Kavet, Rockler & Associates, LLC

985 Grandview Road
Williamstown, Vermont 05679-9003 U.S.A.
Telephone: 802-433-1360
Website: www.kavetrockler.com
E-Mail: tek@kavet.net

Economic & Policy Resources, Inc.

EPR

400 Cornerstone Drive, Suite 310
Williston, Vermont 05495
Telephone: 802-878-0876
Website: www.epreconomics.com
E-Mail: JBC@epreconomics.com

Consensus Economic and Fiscal Impact Analyses Associated with the Future of the Vermont Yankee Power Plant

Executive Summary – March 2010

Prepared by
Economic & Policy Resources, Inc. and
Kavet, Rockler & Associates, LLC

In collaboration with
Synapse Energy Economics, Inc., the Vermont Department of Public Service, Green Mountain Power Corp. and Central Vermont Public Service Corp.

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Introduction

Over the past sixteen months, a group of energy and economic experts came together with the cooperation of State government and the two largest Vermont electric utilities to develop a set of consensus energy and economic impact analyses associated with the continued operation or closure of the Vermont Yankee nuclear power plant. The analytic group engaged in these studies consists of: Energy consultants hired by the General Assembly's Joint Fiscal Committee; State consulting economists hired by Vermont's two largest utilities, with permission and approval for their participation in this project by the Joint Fiscal Committee and Agency of Administration; Economists and power planners from the Vermont Department of Public Service; and, Power planning experts from the State's two largest utilities, Central Vermont Public Service and Green Mountain Power.[1]

This group developed sets of detailed model input estimates associated with four different scenarios regarding the future power supply for Vermont. The two State economists involved in this project, Jeff Carr and Tom Kavet, used these estimates to assess the impact of these scenarios on the Vermont economy and State budget, as summarized herein.

In addition to the specific estimates associated with these four scenarios, one of the primary purposes of this effort was the development of a general impact model that would allow future analyses of additional scenarios based on a variety of input assumptions. For example, economic and fiscal impacts associated with different power source pricing proposals, revenue sharing agreements, decommissioning scenarios, renewable energy policy options and other deliberations regarding Vermont Yankee and future power supply options for the State may be evaluated using this model. The model

[1] Participants in creation of the consensus power cost estimates were: Joint Fiscal Committee consultants Ezra Hausman and William Steinhurst of Synapse Energy Economics, Inc.; State economists and their firms, sponsored by the two utilities, Jeffrey Carr and Lawrence Copp of Economic & Policy Resources, Inc., and Thomas Kavet and Nicolas Rockler of Kavet, Rockler & Associates, LLC; Vermont Department of Public Service economists and power planners David Lamont and George Nagle; and utility power planning experts, Stephen Page of CVPS and Douglas Smith of GMP.

is now available to the Legislature, DPS, other State entities and the participating utilities, in the event they would like to undertake updated or alternative model simulations with differing input assumptions during this legislative session and beyond.

Background and Statutory Basis for the Analysis

In 2002, with the approval of the Vermont Public Service Board (PSB), Entergy Nuclear Vermont Yankee, LLC (hereafter, ENVY) purchased the Vermont Yankee nuclear power plant (hereafter, VY) from its Vermont owners.[2] In connection with this transaction, the new owner agreed to submit itself to the jurisdiction of the PSB Certificate of Public Good process should it seek authority to operate the plant beyond the March 21, 2012 expiration date of its current NRC operating license.

In early 2008, ENVY applied to the PSB pursuant to 30 V.S.A. sec. 248(e) for permission to operate VY until 2032. In the interim, Vermont law was amended, in Act No. 160 of 2006 to say that the PSB "may not issue a final order or certificate of public good until the General Assembly determines that operation will promote the general welfare and grants approval for that operation." This law applies in any PSB proceeding involving extension of ENVY's authority to operate in Vermont. 30 V.S.A. sec. 248(e)(2).

Act No.160 of 2006 consolidated the General Assembly's existing authority over spent fuel storage at VY with its new authority to approve continued operation. In so doing, the General Assembly in Section 1 of the Act said:

(d) It is appropriate that the spent fuel storage issue be framed and addressed as a part of the larger societal discussion of broader economic and environmental issues relating to the operation of a nuclear facility in the state, including an assessment of the potential need for the operation of the facility and its economic benefits, risks, and costs; and in order to allow opportunity to assess alternatives that may be more cost-effective or that otherwise may better promote the general welfare.

In order to provide itself with the information necessary to make the "assessment" referred to in this legislative language, the General Assembly added the following provision to Act. No. 192 of 2008:

Sec. 5.012.2. JOINT FISCAL COMMITTEE – NUCLEAR ENERGY ANALYSIS (Sec. 2.031)

(a) The joint fiscal committee may authorize or retain consultant services to assist the general assembly in any proceeding commenced under 30 V.S.A. § 248(e).
(b) Consultants retained pursuant to subsection (a) of this section shall work under the direction of a special committee consisting of the chairs of the house and senate committees on natural resources and energy and the joint fiscal committee.

[2] See PSB Docket No. 6545 and related documents.

(c) The public service board shall allocate expenses incurred pursuant to subsection (a) of this section to the applicant or the public service company or companies involved in those proceedings and such allocation and expense may be reviewed by the public service board pursuant to 30 V.S.A. § 21.

Pursuant to this authority, after reviewing several responses to its request for proposals, the Joint Fiscal Committee in the summer of 2008 hired Synapse Energy Economics, Inc., of Cambridge, MA, as consultants to the General Assembly with respect to the continued operation of VY.

In their normal course of business, CVPS and GMP (which presently serve about 73% of Vermont's electricity demand) and the Vermont Department of Public Service independently conduct economic analyses of Vermont's electric power supply options for the future. The future of VY has been a significant variable in this work.

The Joint Fiscal Committee, already familiar with using consensus estimates to model state revenue expectations, considered the creation of a consensus estimate regarding future power supply costs in various scenarios. Included in these discussions with the Joint Fiscal Committee Chair and staff were representatives of the Department of Public Service, Synapse, CVPS and GMP.

These parties agreed that a consensus estimate could provide additional value to their individual efforts and initiated joint meetings in late summer of 2008. A rigorous 16 month cooperative process followed, including retention by the legislative consultants of La Capra Associates to run a New England-wide dispatch model so as to analyze the likely wholesale market cost of electricity delivered to Vermont under the defined scenarios. This report assesses the consensus impact of these costs and of the larger overall economic and fiscal impacts associated with the defined scenarios below.

Four Initial Electric Energy Scenarios Evaluated

The consensus estimates herein analyze in detail the economic and fiscal impact of four possible future power supply scenarios. The four scenarios represent stakes in the ground at the corners of what the analytic group considered a reasonable field of possibilities representing the consensus assumptions underlying the potential power supply strategies.

The four scenarios include:

A) The "**VY Shutdown**" scenario, which assumes Vermont Yankee does not operate beyond March of 2012, at which time the so-called "SAFSTOR" decommissioning option is implemented, renewable energy and efficiency efforts continue at a plausible development pace under current law, and Vermont utilities purchase power at market forecast prices to meet load demands beyond committed resource supplies (such as current contracts and utility-owned generation).

B) The "**Green**" scenario, which assumes VY does not operate beyond March of 2012, at which time the SAFSTOR decommissioning option is implemented, and the State adopts very aggressive legislative and agency support for the development of in-State renewable energy power generating sources and energy efficiency expenditures. Table 1 on page 5 summarizes renewable energy development and energy efficiency load reduction assumptions used in the four scenarios.

C) The "**VY Relicense**" scenario, which assumes VY continues to operate until March of 2032, at which time the SAFSTOR decommissioning option is implemented, state utilities purchase reduced quantities of VY power at market prices between 2012 and 2032 (projected market prices were used, given that the terms of the December, 2009 offer provided by ENVY to the VT PSB have yet to be finalized), and revenues from the Revenue Sharing Agreement (RSA) are assumed to be credited to ratepayers at the 55% level.[3]

D) The "**Hybrid VY Relicense Green"** scenario, combines the aggressive renewable energy development and energy efficiency expenditures of scenario B, and the VY operational assumptions and reduced levels of VY purchased power beyond 2012 by Vermont utilities, as specified in scenario C.

With each of these scenarios defined by consensus power supply assumptions, load forecasts, decommissioning assumptions[4] and external fuel source pricing estimates as starting points, the economists used a series of energy, pricing and economic and fiscal models to assess the impact on the Vermont economy of these alternative power supply scenarios.

Analytic Process, Structure and Model Components

There are four major model components that work in sequence to measure total economic and fiscal impacts associated with the various scenarios: A Dispatch Model which generates wholesale electricity costs, a Wholesale to Retail Price Model, which converts these costs to retail power bills by sector, an Economic Impact Model, which incorporates output from these two models and other inputs to generate a wide range of economic impact estimates, and a Fiscal Impact Model, which uses output from the Economic Model and State-specific tax data to estimate State level fiscal impacts.

La Capra Electricity Market Dispatch Model

One of the key economic drivers for the study is the cost of electricity to consumers in the state of Vermont. The cost of power is composed of the cost of electric *energy*, and certain costs associated with the *delivery* of the energy. The cost of energy is the part

[3] There is some ambiguity regarding Vermont's share of the revenues to be derived from this agreement, which can be interpreted as either 55% or 92.5% of the RSA payments. If the final share is higher than the 55% assumed in this analysis, this would increase the benefits associated with the VY Relicense and Hybrid scenarios.
[4] The SAFSTOR decommissioning option was the consensus Working Group assumption for all scenarios, based on the current federal regulatory environment and the absence of any financial incentive for ENVY to immediately undertake full decommissioning upon plant shutdown. If full decommissioning is assumed for all scenarios, expenditure flows would be significantly different and higher than for SAFSTOR, with attendant economic and fiscal impacts.

that is most likely to be affected by decisions regarding the fate of Vermont Yankee or other sources of power for Vermont.

In order to forecast the cost of energy, the modeling team relied on an outside expert, La Capra Associates, to simulate the electricity market in the Northeastern U.S. using the AURORAxmp electricity dispatch model.[5] This model simulates the operations of all generating plants in the region, subject to certain assumptions about electricity demand, fuel prices, the limits of the electric transmission system, and other factors. The model output includes forecasted hourly electricity prices throughout the study region, along with the output of each electric generator in the system. The prices are used to compute the cost of electricity affecting consumers' electric bills, while the output can be used, for example, to calculate annual revenues for a single generating plant such as VY.

Energy supply assumptions, including VY purchases by Vermont utilities, in-state renewable energy development, and modified peak and average load forecasts were developed through a consensus process with the group and provided to La Capra as model inputs. The below Table 1 summarizes assumptions associated with installed net new capacity in place for the two "Green" scenarios vs. the VY Shutdown and VY Relicense scenarios, which assumed more limited renewable energy development.

TABLE 1

Renewable Energy Assumptions in "Green" Scenarios: Estimates of Installed Net New Capacity In-Place (MW) and Energy Efficiency Load Reductions (GWh) by 2040

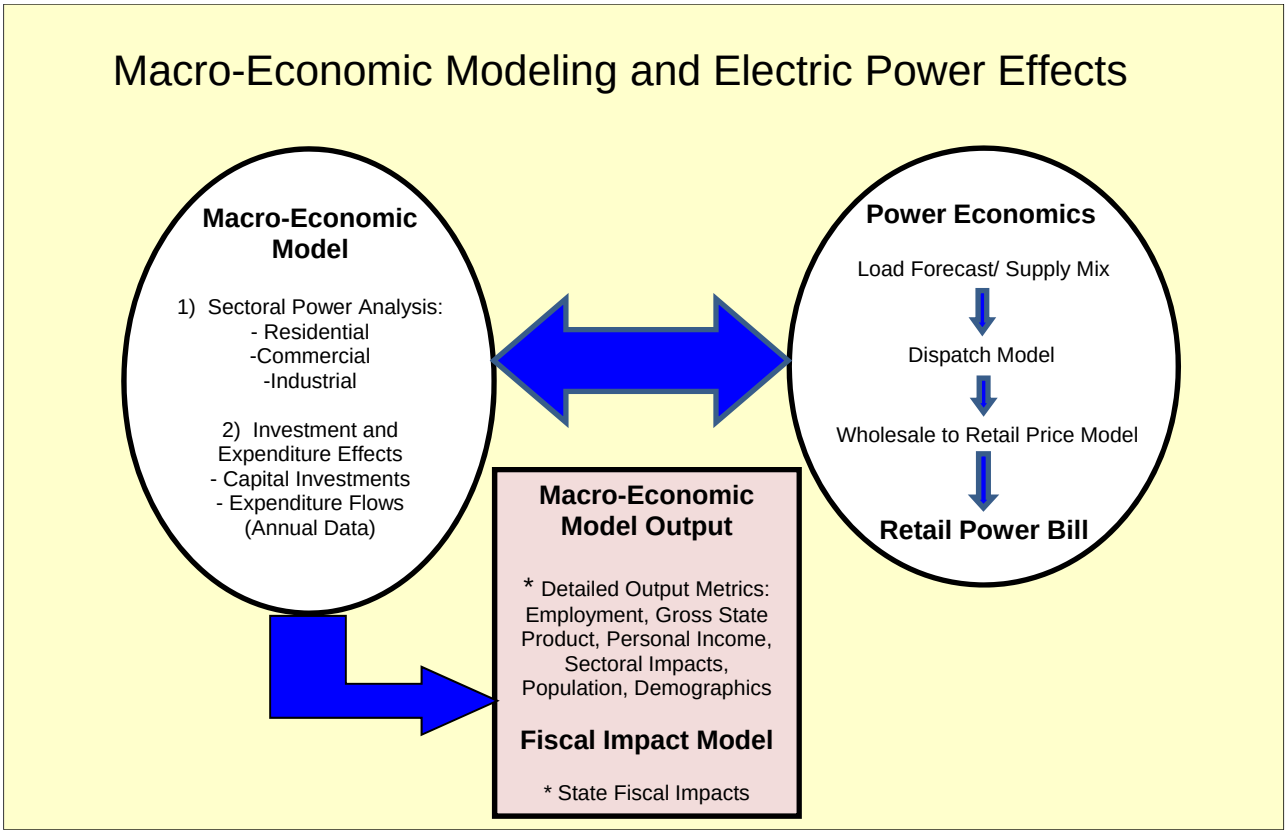
	VY Shutdown and Relicense Scenarios (A and C)	Green and VY Green Scenarios (B and D)	Incremental Difference in Green Scenarios (BD – AC)
Wind: Small	3.1	6.2	3.1
Wind: Community Scale	22.5	100.0	77.5
Wind: Utility Scale	130.0	510.0	380.0
Solar PV: Small	0.6	1.2	0.6
Solar PV: Utility Scale	0.7	29.0	28.3
Hydro: Micro	0	1.0	1.0
Biomass: Utility Scale	50.0	125.0	75.0
Methane: Landfill	2.5	10.0	7.5
Methane: Manure, etc.	3.6	13.5	9.9
CHP: Small	0	20.0	20.0
CHP: Large	0	15.0	15.0
Future Energy Efficiency (Annual Load Reduction in GWh - 2040)	1,568.0	2,591.0	1,023.0

Wholesale to Retail Price Model

The output from the La Capra model produced estimates of power costs to Vermont's load serving electric utilities. To determine the economic impact of changes in power costs it was necessary to convert the power cost to the state's utilities into retail power

[5] See: http://www.epis.com/Products/AURORAxmp.htm

bills charged to ratepayers. Wholesale power cost is only a portion of the total utility operating cost that ratepayers must pay. The cost of transmitting and distributing power must be included as are the general and administrative expenses of utility operation.



Financial records published by the Vermont DPS were examined to determine the historic cost trends and relationship for transmission, distribution and general and administrative expenses for all Vermont utilities. State total power bills were estimated by aggregating total utility costs for all electric load serving entities in Vermont, thus generating an aggregate estimated cost of service. Where official budget forecasts were available, they were used as a takeoff point for future estimates of cost. Such was the case for ISO-NE transmission and network service charges. Aggregate utility operation and maintenance less power production and transmission was found to be stable in real dollar terms, so future values of those costs were estimated from a 3 year weighted average and then trended forward using projections of the U.S. GDP deflator. In-state transmission costs were estimated forward at the GDP deflator less 0.5%. Property taxes were estimated using the most recent consensus JFO–Administration revenue forecast for the Education Fund. An amount equal to $2.00 per MWh of intermittent renewable resources (primarily wind) was added to account for their integration costs (i.e., incremental grid operating costs associated with managing their short term fluctuations). Depreciation, taxes, and operating income show stability relative to total costs historically and were added as a share of total costs based on recent averages.

The total aggregate power bill was distributed to each customer class based on recent average share of total cost data from DPS reports, which have been stable in recent

years. Share of cost of service and share of total energy were then calculated. Share of cost distributed the aggregate power bill to customer class and share of energy was employed to estimate energy efficiency charges. Energy efficiency charges were added to each customer class using rate setting data from the relevant PSB docket.

Economic Impact Model

The core economic model used to develop economic impact estimates was developed by Regional Economic Models, Inc. (REMI), and is widely used throughout Vermont State government. The model is maintained by the Joint Fiscal Office for analytic work associated with legislative economic and fiscal analyses and is also used by the Department of Public Service and the Vermont Economic Progress Council.

Model inputs were derived from a wide range of sources. Source data on ENVY operations, employment, taxes and other expenditures, including SAFSTOR expenditure flows, were provided by ENVY and cross checked with prior study references, VT Department of Labor data, submissions to the Public Service Board, review by independent legislative consultants,[6] other regional economic models and VT Tax Department data. While early cooperation with ENVY was excellent, recent delays in receiving essential information necessitated the estimation of some model input parameters to be made by the model team.

Renewable energy model input protocols specific to Vermont were developed by Economic and Policy Resources (EPR), Kavet, Rockler & Associates (KRA) and the Vermont Department of Public Service (DPS) as a part of a prior study sponsored by the Vermont Council on Rural Development (VCRD)[7] and were updated and expanded for this analysis. U.S. Energy Information Administration (EIA) and National Renewable Energy Laboratory (NREL) data were also used to supplement these protocols, and were applied to the renewable energy build-out specified in Table 1 on page 5. Energy Efficiency input estimates were derived through a series of alternative models estimated by EPR, Synapse, various DPS studies and an independent utility consultant,[8] and the Green scenarios (i.e., Scenarios B and D) assume an approximate doubling of the $40 million (constant dollars through 2040) currently expended on energy efficiency efforts.

Model input specifications were developed with subsets of the Working Group and economists at REMI. Complete model detail and selected output are available in the Appendix sections of this report. All model impacts are for the State of Vermont only.

Fiscal Impact Model

The final step in the impact analysis process is the estimation of all direct and indirect state revenues and costs associated with each of the four "energy future" scenarios. This was completed using an expanded version (from a five year model to a twenty eight year model) of the Vermont Employment Growth Incentive (VEGI) fiscal cost/benefit model as maintained by the Vermont Economic Progress Council (VEPC). The VEGI fiscal

[6] Primarily Bruce Lacy of the Lacy Consulting Group, LLC

[7] See: "*Strengthening Vermont's Energy Economy*" by the Vermont Rural Energy Council, August 2007. These include prototype project cost detail, Vermont-specific labor and materials inputs, and REMI model specifications.

[8] David Grimason of Grimason Associates, LLC, provided valuable model review and alternative parameter specification estimates.

cost/benefit model is a proven fiscal impact model, whose structure has been successfully employed for the past 14 years—with appropriate periodic modifications. While not specifically for this application, the model was approved by the Joint Fiscal Committee and also has undergone several audits by the State Auditor of Accounts and Joint Fiscal Office. Minor modifications were made, where appropriate, to adapt the model for assessing the fiscal impacts of the alternative energy futures involving the Vermont Yankee relicensing question.

To complete this step in the impact assessment analysis, 31 specific REMI impact model outputs for the above alternative energy scenarios were utilized to estimate State revenues and State costs for the General Fund, Transportation Fund, and Education Fund. These REMI outputs included variables such as the change in State Personal Income, the change in State Private Sector Employment, the change in the State Population, the change in the State School Age Population, the change in ten classifications of State Consumer Expenditures (and the change in those expenditure items' relative prices under each scenario), among other variables. Using these economic impacts and their relationship to State revenues and State costs, estimates of changes in the State's revenues and costs under each scenario were developed through calendar year 2040.

The last step in the fiscal impact estimating process involved taking those year-to-year changes in State revenues and State costs and discounting them to a "present value" dollar amount, assuming a 2.96% discount rate (that of a current 15 year State general obligation[9] bond interest rate). That "present value" dollar amount represents the total net fiscal impact (State revenues less State costs) expressed in calendar year 2010 dollars. Calendar year 2010 was selected as the base year for this estimate because calendar year 2010 is the year this impact assessment study was completed.

Economic and Fiscal Model Output and Findings

Although voluminous data are available associated with the model runs for the initial four scenarios, broad findings associated with each, expressed relative to the VY Relicense scenario, are outlined below. Of note, the economic and fiscal impacts vary significantly by year and other time frames and care should be taken in interpreting and converting to a present value or other basis. All annual data are expressed on a calendar year basis.

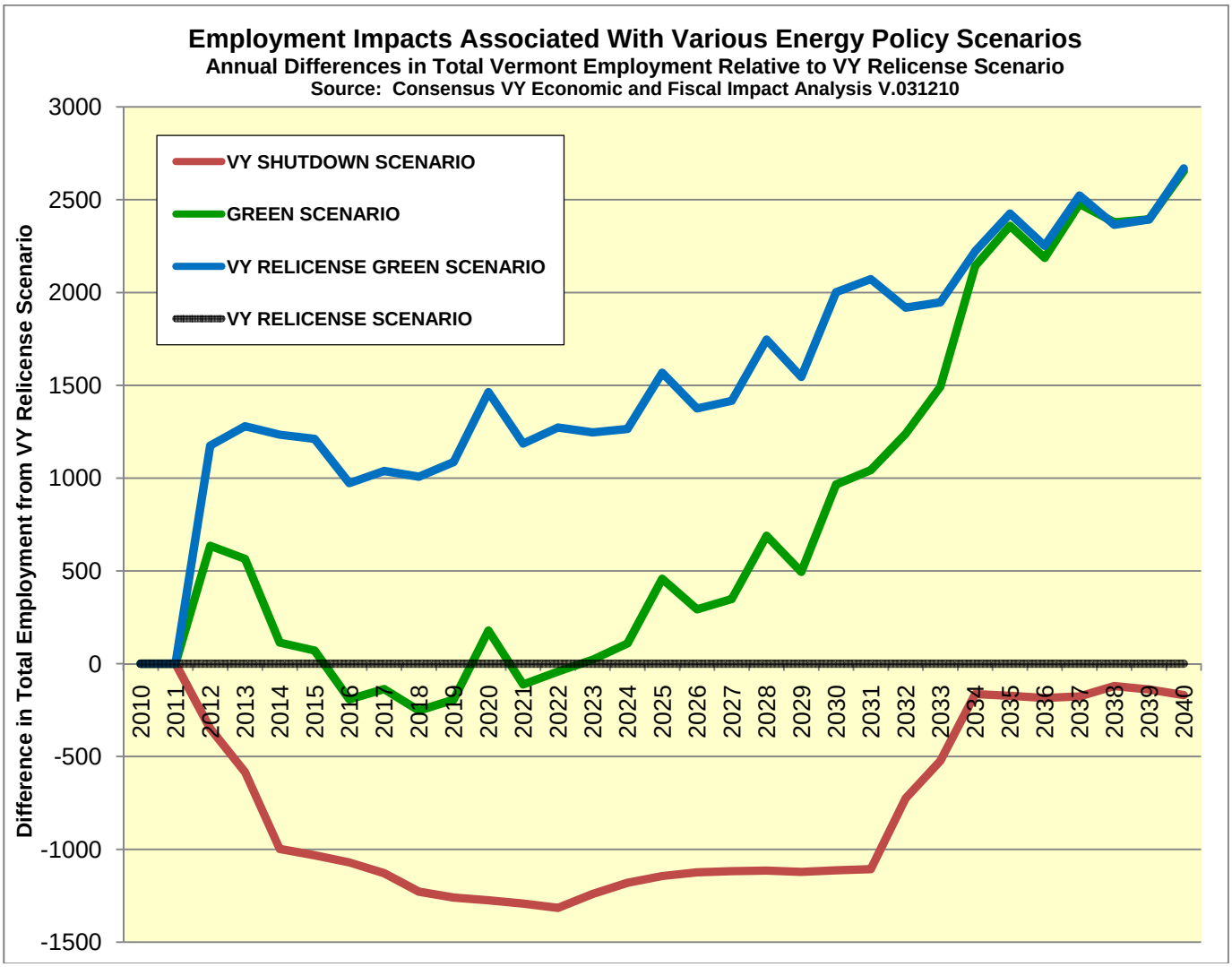
In the VY Shutdown Scenario:

1) *Negative plant shutdown employment impacts are likely to be at about -1,060 jobs (2013-2031 average), relative to the VY Relicense scenario, and prior to SAFSTOR, and at about -950 jobs with the implementation of the SAFSTOR decommissioning option over the period 2013-2031. Secondary indirect and induced economic impacts would be higher, except for the fact that nearly*

[9] The term "general obligation" means these bonds are backed by the full faith and credit of the Vermont State government. Accordingly, the 2.96% interest rate used as the discount rate in this analysis represents a reasonable approximation of the true long term cost of money to Vermont State government.

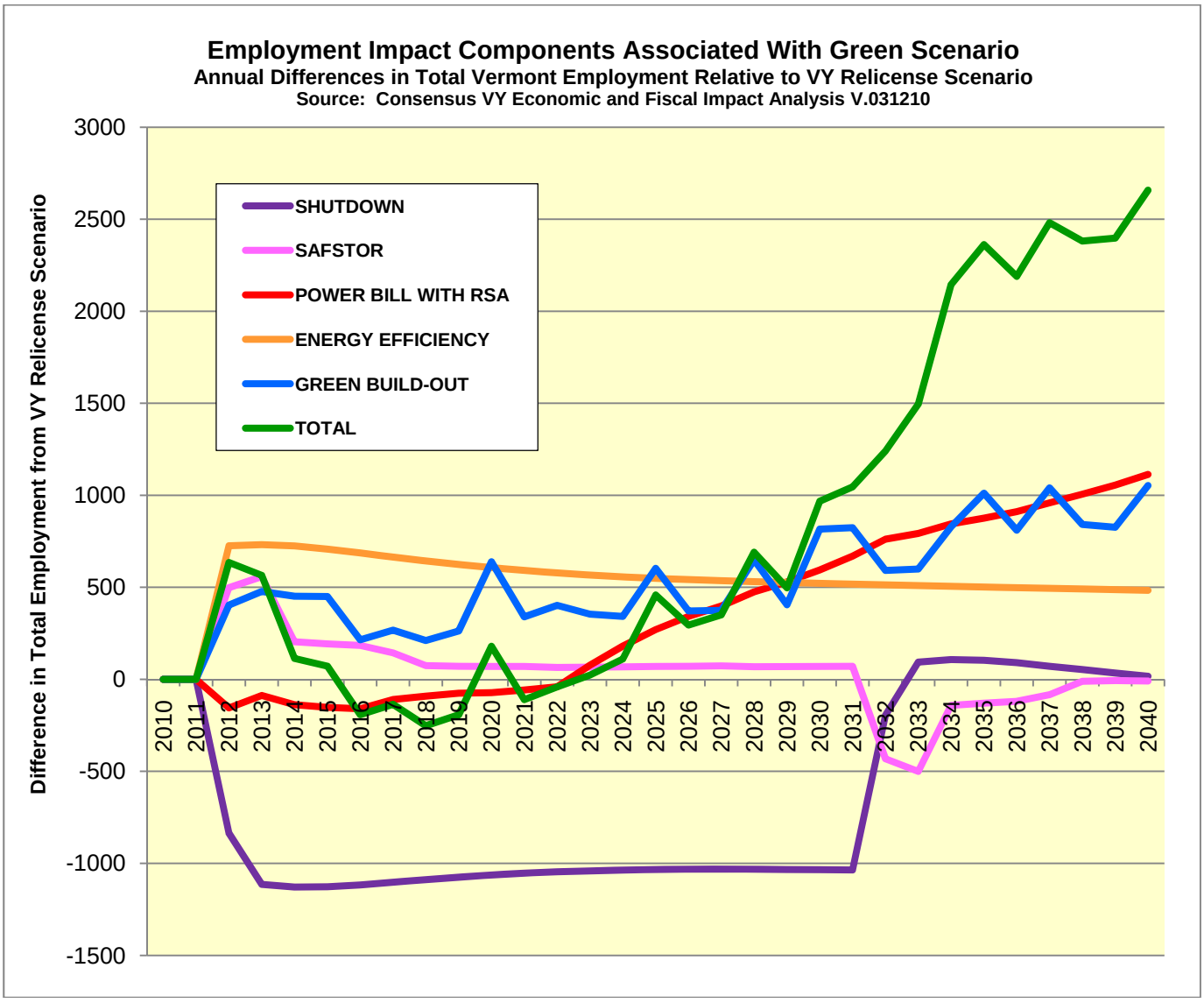
60% of VY employees reside (and spend most of their personal income) outside of Vermont – primarily in NH and MA.

2) *Even assuming replacement power at market prices, the retail power bill is likely to be higher in the event of plant closure, resulting in additional negative economic impacts. Power bill impacts associated with the plant shutdown will further reduce employment by about 120 jobs per year and output by more than $15 million per year in 2012 dollars.*
3) *Revenue Sharing Agreement impacts, estimated at the low end of the possible range (55%) leave the VY Shutdown scenario about 120 jobs per year below the VY Relicense scenario, during the relevant 11 year effective RSA period from 2013-2023.*
4) *Total VY Shutdown scenario impacts, relative to the Relicense scenario, result in about 1,100 fewer jobs per year and real disposable personal income levels more than $60 million per year (in 2012 dollars) below VY Relicense levels between 2013 and 2031.*



The **Green Scenario**, which includes the assumption of timely and aggressive policy action for renewable energy development:

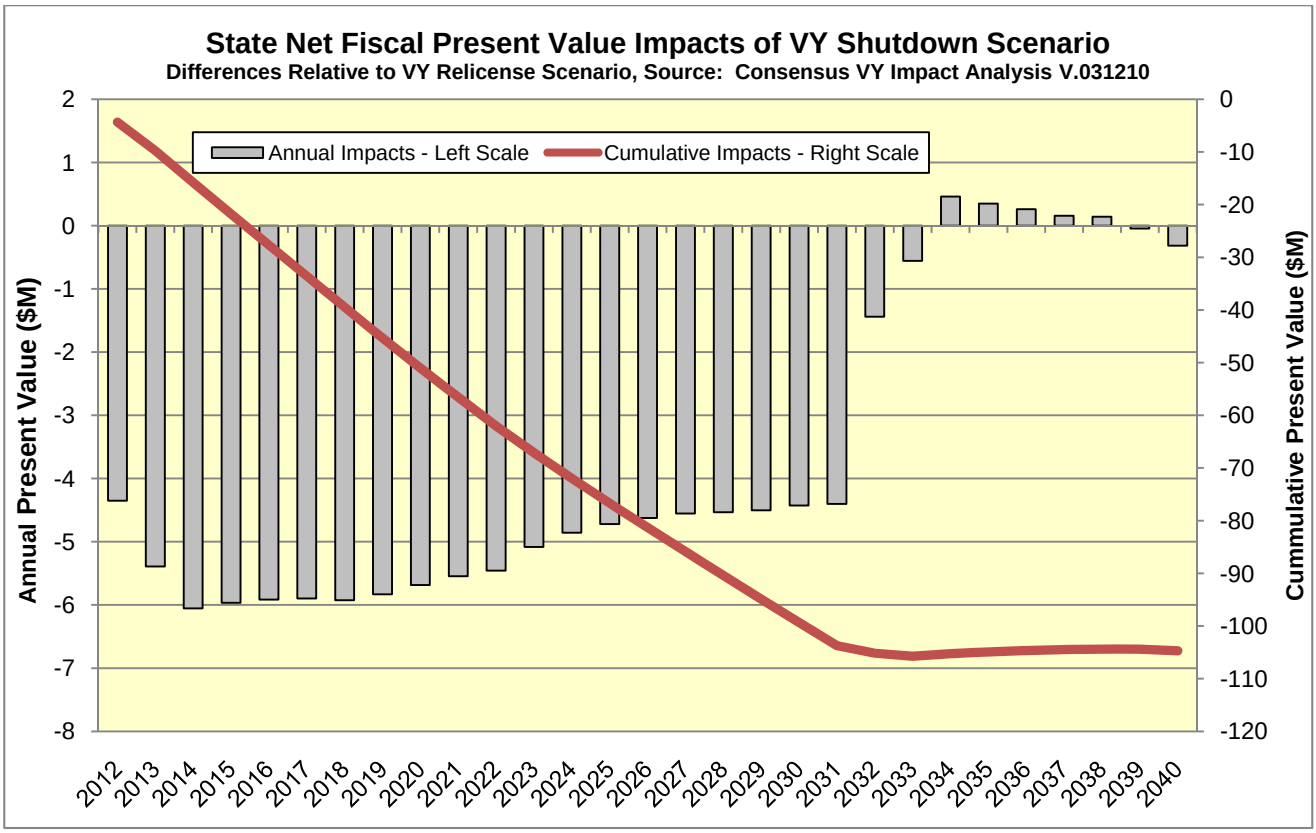
1) *Provides, on average, comparable employment levels relative to the VY Relicense scenario during the first decade of the analytic period and then rapidly outpaces the VY Relicense scenario over the final 17 years. Annual employment differentials relative to the VY Relicense case exceed 2,600 jobs by the end of the forecast horizon in 2040.*
2) *Retail power bills in the Green scenario are generally higher than most other scenarios in the initial 5+ years, but are substantially lower in the out years as consumers buy less power and competitive power source fuel prices (driven by projected fossil fuel price increases and national greenhouse gas limits), increase substantially in real terms. Even with additional negative RSA impacts through 2023, beneficial power bill impacts will eventually result in more than 1,000 jobs per year by 2040.*
3) *RSA impacts are negative in this scenario, as for the VY Shutdown scenario.*
4) *The economic impacts of this scenario are more irregular over the forecast period than some others due to the discrete timing of power supply build-out assumptions made by the Working Group.*

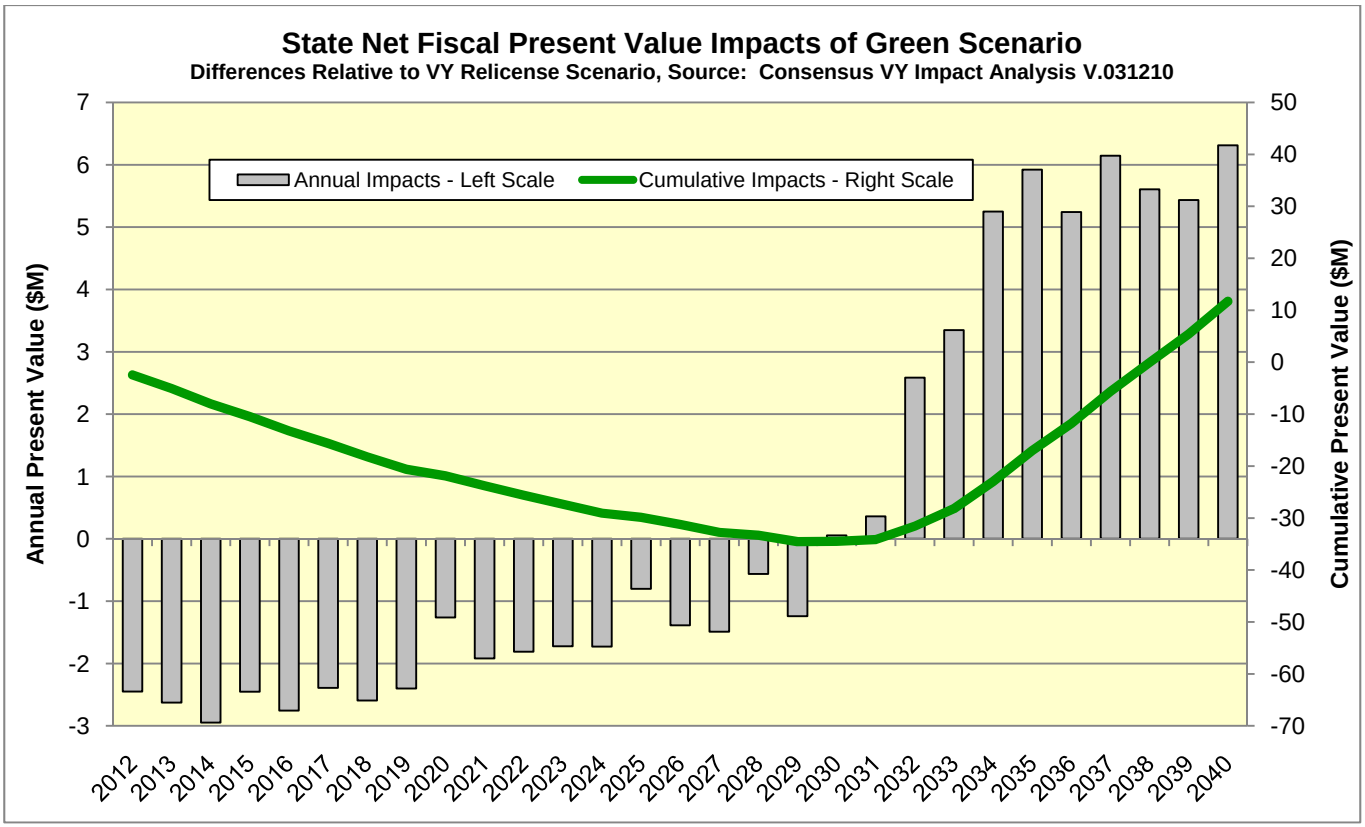


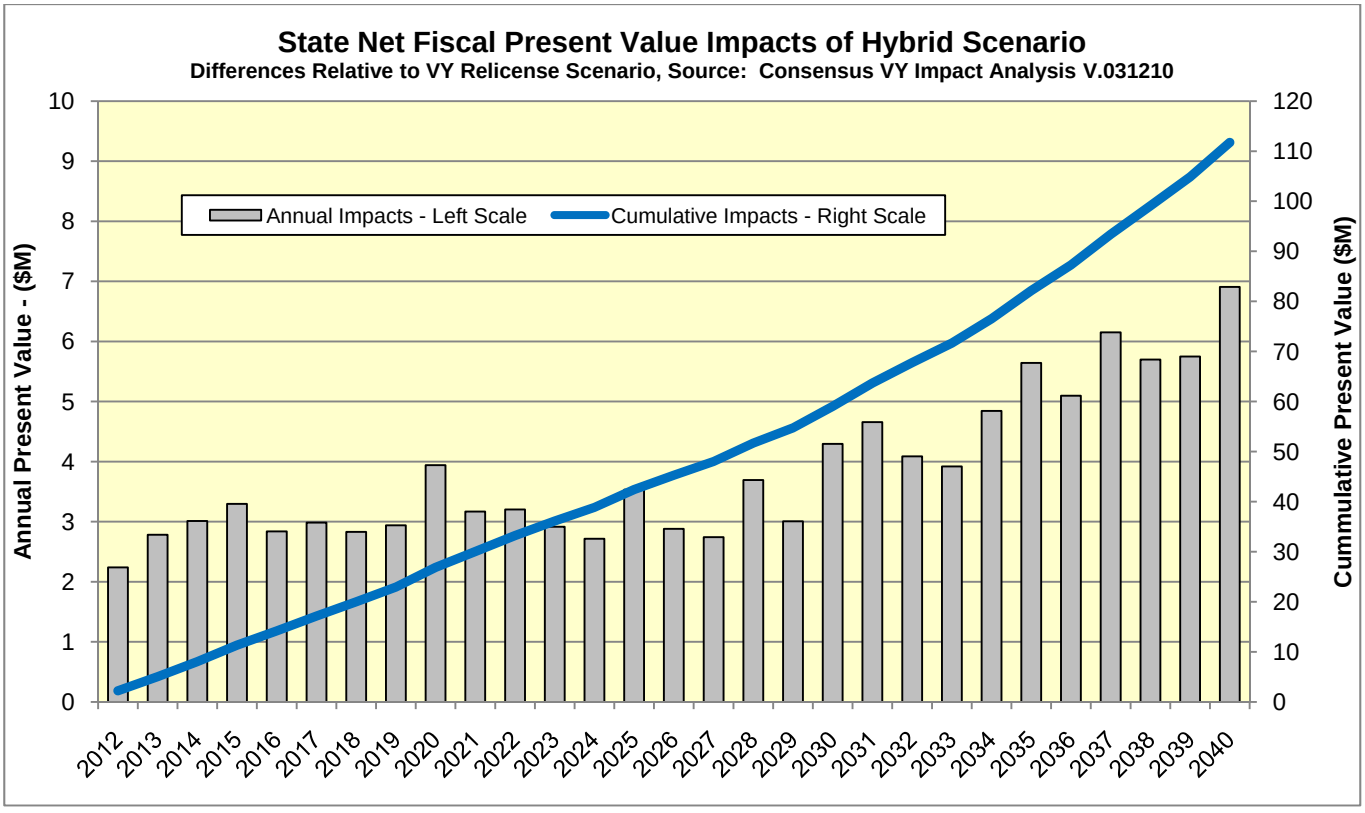
There are no differentials for the **Relicense Scenario**, since it is the comparison case.

Under the **Hybrid VY Relicense Green Scenario:**

1) *Relicensing VY and adopting aggressive renewable energy policies yields the largest average positive employment and other economic impacts, with immediate job gains, no job losses and lower longer term power bills.*
2) *By the end of the forecast period in 2040, this scenario results in more than 2,600 jobs per year and nearly $400 million in Gross State Product per year (in 2012 dollars) than the VY Relicense case.*
3) *In the VY Relicense and Hybrid scenarios, any final revenue sharing agreement or more competitive power price offer would result in positive economic impacts through lower power bills. Specific price offers may be modeled to quantify resultant economic and fiscal impacts.*
4) *Per the below series of charts, net fiscal impacts relative to the VY Relicense scenario are significantly positive in the Hybrid scenario, with a net present value of aggregate State fiscal impacts between calendar 2012 and 2040 of about +$100 million; Net fiscal impacts in the Green scenario are only slightly above zero through 2040, but would escalate rapidly if the analysis were extended beyond 2040; and in the VY Shutdown scenario, net State fiscal impacts are about $100 million negative through 2040, with a maximum annual loss of about $6 million in 2014. Note that in the below charts, the annual impacts (gray bars) are charted against the left axes, while the cumulative impacts (colored lines) are charted against the right axes.*




State Net Fiscal Present Value Impacts of Green Scenario
Differences Relative to VY Relicense Scenario, Source: Consensus VY Impact Analysis V.031210
Annual Impacts - Left Scale
Cumulative Impacts - Right Scale
Annual Present Value ($M)
Cumulative Present Value ($M)
7
6
5
4
3
2
1
0
-1
-2
-3
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040


State Net Fiscal Present Value Impacts of Hybrid Scenario
Differences Relative to VY Relicense Scenario, Source: Consensus VY Impact Analysis V.031210
Annual Impacts - Left Scale
Cumulative Impacts - Right Scale
Annual Present Value - ($M)
Cummulative Present Value ($M)
10
9
8
7
6
5
4
3
2
1
0
120
110
100
90
80
70
60
50
40
30
20
10
0
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040