

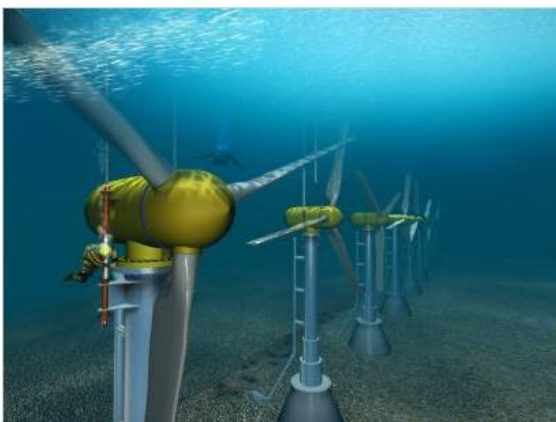
Renewable Energy Siting ToolboxSM

Renewable Energy Siting ToolboxSM is ASA's technology-based assessment service and in-house toolset that employs a set of screening methods for siting of renewable energy facilities. Siting of both onshore (wind) and offshore renewable energy facilities (wind, wave, and current) is performed using a spatial planning, geographic information system (GIS) approach. ASA's toolbox includes two new indices: Technical Challenge (TCI) and Ecological Service Value (ESVI). The TCI assesses the technical difficulty in siting the facility compared to the power production potential while the ESVI assesses the ecology service values that might be impacted by various siting locations and patterns. In addition tools are available to perform the same assessments based on Principal Component Analysis and Cluster Analysis methods. ASA's toolbox represents a significant advance on existing screening methods as it allows quantitative rankings of development sites which include project technical complexity and quantitative ecological valuation.



Renewable Energy Siting Toolbox Highlights:

- Evaluates the tradeoff between power production potential and the technical challenge to extract the power and the ecological value of the biological resources
- Applies to any spatially variable renewable energy source (wind, waves, in-stream tidal currents and ocean currents)
- Applies at a wide variety of spatial scales (large scale screening, site specific evaluation)
- Provides quantitative analysis approach that allows numerical ranking of potential sites
- Incorporates uncertainties in input data and TCI/ESVI formulation via Monte Carlo simulation strategy and allows for in depth sensitivity studies
- Provides objective methodology for alternatives analysis
- Enables input of geospatial data readily available (bathymetry, NOAA ENC Maps, wind, wave, in-stream tidal current power distribution maps, seabed sub-bottom geology, extreme wind and wave conditions, etc.)
- Enables evaluation of use conflicts with existing fisheries (fixed and mobile gear and recreational), aquaculture operations, leases, mineral and aggregate extraction, conservation, and marine transportation)
- Allows evaluation of hard and soft constraints on siting
- Enables assessment of environmental impacts using ASA's well developed bird, fish, and marine mammal population and migration model systems



The Renewable Energy Siting Toolbox Process is Different

The first step in the Renewable Energy Siting Toolbox process creates a map that describes the energy resources that are to be exploited. In step two areas that would prohibit any renewable energy developments are determined. These typically include regulated marine transport areas, preferred marine transport corridors, disposal sites, estuarine and marine protected areas, ferry routes, airport buffers, coastal buffers, etc.

Step three incorporates technology constraints on the remaining potentially developable areas that further restrict the area under consideration. For instance, the technology chosen to support offshore wind turbines is based on water depth (i.e., monopiles in 5 to 25 m water depth, lattice jacket structures in 25 to 50 m, and floating moored structures in deeper water) becomes increasingly complex and costly the deeper the water.

The fourth step of the screening analysis is to incorporate use conflicts and collaborations such as visual impact, recreational and commercial fishing areas, marine mammal feeding and breeding grounds and transit paths, bird migratory paths and feeding and nesting areas, etc. The results of the analysis provide ranked sites that balance the benefits from the renewable energy facility against the economic, ecological and sociological impacts.

One key component of the Renewable Energy Siting Toolbox screening analysis is the **Technology Development Index (TDI)**. The TDI is the ratio of the Technical Challenge Index (TCI) to the Power Production Potential (PPP) of the energy extraction facility. TCI is a measure of how difficult it is to site the device at a given location (e.g. water depth, mooring configuration, foundation, or support structure) plus the distance from the device location to the closest electrical grid connection point. The PPP is the potentially recoverable power from a facility that can be delivered for consumption.



Another key component of the Toolbox is the **Ecological Service Value Index (ESVI)**. The ESVI is a relative measure of natural resource values, based on combinations of individual indices of usage by and of natural resources of concern. The under-lying ecological analysis includes mapping of habitat values, as well as usage by birds, bats, marine mammals, sea turtles, and fisheries resources. To quantify distributions and relative densities of specific species groups of concern, ASA applies its wildlife movement (migration and behavior) model (WILDMAP™) based on life history information and available observational data. The model is supported and ground-truthed by presence/absence, abundance, frequency and spatial observational data. For human usage of natural resources (fisheries utilization, aquaculture and wildlife viewing), spatial and statistical data are incorporated into the overall ESVI.

Renewable Energy Siting Toolbox assigns TDI and ESVI values and identifies areas with the highest potential and lowest impact for development — areas with low values of the two indices are the best locations for siting a renewable energy facility. Uncertainty in the underlying data and formulations of the indices is evaluated by performing a Monte Carlo simulation to estimate TDI and ESVI. These results are typically presented in the form of contours of these indices in the area of interest with the upper and lower 95% confidence intervals.