CAPE LIGHT COMPACT

ENERGY PLAN 2015

Electricity Supply and Use
Recommended Goals, Policies & Action Items
for Cape Cod and Martha's Vineyard

Prepared for the Cape Light Compact
by Ridley & Associates, Inc.

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The *Energy Plan* is the result of collaboration and cooperation among many parties.

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Project oversight was provided by the Compact's Distributed Resources Committee (Bob Mahoney, Charlotte Striebel, John Howard, Barry Worth, John Cunningham, Bob Bigelow, Kitt Johnson and Fred Fenlon), Compact Administrator Margaret Downey and Compact Energy Efficiency Program Manager Kevin Galligan.

The project was designed and managed for the Cape Light Compact by Ridley & Associates. It incorporates results of a *Regional Options Study* based on five individual technical studies which were conducted by Synapse Energy Economics, Inc.; Resource Insight, Inc. and Distributed Utility Associates. It also incorporates local policy research and analysis conducted by Michael Pessolano. Public comments have also been considered in development of *Energy Plan* recommendations.

Many individuals, state and regional agencies, and town departments contributed information, perspective and comments in the course of the project. We thank each for their support and guidance. Copies of comment letters and responses are available from: Margaret Downey, Cape Light Compact Administrator, P.O. Box. 427, Barnstable Superior Court House, Barnstable Village, Massachusetts, 02630.

The Cape Light Compact is an organization of all 21 towns and two counties on Cape Cod and Martha's Vineyard. The Compact's general mission is to protect and advance the interests of consumers and member communities in an emerging competitive market for energy supply. The Compact currently operates a Pilot Project for competitive supply for 50,000 electric customers; operates the regional energy efficiency program; and has a deep interest in facilitating development of distributed generation and "clean and green" energy supply.

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1.0 INTRODUCTION

1.1 Purpose of the Energy Plan

Consumers on Cape Cod and Martha's Vineyard face important choices in future supply and use of energy. Electricity is the most refined and critical energy resource and is the starting point and focus of this initial *Energy Plan* for the region. As we continue to increase consumption and reliance on electricity for our homes and businesses, costs will rise and economic and environmental impacts may deepen. Without local action, the total annual electric costs for the region could increase from $258 million in 2002 to more than $340 million in 2015. Emissions to produce needed electricity could also produce more than 3,300 tons of nitrogen oxide, 1,100 tons of sulfur dioxide, and 1.2 million tons of carbon dioxide. While reliance on New England central generating units could remain the core supply for the Cape and Vineyard through 2015, substantial opportunities exist to achieve economic savings, use more renewable energy, reduce air emissions, increase system reliability, and establish a base for advances in local infrastructure.

The goals, policies, and action items recommended in this *Energy Plan* offer the first steps to pursue those opportunities. The *Energy Plan* is based on the results of five technical studies and a local policy study summarized in a *Regional Options Study*. The studies show that for options that can be pursued by consumers (demand-side options), there is a potential for one-third of projected Cape and Vineyard power supply to be met by cost-effective distributed generation and energy efficiency by 2015. For options that can be undertaken by group purchases of electric supply, or by private companies or utilities (supply-side options), additional potential for the region could arise with the installation of new wind-powered and natural gas fired utility-scale generating facilities, if appropriate sites are available. At an optimum level, all of the region's needs could be met by combining utility-scale development, or competitive power supply, with customer demand-side energy efficiency and distributed generation. All options can reduce emissions below the projected emissions from generating plants in the New England Power Pool.

The goals, policies and action items suggested in the *Energy Plan* provide a flexible framework that will allow choice of a range of options in electric service. They are aimed at what is achievable at the local level. The recommendations can be considered for adoption by municipalities, the Cape Cod Commission, the Martha's Vineyard Commission and the Cape Light Compact, or pursued by individuals and businesses. The recommendations focus on clearing of local barriers, development of incentives, and consumer education. Some recommendations are structural others address the need for updating of zoning, local comprehensive plans, or regional policy plans.

Experience shows that any change is likely to be incremental and result from patient cooperation among many parties. Through a public process, the Cape and Vineyard can create a framework of policies and planning that will allow the region to move toward a range of beneficial electric supply scenarios. The opportunities and choices Cape and Vineyard consumers will face in the future, and the costs we will pay, will be determined in part by the policies and planning ultimately set in place.

1.2 Focus and Scope of the Energy Plan

As noted above, the *Energy Plan* focuses on electricity production, consumption, and transmission and distribution system infrastructure as a starting point in regional energy planning. It also notes features of natural gas availability and infrastructure as they relate to local small-scale electric production. The *Energy Plan* is intended to be a "living document" that will be updated from time to time as technologies, markets, and perspectives evolve. In those updates, other interrelated energy concerns (related to natural gas, fuel oil, propane, hydrogen production, etc.) that offer opportunities for local actions to achieve benefits for consumers and the region may be added and addressed over time.

The *Energy Plan* is based on technical and policy research summarized in the *Regional Options Study* and subsequent public review and comment on the suggested goals, policies and action items contained in that document. The resulting recommendations are offered in Section 2.

Appendix 1 includes a summary of key points from the *Regional Options Study*. It notes the benefits and costs for energy conservation, renewable and distributed energy development for the region, and anticipated production costs and environmental impacts of new utility-scale power plants in the New England region, as well as air emission reductions from utilization of these options. The results provide data and information for consideration of alternatives to investment in generating plants and the transmission and distribution system serving Cape and Vineyard communities.

Appendix 2 includes seven scenarios that illustrate how various options can be combined to gain economic and environmental benefits. The seven scenarios are constructed to indicate a scale of increasing implementation of options by 2015. They are generally targeted to produce savings, reduce emissions, and develop resources at the local level.

Only "clean" generating technologies currently in the market or entering the market are considered. These technologies include: microturbines, fuel cells, reciprocating engines, photovoltaic systems; and wind turbines, and combined cycle plants. Not included at this time are generating technologies such as wave power, tidal power, ocean thermal energy, or electric storage technologies which may offer meaningful alternatives in the future. Similarly, the *Energy Plan* does not include the potential for use of hydrogen fuel, or options for undergrounding of the distribution system, or superconductors for transmission at this time.

The best energy planning considers all viable energy options in a comprehensive context. It is hoped that the policy framework and the public process the *Energy Plan* initiates will allow new technologies to be evaluated and incorporated in the future, and that all options will be considered in a comprehensive context for the benefits and tradeoffs each offers.

2.0 SUGGESTED GOALS, POLICIES & ACTION ITEMS

Cape Cod and Martha's Vineyard communities are just entering the arena of formulating electric energy policy and planning. While it may be premature to determine any preferred scenario at this time, formation of a policy and planning framework will allow flexibility to work toward a range of scenarios.

The sections below include suggested goals, policies, and action items. They include strategic demand-side options such as energy efficiency and distributed generation which can be undertaken by consumers and their communities. They include supply-side options such as renewable and non-renewable power supply and development, and purchase power options that can be carried out by competitive power suppliers and developers. They also include infrastructure options concerning the transmission and distribution system and natural gas delivery system that can be undertaken by utilities and private companies. In the nature of public goals and policy recommendations, most of the suggestions are phrased in a general manner to cover a variety of related concerns or conditions.

The goals, policies and action items ultimately selected will form the building blocks for a regional energy plan.

2.1 Energy Efficiency

Energy efficiency is the cornerstone of any electric supply and demand plan. Energy efficiency programs promote the use of improved operational practices and new technology—motors, appliances, lighting, etc.—that offer greater efficiency than devices currently in use. The Cape Light Compact operates the regional energy efficiency program for all 21 towns on Cape Cod and Martha's Vineyard. Demonstrated benefits are $2 of savings for every $1 invested. There are opportunities to expand and enhance energy efficiency through the Compact program, as well as through the policies and actions of government agencies, businesses and individuals.

Energy Efficiency Goals

- broaden local and regional perspective and understanding of energy efficiency
- continue Compact program at current level of effort through 2015
- increase energy efficiency efforts to the extent possible
- increase energy efficiency performance of residential and commercial buildings

EE 1) Policy Recommendation: Encourage all stakeholders to participate in energy efficiency education and usage of energy efficiency.

Action Items: Governmental agencies, business organizations, and citizen organizations need to undertake activities to promote understanding and use of energy efficiency. Cape and

Vineyard towns should each form an energy committee (if not already formed) with the town's representative to the Cape Light Compact serving as one of the committee members. Towns can also distribute or make Cape Light Compact energy information available; building departments can engage in energy education; regional commissions can co-sponsor forums or discussions with town planners; the Cape Light Compact can produce and distribute energy information; and businesses and business organizations and others can also engage in information distribution and educational forums.

Explanation: The chief barriers to use of energy efficiency are a lack of understanding among consumers and inertia of buying practices and market development.
[Towns, CLC; regional commissions; businesses and business organizations and others]

EE 2) Policy Recommendation: Continue Cape Light Compact energy efficiency program at the current level after 2007.

Action Items: Participate in activities at local and state levels to ensure current program funding.

Explanation: This would mean continuation at a funding level of $5.9 million per year through 2015.
[Towns; CLC; legislative delegation]

EE 3) Policy Recommendation: Increase current energy efficiency efforts subject to the availability of funding.

Action Items: Identify potential sources of increased funding from governmental, public, and private sources; undertake activities to secure increased funding.

Explanation: This would increase funding above the projected level of $5.9 million per year through 2015 (i.e. doubling to $12 million), provided additional sources of funding can be secured.
[CLC]

EE 4) Policy Recommendation: Encourage voluntary increase in energy efficiency of new residential and commercial buildings through local property tax credit or regional planning determination tradeoff.

Action Items: Examine potential for local property tax credit or regional planning determination tradeoff; identify criteria and requirements for improved energy usage per sq. ft; identify proper types and levels of incentive for application of requirements; work with stakeholders and local and regional officials for adoption of selected incentives or tradeoffs. The regional commissions could include this in Regional Policy Plans and prepare Development of Regional Impact requirements, or local density requirements to be met for eligibility for incentives or tradeoffs. Examine possibility of joint effort with Massachusetts Technology Collaborative, or Barnstable County, if the county engages in a wholesale power supply role. Local organizations could support adoption of local programs.

Explanation: This voluntary process would be implemented by the Cape Cod Commission and the Martha's Vineyard Commission, and municipalities that chose to participate.
[Towns; CLC; regional commissions; MTC; Barnstable County; other organizations]

EE 5) Policy Recommendation: Increase energy efficiency of new residential and commercial buildings through amendment of existing buildings codes and requirements.

Action Items: Identify improved standards and requirements; work with stakeholders and local and state officials for state or local adoption; include new standards and requirements in Local Comprehensive Plans, Regional Policy Plans and Development of Regional Impact permitting.

Explanation: This would follow the experience of a voluntary program. It would increase the energy efficiency requirements for new residential and commercial buildings on a mandatory basis.
[Towns; CLC; regional commissions; state legislative delegation; other organizations]

EE 6) Policy Recommendation: New municipal construction and renovations should be as energy efficient as possible and utilize best available technologies and practices.

Action Items: Identify and communicate to municipalities best available technologies and practices and secure funding to assist in implementation; each town's energy advisory committee should monitor energy costs and opportunities for savings. Local residents and organizations can encourage such activity.

Explanation: Municipalities have opportunities to save on energy costs and provide public models for businesses and residential consumers.
[Towns; CLC; other organizations]

EE 7) Policy Recommendation: Encourage the Cape Cod Commission and the Martha's Vineyard Commission to identify methods and measures to reduce air emissions and increase energy efficiency.

Action Items: The Cape Cod Commission and Martha's Vineyard Commission can organize public discussions and identify and implement measures and methods for air emission reduction and energy efficiency (which would include transportation considerations). These items could be included in Regional Policy Plans. The Compact and local organizations could support such efforts.

Explanation: Given the periodic poor air quality in the region, these agencies can provide leadership and coordination for efforts that provide perspective on activities and methods for reduction of air emissions.
[Regional commissions; CLC; other organizations]

EE 8) Policy Recommendation: Engage in New England regional and national discussions on reduction of air emissions and energy efficiency.

Action Items: The Cape Light Compact, on behalf of municipalities and consumers in the region should join and participate in New England and national organizations focused on reduction of air emissions and energy efficiency.

Explanation: Periodic problems with air quality on the Cape and Vineyard are in part the result of regional and national policies.
[Regional commissions; CLC; other organizations]

EE 9) Policy Recommendation: Provide state and local tax incentives for purchase and installation of energy efficiency measures.

Action Items: Towns, Compact, legislative delegation and other organizations should work with stakeholders and state and local officials to identify types of qualified measures and amounts of incentives; undertake activities to have incentives adopted and implemented.

Explanation: Energy efficiency measures provide an array of public benefits including reduction of transmission and distribution system costs, reduced fuel needs, reduced air emissions; incentives can help to recognize and promote these public benefits and savings for individual consumers.
[Towns; CLC; legislative delegation; other organizations]

EE 10) Policy Recommendation: Energy efficiency measures that contribute specifically to peak-shaving should be recognized and supported for their value to individual and aggregated groups of customers.

Action Items: Identify, provide incentives, and promote specific programs that contribute specifically to peak-shaving; work with state officials and stakeholders to assure that demand response programs and electric rates are in place that recognize the value of and support peak-shaving activity for individual and aggregated groups of small customers.

Explanation: As regional electric growth continues to increase, peak-shaving as a planning tool will have greater value. For peak-shaving to meet its potential, supply contract provisions, policies, and programs need to be put in place that reward consumers for that value.

[CLC]

2.2 Distributed Generation

Distributed generation installed by customers offers the greatest magnitude of customer opportunity in terms of total impacts with an upper bound of 30 percent of the region's supply by 2015 and an average benefit/cost greater than $1.80 for every $1 invested. Distributed generation (DG) is the term applied to small-scale electric generating technologies located at the customer site, or close to customer sites. Only "clean" generating technologies that will reduce regional air emissions have been included for recommendation. These include advanced fossil fuel technologies such as microturbines, reciprocating engines and fuel cells, as well as renewable energy technologies such as photovoltaic cells. Wind turbines can also be installed by customers, but are not considered a DG technology because they are intermittent and cannot be turned on when needed. There is a general consensus within the electric industry and among policy-makers that distributed generation will play an increasingly important role in power generation.

Distributed Generation Goals:

- eliminate local barriers and encourage to half of estimated potential for DG on the Cape and Vineyard
- eliminate local barriers and encourage to full estimated potential for DG on the Cape and Vineyard
- utilize DG to the extent possible as an alternative or augmentation of investment in the electric transmission and distribution system

DG 1) Policy Recommendation: Remove local review and permitting barriers with model by-law.

Action Items: Work with regional and local planners to formulate model by-law; work with towns and regional commissions for adoption.

Explanation: Because distributed generation is small scale and is often below federal and state permitting thresholds, review and permitting responsibilities fall to local governments which at the present time lack policies that clearly address review criteria and the permitting process.
[Towns; CLC; regional commissions; other organizations]

DG 2) Policy Recommendation: Remove potential utility technical barriers.

Action Items: Work with state agencies and NSTAR Electric to identify potential problem circuits; in particular review interconnection requirement of less than 7.5 percent of circuit annual peak capacity for certain circuits through system analysis and any necessary system upgrades; work for least-cost resolution of problems.

Explanation: Potential for cost-effective distributed generation installation could be stalled due to unresolved interconnection problems or restrictions.
[CLC]

DG 3) Policy Recommendation: Improve state policies and regulations to facilitate DG installation.

Action Items: Work with legislative delegation and state officials and stakeholders to identify opportunities to restructure utility rates, business practices and services and to facilitate DG installation.

Explanation: Utility charges and policies can stall or limit opportunities for DG implementation.
[CLC; legislative delegation]

DG 4) Policy Recommendation: Provide local property tax credits for fuel cell or photovoltaic installation by businesses or residents.

Action Items: Examine systems that balance tax incentives and tax revenues; work with stakeholders and local officials to identify proper level of incentives and requirements for eligibility for incentives; undertake activities for adoption of selected incentives on a town-by-town basis. Examine possibility of joint effort with Massachusetts Technology Collaborative, or Barnstable County, if the county engages in a wholesale power supply role. Local organizations could support adoption of local programs.

Explanation: Minimal local property tax credits (some credits already apply to photovoltaic system installation) can help to overcome cost barriers and provide demonstration models.
[Towns; CLC; regional commissions; MTC; Barnstable County; other organizations]

DG 5) Policy Recommendation: Encourage pilot projects for implementation of DG technologies, especially for public buildings.

Action Items: Identify and secure public and private funds to establish support for pilot projects; survey potential DG users for assistance needed; identify opportunities for coordinated load response programs; identify opportunities to swap-out existing emergency/standby generators for cleaner DG technologies.

Explanation: Pilot projects can offer coordinated assistance for efforts to install DG technologies that provide energy savings, environmental benefits and public education value.
[Towns; CLC; other organizations]

DG 6) Policy Recommendation: Include distributed generation as a consideration in analyses of alternatives to transmission and distribution system upgrades or expansion.

Action Items: Work with stakeholders, NSTAR Electric and state and regional officials to establish policies for inclusion of DG review as part of transmission and distribution system planning

Explanation: Expenditures for transmission and distribution system upgrades and expansion are made to meet peak load that occurs for a limited period during the year (less than 100-200 hours). Distributed generation can help to offset or defer costs until such time as the upgrade would be more fully utilized.
[Towns, CLC]

2.3 Electric Supply-Side

Electric supply-side options include the purchase of power supply and development of utility-scale generating facilities. The region's power supply is provided primarily through NSTAR Electric and the Cape Light Compact under contracts with competitive power suppliers. This contracted power supply is produced by plants throughout New England. Replacing this power supply with local power supply can be achieved if there is sufficient cost-effective generating capacity appropriately sited on or near the Cape and Vineyard. Benefits from local or non-local power supply can be gained through competitive power supply contracts. These contracts can include terms for the type of power purchased, including the amount of power from clean generating technologies and renewable resources.

Electric Supply-Side Goals

- achieve economic savings for consumers
- upgrade to cleaner and greener power supply
- encourage development of utility-scale clean and green generating facilities at appropriate sites

SS 1) Policy Recommendation: Utilize competitive purchase power agreement to achieve economic savings and cleaner and greener power supply.

Action Items: Continue efforts based on the Cape Light Compact Pilot Program for competitive supply for all consumers on the Cape and Vineyard.

Explanation: Large groups of aggregated electric customers have an opportunity to negotiate terms of supply that may not be offered or available to individual customers, especially residential or small commercial customers.
[CLC]

SS 2) Policy Recommendation: Encourage any individual or group purchasing competitive power supplies on the Cape and Vineyard to seek terms that ensure the power supply is cleaner than the average New England Power Pool generation, and/or greener than the state Renewable Portfolio Standard requirement.

Action Items: Create greater awareness of the availability of clean and green power supplies through information posted on the Cape Light Compact website and/or references to other websites; support and encourage state officials in efforts to educate consumers.

Explanation: All consumers will be placed on Default Service if they have not chosen a competitive supplier by the time Standard Offer Service terminates (March 1, 2005). Consumers have limited understanding of choices in the competitive power supply market.
[CLC; Towns; other organizations]

SS 3) Policy Recommendation: Identify potential sites for utility scale generating plant development in the Cape and Martha's Vineyard region.

Action Items: The Cape Cod Commission and Martha's Vineyard Commission, in conjunction with municipal planners, state officials, and other stakeholders (including NSTAR and KeySpan) should identify potential sites for utility scale clusters of wind turbines, or natural gas combined cycle facilities.

Explanation: If any utility scale generating plant (from 5 to 500 megawatts) is to be developed in the region, identification of an appropriate site or sites will be a critical threshold factor.
[Regional commissions; CLC; Towns; other organizations]

SS 4) Policy Recommendation: Planning, review, and permitting criteria should be developed for utility-scale generating plants below state permitting thresholds, to the extent that such criteria is currently lacking.

Action Items: The Cape Cod Commission and Martha's Vineyard Commission, in conjunction with municipal planners, state officials, and other stakeholders should determine planning criteria for utility scale generating plant development that is below state permitting thresholds.

Explanation: Generating plants below 100 megawatts can fall below the threshold for certain state review processes. The region should be prepared to address generating proposals if appropriate sites are identified.
[Towns, CLC; regional commissions; other organizations]

SS 5) Policy Recommendation: Continue and enhance participation in state review of proposals for siting of generating plants in the region, or proceedings concerning the operation of generating plants in the region.

Action Items: The state legislative delegation, the Cape Cod Commission and Martha's Vineyard Commission, as well as the municipalities, the Cape Light Compact, and other concerned parties, should continue and enhance participation in proceedings concerning construction or operation of utility scale generating plants in the region.

Explanation: These projects have far-reaching impacts for the region and thorough review of proposals is essential to ensure local benefits and minimal adverse impacts. Locations for siting such facilities should consider the capacity needs of the area, and the needs of the electrical transmission system as well as the local environmental impacts.
[Towns; CLC; regional commissions; legislative delegation; other organizations]

2.4 Renewable Energy

Renewable Energy can be supplied to the region by both supply-side and demand-side options. Qualified renewable energy resources in Massachusetts include: solar photovoltaic or thermal electric energy, wind energy, fuel cells utilizing renewable fuels, landfill gas, low-emission biomass conversion technologies, and ocean thermal, wave, or tidal energy. State policies provide market support for development of these technologies. All retail suppliers in Massachusetts are required to meet Renewable Portfolio Standards (RPS) utilizing qualified renewable resources starting at 1 percent of supply in 2003 and increasing to 4 percent by 2009, at which time RPS will be reviewed for continuation. In addition to the RPS requirement, consumers can install photovoltaic electric systems or wind turbines, or utility-scale wind facilities may be developed if appropriate sites are available. Local solar photovoltaic advocates have targeted goals of 500 kilowatts on Martha's Vineyard and 1,000 kilowatts on Cape Cod by 2015. Local and regional policies may help to meet or exceed those goals.

Renewable Energy Goals

- achieve maximum local customer purchases of renewable energy at reasonable prices
- achieve maximum local development of renewable energy at appropriate sites

RE 1) Policy Recommendation: Formulate renewable energy purchase targets for aggregations such as the Cape Light Compact supply contracts greater than RPS requirements.

Action Items: Examine potential with competitive suppliers to include 3 percent RPS purchase for Compact 2005; 6 percent 2010; 10 percent 2015; based on availability and pricing of renewable energy supply; examine purchase of RPS requirements from local renewable sources on a preferential basis with premium price.

Explanation: The Cape Light Compact aggregation program offers an opportunity to facilitate increased renewable energy supplies to all customers.
[CLC; other organizations and aggregators]

RE 2) Policy Recommendation: The Cape Light Compact should continue efforts to create a voluntary green power supply program for consumers who wish to pay a premium to support operations and development of qualified renewable energy resources.

Action Items: Identify interested suppliers and test a pilot program as part of an aggregation supply contract, or independent of the aggregation supply contract.

Explanation: Surveys undertaken by the Massachusetts Technology Collaborative have indicated an interest among Cape and Vineyard consumers to purchase green electric supply at a premium price.
[CLC; other organizations]

RE 3) Policy Recommendation: Engage in public processes to develop local, state, and federal review and permitting of renewable energy proposals.

Action Items: Work with local, state, and federal officials to identify and remedy deficiencies in the review and permitting process for renewable energy facilities.

Explanation: The use, application, or siting of facilities for new technologies can often run ahead of standards, and review and permitting processes.
[Towns; CLC; regional commissions; legislative delegation; other organizations]

RE 4) Policy Recommendation: Consider passive solar design, solar thermal, solar photovoltaic, customer-sited wind turbines and other renewable energy facilities in development of zoning by-laws and other land-use regulations.

Action Items: Based on review of local regulatory problems noted in the *Cape Light Compact Regulatory Assessment*, undertake activities to remove local barriers to renewable energy facilities.

Explanation: A range of barriers and potential barriers have been identified on a town-by-town basis for the 21 towns. Initiatives such as a model zoning by-law would offer a common approach to resolution of these problems.
[Towns; CLC; regional commissions; other organizations]

RE 5) Policy Recommendation: Support maximum use of passive solar design and development of solar thermal and solar photovoltaic installations on the Cape and Vineyard.

Action Items: Support the Million Solar Roofs program and other initiatives and pilot projects designed to promote and install solar design, solar thermal and solar photovoltaic systems.

Explanation: Various pilot programs will advance the use and understanding of solar photovoltaic systems.
[Towns; CLC; regional commissions; other organizations]

RE 6) Policy Recommendation: Examine opportunities for utilization of local property tax credits to support solar and other renewable energy installations.

Action Items: Work with local officials to identify criteria and proper amounts for property tax credits and work to implement. Examine systems that balance tax incentives and tax revenues; work with stakeholders and local officials to identify proper level of incentives and requirements for eligibility for incentives; undertake activities for adoption of selected incentives on a town-by-town basis. Examine possibility of joint effort with Massachusetts

Technology Collaborative, or Barnstable County, if the county engages in a wholesale power supply role. Local organizations could support adoption of local programs.

Explanation: Local governments can play an important role to support development of solar and renewable energy installations.
[Towns; CLC; regional commissions; MTC; Barnstable County; other organizations]

RE 7) Policy Recommendation: Seek to facilitate and prepare uniform Request for Proposals for energy services by municipalities and others.

Action Items: Assist in creating boilerplate language and educate those issuing RFPs.

Explanation: Educational efforts and uniform documents will assist towns and others in procurement process.
[CLC]

2.5 Infrastructure

Electric Transmission and Distribution System

The Cape and Vineyard are served primarily by power generation from competitive suppliers under contract to NSTAR Electric or the Cape Light Compact. The power is delivered over a transmission and distribution (T&D) system owned and operated by NSTAR Electric. This is a system designed to both deliver power to the Cape and to transmit power generated by the Canal plant to the mainland. It is the heart of electric service reliability and quality. The adequacy of this system depends on timely maintenance and upgrades to meet increased electric usage and demand. Utility expenditures on transmission and distribution usually take place to meet system peak demands that occur 100-200 hours per year. Deferral or augmentation of this spending through the use of energy efficiency and distributed generation can produce savings and increase reliability.

Infrastructure Goal:

- ensure safety, reliability, efficiency, and least-cost investment in the transmission and distribution system

T&D 1) Policy Recommendation: Undertake and support activity to ensure maximum safety of public and workers.

Action Items: Support NSTAR Electric communications efforts concerning safety of system; support NSTAR Electric initiatives to advance safety for the public and workers.

Explanation: Safety and education is a cooperative public effort.
[Towns; CLC; regional commissions]

T&D 2) Policy Recommendation: Ensure long term reliability and least-cost long term investment.

Action Items: Participate in long term system planning with NSTAR Electric, ISO New England and state officials. Cape Cod Commission and Martha's Vineyard Commission should examine infrastructure status and planning. If opportunities arise, and costs are reasonable, examine opportunities for systematic undergrounding of T&D system, especially through cooperative street-opening activities for water, natural gas, or other services; examine opportunities for utilization of superconductors for transmission as economics improve. (Also see DG 6.) Support funding for county regional infrastructure planning from Assembly of Delegates. Include long term reliability and least-cost investment in the T&D system as part of Local Comprehensive Plans and Regional Policy Plans.

Explanation: An open public process for T&D long range planning that engages all stakeholders is essential for ensuring system reliability and cost efficiency.
[Towns; CLC; regional commissions; legislative delegation; Assembly of Delegates]

T&D 3) Policy Recommendation: Ensure near term reliability, and least-cost investment.

Action Items: Work with NSTAR Electric and state agencies to review potential problem circuits and optimum problem resolution; work with customers and identify and support measures for Energy Efficiency and DG in potential problem areas. (See related Energy Efficiency and DG policies and action items.) Include near term reliability and least-cost investment in T&D as part of Local Comprehensive Plans and Regional Policy Plans.

Explanation: Problem areas or "hotspots" where there are system stresses or increased growth in electric demand and usage are likely areas for consideration of alternative measures to resolve problems.
[Towns; CLC; regional commissions; legislative delegation]

T&D 4) Policy Recommendation: Increase efficiency of T&D system.

Action Items: Work with NSTAR Electric and state agencies to identify opportunities to decrease line losses; support NSTAR Electric in efforts to decrease line losses.

Explanation: Losses for electricity on the transmission and distribution system are calculated at 2 percent for transmission and 8 percent for distribution for planning purposes.
[CLC; legislative delegation]

Natural Gas Fuel Supply

The Cape has natural gas availability in most communities (except Truro and Provincetown), but distribution lines commonly do not extend through the entire community. The Vineyard has no natural gas access (utilizing propane instead). Natural gas is supplied to the Cape primarily through the Duke Energy Gas Transmission (DEGT) system and KeySpan Energy Delivery. There is also a small Liquefied Natural Gas (LNG) storage facility located in South Yarmouth that is owned and operated by KeySpan. DEGT has access to all of the major supply basins in the U.S. and Canada and access to imported LNG through the Distrigas facility in Everett, Massachusetts. Natural Gas is supplied to the residential and commercial end users on Cape Cod by KeySpan. The interstate transmission and local delivery system is limited to the contractual capacity and design to typically support the residential and commercial space heating loads as well as a portion of the fuel supply for the Canal Electric Generating Plant. Deliverability of the pipeline system can be increased through the addition of or modification to the existing pipeline system including the potential extension of the system through a second directionally drilled pipeline installed under the Cape Cod Canal. A satellite LNG facility for an area such as Martha's Vineyard, may also be an option to consider. Delivery to specific sites to fuel customer-sited DG units could require modifications to the local distribution system.

Natural Gas Fuel Goal:

- ensure safety, capacity of supply, access and least-cost investment in distribution system.

NG 1) Policy Recommendation: Undertake and support activity to ensure maximum safety of public and workers.

Action Items: Support KeySpan and DEGT communications efforts concerning safety of system; support KeySpan and DEGT initiatives to advance safety for the public and workers.

Explanation: Community, customer, and worker safety is a critical issue concerning natural gas fuels, particularly for construction projects for which trenching or excavation is taking place.
[Towns; CLC; regional commissions; legislative delegation]

NG 2) Policy Recommendation: Ensure adequate gas transmission, distribution and supply capacity.

Action Items: Work with KeySpan, DEGT, state agencies, and stakeholders to identify potential system constraints and least-cost remedies. Include adequate gas transmission, distribution and supply capacity as part of Local Comprehensive Plans and Regional Policy Plans.

Explanation: Because most natural gas fuel is utilized on the Cape for heating purposes, capacity during the approximately 90 day winter peak heating period may present a constraint on the Cape. The lack of natural gas supply on the Vineyard needs to be reviewed.
[Towns; CLC; regional commissions; legislative delegation]

NG 3) Policy Recommendation: Ensure access to natural gas fuel and least-cost long term investment in the transport and delivery system.

Action Items: Review with KeySpan, DEGT, state officials and stakeholders the current extent of distribution system and plans and opportunities for expansion; review Martha's Vineyard lack of natural gas fuels and options. Identify any locations where capacity additions and additional natural gas load may be developed at the lowest cost and with the least environmental impact. Cape Cod Commission and Martha's Vineyard Commission should review the status and planning for the fuel delivery infrastructure; include access to natural gas fuels and least-cost investment in the transport and delivery system as part of Local Comprehensive Plans and Regional Policy Plans.

Explanation: An open public planning process for natural gas supply that engages all stakeholders is essential for ensuring system and cost efficiency.
[Towns; CLC; regional commissions; legislative delegation]

3.0 SUMMARY

Consumers on Cape Cod and Martha's Vineyard have a unique opportunity to begin formulation goals, policies and actions to allow greater choice and reduced costs in energy supply and use.

The *Energy Plan* offers a starting point for consideration of those opportunities. For strategic demand-side options there is a technical potential for one-third of projected Cape and Vineyard power supply to be met by cost-effective distributed generation and energy efficiency by 2015. For supply-side options, additional potential for the region could arise with the installation of new wind-powered and natural gas-fired utility-scale generating facilities, if appropriate sites are available. At an optimum level, all of the region's needs could be met by combining utility-scale development, or competitive power supply, with customer demand-side energy efficiency and distributed generation. Additional renewable energy can also be purchased at a premium price. All options can reduce emissions below the projected emissions from generating plants in the New England Power Pool.

Experience shows that any change will be incremental and result from patient cooperation among many parties. Policies suggested in the *Energy Plan* can be considered for adoption by municipalities, the Cape Cod Commission, the Martha's Vineyard Commission and the Cape Light Compact, or pursued by individuals and businesses. By utilizing a public process, the Cape and Vineyard can create a flexible framework of policies and planning that will allow the region to move toward a range of beneficial electric supply scenarios. The opportunities and choices Cape and Vineyard consumers will face in the future will be determined in part by the policies and planning ultimately set in place.

GLOSSARY

Aggregator: any entity that seeks to aggregate consumers for delivery of service under specified contract terms. (Also see Municipal Aggregator.)

Ancillary Services: electric supply services for operating reserves; voltage control, regulation and frequency response; scheduling and system control and dispatch; and other power supply necessary to effect a reliable transfer of electrical energy at specified contract terms between a buyer and a seller.

Baseload: the minimum amount of power delivered or demanded over a given period at a constant rate (contrasted with "peak load").

Bilateral Contract: a direct contract between a power producer, or power marketer, and an aggregator or customer end-user.

Biomass: plant and animal matter utilized for fuel purposes. Within the renewable energy industry, biomass usually refers to wood, wood-processing residues, and energy crops used to create electricity, generate heat, or produce liquid transportation fuels (ethanol).

Broker: a retail agent who arranges power transactions but does not take title to the power.

Bulk Power Supply: a term often used interchangeably with "wholesale" power supply bought and sold among suppliers and aggregators (contrasted with "retail" power supply sold to customers).

Capacity: the rated continuous load-carrying ability, expressed in megawatts (MW) or megavolt-amperes (MVA) of generation, transmission, or other electrical equipment.

Central Power Generation: the traditional method of power generation in which power is generated by large power plants and transmitted to distribution systems.

Cogeneration: production of electrical energy and utilization of heat or steam captured from that process and applied as useful energy rather than waste.

Combined Heat and Power (CHP*)*: also known as "cogeneration" and as an application of distributed resources commonly viewed as providing the most rapid direct economic payback.

Competitive Power Supplier: a supplier of wholesale retail energy and capacity, as well as ancillary services, other than the incumbent utility. The *Competitive Power Supplier* may own generation or may buy and resell energy and capacity and has title to the commodity in contrast to a "Broker".

Contract Path: the most direct theoretical transmission ties between two entities. When parties exchange bulk power supplies, the transfer is assumed to take place across the

Contract Path notwithstanding the fact that power flow in a transmission and distribution network will distribute in accordance with network flow conditions—the "Physical Path." Billing and plant operations follow *Contract Path* requirements but may be constrained by "Physical Path" conditions.

Control and Data Technology: utility service areas are divided into "control areas" for which utilities monitor voltage and power flows and utilize centralized dispatch and transmission equipment to maintain *reliability* and *quality of service*; data technologies are new computer devices that can combine with control technology to monitor power flows and dispatch an array of individual distributed generation units to enhance voltage levels and power flow. Utilities utilize "supervisory control and data acquisition" (SCADA) systems to monitor and obtain data from devices such a circuit breakers and switches.

Default Power Supply: retail electric service provided to customers who became new utility customers after March 1, 1998, or to all customers after the elimination of "Standard Offer Service" set for March 1, 2005 who have not chosen a competitive supplier. Default Power Supply is provided by the utility at market rates for specific periods of time (i.e. six months) at which time the rate changes.

Demand-Side: activities that take place on the customer side of the electric meter that affect customer electric usage, including energy efficiency measures, peak-shaving, and the use of customer sited distributed generation (as contrasted to electric "Supply-Side" activities.

Digital Grid: an "intelligent" transmission and distribution system that utilizes communications equipment to interact with small and large power plants and consumer appliances and equipment; a more comprehensive form of interactive system than might be utilized than a *microgrid,* or *virtual utility* system that may incorporate only generating units and not appliances and equipment consuming power.

Department: the Massachusetts Department of Telecommunications and Energy which has regulatory authority over electric, gas, telephone and other services in Massachusetts.

Distributed Generation (DG): generation of electricity by scalable generating facilities that are located at or near the point of end-use consumption. These facilities can be located on either the customer side of the meter or the utility side of the meter, and may be owned by the individual consumer, the utility, or a third party generator. They are usually connected to the grid, but may be disconnected from the grid as stand-alone systems.

Distributed Resources: include distributed generation, energy efficiency, and data and control technology to dispatch distributed generation.

Distribution System: local wires, transformers, substations, and other equipment used to distribute and deliver electricity to the end-use consumer. This is differentiated from the transmission system which carries high-voltage power to the substation.

Electric Distribution Company: a company that owns and operates the transmission and distribution lines necessary to deliver electricity to end -user consumers; also known as local distribution company (LDC).

Electric System Losses: electric energy losses consisting of transmission, transformation, and distribution system losses between supply and delivery points.

Energy (electric): the output of a generator measured in megawatt hours or kilowatt hours; or the usage by a customer, or group of customers measured in megawatt hours or kilowatt hours.

Energy Efficiency (electric): practices and measures undertaken to reduce the consumption of electricity for a specific task or function (i.e. lighting).

Environmental Benefits: benefits resulting from activity such as development of renewable energy systems, that produce energy with less air, water, soil, or other pollution than production of a similar amount of energy produced by conventional fossil fuel sources.

Externalities: benefits or costs created as a by-product of an economic activity that do not accrue only to the parties involved in the activity, such as *environmental benefits* resulting from renewable energy development, or *multiplier effects*. The dollar value of such externalities may or may not be included in cost/benefit analyses

Federal Energy Regulatory Commission (FERC): the federal agency that oversees interstate utility transactions, transmission grids, and policies and markets regarding wholesale electric supply.

Flywheel: a device for storing kinetic energy that can be used to produce electricity using the inertia of a fast-spinning mass. Kinetic energy stored in a flywheel can be retrieved very quickly on command.

Franchise: a grant of right or privilege to occupy or use public streets and ways and facilities located on public streets and ways to deliver service to consumers. Franchises are historically granted by local governments.

Fuel Cell: a technology capable of generating an electrical current by converting the chemical energy of a fuel directly into electrical energy. There are several different types of fuel cells in development. They include:

> <u>Molten Carbonate Fuel Cell (MCFC):</u> a type of fuel cell that utilizes molten carbonate electrolytes. This system has the advantage of utilizing carbon monoxide as a fuel, allow mixtures of carbon monoxide and hydrogen, such as those produced in a coal gasifer, to be used as fuel
>
> <u>Phosphoric Acid Fuel Cell (PAFC)</u>: a type of fuel cell that employs phosphoric acid electrolytes. It is the most commercially developed type of fuel cell, and can be used in vehicles such as buses and trains.

Proton Exchange Membrane Fuel Cell (PEMFC): a type of fuel cell that operates at relatively low temperatures, has high power density, can vary output quickly to meet shifts in power demand, and is suited for applications such as automobiles.
Solid Oxide Fuel Cell (SOFC): a type of fuel cell that employs solid zirconium dioxide electrolytes. Suitable fuels include hydrogen, carbon monoxide, and methane. Solid oxide fuel cells have the advantage of being relatively insensitive to fuel contaminants such as sulfur and nitrogen compounds that impair the performance of other fuel systems.

Fossil Fuels: energy sources formed by the decay of plants and animals over millions of years: coal, oil, and natural gas.

Gas Turbine: an electric generator using natural gas (or another similar gas product) as a fuel source. Gas turbines generally range in size from a few hundred kilowatts to a few hundred megawatts. Also see *microturbine*.

Generation: the process of producing electrical energy from other forms of energy; also the amount of electric energy produced, usually expressed in kilowatt hours (kWh) or megawatt hours (MWh). Gross generation is the electrical output at the terminals of the generator, usually expressed in megawatts (MW). Net generation is gross generation minus the service power requirements of the generating station itself.

Geothermal Energy: heat energy stored in the Earth's crust which can be harnessed to produce electricity or heat water and living spaces.

Good Utility Practice: Any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. *Good Utility Practice* is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

Green Building: the use of design and construction methods and materials that are resource efficient and that will not compromise the health of the environments or the associated health and well-being of the buildings occupants, builders, or the general public. Such construction is aimed at maximizing energy efficiency. Also called "environmentally-sound" or "sustainable" building.

Green Power: electricity generated with renewable resources.

Grid: a network of interconnected power lines and associated equipment used to transmit and distribute electricity over a geographic area: also see *Microgrid*.

Harmonics: voltages and currents of frequencies that are multiples of 6- Hertz. Excessive harmonics can cause problems with electronic equipment, especially protection systems, as well as overheating equipment. In some cases high voltage and large currents may be caused by harmonics.

Hydropower: the energy captured from the force of flowing water, which can be harnessed to create electricity or mechanical work.

ISO-New England: The Independent System Operator established July 1, 1997 in accordance with the New England Power Pool Agreement and applicable FERC approvals, which is responsible for managing the bulk power generation and transmission systems in New England.

Interconnection Service Agreement: an agreement between a customer and a utility for that includes the terms for connecting a customer-sited distributed generation facility.

Inverter: an electronic device that converts electricity from DC to AC, used with photovaltaic panels and other technologies that produce DC.

Islanded System: a part of the distribution system that is separated from the rest of the power grid (due to some accidental failure or the system or maintenance). An islanded system, would have distributed generation as its only source of power. Unintentional islanding, due to the failure to isolate generating facilities when the interconnected distribution system is not functioning creates safety hazards for workers and the public.

Isolating Generation: the function of separating a generating facility, such as customer-sited distributed generation from a distribution system to prevent and "islanded system" in situations in which the distribution system is not functioning properly. Customer-sited distributed generation requires systems that will monitor the power from the distribution system and automatically isolate the DG unit when the distribution system is not operating correctly.

Kilowatt: a kilowatt is 1,000 watts of electric power capacity. A watt is the measure of power developed by one ampere of current across a potential of 1 volt. A kilowatt (kW) is used to describe the output of an electric generator at a particular moment—the capacity of that generator. Also see *kilowatt hour, megawatt, and megawatt hour.*

Kilowatt Hour: the measure of electric energy delivered, equal to 1,000 watts of power delivered for one hour. Typically noted on consumer electric bills. See *kilowatt.*

Megawatt: equivalent to 1,000 kilowatts of capacity, noted as (MW) and used to rate the potential output of a generating unit. See *kilowatt.*

Megawatt Hour: 1,000 kilowatt hours, typically used in power sales contracts. See *kilowatt hour.*

Microgrid: a small segment of a grid utilizing distributed generation linked through control and data technologies to supply power to the larger grid, for its own use; a microgrid may consist of as few as 50 small distributed generation facilities.

Microturbine: a very small gas turbine, typically less than 200, kilowatts.

Multiplier Effect: the economic effect of development of energy resources or programs that produce additional jobs and other "ripple" effects as the result of an initial investment. The multiplier effect includes direct effects such as on-site jobs, indirect effects such as off-site jobs providing goods and services, and induced effects which includes economic activity generated by respending of wages.

Municipal Aggregation: a program created by municipal approvals and state approvals to allow customers to join together to negotiate and purchase retail power supply and undertake other related services such as energy efficiency, development of distributed generation, or consumer protection. For communities that adopt municipal aggregation programs and offer power supply, each consumer is notified of the terms of participation in writing and given an opportunity to "opt-out" to receive utility-supplied power, or power from another competitive supplier if one is available.

Municipal Solid Waste: trash or garbage that can be utilized to produce heat or electricity through controlled combustion, or capturing the gases it produces and utilizing the gases as fuel; also known as "waste-to-energy" municipal solid waste is included by some states in a category of renewable energy resources.

New England Power Pool (NEPOOL): a voluntary association of entities that are engaged in the electric power business in New England, including utilities, power marketers, aggregators, brokers, competitive suppliers, generation owners, and end-users.
Members operate under the Restated NEPOOL Agreement in the operation of market-based wholesale power operations. NEPOOL operates under the oversight of ISO New England, the regional independent system operator. (See ISO New England)

Net-Metering: a method of metering an end-use consumer's electricity consumption that allows a distributed generation source of 60 kW or less on the customer-side of the meter to run the meter backward when the system is producing more power than the end-user in consuming, thus feeding electricity into the grid and providing an economic credit to the consumer equal to the average monthly market price of generation per kWh, as determined by the Department, in any month during which there was a positive net difference. (See 220 CMR 11.04(7)(c)) This is in contrast to "dual metering" in which two separate meters are used to calculate energy taken from and supplied back to the grid.

Nonrenewable Fuels: fuels that are not naturally replaced as they are utilized; including fossil fuels, nuclear fuels and municipal solid waste.

Off-Peak: the time period when energy demand is not at its highest point, measures on a daily, monthly, or annual basis, and commonly indicated by the lower points on a sine curve. Off-peak power (such as street lighting) is the least-expensive power to supply.
Also see *Peak*.

Off-Grid: electric generating units not connected to distribution or transmission lines.

On-Site Generating Facility: a class of customer-owned generating facilities with peak capacity of 60 kW or less. (See 220 CMR 8.02)

Parallel Operation: the utility and the source of distributed generation are operating so that each is capable of serving the same loads at the same time.

Passive Solar: a system in which solar energy is used for the transfer of thermal energy.

Peak: the time period when energy demand is at its highest points; measured on a daily, monthly, or annual basis, and commonly indicated by the upper portion of a sine curve. Peak power is the most expensive power to supply. (Also see *Off-Peak*.)

Peak-Shaving: technology or measures undertaken to reduce power consumption during periods of anticipated *peak*. This may include timers on air-conditioners or electric water heaters, or practices of washing dishes or running commercial or industrial processes during *off-peak* periods.

Photovoltaic Cell (PV): a technology consisting of layers of semiconductor materials and electrical contacts which is capable of converting light into electricity. There are different arrangements and applications for photovoltaic cells:

> Photovoltaic module: an integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals commonly used for small scale applications.
> Photovoltaic array: a photovoltaic module or set of modules that may be used in larger applications.

Premium Power: generally refers to power that is utilized for critical and/or sensitive equipment such as computers and medical devices and requires high levels of reliability than that which may be delivered by central power generation. Use of distributed generation technologies may have the purpose of assuring lower risk of blackouts, brownouts or voltage fluctuations than power that may be available from central plant service.

Protection Systems: electronic and/or electromechanical devices that open circuit breakers to avert problems due to short circuits, overloads and other malfunctions which could interrupt electric service and/or damage electric distribution system equipment or jeopardize the safety of distribution system workers.

Quality of Service: the constant flow of electric service including voltage fluctuations, and *reliability* factor; especially important as commercial equipment becomes increasingly sensitive and requires greater attention to control and dispatch, and transmission and distribution power flow operations.

Radial Distribution Circuit: consisting of one primary circuit extending from a single substation or transmission supply point arranged such that the primary circuit serves retail in a particular local area (contrasted to a "Network" Distribution System primarily used in urban areas in which the system collectively feeds retail customers from a number of interconnected points).

Reliability: the constant flow of electric energy through to an end-use consumer minus interruptions in the form of brownouts and blackouts; usually expressed as a percentage of continuous operation on an annual basis.

Renewable Energy Resources: sources of energy that are either continuously resupplied by the sun, water, wind, or geothermal forces

Retail Market: a competitive market under which more than one electric provider can sell to retail customers.

Small Gas Turbine: a high-efficiency power production unit with a capacity usually greater than one *megawatt* that burns a mixture of gas and pressurized air at very high temperatures (3,500 degrees Fahrenheit) and releases hot expanding gases to a series of fixed and rotating power turbine blades.

Solar Thermal: a power system which concentrates the sun's heat energy using reflective mirrors, troughs, dishes, and or power-towers in large applications to activate turbines and generators to create electricity. (This should not be confused with solar thermal systems which utilize collectors to heat water for domestic or commercial purposes.)

Standard Offer Service: retail electric service provided to customers based on tariffed rates approved by the Massachusetts Department of Telecommunications and Energy which may include fuel cost additions from time to time. Standard Offer Service is set to expire March 1, 2005 at which time any customer who has not chose a competitive power supplier will be placed on utility provided Default Power Supply at market rates.

Stiffness (of the distribution system): a measure of how well the distribution system resists change due to loads or other connections. A "stiff" system is the opposite of a "weak" system. The greater the short-circuit MVA, the stiffer the system. The stiffer the system, the less effect distributed generation has on it.

Storage System: a battery, pumped storage, flywheel or other system utilized to store energy that may be utilized to produce electricity when desired.

Supply-Side: activities that take place on the utility side of the meter including merchant-scale power generation, or distributed generation at the substation or feeder level (contrasted to demand-side activities undertaken by the customer).

Synchronous Generator (also synchronous source of power): a source of generation that does not need to be connected to other generation in order to provide consistent voltage and energy to a load.

Tidal Power System: a power system that converts the energy present in tides into electricity by utilizing dams to force water through turbines which are connected to power generators.

Time-of-Use Rates: the pricing of electricity based on the estimated cost of electricity during a particular block of time. Time-of-use rate are usually divided into three or four time blocks per twenty-four hour period (on-peaks, mid-peak, off-peak and sometime super off-peak) and by the seasons of the year (summer and winter).

Transmission System: an interconnected grid of electric transmission lines and associated equipment for moving high -voltage electric energy in bulk between points of generation and delivery to a substation for the *distribution system*.

Utility Scale: any supply-side installation that is intended primarily for merchant operation (sale of electric power to others), and is of sufficient size and scale to economically provide such service as its main function (usually greater than 5 megawatts).

VAR Support: the requirement for a certain level of reactive volt-amperes in order to provide certain system power factor and/or voltage level.

Virtual Utility: the concept of utilizing distributed generation that may be dispatched to augment power supplied by *central power generation*.

Wave Power: technologies using the rise and fall of ocean swells to generate electric energy.

Wholesale Market: a market system in which a distributor of power, or an aggregator, broker or power marketer has the option to buy from a variety of power producers, and the power producers have the ability to sell to a variety of buyers. The wholesale market in New England consists of both a “Bilateral” contract market (where most power supply is contracted) and short term purchases from the New England Power Pool.

Wind Turbine: a wind generator atop a tower that may be operated in isolation or as part of a group of wind turbines connected to a common electricity grid.

APPENDIX 1

SUMMARY OF REGIONAL OPTIONS STUDY

SUMMARY OF REGIONAL OPTIONS STUDY

A 1. Regional Options Study Summary

There are currently 195,000 metered electric customers on Cape Cod and Martha's Vineyard. In 2002 these customers spent a total of approximately $258 million for 1,911,914,000 kilowatt hours of electricity. Residential customers used approximately 53.9 percent of this total, commercial and industrial customers used 40.6 percent, and municipal governments used 5.5 percent. At present growth rates, the number of customers will increase to 227,000 by 2015. These customers would use 2,494,119,000 kilowatt hours that year.[1] If no alternative options were utilized, this power would be supplied by the utility from New England power plants with average emissions of more than 1 million tons of carbon dioxide (CO_2), more than 1, 000 tons of nitrogen oxide (NOx), and more than 3,000 tons of sulfur dioxide (SO_2) in 2015. If current electric prices were maintained, the total cost would rise to approximately $340 million. However, fuel costs could rise, and customer electric usage and demand growth will create the need for increased electric supply and upgrades to the transmission and distribution system to deliver this power supply.

Electric customers on the Cape and Vineyard are served primarily by power generation from competitive suppliers under contract to NSTAR Electric or the Cape Light Compact. The power is delivered over a transmission and distribution system owned and operated by NSTAR Electric. This is a system designed to both deliver power to the Cape and to transmit power generated by the Canal Electric Generating Plant to the mainland.

There is utility generation located on Cape Cod and Martha's Vineyard. The Canal Plant in Sandwich, currently owned and operated by Mirant New England LLC, has two generating units in operation, and a site for a third unit that remains undeveloped. Unit 1 (560 megawatts) is utilized as a baseload generator and is fueled by residual (No. 6) fuel oil. Unit 2 (560 megawatts) is utilized as an intermediate generator and has dual fuel capability—either residual fuel oil or natural gas. On Martha's Vineyard there are two small distillate oil fuel generators owned by Mirant. One in Oak Bluffs can deliver 8 megawatts to the transmission system. One in West Tisbury can deliver 5.5 megawatts to the transmission system. These units can be utilized for back-up or emergency purposes, but cannot provide full power needs for the island.

In addition to these utility generating units, there are small customer-owned generators on the Cape and Vineyard targeted to helping meet customer needs. The Cape Cod Community College, for example, operates a 200 kilowatt fuel cell to help meet its power needs and the Sandwich Public Schools have a 150 kilowatt natural gas co-generation unit. There is also a small number of photovoltaic systems for residences on the Cape and Vineyard. In addition, there are sundry stand-by gasoline, propane, or diesel generators

[1] Forecasting electric usage and demand is an imperfect science, and traditionally subject to annual adjustment. We have sought to use growth estimates based on historical data and consistent with those of NSTAR Electric. Regardless of variance in forecast estimates, usage of electricity for the region will grow and require investment in supply and the transmission and distribution system.

located at hospitals, police and fire stations, municipal water department facilities, and private businesses and residences which can provide limited on-site power.

The Canal Plant has more than enough capacity to supply all power for the Cape and Vineyard. However, while the "physical path" of electrons for the Cape and Vineyard area is from this plant and other plants in southeastern Massachusetts, the "contract path" and associated prices and operational obligations may be committed elsewhere in New England. Choices made on the Cape and Vineyard that significantly reduce demand, or provide newly installed supply, can affect the operations of generating plants in southeastern Massachusetts.

Emerging competitive markets, changes in regulatory policies and state law, and advances in technology allow new choices for how to meet anticipated electric supply. These options can create methods to reduce the growth in demand for electricity, create savings, advance renewable energy, increase system reliability, reduce emissions from power plants, and provide other environmental gains.

The *Resource Assessment* shows substantial opportunities for development of strategic options for electric supply and demand for the entire study period of 2005 to 2015. The analysis is contained in five studies that offer detailed evaluation of costs and benefits for key demand-side and supply-side options.

For demand-side options there is a technical potential for one-third of the projected Cape and Vineyard power supply to be met by cost-effective distributed generation and energy efficiency by 2015. For supply-side options, additional potential for the region arises with the installation of new wind-powered and natural gas-fired utility-scale generating facilities, if appropriate sites are available. At an optimum level, all of the region's needs could be met by combining utility-scale development, or competitive power supply, with customer demand-side energy efficiency and distributed generation. Additional renewable energy can also be purchased at a premium price. All of the options would reduce emissions below the projected emissions from generating plants in the New England Power Pool.[2]

A 2, Demand-Side Options

Demand-side options that can be undertaken by consumers and their communities are made up of energy efficiency, distributed generation and peak-shaving measures.

A 2.1 Energy Efficiency

Energy efficiency presents the most cost-effective option, with an average benefit/cost ratio of $2 saved for every $1 invested. Energy efficiency programs promote the use of improved operational practices and new technology—motors, appliances, lighting, etc.—that offer greater efficiency than devices currently in use. It is the cornerstone of any energy plan. However, its application is limited by funding and the amount of energy use that can be reduced for any individual customer. The *Resource Assessment's* Energy Efficiency study examined four scenarios and found:

[2] The only exception is a single landfill gas generator prior to 2010.

* For the base scenario, continuation of the existing Cape Light Compact energy efficiency programs will save enough energy to reduce the load in 2015 by 6.3 percent annually (147,500 megawatt hours) with a capacity savings of 3.5 percent (20.9 megawatts) of peak demand. The annual carbon dioxide (CO_2) emissions from generating plants in New England supplying the Cape and Vineyard communities would be reduced by a comparable amount (6.5 percent), but this would still be roughly 17 percent higher than current levels. The investment for this program is $5.9 million annually which results from $2.50 per megawatt hour state-mandated charge on all electric customer bills.

Table 1: Summary of Efficiency Impacts for the Cape & Vineyard Combined: 2015

	Continuation of Existing Programs	Reduce Load Growth in Half	Stabilize CO_2 Emissions	Eliminate New Load Growth
System Benefits Charge ($/MWh)	2.5	5.0	8.9	10.8
Annual Program Cost (mil. nominal $)	$5.9	$11.0	$17.9	$20.7
Cumulative Net Benefits (mil. 2003 PV$)	$77	$149	$252	$297
Annual Energy Savings (GWh)	147.5	284.4	479.7	567.8
Annual Energy Savings (% of load)	6.3%	12.9%	23.8%	29.5%
Capacity Savings (MW)	20.9	38.9	64.3	75.7
Capacity Savings (% of peak)	3.5%	6.5%	10.7%	12.6%
CO_2 Emissions:				
Reductions (1000 tons/year)	77	148	249	295
Reductions (% relative to BAU)	6.5%	12.5%	21%	25%
Growth (% change relative to 2002)	17%	10%	0%	-6%

* For the second scenario, reducing the load growth by half, the doubling of investment to $11 million annually would reduce load in 2015 by roughly 12.9 percent annually (284,400 megawatt hours) with a capacity savings of 6.5 percent (38.9 megawatts) of peak demand. The annual CO_2 emissions would be reduced by 12.5 percent, but would still be 10 percent higher than current levels.

* Higher goals for energy savings and emissions reductions can be achieved with increased funding. [For more details, see Table 1, the scenarios illustrated in section 3, or the full Energy Efficiency study in the *Resource Assessment*, section 7.1.]

A. 2.2 Distributed Generation

Distributed generation installed by customers offers the greatest magnitude of customer opportunity in terms of total impacts with an upper bound of 30 percent of the region's supply by 2015 and an average benefit/cost greater than $1.80 for every $1 invested. Distributed generation (DG) is the term applied to small-scale electric generating technologies located at the customer site, or close to customer sites. These include advanced fossil fuel technologies such as microturbines, reciprocating engines and fuel cells, as well as renewable energy technologies such as photovoltaic cells. There is a general consensus within the electric industry and among policy-makers that distributed generation will play an increasingly important role in power generation. The Distributed Generation customer study in the *Resource Assessment* found:

* In 2015 for Cape Cod, the total upper bound amount of electric usage subject to cost-effective distributed generation is 785,412 megawatt hours out of a projected total of 2,303,502 megawatt hours. Cost and efficiency improvements anticipated by manufacturers for the Advanced Fuel Cell allow this technology to dominate all markets except for Combined-Heat-and-Power (CHP) and Residential Photovoltaic (PV). [3]

Table 2: DG Market and Technology Results – 2015

Cape Cod

Application	Load in Play MW	Hr/yr	Least-Cost DG Technology	Market MW	Energy MWh	Tech. Cost $/kW-yr	Total Cost $/yr	Net Benefits $/kW-yr	Total Benefits $/yr	NO_X Offset ton/yr	CO_2 Offset ton/yr
Standby Generation	7.7	200	Adv. Fuel Cell	2.4	480	128.2	307,680	18.1	43440	0.19	79.5
Reliability Enhancement	51.0	10	Adv. Fuel Cell	0	0	115.7	0	0	0	0	0
On-Site Energy	95.6	6000	Adv. Fuel Cell	95.6	573,600	480.8	45,964,480	285.5	27,293,800	189.0	93,943
CHP	31.9	6000	Microturbine	31.9	191,400	354.0	11,292,600	658.3	20,999,770	53.2	20,276
Demand Reduction	47.8	600	Adv. Fuel Cell	3.1	1,860	154.5	478,950	6	18,600	0	0
Landfill Gas	1.0	8760	Adv. Fuel Cell	1.0	8,760	224.7	224,700	77	77,000	2.9	1,434
Residential Fuel Cell	2.9	3000	Adv. Fuel Cell	2.9	8,700	358.3	1,039,070	129.5	375550.0	3.000	768.1
Residential PV	1.00	1200	PV	0.51	612	431.0	219,810	56.3	28,713	0.2	320.9
Subtotal:	**238.9**			**137.4**	**785,412**		**59,527,290**		**48,836,873**	**248.4**	**116,822**

Martha's Vineyard

Application	Load in Play MW	Hr/yr	Least-Cost DG Technology	Market MW	Energy MWh	Tech. Cost $/kW-yr	Total Cost $/yr	Net Benefits $/kW-yr	Total Benefits $/yr	NO_X Offset ton/yr	CO_2 Offset ton/yr
Standby Generation	0.5	200	Adv. Fuel Cell	0.1	16	139.7	11,176	12.3	984	0.005	2.5
Reliability Enhancement	3.4	10	Adv. Fuel Cell	0	0	116.2	0	0	0	0	0
On-Site Energy	6.4	6000	Adv. Fuel Cell	0	0	856.3	0	0	0	0.0	0
CHP	2.2	6000	Microturbine	2.2	13,200	578.4	1,272,480	433.9	954,580	4	1,370
Demand Reduction	3.2	600	Adv. Fuel Cell	0	0	189.1	0	0	0	0	0
Landfill Gas	0.0	8760	Adv. Fuel Cell	0	0	224.7	0	0	0	0	0
Residential Fuel Cell	0.33	3000	Adv. Fuel Cell	0.06	180	511.6	30,696	17.4	0	0.0591	15.6
Residential PV	0.43	1200	PV	0.22	264	431.0	94,820	56.3	12,386	0.1	136.4
Subtotal:	**16.5**			**2.6**	**13,660**		**1,409,172**		**967,950**	**4.2**	**1,525**

Anticipated reduction in the cost of PV allows this technology to capture a share of the residential market (although some commercial application would be likely at this time as well.) At this point, markets also emerge in applications for Standby Generation and Demand Reduction. The total technology cost is $59.5 million per year and the resulting net savings is $48.8 million per year. Emissions reductions are 248.4 tons per year for NOx and 116,821.7 tons per year for CO_2.

* For Martha's Vineyard in 2015, the total amount of usage subject to cost effective DG is 13,660 megawatt hours out of a projected total usage of 190,617 megawatt hours. Microturbines capture the CHP market and the Advanced Fuel Cell moves into markets for Standby Generation and Residential Fuel Cell. PV acquires some Residential (and probably commercial) PV markets. The total estimated technology cost is about $1.4 million per year

[3] The amount of cost-effective distributed generation is a function of the technical potential of the Cape or Martha's Vineyard electric demand multiplied by the percentage of potential that is historically developed for a particular application (which results in the "load in play"), multiplied by the number of hours of use per year for that application that would provide economic benefits to the customer. All costs, including fuel, are included in the "total cost."

and the resulting total net savings $967,950 per year. Emissions offsets are 4.2 tons per year for NO_X and 1,524.8 tons per year for CO_2, due in large part to the extremely low emissions from the fuel cells. [For more details see Table 2, the scenarios illustrated in section 3, or the full Distributed Generation End-User study in the *Resource Assessment*, section 7.2.]

A. 2.3 Peak -Shaving

Peak-shaving is the practice of reducing electric usage during peak periods or moving usage from the time of peak demand to off-peak periods during the evening or early morning. This can be achieved through the use of customer-owned generation , timers on appliances, or operational scheduling for start-up of certain equipment or appliances. For individual customers, peak-shaving can reduce demand charges on the monthly electric bill, or if a time-of-use meter is installed, it may result in lower off-peak energy prices. Cumulatively, peak-shaving can reduce peak demand for customers in a region, deferring or offsetting transmission and distribution system costs, improving reliability, enhancing the aggregated customer load factor and reducing prices paid for bulk power supply.

* The potential for municipal, commercial and industrial customer peak-shaving is examined in the Distributed Generation study where it does not show significant potential as an individual application, but has added value for On-Site Energy or Combined Heat-And-Power applications.

* A separate Peak-Shaving Study examines the potential for residential customers to utilize peak-shaving technologies and practices to gain individual and cumulative system benefits. Based on a survey of existing programs and analyses of Cape and Vineyard data, peak shaving for residential consumers is shown to be limited under current conditions and costs to programs for central air conditioning and heating control functions.

A. 3. Supply-Side Options

Supply-side options include the purchase of power supply and development of utility scale generating facilities. The region's power supply is provided primarily through NSTAR Electric and the Cape Light Compact under contracts with competitive power suppliers. This contracted power supply can be produced by plants throughout New England. Replacing this power supply with local power supply can be achieved if there is sufficient cost-effective generating capacity appropriately sited on or near the Cape and Vineyard. It is important to note that the contract path which electricity prices reflect is distinct from the "physical path" of electrons that may be produced locally (such as at the Canal Plant in Sandwich).

* Competitive power supply contracts can shape the terms and type of power purchased, including the amount of power from renewable resources (see Renewable Energy discussion in section 2.3.1 below).

* The Cape and Vineyard have substantial wind resources, and potential sites for combined cycle gas plants including a site for an additional generating unit at the Canal Plant in Sandwich.

* Utility-scale wind turbines and natural gas combined cycle units each offer valuable attributes for power supply; wind can act as a hedge against rising fuel costs; natural gas combined cycle units can provide a steady schedule of energy and offset transmission costs.

* Due to the relative lack of experience and data for offshore wind development, assumptions related to production costs are softer than assumptions for natural gas-fired units for which there is extensive experience. The change in book life for offshore wind from 20 to 15 years for example can create a 10 percent increase in production costs.

* Utility-scale wind generation offers a range of production costs depending on siting and application. Wind production cost estimates include reductions for the federal Production Tax Credit ($11/megawatt hour) and for a green certificate value ($25/megawatt hour). For 2005 to 2015, onshore wind farms indicate the lowest level production cost at an average of $25/megawatt hour. Offshore wind farms indicate an average production cost range of $37 to $44/megwatt hour. A "cluster" of seven or more wind turbines indicates an average of $47/megawatt hour. Customer-sited wind turbines indicate $57/megawatt hour for power sold to the grid and $69/megawatt hour for customer utilized power. [4] Site acquisition costs could increase production costs.

* Natural gas fired combined cycle plants for 2005 to 2015 indicate a production cost of $42/megawatt hour.

* Wind turbine energy production can displace energy from fossil fuel generating plants, but can only displace a limited amount of the need for fossil fuel capacity due to wind power's intermittent nature.

* Both wind and natural gas combined cycle generation reduce anticipated 2015 emissions from New England region power plants, with wind offsetting marginal emissions of 0.7 lbs/megawatt hour for NOx, 0.5 lbs/megawatt hour for SO_2 and 1,040 lbs./megawatt hour for CO_2; and natural gas combined cycle offsetting average emissions of 0.84 lbs/megawatt hour for NOx, 2.696 lbs./megawatt hour for SO_2 , and 132 lbs/megawatt hour for CO_2.

A. 4. Renewable Energy

For strategies targeted to fuel and emissions related concerns, Renewable Energy can be supplied to the region by both supply-side and demand-side options. All retail suppliers in Massachusetts are required to meet Renewable Portfolio Standards (RPS) utilizing qualified renewable resources starting at 1 percent of supply in 2003 and increasing to 4 percent by 2009, at which time RPS will be reviewed for continuation. In addition to this baseline of supply, consumers can install photovoltaic electric systems or wind turbines, or utility-scale wind facilities may be developed is appropriate sites are available. Photovoltaic systems indicate economic benefits with anticipated cost reductions after 2010. New wind-powered and natural gas-fired generation offer economic opportunities for supply-side options,

[4] The federal Production Tax Credit is not applied to production costs for energy from a customer-sited wind turbine that is utilized by the customer and not sold to the grid.

assuming these units produce at costs below the average regional costs of power supply and can be appropriately sited. However, because renewable energy resources are intermittent, sufficient capacity reserves and ancillary services need to be under contract to assure firm full requirements power supply. [For more details see the scenarios illustrated in section 3 and the *Resource Assessment* Distributed Generation End-User study for more information on photovoltaic development and for information on wind turbines see the Wind/Natural Gas study at section 7.5 of the *Resource Assessment*.]

* Renewable energy for 2015 would be at a low of 4 percent of total usage, if RPS requirements remain frozen at 2009 levels and no purchases above that level are made due to high cost and/or lack of renewable resources in New England.

* Increasing RPS purchases if sufficient renewable resources are available at reasonable prices, or if there is sufficient development of local wind generation, could amount to 10 percent or more of projected electric usage in 2015.

* Anticipated reductions in costs for photovoltaic systems would result in meeting goals of regional developers to have 500 kilowatts of PV installed on the Vineyard and 1,000 kilowatts installed on the Cape by 2015.

* As much as 30 percent or more of Cape and Vineyard projected electric usage for 2015 could be supplied if appropriate sites can be developed for utility-scale wind facilities.

Various scenarios can be constructed to outline the potential for customer demand-side options and utility-scale supply-side options. However, such scenarios should be regarded only as illustrations of potential at the present time. Target levels of development will be constrained by the characteristics and preferences of the region's electric customers, transmission and distribution infrastructure, fuel availability and cost, market conditions, and policy evolution. Section 3 presents scenarios that illustrate the combined effect of supply-side and demand-side options.

APPENDIX 2

SCENARIOS TO ILLUSTRATE OPTIONS

SCENARIOS TO ILLUSTRATE OPTIONS

The best planning for a region's power supply utilizes a mix of resources and approaches to ensure least-cost efficiency and diminish the effects of fuel cost increases or reliance on a single fuel source. The following seven scenarios have been constructed to illustrate a scale of increasing strategic options implementation for 2015. They are generally targeted to produce savings, reduce emissions, and develop resources at the local level. Any of the strategic components can be mixed in different combinations to produce alternative results.

While energy efficiency is the beginning of any supply plan, **Scenario 1: No Activity Case**, illustrates the lowest level of policy and planning to establish a baseline for consumption, costs, and emissions. It does not include energy efficiency. It includes default power supply from NSTAR Electric and the state mandated RPS requirement for green energy supply at the 2009 level of 4 percent.

Scenario 2: Business-As-Usual, adds the continuation of the present energy efficiency effort at current spending levels to Scenario 1.

Scenario 3: Half Distributed Generation Potential Case, adds 50 percent of the cost-effective customer-sited distributed generation to Scenario 2. To avoid overlap of benefit estimates, potential commercial and industrial energy efficiency are subtracted from the potential Distributed Generation total.

Scenario 4: Greater Energy Efficiency and Distributed Generation Case, adds two elements to Scenario 3. It doubles the amount of efficiency effort and increases distributed generation toward its upper bound cost-effective potential.

Scenario 5: Greater Green Power Supply Case, adds two elements to Scenario 4. It doubles the amount of Green Power supply from 4 percent to 8 percent and draws 2 percent of power supply from locally sited wind turbines. (This wind power would require approximately 22 megawatts that could be derived from 30 250 kilowatt customer-sited turbines and one utility-scale cluster of 7 two megawatt turbines.)

Scenario 6: Local Power Supply Mix, adds two elements to Scenario 5 to displace all default power supply. It increases wind turbine supply assuming appropriate siting of a utility-scale wind farm or combination of wind farms (123 two megawatt turbines) under contract to supply the region; and it assumes siting of a natural gas combined cycle unit and/or contract for supply from such facility. (Both the wind and gas facility could be life-of-unit contracts with proper contingencies and guarantees.)

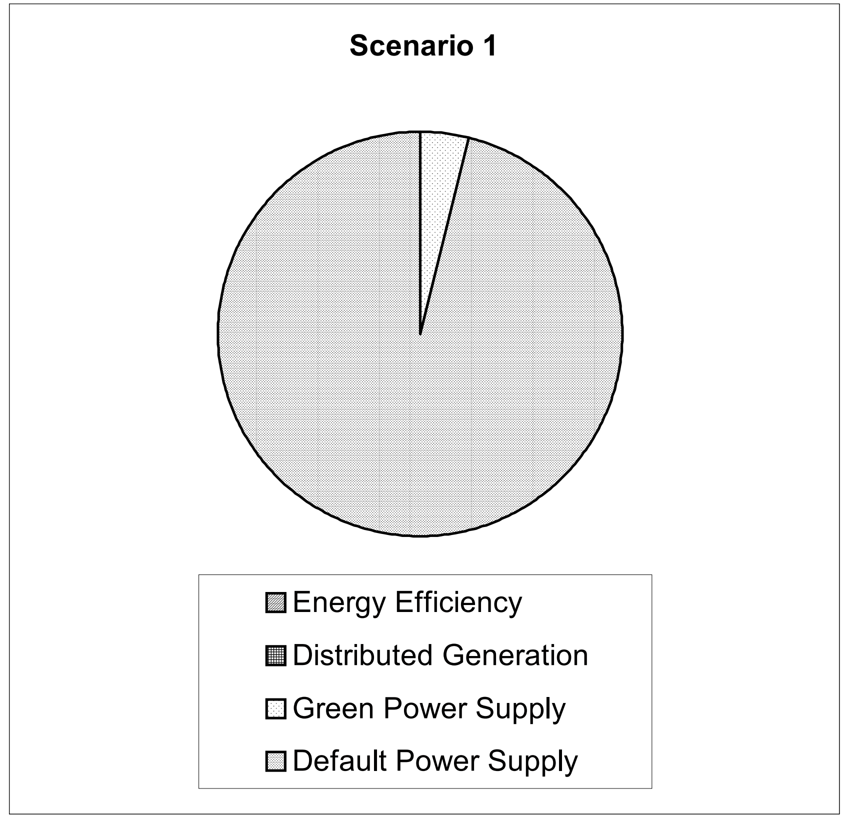
Scenario 7: Competitive Power Supply, replaces default supply in Scenario 5 with competitively purchased power supply at a price reduction of 10 percent; emissions reduction of 10 percent from the default supply average New England Power Pool generation; plus 10 percent green supply. This supply could come from any location.

Cape Cod & Martha's Vineyard 2015

Scenario 1

No Activity Case

Scenario 1 indicates the lowest level of policy and planning. It establishes a data baseline. In addition to Default Supply (assumed from NSTAR at current costs and projected New England Power Pool 2015 emission rates), it includes only the 2009 state Renewable Portfolio Standard requirement of 4 percent of supply from renewable energy resources. There is no energy efficiency effort included in Scenario 1. There is no distributed generation or competitive retail power supply. The results show: the total amount of projected power supply needed in 2015 (2,494,119 megawatt hours based on current growth assumptions); anticipated annual cost of power supply ($358,155,485 based on all customer charges at 14.26 cents per kilowatt hour); the amount of green power certificates equivalent to 4 percent of supply (99,765 megawatt hours in certificate value--no energy provided); green certificate cost (at $25 per megawatt hour); and related emissions offsets credited from the purchase of green certificates.



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	0.0%	0						
Distributed Generation	0.0%	0						
Supply Side:								
Green Power Supply	[4.0%]	99,765	$2,494,125			-51,877	-35	-25
Default Power Supply	100.0%	2,494,119	$355,661,360			0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$358,155,485**		**596.8**	**1,132,829**	**1,087**	**3,342**

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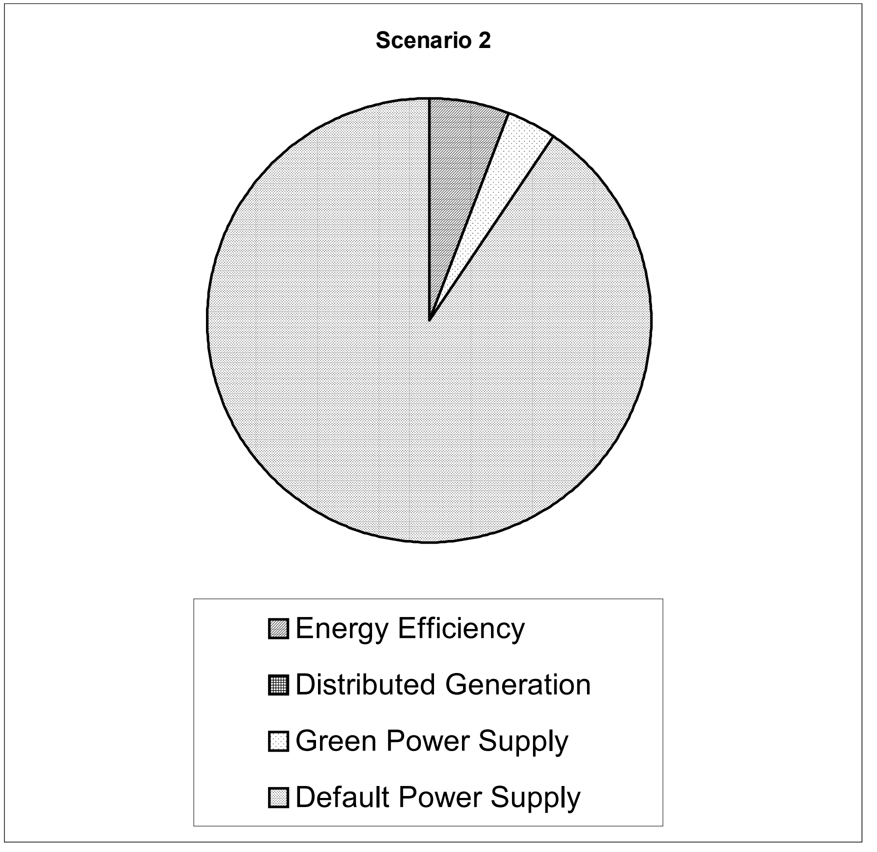
Scenario 2
Business-As-Usual Case

Scenario 2 illustrates the choice of an option to continue the present regional energy efficiency effort of the Cape Light Compact at current spending levels. It adds this choice to Scenario 1. The results show: 5.9 percent of projected power supply for 2015 (147,518 megawatt hours) being offset by energy efficiency. Annual costs are $342,835,638. Net savings of $15,319,847 are indicated based on energy efficiency savings resulting over time (the lifetime of the efficiency installations) from the year's investment of $5,863,737. Peak demand is reduced by 20.9 megawatts. Emissions offsets over the No Activity base case are shown. Local and state determinations would be needed to continue the current energy efficiency program through 2015.



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	5.9%	147,518	$5,863,737	$15,319,847	-20.9	-76,709	-52	-37
Distributed Generation	0.0%	0						
Supply Side:								
Green Power Supply	[4.0%]	93,864	$2,346,601			-48809	-33	-23
Default Power Supply	94.1%	2,346,601	$334,625,300			0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$342,835,638**		**575.9**	**1,059,188**	**1,037**	**3,307**

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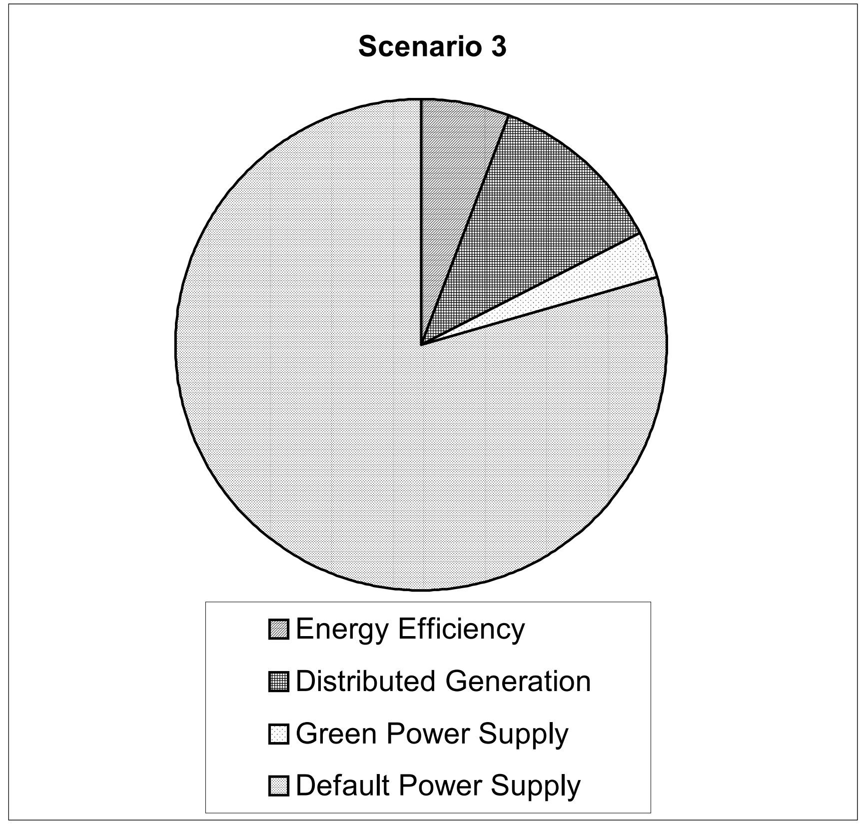
Scenario 3

Half Distributed Generation Potential Case

Scenario 3 illustrates distributed generation choices made by customers that amount to one half of the total cost-effective potential of distributed generation. This is in addition to the choice to continue the Compact's energy efficiency efforts at current spending levels. Scenario 3 adds the distributed generation option to Scenario 2. The results show distributed generation offsets an additional 12.1 percent (302,931 megawatt hours) of projected 2015 power supply needs (energy efficiency and distributed generation combined offsetting 18 percent). The distributed generation annual cost (including fuel and all costs) is $23,098,488 with net savings of $20,402,398. Total costs are $322,433,240. Peak demand is reduce by 58.1 megawatts by this amount of distributed generation, in addition to 20.9 megawatts reduction from energy efficiency. Because the distributed generation technologies are low-emission and no-emission sources (microturbines, fuel cells, and solar PV) they also provide significant reductions in emissions over the No Activity base case. Policy, technical, and market challenges to development of distributed generation would n



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	5.9%	147,518	$5,863,737	$15,319,847	-20.9	-76,709	-52	-37
Distributed Generation	12.1%	302,931	$23,098,488	$20,402,398	-58.1	-45,057	-96	-76
Supply Side:								
Green Power Supply	[4.0%]	81,747	$2,043,675			-42,508	-29	-20
Default Power Supply	82.0%	2,043,670	$291,427,340			0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$322,433,240**		**517.8**	**1,020,432**	**945**	**3,234**

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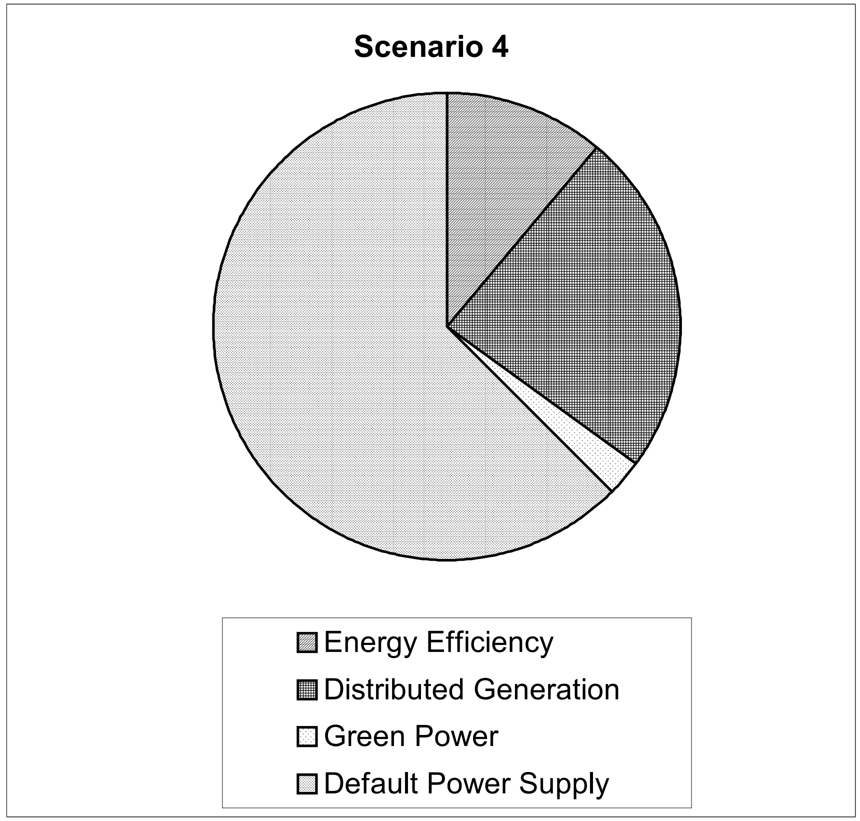
Scenario 4

Greater Energy Efficiency and Distributed Generation Case

Scenario 4 illustrates a choice to double energy efficiency efforts above current levels, and choices by customers to develop distributed generation to an extent that approaches the full cost-effective potential. These options are added to Scenario 3. The results show: energy efficiency offsetting 11.4 percent and distributed generation offsetting 24.6 percent (36 percent combined) of the projected supply needed for 2015. Total costs are $287,088,090, net savings double and emissions offsets double over the offsets of Scenario 3. Doubling energy efficiency efforts would require local and state determinations increased and funding from public and perhaps private sources. If sufficient funding were available, energy efficiency could be increased even futher by a factor of four over current funding. Distributed generation would face policy, technical and market challenges that would need to be addressed in local zoning, state regulatory proceedings, and discussions with utilities.



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	11.4%	284,397	$11,037,618	$29,822,036	-38.9	-147,886	-100	-71
Distributed Generation	24.6%	612,786	$46,730,466	$41,245,379	-118.9	-91,145	-194	-153
Supply Side:								
Green Power	[4.0%]	63,877	$1,596,936			-33,216	-22	-16
Default Power Supply	64.0%	1,596,936	$227,723,070			0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$287,088,090**		**439**	**912,459**	**806**	**3,127**

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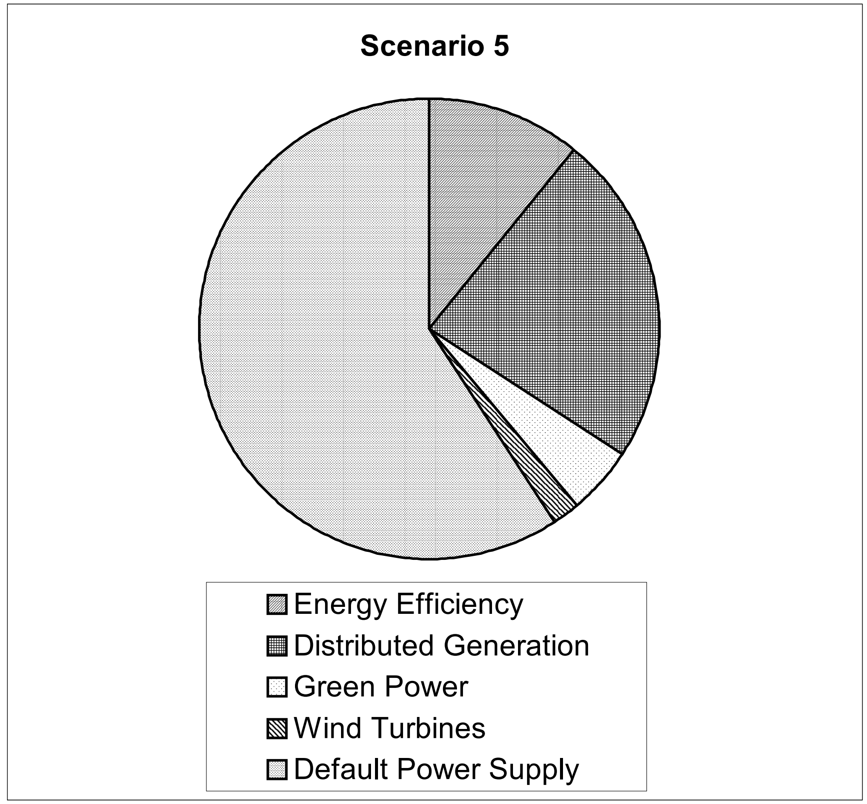
Scenario 5

Greater Green Power Supply Case

Scenario 5 illustrates a choice to double the amount of green power supply. Half of the increase (2 percent) is assumed to come from purchase of additional green power supply certificates, and half (2 percent) from local wind generation (assumed to be 30 customer-sited 250 kilowatt turbines and a cluster of 7 two megawatt turbines). Scenario 5 adds this increased green power option to Scenario 4. The results show a total cost of $287,088,090 and greater reduction of air emissions. Purchase of additional green certificates could be conducted in the established market, provided certificates are available at the assumed cost. Development of local wind generation faces the challenges of finding appropriate sites and cost-effective applications.



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	11.4%	284,397	$11,037,618	$29,822,036	-38.9	-147,886	-100	-71
Distributed Generation	24.6%	612,786	$46,730,466	$41,245,379	-118.9	-91,145	-194	-153
Supply Side:								
Green Power	[8.0%]	123,764	$3,094,100			-64,357	-43	-31
Wind Turbines	2.0%	49,882	$6,704,588	$408,585				
Default Power Supply	62.0%	1,547,054	$220,609,900			0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$288,176,672**		**439**	**881,318**	**785**	**3,112**

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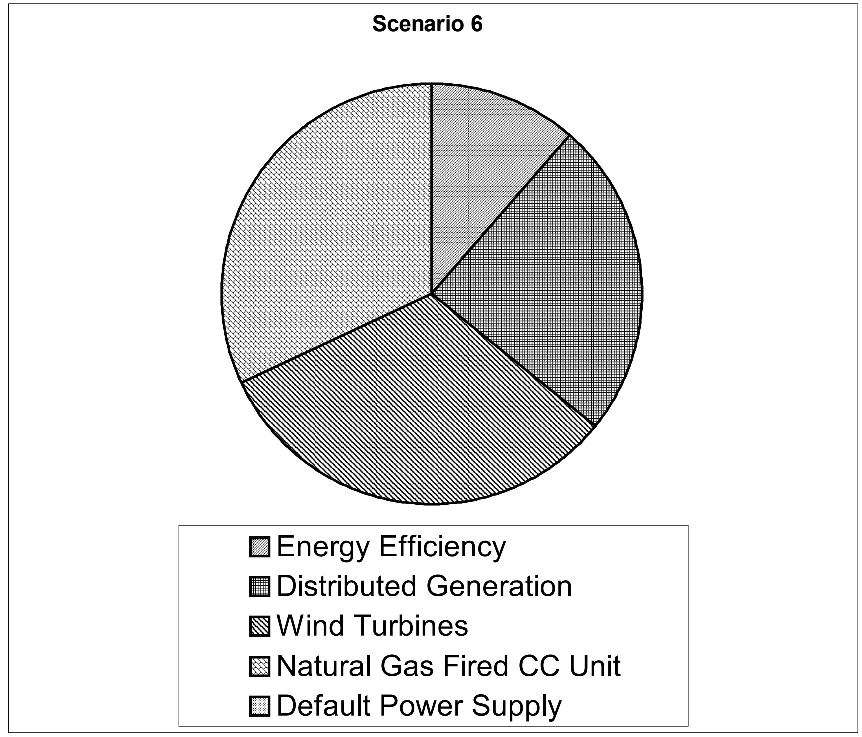
Scenario 6

Local Power Supply Mix

Scenario 6 illustrates choices to utilize local power supply (64 percent) in place of utility Default Supply. Local supply is assumed to be half (32 percent) from a natural gas-fired generating unit or units, and half (32 percent) from a combination of utility scale wind farms, or a single wind farm (123 two megawatt turbines). The cost of power from these sources is considered to be equivalent at the retail level (after reducing the cost of wind power production with the federal Production Tax Credit and green certificate value). The total cost is slightly higher than Scenario 5 ($291,080,424), but the emissions offsets are dramatically increased. Wind turbine energy is shown offsetting marginal emissions rates (due to its intermittent operating schedule) and the natural gas-fired unit is shown offsetting the average NEPOOL generating plant emissions. The challenge for local utility-scale wind development is finding appropriate sites and economical project financing. The challenge for the natural-gas fired unit or units would be financing and permitting at the undeveloped Canal plant si



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	11.4%	284,397	$11,037,618	$29,822,036	-38.9	-147,886	-100	-71
Distributed Generation	24.6%	612,786	$46,730,466	$41,245,379	-118.9	-91,145	-194	-153
Supply Side:								
Green Power (Wind)	[32.0%]	798,468	$19,961,700			-415,203	-279	-200
Wind Turbines	32.0%	798,468	$106,675,320	$7,186,210				
Natural Gas Fired CC Unit	32.0%	798,468	$106,675,320	$7,186,210		-52,699	-335	-1,076
Default Power Supply	0.0%	0				0	0	0
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$291,080,424**		**439**	**477,773**	**214**	**1,867**

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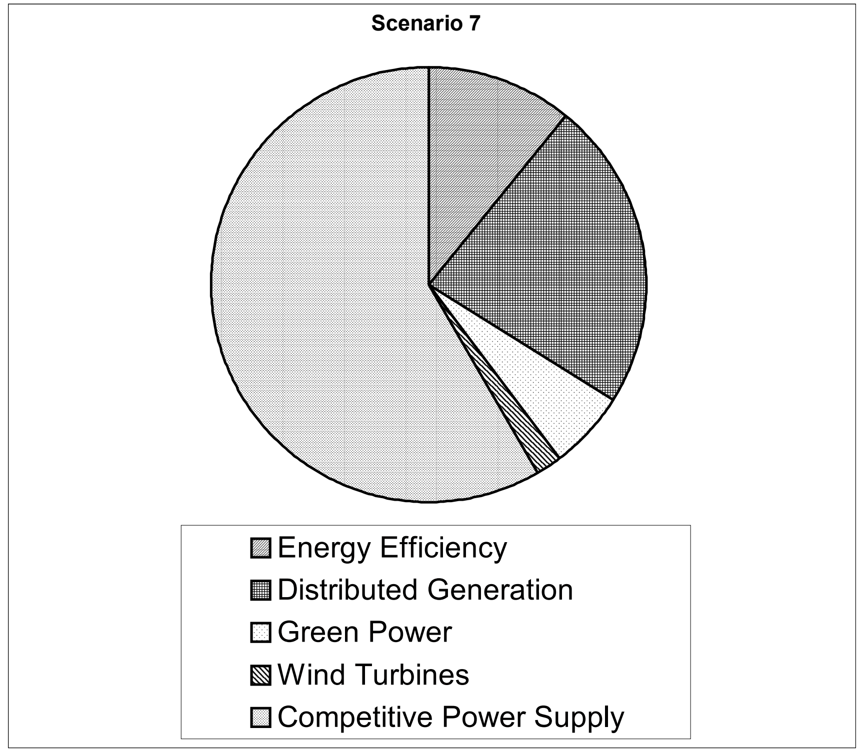
Scenario 7

Competitive Power Purchase Case

Scenario 7 illustrates the choice to substitute the purchase of competitive power supply for the utility Default Supply. The competitive supply terms are assumed to provide a reduction of 10 percent in the energy portion of the customer bill, 10 percent less emissions than the NEPOOL average for 2015. In addition, green certificates of 8 percent of power supply and smaller scale wind development for 2 percent of supply, provide additional emission offsets. Scenairo 7 adds these choices to Scenario 5. The results show a lower total cost than Scenario 5 or Scenario 6 ($279,822,577), but less emissions reductions. Scenairo 7 avoids the challenges of development of major local wind and natural gas power supply facilities in Scenario 6, but requires negotiating a supply contract with a supplier on these terms or better.



	%	Supply Amount	Annual Cost	Net Savings	Peak Reduction	Emissions Reduction (tons)		
		(megawatt hours)			(megawatts)	CO2	NOx	SO2
Demand Side:								
Energy Efficiency	11.4%	284,397	$11,037,618	$29,822,037	-38.9	-147,886	-100	-71
Distributed Generation	24.6%	612,786	$46,730,466	$41,245,379	-118.9	-91,145	-194	-153
Supply Side:								
Green Power	[10.0%]	154,705	$3,867,625			-80,447	-54	-39
Wind Turbines	2.0%	49,882	$6,704,588	$408,585				
Natural Gas Fired CC Unit	0.0%	0	$0					
Competitive Power Supply	62.0%	1,547,054	$211,482,280	$9,127,620		-73,485	-69	-209
Default Supply Baseline					596.8	1,184,706	1,122	3,367
Totals:	**100%**	**2,494,119**	**$279,822,577**		**439**	**791,743**	**705**	**2,895**