# The Vermont Solar Power Generation Challenge

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## 1 Vermont Can Be 100% Solar Powered by Year 2027

The CEP version 2011 has set a visionary goal of 90% of Vermont's energy coming from renewable energy sources by year 2050. The CEP version 2015 should set a visionary goal to deploy in Vermont by the year 2027 at least 500 Megawatts [1] of community owned solar projects with integrated energy storage and fuel cells. In realizing this goal, Vermont would largely achieve base load electrical energy self-sufficiency using existing energy generation technologies that produce zero greenhouse gas emissions [2].

### 1.1 Utility Scale Energy Storage Is a Game Changer

The proposed zero-emissions solar power generation network does not depend any breakthroughs in new energy technologies. It can be built with today's existing solar photovoltaic, utility-scale stationary battery, and fuel cell products. For the first time, intermittent solar energy sources can provide dispatch-able base load power on an equal footing as the incumbent fossil-fuel power generation plants. The current generation of such solar power plants are more expensive at providing base load power generation than the competing fossil-fuel based power plant technologies. Fortunately, the solar photovoltaic, utility-scale battery products, and fuel cells are maturing rapidly.

The utility-scale batteries are similar to renewable energy technologies in that their associated upfront capital investments are the major barrier to their widespread deployment. In the last year, there has been a substantial cost reduction in short term [3] electrical energy storage technology. The recent Tesla product introduction demonstrates it is rapidly trending down below $250 per DC Kilowatt-hour stored [4]. With energy storage becoming cost-effective, a solar array project can add batteries to sponge up the spikes and jitter in its solar power generation. For example, energy storage can smoothly bridge the power production gaps caused by intermittent cloud cover. When energy storage is coupled

1 Vermont's current base load is in the range of 500 to 650 Megawatts. The terms "peak AC Megawatt" and "peak AC Kilowatt" refer to the maximum alternating current power presented at the project's interface to the public grid. This is not the same quantity as the "peak DC Kilowatt", which refers to the direct current power generated by the array's solar photovoltaic panels.

2 This assertion presumes the fuel consumed by the fuel cells is a liquid bio-fuel with neutral greenhouse gas impacts.

3 For the purposes herein, the term "short-term energy storage" is the capability to store a solar array's electricity for periods ranging from a few hundred milliseconds upwards to 48 hours with a round trip efficiency of 90% or better.

4 http://grist.org/business-technology/elon-musk-unveils-fancy-new-tesla-battery-cause-existing-batteries-suck/?utm_source=newsletter&utm_medium=email&utm_term=EDIT%20Weekly&utm_campaign=weekly

with state of the art “smart grid” controls, the time at which the solar energy is consumed by the grid can be shifted to be independent [5] of when the solar energy was produced and stored. The most obvious application is releasing stored solar electricity to the grid at night time or on cloudy days. The solar array's power management can be told by a secure grid operations Internet to modulate the rate of its stored power delivery to follow in real-time  the electrical load presented by the nearby town or neighborhood.

## 1.2 Utility-scale Fuel Cell Backup Power

The quantity of solar photovoltaic power that the solar power generation network will deliver to the grid on any given day may often be lower than the 500 Megawatt-hour per day design ceiling. When bidding to sell base load power at the ISO-NE power auction, the solar power plant operator must make a firm contractual commitment to have no less than the promised power available at each hour of the next day. This rigid commitment to contribute to the grid's operation is at odds with the naturally occurring statistical variance in the actual solar power received by a solar photovoltaic array on that day. To satisfy its commitment, the solar power plant relies on having sufficient energy storage capacity and a prediction of the amount of solar radiation it will have captured the next day. A day's base load commitment capacity will mainly depend on three factors: a) the amount of seasonal solar radiation available per day for that time of the year, b) the weather forecast of how much cloudiness will occur the next day [6],  c) how much electrical energy is stored in the Energy Storage System to fill-in the gap between demand and production when solar power generation starts decreasing in the afternoon. If solar power and energy storage are not sufficient to meet the load then the fuel cell is activated as the backup power source.

Among the fuel cell technologies developed into products for utility-scale stationary power generation, the *Molten Carbonate Fuel Cell* (MCFC) has shown the most promise and maturity. In a DoE NREL study [7], their cost analysis makes a forecast of $2,700 cost per Kilowatt output capacity by year 2020. Because it operates at extremely high temperatures, a MCFC is largely agnostic about what type of fuel it consumes. The fuel is internally reformed (broken down into smaller compounds) into hydrogen and other constituent atoms from the fuel. Although capable of being fueled by fracked gas, MCFC thermo-chemistry can also accept a variety of bio-fuels such as Ethanol, Methanol, and Biodiesel. To the extent the planet's biogenic carbon dioxide recycling loop captures the MCFC carbon dioxide emissions of these fuels then the MCFC operation is a zero-emissions energy technology.

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5 An additional benefit can be to shift solar power delivery to periods of peak demand on the grid. This strategy enables the consumer to mitigate the premium “time of use” tariffs.

6 ISO-NE auctions its power and sets contractual commitments on the day before the power is delivered.

7 *Molten Carbonate and Phosphoric Acid Stationary Fuel Cells: Overview and Gap Analysis*, R. Remick National Renewable Energy Laboratory, Douglas Wheeler DJW Technology, LLC, Technical Report NREL/TP-560-49072, September 2010.

## 1.3 Distributed Management of a Solar Power Network

The solar power generation projects belonging to the solar power generation network should be organized to share a common *Fault, Configuration, Accounting, Performance, and Security* (FCAPS) management infrastructure [[8]]. Most of the time, the solar power generated by an individual solar project would be locally dispatched by an automated power control Internet in real-time response to each community's local loads. The FCAPS network also enables them to be operated collectively as a single distributed solar power generation facility. This would provide the capability for the ISO-NE grid operator to dispatch additional power to help meet both Vermont's and New England's regional power loads.

## 1.4 Solar Energy Storage Project – Base Load Scenario

To help understand this new distributed solar power generation network concept, it is helpful to develop a "thought experiment" and take it out for a test drive. To that end, I've developed a spreadsheet model of an individual solar array and its associated energy storage and fuel cell systems delivering base load power to the grid over a 24 hour period. For a given set of assumptions, the model produces estimates of the distributed solar power generation network's technical, economic, and land use attributes. As a first order approximation of what kind of solar project might be built, the model was configured with the following assumptions:

1. The solar power generation project has a nameplate power rating of 150 peak AC Kilowatts at the public grid interconnection. This is the largest size solar array power rating able to acquire a Certificate of Public Good permit from the Public Service Board without incurring the legal cost and time overhead of a hearing process. Inverter conversion efficiency from DC to AC is 96%.

2. The base load power delivered by the solar project to the grid in each hour was scaled to follow the ISO-NE regional power load forecast for July 20th 2015 [[9]]. This was selected as a representative New England Summer day with temperatures in the 80s. However, it did not have a design peak hour where the power demand can spike to over 30,000 Megawatts-hours.

3. The solar photovoltaic array is 1,069 panels of 290 STC Watts each, totaling 310 peak DC Kilowatts. This solar array size was selected by iteratively adjusting it to find the right amount of solar energy needed to be stored beyond each sunny hour's immediate power demand to fulfill the base load power commitment until mid-evening. The peak rate of solar energy arrival occurs around solar noon whereas the grid's peak demand for power occurs between 5PM and 7PM. The energy storage system enables the shifting of the time solar electricity gets consumed

8 In the electric power industry, these FCAPS management capabilities are implemented by a suite of Internet protocols (e. g. SNMP, DNP3, IEC 60870-5-101) transported over the grid's *Supervisory Control and Data Acquisition* (SCADA) communications network.
9 Refer to the attached spreadsheet file, tab "*solar project hourly output*", the column labeled "*AC KW-h Output to Grid*" and the tab "*ISO-NE hourly forecast*", based on ISO-NE data found at http://www.isone.org/isoexpress/ on July 20th 2015.

until it is needed.

4. The solar panels were assumed to deliver 100% of their STC rated DC power during those hours of the day that had 100% of the available solar radiation. The amount of solar radiation striking a 35% fixed tilt ground mount solar panel in a given hour of the Burlington sunny July day was scaled by data from the NREL *PVWatts* solar photovoltaic tool [[10]]. No attempt was made to optimize how these solar panels might perform with enhanced product-specific characteristics or newer solar panel products with larger power ratings. Solar panels cost $0.83 per peak DC STC Watt.

5. The Energy Storage System was based on the Tesla Power-Pack industrial stationary battery product line. Round trip energy storage efficiency is 92% [[11]]. The cost is $250 per DC Kilowatt of storage [[12]]. The required amount of energy storage is calculated by the model as an output.

6. Solar panels occupy 10 acres of land per 1 peak DC Megawatt [[13]] exclusive of service road, screening and property line setbacks. Although solar trackers would need more space between tracker units, they generate as much as 40% more power for the same peak DC wattage solar array. There was no investigation to find out the land use impacts from solar tracker alternative versus fixed ground mounted solar racks.

7. The solar project's cost data is derived from the *Community Owned Solar Cooperative Inc.* business model spreadsheet from July 2014. It was configured to match the assumptions noted here. The solar project's cost for only the solar array without energy storage or fuel cell is $3,157 per peak DC Kilowatt. This cost assumes the solar array is purchased in year 2017 and Congress has allowed the Federal 30% renewable energy tax credit to expire.

8. The fuel cell is a MCFC sized to deliver up to 150 DC Kilowatts at 67% efficiency. The fuel cell costs $2,700 per AC Kilowatt output. The liquid fuel is bio-Methanol and it has a lower heat value of 16.647 Kilowatts per gallon. The Methanol is assumed to cost $1.50 per gallon. In the model, the fuel cell is programmed with a policy to generate the electrical power sufficient to meet the grid's presented load for each hour when the ambient solar radiation power level is 10% or less of the daily maximum.

9. The distributed solar power generation network has a nominal base load commitment capacity of delivering 500 Megawatt-hours per hour to the ISO-NE grid for 24 hours.

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10 http://pvwatts.nrel.gov/pvwatts.php, and also spreadsheet tab "*PVWatts hourly wattage*", rows 4,802 to 4,828.
11 http://www.teslamotors.com/powerwall
12 https://en.wikipedia.org/wiki/Tesla_Powerwall, section entitled "Market". As of July 23 rd 2015.
13 The rule of thumb is approximately 10 acres of land are needed per solar project peak Megawatt, based on the conversion efficiency of today's solar photovoltaic technology. Future solar technologies promise to cut the land use requirement in half.

## 1.5 Solar Power Generation System Model Results

The solar power generation system spreadsheet model computed the results shown in Table 1. The ratio of the overall DC power generated by the fuel cell versus solar photovoltaic is only illustrative and it will vary daily and seasonally on the basis of how much solar energy reaches the solar array. The system's overall energy efficiency is only 76.87% because the fuel cell's share of the electricity production is 67% efficient.

There are numerous possible trade offs between the system's initial capital cost, how much land to assign to the solar array, the fuel cell's operational costs, and adjusting the energy storage system capacity. For example, one long-term cost minimization strategy might to be reduce the fuel cell's liquid fuel costs by expanding the solar photovoltaic generation capacity along with a larger capacity energy storage system. Another strategy might be to concentrate more power production into a smaller number of larger solar power sites (e. g. 500 sites of 1 Megawatt of AC output each). This initial study has not explored the design space to find the optimal life-cycle cost combination among all of the model's assumptions.

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| **Solar Project Performance Metrics** | |
| Maximum DC Kilowatts stored in Energy Storage System | 316 |
| Solar project's land use (acres) | 3.10 |
| Fuel cell's liquid fuel daily operational gallons consumed | 132 |
| Total base load AC KW-h delivered to grid per 24 hours | 2,996 |
| Total solar DC KW-h generated per 24 hours | 1,703 |
| Total fuel cell DC KW-h generated per 24 hour | 1,470 |
| Energy efficiency of inverter, battery, fuel cell inputs to AC out | 76.87% |
| | |
| **Solar Project Economic Metrics** | |
| Fuel cell's liquid fuel daily operational cost | $198 |
| Energy storage system initial cost | $79,000 |
| Fuel cell system initial cost | $409,500 |
| Solar photovoltaic array initial cost | $958,037 |
| Total solar power generation facility initial cost | $1,446,537 |
| Solar power generation facility initial cost per peak AC Watt | $9.64 |
| | |
| **Vermont Distributed Solar Power Generation Network** | |
| Maximum committed solar generated base load (MW-h) | 500 |
| Number of 150 AC KW solar projects deployed to achieve base load | 3,334 |
| Initial capital outlays to realize base load network ($Million) | $4,823 |
| Total distributed solar power generation network land use | 10,335 |
| Percentage of Vermont's 5.9M acres used by network | 0.18% |

*Table 1: Solar Power Generation Project Model Results*

The spreadsheet model demonstrates that existing component products can be assembled into a scalable solar power generation facility design. The CEP version 2015 should set a goal of realizing a pilot plant implementation of this conceptual plan by the year 2017.

At first sight, the $9.64 cost per peak AC watt would appear to make this proposal economically infeasible. The estimate initial capital outlay of $4.8B to build out the distributed solar power generation network at over 3,300 sites would also suggest the project faces an insurmountable hurdle. However, if one extrapolates the decreasing cost trends caused by economies of scale of the solar photovoltaic, battery, and fuel cell products, then the solar power generation network can realistically be expected to reduce its initial cost in half during the ten year build out period starting in 2017.

More importantly, this is a zero-emissions power plant and the avoided cost of greenhouse gas emissions from its operation is a huge counter-balance in this discussion about the project's economics. In year 2012, the New England power system's average greenhouse gas emissions were 719 pounds of CO2 per Megawatt-hour [[14]]. The Vermont distributed solar power generation network would produce zero emissions while generating 4,380,000 Megawatt-hours per year. The Vermont distributed solar power generation network would avoid 1,574,610 tons of CO2 per year. If priced at $100 per CO2e ton then this greenhouse gas emission reduction is a societal benefit worth $157M per year.

## 1.6 Standardized Modular Solar Rack Subsystems

To maximize this initiative's economies of scale, the State of Vermont in partnership with a solar industry alliance should design and develop a “standard” 10,000 peak AC Watt modular solar rack subsystem manufactured off-site in a central factory (or factories). A solar rack subsystem would integrate the solar panels, DC/AC inverter, energy storage, solar panel rack frame, circuit breakers, remote operations and monitoring subsystem, and wiring. The solar rack subsystems would be transported to the solar project site on a conventional flatbed truck and lifted into place with a crane. This approach is analogous to the economies of scale achieved in the building construction industry by manufacturing modular housing subsystems or kits in a factory. Each solar project would assemble solar rack subsystem modules in a cookie-cutter fashion and complete its installation in less than 15 business days. During the 10 year build-out period, the goal would be to install on the order of 50 peak AC Megawatts per year. If the construction and energy project permitting processes have been optimized, then it should be feasible to deploy 100 to 500 solar array projects per year, each such project having a power generation capacity in the range of 100 to 500 peak AC Kilowatts.

14 http://www.isone.org/static-assets/documents/2014/08/EAG_GHG_Update_8-27-2014.pdf, page 5.

# 2 Win-Win Solar Project Land Use Siting Policy

Ultimately, the major barrier to deploying the Vermont distributed solar power generation network will not be technical or economic. Instead, the main barrier will be overcoming the political resistance to allocating land to about 3,334 solar power projects scattered around the State of Vermont. Let's suppose the CEP embraces the challenge of building a distributed 500 Megawatt solar power generation network. Upon its completion, the combined solar project assets would occupy approximately 10,335 acres out of Vermont's 5.9 Million acres [[15]]. This is only 0.18% of the State's total acreage. None the less, the existing generation of solar projects spawned by the SPEED legislation has already galvanized widespread opposition to siting solar energy wherever they can be seen from a public road right of way, or from an adjacent property, or in view sheds. At least some of this opposition has been triggered by the larger solar array projects being proposed by bad actors. These solar developers do not heed local zoning ordinances or citizen input. Instead of incurring the costs to negotiate and accommodate such inputs, they can exploit the current PSB process bias towards approval "as proposed".

## 2.1 Solar Project Siting Requirements

From the solar project developer's perspective, picking a solar project site must satisfy numerous requirements to establish a candidate site's feasibility:

1. The site must have an unobstructed Southern facing solar exposure (minimal tree cutting). Those solar arrays comprised of fixed solar panel racks must face true South plus or minus 10 degrees. Solar tracker systems must have an unobstructed solar exposure from 80 degrees East through 300 degrees West.

2. The land must be either nearly flat or sloped less than 5 degrees facing towards true South.

3. The land parcel must have approximately 1 acre available per 100 peak Kilowatts. The total acreage should include some extra land to allow future growth in solar generation capacity.

4. The larger solar projects (those greater than 150 peak Kilowatts) must be in the immediate proximity of three-phase power transmission lines [[16]]. A site located more than a few hundred feet from the nearest three-phase transmission line can make the solar project economically impractical [[17]]. Many of Vermont's three phase power transmission lines are collocated in

15 Vermont Comprehensive Energy Plan, December 2011, section 8.3.5.2, page 209.

16 The utility charters a power system engineering study to make the decision whether a proposed solar system requires a connection to a three-phase power line extension. The study examines the circuit's stability if the solar project was added to the existing customer loads and generators. A larger solar project is more likely to need three-phase power.

17 The cost of a 3-phase power line extension depends on complex tariffs, the distance being spanned, and easement legal costs. The transformer vault is on the order of $5,000 to $10,000 plus at least $35 per foot of line extension. This cost includes a gravel service access driveway parallel to the power line poles. The road must be built wide enough so the grid utility truck can enter and turn around in the solar project's property. Buried electrical power conduit will cost even more. There can be unacceptable legal expenses incurred to

existing public road rights of way. This often causes the solar projects to collocate with those roads, making them highly visible to passing motorists and tourists.

5. To avoid adverse land use impacts, a candidate site should not occupy:

    a) Vermont prime agriculture or USDA prime agriculture soils.

    b) Forestland, wetlands, waterway riparian zone, or floodplain, as recognized by the ANR environmental database

6. The subterranean geology should not have rock ledge formations, as they obstruct the pilings used to anchor the solar racks. Ballasted ground mount solar rack systems are feasible but they are more expensive.

7. The solar project should not be easily visible from adjacent public roads or neighboring residences. The budget for evergreen screening, if needed, is estimated at $100 per planted shrub or tree [18].

8. The land must be available for lease or purchase on favorable terms for a period of at least 20 years and preferably longer.

9. The solar project obeys local zoning ordinance property line setback requirements for industrial and commercial developments.

Many of the above solar site requirements could be encoded as land use filters applied to a database query of a Geographic Information System's database. Although the results from this query would narrow the candidate solar site search space, it is not conclusive. The hardest step in determining the eligibility of a candidate site is convincing its adjacent neighbors to accept this land use.

## 2.2 Solar Energy Storage Creates Project Siting Flexibility

One way to loosen the above requirements list is to leverage the advances in energy technology to remove one or more of the constraints. From a solar siting perspective, the key benefit of energy storage is to partially relax the constraint that the solar array must be adjacent to a 3-phase power transmission line. In contrast to three-phase power, single phase power distribution lines are nearly ubiquitous. A solar energy storage system connected to a single-phase electrical power distribution line can modulate the delivery of its stored energy at a rate compatible with the currently available capacity of that distribution line. Energy storage enables far more flexibility in where the solar developer can site small-scale (150 peak AC kilowatt or smaller) solar projects. For the grid operator, a major benefit is avoiding the transmission infrastructure upgrade cost of bringing three-phase power transmission lines out to the periphery of the power grid's distribution network. For the solar developer, the major

acquire an easement for a line extension crossing over private property.

18 A large portion of this cost is the ongoing follow up labor to revisit plantings to assure they have transplanted successfully.

benefit is avoiding the purchase of a more expensive three-phase power transmission line from the nearest grid point of presence to the edge of the solar project site.

Energy storage has another hidden benefit. Given appropriate grid capacity design and land area data from the local grid utility, a community's Planning Commission could more easily designate right-sized solar power generation zones scaled to the power required by their community or each neighborhood within their community. The Planners would also be able to nominate solar project zones that are more likely to be out of sight from tourists and residents. Ideally, these sites would be adjacent to those residents who are the direct beneficiaries of the solar power generation network [[19]].

## 2.3 The Planning Process Is Vulnerable to Crony Politics

Planning commissions are not necessarily sufficiently educated to draw the energy land use zones on a region's or a town's map in alignment with best practices. They are usually volunteer citizens with limited time and interest to allocate to their public service as a planning commissioner. Planning commissions have long standing problems engaging and shaping their community's public consensus to discover what they would ratify in a town plan or zoning ordinance. There is likely to be a reluctance for the Commissioners to be vested with the responsibility to designate energy land use zones. They are well aware it can lead to divisive controversies and the loss of property values in a neighborhood designated to have an energy related land use. Even when the Planning Commission might be inclined to learn what works best and “do the right thing”, there will be people in their community who will actively enforce though back room political negotiation that the best land use practices are not followed by the zoning ordinance. They will sabotage the planning process because “best practice” does not align with their selfish economic interests or their idealogical model of how land should be allocated (e. g. economic development of a forest is always more valuable than preserving a rare plant species habitat). In the worst case, energy project siting is used by a politician as a weapon to retaliate against a citizen or a group of citizens who have previously opposed them on another issue. These are not theoretical problems. As a former planning commissioner and a citizen activist, I have witnessed or else have been the victim of all of these land use planning failure modes.

The only effective counter to these human factors in the planning process is to require educated and compensated town planning commissioners so they can do their legal responsibilities with the level of expertise needed to competently administer the intent of State's land use and energy policies and statutes.

19 The preferred benefit should be to assign a perennial net-meter credit to every adjacent property owner's electrical utility bill. The net-meter credit would have a shrinking ceiling to encourage these neighbors to become more energy efficient.

## 2.4 Community Owned Solar Utility Financing Model

There are many competing solar project business models [20] and they are all complicated. A full discussion of them is out of scope of this document. The vast majority of these business models start with the assumption there is an investor group willing to front the initial capital expenditures needed to build the solar project. Not surprisingly, the majority of the economic benefits accrued to these investors are the various Federal tax code incentives specifically designed to encourage the wealthy to invest in solar energy.

There is a strong unifying benefit to a community owning a public asset with one's neighbors. To that end, the locus of management control for a solar project should be vested in a public utility organized as a cooperative with the individual citizens who have invested in its assets as the cooperative's shareholders. The solar utility project's funding would be developed under the terms of the Vermont Solar Utility No-action "SUN" Exemption promulgated by the Vermont Department of Financial Regulation [21] To a large extent, the ownership and sharing of the benefit of an energy project will mitigate the misgivings of having such a project as a neighbor.

## 2.5 Sharing a Community's Solar Site with Other Towns

Every town should be obligated as part of its town planning process to develop a legally binding energy plan specifying in detail the where, what, when, and how of the energy infrastructure producing their own renewable energy at the granularity of Megawatt-hours. Viewed at the State-wide level, it is clear there will be many towns who will not have their own land resources suitable for solar sites, or wind turbine sites, or hydroelectric sites. Inevitably, there will be political tension between the bias to maintain an exclusively local ownership and control of the community solar project and the public good obligation to host a larger solar generation capacity on behalf of these other towns. This raises the question: at what threshold is a community being asked to sacrifice too much of its land in service to the wider public good?

The town hosting a solar power generation or other energy production facility on behalf of one or more other towns should be compensated by those other towns through a State of Vermont accounting mechanism that tracks the production and consumption of renewable energy Megawatts. The State of Vermont would annually assign a single price to a Megawatt. A hosting town's compensation should be scaled in proportion the number of Megawatts produced by the hosting town's energy facility that are consumed by other Vermont towns. The towns producing renewable energy Megawatts within the State of Vermont must satisfy the solicitation from any other Vermont town's need for renewable energy before selling those Megawatts out of state.

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20 LBNL-6610E, "*An Analysis of the Costs, Benefits, and Implications of Different Approaches to Capturing the Value of Renewable Energy Tax Incentives*", M. Bolinger, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, May 2014, emp.lbl.gov/reports/re.

21 http://www.dfr.vermont.gov/sites/default/files/S.U.N.%20Securities%20Exemption%2014-023-S.pdf

## 2.6 CEP Recommendations for the Solar Siting Process

Unfortunately, no matter how technically advanced and ambitious the Comprehensive Energy Plan might aspire to be, its implementation will be at the mercy of numerous political, economic, land use, and human factors. The CEP version 2011 did not have a chapter dedicated to directly identifying these barriers to success or articulate what to do about them. The following list provides a sampling of those siting process improvements that could also improve the likelihood of success of the Comprehensive Energy Plan.

1. Regional plans can not propose an energy corridor straddling multiple towns unless there is a compensation plan scaled to the whole property's value funded by the State for all landowners whose properties are directly impacted or adjacent to that corridor.
2. Energy corridors built outside of an approved regional plan specified route should be fined annually in proportion to the economic value of the product being conveyed through that corridor. The proceeds from the fines are distributed to the impacted landowners.
3. Regional plans should be approved by an Australian ballot as part another ballot item to vote on within a general election.
4. The PSB permitting process should honor as preemptive a town or region legislation that explicitly identifies energy zones and places restrictions on those zones for a town's citizen approved town plan map and zoning ordinances.
5. Town energy plans are subject to approval by the registered voters of the surrounding regional planning area.
6. Town energy plans are authorized to require electric transmission lines to be buried underground.
7. Town energy plans may impose a ceiling on the total MM-BTU of gas or liquid product flowing per day through the one or more pipeline(s) in an energy corridor.
8. The State of Vermont might consider enacting legislation to empower planning commissioners to propose land use policies, such as designating the land to be used for siting energy project zones. Those decisions will impact property values and shape the aesthetic character of towns for many future decades. It stands to reason then that these citizens must be educated and hold the credentials needed to be competent to carry that responsibility. Local and regional planning commissioners must be certified as graduates of an adult education program operated by an accredited planning professional organization. The educational program should require not less that 80 hours of class attendance and the passing of a written exam qualifying them in their competence to understand Vermont's land use and energy statutes.