

Scope of Work

EXISTING AND POTENTIAL OCEAN-BASED ENERGY FACILITIES AND ASSOCIATED INFRASTRUCTURE IN MASSACHUSETTS

TRC Environmental Corporation

NOTE: Details in the final report were the result of on-going communication with CZM through draft deliverable reviews, as the Scope was further refined throughout the project period.

TRC understands that the purpose of the proposal is to gather descriptive and spatial information to further the Commonwealth's understanding of offshore energy facilities' siting parameters (i.e., technological capabilities/limitations and other feasibility issues) to help inform decision-making in these areas. In order to meet this goal, the following work tasks have been identified: (a) inventory existing, proposed, and reasonably foreseeable (within the next decade, approximately) energy facilities and associated infrastructure located within Massachusetts state waters, in addition to federal waters beyond state jurisdiction, up to 200 miles offshore; and (b) incorporate the inventory into a GIS database and GIS-produced map products.

1.1 Definition of Energy Facilities

For the purposes of this project, TRC defines "energy facilities" as electric generation facilities, fossil fuel-related importation facilities, and their associated interconnection pipelines and transmission lines. Additionally, because the focus of this project and proposal is ocean-based energy facilities, associated infrastructure is limited to ocean-based energy facilities. For example, if an energy facility is land based, but has associated infrastructure (i.e., electric transmission line) that is located within Massachusetts state waters or federal waters up to 200 miles out, the associated infrastructure is not considered in the inventory of existing, proposed, or reasonably foreseeable energy facilities and associated infrastructure. However, associated infrastructure that is a part of or necessary to an ocean-based energy facility is considered in the inventory of energy facilities and associated infrastructure.

1.2 Task 1: Inventory of Existing and Proposed Energy Facilities and Associated Infrastructure

Based on available information (i.e., not confidential) from the public and private sectors, TRC will conduct an inventory of existing and proposed energy facilities and associated infrastructure within Massachusetts state waters, in addition to federal waters beyond jurisdiction, up to 200 miles offshore. When referring to Massachusetts state waters, the following definition will be used, "State jurisdiction generally extends from the low water mark to the seaward boundary of the Commonwealth. Typically, the Commonwealth's marine boundary extends three

nautical miles offshore with the exception of areas within Massachusetts Bay, Cape Cod Bay, and Nantucket Sound that extend farther due to bay closure lines established by the U.S. Supreme Court.” (Massachusetts Ocean Management Task Force Recommendations, March 2004)

TRC will use its strong position and large client base within the energy market to compile a list of existing and proposed ocean-based energy facilities. TRC has supported numerous clients in the siting, licensing, and permitting of offshore energy projects. Some of TRC’s offshore energy clients include Duke Energy, Excelerate Energy, ExxonMobil, the Army Corps of Engineers (ACOE), and the Federal Energy Regulatory Commission (FERC).

TRC also proposes to use such information sources as FERC, Massachusetts Energy Facilities Siting Board (EFSB), Department of Telecommunications and Energy (DTE), and ACOE.

The information obtained will be incorporated into the inventory, along with descriptions of purpose, location, and physical description (aerial extent of a facility, type of facility from a technological standpoint, and electrical output or conductance).

TRC recognizes the potential for new energy facilities to be proposed during the course of the project. As a result, and for the purpose of this project, TRC defines proposed energy facilities and associated infrastructure as:

- Any project that is still seeking permits and/or approvals prior to or within the first month of CZM’s project;
- Any new project where information has been made available through the public sector prior to or within the first month of CZM’s project and that has not filed for any permits; or
- Any new project where information has been obtained through the private sector prior to or within the first month of CZM’s project and TRC has been given permission to release information on the project.

1.3 Task 2: Develop Methodology for Inventory of Reasonably Foreseeable Energy Siting

The inventory of reasonably foreseeable technological advances will identify and, where possible, spatially represent areas in Massachusetts state and federal waters that represent potential siting locations for future energy facilities and associated infrastructure. The intent is to identify candidate areas for the respective facilities that appear reasonably capable of development, by virtue of being: 1) feasible for technologies commercially available now, or expected to be so within the next decade; and 2) not likely to be cost prohibitive, in terms of macro-level locational factors affecting the balance of development costs/benefits. Spatial representations will include GIS points, lines, or polygons. Where spatial information is not available,

identified areas will be described to the greatest extent practicable within the text of the written report.

TRC envisions the inventory of reasonably foreseeable energy siting as a two-step process. In order to successfully develop an inventory of reasonably foreseeable ocean-based technological advances of energy facilities, TRC believes that it is paramount to first identify all existing and proposed ocean-based energy facility technologies within and outside of the United States. To compile the list of existing and proposed ocean-based energy facility technologies, TRC proposes to use the following information sources (please note this list is not meant to be comprehensive):

- Electric Power Research Institute (EPRI)
- FERC
- Edison Electric Institute (EEI)
- American Wind Energy Association (AWEA)
- National Renewable Energy Laboratory (NREL)
- U.S. Department of Energy, Energy Efficiency and Renewable Energy, Wind and Hydropower Technologies Program
- Strategic Environmental Assessment, UK Public Consultation of Offshore Energy Licensing, UK
- Energy Information Administration, Official Energy Statistics from the US Government
- Energy Information Administration, Renewable Potential Maps, New England Division
- Information Administration, Infield Offshore Energy Database
- U.S. Liquefied Natural Gas (LNG) Market and Uses, June 2004 Update. Energy
- European Union (EU)
- Consumer Energy Council of America (CECA)
- Renewable Energy Access
- Canadian Wind Energy Association
- European Wind Association
- World Wind Energy Association

TRC will contact the manufacturers of energy facility equipment (generators and turbines) to inquire about the latest developments in equipment and technology and the limitations imposed by the marine environment.

An example list of vendors includes the following:

- GE Power

- The Wind Turbine Company
- Northern Power Systems
- Enertech
- Clipper Wind Power, Inc.
- Marine Current Turbines Ltd
- Wavegen
- Energetech

Existing and proposed ocean-based energy facility technologies will include, but are not limited to, wind turbines; free flow hydropower turbines such as wave turbines; tidal (hydrokinetic); ocean thermal; on-sea biomass; on-sea solar electric, and solar thermal electric.

Once all ocean-based technologies have been identified, the second step will be to analyze the technological capabilities, technological limitations, and other siting characteristics that relate directly to each of the technologies, including, but not limited to, water depths, geology, currents, wind conditions, etc. Through this analysis, TRC anticipates to gain an understanding and perspective on why certain technologies have been successful to date and why others have not been successful.

Additionally, based on the above analysis, TRC will identify key siting requirements for each reasonably foreseeable ocean-based technology in order to assist in spatially incorporating this information into a GIS database. For example, based on the analysis of the existing and proposed ocean-based energy facility technologies, if it is determined that it is not technically feasible to mount wind turbines in areas of bedrock, all offshore locations with bedrock at or near the ocean's surface will be precluded from siting existing wind turbine generation technology in this study. However, if a reasonably foreseeable type of wind turbine generation is defined during this study that can mount turbines through means other than using a pile(s) on the ocean floor, areas of bedrock at or near the ocean's surface will not necessarily be precluded for the siting of this reasonably foreseeable wind turbine energy facility.

TRC will also describe an approach to consider macroeconomic factors that influence candidate area selections and within the larger areas defined to be capable of development in terms of reasonably foreseeable ocean-based technology, will further define those sub-areas which are not cost-prohibitive from a broad cost/benefit standpoint.

TRC will submit a draft of the "Inventory Methodology for Reasonably Foreseeable Advances in Energy Siting" in Microsoft Word format for approval by CZM before initiating the actual inventory activities described in Task 3 below. Section 3.0 discusses the project schedule for completing this task as well as CZM review periods.

1.4 Task 3: Inventory of Reasonably Foreseeable Energy Siting

TRC will conduct an inventory of all existing and proposed ocean-based energy facility technologies within and outside of the United States, an analysis of each of these technologies focusing on technological capabilities and limitations, and an inventory of reasonably foreseeable technological advances in energy siting and their technological capabilities and limitations. For purposes of this proposal, TRC defines reasonably foreseeable as those technologies that have already been identified by a credible source, even if at only a concept level with no actual design. In addition, the technology must be based on something with a likelihood of actually occurring in the next 20 years. Technologies premised on some yet to be invented material or mechanical/chemical process or requiring some futuristic (science fiction) construction methods or equipment are not valid reasonably foreseeable technology.

As stated in Task 2, upon completion of the inventories and analyses, TRC will complete a reconnaissance level screening for existing and proposed energy facility technology as well as all reasonably foreseeable technological advances. The result of this work effort will be candidate geographic areas for various types of offshore/ocean-based energy facilities and associated infrastructure, including existing, proposed, and reasonably foreseeable energy facility technologies. Reconnaissance level screening will initially consist of developing a macro-scale model by incorporating selection criteria that defines an appropriate range of appropriate physical parameters such as ocean floor contours, water depth, currents, tides, wave heights, sediments, bedrock, and wind speeds (where available) for the respective energy facility technology. Once selection criteria have been developed, a Priority Candidate Area Scoring Index (Index) will be defined. This Index will rank physical parameters in order of importance for the technology and will serve to screen potentially suitable geographic areas. It should be noted that this analysis will not account for existing uses such as boating channels, major fly-ways for birds, etc.

This work effort will address technological capabilities and limitations, and macro-economic factors, as described above, but will not address feasibility issues such as politics, public and agency acceptability and permitting challenges such as those associated with biological resources.

1.5 Task 4: Complete a Written Report, "Existing and Potential Ocean-Based Energy Facilities and Associated Infrastructure in Massachusetts"

TRC will complete a written report titled, "Existing and Potential Ocean-Based Energy Facilities and Associated Infrastructure in Massachusetts," as part of the project. The draft and final written reports will include the following sections:

- Executive Summary;
- Description of methodology used to inventory existing energy facilities, including public and private sector developed data sets;

- Description of “Inventory Methodology for Reasonably Foreseeable Advances in Energy Siting”;
- Description of elements beyond the scope of this project and recommendations on how they may be addressed in future studies;
- Profiles that describe purposes, locations, and physical descriptions of existing and proposed energy facilities and associated infrastructure;
 - Report shall disclose the individual parameters used for Priority Candidate Area Scoring Index (Index) and their values that are used in the ranking process. This information will be described in the report in text, in addition to similar information that is also provided in the metadata requirements for each data layer.
- Discussion of analyses completed for geographical identification and discussion of areas of offshore Massachusetts that may be suitable in the reasonably foreseeable future for siting energy facilities;
- Discussion of information gaps found during data collection to identify areas and issues with limited to no information (gap analysis);
- Recommendations for incorporating results of the project into ocean planning efforts;
- Maps, figures, tables, and graphics;
- List of sources and contacts; and
- Supporting information.

TRC has provided several clients with site selection study reports. Site selection reports have included: an executive summary; description of methodology used to perform the study; profiles of each potential site location, including physical description of each site and natural gas and electric transmission interconnections as applicable; and analysis of existing planning and zoning and wetlands regulations. We provide a sample report in Appendix A.

The full written report for CZM’s project will be submitted once in draft form in Microsoft Word format. Upon written approval by CZM, TRC will finalize the full written report including maps, figures, tables, and graphics as a final deliverable to CZM. The schedule for these deliverables and CZM review are presented in Section 3.0. The full draft and final written reports will be submitted to CZM electronically as Microsoft Word and pdf files along with six bound paper copies.

1.6 Task 5: Create GIS Data and Static Data Map Products and Associated FGDC Compliant Metadata

From the inventories conducted under Tasks 1 and 3, TRC will create point, line, and/or polygon GIS data and static GIS map products and associated FGDC compliant metadata. The purpose of the GIS data and static GIS map products will be to capture the geographic location and relevant attributes of existing, proposed, and potential future energy facilities and associated infrastructure.

To complete this task, TRC will use a basemap created by the summer 2005 phase of the Human Use Characterization project that will be provided by CZM during the kick-off meeting. The data for this deliverable will be stored as ESRI shapefiles and submitted on a CD.

The number of static GIS map products will be determined based on data generated, the number of siting criteria that are identified and/or the appropriate scale to illustrate uses in coordination with CZM. As stated in the RFR, CZM anticipates a minimum of four such maps. TRC's cost estimate is based on a total number of maps not to exceed 10. Additionally, for the cost estimate portion of this proposal, it was assumed that all maps would be color maps no larger than 24 inches by 36 inches in size.

We provide sample GIS map products in Appendix B, associated with the work we have done on the Northeast Gateway Project. Much of the GIS effort for this project, in addition to providing support for permitting efforts, involved offshore environmental and physical data assessments relevant to a proposed 16.4-mile natural gas pipeline interconnect and offshore deepwater port. TRC possesses numerous agency offshore datasets in addition to the datalayers available at MassGIS.

1.7 Task 6: Complete Reports Twice a Month

In accordance with the RFR, TRC will submit a written progress report twice a month falling on the first and third Wednesday of each month (before the end of the day). Each progress report will describe the status of each task listed in "Scope of Work." In addition to reporting on the scope of work tasks, the progress reports will also include descriptions of any problems encountered. Each progress report will be designed to provide CZM with a status update on each task; however, the progress reports will not provide detailed descriptions of the findings of each task.

TRC will submit seven progress reports to CZM. Each progress report will be submitted electronically to Kate Killerlain Morrison at kate.killerlain-morrison@state.ma.us and John Weber at john.weber@state.ma.us as Microsoft Word attachments. .

TRC's Principal-in-Charge and Project Manager will be available for any follow-up calls, as needed, in response to the twice a month progress reports.

1.8 Task 7: Create a GIS Data CD

Upon completion of all GIS mapping tasks, ESRI shapefiles, and FGDC compliant GIS metadata for all newly created data will be saved on a CD and submitted to CZM. The six copies of the GIS data CDs will be submitted to CZM at the same time the final full written report, "Existing and Potential Ocean-Based Energy Facilities and Associated Infrastructure in Massachusetts," is submitted to CZM (see Figure 3-1, Project Schedule).

