FINAL DRAFT

CAPE LIGHT COMPACT

REGULATORY ASSESSMENT

A Review of Regulatory Issues Concerning Development of Small Scale Renewable Energy and Distributed Generation on Cape Cod and Martha's Vineyard

Prepared for the Cape Light Compact
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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 48,000 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

The Cape Light Compact has undertaken this *Regulatory Assessment* to examine potential local barriers to development of small-scale renewable energy and distributed generation. These are electric generating technologies located at the customer site, or close to customer sites. They include advanced fossil fuel technologies such as microturbines, reciprocating engines and fuel cells, as well as technologies such as wind turbines and solar photovoltaic.[1] (See Appendix A for description of the technologies.) Growing interest in renewable energy and distributed generation for electric supply within the Cape and Martha's Vineyard region has prompted the need for this examination.

1.2 Background

Advances in technology, restructuring of utility companies, and formation of competitive markets are creating unique historic opportunities in the electric industry. In the near term, upgrading of policies and regulations can provide a framework for greater use of small-scale generation technologies that offer economic, environmental and reliability benefits. In the long term, development of such small-scale generation may also offer opportunities for integration with communications technologies to create "smart buildings" or "smart cities" and local "digital" electric grids resulting in greater reliability, lower costs, self-reliance and efficiency.

At the current stage, key challenges for most emerging distributed generation technologies are related to market development, equipment improvements, and mass production that will reduce costs. However, there are also significant policy-related challenges and barriers at the federal, state, and local levels. These include problems with utility interconnection, a lack of standards and insufficient regulatory experience, and the absence of policies and rules that apply to small generators. How distributed generation facilities are developed and the extent to which they enter service over the next few decades will depend in part on public policy developed to guide markets and operations

Substantial progress is being made on policy issues. At the federal level, work is currently underway to establish uniform technical standards and market policies to facilitate development of distributed generation. At the state level, the Massachusetts Department of Telecommunications and Energy has initiated a process to establish uniform policies for utility interconnection. Renewable energy portfolio requirements and a market for renewable energy certificates have also been put in place. And at the local level, municipal governments are also beginning to examine and formulate rules and regulations for distributed generation.

[1] For the purpose of simplification we have utilized the term "distributed generation" or "DG" to refer to all small scale generation at or near a customer site, although intermittent resources such as wind turbines cannot be dispatched and are not technically distributed generation.

The role of local governments is important because most distributed resource units are of a size or operational profile that is below federal and state regulatory permitting thresholds. Siting and permitting of these facilities will therefore rely primarily on local jurisdiction. Development of local government policy and permitting is vital to the regulation of distributed generation.

1.3 Scope and Methodology

The study includes an overview of key federal and state initiatives related to distributed generation for the purpose of providing context. The focus of the research and analysis, however, is on local zoning requirements, building codes, health and safety regulations and rules, and planning requirements.

The *Regulatory Assessment* reviews current municipal policies for the 21 Cape Light Compact member communities—15 Cape Cod towns and the 6 Martha's Vineyard towns. It also reviews regional requirements of the Cape Cod Commission and Martha's Vineyard Commission, as well as restrictions and requirements of "historic" districts.

The *Assessment* utilized a document survey and interview process, with two levels of peer review. Key documents were identified and reviewed and discussions were conducted with specific individuals who formulate, interpret and work within the framework of municipal and regional policies. The results of the research were compiled in draft form and reviewed by local and regional planners and the Cape Light Compact Distributed Resources Committee. A meeting of local and regional planners was also convened to review and discuss the results of the study, and to begin examination of strategies for formulation of model zoning. Comments and suggestions received at both levels of review were included in revisions of the draft report.

1.4 Findings

The regulatory framework for distributed generation is an integration of federal, state, and local rules and law. In addition, federal and state government offer financial support or incentives. At the federal and state levels, substantial progress has been made, although much work remains in process.

At the federal level, for example:

- National standards intended to establish uniform practices and requirements for safety, equipment protection and power quality have been proposed by the Institute of Electric and Electronics Engineers (IEEE P1547). IEEE has also formulated practices for utility interface with photovoltaic systems. Similarly, Underwriters Laboratory Inc. has developed standards for equipment to be used in independent power systems (UL 1741).

- Tax credits and financial incentives for investment in solar, wind and geothermal property and equipment for individuals, businesses, and local governments have been established and extended.

- In its "Standard Market Design" rulemaking, the Federal Energy Regulatory Commission has proposed policies and market rules for regional transmission organizations to include demand response programs that will add value for distributed generation located behind the customer meter.

At the state level:

- Massachusetts has established Renewable Portfolio Standards (RPS) for utilities and competitive suppliers selling electricity at retail. Coincident with RPS, the New England ISO, along with state agencies and market stakeholders, has established a market for the sale of renewable or "green" energy certificates which will assist in meeting the RPS requirement and support renewable energy development.

- The state also established the Renewable Energy Trust Fund administered by the Massachusetts Technology Collaborative to help stimulate the use and generation of renewable energy in the region. The state has also offers tax incentives for individuals and business for qualified renewable energy systems.

- Massachusetts has also developed "net-metering" rules that allow customers with distributed generation systems of 60 kilowatts or less to spin their meters backwards and receive a credit for any month in which the customer generates more power than consumed.

- The Massachusetts Department of Telecommunications and Energy initiated a rulemaking process (DTE 02-38A) to establish uniform policies to be followed for interconnection of a distributed generation facility with a utility transmission and distribution system.

At the municipal level, examination of issues related to distributed generation is just beginning. Conditions vary from municipality to municipality as noted in Section 5. However, general findings show the types of barriers that may be anticipated at the emergence of any new technology development. These include:

<u>Local Municipal Zoning</u>

- Lack of clarity about threshold for transition from accessory use to primary use for distributed generation facilities
- Lack of consistent definitions and interpretation of distributed generation as a primary use
- Inconsistent attention to permitting power generation in local by-laws

- Absence of appropriate use terms to cover distributed generation provides for uncertain permitting pathway
- Inconsistent treatment of wind machines
- Lack of height exemptions for wind machine towers
- Extensive review process and potential for excessive time delays due to need for special permits, variances, or zoning amendments to accommodate distributed generation facilities

Regional Commissions

- Threat of referral to regional commissions for Determination of Regional Impact (DRI) review
- Potential time and expense cost of DRI review
- Lack of clarity in application of standards to distributed generation facilities
- Absence of direct attention to distributed generation in energy sections of Regional Policy Plans of Cape Cod and Martha's Vineyard Commissions

Historic Commissions

- Absence of consideration for wind power generating facilities
- Incompatibility of modern wind towers in historic areas
- Absence of exemption from historic district regulation for public utilities

Other Local Regulatory Barriers

- General lack of understanding about distributed generation technologies in the regulatory and policy-making communities
- Potential for Conservation Commission review and possible appeals/time delays
- Costs of flood-proofing structures pursuant to local flood regulations may make distributed generation projects in flood zones economically infeasible

2.0 Federal Activities and Initiatives

The federal government plays an overarching role in a regulatory framework that combines the participation of state and local governments. The federal government establishes national standards for health and safety (such as air emissions and water pollution limits), and conducts or assists with research and development for generating technologies and industry standards. Federal agencies also take part in siting and permitting activities of utility-scale facilities that cross certain siting, operational, or market thresholds. (See Appendix B for additional information on federal requirements and permits.)

Among the many national level activities and initiatives are three key elements related to development of distributed generation: formulation of national standards for equipment; tax credits and financial incentives; and proposed Standard Market Design provisions.

2.1 Formulation of National Standards for Testing, Safety and Maintenance of DG

After a lengthy period of study and debate, the Institute of Electrical and Electronics Engineers (IEEE) has recommended "Standards for Interconnecting Distributed Resources with Electric Utility Systems" (IEEE P1547). The standards are intended to provide uniform practices and requirements for safety, equipment protection and power quality. IEEE has also formulated a "Recommended Practice for Utility Interface of Photovolatic Systems." Similarly, Underwriters Laboratory Inc. has formulated Standard UL 1741: "Inverters, Converters and Charge Controllers for Use in Independent Power Systems." Although not the direct work product of a federal agency, these standards contribute to a uniform approach to facilitate DG interconnection with electric utilities and state policies concerning interconnection.

2.2 Financial Incentives and Tax Credits

The national Energy Policy Act of 1992 and the U.S. Internal Revenue Code offer several measures to encourage investment in renewable energy and distributed generation by public and private entities. These include: the Federal 10 Percent Investment Tax Credit for a business that purchases and installs solar or geothermal equipment;[2] a Federal Renewable Energy Production Tax Credit for electricity sold from a wind or biomass project[3]; and accounting measures under the Modified Accelerated Cost Recovery System that allow accelerated depreciation of investments in solar, wind and geothermal property.[4] Various grant funds and loan support are also available from the

[2] Relevant IRS forms to file for the credit are: *Form 3800: General Business Credit* and *Form 3468: Investment Credit*. Instructions on this credit are contained in Instructions for *Form 3468: Investment Credit*

[3] For information on private claims for the credit see IRS *Form 8835: Renewable Electricity Production Tax Credit* and also *Form 3800:General Business Credit*.

[4] For information or claims regarding MACRS see IRS *Form 4562: Depreciation and Amortization* and *Instructions for Form 4562*.

U.S. Department of Energy, the Environmental Protection Agency and the U.S. Small Business Administration.

2.3 Standard Market Design

The Federal Energy Regulatory Commission (FERC) has proposed in its "Notice of Proposed Rulemaking on Standard Market Design" that regional transmission organizations establish demand response programs for distributed generation installed behind the customer meter.[5] Standard Market Design is aimed at creating uniform rules for wholesale markets, market access, and oversight in regional transmission grids. Demand response programs help to recognize and provide financial returns for the value of distributed generation facilities as well as promote cost-effective enhancement of transmission and distribution system reliability. The New England Power Pool has placed two demand response programs in operation and plans two additional programs.

While Standard Market Design proposals have been the focus of congressional debate, federal concern over national security issues related to energy production and use have supported U.S. Department of Energy efforts to promote appropriate state code modifications to facilitate installation of distributed generation.

[5] See Federal Energy Regulatory Commission Notice of Proposed Rulemaking (RM01-12-00) issued July 31, 2002.

3.0 State Activities and Initiatives

State agencies typically implement and enforce federal policy. They also augment and refine federal policy and provide additional rules for siting and permitting. Massachusetts has established certain thresholds for size and operational profiles of electric generation requiring a state permit. In general, the threshold is a facility greater than 25 megawatt in capacity (or combustion units with certain heat rates and daily hours of operation). The need for state permits can also be triggered by levels of a facility's air emissions, withdrawals from or discharges into water bodies, or other operational activities. (See Appendix B for additional information on state requirements and permits.) In addition to permitting activity, states can also provide incentives and tax credits for investments in renewable and other energy resources.

Five key measures Massachusetts has undertaken to support development of renewable energy and distributed generation are: Renewable Portfolio Standards and Green Certificates; financial incentives and tax credits and grants, net-metering, and uniform policies for utility interconnection.

3.1 Renewable Portfolio Standards and Green Certificates

The Massachusetts Division of Energy Resources (DOER) has established Renewable Portfolio Standards (RPS) that require every utility and competitive supplier to include energy from qualified renewable energy facilities in its supply mix.[6] The RPS standards are set at 1 percent of retail sales in 2003 and increase 0.5 percent of sales annually from 2004 to 2009. After that time RPS will increase at the rate of 1 percent per year, unless revised by DOER. Only new renewable energy facilities that entered production after December 31, 1997, or increased production after that time are eligible. Qualified sources are those producing: solar photovoltaic or solar thermal electric energy; wind energy; ocean thermal or wave or tidal energy; fuel cells utilizing renewable fuels; landfill gas; and low-emission advanced biomass.

Coupled with the RPS requirement, DOER and the New England ISO (ISO-NE) have worked with stakeholders to establish a process for marketing of renewable or "green" energy certificates. The renewable energy "attribute" from a qualified facility, can be sold distinct from the energy from the facility. Sales are held quarterly through a central administrator who posts and tracks ownership of certificates. (one megawatt hour per certificate). The average anticipated certificate price through 2009 is $25/megawatt hour. Electricity production from small generators (i.e. small photovoltaic) that are not currently telemetered by ISO-NE can combine their data with similar generators to participate in the market.

[6] Formulation of a Renewable Portfolio Standard was set out by the Legislature in the Electric Utility Restructuring Act of 1997 (MGL, c 25A, s. 11F)

3.2 Financial Incentives, Grants and Tax Credits

Massachusetts has established a Renewable Energy Trust Fund administered by the Massachusetts Technology Collaborative (MTC). The fund is collected through a small charge on every retail electric customer's monthly bill.[7] The MTC awards grants and funds to increase the use and generation of renewable energy in the state and region; and to enable Massachusetts companies to capture a greater share of the market for renewable energy technologies. The funds are available for approved projects undertaken by public or private entities.

Massachusetts also offers tax incentives designed to promote the development and use of renewable energy resources. These include: a state individual income tax credit for solar thermal, solar water and space heat, solar photovoltaic systems, wind turbines, and hydro systems for 15 percent of the expenditure up to $1,000;[8] a corporate income tax deduction of any costs for qualified a solar or wind-powered "climatic control unit" or "water heating unit" and a related exemption from the corporate excise tax;[9] a local property tax exemption for a solar or wind-powered system; [10] a state sales tax exemption for equipment directly relating to any solar, wind, or heat pump system to be used as primary or auxiliary power system for a primary residence.[11]

3.3 Net-Metering

Consumers with a distributed generation facility of less than 60 kilowatts can avoid distribution utility charges through self-supply, and receive credit from the distribution utility for any power they generate in excess of what they consume ("spin the meter backwards").[12] The amount of the credit is equal to the arithmatic average of the NE-ISO power exchange price in the previous month. Distribution companies are prohibited from imposing special fees on net metering customers such as backup charges and demand charges, or requiring additional controls, or liability insurance, as long as the facility meets interconnection standards. Consumers with facilities larger than 60 kilowatts may sell power to the utility or other parties under a contract, rather than net-metering.

3.4 Uniform Utility Interconnection Policy Development

One of the primary barriers to development of distributed generation can be problems with interconnection of the distributed generation unit with the utility distribution system. Utility concerns are based on safety and equipment considerations and the process can result in increased costs and time delays. To establish a uniform process to facilitate distributed generation installation, the Massachusetts Department of

[7] The exception to this charge are the state's 40 municipal electric systems which may administer their own charges and programs at their local discretion.
[8] See MGL c. 62, ss. 6 (d).
[9] See MGL c. 63, ss. 38H and MGL c. 63, ss. 38H (f)
[10] See MGL c. 59, ss. 5, cl.45
[11] See MGL c. 64H, ss. 6(dd)
[12] See 220 CMR 11.04

Telecommunications and Energy (DTE) established a rulemaking in 2002.[13] A group of stakeholders subsequently convened and engaged in a series of meetings to discuss and make recommendations to DTE. The group identified three interconnection review paths: "simplified" review for distributed generation facilities of less than 10 kilowatts with a qualified inverter on a radial system; "expedited" review for any certified facilities that pass pre-specified screens on a radial system; "standard" review for all facilities not qualifying for either the "simplified" or "expedited" interconnection reviews, and for all facilities on area network systems.[14]

Under the proposed rules, the total capacity of distributed generation installation would be limited to 7.5 percent of the annual distribution system circuit load. As technology advances, and experience with system integration progresses, this limitation may be revisited. (See further information on proposed utility interconnection review at Appendix C). The DTE will consider these recommendations and formulate uniform rules for all utilities in Massachusetts.

In general, the regulatory framework will continue to evolve as the state responds to federal or New England-wide initiatives, or undertakes its own initiatives on distributed generation. The state-and-local relationship in the regulatory framework may also change as experience progresses at the local level.

[13] Massachusetts Department of Telecommunications and Energy Order 02-38A

[14] See: *Proposed Uniform Standards for Interconnecting Distributed Generation in Massachusetts*; submitted to Massachusetts Department of Telecommunications and Energy in Compliance with DTE Order 02-38A; by the Distributed Generation Interconnection Collaborative; February 28, 2003.

4.0 Survey of Local Land Use and Structure Regulation

Local government has a very significant role to play in the development and regulation of distributed generation. This role results from the fact that most small scale distributed generation facilities are below federal and state thresholds and will be subject to local siting and permitting jurisdiction. The key areas of local rules or law that will apply are: municipal zoning, regional commission requirements, historic commission requirements, and conservation commission rules, or other local policies.

4.1. Municipal Zoning

4.1.1 Overview

Massachusetts General Laws (MGL), Chapter 40A, commonly referred to as the Zoning Act, provides for municipal regulation of the use of land and structures in Commonwealth of Massachusetts communities. The specific provisions of Chapter 40A temper the constitutional authority to zone land in any Massachusetts community. This chapter of the law sets forth what zoning may regulate by specifying the particular limitations on the content and scope of local zoning regulations.

As such laws pertain to distributed generation (DG) facilities, local zoning regulations are an intricate maze of interpretation issues, nuances, and gray areas. However, there are also some very direct and easy-to-understand provisions of zoning that may serve as partial barriers to deployment of DG facilities in Cape Cod and Martha's Vineyard communities. These include the status of such facilities under zoning as structures (or parts thereof), which require compliance with building setbacks from property lines, observance of total site coverage requirements, and adherence to building height limitations.

Zoning also impacts subdivision control to the extent that subdivisions must be laid out in agreement with local zoning standards as well as local subdivision regulations. Where zoning encourages grid style subdivisions to occur, as opposed to cluster or open space development, there is less opportunity to incorporate shared power generation facilities because all the land is dedicated to roadway and lots. Also, this approach may render house lots difficult to build on for optimal solar access if the new street runs north/south, for example, and houses must face the street. When zoning facilitates open space subdivisions, which allow more flexibility, it would enable setting aside land for a generation facility and for more opportunities to design home sites for solar access.

4.1.2 How Zoning Regulates Land Use

The Zoning Act provides for the establishment of regulations governing classes or categories of land use with the express requirement that all uses in a particular class or category are regulated in the same manner. Zoning by-laws spell out in either a comprehensive table or narrative by zoning district, the uses permitted in each zoning district. These use regulations further specify whether each use is allowed by right or by

special permit. They also indicate which uses are not allowed at all. When uses are allowed and they involve new construction, all required approvals and conditions under zoning as well as other land use regulation (Conservation, Historic, Health, Building Code, etc.) must be obtained prior to the issuance of the building permit. (See Chart 1, which outlines the permitting process described below.)

4.1.2.1 By Right

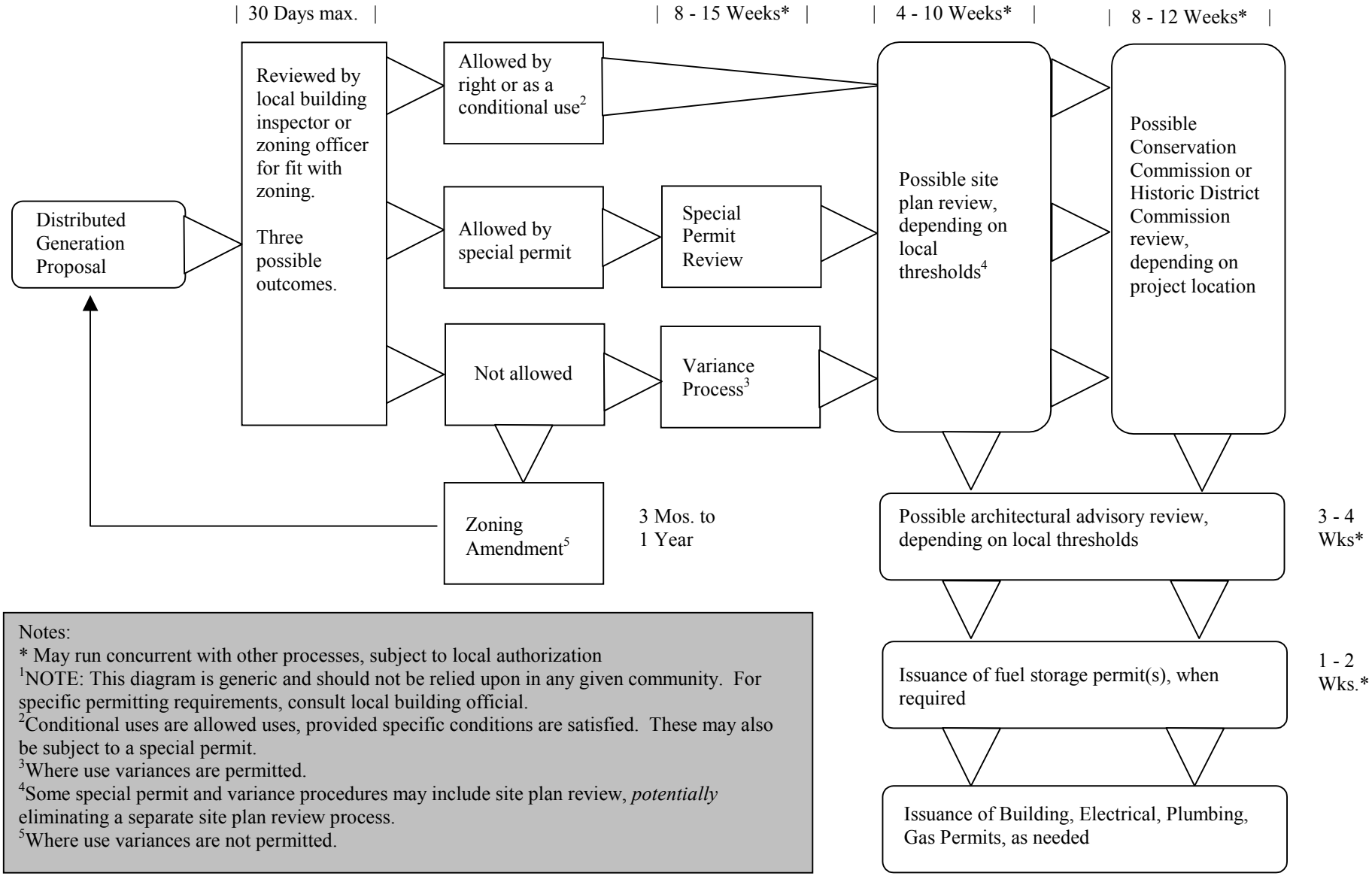
Zoning Codes may specify that certain uses are allowed by right (sometimes expressed as "as-of-right"). In such cases, a proponent merely submits an application for a building permit to establish the proposed use on a parcel of land, including detailed plans for the proposed structure or activity. If all setbacks and other "bulk" or physical aspect provisions are complied with and the reviewing building official agrees that the use is listed as permitted by right in the zoning by-law, the town issues the building permit. In most cases, uses other than single-family detached residential are subject to site plan review to assure safe and functional site design and confirm compliance with applicable development standards in the zoning by-law. Other than site plan review, there are usually no other permitting requirements under zoning for such uses.

4.1.2.2 By Special Permit

Zoning by-laws may also specify that certain uses are allowed only upon the issuance of a special permit. Such permits may be issued by the Zoning Board of Appeals (ZBA) or the Planning Board (PB). Special permits are much more subjective than by right permits. Most zoning codes require that the special permit granting authority (usually ZBA or PB) must find that specific criteria stated in the by-law are met before issuance of the permit. These criteria vary greatly in their scope and substance from town-to-town. The minimum requirements of a special permit under the statute are that the proposed use would not be detrimental to the neighborhood or derogate from the intent and purpose of the zoning by-law. Most Cape and Vineyard by-laws include a lengthy set of special permit criteria covering matters such as environmental protection; avoidance of noise, odors, dust, glare, and vibration; traffic generation and safety; screening and landscaping; and compatibility with certain municipal planning objectives, principles, and standards.

Special permit uses face challenges, uncertainty, and delays due to the requirements for processing such permit applications. For example, abutters must be notified of the public hearing required for these types of permits. All abutters to any land affected by a subject development proposal are required to be notified and have legal standing to appeal a decision to grant a special permit. Such litigation can delay project implementation for years. Even without litigation, the special permit granting authority may defer action, extend the public hearing or otherwise not act on the special permit application for a period of up to 120 days after the close of the public hearing. Following the filing of the decision, a thirty day appeal period must lapse before a building permit can be issued.

CHART 1. GENERALIZED PERMITTING PROCESS OVERVIEW[1]
ZONING AND OTHER LOCAL REGULATIONS APPLICABLE TO DISTRIBUTED GENERATION



Notes:
* May run concurrent with other processes, subject to local authorization
[1]NOTE: This diagram is generic and should not be relied upon in any given community. For specific permitting requirements, consult local building official.
[2]Conditional uses are allowed uses, provided specific conditions are satisfied. These may also be subject to a special permit.
[3]Where use variances are permitted.
[4]Some special permit and variance procedures may include site plan review, *potentially* eliminating a separate site plan review process.
[5]Where use variances are not permitted.

Finally, the discretionary nature of special permits and the required vote by a 2/3 or 4/5 majority (depending on the size of the board) make for great uncertainty. A special permit is not something to which an applicant is entitled because of the need for the reviewing board to interpret compliance with typically qualitative criteria. A board may deny a special permit with written reasons and the courts have given wide latitude to local boards in their bases for denying an application, provided they bear some relation to a specific provision of the by-law. Thus the allowance of a DG facility by special permit represents a significant potential barrier. Only after multiple experiences with DG proposals in a particular community would there be more predictability regarding the likely outcome. However, the right of abutters to appeal will always remain a wild card in special permit proceedings. The net effect of a protracted appeal may be to render the proposal financially infeasible, especially if the appellants seek monetary or other forms of mitigation.

4.1.2.3 Prohibited Uses

Zoning regulations may specifically prohibit certain uses in some or all zoning districts in a community. When a use is specifically prohibited, it may not obtain a building permit unless the local ZBA issues a variance for the prohibited use. In order to grant a variance for use, the ZBA must hold a public hearing and find that the applicant or the community would suffer a hardship, financial or otherwise, if the relief were not granted. It must also find that granting the use variance would not substantially derogate from the intent and purpose of the zoning by-law. The specific requirements for approval of a variance are found in MGL Chapter 40A, Section 10, as follows:

> The permit granting authority shall have the power after public hearing for which notice has been given by publication and posting as provided in section eleven and by mailing to all parties in interest to grant upon appeal or upon petition with respect to particular land or structures a variance from the terms of the applicable zoning ordinance or by-law where such permit granting authority specifically finds that owing to circumstances relating to structures and especially affecting such land or structures but not affecting generally the zoning district in which it is located, a literal enforcement of the provisions of the ordinance or by-law would involve substantial hardship, financial or otherwise, to the petitioner or appellant, and that desirable relief may be granted without substantial detriment to the public good and without nullifying or substantially derogating from the intent or purpose of such ordinance or by-law. Except where local ordinances or by-laws shall expressly permit variances for use, no variance may authorize a use or activity not otherwise permitted in the district in which the land or structure is located; provided however, that such variances properly granted prior to January first, nineteen hundred and seventy-six but limited in time, may be extended on the same terms and conditions that were in effect for such variance upon said effective date.
>
> The permit granting authority may impose conditions, safeguards and limitations both of time and of use, including the continued existence of any particular

structures but excluding any condition, safeguards or limitation based upon the continued ownership of the land or structures to which the variance pertains by the applicant, petitioner or any owner.

4.1.3 Variances

As indicated in the above excerpt, granting use variances is an option for Massachusetts communities. Some towns may not authorize their ZBA to grant variances for use. This is done through an express statement in the zoning by-law that the ZBA does have the authority to grant use variances. Study area communities that do not authorize granting use variances are identified below in the section on zoning review by town. (See the discussion and town-by-town zoning summary on Table 1, Section 5.)

In standard zoning enforcement practice, when a zoning by-law does not mention a specific use in its section on permitted uses and the use does not fit within the definition of any other use in said section, the use not mentioned is considered specifically prohibited. When this is the case in a town that does not allow use variances, the only recourse for a proponent of a use that is not mentioned is to petition the town for an amendment to the local zoning by-law so as to permit the desired use. For any DG facilities that may fall into this particular category, zoning can be a formidable barrier that could be difficult to surmount.

4.1.4 DG as a Primary Use

When a DG facility would be the primary use of a parcel of land, it must be specifically permitted as an allowed use in zoning district in which it is proposed. Otherwise it will not be permitted. This single aspect of zoning regulations in the study area poses a substantial barrier to proliferation of higher output DG facilities. Most local by-laws examined do not specifically list power generation as a use, thereby rendering it as prohibited. Moreover, such use terms, when they are mentioned, support only public power generation.

Another exception is the requirement contained in MGL Chapter 40A, Section 3, that specifically prevents a municipal zoning by-law from prohibiting or unreasonably regulating the installation of solar energy systems or the building of structures that facilitate the collection of solar energy, except where necessary to protect the public health, safety or welfare. This, too, is discussed in the section on incentives.

4.1.5 DG as an Accessory Use

When DG facilities are part of the power supply facilities of a single residential, commercial or industrial parcel or site, they are universally considered accessory uses and not subject to independent scrutiny or any separate permitting requirements under local zoning codes. However, when such facilities involve generating additional power to be delivered to the power grid, these otherwise accessory uses may be subject to widely different interpretations, according to local building officials interviewed on this

question. The selling of power over the property line could potentially put the formerly accessory use into a commercial use category, subject to a proper fit in the zoning by-law as if it were a primary use. Thus the interpretation of accessory vs. primary use for a particular DG facility may pose a substantial barrier for units that could deliver power to the regional electric grid, if such units are found to be more than accessory to the permitted primary use.

When a fuzzy interpretation situation arises, as it might with DG facilities designed for more than back-up power generation, the local building official charged with interpreting the zoning regulations would be likely to send the matter to the Zoning Board of Appeals (ZBA), rather than risk being responsible for a potentially controversial ruling.

4.1.6 Power Generation

Most zoning codes lack specific reference to any of the forms of DG examined in this report, except for some scattered references to solar and wind generation facilities. The codes occasionally mention "power plant", "power generation", or "public utility" as a specifically permitted or prohibited use. They also include "electric distribution facilities" as a specifically regulated and/or defined use. Most by-laws specifically separate terms like "power plant" and "electric distribution facilities" and regulate each quite differently. Typically, power plants, if they are allowed at all, are permitted only in industrial zones. When these are permitted, they are usually subject to the issuance of a special permit. Due to their eligibility for zoning exemptions, many towns may have intentionally left this use term out of the by-law.

Electric *distribution* facilities (as opposed to *generation* facilities) tend to be allowed in all zones, exclusive of buildings used in connection with such facilities.

4.1.7 DG as Power Plant

If a DG facility were proposed as a primary use, it most likely would be labeled and regulated as a "power plant" or "power generation" under local zoning. Under this scenario, most local zoning codes on the Cape and Vineyard would not permit this use and the matter would go before the Zoning Board of Appeals in towns where a use variance may be issued. The other option is that the Building Inspector's *decision* to call it a power plant may be appealed (commonly called an "interpretation appeal"), which would enable Board of Appeals review and re-categorization of the proposed DG use into a permissible use category. This process may also go the other way and affirm the Inspector's decision, thereby closing the door on zoning relief through the Board of Appeals. When this happens or at any time, a DG power plant proponent may petition the local town meeting or town council for a zoning change that would allow the power plant use in an acceptable location.

The zoning change route has some merit for DG power plants because they are clean energy sources as opposed to the traditional, air-polluting power plant. The

individual town can accommodate the specific design of a DG with the knowledge that green power may come from it and that the generating capacity would be limited to a reasonable level. (See Section 7 for more discussion on zoning strategies.)

4.1.8 Uses Related to Scientific Research

MGL Chapter 40A requires all municipal zoning codes to include an allowance for uses accessory to a permitted scientific research use that may include production, provided such activities are necessary to the scientific research. Such accessory uses and production may be on a separate lot from the permitted primary use. Towns allow such activities by special permit. This provision, while not necessarily an easy route, is a possible early initial option for DG deployment (through a research-oriented application) in all study area towns until other remedies to zoning barriers are implemented.

4.1.9 Zoning Findings Overview

Distributed generation uses and equipment are regulated differently in the study area towns, according to the specifics in each town's zoning by-law. As stated above, in most cases, the local zoning regulations do not even mention such a use or any of its component forms other than wind generation (i.e. no mention of microturbines or reciprocating engines, photovoltaic generation).

Under standard zoning interpretation practices in Massachusetts, a use that is not specifically listed in the by-law section on permitted uses is typically viewed as not permitted. However, building inspectors, the town agents typically charged with official interpretation and enforcement of the town zoning regulations, may rule that any one or several types of distributed generation are *accessory* uses and are therefore treated as such and not scrutinized as a primary use would be. For example, all permitted land uses do not now need separate permission to have a connection to the existing power supply grid. In other words, the use of electricity is implicitly allowed via the standard form of delivery, which is by way of overhead and underground power supply cables. Thus a distributed generation unit as a stand-alone, primary use, may not be allowed without a variance while such unit within the context of a commercial or residential primary use may be allowed as-of-right as part of the building permit for the primary use.

The project consultant interviewed several building inspection officials in Barnstable County to explore their handling of DG units where the respective zoning by-laws were silent on DG uses or equipment. All concurred that when part of a single primary commercial, residential, or industrial use, DG facilities would not be subject to any zoning scrutiny (subject, of course, to building and electrical code compliance). However, all respondents also agreed that any such units which were designed and intended/used for provision of power to other parties, would require a variance from the Zoning Board of Appeals, where use variances were allowed, or would not be permitted at all where use variances were not allowed.

The local zoning by-law research confirmed that DG facilities are generally not allowed as primary uses but may be readily permitted as accessory uses up to the point of the design exceeding the energy needs for the primary use. The limitation on primary use is that "power generation" or "power plant" terms are either not included at all in the list of permissible uses or are sufficiently cloudy in their meaning (i.e. lacking definitions) to result in DG power generators being sent to the Board of Appeals for interpretations or use variance consideration.

Regarding use variances, nine of the study area towns do not authorize their Board of Appeals to issue them at all. If a DG use is rejected by the Building inspector as not permitted in these towns, the only two remedies would be to seek a review of the Building Inspector's decision through an application to the Board of Appeals or petition the Town for a zoning amendment. The latter requires action at a town meeting in all towns but Barnstable, which has a Town Council. Zoning amendments need a two-thirds majority vote of a town meeting quorum or two-thirds of all members of a town council.

One particular DG type - windmills - was frequently addressed in the 21town by-laws reviewed. Where specifically mentioned, they are allowed as accessory uses in most zoning districts. However, height limitations in some communities pose limitations on the efficiency of such devices. Conversely, some communities allow windmills and height exemptions for them to encourage energy production efficiency. Other issues with windmills include a substantial setback requirement that could require a large amount of land to properly accommodate a tall (efficient) windmill. (See the Town-by-Town Zoning Review Summary below in Section 5 for specific issues in each town).

Clearly, there are significant barriers to DG deployment nestled within the various zoning codes of the study area towns. Different issues in each community mean that a single solution would need to transcend all of the obstacles. Addressing these issues town-by-town with specific zoning amendments would be tedious, time-consuming, and questionable as to the chances for universal success in producing consistent regulations for DG uses. However, if energy load centers can be identified and the needed DG technology and capacity can be specified, then the local zoning by-law amendment approach could be productive by focusing efforts just on the towns containing the load centers.

4.1.10 Site Plan Review

All of the study area communities have in their zoning codes a site plan review process that might apply to DG units designed and used for more than back-up power. Site plan review, when required, must occur prior to issuance of a building permit. Site plan review varies widely in its scope of review, filing requirements, review process, notification of abutters, etc. This is due to the lack of specific guidance in the State zoning legislation (MGL Chapter 40A) on site plan review. While the statute is silent on site plan review, local zoning codes have been amended (i.e. passed muster with the state Attorney General's Office, which affirms that the by-law is not inconsistent with state statutes or the State Constitution) so as to include some form of plan review for

commercial, industrial, institutional, and some types of residential development. These amendments, largely adopted by Cape and Vineyard communities over the last two decades, are very individualized in their design and function and therefore do not lend themselves to generalizations.

However, the important point is that site plan review does not represent a significant barrier, other than time delay of up to two months or possibly longer for processing. Site plan review governs *how* something is developed (as opposed to *whether* it should be developed) and is usually aimed at making sure all other local zoning laws are satisfied. If something is noncompliant, then the applicant can correct it and eventually obtain site plan approval.

Site plan review is typically for large buildings, intensive uses, changes in use, new commercial uses, and the like. Thus, unless a proposed DG unit was a primary use, site plan review would probably not be required. However, thresholds may change. Therefore, it would be appropriate to consider a model to deal with the relationship of site plan review to DG facilities, both large and small.

4. 2 Regional Commissions

4.2.1 Cape Cod Commission

The Cape Cod Commission, established pursuant to the Cape Cod Commission Act in 1989, has regulatory jurisdiction over "Developments of Regional Impact" (DRI). A development proposal qualifies as a DRI if it triggers one of the thresholds for mandatory DRI review or is referred to and accepted by the Cape Cod Commission as a DRI under a discretionary referral process. DG installations would be automatically subject to DRI review only if the thresholds for mandatory DRI review were triggered by the size of such facility in terms of buildings and/or disturbed land area. The Cape Cod Commission Act provides that certain local agencies and officials could refer a proposed project to the Commission as a discretionary referral. History has shown that controversial projects have been the subject of discretionary referrals. It is reasonable to expect the potential for discretionary referrals of larger DG proposals, especially wind towers, given their uncommon nature.

In considering acceptance of a development proposal for DRI review, the Commission must affirm the project's alignment with truly regional concerns.
If a DG proposal does get referred to the Commission and the Commission accepts it as a DRI, the project would be reviewed by the Commission against a lengthy set of comprehensive policies that all DRIs must comply with. (See Cape Cod Commission Regional Policy Plan for the full criteria required for approval of a DRI.) The consultant interviewed John Lipman, Deputy Director of the Commission, to learn about how certain DG facilities might be handled by the Commission. Mr. Lipman indicated that if a town referred to the Commission a small-scale DG proposal with a structure containing less than 10,000 square feet, it would probably not be accepted as a DRI unless it was in such a poor location, either by virtue of being in an historic resource area or

environmentally sensitive location for any development. However, the absence of experience with DG units necessitates specific attention to DG facilities in the Regional Policy Plan and in the Commission's regulatory policies.

The Regional Policy Plan is the official set of regulatory policies that apply to all DRIs. Two sections in particular, (4) Energy Policies and (6) Historic and Cultural Resources, include cursory discussions of energy facilities. The Energy section includes two recommendations for actions by entities other than the Cape Cod Commission. First is a recommendation that the County Energy Committee generally support and encourage the use of "financially feasible alternative energy sources, especially wind power, throughout the Cape. The other is a suggestion to towns to consider providing incentives for energy conservation and renewable energy devices in all existing and new buildings.

The Heritage Preservation/Community Character element (Section 6) includes the following minimum performance standard: "6.2.9 All utilities for development shall be placed underground, except where wetlands or archaeological resources may be damaged." While this is interpreted to apply to electric transmission lines and other types of utility transmission lines, its wording should be examined in the context of DG, which would need some recognition of the potential for above-ground facilities, especially wind-powered generation facilities. This provision may be an issue for DG proposals that were deemed DRIs and for all DG projects that may be reviewed locally against this standard by towns that incorporate this RPP standard into their own Local Comprehensive Plans and/or their zoning. Local adoption of RPP standards and policies is one of the criteria for certification of Local Comprehensive Plans as consistent with the Regional Policy Plan. Towns are encouraged to seek such certification because it entitles them to additional growth management tools, such as impact fees and development agreements. Mr. Lipman stated that he doubts the Commission would ever recommend placing generation facilities underground and that such facilities may require screening and buffering. Thus a slight wording change may be sufficient to address this particular issue by clarifying the intent.

Section 6 also includes two recommended town actions as follows:

> "(H) Towns should adopt by-laws which regulate the placement of utility structures such as radio towers, high voltage lines, water towers, and other transmission structures." Such regulations would appear in local zoning and all 21 local zoning by-laws have been reviewed for their regulations concerning how wind towers would be treated.
>
> "(I) Towns should bury utility lines and structures where they detract from historic and cultural features, community character, and scenic views." This suggestion does not appear to accommodate wind energy facilities. Nor does it directly seek to prevent them. However, revised language may be appropriate to clarify what structure types are undesirable and help support the establishment of wind energy facilities, in addition to the other DG technologies.

These items do not stand as barriers to DG at the County level but may translate into unsupportive regulation at the local level.

The Cape Cod Commission may also make possible the creation of Districts of Critical Planning Concern (DCPCs). A DCPC is an additional layer of land use regulation that is built into the local development regulations of a municipality. The DCPC mechanism is mentioned here because they are created through the collaboration of a town and the regional commission and may span more than one community. DCPCs are typically specific geographic areas that encompass certain unique and valuable natural and/or built features that warrant extra protection. These powerful tools can enable a community to eliminate all grandfathering protection against new land use regulations that is provided under MGL Chapter 40A (Zoning). It allows communities to re-write the land use regulations to provide adequate protection of special resources, based on current knowledge and needs. It can also promote economic development and other desired results.

A noteworthy aspect of DCPCs is that they can be nominated by numerous agencies. Once a nomination is made, a moratorium may prohibit certain categories of development until new regulations are adopted by the applicable town(s).

A total of five DCPCs have been adopted in five different Cape Cod towns. The implementing regulations for these DCPCs have been incorporated into the local zoning regulations of each town (Dennis still in process).

4.2.2 Martha's Vineyard Commission

DG facilities, especially wind machines, may face a more uncertain regional review path on Martha's Vineyard than on Cape Cod. As with the Cape Cod Commission, there are two layers of potential regional regulation - review as a Development of Regional Impact (DRI) and special regulations within a District of Critical Planning Concern (DCPC). The latter are technically local regulations but they are created through the collaboration of a town and the regional commission and may span more than one community.

4.2.2.1 Developments of Regional Impact

Martha's Vineyard Commission Regulations specify that certain proposed activities must be reviewed by the Martha's Vineyard Commission as DRIs. The thresholds for review are considerably lower and more numerous on the Vineyard than on Cape Cod. These are detailed below. The significance of DRI review is the *additional time* and *potential additional expense* typically required for this process. Also, DRI review is in *addition to and prior to* all local permitting processes. A typical DRI review runs from two to four months and may take considerably longer if the proposal attracts objectors, due to the likelihood of extended hearings and appeals. The potential for additional expense is always present with DRIs because of the potential for the Commission to require special technical studies to document expected impacts.

Mitigation that may be required to address the identified impacts may also create additional unanticipated project costs. These additional costs would weaken the economic viability of a DG project.

The specific thresholds that may have some bearing on DG proposals are as follows, excerpted from the regulations of the Martha's Vineyard Commission (MVC):

6.1 (Paraphrased for brevity) Discretionary referrals of any project, provided the MVC accepts it for DRI review. These referrals may be made by a.) Any town agency within the subject town, b.) The Board of Selectmen of any Dukes County town (except Cuttyhunk, which is not within the MVC's jurisdiction), and c.) The Dukes County Commission regarding any project anywhere on Martha's Vineyard. Thus, if a DG proposal were filed locally and any of the above wished to slow it down or fight it, they could attempt to invoke DRI review by the MVC. Insufficient history exists with DG facilities to predict how they might be handled. In the opinion of the Consultant, wind towers may be the most likely type of DG facility to attract scrutiny by the MVC. The high visibility of such facilities and the careful attention to scenic preservation evident in the town zoning by-laws, including District of Critical Planning Concern regulations, could mean an unpredictable and time-consuming permitting path for wind towers.

When projects are studied for referral to the MV Commission under this section, a fifteen-point checklist of questions is in place for local agencies to consider when contemplating a discretionary referral. This document (known as Attachment A), while not an exhaustive checklist, mentions two situations that could apply directly to DG facilities. These are:

n.) "Will the project obstruct significant viewsheds or historic or ancient ways?" This item could realistically apply to a wind tower proposed anywhere on the island.

o.) "Are there any other factors peculiar to this project that, in the consideration of local permitting authorities, might have a regional impact? This "catch-all" prompt may cause a local agency to consider the DG-produced power to be provided into the island-wide power grid something that would have regional implications. While the regional impact would likely be perceived as a benefit, it may take an entire DRI review to reach that conclusion.

6.1 "Any development located on lands that are listed in the acquisition priorities or long-term goals of the County or of any Town's plans and programs." With this provision in place, the mere listing of a privately-owned parcel as a desirable acquisition by a local land acquisition committee, for example, could trigger DRI review by the MV Commission. This would not be an obstacle if the sites desired for DG use were not on such lists. However, a group to keep out windmills could

easily encumber prime wind sites by promoting their listing as described above.

6.2 "Any development which proposes to divide land which is located in a business, commercial or light industrial zoning district." If a parcel needs to be created to accommodate a DG use in any of the subject zones on the Island - a potential scenario - then this provision would pose a moderate barrier.

6.3 (Paraphrased) a.) Any new nonresidential construction of 2,000 square feet or more and b.) Any new construction of addition(s) or auxiliary building(s) totaling 1,000 square feet or more when such square footage results in a total area of 2,000 square feet or more. When DG facilities meet either of these thresholds, they must be reviewed by the MV Commission as a DRI. DG units individually are typically well under these thresholds, unless bundled together in a series of small structures.

6.4 (Paraphrased) Any development in a commercial district that proposes demolition of an existing structure that contains 2,000 square feet or more. This is not a likely scenario for DG facilities, so the potential as a barrier is minimal.

6.5 "Any development which proposes the creation of a health, recreational or educational place of assembly, or governmental or other publicly owned or quasi-publicly owned facility of 2,000 square feet or more and which is designed to serve the residents of more than one town." It is conceivable that this provision could trigger DRI review for a DG use when such use is a public service corporation formed for providing electric power. A new DG electric company could need a building for administrative and maintenance purposes, in addition to the generating units on the same parcel, thereby reaching the 2,000 square foot threshold. While the public service corporation could obtain *zoning* relief through the DTE, no such relief from County-level DRI review is available.

4.2.2.2 Districts of Critical Planning Concern (DCPC)

The Martha's Vineyard Commission has co-established in the various towns a number of DCPCs. A DCPC is an additional layer of land use regulation that is built into the local development regulations of a municipality. DCPCs are typically specific geographic areas that encompass certain unique and valuable natural and/or built features that warrant extra protection. These powerful tools can enable a community to eliminate all grandfathering protection against new land use regulations that is provided under MGL Chapter 40A (Zoning). It allows communities to re-write the land use regulations to provide adequate protection of special resources, based on current knowledge and needs. It can also promote economic development and other desired results as well as cover the use of water surface areas.

A noteworthy aspect of DCPCs is that they can be nominated by numerous agencies. Once a nomination is made, a moratorium may prohibit certain categories of development until new regulations are adopted by the applicable town(s).

The DCPCs span from one to all Island municipalities. Review of these specialized district regulations in each community yielded no specific intent to prohibit DG uses, except that the Roadside District seeks to preserve the views 200 feet back from the affected road edges. Any DG facilities within this type of area may face a tough permitting challenge, especially a wind generating proposal. Another exception would be the Coastal District, which is intended to protect the coastline and the related fragile natural features by avoiding any type of major new construction but specifically exempting customary accessory buildings. Wind facilities or larger DG installations may be categorically prohibited by these regulations, subject to each Building officials' interpretation of the meaning of accessory use, as it would apply to DG facilities.

4.3 Historic Commissions

Most Cape and Vineyard towns have one or more historic districts, which have been established pursuant to MGL Chapter 40C. This portion of the Law provides for protection of historic resources through enactment of local historic district regulations. These codes act in a manner similar to zoning rules in that before a building permit is issued, compliance with the requirements of the historic district regulations must be demonstrated.

A proponent of a structural change or addition on a parcel in a Chapter 40C sanctioned historic district must first file an application for a determination of appropriateness (DA) with the local historic district commission before seeking a building permit for the proposed change. The Historic District Commission schedules a public hearing on the proposal and following the hearing, makes its ruling on whether the proposed new construction or change is in keeping with the character of the historic district.

Distinct from zoning regulations, the Chapter 40C approach to development regulation can scrutinize every aspect of the appearance and placement of a proposed structure. Any new structure, including a DG unit, may be subject to scrutiny for compatibility with the proposed setting, compatibility with existing structures in the area, placement on the lot, screening and landscaping, noise levels, structural design, size, and color. Some historic district commissions publish guidelines for compatibility while others consider applications independent of guidelines or treatment of other proposals. Conversely, the Zoning Act does not allow detail-oriented regulation of materials and colors, even under special permit review. Building aesthetics are the sole domain of historic district regulations, except that DRI review by a regional commission may involve scrutiny of aesthetics.

Since historic district commission review is a very subjective process, it can therefore represent a fairly unpredictable obstacle to installation of a DG unit. However, the good news is that such commission must express in its negative determination why the proposal did not meet the commission's approval. This gives the proponent direct

feedback on how to change the project design so as to obtain approval via a new, revised submittal.

Since there is no known history (none discovered by the Consultant) of any DG facilities other than photovoltaics being proposed within an historic district, the administrators interviewed felt there would be some inaccuracy in predicting how such facilities might be regulated. All agreed that if the DG unit had its own "box" as a structure, there might be a requirement to screen it with appropriate material, if the box would otherwise be visible from the street.

Regarding windmills in historic districts, these structures would probably not pass muster due to the sleek, modern designs required for optimal efficiency, according to all historic district administrators interviewed.

Photovoltaic equipment and structures do not enjoy the same protection from undue regulation under Chapter 40C (Historic Commissions) as they do under Chapter 40A (Zoning). However, rooftop placement of photovoltaic panels would likely be found acceptable if they were hidden from view from the street level. Panels mounted on a rack in a side or rear yard might also be found acceptable if they were well-screened from street-level views.

Finally, there appears to be no parallel provision for exempting public service utility corporations from the requirements of local historic district regulations, as may occur under zoning.

4.4 Other Potential Barriers

4.4.1 Governmental Environment

Both the policy-making and regulatory functions of local and regional government need to be informed about the specific issues and opportunities regarding distributed generation. Education has begun through outreach efforts by the US Department of Energy to local regulatory officials. However, the education effort must go into the leadership, governance, constituent and consumer levels to enable all of the above to do their respective roles in making DG deployment feasible and effective at what it can do.

During his research, the Consultant encountered very little awareness of the term "Distributed Generation" among public officials. There was a much greater awareness of some of the more common and renewable DG technologies - photovoltaic and wind power generation. However, these were still viewed in the context of their former associations and not with an awareness of what role they may play in an integrated and dynamic network of more efficient and cost-effective energy supply resources. This latter context for any of the DG technologies appears to be quite absent at nearly all levels of government.

4.4.2 Conservation Commissions

According to the building inspectors interviewed for this project, placement on a lot of any DG facilities (considered structures for the purpose of regulation) would need to respect the requirements of wetland regulations. Such requirements are typically part of local wetland by-laws, which are typically more restrictive than the default state regulations governing wetland protection (MGL, Chapter 131). The default regulations apply in all communities. Local wetland regulations are typically part of a town's general by-laws and not part of zoning. However, On Martha's Vineyard, some towns have specifically incorporated their wetland regulations in the zoning by-laws through the DCPC process.

DG structures and any earth disturbances related thereto in connection with installing them or their appurtenant subsurface cables must abide by the wetland setback regulations for all structures and earth disturbances. Most wetland regulations provide for a fixed distanced to serve as a buffer area within which no work shall occur without review by the local conservation commission and issuance of an approval. Such approvals take one of two forms. One is an Order of Conditions, which sets forth how work may be done within and around the affected wetland resource area(s). Typical orders of conditions involve placement of erosion prevention barriers, minimization of vegetation removal, and appropriate mitigation of any foreseen impacts.

The other form of approval is a Determination of Non-Applicability, which the local conservation commission issues when it sees no significant impacts from the proposed work. The conservation commission may place reasonable conditions on the validity of such determinations.

In order to obtain review by a conservation commission, one must file a Notice of Intent, which sets forth a description of the proposed work, distances to wetland resources, and a description of probable impacts. The burden of delineating the exact location of protected wetland areas rests with the proponent, subject to verification by the local conservation commission itself or its agent. Filing a Notice of Intent triggers notification to abutters of the public hearing required prior to action on application. Abutters have standing to appeal a conservation commission's approval and may delay the issuance of an Order of Conditions while the appeal is processed.

Due to the lack of awareness of certain DG technology, neighbors may be sensitive to distributed power generation proposals, even at relatively low levels. This sensitivity may lead to aggressive opposition at every level of permitting, including any conservation commission review.

4.4.3 Architectural Review

Outside historic districts that are regulated pursuant to MGL, Chapter 40C or in the absence of such districts, many communities have a requirement for commercial and industrial uses and signs to undergo an advisory architectural review prior to issuance of

a building permit. Since this type of review is not binding and does not involve a public hearing process with notice to abutters, there is very little potential for such review to serve as a barrier to DG deployment. At most, a project may be delayed four to five weeks while the architectural review application is processed, unless such action is within the context of a regional commission's DRI review, which may be a lengthier overall process that includes scrutiny of architectural details.

4.4.4 Flood Regulations

Most zoning by-laws and/or subdivision regulations reviewed had specific provisions for regulation of flood prone areas and structures. These universally addressed the design of utilities in the same manner. They all required the design and placement of all utilities, including electrical supply, to be able to continue uninterrupted operation and avoid any damage during a flood up to the base flood elevation. The base flood elevation is the predicted level of flood water expected from a 100-year intensity storm.

Flood regulations, therefore, may pose a cost barrier in flood prone areas if the required design includes too much expense for constructing damage-proof facilities. In most cases involving DG facilities, though, the solution would simply be erection of a flood-safe platform upon which to mount the generation and interconnection equipment, if any.

4.5 Local Administration of State Codes

Each of the study area towns has local officials charged with interpreting and enforcing statewide regulations dealing with construction standards in the following technical areas:

4.5.1 Building Code, Electrical Code, Plumbing Code

These regulations, found in the Code of Massachusetts Regulations (CMR), empower local officials to regulate local construction activity in terms of materials used, installation methods, required performance ratings, etc. All but one of these regulations do not specifically address DG as a separate item. The Electrical Code contains provisions for wiring photovoltaic and other types of generators. The role of the local official is to enforce the respective code when considering DG. In the absence of specific regulations for the DG facilities covered by this report, these officials will rely on the specifications of the manufacturer, provided it is UL listed. The UL (Underwriters Laboratory) lists products that have been reviewed for consistency with accepted standards for assembly, design, operation, and safety. Any technologies not UL listed are likely to trigger review by an independent engineer, at the request of the local code official and at the expense of the applicant.

These three state codes do not appear to be much of a barrier but local handling of new technologies may be a bottleneck with additional expense in the regulatory process

when independent engineering review is required. It is very probable that when DG is commercially viable and widely available, UL registration will support local approval and independent engineering review will be very unlikely.[15]

4.5.2 Fire Code

The CMR provides for regulation of fuel storage facilities under the Massachusetts State Fire Code. This set of rules is enforced at the local level by local fire inspectors. Certain DG technologies will require fuel storage where natural gas is not available, especially Martha's Vineyard and much of the Lower and Outer Cape areas. LP gas is a readily available fuel source for DG facilities and this gas must be stored on site in containers (tanks), which may vary in size, according to the needs of the DG unit(s). The installer of such a tank must first obtain a fuel storage permit from the local Fire Department. Tanks up to 2,000 gallon capacity need only the Fire Department permit. Tanks greater than 2,000 gallons but less than 12,000 gallons need the Fire Department permit plus a license from the Board of Selectmen or Town Council. Storage of more than 12,000 gallons requires both previously mentioned permits, plus approval from the State Fire Marshall's Office. The Fire Department permits are typically not an obstacle as they usually only require siting the tanks a reasonable distance away from dwellings and other occupied structures. The latter two permit types may include a requirement for fire suppression apparatus, in addition to proper siting.

Fuel storage in large quantities would encounter very restrictive regulation under local zoning when such activity is the primary use on a parcel of land. However, the accessory storage of fuel needed for a permitted primary use would not be subject to such regulation.

A connection to the local natural gas network simply requires a permit from the local gas inspector, which is obtained by the gas company that makes the connection.

4.5.3 Health Regulations

While local Boards of Health were not found to be concerned with directly regulating DG facilities, they may serve as an intermediary in the referral of a suspected air pollution generator to the State Department of Environmental Protection. The State's air quality standards would govern the treatment of any DG facility that exceeded the permissible discharge pursuant to current regulations. DG units may involve some air quality issues when diesel fuel is used. However, the focus of this report is on the cleaner applications of DG, which involve use of natural gas and LP gas.

4.5.4 Water Withdrawal

Any entity that proposes to withdraw more than 100,000 gallons per day of groundwater must obtain a water withdrawal permit from the Massachusetts Department

[15] Conclusions based on interviews with local inspection officials in several study area communities and the Massachusetts Office of Building Regulations and Standards.

of Environmental Protection. This threshold would be unlikely to affect water-using DG units on the scale contemplated for the study area.

4.6 Summary of Local and Regional Regulation of Specific DG Technologies

4.6.1 Turbines and reciprocating engines

See discussions of DG as accessory use and primary use in Sections 4.1.4 and 4.1.5.

4.6.2 Fuel cells

See discussions of DG as accessory use and primary use in Sections 4.1.4 and 4.1.5.

4.6.3 Wind machines

Various towns on Cape Cod and Martha's Vineyard have zoning regulations governing "windmills," "wind generating machines," and "wind energy conversion systems." They are handled quite differently in each town. Some regulations consider them only as accessory uses while others allow them as primary uses. In all cases where they are allowed, a special permit is required. In some towns, the regulations make no allowance for exceeding the standard height limitation for structures (typically 28 to 35 feet), resulting in the requirement for a height variance.

In some other towns, exceptions to height regulations may be applied to wind machine towers. In such cases, the regulations require a "fall zone" within which the wind tower could collapse from structural failure without threatening adjacent properties. These fall zones are typically determined by the height of the tower, plus the rotor length, plus 10-20 feet for equipment dispersion from the impact. For a fall zone of 150 feet, a minimum parcel area of 300' by 300' (90,000 square feet or 2.07 acres) would be required.

This regulation, while protecting the health, safety and general welfare of a community's residents, establishes a formidable economic barrier to development of efficient, high-capacity wind generation facilities, due to the high cost of land. This land cost is not just the per acre cost of acquisition and real estate taxes but also the lost opportunity cost from unrealized economic return from a more profitable use of the land other than power generation.

However, smaller scale wind generation facilities may not be so burdened. A fall zone of 50 feet would necessitate a minimum open land area of only 7800 square feet, which would probably fit in many rear yard areas of typical single-family residential parcels.

Proponents of wind machines can expect other structure-based regulations to apply as discussed above. Of particular concern is the current incompatibility between traditional Cape and Vineyard historic settings and architecture and the sleek, modern-

looking wind machines needed for efficient power generation. Not only are wind machines likely to be taller than any structure in an historic district, they are usually made of materials that do not comport with visible materials typically required for new construction in historic districts.

Thus they are not likely to win approval of local historic districts commissions, which have long enjoyed the supported of the courts when their decisions have been appealed.

Regional review of wind machines on Cape Cod is not likely, unless the size of a proposed wind farm is such that it warrants review as a Development of Regional Impact (DRI) by the Cape Cod Commission. (See discussion in Section 4.2 under the heading "Regional Commissions.") However, discretionary referral to and acceptance by the Martha's Vineyard Commission of a single wind machine is a real possibility since the thresholds for MV Commission DRI review of commercial projects are much lower and there is always the possibility of a referral of anything for concurrence.

4.6.4 Photovoltaics (PV)

This technology has been in use for many years in the study area on a limited number of properties, mostly single-family residential. No local zoning limitations for accessory installation of PV panels were discovered other than the need to observe rules for structure placement. Building code (attachment and load bearing) and electric code (wiring design) requirements for mounting PV panels on structures would apply, as would the need to obtain location approval from any local historic district commission having approval jurisdiction of the subject property. (See the separate discussions above on DG as primary use in Section 4.1.4 and accessory use in Section 4.1.5.) It is also important to note that Massachusetts law prohibits zoning regulations from unreasonably denying "solar access"—the access of a solar energy system to direct sunlight.[16] This can be done by regulating the orientation of streets, lots, buildings, and placement of vegetation. Communities can also develop by-laws to provide for the issuance of special permits that protect access to direct sunlight for owners of solar energy systems.

[16] MGL c. 40A ss. 1A, 9B

5.0 Town-by-Town Summary of Zoning Review Findings

5.1 Barnstable -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Windmills permitted in most zoning districts as an accessory use only, via special permit from the Board of Appeals.
- Power generation not mentioned.
- Use variances not allowed.

5.2 Bourne -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Towers (of any kind) over 40 feet are permitted through special permit from Planning Board in three business districts and GD/SDD District.
- Power generation not mentioned.
- Use variances not allowed.

5.3 Brewster -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Power plant" mentioned in table of permitted uses, allowed by right in Commercial High Density and Industrial zones.
- Includes height limit exemption for windmills
- Use variances allowed

5.4 Chatham -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Public Utility Building and Facilities" definition allows buildings and facilities for public service corporations contemplated in MGL Chapter 40A, sec 3. The use table allows this use in eight of ten zoning districts with a special permit from the ZBA and as-of-right in the municipal district. It is prohibited only in the Municipal Conservancy District.

- Wind power generating machines are not specifically mentioned.
- No height limit exemption for wind towers.
- Use variances allowed.

TABLE 1. SUMMARY OF ZONING TREATMENT OF DISTRIBUTED GENERATION ON CAPE COD AND MARTHA'S VINEYARD				
Jurisdiction	**Relevant Use Terms in Zoning By-Law**	**How Treated**	**Use Variances Allowed**	**Comments**
Barnstable County	NA	General Note: In all towns, DG generally allowed as accessory use to serve single premises but may become a principle use if designed for greater output than single premises.	NA	
Barnstable	Windmills	Windmills allowed as accessory use in most zoning districts with special permit. No height exemption	NO	Power generation as a specific use not mentioned
Bourne	--	Towers (of any kind) over 40 feet are permitted through special permit from Planning Board in three business districts and GD/SDD District.	NO	Power generation of any kind as a specific use not mentioned
Brewster	Power plant	Power plant permitted by right in CH and I zones. While windmills not mentioned in permitted uses, the By-Law allows height exemption for them.	YES	No definition of "power plant" puts question on how DG units would be treated.
Chatham	Public utility buildings and facilities	These uses are the ones that could be granted a zoning exemption under CH 40A, Sec 3 (public service corporations). Special permit required.	YES	Wind power machines not specifically mentioned and no height limit exemption for wind towers.
Dennis	Public/private facility/utility	This term, which is not defined, is allowed with special permit in all districts	YES	Lack of definition provides no guidance on treatment of DG facilities. No mention of windmills or power generation
Eastham	Light or heavy industry uses not mentioned in use table	These uses, which could include DG, are allowed with a special permit	YES	No specific mention of windmills or height limit exemptions nor of power generation
Falmouth	Windmills	Allowed in 7 zones only as an accessory use with special permit. Height limit exemption not provided.	NO	Power generation as principal use not allowed in any zone
Harwich	Essential services, not including power plant	Allowed by right in all zones but only pertains to distribution facilities	YES	Power generation as principal use not permitted anywhere. No mention of windmills or height exemptions for wind towers
Mashpee	Public Utilities	Allowed in all zones with a special permit but such uses are already entitled to obtain a zoning exemption	NO	No specific mention of windmills or height limit exemptions nor of power generation
Orleans	Windmills	Specifically allowed in all zones with special permit but no height exemption provided for wind towers	YES	Power generation as principal use not allowed in any zone
Provincetown	Public Utility	Allowed in four zones but not applicable to private DG	YES	No mention of windmills, power generation or height exemptions for wind towers.

Jurisdiction	Relevant Use Terms in Zoning By-Law	How Treated	Use Variances Allowed	Comments
Orleans	Windmills	Specifically allowed in all zones with special permit but no height exemption provided for wind towers	YES	Power generation as principal use not allowed in any zone
Provincetown	Public Utility	Allowed in four zones but not applicable to private DG	YES	No mention of windmills, power generation or height exemptions for wind towers.
Sandwich	Power Generation	This undefined use is allowed as a primary use with a special permit in Ind & Marina Zones. DG as primary use likely to require Board of Appeals interpretation.	NO	Wind turbines or generators allowed as accessory use only with special permit.
Truro	Public Utilities and Windmills	Public utilities allowed by right only in Seashore District, not mentioned in other districts. Term not defined and probably does not contemplate private DG. Windmills allowed in any zone to max. height of 60 feet. Fall zone required.	NO	Fall zone equal to height of tower & rotor, plus 20 feet
Wellfleet	Wind energy conversion system (defined) Utilities without open storage (undefined)	Wind systems allowed as accessory use on special permit per sec 6.5. Utilities allowed in all zones with special permit and by-right in Commercial zone.	NO	Lack of utilities definition probably means private DG would be prohibited.
Yarmouth(1)	Public utility (undefined)	Allowed by special permit in nonresidential zones	YES	Definition of public utility may include power plant; No height exemptions for windmills
Yarmouth(2)	Municipal use (i.e. could be municipal electric co.)(undefined)	Allowed in all zones, special permit required in residential and aquifer protection zones	YES	Municipal uses do not currently include electric company
Dukes County	NA		NA	
Chilmark	Windmills	Allowed as accessory use with special permit and are exempt from height limitations	YES	No mention of power generation or utilities as primary use, meaning DG proposals would require Bd of Appeals action

Jurisdiction	Relevant Use Terms in Zoning By-Law	How Treated	Use Variances Allowed	Comments
Edgartown(1)	Wind energy conversion systems	Allowed with special permit as conditionally permitted use; allowed in 4 residential zones & one bus. Zone; height exemption allowed; fall zone required	YES	Fall zone equal to height of tower & rotor, plus 20 feet
Edgartown(2)	Public utilities and Underwater electric cables	Both allowed with special permit; no definition for public utilities	YES	By-law contains a section on public utilities, including a review process; may serve as basis for a model
Aquinnah	--	No mention of power generation, utilities, or windmills	YES	Any power generation as primary use would require Board of Appeals approval
Oak Bluffs	Windmills and Public Utility Building	Windmills permitted by special permit to height of 87.5 feet with opportunity to obtain greater height based on efficiency issues and impacts; fall zone required to height of facility plus 20 feet	YES	Public utility building does not include generation facility. No specific mention of power generation, meaning private DG as primary use likely to require Board of Appeals action.
Tisbury	Public utility structure	Allowed by special permit but term not defined	NO	Absence of mention of power generation or windmills as primary uses means these would be prohibited with no option for variance.
West Tisbury(1)	Public utility facility, except power plant	Allowed by right with Plan Review or special permit, depending on size	NO	Plan review for small facilities; special permit for larger floor area
West Tisbury(2)	Wind energy conversion systems	Allowed by special permit from Board of Appeals with option for height increase equal to setback increase	NO	No allowance for private power generation as primary use
Note: MGL Ch 40A, Sec 3 prohibits local zoning codes from prohibiting or unreasonably regulating solar power generation facilities				

5.5 Dennis -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Use table permits "public/private facility/utilities" in all zoning districts with a special permit from ZBA, provided outside bulk storage is screened. This term is not defined and may not apply to private development of DG.
- No specific mention of windmills or height limit exemptions for towers.
- Use variances allowed.

5.6 Eastham -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Power generation not specifically mentioned as an allowed use but "light or heavy industry uses not mentioned in use table" may be permitted through special permit from ZBA.
- No specific mention of windmills or height limit exemptions for towers.
- Use variances allowed.

5.7 Falmouth -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Windmills specifically allowed as an accessory use only by special permit and only in 7 districts and not including marine districts.
- Height limits plus fall zone for windmills requires variance and large lot.
- Use variances not allowed.
- Power generation as primary use not allowed in any zone.

5.8 Harwich -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations. Selling back power to grid would likely trigger scrutiny as a commercial use.
- Power generation not mentioned in use table. "Essential services" allows distribution facilities of electric companies in all zones via special permit.
- Windmills not specifically mentioned.
- Use variances are allowed.
- No height limit exemption for windmills but community facilities and essential service structures are exempt, leaving room for interpretation favorable to wind towers.

5.9 Mashpee -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Use variances not allowed.
- "Public utilities" permitted with special permit in all zones but this term is subject to interpretation. Such uses already entitled to zoning exemption.
- No specific mention of windmills.
- No height limit exemption for windmills.

5.10 Orleans -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Use variances are allowed.
- Windmills specifically allowed in all zoning districts with special permit from ZBA.
- No height limit exemption for windmills.

5.11 Provincetown -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- Use variances allowed
- "Public utility" allowed with special permit from ZBA in 4 zoning districts.
- No mention of wind powered generation facilities nor height exemption for same.

5.12 Sandwich -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Power generation" allowed as a primary use with a special permit only in Industrial and Marina zoning districts. However, "power generation" not defined in by-law. DG as primary use likely to face ZBA review via interpretation of power generation term.
- No use variances allowed.
- Wind turbines or generators are allowed by special permit as an accessory use only.
- ZBA may allow greater height for wind power generators if proponent can demonstrate that greater height is needed for efficient power output.

5.13 Truro -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other

structure that would exceed the Town's height, setback or lot coverage limitations.

- Public utilities allowed by right only in Seashore District and not mentioned in other districts. Public utilities not defined. Lack of definition means probable review of DG power generation by Board of Appeals.
- No use variances allowed.
- Windmills allowed by special permit from ZBA in any zone. Maximum height limit of 60'. Minimum property line setback = height of windmill plus 20 feet. Maximum rotor diameter = 35'. Minimum rotor clearance from ground = 15'.

5.14 Wellfleet -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Utilities without open storage" allowed in all zones by special permit from ZBA and by-right in Commercial Zone. No definition of "utilities without open storage". Lack of definition means probable review of DG power generation by Board of Appeals.
- No use variances allowed.
- Windmills allowed by special permit from ZBA in any zone. Maximum height limit of 65'. Minimum property line setback = height of windmill plus 20 feet. Maximum rotor diameter = 35'. Minimum rotor clearance from ground = 15'.

5.15 Yarmouth -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Public utility" allowed by special permit in six of eight zoning districts. Term not defined. Lack of definition means probable review of DG power generation by Board of Appeals.
- Windmills not specifically mentioned. If large windmill were proposed in flight path for Barnstable Municipal Airport, FAA would need to review as well as ZBA.
- Use variances are allowed.

5.16 Aquinnah -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- No mention of allowing utilities, power generation or windmills, meaning any of these would have to be considered by the ZBA.
- Use variances are allowed.
- The entire town of Aquinnah is a DCPC for development guidelines.

5.17 Chilmark -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other

structure that would exceed the Town's height, setback or lot coverage limitations.

- Windmills allowed as an accessory use only by special permit from the ZBA.
- Windmills are exempt from building height limitations.
- No mention of utilities or power generation as primary or accessory uses (other than windmills). Their absence means DG proposals as primary uses would likely face ZBA review.
- Use variances are allowed.

5.18 Edgartown -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Wind energy conversion systems" allowed on special permit from ZBA as conditionally permitted use (i.e. permit granted when conditions specified in by-law are met). Allowed only in 4 residential zones and one business zone. Not allowed in R-120 Zone, which is one of two large lot (3 acre minimum) districts. Height exemption allowed but setbacks must be at least the maximum height of the windmill plus 20 feet.
- "Wind energy conversion systems" allowed by right in B-III District at Martha's Vineyard Airport.
- "Public utilities" and "underwater electric cables" allowed specifically by special permit from Planning Board. No definition for public utilities.
- Other forms of private power generation not mentioned and thus not allowed.
- Zoning by-law contains section on public utilities, including details of a review process, which could be a working model. Modifications would be needed to specifically address DG facilities and any relevant rules for them.
- Use variances are allowed.

5.19 Oak Bluffs -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Public utility building" allowed by special permit from ZBA. No other mention of power generation, meaning any such use would require ZBA approval as well.
- "Windmills" permitted by special permit. Maximum height = 87.5 feet to tip of rotor. Minimum property line setback = height of wind machine, including rotor, plus 20 feet. Maximum rotor diameter = 35 feet. Maximum height and rotor size may be increased by special permit with evidence of need for greater efficiency and proof of no negative impacts, such as excessive noise or otherwise substantially derogate from the public good.
- Use variances are allowed.

5.20 Tisbury -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other

structure that would exceed the Town's height, setback or lot coverage limitations.

- "Public utility structure" allowed by special permit from ZBA but term not defined.
- Windmills not mentioned as accessory use.
- No other mention of power generation or windmills as primary uses, meaning they are prohibited.
- No use variances allowed.

5.21 West Tisbury -

- DG as accessory use, intended and designed for single premises, permissible without separate permitting process, except if DG unit is a wind tower or other structure that would exceed the Town's height, setback or lot coverage limitations.
- "Public utility facility" allowed in all districts pursuant to "Plan Review" process when no greater than 1500 square feet in floor area. Special permit if greater floor area. Up to 3000 square feet subject only to Plan Review if in LI or MB Zoning Districts.
- No allowance for private power generation as primary use.
- No use variances allowed.
- Wind energy conversion systems allowed by special permit from ZBA.
- Maximum building height exemptions apply to wind energy conversion systems, provided that for each foot above the height limit, the property line setback is increased by one foot.

6.0 Summary of Local/Regional Barriers

6.1 Local Municipal Zoning

- Lack of clarity about threshold for transition from accessory use to primary use for DG facilities
- Lack of consistent definitions and interpretation of DG as a primary use
- Inconsistent attention to permitting power generation in local by-laws
- Absence of appropriate use terms to cover DG provides for uncertain permitting pathway
- Inconsistent treatment of wind machines
- Lack of height exemptions for wind machine towers
- Extensive review process and potential for excessive time delays due to need for special permits, variances, or zoning amendments to accommodate DG facilities

6.2 Regional Commissions

- Threat of referral to regional commissions for DRI review
- Potential time and expense cost of DRI review
- Lack of clarity in application of standards to DG facilities
- Absence of direct attention to DG in energy sections of Regional Policy Plans of Cape Cod and Martha's Vineyard Commissions

6.3 Historic Commissions

- Absence of consideration for wind power generating facilities
- Incompatibility of modern wind towers in historic areas
- Absence of exemption from historic district regulation for public utilities

6.4 Other Local Regulatory Barriers

- General lack of understanding about DG technologies in the regulatory and policy-making communities
- Potential for Conservation Commission review and possible appeals/time delays
- Costs of flood-proofing structures pursuant to local flood regulations may make DG projects in flood zones economically infeasible

7.0 Policy Options at the Local Level

7.1 Municipal Zoning Strategy Options

7.1.1 Identify Energy Demand Load Centers

Since local zoning issues are unique to each town, understanding where the first few DG facilities would be most effective at reducing peak demand on the power grid would be of great benefit to the overall process of overcoming zoning barriers. This could be a combination of DG development at distribution substations or feeders, or at the customer's site. Then the Compact could initially focus its zoning remedies on just those communities that contain the load centers while a more comprehensive solution is crafted. Knowledge of load centers and their respective current and projected peak demands would be valuable to the design of any DG facilities. Such information would also inform the process with critical intelligence so that appropriate generating capacity can be planned and the proposed zoning amendments can be specific to the needed design capacity. Local planning boards and town meetings/town council would be more receptive to a proposed zoning amendment that specifies both the look and limits of a new land use than one that is open-ended and speculative in its form and operation.

7.1.2 Model Regulations

The Compact could work to develop model zoning regulations that would eliminate the current barriers and uncertainty for DG facilities. These regulations need to address the following concerns:

- Interpretation issues for thresholds for when DG should be treated as an accessory use and when it would become a primary use.
- Amendments to the sections of local zoning by-laws dealing with allowed uses so as to provide a defined use term specific to DG facilities and authorizing such use in all zoning districts.
- Uniform and streamlined processes for permitting wind machines, including appropriate height limits for efficient power production by wind facilities.
- Treatment of DG uses under site plan review needs to be clarified as to applicability thresholds with a goal of exempting DG from site plan review entirely.
- Inclusion of the protections for solar power generation and passive solar access as noted in Section 4.6.4.
- Inclusion of additional incentives for open space development to enable flexibility for subdivision layouts to facilitate optimal solar access.

These model regulations would be most effectively developed in cooperation with the professional planners from Cape and Vineyard towns and regional planning commissions. Efforts should be focused on those planners with a greater interest and where energy demand centers are located. On Cape Cod, local planners routinely join together to focus on issues of common concern. These collaborations are usually sponsored by the Cape Cod Commission and the DG zoning issues would be a timely and

appropriate topic for this group to explore. A similar design could be explored for Martha's Vineyard, if not already underway.

7.1.3 Propose Legislation

While specific zoning amendments are pursued with individual towns as described above, the Compact could work through the Cape's legislative delegation to develop a proposal to amend MGL, Chapter 40A to include provisions that authorize zoning exemptions for the cleaner combustion (i.e. not diesel or gasoline-fueled) and renewable DG facilities and/or set limits for the regulation of such facilities. This approach has significant merit considering the fact that Chapter 40A already contains amendments that address energy issues, as discussed above. In addition, as noted in Section 2.3 the federal government in interested in a transition toward more decentralized power supply infrastructure, in the interest of national security. This, in turn, has supported the U.S. Department of Energy efforts to promote appropriate state code modifications to facilitate deployment of distributed generation.

New legislation could be very effective at eliminating the zoning barriers identified above. A similar situation existed for the telecommunications industry. When wireless communications were emerging as an essential component in the nation's communication infrastructure in the late 1980's, the Federal Telecommunications Act cleared the way for the deployment of the towers needed to build a still-evolving network of facilities to carry out this national initiative. The end result was development of local permitting processes to accommodate wireless facilities rather than prohibit them. State level legislation can be just as effective as Federal legislation in bringing about a more direct and permissive approach to DG facilities.

Regardless of which strategies are pursued, developing an outreach and education campaign should be initiated immediately. As with most things new and technical, there will be a learning curve for the people and organizations that need to embrace the value of promoting DG deployment. The uptake may be slow at first but through the deliberate and continuous exposition of the need for DG implementation in various venues, the appropriate level of understanding and acceptance can be achieved.

7.2 Regional Commissions Strategy Options

7.2.1 Education

The Compact could plan and carry out one or more educational forums specifically for staff and commissioners of the Cape Cod and Martha's Vineyard Commissions. The primary objectives of these meetings should be to educate the participants on all the relevant aspects of DG facilities and to obtain a commitment and date to commence the development of revisions to the respective Regional Policy Plans (RPPs)

7.2.2 Collaborate on Revisions to RPPs

The Compact could complement the educational forums proposed above by taking a pro-active role in organizing and conducting one or more joint workshops with regional commission representatives for the express purpose of drafting revised energy sections in the respective RPPs. These revisions should:

- Address the absence of DG facilities as a viable and necessary component in the region's energy infrastructure and the reasons therefore, including express policy statements regarding encouragement of these technologies.
- Suggest appropriate town actions to carry out the regional energy section policies on DG facilities. They should also provide for reasonable standards for such facilities at the local level, consistent with what is developed under the zoning recommendations discussed above.
- Finally, there should be express language in the regional development regulations that sets a threshold for when a DG facility should be referred for review as a DRI (if at all) and what types of DG are categorically exempt from DRI review.

7.3 Historic Districts/Other Entity Strategy Options

7.3.1 Historic Districts

The Compact could pursue the following actions to minimize the identified barriers to DG in Cape and Vineyard historic districts:

- Focus on promoting compatible types of DG facilities in historic districts
- Develop model guidelines for local historic commissions to adopt on how to regulate DG "boxes" or photovoltaic panels, such as ways to screen or camouflage these facilities. This should be done with the participation of representatives from area historic district commissions.
- Explore with Cape and Vineyard legislators and representatives of local historic districts the possibility of proposing amendments to MGL Chapter 40C concerning possible categorical exemptions of certain DG facilities from historic district commission regulation.

7.3.2 Other Initiatives

Education - As discussed under zoning options above, education of the area's regulators, policy makers, and electricity consumers will be key to making needed corrections to the current barriers to DG deployment.

Appropriate Siting - Conservation commissions are obligated to protect local natural resources and their regulations are aimed at that primary purpose. It would be inappropriate for DG structures to have an exemption from these regulations. Therefore, the Compact could emphasize planning DG facilities for areas that would be outside the jurisdiction of local conservation commissions, in order to avoid potential delays and project cost increases for mitigation.

Best Development Practices - The Compact could consider developing with area conservation professionals a set of best development practices for local conservation commissions to adopt and follow when DG facilities are before them. These would also serve to guide the designers of DG facilities in sensitive areas. It may also streamline the review process and help avoid currently unpredictable reactions to DG proposals. Martha's Vineyard Commission has started hosting quarterly meetings of the island's Conservation Commissions to share information and as an educational (and possibly training) forum.

Flood Zone Issues - Since flood-proofing is a standard requirement for electric power appurtenances in flood prone areas, the Compact could explore with a qualified engineer how flood-proofing measures would impact the economic viability of DG facilities. The results of this investigation should then guide the formation of a Compact policy regarding promoting or discouraging locating DG facilities within designated flood zones.

Local Tax Incentives – Tax incentives can offer a very useful tool for helping to overcome cost barriers for emerging technologies such as photovoltaic systems and fuel cells. Local governments could consider offering property tax credits to help offset the costs of these systems. Pilot efforts could be undertaken with capped amounts and limited terms in a manner that could pose little impact on overall tax revenues, but result in significant gains for installing technologies that provide models and valuable experience for the community.

8.0 Glossary of Terms

Accessory Use
A zoning term meaning a use of land that is not the primary or principal use but is ancillary and secondary to a principal permitted use.

Architectural Review
Advisory review process for development proposals in which scrutiny is applied to architectural features of a proposed structure or structures.

Building Inspector
Local official charged with interpreting and enforcing the State Building Code. May also be responsible for interpretations and enforcement of local zoning by-law. Building Inspector may delegate zoning interpretation and enforcement duties. Issues building permits and inspects permitted work. Determines permitting path of a development proposal.

Building Permit
The final approval before new construction may begin in a municipality, issued by the Building Inspector. Prior to issuance of a building permit, all other required local and regional approvals must be issued and valid.

By-Right
A phrase used to describe land uses that are allowed by zoning regulations without a special permit, variance, or other type of land use permit.

Chapter 30B
The Massachusetts law governing how public entities spend public dollars to purchase goods and services.

Chapter 40A
The Massachusetts law governing how communities may regulate the use of land (zoning).

Chapter 164
The Massachusetts law governing Public Service Corporations that are formed for the purpose of providing electric or gas utilities.

Code
Any set of laws or regulations. Used herein to refer to building, electric, fire, plumbing, health, zoning, conservation requirements.

Conservation Commission
The official group in a municipality charged with enforcing any local wetland protection regulations and the Massachusetts Wetlands Act.

Development of Regional Impact (DRI)
Used herein as any development that is accepted for regional regulatory review by the Cape Cod Commission or Martha's Vineyard Commission. A DRI is presumed to be of such scale or impact that it would affect an entire region of one or more communities. DRI review is conducted against a series of development policies and may include conditions of approval to mitigate the expected impacts.

District of Critical Planning Concern (DCPC)
A unit of geography within one or more communities that has been designated by a regional commission for the purpose of promulgating local regulations aimed at protecting and/or supporting special resources within the designated area. DCPC regulations are adopted as local zoning amendments to implement the purposes of the specific DCPC.

Historic District Commission
The local regulatory agency charged with reviewing proposed development or structural and appearance modifications within an historic district designated pursuant to MGL, Chapter 40C. There may be multiple historic districts and an equal number of historic district commissions in any one municipality.

Land Use
The primary or accessory activity on a parcel of land. Typical land use categories include residential, accessory, recreational, agricultural commercial, industrial, institutional. There may be many specific activities under each of these categories in a local zoning by-law, which is the principal local instrument for regulating what may take place on every parcel in a community.

MGL (Mass. General Laws)
The collection of State statutes governing all aspects of regulation in the Commonwealth of Massachusetts.

Permit
A document that certifies that a development project meets the requirements of the law governing such project. A project usually requires multiple permits with each one addressing a set of regulations concerning a particular topic, such as zoning, wetlands protection, health, etc.

Primary Use
The principal or main use of a parcel of land, as determined by the local building inspector. Examples of primary uses may include: dwellings, stores, warehouses, power plants.

Procurement
The process of purchasing goods or services. In the public sector, procurement is governed by MGL, Chapter 30B, which sets forth requirements on how public agencies shall purchase goods and services. This includes requirements regarding when the lowest bid must be accepted and what types of purchases are exempt from certain purchasing procedures.

Prohibited Uses
Uses of land that are not allowed in one or more zoning districts in a municipality.

Regional Commission
In this report, regional commission means either the Cape Cod Commission or the Martha's Vineyard Commission.

Regional Policy Plan (RPP)
The primary guidance and regulatory document of a regional commission. An RPP sets forth recommendations on how growth and related land and service management should be handled county-wide. It also contains minimum performance standards that must be met by all Developments of Regional Impact.

Site Plan Review
A development review process that is usually administrative, rather than a permit procedure, that is usually required for larger, intensive uses of land. Site plan review may be conducted by different groups from town-to-town and specific requirements and procedures may vary greatly.

Special Permit
A specific type of land use permit contained in a local zoning by-law or ordinance, consistent with the provisions of MGL, Chapter 40A, Sec 9, that authorizes the use of land for a specified purpose, following a prescribed review process. Most special permits are issued by the local Board of Appeals but certain ones be issued by the Planning Board in a community. Special permits require a public hearing with notice to abutters who have legal standing to challenge a vote to grant a special permit. Reasonable conditions may be imposed with the granting of a special permit. Special permit proponents must demonstrate compliance with the special permit requirements contained in the local zoning code but do not have to demonstrate hardship.

Variance
A specific type of permit contained in a local zoning by-law or ordinance that may authorize a use of land that is not permitted in one or more zoning districts in a town or to vary the specific physical limits contained in such by-law or ordinance. Variances in Massachusetts communities may only be issued by the Board of Appeals. Use variances must be expressly authorized by the local zoning code. All variance processes require a public hearing and notices to abutters who have legal standing to challenge a vote to grant a variance. Variance proponents must demonstrate some form of hardship that would occur if the zoning relief is not granted

Zoning Bylaw
A law approved to regulate land use or structures within a municipality under MGL Chapter 40A.

CAPE LIGHT COMPACT
REGULATORY ASSESSMENT

APPENDIX SECTION

Appendix A

DESCRIPTION OF TECHNOLOGIES

Excerpt from*: Local Government and Distributed Generation;*

Prepared by Ridley & Associates for the Cape Light Compact; September 2000

THE TECHNOLOGIES

There is a range of distributed generation technologies that use fossil fuels or renewable resources. Some, such as reciprocating engines, are already in widespread use as back-up units. Other new technologies are entering the electric industry from a variety of sources. Fuel cells are being developed in part by automakers. The military developed microturbines as a power source for M-1 tanks and missile launchers. High-efficiency jet turbines developed by the aero-space industry have contributed to improvements in the combined cycle plant, and in options for mobile and quickly-installed small gas turbine peaking capacity. New data and control technologies from the computer industry are making use of smaller distributed power units and efficiency of appliances and industrial electric motors more versatile.

The generally accepted approach is that no single technology, but a variety of technologies based on best-application-for-use, will be employed to provide beneficial distributed generation. While many of these technologies are available and in growing use today, most are still in continuing stages of development. Those described below are the most common commercial technologies currently considered for use in distributed generation.

Reciprocating Engine

Reciprocating engines are internal combustion engines that are piston-driven, and are widely familiar from their use in the automotive industry. In the utility industry they are well known for their use as back-up generators, and in applications of combined heat-and-power (cogeneration). They are typically less than 20 kilowatts in size, and offer low cost ($400-600 per kilowatt), flexibility in fuels (diesel, natural gas, waste fuels), and are easily maintained and operated. They are the most common form of distributed generation and may be either consumer-owned, or owned by a utility or independent power supplier. Their low capital cost and easy operation advantages are expected to make reciprocating engines as an attractive option for onsite power production while more advanced technologies such as small gas turbines, microturbines, fuel cells, and photovoltaics are attain mass production and resulting cost reductions. Disadvantages are low efficiencies (less than 40 percent), regular maintenance requirements, fuel costs, and emissions at rates higher than other distributed energy sources. [i]

Applications: Reciprocating engines are considered primarily for peaking-shaving or short-term emergency or back-up applications.

Small Gas Turbines

Small gas turbines incorporate advances in combustion technology and high-efficiency turbines resulting from advances in aero-space technology. They are greater than one megawatt in size (as differentiated from microturbines described below) and consist of three primary components: 1) a compressor pressurizes air and transmits it to the combustion chamber; 2) the combustion chamber in which air and gas fuel are mixed and burned at a very high temperature (3,500 degrees Fahrenheit); 3) a power turbine consisting of a series of fixed and rotating blades that are turned by hot, expanding gases released from the combustion chamber. Basic costs start at $400-900 per kilowatt and siting and other project development requirements which can add 150-300 percent to the total cost. Although they produce much lower levels of NOx and CO than reciprocating engines, environmental control systems and noise abatement measures may be needed. Development is on-going and the U.S. Department of Energy has announced creation of a 4.3 megawatt natural gas fired system with a 40 percent thermal efficiency and extremely low nitrogen oxide and carbon monoxide emissions. Among the challenges for utilization of this technology is that the typical range of gas pressures in local distribution systems is substantially below the range needed for gas turbine generation. [ii]

Applications: Small gas turbines are considered a superior technology for combined heat-and-power applications. They provide the opportunity for more constant usage than reciprocating engines and can also be utilized by utilities in black-start conditions. It is expected that they will provide an attractive option for custom-tailored needs for large commercial and industrial consumers.

Microturbines

High speed gas turbines in the range of 15 kilowatts to 500 kilowatts are generally considered microturbines. This technology has emerged from advances in four different areas: small gas turbines, auxiliary power units for aircraft, automotive gas turbines and automotive turbochargers. They are considered cleaner, quieter, and simpler mechanically than reciprocating engines. The key components are a high-speed compressor-turbine connected to a high-speed generator. They are sized to fit a specific facility or use and can maintain continuous operation. A 30 kilowatt system is the size of a refrigerator and generates enough power for a small business. The units can run on a variety of gaseous and liquid fuels and their advantage as fossil fuel burners are low emissions and low maintenance (once annually). More than 100 units are now in operation and field tests have been planned by a joint program of the National Rural Electric Cooperative Association and the Electric Power Research Institute. The largest challenge for microturbines is cost. Single units currently cost about $1,100 per kilowatt. Increased production at an annual volume of 100,00 units is anticipated to reduce costs by about half to the range of reciprocating engines. Microturbines also face engineering challenges with efforts now on-going to create units in the 25 to 500 kilowatt range with 40 percent efficiency and with nitrogen oxide and carbon monoxide emissions of less than 10 parts per million and low levels of unburned hydrocarbons.[iii]

Applications: Microturbines offer the advantage of continuous small scale power generation in situations for peak-saving, prime power, and off-grid applications.

Fuel Cells

Fuel cells have received growing attention for their versatility in application, low level emissions, and the potential they hold for power production. While advanced development and pilot projects are on-going, utilities and electric equipment manufacturers have begun marketing various models for homes and businesses. Sizes range from 2 kilowatt up to 250 kilowatts for low temperature fuel cells and 100 kilowatts to 1 megawatt for high temperature fuel cells. There is also the capability for fuel cells to be "stacked" to create 100 megawatt plants to add to utility baseload capacity and supply districts or small towns.

Fuel cells operate on an electrochemical process to convert a fuel directly into electrical energy. A fuel cell has no internal moving parts and operate similar to dry cell batteries, except that they produce a continuous production of electricity as long as fuel, normally hydrogen, is supplied. In a fuel cell power plant, natural gas or coal gas or similar fuels containing hydrogen is first cleaned, then converted to hydrogen-rich gas by a fuel processor or internal catalyst. The fuel is combined with an oxidant within the cell without burning, and transfers an electric charge between a positively charged anode and a negatively charged cathode plate. With hydrogen fuel, the byproducts are heat and water, with virtually zero pollutant emissions, natural gas fuel produces very low levels of NOx, CO, and SOx, with CO2 emissions similar to those of a microturbine.

Fuel cells can operate as stand alone units, or connected to the grid. In residential or other individual facility applications they can produce both electricity and heat. They can also be operated as part of "hybrid" systems in conjunction with photovolatics, wind turbines, or other systems.

Types of fuel cells commonly discussed are:

Molten Carbonate Fuel Cell (MCFC): a type of fuel cell that utilizes molten carbonate electrolytes. This system has the advantage of utilizing carbon monoxide as a fuel, allowing mixtures of carbon monoxide and hydrogen, such as those produced in a coal gasifier, to be used as fuel. With its higher operation temperature and higher efficiency it is viewed, along with SOFC's described below as suitable for power production, either as a stand-alone unit, or as part of a hybrid or grid-connected system.

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.

Phosphoric Acid Fuel Cell (PAFC): 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. This is viewed as the first generation of fuel cell products to enter the commercial market

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 lighting, communications, and in automobiles.

The key challenges for fuel cells are engineering advances and reduction in cost. Costs are currently estimated at $3,750 per kilowatt and operation and maintenance costs at a low level of .0017 cents per kilowatt hour. More than 150 PAFC power plants are currently in use and Bonneville Power Administration is developing a program to commercialize fuel cells for residential and commercial use by 2003. The program will involve cost sharing by customer to install and test efficiency for 110 systems. Efficiencies for fuel cells are currently in the 40 to 57 percent range. Work is underway to develop large fuel cells with 60 percent efficiency and to reduce costs to $1,000 or less per kilowatt. [iv]

Applications: Because of their relatively high capital cost, fuel cells offer their best economy in situations for continuous, high quality power with low emissions and no noise. They may be utilized on or off-grid, and may be combined with solar or other technologies in hybrid systems. High-temperature fuel cells are also useful for combined heat-and-power applications.

Hydro

Hydro power currently contributes 10 percent of the nation's total electric energy. There are three types of hydropower facilities. Impoundment Hydropower Plants use a dam to store water and direct it through a turbine. Diversion Hydropower Plants channel a portion of a running river through a canal or penstock where a turbine is placed. Pumped Storage Hydropower Plants utilize water pumped from a lower reservoir or water source at a time when electricity prices are low (at night). The water is released back to the lower reservoir when the cost to generate electricity is high (during the day, or peak periods).

Large hydro plants, greater than 30 megwatts in size are severely limited both by siting availability and restrictions and are not considered "distributed generation." Hydro plants less than 30 megawatts fall into three categories: 1) small hydro of 1-30 megawatts; mini-hydro of 100-1000 kilowatts, and micro-hydro of less than 100 kilowatts. Advances in generator and turbine technology have brought sites formerly considered marginal to consideration for development. The U.S. Department of Energy has estimated on a state-by-state basis that undeveloped capacity for hydropower totals approximately 30,000 megawatts. Hydro costs per kilowatt vary widely depending on the requirements for site development. Generation cost depends on the flow capacity of the water body—the levels water supply available on a year-round, or seasonal basis. Development is also restricted by environmental concerns for impacts on water quality and fish habitat. [v]

Applications: Hydro power of less than 30 megawatts is most economical as baseload power, however, it is commonly seasonal in nature. These facilities may be grid-connected or off-grid in isolated areas. On a seasonal basis, depending on the size of the hydro facility, it may be utilized for central system dispatch to feed power into the grid.

Wind

Wind turbines are noted to be the fastest growing energy source in the world, with power production costs currently competitive with traditional power plants. Modern wind turbines, which have undergone significant advances in the last two decades, fall into two basic groups: the traditional propellers (rotors) on a tower, and the egg-beater style Darrieus model. Most common is the tower-and-rotor design that ranges in size from individual home-sized wind machines with rotors of 8 to 25 feet, to the large grid-connected models, the largest of which is in Hawaii that has rotors more than 300 feet long on a 20 story tower. Generally, grid connect machines have towers up to 200 feet high and have a capacity of 750 kilowatts to one megawatt. These may be grouped together into what is known as a "wind farm."

As wind technology has advanced, cost has dropped dramatically. Installation costs are currently about $1,000 per kilowatt, with 80 percent of the cost related to the machinery. Advantages include the fact that wind power produces no pollutants and provides more jobs per dollar invested than any other energy technology. Prices per kilowatt hour range from 3.2 to 7 cents, with the variance dependent upon wind availability. Wind resources are characterized by wind-power density classes. Good wind resources (class 3 and above) have an average annual wind speed of at least 13 miles per hour. These good wind density areas are common along the east coast, the Appalachian Mountain chain, the Great Lakes, the Pacific Northwest, the Midwest, and the Southwest.

There are numerous wind farm and pilot projects sponsored by utility systems and independent power producers. An Iowa wind farm sponsored by municipal utilities is targeting the "green" power market. Other systems are adding to the "green" mix in retail power sold to consumers—in some programs, with funds paid voluntarily as customer premiums.

Wind power development faces a number of challenges. The primary disadvantage of this technology is that it only produces power when the wind is blowing, and unless expensive battery systems are installed, it requires back-up power, or needs to be used in combination with another technology, such as fuel cells. Connection to the grid eliminates the problem of intermittent wind flow and power production, but can restrict siting. Good wind sites can be in remote locations, and sites close to the grid can draw public opposition due to aesthetic or noise concerns.

Costs of power production from wind technology are expected to continue to drop as this technology advances further. A federal target of 2.5 cents per kilowatt hour makes wind a highly attractive option for the power mix. The U.S. Department of Energy has announced goals to power at least 5 percent of the nation's electricity with wind by 2020. [vi]

Applications: Wind generators provide intermittent power flow at economical rates and may be combined with other technologies in hybrid projects, or connected to the grid. While wind turbines may feed power into the grid they cannot be scheduled for central system dispatch because of the intermittent production.

Photovoltaic

Photovoltaic (PV) solar technology uses semiconductor-based cells to directly convert sunlight into electricity. In the past two decades small calculators and watches have become common applications for PV, but the worldwide market to utilize PV cells for distributed generation is growing rapidly. There are many programs now promoting solar power systems such as the federal government's Million Solar Roofs program which targets placing one million solar power systems on rooftops by 2010. Parallel to this program the Long Island Power Authority has allocated $160 million to install 10,000 solar panels on Long Island by 2010.

A typical photovolatic cell consists of a glass cover other type of transparent encapsulant weathersealed to a box containing the collection technology. The technology is constructed in layers: an anti-reflective layer to keep the cell from reflecting light away from the contact points; a top metallic grid or other electrical contact to collect electrons from the semiconductor and transfer them to the external load; and a back contact to complete the circuit.

Sizes of PV systems may range as low as one kilowatt—to one megawatt or more in large systems where cells are combined in a field. Applications for PV technology is usually grouped into six types: 1) simple, "stand alone" PV systems; 2) PV with battery storage; 3) PV with backup generator power; 4) PV connected to the local utility; 5) utility-scale PV power production; 6) hybrid power systems.

Simple Stand Alone PV Systems: These off-grid systems are considered for remote areas in applications for a specific job that does not require a constant flow of power, such as water pumps for irrigation or ventilation fans for air cooling. Complex wiring, storage, and control systems are not utilized. The system provides power only when there is adequate sunlight.

PV With Battery Storage: For situations in which a constant flow of electricity is needed, battery systems are incorporated. Battery storage is usually expensive, however, and does not guarantee reliability if there are extended periods of low intensity sunlight. This is also an off-grid application.

PV With Backup Generator Power: When a steady, reliable flow of power is needed in an off-grid application, an electric generator can be linked to the PV and battery storage system to assure that the batteries remain charged. In some systems, the generator can run simultaneous with PV production when demand is exceeding output of the PV modules and batteries. (See Hybrid System below.)

PV Connected to the Local Utility: Grid-connected PV systems can avoid the need for batteries or a generator by drawing power from the utility distribution system when it is needed. However, interconnection with the utility grid requires installation of protection equipment to separate the PV system from the grid when necessary. It also requires agreement with the utility on access to the shutoff to assure worker safety. Fees depend upon utility policies. Where net-metering is

allowed, the grid-connected PV systems can transfer power back into the grid, allowing the customer meter to run backward, resulting in a customer credit on monthly utility bills.

Utility Scale PV Power Production: Utilities can combine may PVs in a field to produce a photovoltaic power plant. Such a plant can be constructed more quickly than a conventional power plan and can be located in the grid where they are most needed. They can also be expanded incrementally as power demand increases.

Hybrid Power Systems: These systems combine another technology with PV power production usually in an off-grid situation to meet the energy demand of a facility or community. PV can contribute to off-setting peak demand during the day for a system that also utilizes fuel cells, hydro power, gas turbines, or reciprocating engines. Essential to the hybrid system is knowledge of the demand of the facility or community.

The primary disadvantages of photovoltaic systems are cost and production capability that varies with sunlight. Current capital cost is estimated at $6,600 per kilowatt with total production prices ranging from 37 to 81 cents per kilowatt hour due to variations in geography, installation, incentives and financing terms. Off-grid systems provide benefits in situations where the location is remote and extension of distribution lines is too costly or infeasible. For grid-connected systems, net-metering may help to offset costs, however the cost of PV remains too high for it to be considered for the bulk power market.

PV costs are anticipated to continue to decline as the working life of PV cells is extended and as conversion efficiency (the proportion of sunlight energy converted to electrical energy) increases. Conversion efficiency is currently in the 6 to 19 percent range. The U.S. DOE projects costs will drop to 10 cents per kilowatt hour by 2010. At this price, PV may become a cost competitive power option in urban areas where transmission and distribution systems are constrained and in rural areas where distribution costs are high. [vii]

Applications: Photovoltaic systems are highly versatile and may be utilized in grid-connected or off-grid applications. These applications range from: electronic road signs in temporary or remote locations to water pumping stations and central plant production, to hybrid use with fuel cells or wind turbines for powering specific facilities. Because of their daytime production, PV technologies can provide peak-shaving benefits, but in most applications, like wind technology PV cannot be scheduled for centralized dispatch to provide system power to the grid.

Summary

Comparisons between technologies are not simple, and for some elements such as heat efficiencies, comparisons may be apples-to-oranges. However, each technology has advantages and disadvantages to be weighed in terms of the type of use or application, and the relative types of benefits desired. Final cost will vary depending upon site and fuel

specific conditions. The summary chart below outlines some of the general characteristics of each technology.

Table 1
COMMON DISTRIBUTED GENERATION TECHNOLOGIES

Technology	Power Cost cents/kW	Capital Cost $/kW	O&M Cost $/kWh	Capacity Range	Emissions NOx/CO/THC*	Dispatch
Reciprocating Engine	**	400-600	0.01	<100 kW >1 MW	2,100/340/150	Yes
Small Gas Turbine	**	400-900	.005-.0065	> 1 MW < 5 MW	25/ 50 /10	Yes
Microturbine	**	1,100	0.005-.01	15 kW 500 kW	9 / 25 / 9	Yes
Fuel Cell	10-12.5	3,750	0.0017	50 kW >1 MW	0/0/0****	Yes
Hydro	2.6-16.1	***	***	<30 MW	0/0/0	Yes
Wind	3.2-7.4	1,000	0.01	15 kW >1 MW	0/0/0	No
Photovoltaic	37-81	6,600	0.001-.004	1 kW >1 MW	0/0/0	No

Sources: Distributed Power Coalition of America; (www.dcp.org), Gas Research Institute, U.S. DOE
Notes: * measured in parts per million
** depends significantly on fuel costs/and in-service time
*** wide variance depending upon fuel and size
**** near zero emissions based on hydrogen fuel; natural gas fuel will produce very low levels of NOx, CO, and SOx, with levels of CO2 similar to microturbines

Endnotes:

[1] U.S. DOE Advanced Power Systems, "DOE Energy Resources R&D Portfolio FY 1999-2001," (February 2000) and also U.S. DOE EREN website for background on distributed generation technologies generally.
[2] ibid.
[3] ibid.
[4] ibid.
[5] ibid.
[6] ibid.
[7] ibid.
[8] ibid.
[9] ibid.
[10] ibid.
[11] ibid.

Appendix B

KEY STATE AND FEDERAL PERMIT THRESHOLDS

Key State Thresholds for Electric Facility Permitting

Massachusetts Environmental Policy Act (MEPA)
(Under Executive Office of Environmental Affairs)
Environmental Impact Assessment needed if:
*unit greater than 25 MW
*includes a new fuel pipeline greater than 5 miles
*includes new transmission line greater than 69 kV
*includes new transmission line longer than 1 mile
*poses significant land/species habitat alteration, water withdrawal, sewer construction, waste disposal, air emissions, or impacts on areas of historical/critical concern
(This can trigger examination by other state environmental agencies.)

Energy Facilities Siting Board
(Within Department of Telecommunications and Energy, and includes board members from other agencies)
Provides approval to construct:
*units with size greater than 100 MW
*transmission line in a right of way 69 kV or greater and 1 mile or greater, or 115 kV and more than 10 miles

Department of Environmental Protection Air Program Planning Unit
Approves emissions plans:
*for units with heat rating input of more than 3 million Btu/hour
Examines noise impacts:
*for facilities that operate on a 4-hour per day minimum basis

DEP Water Pollution Program
Provides water quality certification concerning wastewater discharge
*units that require dredging, filling, or construction of intake or discharge structure in surface or groundwater

DEP Drinking Water Program
Examines present and future water use for units that extract water for heating/cooling purposes
*withdrawals of more than 100,000 gallons per day

Department of Public Safety
Requires permits for storage tanks for oil and other flammable fluids with capacity greater than 10,000 gallons.

Key Federal Thresholds for Electric Facility Permitting

Federal Energy Regulatory Commission
Approval of membership in ISO to sell on wholesale market
Certification required for determination as a "Qualifying Facility"
*for facilities of 80 megawatts or less that utilize biomass, waste, renewable resources, or geothermal
* "Qualifying Facility" must also be less than 50 percent utility-owned

U.S. Environmental Protection Agency
Requires an NPDES Permit for facilities that plan point source discharge of sanitary waste or gray water, or toxic pollutants including metals and non-conventional pollutants

Federal Aviation Administration
Agency approval required if facility is located within 20,000 feet of an airport runway and height exceeds 200 feet

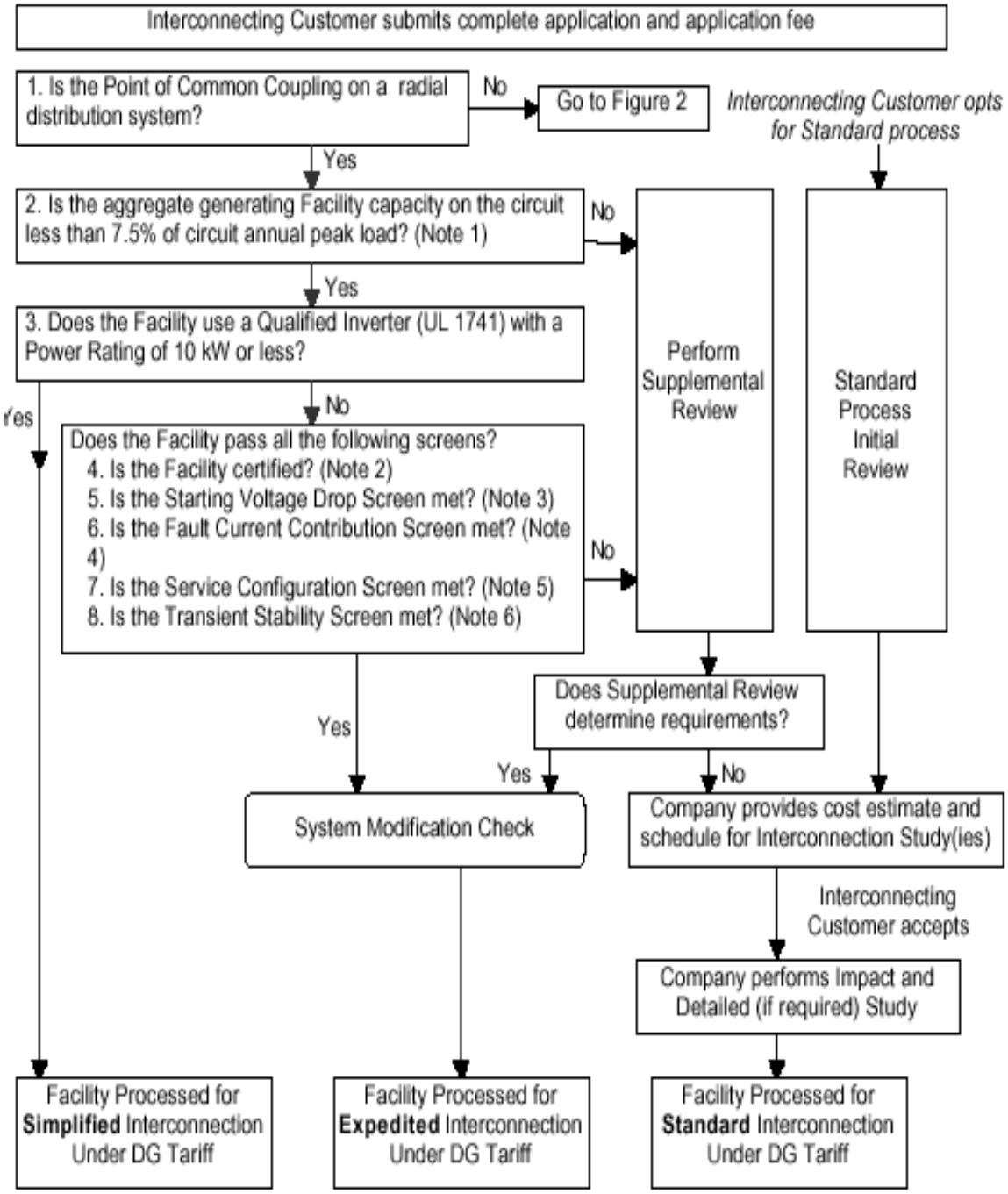
Federal Emergency Management Administration
Restrictions and requirements if facility sited within the 100-year flood plain

Appendix C

PROPOSED INTERCONNECTION PROCESS, SCHEDULE & FEES

(Excerpt of Distributed Generation Collaborative Report filed with the Massachusetts Department of Telecommunications and Energy, May 14, 2003)

Figure 1: Schematic of Massachusetts DG Interconnection Process



Explanatory Notes to Accompany Figure 1

Note 1. On a typical radial distribution EPS circuit ("feeder") the annual peak load is measured at the substation circuit breaker, which corresponds to the supply point of the circuit. A circuit may also be supplied from a tap on a higher-voltage line, sometimes called a subtransmission line. On more complex radial EPSs, where bidirectional power flow is possible due to alternative circuit supply options ("loop service") the normal supply point is the loop tap.

Note 2: California and New York have adopted certification rules for expediting application review and approval of Facility interconnections onto Company electric systems. Facilities in these states must meet commission-approved certification tests and criteria to qualify for the Expedited process. Since the certification criterion is based on testing results from recognized national testing laboratories, the Company will accept Facilities certified in California and New York as candidates for the Expedited process. It is the Interconnecting Customer's responsibility to determine if and submit verification that the proposed Facility has been certified in California or New York.

The above states and Massachusetts have adopted UL 1741, *"Inverters, Converters and Charge Controllers for Use in Independent Power Systems*", for certifying the electrical protection functionality of independent power systems. UL 1741 compliance is established by nationally recognized testing laboratories. Interconnecting Customers should contact the Facility supplier to determine if it has been listed. The IEEE P1547 Draft Standard includes design specifications and provides technical and test specifications for Facilities rated up to 10MVA. To meet the IEEE standard, Interconnecting Customers must provide information or documentation that demonstrates how the Facility is in compliance with the IEEE P1547 Draft Standard. A Facility will be deemed to be in compliance with the IEEE P1547 Draft Standard if the Company previously determined it was in compliance. A registry of Facilities previously certified in other states or in compliance with the IEEE standard can be obtained from the Massachusetts Division of Energy Resources or as determined by the Department. Applicants who can demonstrate Facility compliance with either standard will be eligible for the Expedited process.

Note 3. This screen only applies to Facilities that start by motoring the generating unit(s) or the act of connecting synchronous generators. The voltage drops should be less than the criteria below. There are two options in determining whether Starting Voltage Drop could be a problem. The option to be used is at the Companies' discretion:

Option 1: The Company may determine that the Facility's starting inrush current is equal to or less than the continuous ampere rating of the Facility's service equipment.

Option 2: The Company may determine the impedances of the service distribution transformer (if present) and the secondary conductors to the Facility's service equipment and perform a voltage drop calculation. Alternatively, the Company may use tables or nomographs to determine the voltage drop. Voltage drops caused by starting a generating unit as a motor must be less than 2.5% for primary interconnections and 5% for secondary interconnections.

Note 4. The purpose of this screen is to ensure that fault (short-circuit) current contributions from all Facilities will have no significant impact on the Company's protective devices and EPS. All of the following criteria must be met when applicable:

a. The proposed Facility, in aggregation with other generation on the distribution circuit, will not contribute more than l0% to the distribution circuit's maximum fault current under

normal operating conditions at the point on the high voltage (primary) level nearest the proposed PCC.
b. The proposed Facility, in aggregate with other generation on the distribution circuit, will not cause any distribution protective devices and equipment (including but not limited to substation breakers, fuse cutouts, and line reclosers), or Interconnecting Customer equipment on the EPS to exceed 85% of the short circuit interrupting capability. In addition, the proposed Facility will not be installed on a circuit that already exceeds 85 percent of the short circuit interrupting capability.
c. When measured at the secondary side (low side) of a shared distribution transformer, the short circuit contribution of the proposed Facility must be less than or equal to 2.5% of the interrupting rating of the Companies' service equipment. Coordination of fault-current protection devices and systems will be examined as part of this screen.
Note 5. This screen includes a review of the type of electrical service provided to the Interconnecting Customer, including line configuration and the transformer connection to limit the potential for creating over voltages on the Company EPS due to a loss of ground during the operating time of any anti-islanding function.

Primary Distribution Line Type	Type of Interconnection to Primary Distribution Line	Result/Criteria
Three-phase, three wire	3-phase or single phase, phase-to-phase	Pass screen
Three-phase, four wire	Effectively-grounded 3 phase or Single-phase, line-to-neutral	Pass screen

If the proposed generator is to be interconnected on a single-phase transformer shared secondary, the aggregate generation capacity on the shared secondary, including the proposed generator, will not exceed 20 kVA. If the proposed generator is single-phase and is to be interconnected on a center tap neutral of a 240 volt service, its addition will not create an imbalance between the two sides of the 240 volt service of more than 20% of nameplate rating of the service transformer.
Note 6. The proposed Facility, in aggregate with other Facilities interconnected to the distribution low voltage side of the substation transformer feeding the distribution circuit where the Facility proposes to interconnect, will not exceed 10 MW in an area where there are known or posted transient stability limitations to generating units located in the general electrical vicinity (e.g., 3 or 4 transmission voltage level buses from the PCC).

Figure 2 - Simplified Interconnection to Networks

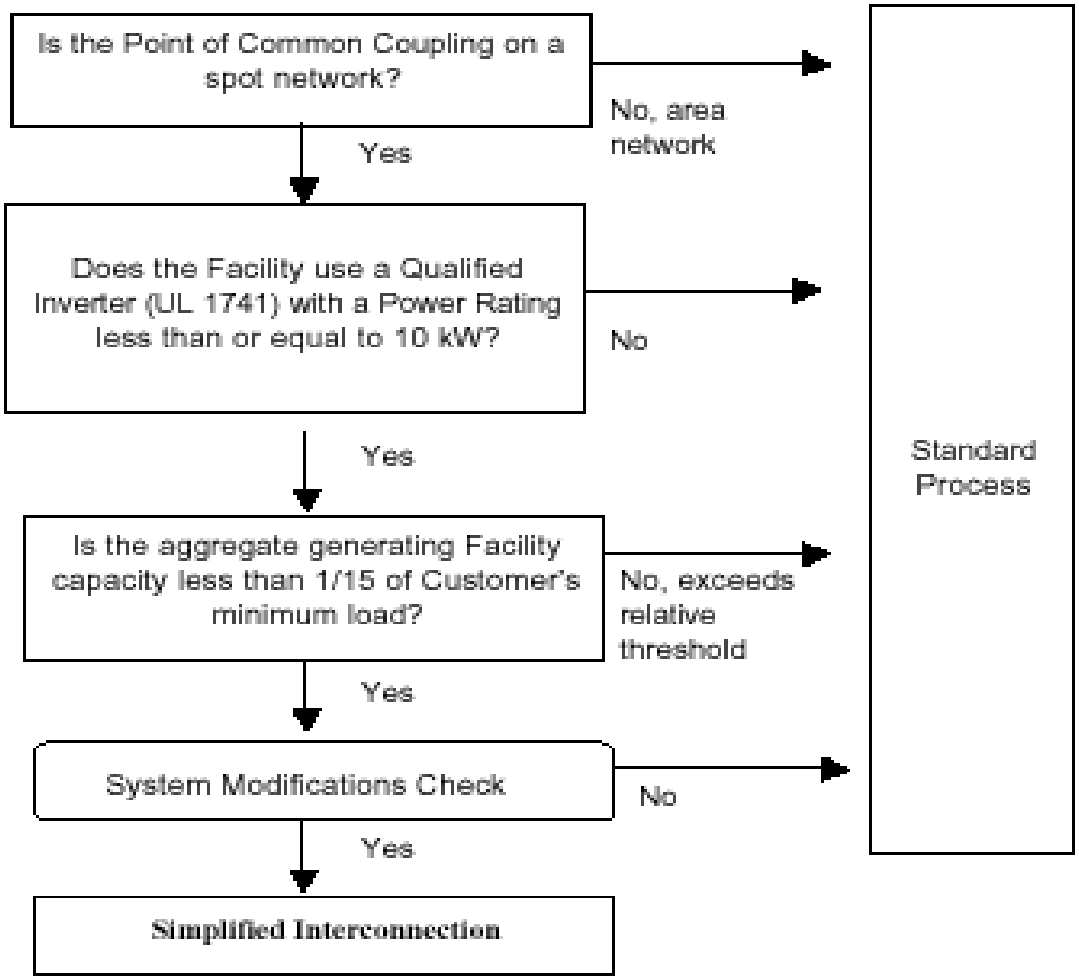


Table 1: Time Frames[2] (Note 1)

	Certified Inverter =10kW	Qualified DG	Any DG	Certified Inverter =10 kW
	Simplified	**Expedited**	**Standard**	**Simplified Spot Network**
Acknowledge Receipt of Application	(3 days)	(3 days)	(3 days)	(3 days)
Review Application for Completeness	10 days	10 days	10 days	10 days
Complete Review of All Screens	10 days	25 days (RE: 15 days)		Site review 30/90 days (Note2)
Complete Supplemental Review (if needed)		20 days (RE: 15 days)		
Complete Standard Process Initial Review			20 days	
Send Follow-on Studies Cost/Agreement			5 days	
Complete Impact Study (if needed)			55 days	
Complete Detailed Study (if needed)			30 days	
Send Executable Agreement (Note 3)	Done	10 days	15 days	Done (Comparable to Simplified Radial)
Total Maximum Days (Note 4)	15 days	40/60 days (RE: 25-40 days) (Note 5)	125/150 days (RE: 65-80 days) (Note 6)	40/100 days
Notice/ Witness Test	<1 day with 10 day notice or by mutual agreement	1-2 days with 10 day notice or by mutual agreement	By mutual agreement	1 day with 10 day notice or by mutual agreement

Table 2: Fee Schedules

	Certified Inverter =10kW	Qualified DG	Any DG	Certified Inverter =10 kW
	Simplified	**Expedited**	**Standard**	**Simplified Spot Network**
Application Fee (covers screens)	0 (Note 1)	$3/kW, minimum $300, maximum $2,500	$3/kW, minimum $300, maximum $2,500	=$3/kW $100, >3kW $300
Supplemental Review or Additional Review (if applicable)	N/A	Up to 10 engineering hours at $125/hr ($1,250 maximum) (Note2)	N/A	N/A
Standard Interconnection Initial Review	N/A	N/A	Included in application fee (if applicable)	N/A
Impact and Detailed Study (if required)	N/A	N/A	Actual cost (Note 3)	N/A
Facility Upgrades	N/A (Note 4)	Actual cost	Actual cost	N/A
O&M (Note 5)	N/A	TBD	TBD	N/A
Witness Test	0	Actual cost, up to $300 + travel time (Note 6)	Actual Cost	0 (Note 7)

Explanatory Notes to Accompany Tables 1 and 2
Table 1: Time Frames
Note 1. All days listed apply to Company business days under normal work conditions. All numbers in this table assume a reasonable number of applicants under review. All timelines may be extended by mutual agreement. Any delays caused by Interconnecting Customer will interrupt the applicable clock. Moreover, if an Interconnecting Customer fails to act expeditiously to continue the interconnection process or delays the process by failing to provide necessary information within the longer of 15 days or half the time allotted to the Company to perform a given step, or as extended by mutual agreement, then the Company may terminate the application and the Interconnecting Customer must re-apply. However, the Company will be required to retain the work previously performed in order to reduce the initial and Supplemental Review costs incurred for a period of no less than 1 year.
Note 2. 30 days if load is known or can be reasonably determined, 90 if it has to be metered.

Note 3. Company delivers an executable agreement form. Once the Interconnection Service Agreement is delivered by the Company, any further modification and timetable will be established by mutual agreement.
Note 4. Actual totals laid out in columns exceed the maximum target. The Parties further agree that average days (fewer than maximum days) is a performance metric that will be tracked.
Note 5. Shorter time applies to Expedited without Supplemental Review, longer time applies to Expedited with Supplemental Review.
Note 6. 125 day maximum applies to an Interconnecting Customer opting to begin directly in Standard process, and 150 days is for an Interconnecting Customer who goes through initial Expedited process first. In both cases this assumes that both the Impact and Facilities Studies are needed. If the Detailed Study is not needed, the timelines will be shorter.

Table 2: Fee Schedules

Note 1. If the Company determines that the Facility does not qualify for the Simplified process, it will let the Interconnecting Customer know what the appropriate fee is.
Note 2. Supplemental Review and additional review are defined in Section 3.2.
Note 3. This is the actual cost only attributable to the applicant. Any costs not expended from the application fee previously collected will go toward the costs of these studies.
Note 4. Not applicable except in certain rare cases where a System Modification would be needed. If so, the modifications are the Interconnecting Customer's responsibility.
Note 5. O & M is defined as the Company's operations and maintenance carrying charges on the incremental costs associated with serving the Interconnecting Customer.
Note 6. The fee will be based on actual cost up to $300 plus driving time, unless Company representatives are required to do additional work due to extraordinary circumstances or due to problems on the Interconnecting Customer's side of the PCC (e.g., Company representative required to make two trips to the site), in which case Interconnecting Customer will cover the additional cost.
Note 7. Unless extraordinary circumstances.