

Zero Energy Building Pathway to 2035

Whitepaper Report of the Rhode Island
Zero Energy Building Task Force

Prepared by National Grid, November 2016



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National Grid: Puja Vohra, Francis Boucher, Laura Rodormer, Sneha Sachar
New Buildings Institute (Advisors): Mark Lyles, Ralph DiNola

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Organization	Name
Penley Systems (facilitator)	Kevin Bernier
RI-Office of Energy Resources (OER)	Becca Trietch
RI-Office of Energy Resources (OER)	Shauna Beland
RI-Office of Energy Resources (OER)	Rachel Sholly
US Senator Sheldon Whitehouse	Karen Bradbury
Union Studio	Joe Haskett
Gilbane Building Company	Mark Winslow
Rhode Island School of Design	Laura Briggs
Church Community Housing	Christian Belden
American Institute of Architects (AIA)	Jennifer Space
The Northeast Sustainable Energy Association (NESEA)	Jennifer Marrapese
Rhode Island Builders Association (RIBA)	John Marcantonio
US Green Building Council (USGBC), RI Chapter, Filarski Architecture	Kenneth Filarski
Northeast Energy Efficiency Partnership (NEEP)	Carolyn Goldthwaite
RI - Dept of Education (RIDE)	Joseph DaSilva
RI - Dept of Education (RIDE)	Manuel Cordero
Energy Futures Group, Inc (EERMC Consultant)	Richard Faesy
Optimal Energy (EERMC Consultant)	Mike Guerard

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Note: National Grid developed this white paper based on ZEB Task Force's recommendations. This paper may not necessarily represent opinions of each and every stakeholder in the Task Force.

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1. Executive Summary

Abstract: Zero Energy Buildings (ZEBs) have the potential to serve as a strong contributor in helping Rhode Island meet its 'Energy 2035, State Energy Plan' Greenhouse Gas (GHG) reduction target. This whitepaper proposes a 20-year pathway toward zero energy residential, commercial and public buildings by establishing three over-arching recommendations: One: establish policies and legislation that supports ZEB goals to align with the GHG Emissions goals of Rhode Island; two: launch a state-wide ZEB Program ("Zero Energy RI") across all building sectors; and three: enhance utility's energy efficiency programs, and address integration between energy efficiency and renewable energy and grid modernization.

1.1 Context

Rhode Island has a long-standing commitment to reduce the state's energy costs and minimize impacts to the environment as evident from the Executive Order 14-01 that calls for 80% Greenhouse Gas (GHG) reduction by 2050. Central to Rhode Island's energy future is the "Energy 2035, Rhode Island State Energy Plan"¹ that establishes a target to reduce greenhouse gas (GHG) emissions by 45% below 1990 levels by 2035, also in support of the Resilient Rhode Island Act, introduced in 2014². According to this Plan, the state spends approximately \$3.6 billion on energy resources each year that emit more than 11 million tons of GHG into the atmosphere. A significant portion of these GHG emissions – 40% per national statistics – is attributable to residential and commercial buildings. According to EIA, residential and commercial buildings in Rhode Island account for 57% of the state's energy consumption. The building sector is a significant cause of, and by direct corollary, an important opportunity to address GHG emissions.

Zero Energy Buildings (ZEBs) – with their markedly reduced energy needs achieved through design and efficiency measures, and the remaining energy needs produced through renewable technologies – carry significant potential to reduce building related energy usage to negligible or zero levels. This indubitably positions ZEBs as a contributor to meeting the state's GHG emission reduction target (approx. 27% contribution based on the Task Force's preliminary analysis) along with additional benefits such as enhancing inhabitants' comfort and wellbeing, contributing to economic development, resiliency to disasters and the effects of climate change.

The Rhode Island ZEB task force was established by National Grid³ in June 2015, to substantiate the role ZEB can play over the next 20 years in Rhode Island. The ZEB Task Force was comprised of the utility, state representatives, industry associations and building industry stakeholders.

1.2 Task Force Mission and White Paper Purpose

The Task Force embraced the mission to create a pathway for delivering ZEBs across all building sectors as a means of contributing to the Energy 2035 goals, especially the target to reduce GHG emissions by 45% by 2035. Two key actions were identified:

1. Establish quantitative ZEB targets, realistic but also meaningful enough to make a solid contribution toward the state's GHG target;
2. Develop actionable recommendations for attaining these ZEB targets, at a pace requisite to support the Energy 2035 State Energy Plan goals.

The outcome of the two actions is documented in this whitepaper, essentially defining a 20-year pathway to advance ZEBs across the commercial and residential building sectors in Rhode Island. This white paper offers a high level overview of considerations for ZEB growth in RI, a quantitative analysis and recommendations toward ZEB growth. It is intended for policy makers, state/municipal representatives, utility representatives, appraisers, lenders, real estate agents, solar installers, building professionals, owners, and developers to help shape their efforts related to ZEB.

¹ <http://www.planning.ri.gov/documents/LU/energy/energy15.pdf>

² Resilient Rhode Island Act sets GHG emission reduction targets of 25% below 1990 levels by 2025, 50% below 1990 levels by 2035, and 85% below 1990 levels by 2050; <http://www.resilientri.org/legislation.php>

³ supported by National Grid's Energy Efficiency Programs funded by the energy efficiency charge on all customers' utility bills, in accordance with Rhode Island law

1.3 Definition of ZEBs

The Task Force established the Department of Energy's (DOE) definition of ZEB as a starting point for Rhode Island and determined that building level, campus and portfolio level definitions are most apt for the building stock in Rhode Island (see details in the introduction section of this document). The Task Force also agreed upon the three basic principles that constitutes ZEB: energy efficiency first (during design and construction), followed by a combination of on-site/off-site renewables, and finally post occupancy operations. The Task Force concluded that in order to meet the quantitative goals identified below, on-site renewable energy may not be sufficient to attain ZEB status and may have to include owned renewable energy certificates (RECs) or other off-site renewable energy sources.

1.4 Zero Energy Building Goals

Based on qualitative and high level quantitative analysis, the Task Force proposes the following aspirational goals for ZEBs in Rhode Island, given that a supportive environment is created in Rhode Island to achieve these goals. The Task Force recommends that the next ZEB Committee (per Recommendation #1 in section 4 of this paper) conduct deeper analysis and recalibrate these goals if necessary.

1. Establish a ZEB residential and commercial building energy code by 2035
2. **100%** of new construction to be ZEB after 2035, across the three building sectors: residential, commercial⁴ and public buildings
3. **10%** of existing homes and commercial building stock to be retrofitted to ZEB by 2035, across the three building sectors: residential, commercial and public buildings

The ZEB goals stated above assist in meeting roughly 27% of the State's 2035 GHG emission reduction goals (details provided in chapter 3 of this document).

1.5 Recommendations for Creating a 20-Year Pathway to ZEBs

The Task Force proposes three major recommendations that, when implemented, should put the state on a clear path for ZEBs to achieve the aspirational goals by 2035.

1. **Establish Zero Energy Buildings as a state priority to align with GHG emissions goals of State Energy Plan by 2035**
 - i. Institute state-wide ZEB goals, and the supplementing infrastructure in support of achieving the goals set by the State Energy Plan
 - ii. Institute ZEB supportive legislation to help create ZEB markets
2. **Launch a state-wide ZEB Program ("Zero Energy RI") across all building sectors**
 - i. Phase 1: Establish ZEB demonstration projects across building sectors
 - ii. Phase 2: Full launch of the state-wide ZEB program, with a financial, technical, marketing, and educational component, to promote and scale-up ZEB projects to mainstream
3. **Enhance utility's energy efficiency programs, and address integration between energy efficiency and renewable energy**
 - i. Establish a ZEB track as part of utility Energy Efficiency (EE) incentive programs
 - ii. Create a utility working group to address energy efficiency and renewable energy systems integration for its customers, and grid modernization efforts

⁴ Excludes industrial and manufacturing facilities

2. Introduction

2.1 Background

2.1.1 Formation of ZEB Taskforce

National Grid, as the electric and gas utility in Rhode Island, has been implementing energy efficiency (EE) programs for its customers over two decades. In response to a growing interest in Zero Energy Buildings (ZEB) in the New England region, National Grid created a Task Force to understand their feasibility and marketability in Rhode Island so as to expand its EE services to such buildings in the future. This also supports the “Energy 35, Rhode Island State Energy Plan” authored by Office of Energy Resources (OER) (herein referred to as “State Energy Plan” throughout the document) that directs Rhode Island to chart a long-term path to zero net energy buildings.

The task force was comprised of the utility, state representatives, member associations, building professionals, builders, developers and solar installation companies⁵. Through a series of work-sessions, the taskforce concluded the following:

- There is a desire for ZEB growth in Rhode Island and that market research is needed to identify areas of opportunities and challenges.
- A simple and consistent definition of ZEB is required, that is tailored to Rhode Island.
- The Task Force mission aligns with the State Energy Plan’s GHG emission reduction goals, and hence should be structured to support the objectives of this Plan.

With the above conclusions, the Task Force established two key actions for directing its efforts:

- Publish a whitepaper that defines a 20-year pathway to advance ZEBs across all the building sectors in Rhode Island.
- Develop quantitative ZEB goals to help contribute to GHG emissions in Rhode Island’s residential and commercial buildings thereby supporting the State Energy Plan.

A stakeholder workshop was also held to gather feedback from other external stakeholders. A summary of the workshop along with the attendees is provided in the Appendix.

The Energy 35, Rhode Island State Energy Plan is the state’s first data-driven energy planning and policy document that provides a long-term, comprehensive energy strategy, and establishes ambitious but achievable goals and performance measure targets for transforming Rhode Island’s energy system. <http://www.planning.ri.gov/documents/LU/energy/energy15.pdf>

DOE’s Definitions

Zero Energy Building (ZEB) - An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

Zero Energy Campus –An energy-efficient campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

Zero Energy Portfolio –An energy-efficient portfolio where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

Zero Energy Community –An energy-efficient community where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

⁵ A list of task force members is provided in acknowledgements above.

2.1.2 Definition of Zero Energy Buildings (ZEBs)

The Task Force established the Department of Energy's (DOE) definition of ZEB⁶ as a starting point for Rhode Island and determined that single building, campus and portfolio level definitions are most appropriate for the building stock in Rhode Island (described in the table in previous page).

Through high-level quantitative analysis, the Task Force also concluded, that in order to meet the ZEB goals identified in this paper, limiting on-site generation of renewable energy (RE) may not be sufficient to attain these goals especially for existing building stock. Thus it may be appropriate to use a modified DOE definition to include site-owned renewable energy certificates (RECs)⁷ or other off-site RE sources in addition to on-site RE already defined by DOE. There are many national-level discussions related to accountability of RECs that need to be considered when allowing for RECs or other off-site RE into the Rhode Island definition of ZEBs (also highlighted in the appendix of this document).

In summary, the taskforce proposes the following direction for the subsequent ZEB committee to define Rhode Island specific Zero Energy Buildings:

- DOE's definitions for buildings, campuses and portfolios should be applied as a starting point and then tailored to Rhode Island-specific needs.
- The modified ZEB definitions should include the three core components of ZEBs, also highlighted in the figure here as the three core components of ZEBs:

1. Energy efficiency first (design the home/building energy usage to its base minimum EUI during design and construction).
2. Use on-site renewable energy (RE) to support the remaining home/building energy needs. If the on-site RE potential is limited or not feasible, the definition should allow site owned RECs or off-site RE. (Refer to RECs implications in appendix of this document).
3. Post Occupancy: After occupancy, operate and use the home/building per ZEB design specifications for at least twelve months before considering it a ZEB home/building. (Figure here shows that plus loads and post occupancy operations are a big portion of the energy use in a high performance commercial ZEB.)

2.1.3 Rhode Island Leadership in Energy Efficiency and Clean Energy

Rhode Island has a long-standing commitment to reduce energy costs and deliver GHG reductions through investments in least-cost supply, including cost-effective energy efficiency. In addition, Rhode Island has consistently demonstrated national leadership in the advancement of energy efficiency and clean energy, and has been recognized as one of the nation's most energy efficient states in the nation by the American Council for the Energy-Efficient Economy (ACEEE)⁸.

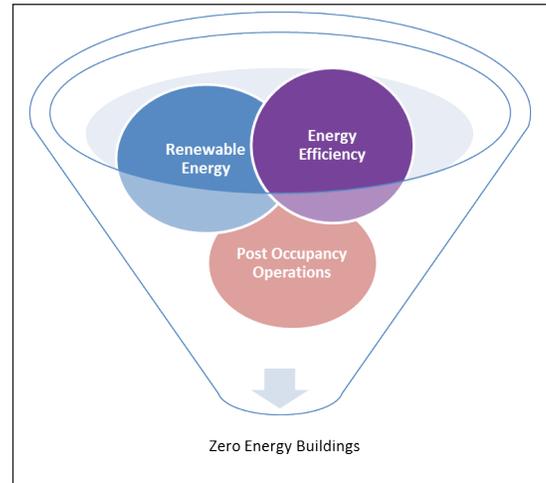


Figure 1: Core components of ZEB per Task Force

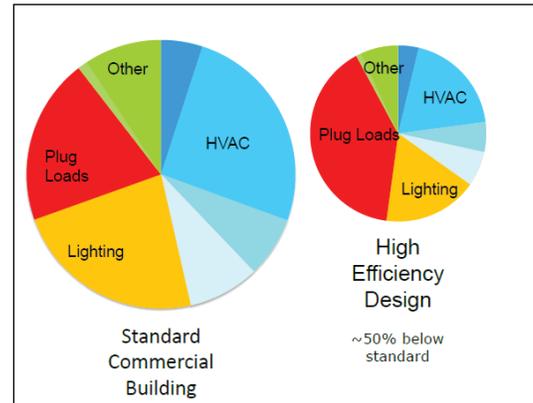


Figure 2: Energy use breakdown in a high efficiency design compared to standard design

⁶ <http://energy.gov/eere/buildings/articles/doe-releases-common-definition-zero-energy-buildings-campus-and>

⁷ [http://www.ripuc.org/utilityinfo/PUC-RES-AnnualReport2012-Rev\(3-25-14\).pdf](http://www.ripuc.org/utilityinfo/PUC-RES-AnnualReport2012-Rev(3-25-14).pdf), and http://www.green-e.org/learn_recs_101.shtml

⁸ American Council for a Energy Efficient Economy. <http://database.aceee.org/state-scorecard-rank>

Leadership positions in Rhode Island continue to ensure that energy efficiency and clean energy are paramount. The Task Force believes that the ZEB mission of this paper aligns with the goals of the following entities:

- The Rhode Island Office of Energy Resources (OER) is the lead state agency on energy policy and programs in Rhode Island and also the authored the State Energy Plan⁹. The Rhode Island Executive Climate Change Coordinating Council (EC4), established by the 2014 Resilient Rhode Island Act, has been assigned the task of quantifying measures that will contribute to economy-wide greenhouse gas emission reduction targets, including a 45% reduction target by 2035.
- The EERMC¹⁰, a stakeholder-driven advisory council, evaluates and make recommendations for state energy efficiency plans and programs.
- National Grid EE programs and Least Cost Procurement Legislation.
- Rhode Island Infrastructure Bank (RIIB), a quasi-public agency that provides financial assistance programs such as Property Assessed Clean Energy (PACE) and the Efficient Buildings Fund (EBF) for energy efficiency and renewable energy projects.
- The Systems Integration Rhode Island (SIRI) working group works on mapping out the challenges faced by the state’s evolving electric distribution grid and identifying opportunities and solutions.

2.2 Why Zero Energy Buildings (ZEBs) and Why Now?

Zero Energy buildings (ZEBs) are poised to play an important part of the GHG emission reduction solution as they are energy efficient and produce their own energy while minimizing impacts to the environment, and being resilient to the effects of climate change. The benefits of ZEBs are many and described in the table here.

A study conducted by the National Association of Home Builders (NAHB) Research Center asserts that by 2050, zero-energy homes should scale up to result in annual energy savings in that sector of approximately three quadrillion BTUs nationwide¹¹.

These impacts cannot possibly be achieved without an integrated approach to energy efficiency (EE) and renewable energy (RE). While EE reduces the overall energy consumption, it does not displace fossil fuel dependence. As for RE alone, without the bundling of energy efficiency technologies to reduce the energy load before RE generation is applied – this results in annual energy savings in 2050 of 0.4 quadrillion BTUs in single-family homes³ - less than 15% of the projected savings from zero-energy homes. ZEBs embody the beneficial interaction of bundling energy efficiency and renewable technologies together.

Benefits of ZEBs	
Occupant Benefits	<ul style="list-style-type: none"> • Healthier & comfortable indoor environment to live and work in. • Significantly lower cost of operating the building. • Reduced impacts of energy price volatility. • Increase in property value.
Local & Environmental Benefits	<ul style="list-style-type: none"> • Reduced strain on, and hence enhanced reliability of, existing utility infrastructure. • Reduce need to import fossil fuels; take RI toward energy adequacy. • Environmental benefits of lower GHG emissions. • Job creation, contributing to a healthy state economy.
National Benefits	<ul style="list-style-type: none"> • Reduce greenhouse gas emissions. • Reduced need for new power plants and hence impacts on the ecosystem. • Progression toward energy independence.

While the idea of ZEBs has been around for some time, the time is ripe now for market penetration of ZEBs in Rhode Island. This is due to several factors:

- Incredible decreases in solar electric costs - photovoltaic (PV) costs have decreased by more than 70% in the last 15 years¹².

⁹ ENERGY 2035 Performance Measure Target, p. 65. <http://www.planning.ri.gov/documents/LLU/energy/energy15.pdf>

¹⁰ Energy Efficiency Resource Management Council, <http://www.riermc.ri.gov/>

¹¹ <http://www.homeinnovation.com/~media/Files/Reports/ZEHPotentialImpact.pdf>

¹² https://emp.lbl.gov/sites/all/files/pv_system_pricing_trends_presentation_0.pdf

- Recent enactment of state laws and programs in Rhode Island that have stimulated a nascent market for renewable energy in the state¹³.
- Evolving high performance/efficient building technologies.
- Growing knowledge base for cost-effective ZEBs, championed by the U.S. Department of Energy.
- Early adopters and leading practitioners demonstrating the feasibility of ZEB's across building types and sizes in a variety of locations.

With Rhode Island's drive toward a sustainable energy future, and a target to reduce greenhouse gas (GHG) emissions by 45% by 2035, ZEBs become an important part of the solution with potentially contributing 13% reduction of the 45% GHG reduction goal per analysis in the next chapter.

2.3 Alignment between the “State Energy Plan” and the Proposed ZEB Pathway

To achieve Rhode Island's vision of a secure, cost-effective and sustainable energy future, the State Energy Plan that was released in 2014 recommends a suite of strategies grouped under six major policy-areas. The Task Force believes that three of these relate directly to ZEBs and their potential impacts, and substantiate this whitepaper's drive for a ZEB Pathway:

- Maximize energy efficiency in all sectors through Least-Cost Procurement Law, continue ongoing efforts to innovate with building codes, and chart a long-term path to zero net energy buildings for the new construction / renovation and existing housing markets alike.
- Promote local and regional renewable energy by expanding the Renewable Energy Standard (RES) - Rhode Island's current RES goal is set at 16% by 2019. Achieving the State Energy Plan's greenhouse gas emissions reduction target should require RES levels to expand to 75% by 2035.
- Reduce greenhouse gas emissions: Develop a carbon reduction strategy to align with the State's GHG emissions reduction goals.

¹³ As of December 31, 2015, Rhode Island was home to over 820 distributed generation projects (systems under 5 MW) comprising nearly 40 MW of installed renewable energy capacity. (Source: National Grid, Federal Energy Regulatory Commission)

3. Market Analysis of ZEBs in Rhode Island

In order to develop recommendations for delivering ZEBs across all building sectors, the Task Force conducted the following two steps, described in this chapter:

1. A preliminary assessment of the market conditions and the current status, identifying barriers in ZEB adoption in Rhode Island and then possible solutions to overcome the barriers.
2. Applied qualitative and quantitative analysis to establish ZEB targets and identified many areas of further research needed to establish an accurate goal for ZEBs by 2035.

3.1 Issues and Considerations for ZEB Growth in Rhode Island

ZEBs adoption has begun in the public, commercial and residential building sectors across the country. Rhode Island is still in very early stages of ZEB adoption with six ZEB/ZEB Ready¹⁴ homes and two ZEB Ready schools in Rhode Island (see Appendix for more details). The table below highlights the Task Force’s eight broad areas of concerns for ZEB growth and possible solutions to promote the growth in Rhode Island.

Areas of Concern	Rhode Island Specific Issues and Possible Solutions	
	Issues	Solutions
Awareness	ZEBs are relatively new in the building industry and implementation is limited to few early adopters thus far.	A proactive educational and outreach plan is critical to generate momentum around ZEB adoption, enhance the public awareness, and align the various stakeholder groups.
Higher Upfront Costs	Perception is that construction of ZEBs is cost prohibitive and suitable only for showcase projects with large budgets.	<p>-Technology improvements and a progressive shift in industry practices have dramatically improved the economic viability of ZEBs. Documentation on successful cost-effective ZEB projects is available by NREL¹⁵ and the U.S. DOE¹⁶ to guide building professionals in ZEB design and construction control costs.</p> <p>-The RI ZEB committee needs to work together with builders, builders' associations like RIBA, commercial developers and A&E firms to get a better understanding of incremental costs of building ZEBs in Rhode Island, especially during demonstration stages of this effort and identify ways to reduce first costs.</p>
Cost of Ownership	There is concern, particularly in the residential sector, that because a ZEB is priced higher, it comes with higher mortgage payments and thus higher annual cost to ownership.	As stated above, incremental costs need to be determined during the demo stages and strategies need to be in place to reduce costs. In addition, the demo stage through actual examples needs to make a case that annual cost of ownership of a ZEB can be lower than that of its non-ZEB counterparts.
Valuation and Financing	Correct and consistent valuation of ZEBs and a lack of financing products that recognize ZEBs are challenges for lenders, appraisers and other	New financing tools are beginning to be available for financing new solar PV installations to mitigate upfront-capital

¹⁴For the purpose of this document, ZEB "Ready" is any building or home that is designed with optimum EE to potentially be ZEB when RE component is added later.

¹⁵ <http://www.nrel.gov/docs/fy14osti/62752.pdf>

¹⁶<http://energy.gov/eere/buildings/zero-energy-buildings>

Rhode Island Specific Issues and Possible Solutions		
Areas of Concern	Issues	Solutions
	real estate stakeholders. The lack of information and financing tools can result in cost-effective ZEBs being denied financing and therefore never getting built. Conventional appraisal and loan approaches don't recognize true "value" of ZEBs.	concerns ¹⁷ . In addition, Elevate Energy and the National Home Performance Council ¹⁸ developed a list of seven steps that involve a multi-pronged approach of building energy labeling, data availability and partnerships with appraisers, lenders and realtors. In Rhode Island, more training may be needed for this group and a similar effort needs to take place specifically for commercial valuation and financing.
Technical know-how	ZEBs are often associated with complex technologies with building teams presented with many questions during design and construction phases like type of EE strategies and RE options for the site. In addition, finding qualified and experienced ZEB professionals to implement solutions has been a challenge for building owners. Post occupancy, assuring that the ZEB continues to operate as efficiently as the design intended, is also a challenge.	Research has shown that ZEBs are not necessarily technologically complex ¹⁹ , the perception likely comes from the inherent challenge of integrating many technological elements - including EE and RE integrations, and building operational modifications. Progress is being made on all fronts through DOE and affiliated technology centers. Locally, the state and utility continue to offer assistance through Energy Efficiency Programs. Going forward, more needs to be focused towards ZEB-based assistance.
Alternatives for on-site generation	When it comes to on-site renewable energy, rooftop solar PV generation is currently the prevalent technology. The State Energy Plan indicates that in Rhode Island there is PV rooftop potential for 35% of residential homes and 35% of the commercial buildings with an estimated technical potential of 800 MW of solar by 2035. The Plan also provided scope for other RE sources.	Possible strategies need to be developed to address RECs and off-site generation opportunities. The ZEB guidelines in this whitepaper propose that such properties can leverage RE from offsite sources in order to meet their ZEB requirements. Appropriate state policies, utility regulations and administrative processes need to be set up to enable this strategy to work at the scale called for in this paper.
Multiple Stakeholders' Interests	Driving sizeable ZEB growth to realize a major reduction in GHG emissions inevitably involves new regulations, public and private investment, new demands on utilities and on building/real estate industries, and in turn impacts building owners and occupants. Conflicts between various stakeholder groups triggered by new expenditures and regulatory requirements would seem inevitable and will need to be managed as they arise and as solutions are developed.	This strongly points to the need for a leadership role (as recommended in the next section) to ensure alignment and a statewide program as a unifier, to bring together the interests of multiple stakeholders.
Need for supportive utility infrastructure	ZEBs entail two-way interaction between buildings and energy grids, imposing new challenges on the legacy electricity grid originally built as a one-way energy flow – generator to customer. In addition, the added load can also put strains on the distribution system. There may also be perceptions of higher utility costs in the future.	To accommodate the desired ZEB growth and need for regulatory design changes in a cost effective way, a supportive energy delivery infrastructure is critical. National Grid has already advanced distribution system modernization improvements in Rhode Island and can build on this experience by creating an infrastructure that not only meets the needs of ZEBs cost effectively to its customers but also delivers energy more efficiently, accommodates regulatory design changes, and supports new technology deployment like energy storage.

¹⁷ Department of Housing and Urban Development (HUD and Fannie Mae http://blog.rmi.org/blog_2016_06_01_fannie_maes_financing_for_solar)

¹⁸ August 2013 publication: CNT Energy and National Home Performance Council, "Unlocking the Value of an Energy Efficient Home - A Blueprint to Make Energy Efficiency Improvements Visible in the Real Estate Market"

¹⁹ <http://www.caba.org/CABA/Research/Zero-Net-Energy-Buildings.aspx>

3.2 ZEB Targets and Quantitative Analysis of Rhode Island Building Stock

This section provides a high level projection of energy savings and renewable energy production that would be required to meet the 2035 ZEB goals stated in this white paper and given below. The Task Force recommends that the next ZEB Committee (per Recommendation #1 in section 4 of this paper) conduct deeper analysis and recalibrate these goals if necessary.

1. Establish a ZEB residential and commercial building energy code by 2035
2. **100%** of new construction to be ZEB by 2035, across all building sectors
3. **10%** of existing building stock to be ZEB by 2035, across all building sectors

3.2.1 Methodology and Assumptions:

Source: A number of assumptions were made based on insights from industry leaders, statistics provided in the State Energy Plan and National Grid's database of participants in its energy efficiency programs.

Modeling: To generate quantitative impact of energy savings and renewable energy production (in this case PVs were used as RE technology) needed to meet ZEB goals of the white paper, separate models were created for residential housing stock (new and existing homes) and commercial buildings (new and existing buildings).

Limitations: The focus of this analysis was on the EE and RE systems capacity that is required to meet the ZEB goals of this paper. Construction costs, incremental costs of ZEBs and other benefits like jobs, resiliency and other metrics to the cost benefit analysis or physical capabilities of the electric grid to accommodate RE, were not analyzed. Due to limited funding to support the Task Force findings, the quantitative analysis presented below is limited and would require further analysis by the next ZEB committee.

3.2.2 Findings

The high level calculation shows that execution of the ZEB goals can contribute to 27% of the state's 2035 GHG emission reduction goals.

Existing Buildings versus New Construction

- The square feet of existing buildings (residential and commercial combined) is more than 4 times that of new construction²⁰.
- As shown in Figure 3, existing residential stock has the largest share of square feet that will need to be retrofitted to ZEB in order to meet the 10% goal determined by this white paper. This indicates that there will need to be more state investment to support the residential ZEB goals than the commercial sector.
- Existing buildings (vast majority of the ZEB area) will need to rely on off-site RE because key architectural features that are barriers to onsite RE are too expensive to change universally.
- In new construction, architectural practices will allow for more on-site RE than existing buildings.

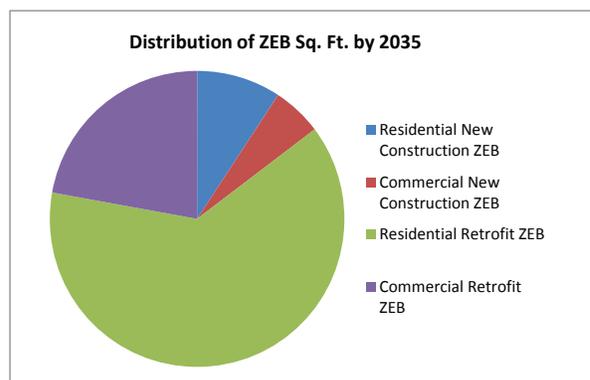


Figure 3: Break down of residential and commercial ZEB square feet to meet ZEB goals of white paper

²⁰ The modeling assumed a growth rate of 1 to 1.5% per year for new construction. Existing homes and building square feet was calibrated using OER's market assessment report. Approx 751 Million sqft was assumed as the existing housing stock of which 10% will be targeted for ZEB conversions. For new homes, 2 million sqft annual construction is assumed. market segmentation summary tables

Energy Efficiency

- **Energy Use Intensity (EUI):** All ZEBs are expected to have a certain level of energy use per square foot (also called Energy Use Intensity—EUI) that make for a reasonable requirement of renewables. New Buildings Institute’s recommended EUIs for the Southern New England climate zone were used to create these Rhode Island specific EUIs. For commercial ZEBs, the Task Force assumed an EUI of 28 KBtu/sqft for new construction and 36 KBtu/sqft for retrofits, and for residential ZEBs an EUI of 24 Kbtu/sqft for new construction and 30 kbtu/sqft for retrofits. The Appendix provides more details on how these EUIs were derived.
- **Fuel Mix:** Oil is a significant part of residential usage for heating (in addition to gas) and a small percentage in commercial. If fuel switching from gas/oil to electric happens (to meet ZEB goals), there will be a dramatic reduction in oil and natural gas consumption and only a modest reduction in electric consumption as fossil fuel heating will be replaced with electric heat pumps.
- **Magnitude of Energy Efficiency:** Figure 4 below shows that there has to be tremendous reduction in EUIs and energy usage both for residential and commercial buildings in order to accommodate remaining energy through on-site or off-site RE to meet the ZEB goals.

Renewable Energy

- The Figure below shows how much on-site PV production is needed to achieve the 10% retrofits and 100% new construction in both residential and commercial building stock, and how much is possible on-site given what is currently understood about site conditions and PV panel output.
- This analysis demonstrates the necessity to use onsite and off-site RE, and supports the Task Force’s recommendation to allow for on-site and off-site renewable energy (RE) in ZEBs.

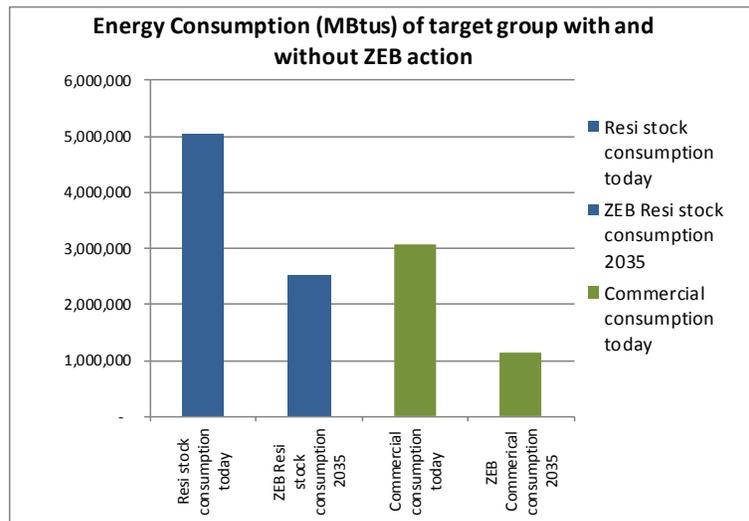


Figure 4: Energy consumption of target groups with and without ZEBs (10% existing and 100% new)

	Residential (MW)		Commercial (MW)	
	10% Retrofits	100% New	10% Retrofits	100% New
PV needed	600	71	464	70
PV possible on-site	195	71	60	45
Balance off-site PV	405	0	404	25

Figure 5: On-site Photovoltaic (PV) production needs to meet ZEBs goals by 2035

Greenhouse Gas Emission:

- If the ZEB goals of this paper are met, by 2035, total carbon reduction is in the magnitude of approximately 1.3 million metric tons (using EPA's online calculator) which translates into 27% of the state's GHG emission goal for 2035—Figure 6.
- Figure 7 shows that PV production (combining residential and commercial) contributes more than 50% of that carbon reduction (out of the 27% GHG reduction)

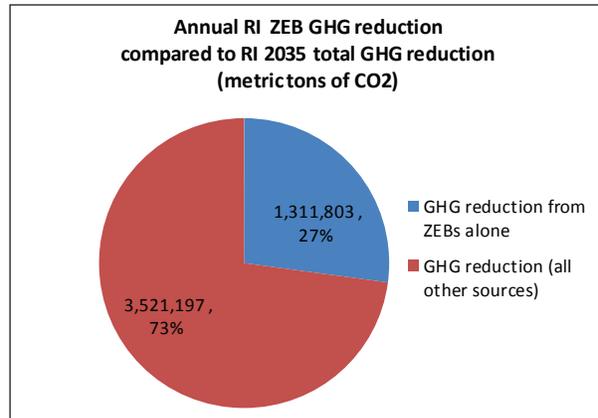


Figure 6: Percent contribution of ZEBs to meet the 2035 state target of 45% GHG reduction

3.2.3 Conclusion:

The intent of this analysis was to show the impact of ZEB goals on EE and RE production. This analysis also brought forth many issues that still need to be addressed in order to determine a realistic goal for ZEBs in Rhode Island. Due to limited budget, timeline and lack of complete data, the Task Force could not address many issues raised in its analytical work and have listed them below. The Task Force recommends that the ZEB Committee (per Reco#2) use this analysis as the basis for next level of research and analysis and determine appropriate goals for ZEBs and their GHG contribution to the 2035 State goal.

- Cost for achieving the scale of energy efficiency needed to meet the ZEB goals needs to be assessed.
- Due to the large magnitude of retrofit area impacted, retrofit conversion will have a commanding influence on the policies and investments that must be made to achieve the ZEB goals.
- There is little known about the feasibility and economics of large scale ZEB retrofits in occupied buildings and requires a deep dive exploration by the next ZEB Committee
- Incremental costs to support high levels of energy reductions will have to be considered by the state and utility when planning their EE programs. New ways of approaching EE funding for ZEBs will have to be considered. With the current EE funding, it will be a challenge to meet incremental costs of ZEBs.
- Impact of gas measures being converted to electric will have to be studied and examined. Analysis will be required to measure the impact on the grid and electric generation resources of increased winter peak electric demand, as gas heating transfers in large volumes over to electric heating demand.
- This analysis demonstrates the need to use onsite and off-site RE, and supports the Task Force's recommendation to allow for on-site and off-site renewable energy (RE) in ZEBs.
- The GHG emission reductions stated here need to be communicated to the EC4²¹ committee so that a more accurate GHG emission calculation can be done using EC4's method and so that this state agency can incorporate ZEBs as a pathway toward the 45% reduction by 2035

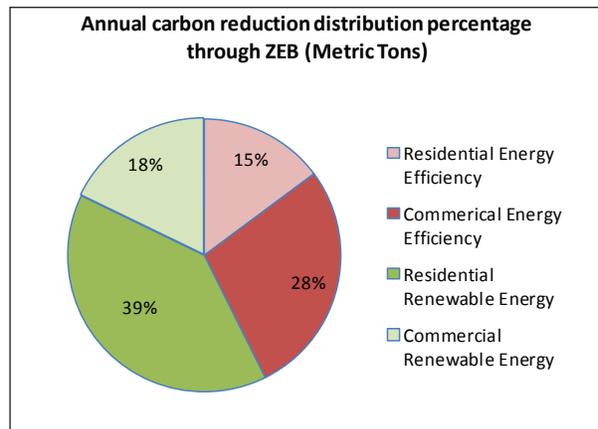


Figure 7: Carbon reduction contribution of ZEBs by sector

²¹ Executive Climate Change Coordinating Council, established by Resilient Rhode Island Act, assigned the task to quantify measures resulting in 45% GHG reduction by 2035

4. Task Force Recommendations

The Task Force explored the motivations and benefits behind ZEBs, and identified the key influencers listed below that would enable ZEB adoption into the mainstream in Rhode Island:

Key Influencers	Motivation
State policies and legislation	These would be key in elevating ZEBs as a priority
Utility energy efficiency program, and grid infrastructure	The utility's role is critical in many ways: providing supportive and cost effective energy delivery infrastructure and energy efficiency services
Infrastructure for financial, technical and educational support	Given the very early stage of ZEB adoption for building owners and building industry professionals alike, this support is crucial
Marketplace implementation through building professionals and owners	These are catalysts in promoting the growth of ZEBs if provided with the tools mentioned in the three points above

The three major recommendations, that when implemented, will advance ZEBs across all building sectors in Rhode Island by 2035, and are:

1. **Establish Zero Energy Buildings as a state priority to align with GHG emissions goals of State Energy Plan by 2035**
 - i. Institute state-wide ZEB goals, and the supplementing infrastructure in support of achieving the goals set by the State Energy Plan
 - ii. Institute ZEB supportive legislation to help create ZEB markets
2. **Launch a state-wide ZEB Program (“Zero Energy RI”) across all building sectors**
 - i. Phase 1: Establish ZEB demonstration projects across building sectors
 - ii. Phase 2: Full Launch of the state-wide ZEB program, with a financial, technical, marketing, and educational component, to promote and scale-up ZEB projects to mainstream
3. **Enhance utility’s energy efficiency programs, and address integration between energy efficiency and renewable energy**
 - i. Establish a ZEB track as part of utility Energy Efficiency (EE) incentive programs
 - ii. Create a utility working group to address energy efficiency and renewable energy integration for its customers, and grid modernization efforts

Buildings Sectors & Timeline of Implementation

The white paper recognizes that the three building sectors (public, commercial and residential) all have unique characteristics in terms of design and construction, energy usage, costs of construction and maintenance, and policies supporting energy reduction and renewables in these buildings. For the purpose of this paper the following sections are generic recommendations applicable to all market sectors. The Appendix provides specific activities for each sector.

4. 1 Recommendation 1: Establish Zero Energy Buildings as a state priority to align with GHG emissions goals of the State Energy Plan

Objective

Electricity and thermal loads that comprise the predominant end-use consumption in the building sector, account for 60% of the state's CO2 emissions (with transportation accounting for the remaining)²² and thus a major factor in achieving the state's GHG emission reduction target. ZEBs with their markedly reduced energy needs through design and RE technologies positions them as powerful contributor for meeting the state's GHG emission reduction goals, forming the rationale for the two key recommendations proposed in this section.

Category: Policy and Legislation

Primary Leadership Agency: RI Office of Energy Resources

Primary Partners: Policy makers, code commission, legislative reps, utility, building and solar experts

4.1.1 Reco#1, Action 1: Institute state-wide ZEB goals and supplemental infrastructure

Intent: Designate a state champion who manages all aspects of the ZEB goals, form a committee of experts who will define quantitative state-wide goals, identify funding sources and partnerships to help meet the goals.



Figure 8: Initial Steps to ensure formal appointment of ZEB Committee to achieve state ZEB Goals

4.1.1.1 Identify capacity for staffing resources at OER in support of ZEB program implementation

To build the momentum of ZEBs in RI and to implement all recommendations of this white paper, the Task Force recommends instituting two immediate and critical elements: appoint a state-wide ZEB champion, and establish a ZEB committee by January 2017.

- **ZEB Champion:** Embedded within the Office of Energy Resources (OER), the ZEB champion should be the driving force behind the state's ZEB goals. The champion should orchestrate ZEB activities across all the building sectors to drive for ZEB participation. The ZEB champion should establish an annual reporting mechanism to assess progress toward the goals, and recalibrate the ZEB implementation efforts accordingly.
- **ZEB Committee:** The advisory committee, managed by OER's ZEB champion, should be

²² <http://www.planning.ri.gov/documents/LU/energy/energy15.pdf>; pg 2, 3

comprised of representatives across a wide range of organizations and stakeholders such as state agencies, building professional associations, the utility, builders and developers, solar industry representatives, business and finance community, including members of the ZEB Task Force. Some of the functions of the committee as an objective multi-disciplinary group are as follows:

- o Support the efforts of the ZEB Champion in achieving the state's ZEB goals, assure that the interests of various stakeholder groups are represented and aligned, and provide guidance for mitigating any challenges to meet ZEB goals.
- o Align funding for state-wide ZEB program: Pursue specific ZEB funding through existing programs, such as but not limited to: DOE grants; National Grid incentives, Renewable Energy Funds, RIBB and Regional Greenhouse Gas Initiative (RGGI).
- o Advance ZEB goals through strategic partnership programs through engaging city level ZEB goals that align with the state's ZEB goals. Partner with the Department of Education to develop and implement a ZEB program across all schools.
- o Monitor the demonstration stages of the ZEB program.
- o Develop a technical and financing package for the building industry to scale ZEBs.

4.1.1.2 Incorporate ZEBs into the state's goals for GHG reduction and clean energy

Using the quantified projections in the previous section and the list of recommendations the ZEB Committee should conduct the next level of research and analysis that is more accurate and to solidify ZEB goals accordingly. The appropriate goals for each building sector should be defined as the ZEBs advance through demonstration projects/pilots and the early stages of full implementation.

4.1.2 Reco#1, Action 2: Institute ZEB supportive legislation to help create ZEB markets

Intent: The Task Force envisions a three-pronged approach for how legislation should support and expand ZEB market share in Rhode Island:

- Use building energy disclosure to increase visibility into building energy efficiency, thus reinforcing EE as the first essential step toward a ZEB building (existing buildings).
- Drive buildings progressively toward ZEB through code (state energy code and/or voluntary stretch code) requirements (new construction/major rehab).
- Make renewable energy available at all projects (existing and new)

The comprehensive legislation serves as a cornerstone to achieve ZEB market growth, but a whole range of supplementing ZEB initiatives in the state are necessary to support greater ZEB adoption on a timetable to meet the Energy 2035 carbon goals. The Task Force recommends that the State initially focuses on aligning and enhancing existing legislation and filling in the gaps to complement ZEB growth in Rhode Island.

The following legislative activities recommended by the Task Force are not intended as a precursor to the ZEB initiatives in the state, but rather as gradual work that shapes the conditions for greater ZEB adoption. A timeline in the Appendix suggests a short-term, mid-term and long-term sequencing of activities.



Figure 9: Energy Efficiency (EE) and Renewable Energy (RE) policies and legislation activities to support ZEBs

4.1.2.1 Adopt Energy Benchmarking and Disclosure for Existing Buildings and Homes

To make ZEB achievable and cost-effective for all buildings, energy efficiency should be optimized before renewable energy systems are sized and installed. However, a building’s energy usage/performance can be challenging to gauge because it is not easily available or understood. The Task Force recommends adopting building energy benchmarking, disclosure and labeling as a means to increase visibility into a building’s energy performance, and encourage building owners, operators, and builders to consider energy efficiency first.

Building energy benchmarking can help guide the development of specific legislative/policy and utility program activities to support the advancement of ZEBs in a way that is logical and applicable to the buildings.

The supporting activities include:

- **Easy Access to Data:** OER should work with National Grid to make aggregate, whole-building level energy use data available to all building owners for energy performance benchmarking, reporting and labeling (residential, commercial and public) and address the issue of data privacy through legislation.
- **Public Buildings:** The State should adopt mandatory building energy benchmarking, disclosure reporting and labeling for all public and municipal buildings in concert with Leading by Example energy reporting efforts.
 - o Require the use of Energy Star Portfolio Manager (PM) or equivalent
 - o Stagger benchmarking and reporting requirements starting with public and municipal buildings with a gross floor area 50,000 square feet and over followed by all buildings with a gross floor area 20,000 and over. Benchmarked public buildings must maintain their PM accounts and disclose publicly how the buildings are functioning.
 - o Evaluate using a benchmarking tool appropriate to target potential public buildings to retrofit as ZEB’s.
- **All Other Buildings:** The State should develop benchmarking, labeling and disclosure procedures, and tools to rate commercial and residential buildings. The ZEB Committee should review varying methods for energy disclosures – voluntary or mandatory – and determine the appropriate approach for each building sector.
- **City-led Efforts:** Support city-led energy performance benchmarking reporting efforts and model a statewide mandate on key lessons learned from the city-led efforts.
- Support the development and piloting of a building energy asset score program that can generate an energy efficiency rating for commercial and multi-family buildings. Work with home builders to create a public recognition platform based on the DOE Zero Energy Ready Home label that highlights the lasting value and benefits of ZEB’s.

- Set energy targets and utilize the Zero Energy Performance Index (zEPI)²³ scale as an effective way to chart the progress of policies and building on the path to Zero Energy (Figure 10).

4.1.2.2 ZEB energy codes legislation

State Energy Code: In Rhode Island, State Building Energy Code follows the provisions of the International Energy Conservation Code (IECC), as published by the International Code Council, Inc. (ICC), together with State amendments (2012 edition is the current adopted code).

The Task Force identified two pathways for the next ZEB committee to consider when planning a road map for ZEB codes in Rhode Island:

Option 1: Recommendation for the State Legislature to consider setting timetables to ensure Rhode Island base energy code achieves a ZEB-level by 2034. Each three-year adoption cycle between 2019 and 2034 should accelerate energy savings beyond those in the contemporaneously published IECC codes. Most of the Task Force participants support this option because this accelerated schedule aligns with and is essential to meeting the ZEB targets in this white paper. Each three-year cycle delay in achieving ZEB in the code means millions of additional square feet of residential and commercial construction would be built to traditional codes in Rhode Island, moving it measurably further from the 2035 carbon reduction goals. At the same time, the Task Force understands that this will require a detailed cost benefit analysis and stakeholders support before it is adopted.

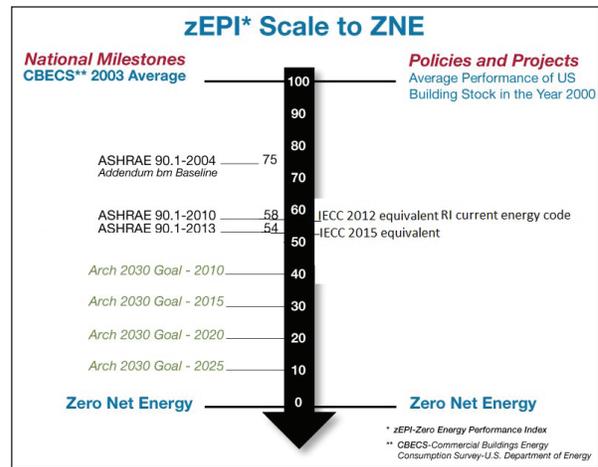


Figure 10: zEPI scale that shows various national standards including today’s RI state energy code relative to getting to zero (source: New Buildings Institute)

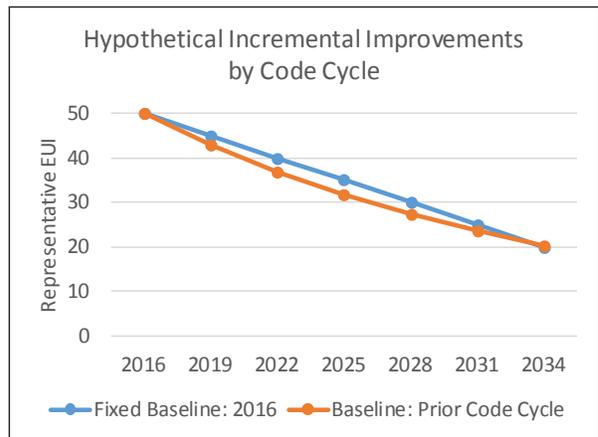


Figure 11: Rate of EUI reduction to get to ZEB code by 2034 via two options: fixed baseline (Path 1) and Prior Code Cycle Baseline (Path 2) (source: New Buildings Institute)

Figure 11 illustrates in the form of EUI reduction that there are two paths to move from a hypothetical current baseline of 50 KBtu/sf in the 2016 code to a hypothetical ZEB target of 20 KBtu/sf in the 2034 code. For the sake of simplicity, a ZEB target of 20 KBtu/sf is shown in this table even though previous section assumes a ZEB target of 28 KBtu/sf to be more relevant for Rhode Island. Path 1 (labeled as fixed baseline) would require a fixed reduction of 10% from the 2016 baseline (ie. reduction of 5 EUI points each cycle); and path 2 (labeled as Baseline: Prior Code Cycle) would require a 14% reduction each cycle from the code active at that time. Each path results in ZEB-level buildings, but path 1 would require a final code change meeting a 20% reduction from already low levels. Our recommendation is path 2 – for legislative milestones to achieve a 14% energy use reduction per code cycle. Figure 12 illustrate the same paths showing percent improvements per code cycle for each path.

Stretch Energy Codes: Stretch codes provide a more energy efficient alternative to the standard energy provisions of the code thereby expediting market transformation to the next round of state energy codes. Rhode Island leadership is already on a pathway for developing ‘stretch’ energy codes for state facilities (as stated in the Executive Order 15-17) and voluntary stretch codes for commercial and residential sectors. These stretch codes can be a strong enabler in accelerating the market and legislation to the goal of achieving a state energy code by 2035. The Task Force recommends that the voluntary stretch energy codes be supported by incentives to projects that opt for these codes (for example, utility EE program incentives, expedited permitting through building departments) and that these codes be regularly published every three years to accelerate the market to State ZEB codes by 2035.

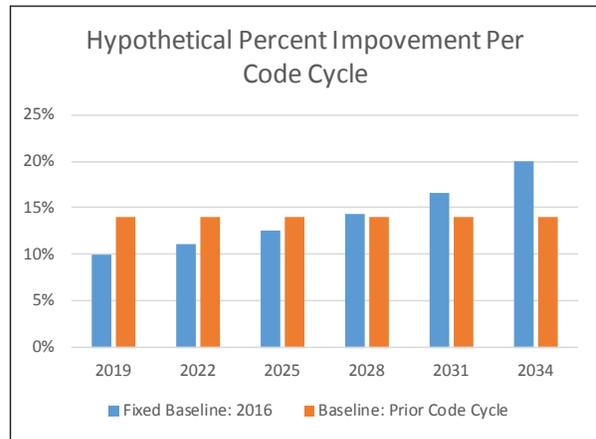


Figure 12: Percentage reduction required to get to 2034 ZEB code using options 1 and 2 (source: New Buildings Institute)

Option 2: Recommendation for State Legislature to focus on legislations that support incentives, tax credits and other avenues to promote growth of ZEBs in Rhode Island. This is in addition to the availability of voluntary stretch codes that incrementally lead to stretch ZEB codes by 2035. This option relies on the market to evolve to ZEBs if all market barriers to ZEB implementation have been eliminated.

	Description	Considerations
Option 1	State Legislature to focus on achieving a State ZEB Code by 2035, to be supported by voluntary stretch codes	Ensures the adoption of a ZEB code by 2035. Ensures that 100% of new construction and major rehab will meet the goals of this paper. -Involves a detailed cost benefit analysis and stakeholders support before it is adopted.
Option 2	State Legislature to focus on legislation that supports the growth of ZEBs and removes market barriers to enable the market to evolve into meeting the ZEB goals of this paper. This is in addition to voluntary ZEB stretch code by 2035	No guarantee for meeting the goals of this paper. If market barriers are completely removed, there is a possibility for market transformation to lead to 100% NC to be ZEB by 2035

EE and RE Integration: By definition, ZEB building codes must comprise both energy consumption and energy generation components. The Task Force suggests that later cycles of code include pathways for onsite and offsite renewable energy integration, electric vehicle charging, and energy storage.

Trainings: Expanded training and education to code officials and other building professionals across all building sectors at each code update is essential for the success of this code trajectory. Currently the utility based EE programs offer this support for base energy code and should expand their outreach to stretch code and ZEB code trainings in the future. The Appendix of this document outlines a code-specific timeline as a guideline to the code planning group.

²³ The 2015 International Green Construction Code (IgCC) includes many progressive measures that will improve the energy performance of buildings. One important provision describes the Zero Energy Performance Index (zEPI), which provides a scale for measuring commercial building energy performance. <http://shop.iccsafe.org/media/wysiwyg/material/3751S15-Sample.pdf>

²⁵ Even though NBI used a lower EUI of 20 Kbtu/sqft for this example, our earlier quantitative analysis (in chapter 3) used a higher EUI of 28 Kbtu/sqft, assuming this to be a more realistic target for Rhode Island

4.1.2.3 Legislation and/or Policies to ensure renewable energy is readily available to owners across all building sectors for achievement of ZEB through 2035

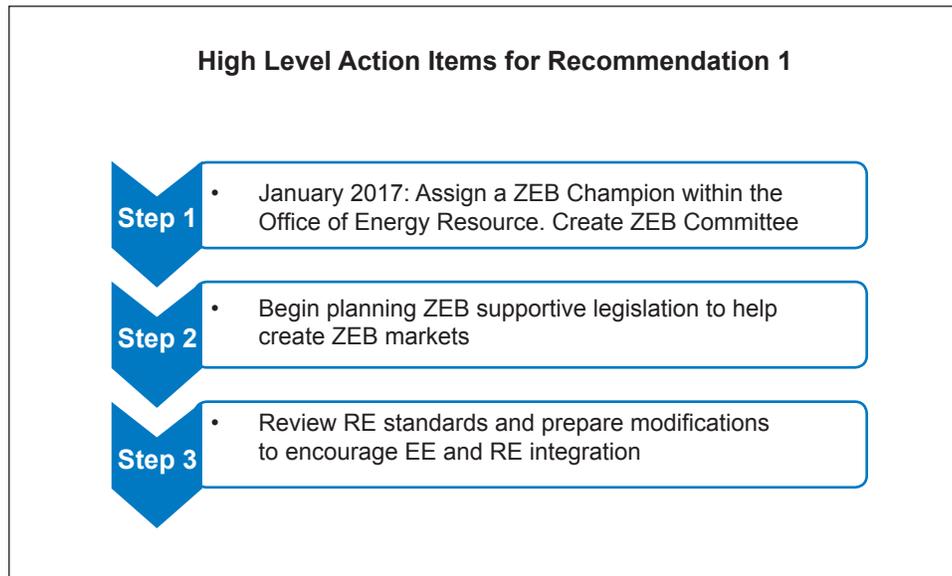
- The ZEB Champion at OER should work with the State Legislature to update, align and integrate State policies to integrate RE with EE to achieve ZEB by 2035.
 - Map Rhode Island's current renewable energy promotion processes and assess adequacy and gaps as listed in the System Integration RI (SIRI) vision document²⁶. As Rhode Island's efforts to expand renewable energy proceed, close attention must be paid to the integration of the different processes so as to simplify the experience of customers and developers, optimally stimulate the state's growing clean energy industry, and achieve clean energy goals at maximum benefit and minimum cost.
 - Ensure existing renewable energy programs are extended and continued into the future. For example the Renewable Energy Fund²⁷ was just extended until 2021 last legislative session.
 - Expand the Rhode Island RE Growth²⁸ program into the future. RE Growth enables utility customers to sell generation output under long-term tariffs at fixed prices.
 - Review and revise goals for Renewable Portfolio Standards (RPS) in State Energy Plan so that they align with the State's ZEB goals. Clarify the distinction between RE generation that is counted toward achieving the RPS from those used to account for ZEB achievement. Renewable Energy Certificates (RECs) resulting from new renewable energy systems should contribute either to the RPS or ZEBs, but not be counted for both. RECs for renewables associated with ZEBs should be retained or retired by the building owner. (See Appendix Y for a list of national issues related to RECs).
- Implement policies that should facilitate the development of renewable energy generation at scale:
 - Commission a study to evaluate the community solar/shared solar programs that were recently passed through legislation. Identify how best to use community solar as an option for off-site RE to meet the requirements of RE for ZEB status.
 - Consider the diffusion of renewable fueled Combined Heat and Power (CHP) technologies especially as they apply to district heating and cooling systems, and integrate them with utility EE incentive program offerings.
 - Support innovative land use policies that can foster district-level pathways for ZEB's. Examples of this strategy include Fort Collins Zero Energy District (Fort ZED) and Vancouver's District Energy Strategy.
 - Consider adding language regarding zoning guidelines for ZEBs. For example, there are no solar specific zoning guidance for municipalities to include in their comprehensive plans. The zoning guidelines would enable that to happen.
- Market Development
 - Mandate public sector pilot demonstration projects and programs that feature and highlight ZEB facilities and renewable energy technologies.
 - Work with stakeholders from the real estate sector to incorporate photovoltaic system characteristics into multiple listing services for residential buildings that show whether a home has PV, whether the PV is directly owned or third-party financed.

²⁶ <http://www.energy.ri.gov/documents/siri/Systems%20Integration%20Rhode%20Island%20Vision%20Document%20January%202016%20FINAL.pdf>²⁶ http://newbuildings.org/code_policy/outcome-based-energy-codes/

²⁷ The Renewable Energy Fund (REF) provides grants and loan opportunities for eligible renewable energy technologies for preliminary feasibility studies as well as direct residential, commercial, and municipal installations. <http://www.energy.ri.gov/renewable/>

²⁸ Available to eligible renewable distributed generation (DG) projects, the RE Growth Program enables customers to sell their generation output under long-term tariffs at fixed prices. https://www9.nationalgridus.com/narragansett/business/energyeff/4_dist_gen.asp

- Market Development
 - o Mandate public sector pilot demonstration projects and programs that feature and highlight ZEB facilities and renewable energy technologies.
 - o Work with stakeholders from the real estate sector to incorporate photovoltaic system characteristics into multiple listing services for residential buildings that show whether a home has PV, whether the PV is directly owned or third-party financed.



4.2 Recommendation 2: Launch a state-wide ZEB program (“Zero Energy RI”)

Objective

In order to establish ZEB as a statewide initiative, it is essential that the State’s Office of Energy Resources (OER) and National Grid jointly lead this initiative for the following reasons:

1. OER is the State’s primary energy policy office and bridges all of the State’s utility districts and building sectors. It also maintains the state’s Renewable Energy (RE) portfolio
2. As Rhode Island’s only electric and gas utility, National Grid also implements the state energy efficiency (EE) programs with a wide range of residential and commercial projects.

Under OER’s and National Grid’s leadership, a structured state-wide ZEB program should be launched targeting not only builders, building owners, operators and managers, but also a wide range of stakeholders including appraisers, inspectors, energy auditors, loan underwriters and renewable energy installers. The essential components of this program are: (a) market mobilization through successful pilots/ demo projects; and (b) market transformation through financial support, technical support, marketing and branding, and educational support.

Category: Marketplace Implementation

Primary Leadership Agency: RI Office of Energy Resources and National Grid

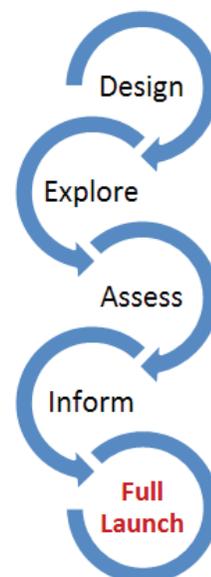
Partners: Building owners, architects, engineers, contractors, state agencies, municipalities, cities, financial industry, solar reps.

4.2.1 Reco#2, Action 1: Launch “ZEB demonstration projects” across building segments

Intent: At the onset, OER and National Grid in consultation with the ZEB Committee and other stakeholders, should design and launch ZEB demonstration projects (demo-projects) for residential, commercial and public building sectors, new and retrofits. These projects should help mobilize the market by demonstrating the benefits of ZEB, establishing scalability, and making a case for ZEB as a financially worthwhile choice. The demo-project phase encompasses four primary elements – Design, Explore, Inform, and Assess – which are detailed below. The Task Force recommends a five year period to complete the ZEB demonstration stage, starting in 2017.

4.2.1.1 Design & Identify Projects: *Design the demo-project criteria to assure clear instruction and ease of participation.*

Working closely with the ZEB Committee, the OER/National Grid team should design the structure and criteria of the demo-projects incorporating the following aspects. A phased strategy may be considered during selection. For example new homes/buildings could be part of phase 1 of demo projects followed by retrofit projects. Schools could be targeted because of their already assessed energy reports and ZEB targets:



- Conduct statewide outreach to generate interest for the demo-projects.
- Identify funding sources for technical and financial assistance needed to complete the projects.
- Prioritize based on new versus retrofits and by building types to assure that the demo-projects cover a representative sample of building.
- Use the white paper ZEB definition to define technical guidelines for attaining ZEBs for this demo projects (design and post occupancy operations guidelines).
- Schools: In October 2016, the Rhode Island Department of Education (RIDE) recently completed an energy assessment of 307 schools and developed an energy report card that defined action plans to achieve net zero energy for all schools. The ZEB committee should tap into this report and identify school projects that can be used as demonstration projects and establish a funding mechanism to support these. In addition, the North East CHPS²⁹ manual provides guidelines for schools to incorporate ZEB features that should be tapped into when developing guidelines for ZEB schools.
- Outline the metrics for project success for each building sector like performance measurement criteria (such as HERS rating, or energy performance using one-year's utility bills).
- Set up training programs for building operators and occupants for completed demo projects.

4.2.1.2 Explore: *Utilize the demo-projects to explore options for their feasibility and impacts.*

The demo-projects should serve as a testing ground for identifying the best course of action with respect to critical elements of the full launch of ZEB Program, such as:

- Treatment of RECs – The ZEB Committee should test out various options for the RECs - such as retiring them, selling to the utility, selling to the open market – and recommend the best fit for scaling-up ZEBs in the state.
- Stakeholder Partnerships – The demo-projects should serve as a medium for fostering and honing working relationships with key stakeholder entities such as the developers and builders, RIDE and Rhode Island Housing. With effective partnerships, these entities can become strong change agents to meet the ZEB goals.
- Zero Energy Cities: Many U.S. cities like Cambridge³⁰ have begun work toward net zero communities, with building energy use alone being just one piece of integrated planning that should address impacts from transportation emissions, water conveyance, and waste infrastructure. During the demo stages, the ZEB committee should begin discussions with key cities in Rhode Island and evaluate if Zero Energy Cities is a relevant model for them and how the ZEB goals can contribute to these models.
- Education and Outreach – The ZEB Committee should review methods for stakeholder outreach and education, and recommend the best methods to be sustained for future use.
- The demo-project phase should incorporate design and construction competitions to build market momentum and to attract and reward innovations and to further refine and develop the elements of the future projects.
- The demo-projects outcomes should inform marketing campaigns, and serve as training platform for promoting future ZEB projects. The demo-projects should thus help shape the statewide ZEB program, and refine policies and guidelines to support wider adoption of ZEB projects.

4.2.1.3 Assess & Evaluate: *Track and evaluate aspects of the demo-projects to identify areas for calibration and modification.*

- Review white paper ZEB definition and assess if it needs modification.
- Review and establish technical and post occupancy operations package for ZEBs based on building sectors (EE + RE).
- Track actual building and designs costs across all market sectors.

²⁹ <http://www.chps.net/dev/Drupal/NE-CHPS>

³⁰ https://www.cambridgema.gov/cdd/projects/climate/~/_media/6087ff675ade4d51a6677e689d996465.ashx

- Review and establish financial package for ZEBs based on building sectors.
- Assess effectiveness of the metrics for project success and recalibrate as need be.
- Track and address any issues that come up with regards to EE and RE integration.
- Monitor the ease of obtaining loans and getting fair appraisals, and address any challenges.
- Identify any difficulties with the adequacy of the work-force.
- Assess effectiveness of demo-projects training programs on meeting the ZEB goals.
- Based on the sample size of demo projects (and quantitative analysis provided in this paper), conduct a detailed analysis of state-wide ZEB potential (energy savings, GHG reductions, other metrics, cost effectiveness, etc.). Recalibrate ZEB targets of the white paper if appropriate.

4.2.1.4 Inform: *Share information on resources, project successes and details, and lessons learned.*

- Establish an information channel (such as a website) for assembling all demo-projects related instructions, information and resources.
- Facilitate a database for capturing information on ZEB projects, such that it helps the future ZEB projects in the state. This database should serve as a platform for showcasing the project details and achievements of the ZEB projects and sharing lessons learned from each project.
- Create a playbook with proven cost-effective approaches to be used by residential and commercial professionals.
- Create a mechanism for recognizing the ZEB successes and assure successes are widely publicized.

4.2.2 Reco#2, Action 2: Full Launch: Design program elements – financial, technical, marketing, and educational - to promote and scale-up ZEB projects to mainstream

Intent: The steps described during the demo-projects phase should be used to inform and establish a full launch of ZEB program at the state-wide level. The full launch may also require a staged approach. For example, during the earlier part of full launch, the State could lead by example and mandate that all new state buildings be designed to zero by 2025³¹, followed by schools as the next obvious targets that have the advantage of engaging students. Following elements should be resolved before or during the full launch stage.

4.2.2.1 Financial Support

- To address upfront capital availability the OER/National Grid should work with the following stakeholders to expand available financing mechanisms:
 - Banks: Seek collaboration with banks to roll up energy-related investments that provide annual operation savings, into mortgages.
 - Partner with Rhode Island Infrastructure Bank (RIIB)
 - Develop a ‘packaged’ funding model for ZEBs using Efficient Building Fund, Commercial-PACE and Residential-PACE products.
 - Identifying special loans specifically for solar farms, community solar, to municipalities to do solar for their specific municipality.

³¹ Per Executive Order 15-17 Lead by Example state facilities are directed to reduce energy usage and comply with a stretch code.

- National Grid EE Incentives & Financing
 - Structure incentives to support initial incremental costs for ZEBs, including allocation of On Bill Financing for commercial/public buildings and Heat Loans for residential ZEB projects, and also coordinate with RIBB on C-PACE and R-PACE product options to fund upgrades.
- State financing / funding:
 - Evaluate RGGI allocation for residential and commercial ZEBs for next 5 years until market ramps up to market transformation.
 - Seek other State funding to support financing for public ZEB demonstration projects and Schools global change.
 - Work with RI Housing to identify opportunities to leverage state and federal funds for Affordable Housing to strive to ZEB.
- Develop a standardized financial tool that simplifies decision-making for stakeholders by enabling analyses, such as incremental cost and total-cost-of-ownership for potential ZEB projects.
- Work with real-estate stakeholders to ensure that appraisers and the Multiple Listing Service (MLS) incorporate energy technologies, systems and labels that better inform the market.

4.2.2.2 Innovative Technologies

Develop a mechanism to implement innovative technologies across markets that support ZEBs. Some specific strategies include:

- Work with the RI Office of Innovation to monitor emerging technology opportunities in the ZEB building construction space and support their adoption.
- Promote technology innovations through the utility programs and demonstration-projects.

4.2.2.3 Marketing strategy to establish ZEB as a recognizable 'brand'

Launch an outreach and awareness campaign in concert with all service agencies and trade organizations that may include the following features:

- Identify a branded name for the ZEB program (such as "Zero Energy RI") which becomes a consistent identifier and message that people relate to.
 - Leverage existing partnerships to develop and deliver outreach materials that convey value proposition of ZEB and guide owners towards the various resources and technologies available to facilitate ZEB projects.
- Utilize electronic and social media to create momentum around "Zero Energy RI" (or chosen name).
- Implement a ZNE Recognition program for ZEB successes.
- Social media portals in the form of blogs and website.

4.2.3.4 Education and training

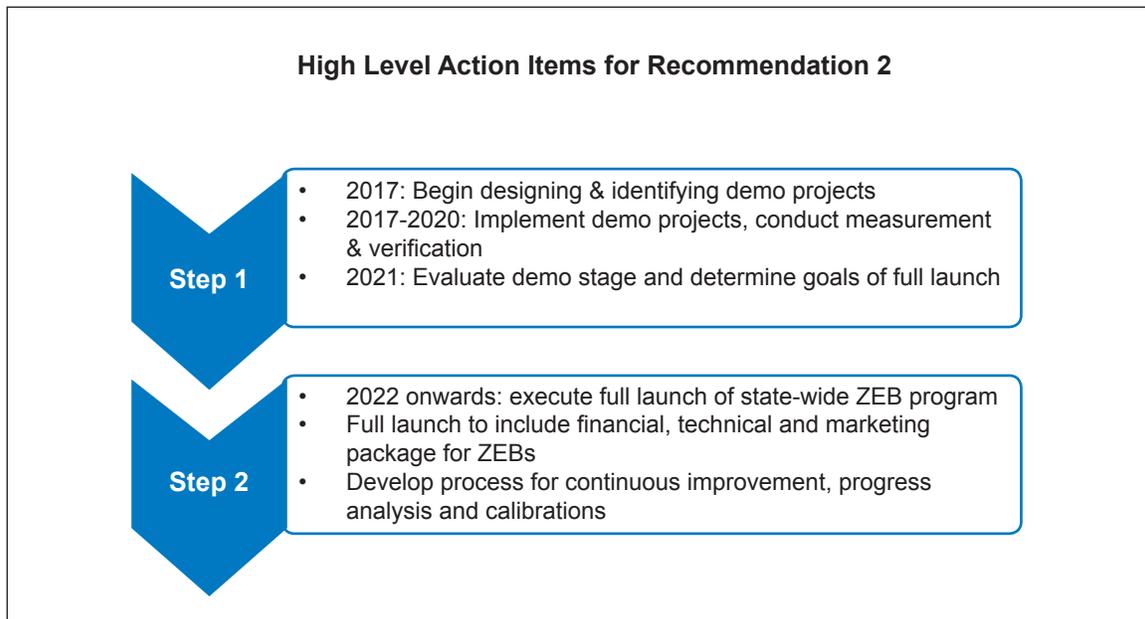
To expand uptake of ZEB projects, OER should coordinate with National Grid's energy efficiency program trainings and other educational entities like NESEA/AIA etc to leverage resources. Some of the envisioned activities are:

- Explore opportunities to integrate ZEB training into the State's workforce development initiatives.
 - Coordinate with the Governor's Workforce Board to investigate if ZEB related metrics can be integrated into the existing state-wide workforce development programs and goals.

- Target all building professionals like architects, engineers, contractors, solar installers etc. for ZEB and code trainings.
- Provide ZEB building operation training for facility managers and occupants.
- Work with RI Association of Realtors to ensure training is readily available for all real estate professionals and incentives are provided.

4.2.3.5 Zero Energy Cities: If select cities in Rhode Island are interested to pursue a Zero Energy City status, the ZEB committee should collaborate with these cities to assist in city level ZEB goals.

4.2.3.6 Public schools facilities: This state-wide launch should work toward implementing the net zero energy action plans laid out for all public schools through the schoolhouse energy report card mentioned earlier. Per this report, ZEB schools are a win-win for schools in terms of savings in this operating budget savings and also serve as living laboratories for the student. A concerted effort by the ZEB committee is needed to prioritize public (and other) schools as ZEB examples in Rhode Island.



4.3 Recommendation 3: Enhance utility's energy efficiency programs, and address integration between energy efficiency and renewable energy

Objective

National Grid serves the energy needs of 20 million people across Rhode Island, New York and Massachusetts. In Rhode Island, the company provides gas and electricity to approximately 480,000 electric and 260,000 gas customers.

National Grid's (herein referred to as the 'utility' in this section) overall desire for a decarbonized energy network and its cost-saving energy efficiency programs aligns well with the ZEB Task Force mission. With this guiding principle, the following two actions are proposed.

Category: Energy Services

Primary Leadership Agency: National Grid

Partners: OER, policy makers, building industry solar installation companies & financial organizations

4.3.1 Reco#3, Action 1: Establish a ZEB track as part of utility EE program offering

Intent

Under the Rhode Island Least Cost Procurement Law, the utility has been offering a comprehensive suite of energy efficiency (EE) programs for the past few decades resulting in Rhode Island being recognized as one of the nation's top energy efficient states. Expanding on the success of the EE programs as a change agent for energy efficiency, National Grid should include a ZEB-focused track among its offerings. The ZEB program would mobilize and enable ZEB projects through National Grid's technical support, financial support and customer outreach activities (refer to figure 13). The following actions are recommended as part of the utility's ZEB Program.

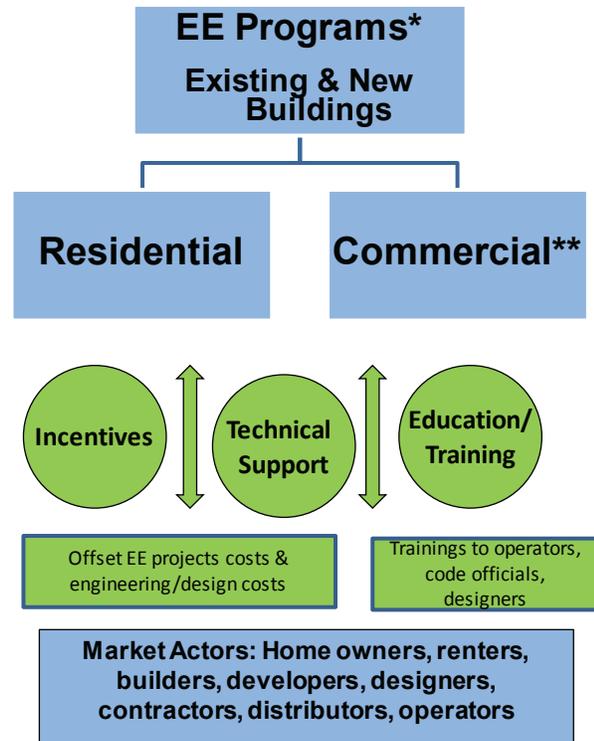
4.3.1.1 Establish Funding & Technical Support for Demonstrations Projects (Five Year Period):

As stated in Recommendation 2.1, the utility, along with OER, is responsible for the ZEB demonstration project stages. The utility needs to establish funding and resources through its EE programs for the demo projects and needs to identify type of incentives and technical expertise it would offer projects during the demo stages. It also needs to develop and a measurement and verification protocol to collect data from these projects post occupancy. Currently the EE programs are designed to support only the EE aspects of buildings, thus limiting the demo project incentives to ZEB 'Ready' components only. However, the utility should consider expanding its technical support to integrating EE and RE components of the projects. After five years of implementing the demo projects, it should be able to launch a ZEB track within its EE programs, below.

4.3.1.2 Add a ZEB Track to Mainstream EE Programs: National Grid's current new construction programs offer 'incremental cost' incentives and technical expertise to projects that are more EE than the energy code. The task force recommends adding a new ZEB track to this that will be geared toward enabling ZEB market transformation by 2035. This may require providing a higher incentive

for the ZEB 'Ready' buildings along with extra technical assistance than traditional programs. For existing buildings, the utility offers incentives based on 'project' costs. A ZEB 'Ready' track should be introduced in the retrofit EE program to support deeper technical expertise and incentives. Additional features may include:

- Incorporate industry standard predictive modeling tools, like Home Energy Rating System (HERS), or EQuest for commercial projects which help predict how energy efficient the building is.
- Instill a discipline of Continuous Energy Improvement (CEI) such that the completed building continues to perform as was intended during design. Approaches may include commissioning protocol, and/or utility supported sub-metering and performance based incentives.
- Utility program should also establish clear and consistent ZEB targets leveraging existing national ZEB certifications as part of program requirements. For example: net-zero energy building certification from the International Living Future Institute's (ILFI) Living Building Challenge or Architecture 2030, etc.



* Funded by the energy efficiency charge on all customers' utility bills, in accordance with Rhode Island law

** Includes all non-residential buildings

Figure 13: State-wide Energy Efficiency Programs administered by National Grid

4.3.1.3 Provide ZEB technical support and education to the building industry

- Assume primary role in providing technical support on projects to drive ZEB growth and adoption.
- Leverage successful model for market awareness of energy efficiency and incorporate educational series/trainings for ZEBs like:
 - o Integrate ZEB/ZEB ready topics into existing energy code trainings.
 - o Include ZEB Program guidance in training programs for vendors and trade allies.
- ZEB toolkits, such as: ZEB Charrette facilitation, integrative design roadmap readiness checklist, energy modeling that addresses ZEB needs around glazing and building envelope design.

4.3.1.4 Incorporate meaningful ZEB targets within the Energy Efficiency Plans: As part of the current utility-EE program, every three years, the RI utility commits to energy efficiency savings targets in its Energy Efficiency Program Plan filed with the Public Utilities Commission (PUC). It is recommended that the next six EE Program Plans – between 2018 and 2035, incorporate incremental ZEB targets. Including ZEB target will help establish a tangible and progressive roadmap toward achieving the 2035 ZEB goals.

EE and RE Integration: The EE Plan should drive the integration of EE and renewables by building upon the new 2016 SolarWise³² program in RI that integrates energy efficiency and solar. Some suggested strategies include:

³² https://www9.nationalgridus.com/narragansett/non_html/SolarWise_Customer_Guide.pdf

- ZEB projects that meet an EE threshold set by the program receive a bonus ceiling price for the REG program. This enables the project to benefit from a lower electric load and hence lower cost of solar panels and benefit from a lower utility net-meter rate.
- Determine ways to stimulate ZEB projects leveraging the SolarWise program; such as, by offering a different/higher reward system for bonus utility net-meter rates.
- Recalibrate the next cycles of the SolarWise program so as to increase participation in both solar as well as ZEB projects.

4.3.1.5 Influence regulators: Continuing to work with the regulators and the Energy Efficiency and Resource Management Council (EERMC), the utility should be a driving force behind policy improvements that support ZEB. Specifically, support a benefit cost analysis that accommodates ZEB within the utility's EE program portfolio. In addition, the utility may consider policy suggestions around expanding incentives to not only ZEB Ready (EE only) projects but supporting incentives for ZEBs (EE and RE).

4.3.1.6 Support technical aspects of ZEB code development: The utility should provide technical assistance to support development of future iterations of stretch code and state energy code as well as the development of a code roadmap, in collaboration with Code Commission and OER, such that measures supporting ZEB can be incorporated in future code (*refer to energy code section for more details*).

4.3.1.7 Provide ZEB financial support to the building industry - Aside from the incentives to offset the costs of ZEB projects, the utility should provide additional financial support such as:

- Provide performance-based incentives to encourage the market to problem-solve in ways that work best for each projects. Work toward tapering incentive rates down as we approach 2035 and the ZEB market matures.
- Modify the utility's suite of financing instruments to support ZEBs, such as: ZEB specific heat loans for residential ZEB projects and On Bill Financing for commercial ZEB projects.
- Sponsor ZEB competitions to help ramp up the market

4.3.2 Reco#3, Action 2: Address integration between energy efficiency and renewable energy

Intent

ZEBs place unique demands on the utility in many different ways, necessitating:

- Grid enhancements to provide an enabling energy delivery infrastructure;
- Changes in the rate design to assure fairness for all customers, and appropriate cost recovery for the utility;
- Changes in administrative processes to serve the needs of ZEB customers, and;
- A new level of customer support to address ZEB customers.

National Grid, therefore, has an integral role to play in enabling and accelerating the adoption of ZEBs in the state. National Grid is already aligning its vision through its Connect21 strategy that includes community solar, microgrids, smart grids, green transmission and many other opportunities that advance its electricity and gas networks so that the 21st century digital economy is sitting atop a 21st century

energy infrastructure. National Grid is proposing a ‘balanced approach’ for its Connect21 strategy³³, that is, it includes large scale renewables, energy efficiency and natural gas infrastructure, as shown in the figures below.

Recognizing National Grid’s progress toward a decarbonized energy network, the Task Force proposes that National Grid create an internal working group to drive near-term and future actions that should advance ZEB growth at the pace necessary to meet the state’s emissions reduction target. This utility working group (UWG) should focus on the following topics relating to the evolving needs of ZEB customers, utility integration with ZEB projects, and the growth of renewable energy in RI:

Advance RE Growth³⁴ programs and expand on other prototypes

- Achieve higher participation through the RE Growth program
- Determine ways to expand RE Growth program
- Determine how growing “large scale” solar might be beneficial for RI and evaluate related transmission system upgrades

Next Gen Innovations: Start planning toward initiatives/research toward

- Customer owned and utility owned battery storage
- Use of customer advanced PV inverters for Volt/VAR³⁵ optimization
- Incentivizing and testing high performance building envelopes and other technologies found in ZEBs such as ground and air-source heat pumps, and central make up air systems
- Smart grid technologies specifically focused on improving management of renewables in the grid and expediting interconnection for distributed generation resources

Cost/Rate Impacts: With the growth of on-site generation in the state, UWG should evaluate its impact on customers and on National Grid. The UWG should propose appropriate net metering guidelines, and guide modifications in utility rate design to assure parity for RI rate-payers. This should also include aligning resource capacity and processes to support the growth of ZEBs like providing clear guidelines for utility integration of ZEB projects and appropriate levels of customer support.



Figure 14: National Grid’s balanced approach: large scale renewables, energy efficiency and natural gas infrastructure

The Near Term	The Mid Term	The Long Term
Investing in natural gas infrastructure, green transmission, and energy efficiency today to prepare us for the electrification of transportation and cleaner home heating tomorrow.	Achieving an 80 percent reduction in emissions in all three of the states we serve by 2050, driven primarily by cleaning up the transportation and heating sectors (and once again fueled by renewables, efficiency and natural gas).	A future economy that is powered by an integrated decarbonized energy system.

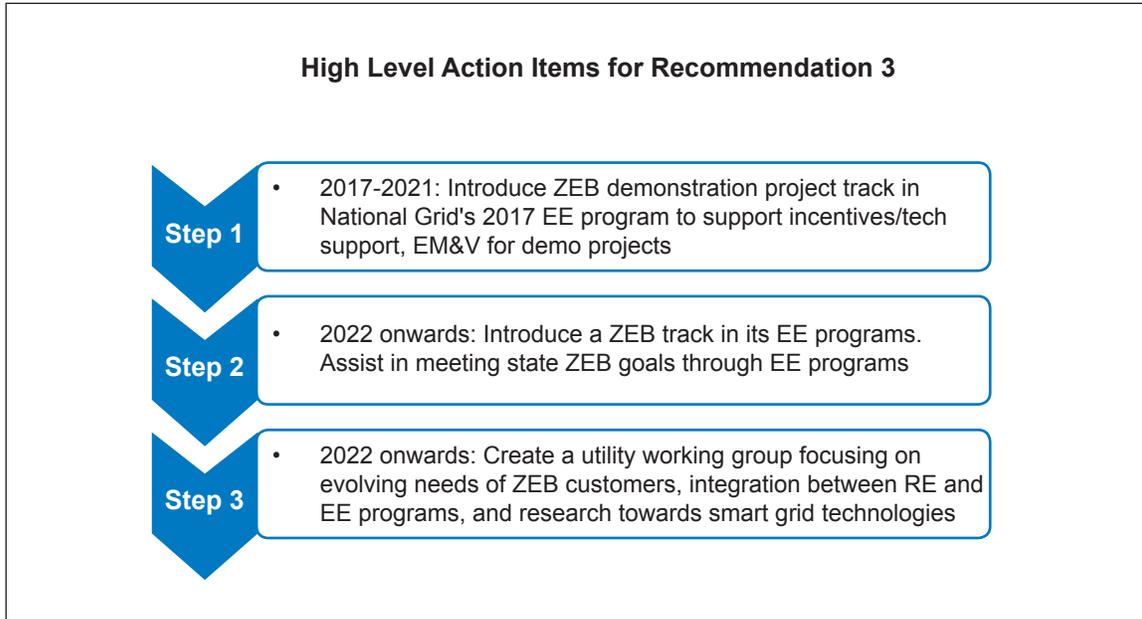
Figure 15: Near, mid-term and long-term vision for National Grid

³³ https://www.nationalgridus.com/media/pdfs/our-company/ng_ebook.pdf

³⁴ https://www9.nationalgridus.com/narragansett/business/energyeff/4_dist_gen.asp

³⁵ <https://www.nema.org/Policy/Energy/Smartgrid/Documents/VoltVAR-Optimization-Improves%20Grid-Efficiency.pdf>

Education/awareness: Create clear educational support material for stakeholders, regulators, and legislators on costs beyond the renewables generation equipment cost so they are all factored into the true cost of renewables.



5. Call to Action

The path to a prosperous future of environmental stewardship, economic development, much-needed cost and energy savings, and innovation is a challenging one; but one that must be traveled and embraced with passion and boldness. The environmental and economic importance of reducing energy use, and more specifically the greenhouse gases that are producing climate change, is beyond dispute. Equally important to Rhode Island is the need for economic development and job growth. By implementing the ZEB Task Force's recommendations in this report, Rhode Island can address climate change, contribute to economic development and demonstrate innovation and leadership.

ZEBs are technically and financially viable today and are delivering benefits to their owners and occupants across the world. It is time now to solidify Rhode Island's commitment to ensure that ZEBs are a significant part of its future.

ZEB Pathway to 2035

The pathway that the ZEB Task Force outlined will lead to the adoption of ZEBs throughout Rhode Island by 2035. The Task Force believes that through the comprehensive set of policies, mandates, and programs, Rhode Island can dramatically improve building performance and significantly contribute to the environmental goals of the Energy Plan 2035.

The Task Force proposes three major recommendations that, when implemented, should put the state on a clear path for ZEBs to achieve the aspirational goals by 2035. The implementation of the recommendations will require significant investment of time and money, effective coordination across public and private organizations, and the ongoing monitoring of performance throughout the 20-year pathway.

Rhode Island Office of Energy Resources (OER)

To ensure cost-effectiveness as well as adaptability to changing economic and technical circumstances over the next two decades, and to build the momentum of ZEBs in RI, the Task Force recommends OER institute two immediate and critical elements to ensure Rhode Island stays on course to implement the broad recommendations of this report: appoint a state-wide ZEB Champion, and establish a ZEB Committee with diverse representation by January 2018.

In addition, bold ZEB legislation needs to be instituted across all building sectors to help create cost effective residential and commercial ZEBs.

Under OER's leadership and in partnership with National Grid, a structured state-wide ZEB program should be launched targeting not only builders, building owners, operators and managers, but a wide range of stakeholders including appraisers, inspectors, energy auditors, and renewable energy installers. At the onset, the focus should be on design and launch of ZEB demonstration projects (demo-projects) specific to residential, commercial and public building sectors throughout Rhode Island. These projects should help mobilize the market by demonstrating the benefits of ZEB, establishing scalability, and making a case for ZEB as a financially worthwhile choice. The demo-projects phase should be used to inform and establish a full launch of a ZEB program at the state-wide level with financial, technical, marketing, branding, and educational support. Even though the emphasis of this white paper has been on the state level, broadening its reach to a regional approach should also be considered. Building professionals cross state lines in the New England region and how this affects the ZEB goals in Rhode Island should be examined regionally.

National Grid

As the largest electric and natural gas utility in Rhode Island, National Grid has an integral role to play in enabling and accelerating the adoption of ZEBs in the state. National Grid is already making progress toward a decarbonized energy network based on its long-term strategy called Connect21 – a strategy focused on community solar, microgrids, smart grids, electric vehicles, offshore wind, green transmission and many other opportunities. Connect21 has set the course for National Grid to ensure that the 21st century digital economy is sitting atop a 21st century energy infrastructure.

Expanding on the success of National Grid's Energy Efficiency programs as a change agent for energy efficiency, the Task Force recommends that National Grid include a ZEB-focused program among its offerings. The ZEB program would mobilize and enable ZEB projects through National Grid's technical support, financial support and customer outreach activities.

The Task Force also proposes that National Grid create an internal working group to drive near-term and future actions that should advance ZEB growth at the pace necessary to meet the state's emissions reduction target. This utility working group (UWG) should focus on topics relating to the evolving needs of ZEB customers, utility integration with ZEB projects, and the growth of renewable energy in RI.

Adaptive Framework for Success

It is apparent that the prospect of ZEBs in all buildings is substantial, warranting Rhode Island to set a bold course for ZEB targets. As this report highlights, investing in the delivery of first demonstration projects will confirm the viability of ZEB construction through considerable long-term energy cost savings. A framework will be developed with the business environment to expand ZEBs across all building sectors.

The ZEB Task Force recommendations are intended to form a framework by which significant emissions reductions can be achieved. The framework creates a balance between outlining a clear long term direction while also maintaining the flexibility to manage the ZEB program in such a way that it can adapt to the evolving market, changes in energy prices and advances in technology.

The recommendations are comprehensive and work together to address all building types in a manner that is balanced and will accelerate action. The Task Force recognizes that charting a 20-year course of action intended to transform the local built environment will not be a one-time exercise and recommends that the action plan be reviewed every five years to ensure it remains an effective plan and reflects both the evolving state of technology and the Rhode Island economy. Finally the majority of recommendations require further study and stakeholder input at the design phase and many require further action.

Achieving the Vision

As outlined in this report, the Task Force believes the opportunities of ZEB construction and renovation can transform Rhode Island, creating a prosperous future of innovation, economic development, much-needed cost and energy savings, and environmental stewardship. The ZEB Task Force has outlined the visionary path; now is the time for Rhode Island to marshal its people and policies to achieve the vision.