		157,690	37.8	1.1	5.0	8.2	1.1	1.1	1808.0	0.0
Subtotal										**1,332,982**	**320.9**	**10.0**	**42.4**	**70.0**	**9.6**	**9.6**	**15,281**	**0.1**

Cape Wind Project
Construction Emissions Inside of 25 miles

Note: All trips are one-way (not round trips).

Emission Factors (g/hp-hr)Diesel Recip. >600 hp Based on AP-42 Vol.1 , Tables 3.4-1 - 3.4-4							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
11.00	0.33	1.47	2.40	0.32	0.32	526.16	0.00474
Emission Factors (g/hp-hr) Diesel Recip. <600 hp Based on AP-42 Vol.1 , Tables 3.3-1 - 3.3-2							
NOx	TOC*	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
14.06	1.14	0.93	3.02	1.00	1.00	521.63	0.00003

* Emission factor for VOC was not available; TOC emission factor is used instead, which will result in a very conservative estimation of VOC emissions.

Activity Type	Vessel Type/ Emission Source	Number of Sources	Equipment Size (HP)	Equipment Size (kW)	Activity	Count	Duration	Operating Hours (per unit)	Assumptions	Fuel Use (gal)	Emissions (tons)							
											NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
Cable laying																		
115 kV Cable laying barge to wind farm	tow tug	1	1,500	1,119	Travel b/w 25 mile boundary and WP	4 trips	4 hrs/trip	16		1,213	0.3	0.0	0.0	0.1	0.0	0.0	13.9	0.0
Put cable in place	crane barge	1	400	298		15 days	10 hrs/day	150	10 hrs/day for 15 work days	3,032	0.9	0.1	0.1	0.2	0.1	0.1	34.5	0.0
Put cable in place	attendant tug	1	1,500	1,119		15 days	10 hrs/day	150	10 hrs/day for 15 work days	11,372	2.7	0.1	0.4	0.6	0.1	0.1	130.4	0.0
Put cable in place	anchoring tug	1	4,000	2,983		15 days	10 hrs/day	150	10 hrs/day for 15 work days	30,325	7.3	0.2	1.0	1.6	0.2	0.2	347.7	0.0
Moving crew in and out	crew boats	1	750	559		15 days	2 hrs/day	30		1,137	0.3	0.0	0.0	0.1	0.0	0.0	13.0	0.0
33 kV Cable laying barge to wind farm	tow tug	1	1,500	1,119	Travel b/w 25 mile boundary and WP	26 trips	4 hrs/trip	104	13 round trips	7,884	1.9	0.1	0.3	0.4	0.1	0.1	90.4	0.0
Put cable in place	crane barge	1	400	298		130 days	10 hrs/day	1300	10 hrs/day for 10 work days/string - 13 strings	26,282	8.1	0.7	0.5	1.7	0.6	0.6	298.7	0.0
Put cable in place	attendant tug	1	1,500	1,119		130 days	10 hrs/day	1300	10 hrs/day for 10 work days/string - 13 strings	98,556	23.6	0.7	3.2	5.2	0.7	0.7	1130.0	0.0
Move Crane barge to cofferdam location	tow tug	1	1,500	1,119	Travel b/w 25 mile boundary and WP	4 trips	3 hrs/trip	12		910	0.2	0.0	0.0	0.0	0.0	0.0	10.4	0.0
HDD Cofferdam Excavation	crane barge	1	400	298	Excavation	2 days	10 hrs/day	20	2 day @10 hrs/day - Spd. ~ 12 knts	404	0.1	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Sheet Pile Driving for cofferdam		1	400	298		2 days	10 hrs/day	20	2 day @10 hrs/day	404	0.1	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Compressor Drive		1	100	75		2 days	8 hrs/day	16	2 day @8 hrs/day	81	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Sheet Pile Removal		1	400	298		2 days	10 hrs/day	20	2 day @10 hrs/day	404	0.1	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Cofferdam Backfill	crane barge	1	400	298	Backfill	2 days	10 hrs/day	20	2 day @10 hrs/day	404	0.1	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Moving crew in and out	crew boat	1	750	559		10 days	2 hrs/day	20	1hr each way per crew boat	758	0.2	0.0	0.0	0.0	0.0	0.0	8.7	0.0
Subtotal										**183,168**	**46.0**	**1.9**	**5.5**	**10.0**	**1.7**	**1.7**	**2,097**	**0.0**
Turbine installation																		
Turbines to Wind Farm	one specialized vessel	1	6,000	4,474	Travel b/w 25 mile boundary and WP	86 trips	4 hrs./trip	344	Only emissions within 25 miles of Wind Park	104,318	25.0	0.8	3.3	5.5	0.7	0.7	1196.0	0.0
Stablizing the the WTG vessel in correct location and elevation	jacking system with 6 legs	1	476	355		130 days	2 hrs/day	260		6,255	1.9	0.2	0.1	0.4	0.1	0.1	71.1	0.0
Tower Installation	primary 500 ton crane	1	800	597		130 days	2 hrs/day	260		10,513	2.5	0.1	0.3	0.5	0.1	0.1	120.5	0.0
Nacelle installation	primary 500 ton crane	1	800	597		130 days	2 hrs/day	260		10,513	2.5	0.1	0.3	0.5	0.1	0.1	120.5	0.0
Rotor installation	primary 500 ton crane	1	800	597		130 days	2 hrs/day	260		10,513	2.5	0.1	0.3	0.5	0.1	0.1	120.5	0.0
Moving crew in and out	crew boats	4	750	559		130 days	2 hrs/day	260	2 days per WTG	39,422	9.4	0.3	1.3	2.1	0.3	0.3	452.0	0.0
Subtotal										**181,533**	**43.9**	**1.4**	**5.7**	**9.6**	**1.4**	**1.4**	**2,081**	**0.0**

Cape Wind Project
Construction Emissions Inside of 25 miles

Note: All trips are one-way (not round trips).

Emission Factors (g/hp-hr)Diesel Recip. >600 hp Based on AP-42 Vol.1 , Tables 3.4-1 - 3.4-4							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
11.00	0.33	1.47	2.40	0.32	0.32	526.16	0.00474
Emission Factors (g/hp-hr) Diesel Recip. <600 hp Based on AP-42 Vol.1 , Tables 3.3-1 - 3.3-2							
NOx	TOC*	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
14.06	1.14	0.93	3.02	1.00	1.00	521.63	0.00003

* Emission factor for VOC was not available; TOC emission factor is used instead, which will result in a very conservative estimation of VOC emissions.

Activity Type	Vessel Type/ Emission Source	Number of Sources	Equipment Size (HP)	Equipment Size (kW)	Activity	Count	Duration	Operating Hours (per unit)	Assumptions	Fuel Use (gal)	Emissions (tons)							
											NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
ESP Installation																		
Crane barge towing	tow tug	1	3,000	2,237	Travel b/w 25 mile boundary and WP	2 trips	12 hrs/trip	24	12 hrs. out, 12 hours back	3,639	0.9	0.0	0.1	0.2	0.0	0.0	41.7	0.0
Setting template for ESP installation	crane	1	3,000	2,237		1	16 hrs.	16		2,426	0.6	0.0	0.1	0.1	0.0	0.0	27.8	0.0
Handling crane barge	attendant tug	1	3,000	2,237		1	16 hrs.	20	4 hrs. transit and 16 hrs. on site	3,032	0.7	0.0	0.1	0.2	0.0	0.0	34.8	0.0
Pile Installation barge towing	tow tug	1	3,000	2,237	Travel b/w 25 mile boundary and WP	2 trips	9 hrs/trip	18	12 hrs. out, 6 hours back	2,729	0.7	0.0	0.1	0.1	0.0	0.0	31.3	0.0
Pile setting	crane	1	3,000	2,237		6	3 hrs.	18		2,729	0.7	0.0	0.1	0.1	0.0	0.0	31.3	0.0
Handling barge	attendant tug	1	3,000	2,237		6	3 hrs.	18		2,729	0.7	0.0	0.1	0.1	0.0	0.0	31.3	0.0
Pile driving	Hydraulic ram	1	3,200	2,386		6	2 hrs.	12	IHC S-500 hydrohammer	1,941	0.5	0.0	0.1	0.1	0.0	0.0	22.3	0.0
ESP deck to wind farm	tow tug	1	6,000	4,474	Travel b/w 25 mile boundary and WP	2 trips	9 hrs/trip	18	12 hrs. out, 6 hours back	5,458	1.3	0.0	0.2	0.3	0.0	0.0	62.6	0.0
Crane barge towing	tow tug	1	3,000	2,237	Travel b/w 25 mile boundary and WP	2 trips	12 hrs/trip	24	12 hrs. out, 12 hours back	3,639	0.9	0.0	0.1	0.2	0.0	0.0	41.7	0.0
Setting the deck for ESP installation	crane barge	1	6,000	4,474		1	16 hrs.	16		4,852	1.2	0.0	0.2	0.3	0.0	0.0	55.6	0.0
Handling crane barge	attendant tug	1	3,000	2,237		2 trips	9 hrs/trip	18	12 hrs. out, 6 hours back	2,729	0.7	0.0	0.1	0.1	0.0	0.0	31.3	0.0
Moving crew in and out	crew boats	4	750	559		160 trips	2 hrs/trip	320	40 days, 2 RT/day - 2 hrs.each way	48,520	11.6	0.3	1.6	2.5	0.3	0.3	556.3	0.0
Subtotal										**84,425**	**20.2**	**0.6**	**2.7**	**4.4**	**0.6**	**0.6**	**968**	**0.0**
TOTAL Construction Emissions Over 2-year Construction Duration										**1,782,107**	**431.0**	**13.8**	**56.3**	**94.0**	**13.3**	**13.3**	**20,427**	**0.2**

All operating hours will be metered to track actual emissions.