Rhode Island State Energy Plan

Advisory Council Meeting #6

July 12, 2013

Advisory Structure

Advisory Council

- Meets on a monthly basis
- Evaluates and provides feedback on research to assist staff in preparing a Preliminary Draft Plan
- Recommends Preliminary Draft Plan to the State Planning Council's Technical Committee for forwarding to the State Planning Council for public hearing, revision, and adoption

Timeline

Project Phases

Phase I: Research & Data Collection (December 2012 – May 2013) Gather and synthesize the best available energy data
Phase II: Preparation of Preliminary Draft Plan (June 2013 – September 2013) Set measurable goals based on modeling analysis and stakeholder feedback; Design an actionable implementation strategy Distill research developed during Phase I into a Preliminary Draft Plan
Phase III: Technical & Public Review (October 2013 – March 2014) Vet Preliminary Draft Plan through a technical and public review process; Adopt Plan as State Guide Plan Element

Today

July Meeting Agenda

- Today we will be viewing **preliminary** results of Navigant's scenario modeling:
  - Results are not final
  - Further improvements will be made to data and assumptions
  - Seeking Advisory Council input to help inform

Today

A reminder of what the scenario modeling is:

- Scenario modeling ≠ forecast or projection
- Scenario modeling ≠ recommendations of the Rhode Island State Energy Plan

- Scenario modeling looks at **different changes in RI's supply and demand energy profile** and how they might **impact key directional objectives** with respect to a business-as-usual forecast that only takes into account **existing** policies

Today

What are the scenarios we modeled?

- We developed a broad stakeholder consensus among the Advisory Council and the RISEP Project Team to model 3 unique, independently-viable scenarios representing 3 different paths for Rhode Island
- One scenario focuses on security, one scenario focuses on economics, and one focuses on sustainability
- This means that you may not see everything you want in one scenario
  - For instance, the model focusing on sustainability objectives seeks the most cost-effective ways to achieve environmental end goals

Today

How will the modeling results ultimately be used?

- The recommendations of the Plan will draw from each of the scenarios
- Modeling results will be used to help support Plan recommendations, but the recommendations may not be cut and paste from the modeling “word for word”

Today

What impact do existing policies have on the modeling?

- Navigant reports results **with respect to a "business-as-usual" baseline (BAU)**
- ENE developed BAU projections for consumption, prices, expenditure and emissions based on the current fuel mix and **existing** policies:
  - Least Cost Procurement
  - RGGI
  - RES
  - Federal CAFE Standards
- Renewable capacity and generation associated with the existing DG program, LTC program, and the 150 MW offshore wind project are baked into Navigant's reference case in the model

Today

TAKE HOME:
What is the ultimate purpose of the modeling?

- This hasn't been done before → starting point
- We are looking for order of magnitude impacts
  - For example: Do climate objectives cost more? If so, do they cost 20% or 200% more than a business-as-usual case?
- What are the cross-sector impacts of **significant transformations** of our energy system?

Today

Other supporting analyses are going forward

- **Large Hydro Opportunities Study by NESCOE**
- **NREL Solar Value/SRP Study** - Completed by September 2013
- **DG Economic/Jobs/Environmental Report** - Due by January 15, 2014 to General Assembly

“All models are wrong, but some are useful”

- George E. P. Box

NAVIGANT ENERGY

AQUINERGY

Experts in Renewable Energy and Sustainable Development

RHODE ISLAND STATE ENERGY PLAN TECHNICAL ASSISTANCE

Advisory Council Meeting – Preliminary Model Results

RIEDC Rhode Island Economic Development Corporation

Rhode Island, Working Again.

REF Renewable Energy Fund

A Program of the Rhode Island Economic Development Corporation

July 12, 2013

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DISPUTES & INVESTIGATIONS • ECONOMICS • FINANCIAL ADVISORY • MANAGEMENT CONSULTING

Today's agenda will include the following items:

1. Scope
2. Model Overview and Key Drivers
3. Summary of Results by Sector
4. Scenarios Setup and Results
5. Next Steps

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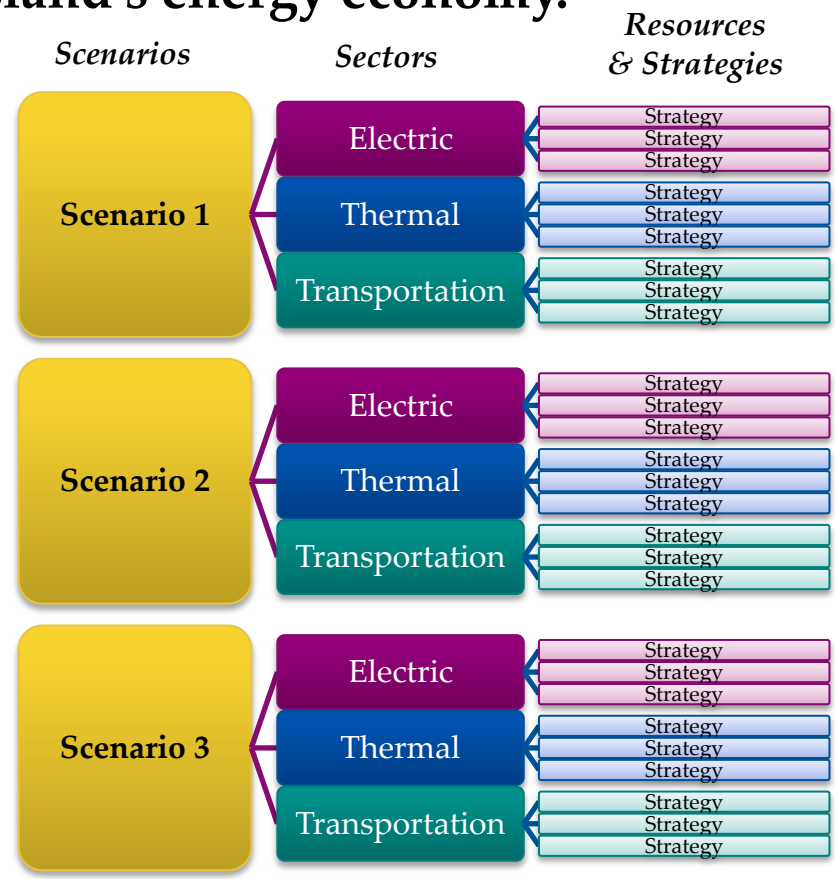
NAVIGANT ENERGY

Navigant was tasked with developing strategies spanning the electric, thermal, and transportation sectors, and modeling their effects on Rhode Island's energy economy.



Security	Economics	Sustainability
+++	-	+
-	++	+++
+	+++	+

With input from the Steering Committee, Navigant modeled changes in resources across three scenarios to examine the trade-offs between energy security, economics, and sustainability.

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NAVIGANT ENERGY

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NAVIGANT ENERGY

The electric sector was modeled using Navigant's Portfolio Optimization Model (POM) while the thermal and transportation sectors were modeled using a modular flow model using a mix of low, moderate, and aggressive resource targets.

Electric

- For this study the entire ISO-NE footprint is represented, which includes all individual units.
- POM determines the optimal unit build-out and dispatch to meet load requirements, RPS requirements, and additional system operating constraints.
- In the different scenarios, POM considers a variety of constraints, including in-state generation requirements, fuel diversity requirements, REC trading, and in-state RPS requirements.
- POM outputs include the marginal cost of generation as well as the costs to meet the different scenario constraints.

Thermal and Transportation

- The spreadsheet-based modular flow model converts the effects of resources to a common basis and performs a separate impact analysis for each resource, accounting for annual changes in allocation of each resource considered.
- The model then incorporates economic and technical attributes of each resource based on Navigant research and calculates the first-order effects of adopting a set of resources on the economic, fuel-based, and environmental directional objectives.
- The results of these scenarios are then compared with the ENE BAU Forecast.

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The business as usual (BAU) case was developed with inputs from the ENE's task 2 analysis, Navigant reference case assumptions, and inputs from the steering committee.

Navigant

1. CELT Report load forecast for rest of NE
2. New England electric infrastructure
3. Fuel cost forecast
4. Non-RI generation build-out and costs
5. Non-RI renewable resource availability

ENE Task 2

1. Rhode Island demand forecast
2. Rhode Island system costs

Steering Committee

1. Rhode Island Infrastructure Build-Out

The BAU Case

1. POM load was created from CELT load and benchmarked to ENE load for RI by adding energy efficiency resources.
2. Rhode Island build-out was loaded into POM.
3. POM system costs were benchmarked to ENE system costs to create a basis for comparing scenarios.

Results from scenario modeling are presented in contrast with the BAU.

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The BAU case used in the electric sector was created by benchmarking BAU results from ENE's Task 2 report to ISO-NE infrastructure assumptions provided by Navigant

New Builds

- The BAU case shows 262MW of new renewables in Rhode Island by 2035, 180MW of which are off-shore wind projects.

(MW)	Rest of NE	RI
BIOMASS	300.00	-
CC	2,795.16	-
CTGAS	1,400.00	-
Solar	810.47	66.00
WIND	4,218.37	16.00
WIND_OFF	-	180.00

- The rest of ISO-NE is building a considerable amount of wind due to RPS mandates.
- The BAU case assumes the inclusion of 1200MW of hydroelectric transmission capacity from Canada.

Load Forecast

- The load forecast shows a 25% reduction in demand from 2013 to 2035.
- The main cause of demand reduction is the increased penetration of energy efficiency in all sectors.
- Due to the falling demand and renewable mandates, the BAU case shows no thermal additions throughout the forecast period.

Benchmarking ENE BAU

- The load forecast and BAU system costs come from the ENE BAU case from Task 2 of this project.
- The load forecast has the same shape as the forecast in the 2013 CELT report, but the total load and energy efficiency penetration for RI is taken from the load reported by ENE.
- System costs are benchmarked to the ENE case by scaling the costs reported by POM to the ENE values in the BAU case. All side case costs maintain the same benchmarking to provide a consistent basis for comparison.

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The Business As Usual (BAU) case in each sector is dominated by a few key drivers and resource characteristics

Electric

- Rhode Island accounts for a small fraction of ISO-NE load and thereby state policies have a minimal impact on wholesale energy prices.
- New construction is largely driven by regulatory requirements such as RPS mandates.
- Due to resource limitations and declining load, RPS requirements are usually met by financing out-of-state resources.

Thermal

- Substantial growth in demand in the industrial sector dominates the BAU forecast and provides clear opportunities for efficiency retrofits and CHP.
- While demand reduction efforts yield positive economic returns in the near term (CapEx), the long term energy savings have negative repercussions for economic activity (fuel expenditures).

Transportation

- Changes in energy demand in the Transportation sector are heavily influenced by the large capital requirements associated with changes to the fleet.
- Despite the large capital expenditures, the cumulative effects of reduced demand for fuel have large negative repercussions for economic activity (revenues, taxes, and jobs associated with fuel delivery)

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NAVIGANT ENERGY

Results of the modeling exercise demonstrate the tradeoffs between scenarios in the electric sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	87%	50%	87%	85%
	Grid Tied Storage	MW in 2035	0	200	0	150
	Stability, Reliability, Resiliency	+/-	N/A	+++	-	+
Economic	Average Annual Electric Energy Expenditures*	$2012 Millions	902	1,119	934	1,090
	Average Cost of Electricity*	$2012/MWh (Wholesale)	$59.76	$59.81	$59.74	$59.43
	Average Price Volatility of LMPs	Index in 2035 (Relative to BAU)	1	0.926	0.999	0.961
	Economic Activity (Total In-State Expenditures*)	$2012 Millions	21,959	22,365	22,296	23,383
	In-State Employment Impact* (Relative to BAU)	Job Years	N/A	3,444	20	1,170
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	23%	35%	23%	56%
	NOx & SO2 (RI)	% below 2013 levels in 2035	14%	57%	14%	14%
	Land Use Conversion	Acres	408	2,072	426	651

- Averages and totals are across the analysis period spanning 2013-2035
- Wholesale costs only consider marginal cost to meet load, system costs include all electric system infrastructure expenditures

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NAVIGANT ENERGY

Results of the modeling exercise demonstrate the tradeoffs between scenarios in the thermal sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	67%	62%	74%	63%
	Thermal Storage (ETS)	MW in 2035	0	1,067	0	217
	Stability, Reliability, Resiliency	+/-	n/a	+++	+	++
Economic	Average Annual Thermal Energy Expenditures*	$2012 Millions	$1,126	$1,148	$1,062	$1,092
	Average Cost of Energy*	$2012/MMBTU	$18.07	$18.67	$17.43	$17.74
	Average Price Volatility of Fuels	Index in 2035 (Relative to BAU)	1.000	0.961	0.976	0.963
	Economic Activity (Total In-State Expenditures*)	$2012 Millions	$0	$1,917	($1,616)	$1,063
	In-State Employment Impact* (Relative to BAU)	Job Years	0	1,275	(1,534)	538
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	8%	25%	8%	34%
	NOx & SO2 (RI)	% below 2013 levels in 2035	19%	80%	41%	80%

* Averages and totals are across the analysis period spanning 2013-2035

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Results of the modeling exercise demonstrate the tradeoffs between scenarios in the transportation sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	56%	32%	34%	39%
	Grid Tied Storage (EV Battery)	MW in 2035	137	1277	1277	6292
	Stability, Reliability, Resiliency	+/-		+++	+	+++
Economic	Average Annual Transportation Fuel Expenditures*	$2012 Millions	$1,696	$1,098	$1,096	$1,132
	Average Cost of Fuels*	$2012/MMBTU	$29.87	$29.75	$29.45	$30.22
	Average Price Volatility of Transportation Fuels	Index in 2035 (Relative to BAU)	1.000	1.013	1.018	0.999
	Economic Activity* (Total In-State Expenditures)	$2012 Millions	$0	$4,187	$2,194	($9,179)
	In-State Employment Impact* (Relative to BAU)	Job Years	0	528	(317)	(5,454)
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	11%	54%	52%	56%
	NOx & SO2 (RI)	% below 2013 levels in 2035	19%	52%	51%	65%

* Averages and totals are across the analysis period spanning 2013-2035

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Scenario 1 prioritizes energy security through fuel diversification and grid modernization.

Electric

- Targets a diverse power generation portfolio which does not rely on any one fuel source for more than 50% of generation by 2035.
- Aims to increase grid reliability through deployment of smart meters and grid tied storage.

Thermal

- Promotes the adoption of a diverse set of options for heating and space conditioning across the residential, commercial, and industrial sectors.
- Provides load shifting through aggressive deployment of ETS.

Transportation

- Promotes energy security in the transportation sector through a diverse portfolio of transportation fuel options including CNG, PEVs, and biofuels as well as increases in fleet efficiency and public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Minimize contributions of the dominant fuel source • Target a balance of 50% in-state and 50% out of state generation by 2035 • Maximize build out of energy storage technologies and DR capabilities • Maximize diversity of fuels in Thermal and Transportation	• Change in 'Job Years' is positive • Meet all other criteria in the most cost effective manner	• 40% renewables (25% in state)

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Highlights of the changes modeled in Scenario 1 include reliance on gas fired generation for 50% of demand and 200 MW of grid tied storage.

Electric Sector

- By 2035, average system costs are 24% higher than in the BAU.
- In-state renewable build includes 70 MW on-shore wind, 302 MW solar, 7.5 MW biomass, and 180 MW off-shore wind. Additionally, 228 MW of out-of-state wind is financed to meet the RPS.
- The most cost-effective solution to reducing reliance on natural gas is to increase imports into Rhode Island.
- Once the 50% import limit is reached, Rhode Island builds renewable resource in-state to reach the required fuel diversity metric.
- This scenario exhibits significantly less volatile wholesale energy prices relative to the BAU.

Thermal Sector

- Scenario 1 sees substantial build out of ETS to shift load creating a more stable grid and renewable thermal resources to diversify away from fossil fuel powered heating

Transportation Sector

- Natural Gas powered transportation doubles in market share from the BAU, rivaling gasoline and diesel fuel.

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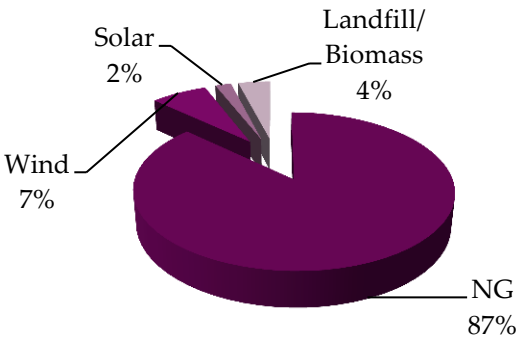
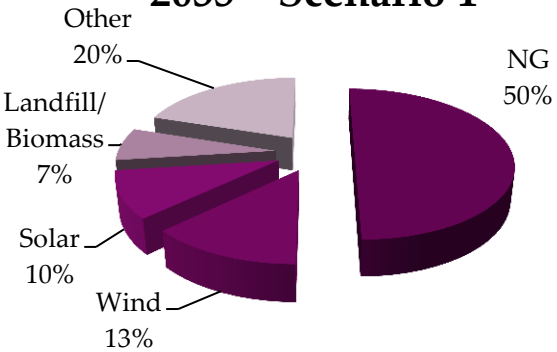
In Scenario 1, Natural Gas is constrained to meet only 50 % of electric demand (87% in the BAU case), Renewables take over 8% of the thermal energy market, and AFVs reach 34% of the market.

Electric Sector

2035 – BAU

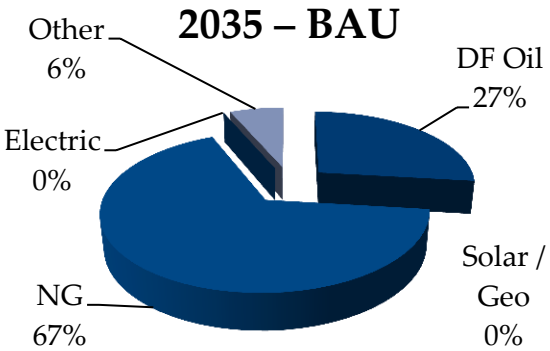


2035 – Scenario 1

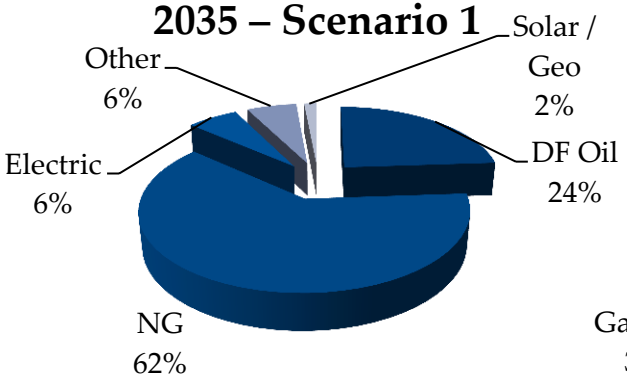


Thermal Sector

2035 – BAU

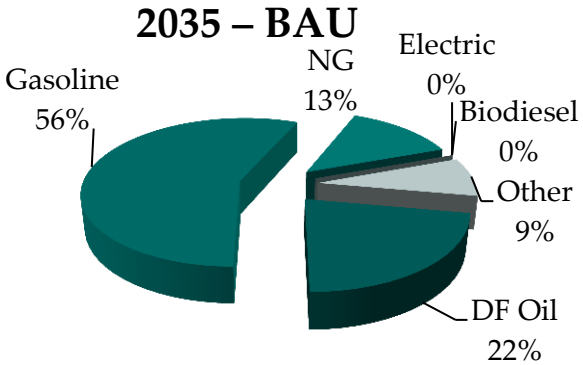


2035 – Scenario 1

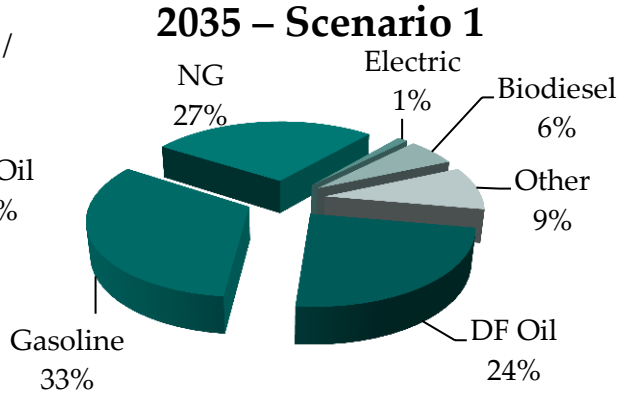


Transportation Sector

2035 – BAU



2035 – Scenario 1



*Electric Sector 'Other' includes: large-scale hydro, nuclear, and oil
**Thermal Sector 'Other' includes: gasoline, kerosene, propane and residual fuel oil.
***Transportation Sector 'Other' includes: ethanol E85, jet fuel, propane and residual fuel oil.

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Scenario 2 prioritizes cost effectiveness and economic development while hitting key targets for GHG reduction.

Electric

- Minimizes electricity expenditures through demand side management while promoting economic development and meeting established targets for GHG reduction.

Thermal

- Targets a 10% reduction in total thermal energy expenditures by 2035.

Transportation

- Aims to cut transportation related fuel expenditures through programs that dramatically increase vehicle average efficiency and provide for cost effective public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Net increase in diversity of fuels used to meet demand	• Minimize expenditures across all sectors • Change in 'Job Years' is positive • **Meet all other criteria in the most cost effective manner**	• 25% renewables by 2035

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Highlights of the changes modeled in Scenario 2 include a substantial reduction in expenditures in the thermal and transportation sectors.

Electric Sector

- Total expenditures are the lowest of any scenario, however they remain slightly higher than the BAU case due to the imposition of a higher RPS mandate and increased electrification of other sectors.
- The In-state renewable build includes 16 MW on-shore wind, 66 MW solar, and 180 MW off-shore wind. Additionally, 11 MW of out-of-state wind is financed to meet the RPS.
- The primary deviations from the BAU case include a higher RPS mandate and higher load in the residential and transportation sectors.

Thermal Sector

- Extensive deployment of CHP and industrial efficiency measures drive down aggregate expenditures in the thermal sector, resulting in lower average costs of energy with less capital investment than alternatives.

Transportation Sector

- Annual fuel expenditures drop by more than half by 2035 owing to drastic increases in average fleet MPG and moderate vehicle electrification.

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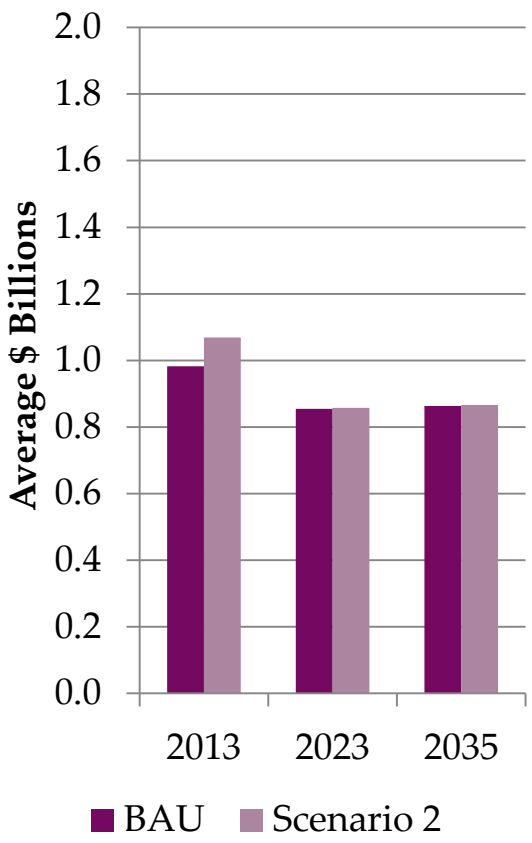
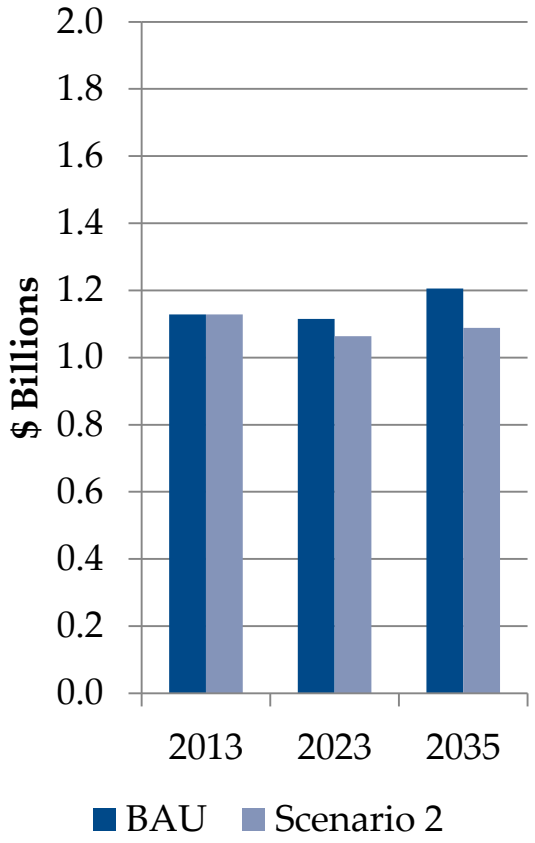
In Scenario 2, total electric expenditures increase slightly to keep pace with increased RPS and increased electrification, whereas thermal and transportation fuel expenditures drop to 90% and 41% of the BAU, respectively.

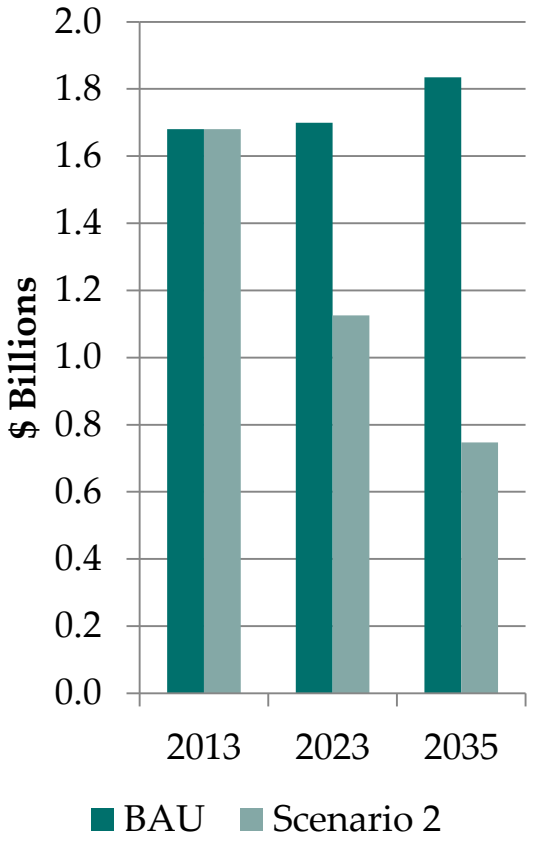
Electric Sector



Thermal Sector



Transportation Sector



* Electric sector figures are averages across the periods 2013 – 2020, 2021 – 2028, and 2029 – 2035 to eliminate spikes from single year infrastructure investments.

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Scenario 3 prioritizes sustainability through the widespread deployment of renewables, thermal alternatives, and vehicle electrification.

Electric

- Aims to cut regional GHG by targeting a high penetration of renewables
- Targets security through the construction of energy storage facilities.

Thermal

- Aims to cut in-state GHG emissions through substantial adoption of heating by solar thermal, geothermal, and a switch to biofuels.

Transportation

- Aims to aggressively cut transportation related pollution through widespread vehicle electrification, modest gains in vehicle efficiency, and expansive public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Build out energy storage technology at pace with renewables	• Change in 'Job Years' is positive • **Meet all other criteria in the most cost effective manner**	• 25% renewables by 2023 • 75% renewables by 2035 • Maximize reduction in transportation and thermal sector GHG subject to other constraints

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Highlights of the changes modeled in Scenario 3 include 1,165 MW of new renewables, deep thermal efficiency retrofits, and 46% of transportation energy needs coming from alternative fuels in 2035.

Electric Sector

- There is a 54% decrease in CO_2 emissions by 2035 from 2013 levels. To some extent, increased carbon efficiency in the electric sector is offset by significantly increased electrification of other sectors.
- In-state renewable build is 70 MW on-shore wind, 66 MW solar, and 180 MW off-shore wind. Additionally, 1,111 MW of out-of-state wind is financed to meet the RPS.
- Due to high EE penetration, load can be met with existing generating resources, reducing the incentive to meet the RPS requirement through in-state development.
- The results show 21% increase in total system expenditure vs. the BAU.

Thermal Sector

- Emissions from this sector drop below 50% of those in the BAU by 2035 resulting from a high penetration of solar and geothermal heating (combined BBTU/year in 2035).

Transportation Sector

- Emissions in the transportation sector are cut dramatically (44% of the 2013 BAU level) through an expansive roll out of public transit options and city planning which discourages single occupancy vehicles combined with widespread electrification and switching to lower carbon fuels like CNG.

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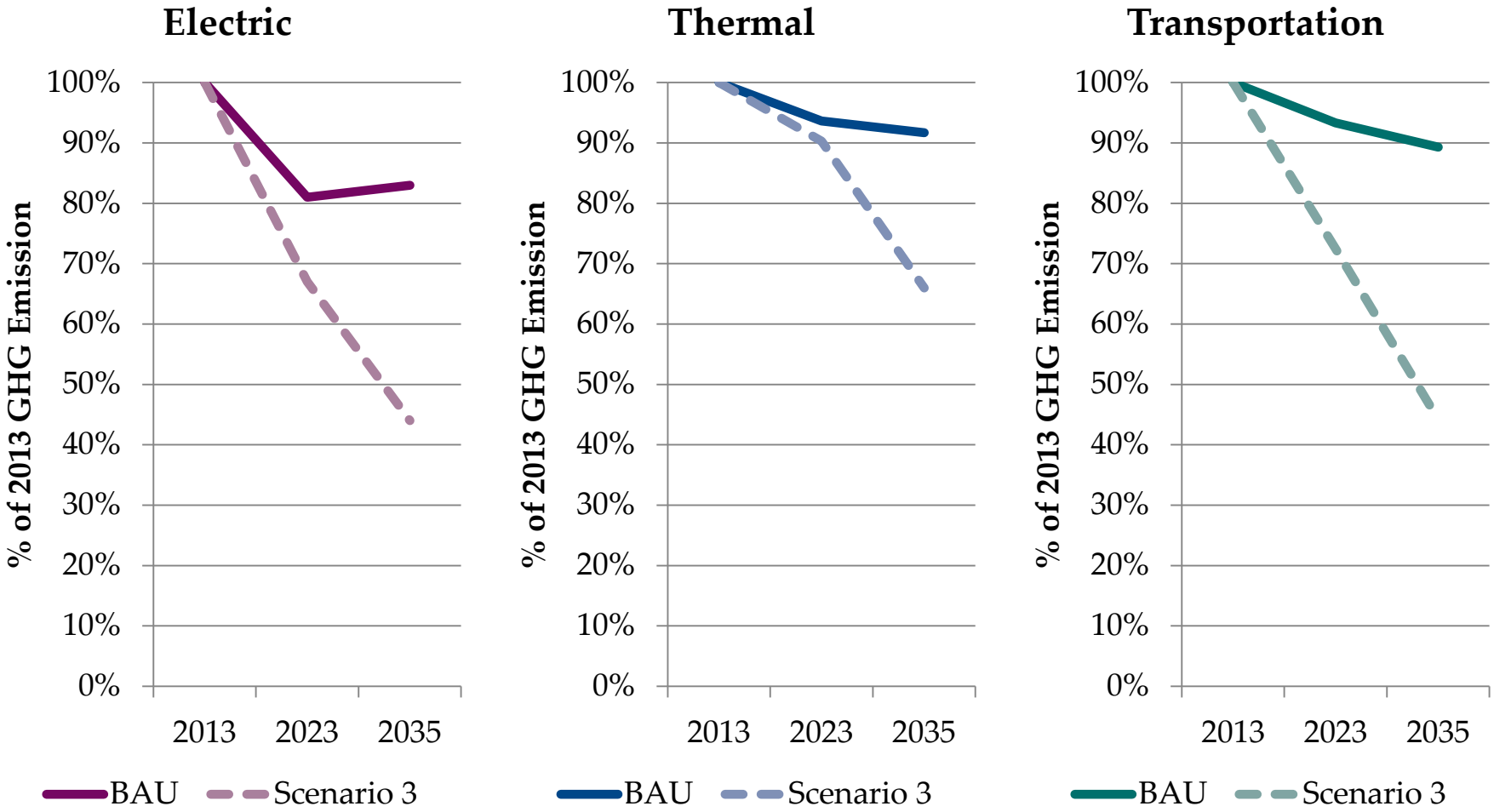
In Scenario 3, GHG emissions drop by 56%, 34%, and 56% below 2013 levels of the BAU case in 2035, across the three sectors respectively.



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Following this meeting, Navigant will solicit feedback, finalize the scenarios and model results, and facilitate handoff to the RISEP Steering Committee.

Solicit Feedback

- Distribute Model Results
- Collect Feedback
- Propose Modifications and Adjustments

Finalize Scenarios

- Integrate feedback from Steering Committee and Advisory Council
- Update Results

File Report

- Complete the Report
- Compile Additional Documentation
- Write Executive Summary
- Facilitate Handoff

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Next Steps

Next Steps

- Advisory Council members will provide feedback on **preliminary modeling results** via email to OER **by Wednesday, July 24th COB**
- The next Advisory Council meeting will be scheduled for **late August or early September**
- The focus of the next meeting will be **developing policy recommendations** of the Plan

Rhode Island State Energy Plan

Advisory Council Meeting #6

July 12, 2013

ADVISORY COUNCIL MEETING

RHODE ISLAND STATE ENERGY PLAN (RISEP)

Friday July 12, 2013
9:00 AM-11:00 AM
Narragansett Room
RI Economic Development Corporation
315 Iron Horse Lane
Providence, RI

ATTENDANCE:

Advisory Council Members: Abigail Anthony, Bob Chew, Doug McVay, Nick Ucci, Jerry Elmer, Melissa Long, Bob Tormey, Ian Springsteel, Julian Dash, Julie Gill

Steering Committee & Project Team Members: Marion Gold, Chris Kearns, Hannah Morini, Rachel Sholly, Dan Carrigg, Nancy Hess, Kristine Daly, Danny Musher

Other Attendees & Members of the Public: Ben Barrington, Matt Tanner, Stephan Wollenburg, Bruce DiGennaro, Rachel Henschel, Charles Hawkins, Pam Mandler, Charity Pennock, Kristina DiSanto, Mike Giles, Meghan Rowe, Mike Henry, Frank Stevenson, Ben Swanson, Mike Guerard, Lisa Frantzis (by phone), Lea Poquerusse (by phone), David Hill (by phone)

AGENDA:

9:00 Welcome – *Danny Musher, RIOER*

9:10 Scenario Modeling: Preliminary Results – *Ben Barrington & Matt Tanner, Navigant Consulting*

10:10 Questions & Discussion

10:40 Next Steps – *Danny Musher, RIOER*

10:50 Public Comment

11:00 Adjourn

MINUTES:

The meeting was called to order at 9:05 AM. Danny Musher welcomed everyone to the sixth meeting of the RI State Energy Plan (RISEP) Advisory Council (AC). Currently the AC is working on the third task (scenario modeling) of the first phase (research and data) of the RISEP. The RISEP, when completed will be incorporated in

the State Guide Plan (SGP). Today the AC will hear the preliminary results of the scenario modeling which will inform the RISEP recommendations. These results are not final and the project team is seeking AC input on this data. This modeling is not a forecast and are not recommendations for the RISEP, rather it looks at different changes in RI's energy supply and demand energy profile and how they might impact directional objectives (DOs) with respect to the business as usual (BAU) forecast. Three unique, independently-viable scenarios were developed for the exercise to provide good data points. They focus on security, economics, and sustainability. The scenarios will look at the cross-sector impacts of significant transformations of our energy system.

The BAU forecast used existing RI policies like Least Cost Procurement (LCP), RGGI, the Renewable Energy Standard (RES) and federal CAFE standards. Danny M. then introduced Ben Barrington of Navigant to present the preliminary findings of the modeling.

Model Overview and Key Drivers

Ben B. introduced Matt Tanner, also from Navigant, who will also be presenting. Matt T. has worked on the modeling in the electric sector. The electric sector was modeled by Matt T. using Navigant's Portfolio Optimization Model (POM) while the thermal and transportation sectors were modeled using a modular flow model using a mix of low, moderate and aggressive resource targets. POM models the optimal unit buildout and dispatch needed to meet load and RPS requirements and additional operating constraints. For this study, the entire ISO-NE footprint is represented because you can not look at just RI. Constraints like Renewable Energy Credits (RECs) trading and RPS requirements are considered.

Nick U. asked if it was an economic dispatch of the system. Is it hourly? Matt T. said that each month is divided into six load periods totaling seventy-two for the year. Frank S. cited generator retirements especially nuclear which have internal political factors.

The BAU used in the electric sector was created by benchmarking ISO-NE assumptions provided by Navigant to BAU results from ENE's Task 2 report. The BAU forecast shows a 25% reduction in demand from 2013-2035 caused mainly by an increased penetration of energy efficiency (EE). The RI build out is layered over New England in the BAU using the CELT report. Danny M said the OER worked to provide Navigant with information on how much renewable capacity will result from the Distributed Generation (DG) program and the long-term contracting program.

Frank S. asked if RGGI was factored in. Yes, in the BAU. Nick U. asked if the assumption of off-shore wind power has all of that power going to RI and not Long Island or New York. While New England is an integrated market, it is impossible not to look at things occurring in the region like Long Island and Quebec hydro. The BAU shows 262MW of new RE in RI by 2035, 180MW of it off-shore wind. Julian D. asked if the capacity from RI's DG long term contracting program were included in the BAU.

Yes, it was. Matt T. said the cheapest way for RI to meet its RPS is through imported wind. Ian S. noted that the actual solar capacity in NE is twice what the BAU forecast shows. David H. said a useful reference point for this is a report done by Synapse on forecast of regional DG. It indicates that the DG build out in New England may be significant higher than in the CELT forecast. He suggested RISEP reference this report for their new build assumptions. Nick U. cited the 25% load reduction caused by EE. He asked if production cost increases were factored in the out years in these metrics. Abigail A. said that fairly conservative estimates were used for the out years in the BAU forecast. Matt T. said the model does take in the life time costs.

Ben B. then went on to the key drivers in the thermal and transportation sectors. One of the key drivers in the thermal sector is increased demand in the C&I sector with opportunities to convert to combined heat & power (CHP) and EE retrofits. While reduction in demand yields short term economic returns in these sectors, long term energy savings have negative repercussions for economic activities like fuel expenditures. Ian S. asked what accounts for the substantial growth in C&I demand. Danny M. said that was a good question and he will check back with ENE.

Summary of Results by Sector

Electric Scenario 1 reduces price volatility by reducing natural gas (NG) to 50% down from 87% in the BAU. In Electric Scenario 2, costs rise in all sectors from the BAU. Electric Scenario 3 raises costs but it reduces greenhouse gas (GHG) emissions by 56%. While price is just the marginal cost of electricity, expenditures represent all of the infrastructure cost of electricity. Bob T. asked if weather is factored in. It is a weather normalized forecast. Stephan W. said that it is hard to look at energy expenditures and GHG reductions in each sector separately. There is substantial interplay between the sectors. Ian S. asked how they got at the 2,000 acres of land conversion for Electric Scenario 1. Ben B. said that to get NG down to 50% there would need to be a RI RE buildup and that would include solar.

The thermal & transportation scenarios were not able to push down the dominant fuel in the BAU. It was interesting to note that the dominant fuel source in the thermal sector was virtually the same for Scenario 1 and Scenario 2. Thermal storage, which is high in Scenario 1, could help in the electric sector with load shifts.

In the Scenario 1 transportation sector there was a lot of fuel switching, in Scenario 2, fuel efficiency & CAFE standards were emphasized and in Scenario 3 there was a big push for substantial increases in public transit, with ridership doubling. There is a large capital investment involved in this expansion but the impact on fuel consumption is huge. Bob T. asked what impact increased use of alternative fuels will have on price. What happens to the price of gas? Ben B. said in the model they used a fixed forecast price for gas with no demand elasticity.

Dan C. asked if vehicle miles travel (VMT) get modeled. Ben B. said there were two resources used to reduce VMT, more public transit and the complete streets initiative,

which look to reduce VMTs by redesigning urban infrastructure. Scenario 2 uses CAFE standards to get at more EE cars. Frank S. asked if the model used secondary use of increased disposable income impacts like the REMI model. Ben B. said the model is not like REMI which uses indirect impacts.

Scenario Setup and Results

Highlights of the changes modeled in Scenario 1 include: reduction of NG reliance to 50% to reduce RI's reliance on it for generation; and adding 200 MW of grid storage to make the grid more reliable and use in load shifting. In the transportation sector, a diverse portfolio of fuel options, (CNG, bio-fuels, and EVs) was emphasized with a goal of 40% RE in Scenario 3 by 2035, with 25% of it in-state. The constraint of 50% NG forces a lot of RE activity, much of it in-state. The overall costs are 24% higher than in the BAU but a lot of the costs are back loaded. Frank S. said a key factor in this scenario should be grid modernization but he does not see it as a highlight. Matt T. said the model put in 200 MW of grid storage so grid modernization was occurring. Frank S. said that grid storage and grid modernization are two different things. Stephan W. said it would be better if the model looked at what costs are in 2036.

In Scenario 1, NG is constrained to meet only 50% of generation, RE takes over 8% of the market in the thermal sector, and in transportation alternative fuel vehicles reach 34% of the market. Nick U. would like to see more detail in the RE charts. Break out the types of RE. David H. asked if in the thermal sector you would account for advanced heat pumps under solar/geothermal or would that show up under electric. Ben B. said advanced heat pumps were included in the original list of resource types.

Julie G. is concerned about the increased use of NG in the thermal sector as a means to reduce GHG emissions. She feels there could be future constraints on the NG distribution system. She cited a new RI law that mandates a 2% bio-fuel blend in oil that increase yearly to 5%; but she does not see bio-fuels in the thermal sector. She also feels if oil goes down to 27%, half of the oil companies in RI will go out of business. She also cited the methane problems associated with NG. Ben B. noted that biofuel was included in the DF oil category and that it can be broken out. Bob C. was discouraged to see that geothermal and solar was only 2% in the thermal sector in 2035. He thinks this is very small. Ben B. said that might come up higher if a different model for cost-effectiveness (CE) was used. He also said that the technical potential of those two technologies was not that high.

Dan C. said that the BAU model for NG in transportation is up to 13%, it is only 2% today, is this based on the ENE model. Ben B. said that if RI totally converted public transit vehicles and some commercial fleets to NG it would go above the 13%. The 27% in the Scenario 1 forecast would include private vehicles changing as well.

Scenario 2 prioritizes CE and economic development while hitting GHG targets. It assumes a stronger RPS and pushes hard on CAFE standards in the transportation sector. There is less happening the electric sector then in other scenarios and it gets to its goals

through demand side management. In the thermal sector, deployment of CHP and EE drives down aggregate expenditures. Frank S. asked how RI can get at the extra vehicle EE. You can't vary from the CAFE standards from California. RI can't mandate CAFE standards. How does this happen? Will it be economically driven in RI? Ben B. said a higher state gas tax or a carbon tax may be a way to get there. Plus there is a market driven move to more EE vehicles. There could also be incentives for people to buy more EE cars.

In Scenario 2, total electric expenditures increase slightly to keep pace with increased RPS and electrification. But thermal and transportation expenditures drop to 90% and 41% of the BAU. Julian D. asked if they are just looking at costs in this scenario. A discussion then ensued about the cost of RE and the overall economics of RE, especially in regard to job creation. Julian D. would like to see this included in the modeling.

Scenario 3 gets to its goals though widespread deployment of RE, thermal alternatives, and vehicle electrification. The goal is the cheapest way to get to 75% RE by 2035. It appears the cheapest resource is on-shore wind that will need to be imported to meet the RPS. David H. commented that the in-state RE buildout was the same as in the BAU. Matt T. said there was slightly more in the model but not very much. In the Scenario 3 transportation model, GHG was cut using widespread use of EVs, gains in vehicle EE, and expansive public transit options. In the thermal sector it includes a substantial switch to bio-fuels.

The highlight of Scenario 3 is a 54% decrease in CO2 emissions by 2035. In addition, 1,111 MW of out-of-state wind is financed to meet the RPS. For RI, the mix will be almost all wind, but for all of New England you would need more than wind to meet the RPS. The thermal sector shows a high penetration of solar and geothermal. In transportation emissions are cut 44% by increased use of public transit and city planning that discourages single occupancy vehicles.

Frank S. said that most of the reduction in GHG was attributed to NG. What carbon intensity is assigned to NG that allow for this drop in emissions. Navigant used the carbon intensity data from the BAU forecast. Stephan W. would like to know what percent of NE's energy will be coming from RE in 2035. What does the BAU look like for the other NE states? Ben B. said the goal for NE is around 52% carbon free generation by 2035 and that includes nuclear. Nick U. asked how average expenditures factors in transmission growth and investment. Matt. T. said with load dropping 25% there will not be a lot of need for new transmission. Nick U. said the reason for his question is that there is not a lot of electric cost decrease in Scenario 3 as a result of such a robust RE portfolio which will require interconnections.

Next Steps

Navigant will solicit feedback from the AC, finalize the scenarios and model results, and facilitate handoff to the RISEP Steering Committee. They would like to get the feedback from the AC by July 26th and it should be funneled through Danny M. Frank S. said

once the report is done there needs to be a process to pick and choose recommendations and create a plan. Danny M. agreed with Frank S. that the next phase is the most challenging: to outline a process and develop final policy recommendations. They need to take the data and develop policy levers and tools, ways to mobilize the capital and expertise to achieve these scenario targets. Frank S. asked at what point do these recommendations fold back into the models and become more than scenarios. At some point will we be modeling what we will put forward as a plan? There is so much interconnection between the activities, you may get consequences you were not expecting. It would be good to to tie the model back to the original assumptions in the BAU. He feels you will have a hard time selling it if you can't answer the questions we laid out here. You will have to have a handle on all the numbers presented in the plan.

Danny M. said that was a good point and will be grappled with by the project team. Danny M. said the project team will be working on developing policy recommendations and hope to have them ready for an early September meeting.