

Renewable Generation & Electrification: Technology Strategy for the Carbon-Constrained Future (Innovator's Circle)



Cape Cod and the islands.
LANDSAT image.

Objective: Support development of technology strategy for Cape & Islands region and identify RDD&D priorities for renewable generation, advanced delivery and end-use technologies, and increased electrification as means toward emissions reduction

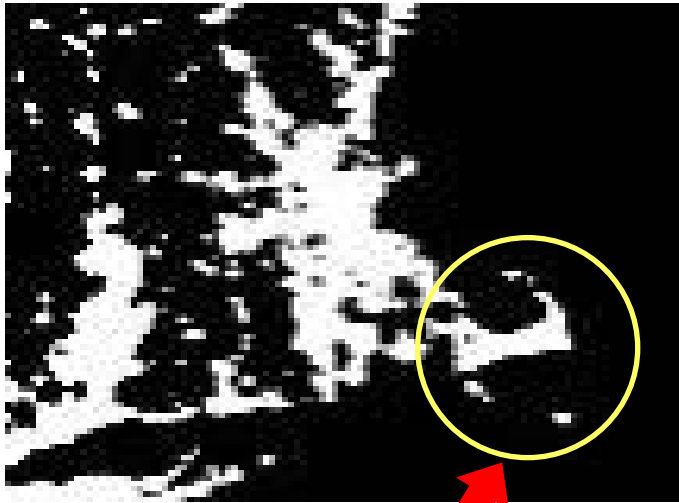
Description:

- Engage stakeholders in (1) assessing energy objectives, technology priorities, and RDD&D opportunities and (2) evaluating priority applications and site-specific opportunities (ongoing)
- Develop energy inventory and baseline forecasts and scenarios for power needs in the Cape & Islands through 2020 (complete)
- Perform conceptual design, economic analysis, and modeling of priority applications and site-specific opportunities within current policy and market contexts (ongoing)
- Transfer results via reports and a workshop (Fall 2008)

Deliverables:

- Spreadsheet-based formulation of the inventory, forecasts, modeling results, and technology strategy
- Workshop, executive summary, and other informative communications geared to Cape & Islands stakeholders
- Final EPRI report detailing strategy, R&D opportunities, and lessons learned

Regional Technology Strategy for the Cape & Islands – Stakeholder Process, Goals & Action Plan



Process: Local to
Global & Back Again



Credit: NASA/ Goddard Space Flight Center

1. “Beyond Cape Wind” Process brings diverse stakeholders to table
 - “Beyond” = *in addition to ... or instead of* the Cape Wind project
2. Facilitated meetings spark dialogue and build consensus on national/global levels
3. Visioning establishes long-term local goals
 - *Develop renewable resources to meet 100% of net annual electricity needs by 2020*
 - *Reduce direct fossil fuel use for heating and transport by 50% by 2020*
4. Regional energy action plan (2/08) organizes and accelerates progress
 - Includes *qualitative* action plans for residents, businesses, communities, etc.
 - Identifies technology strategy project as source for *quantitative* action plans

Regional Technology Strategy for the Cape & Islands

- Key market and policy drivers
 - High prices (>20 cents/kWh) and strong renewable resources
 - MA Green Communities Act: RPS and CHP-PS; least-cost procurement; standard/“virtual” net metering to 2 MW w/ cap
 - State/federal ocean management, offshore renewables policies
 - Regional Greenhouse Gas Initiative
- Technology scenario emphases
 - Efficiency & demand response
 - Onshore wind, PV, and cogeneration
 - Offshore renewables: shallow, transitional & deepwater wind; tidal and wave; hybrid systems; test center
 - Electrification: all-electric transportation systems and buildings



Credits: Joan Muller, Toyota, BusinessWire, Ocean Power, GE, MCT

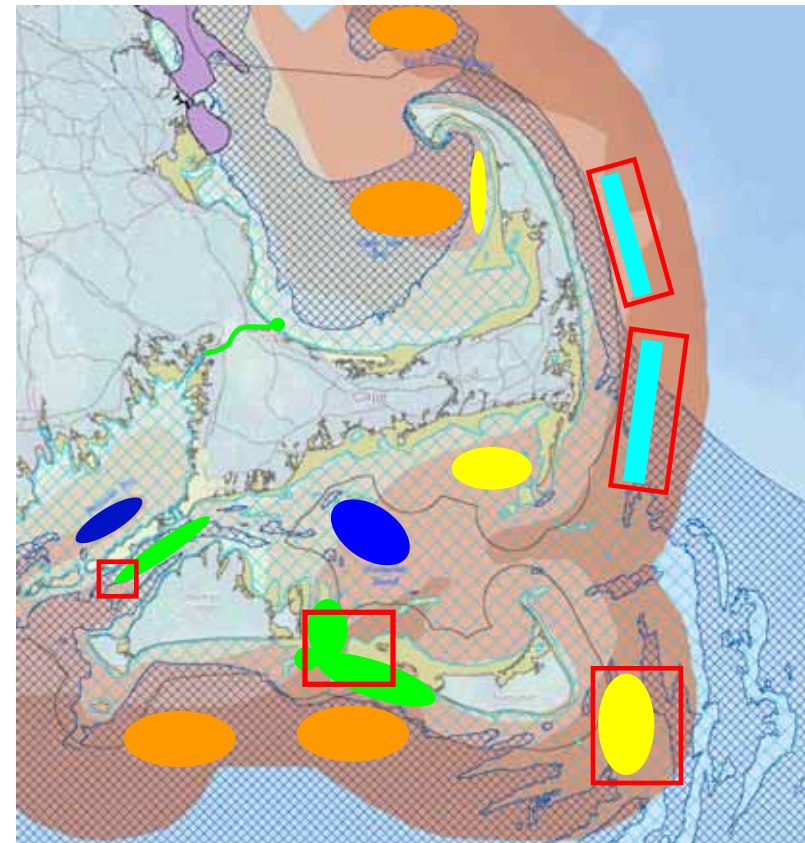
© 2007 Electric Power Research Institute, Inc. All rights reserved.

Regional Technology Strategy for the Cape & Islands – Offshore Energy Cases (10 MW – 1000 MW)

- **Shallow Water Wind:** Cape Wind, South Coast Wind
- **Shallow Water Wind:** Representative Sites
- **Transitional Depth Wind:** Representative Sites
- **Tidal Energy:** Proposed Projects
- **Wave Energy:** Representative Sites
- **Hybrid Wind/Tidal & Wind/Wave:** Representative Sites

Deepwater Wind: Sites Not Shown

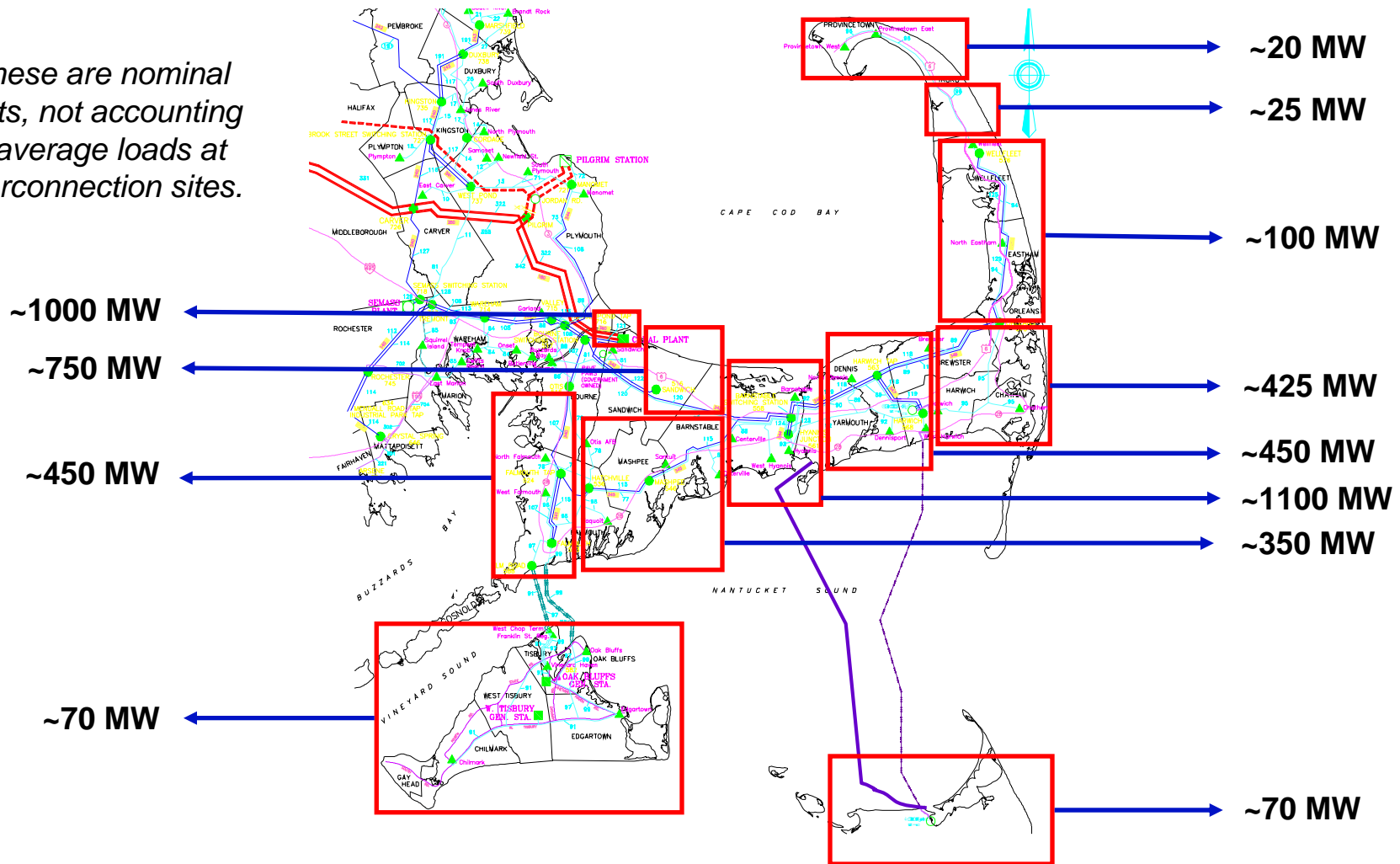
Base Map of Water Depth, Wind Resources:
Massachusetts Coastal Zone Management



Selection Criteria for Representative Sites:
Resource Availability & Water Depth,
Transmission Access & Capacity, Jurisdiction

Regional Technology Strategy for the Cape & Islands – Current Interconnection Limits*

* These are nominal limits, not accounting for average loads at interconnection sites.



Base Map of Grid Infrastructure: NStar

Regional Technology Strategy for the Cape & Islands – Status & Key Findings

Key Stakeholders

Communities

Residents

State & Federal Decision-Makers

Businesses

Environmental Groups

NStar: DisCo & Default Supplier for Cape & Vineyard

National Grid: DisCo, Default Supplier & Efficiency Administrator for Nantucket; Gas Delivery, Supply & Efficiency for Cape

Cape Light Compact: Efficiency Administrator & Competitive Supplier for Cape & Vineyard

***Status:** Technical and economic analyses under way using EPRI and other cost-performance data, as well as NESSIE; results to be captured in technology strategy and in quantitative actions plans for all regional stakeholders*

• 2020 Goals Achievable

- Offshore wind, tidal, wave: potential to meet any and all future needs for electricity w/o major transmission capacity upgrades
- Conservation and efficiency in heating and transport may substantially reduce overall fuel consumption
- Ocean energy resource base: additional potential to support large-scale electrification of heating and transport sectors

• Other Key Findings

- End-use efficiency, demand response, and net-metered generation may constrain load growth and peak loads substantially relative to historical values
- Aggressive land-based wind and PV scenarios can capture >10% of load but can't have major impact on electricity independence
- Net-metered applications may cause significant erosion in electricity sales and in heating oil usage, plus increase in gas sales
- State policy may constrain deployment of net-metered projects within 5 years

Regional Technology Strategy for the Cape & Islands – Illustrative Results

- **Ocean Energy**

- Offshore wind capacity to meet net annual 2020 needs (for cases w/ no major electrification of transport/heating sectors):
 - Cape: < 700 MW
 - Vineyard: < 65 MW
 - Nantucket: < 55 MW

- **Electrification**

- **All-Electric “Community Green” Housing & Energy Center**
 - High-performance construction
 - No on-site fossil fuel use
 - ~400 MWh annually for 60 units with community center
 - Electricity via solar PV and wind
 - Space heating via air- or ground-source heat pumps, water heating via solar thermal
- **All-Electric Transportation (EV and Plug Hybrids) for Personal Vehicle Use**
 - Martha’s Vineyard: ~75,000 MWh (~20 MW offshore wind capacity) to replace all projected gasoline consumption from personal vehicle use in 2020 with electricity; “fuel” cost savings of ~30 to 70%
 - Nantucket: ~50,000 MWh (~15 MW offshore wind capacity)
 - Cape Cod: ~1,050,000 MWh (~300 MW offshore wind capacity)