APPENDIX A

Catalogue of Clean Energy Case Studies Highlighted in the Multiple Benefits Guide

DOCUMENT MAP

CATALOGUE OF CLEAN ENERGY CASE STUDIES HIGHLIGHTED IN THE MULTIPLE BENEFITS GUIDE

Chapter 1: Introduction							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
Connecticut: Incorporating Multiple Benefits in Evaluation Criteria for New Capacity Additions	In June 2005, Connecticut policymakers enacted Public Act 05-01, An Act Concerning Energy Independence (EIA), which authorized the Connecticut Department of Public Utility Control to launch a competitive procurement process geared toward motivating new supply-side and demand-side resources. As part of the bid evaluation process, each capacity project is scored based on a multiple benefits weighting system: A total of 85% of the evaluation score is based on a benefit-cost analysis of the project. A total of 15% of the evaluation score is determined through the assessment of five other criteria with their associated weights (see benefits, right).	Connecticut Climate Change 2005. Connecticut Climate Action Plan.	• Use of existing sites and infrastructure – 2.5% • Benefits of fuel diversity – 2.5% Other benefits (e.g., transmission reliability, employment effects, benefits of high level efficiency such as CHP) – 2.5%	Reduced emissions of SO_2, NO_x, and CO_2 – 5%	Front-loading of costs – 2.5%	2005–2020	P
Ohio: Clean Energy Initiatives Can Benefit Economic Development	A 2007 study by the American Solar Energy Society assessed the renewable energy and energy efficiency market and developed forecasts of the market's future economic growth. The study established a baseline of 2006 and forecast the growth of the renewable energy and energy efficiency industry from this baseline to 2030 under three different scenarios. Using this approach, the authors developed a case study for Ohio, an area hard hit by the loss of manufacturing jobs. The analysis concluded that the energy efficiency and renewable energy industries offer significant development opportunities in the state.	Bezdek, Roger. 2007. Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century. Prepared for the American Solar Energy Society.			In 2030: • $18 billion in revenues and 175,000 jobs annually in the renewable energy industry • $200 billion in revenues and more than 2 million jobs in the energy efficiency industry	2006–2030	P

* P = Prospective; R= Retrospective

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Multiple States: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency	A recent study by the Lawrence Berkeley National Laboratory (LBNL) examined several studies of the natural gas consumer benefits from clean energy programs. Most of the studies evaluated a national or state RPS, or a combined RPS and EE program and consistently showed that "RE and EE deployment will reduce natural gas demand, thereby putting downward pressure on gas prices" (Wiser et al., 2005).	Wiser, R., M. Bolinger, and M. Clair. 2005. Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency. Ernest Orlando Lawrence Berkeley National Laboratory (LBNL). January.			• Each 1% reduction in national gas demand is likely to lead to a long-term average reduction in wellhead gas prices of 0.8% to 2%. • The present value of natural gas bill savings from 2003-2020 are within the range of $10 - $40 billion. • Consumers' gas bill savings are estimated between $7.50 and $20 for each MWh of electricity produced by RE or saved with EE.	2003–2020	P
Multiple States: How Many Jobs Can the Clean Energy Industry Generate?	In 2004 the University of California-Berkeley reviewed 13 independent reports and developed a model to examine the job creation potential of the renewable energy industry. The study analyzed the employment implications of three national 20% RPS scenarios and two scenarios where the generation required by the RPS is produced instead by fossil-fuel generation.	Kammen, D., K. Kapadia, M. Fripp. 2004. Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate? April.			• The RE industry generates more jobs than the fossil-fuel industries per unit of energy delivered and per dollar invested, driven primarily by the general shift from mining and related services to increased manufacturing, construction, and installation activity.	1998–2004	R

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New England and NE Canada: Multiple Benefits Analysis is Being Used in Regional Planning	The Conference of New England Governors and Eastern Canadian Premiers (NEG-ECP) developed a comprehensive Climate Change Action Plan in 2001 with the long-term goal of reducing GHG emissions in the region by 75–85% and enacted Policy Resolution 30-2 to promote energy efficiency and renewable energy in the region. A study, Electric Energy Efficiency and Renewable Energy In New England: An Assessment of Existing Policies and Prospects for the Future, estimates that by 2010, the combined effect of expected energy efficiency and renewable energy deployment will provide a wide range of benefits that go beyond direct energy savings.	New England Governors and Eastern Canadian Premiers (NEG-ECP). 2006. Resolution 30-2: Resolution Concerning Energy. May.	Energy security benefits between 2000 and 2010 included: • A stabilizing and reducing influence on the wholesale price of, and demand for, natural gas • Reduced wholesale electricity prices in the regional market • Reduced demand for new facilities in the electric market • Increased resiliency of the grid	Estimated environmental benefits between 2000 and 2010 included: • savings of 31.6 million tons of CO_2 emissions • 22,000 tons of NO_X emissions • 34,000 tons of SO_2 emissions	Estimated economic benefits between 2000 and 2010 included: • A net positive $6.1 billion for the New England economy • More than 28,000 job-years • $1 billion in wages	2000–2010	R and P

Chapter 2: Assessing the Potential Energy Impacts of Clean Energy Initiatives Programs							
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New Jersey: Energy Plan-Basic Demand Forecast	The New Jersey energy plan-basic demand forecast projected the electricity growth rate for all sectors for 2005-2020. This study illustrates an example of a linear extrapolation analysis. The BAU electricity forecast was developed using a relatively simple approach in which past load growth rates were reviewed and assumptions were made regarding the ways in which industry trends and existing policies affect future growth patterns.	Summit Blue Consulting. 2008. Assessment of the New Jersey Renewable Energy Market, Volume I and II. Prepared for the New Jersey Board of Public Utilities. March.	• The electricity growth rate for all sectors from 2005-2020 is projected to be 1.52%			2005–2020	P

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New York: Energy $martSM Public Benefits Program	New York's public benefit program was established by order of the New York State Public Service Commission (PSC) in January 1998 and funded by the System Benefits Charge (SBC). New York State Energy Research and Development Authority (NYSERDA) administers the New York Energy $martSM Program which promotes competitive markets for energy efficiency services, provides direct benefits to electricity ratepayers and/or to the people of New York and stimulates demand for energy-efficient products and services, and renewable resource technologies. In this study, NYSERDA uses a production costing model, MAPS, to forecast the avoided energy and capacity benefits of the programs for several years.	NYSERDA. 2005. New York Energy $MARTSM Program, Evaluation and Status Report for the Year Ending December 2004. New York Public Service Commission and New York State Energy Research and Development Authority. May. NYSERDA. 2008. New York Energy $MARTSM Program, Evaluation and Status Report for the Year Ending December 2007. New York Public Service Commission and New York State Energy Research and Development Authority. March.	Electricity savings of: • 1,400GWh between 1998-2004 • 3,000 GWh savings by 2007	• Reduced nearly 2,600 and 4,700 tons of NO_x and SO_x respectively • Decreased annual CO_2 emissions by 2 million tons	Between 1998-2004: • Saved $195 million in energy costs • Reduced annual energy bills by $570 million Created and retained 4,700 jobs By 2027 the program is expected to: • Create more than 7,200 jobs • Increase labor income more than $300 million each year • Increase total annual output in the state by $503 million	1998–2027	R and P
Texas: Building Code	The legislation (Senate Bill 5, 2001) that initiated the Texas Emissions Reduction Plan (TERP) requires the Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station of the Texas A&M University System to submit an annual report to the Texas Commission on Environmental Quality estimating the historical and potential future energy savings from energy building code adoption and, when applicable, from more stringent local codes or above-code performance ratings. Using data from the TCEQ and EPA, including eGRID, ESL estimated the energy savings and NOX reductions from energy code compliance in new residential construction. ESL has conducted this annual analysis since 2002.	Texas A&MEnergy Systems Laboratory (ESL). 2007. Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP). Volume II-Technical Report.	Annual Energy Savings: • 1,440,885 MWh of electricity each year • Approximately 2.9 million MWh by 2013	NO_x emissions reduced by: • 1,014 tons-NO_x/year in 2007 • 2,047 tons/year by 2013		1998–2027	P

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Vermont: Energy and Energy Savings Forecasting	The Vermont Department of Public Service (DPS) conducts forecasting as a part of its long-term state energy policy and planning process. The state uses the Comprehensive Energy Plan (CEP) to help manage the transition from fossil fuels to cleaner energy in order to benefit Vermont's economic and environmental future. An analysis performed in 2008 inlcuded an examination of historical energy consumption across all sectors 1960-2005. The forecasting process required the following steps: 1) Determine fuel price projections and avoided costs; 2) Estimate the achievable, cost-effective potential for electric energy and peak demand savings; 3) Develop a 20-year forecast of electric energy use; and 4) Develop a peak demand forecast. It also employed historical data to compare energy demand in Vermont with New England from 1990-2004.	Vermont's Energy Forecasting Efforts. Vermont Department of Public Service. June 19, 2008	• Electricity demand is expected to grow an average of 0.93% on an average annual basis 2008-2028. • When new DSM measures are implemented, DPS anticipates a decline of 0.19% on an average annual basis.		• Due to forecasts of a large supply gap with high costs to replace power contracts, Vermont committed itself to pursue very aggressive energy efficiency measures.	1960–2005	P
Wisconsin: Office of Energy Independence: Demand & supply baselines & energy consumption by fuel type data	In 2006, then-Wisconsin Governor Jim Doyle launched the ***Declaration of Energy Independence***, which included a goal of using renewable energy to generate 25 percent of the state's electricity and 25 percent of its transportation fuels by 2025. It uses a top-down approach to help a state understand the large and small consumers within the state and helps target sectors for policy interventions. It also employs a bottom-up approach to explore a sector- or technology specific clean energy policy. This analysis was performed in 2007 by breaking down consumption data by the sectors that consume the fuels, including the commercial, residential, industrial, transportation, and utility sectors. Consumption and/or generation-related baseline data can be obtained from DOE's EIA, EPA's eGRID, NERC, IOSs, public utility commissions, and many more.	Wisconsin Office of Energy Independence. 2007. Wisconsin Energy Statistics.	• Overall petroleum use decreased 2.3% in 2009. Of the total petroleum used in Wisconsin, 81.4 percent is in the transportation sector, which saw a decrease of 4.2%.	From 2008-2009 • Utility SO_2 emissions decreased 18.9 percent Utility NO_x emissions decreased 28.2 percent	• Total electricity sales decreased 6.4% in 2009 but have grown 3.7% over the past ten years. • In 2009, electricity sales decreased in all sectors.	1970–2006	R

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Chapter 3: Assessing the Electric System Benefits of Clean Energy Programs							
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State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
California: Utilities' Energy Efficiency Programs	The California Public Utilities Commission (CPUC) approved a new method for calculating avoided costs for use in evaluating utility energy efficiency programs in California and demonstrated how clean energy can be used in the state energy planning and policy decision-making process. A new methodology was used that includes five major categories of costs that are avoided when demand is reduced through installation of energy efficiency resources. It produces time- and location-specific cost estimates, whereas the previous avoided-cost methodology relied more upon average statewide values.	*Energy Efficiency Portfolio Plans and Program Funding Levels for 2006-2008—Phase 1 Issues.* California Public Utilities Commission. Interim Opinion. September 22, 2005.	• The electricity growth rate for all sectors from 2005-2020 is projected to be 1.52%		Avoided electricity generation costs: • $133/MWh with the new method (compared with $80/MWh with the old method) Avoided T&D costs: • Avoided environmental externality costs • Avoided ancillary services costs • Reduced wholesale market clearing prices	2006–2008	P
Massachusetts: Energy Efficiency and Distributed Generation	This study explores the potential price and emissions benefits of increasing distributed generation, photovolatics (PV), combined heat and power (CHP) and energy efficiency in Massachusetts through 2020. A reference case was developed to determine what the wholesale electric prices and carbon dioxide emissions would be without the additional clean energy resources. PROSYM simulation model was used to determine the potential price and emissions impacts of the four scenarios which are then compared against the reference case to determine the impacts.	Impacts of Distributed Generation on Wholesale Electric Prices and Air Emissions in Massachusetts, Synapse Energy Economics, March 31, 2008.		• Each scenario was found to achieve reductions of CO_2 emissions relative to the reference case: EE and CHP combined will have a reduction of 2.4 million short tons CO_2/year in 2020	• The 250MW of PV is expected to displace 356 GW of purchases from the wholesale market and reduce prices by 0.4% • EE is expected to reduce prices by 1.6% • EE and CHP would produce 5.1% reduction	2007–2020	P

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Northeast: Price Effects of Demand Response	In all four of the structured, RTO-run eastern spot electricity markets, historically high peak load values occurred during a week-long heat wave in August 2006. Market coordinators all acknowledged the role that demand response (DR) played in keeping peak load lower than what otherwise would have occurred and the study estimate the wholesale price effects from using DR during these peak times.	"Early Aug. Demand Response Produces $650 Million Savings in PJM: Reducing Electricity Use Stretches Power Supplies, Lowers Wholesale Electricity Supplies." August 17, 2006.			• Wholesale prices would have been $300/MWh higher without demand response during heat wave • Demand response to heat wave reported savings of about $650 million for energy purchasers	2006	R
Vermont: System Planning Approach to Estimate Avoided Transmission Costs	Vermont: System Planning Approach to Estimate Avoided Transmission Costs The Vermont Electric Company (VELCO) undertook a study in 2003 of alternatives to a proposed major upgrade in the northwest corner of Vermont. VELCO conducted a thorough study of distributed generation, energy efficiency, and new central generation as alternatives to the upgrade. It demonstrates one way to use the system planning approach to estimate avoided transmission costs. The study identified a range of central generation and distributed generation options and estimated their costs. In addition, a location-specific study of the available energy efficiency potential and the program costs for delivering that potential was prepared. Various combinations of energy efficiency and generation were assembled as alternatives to the proposed transmission project and compared based on total present value of cost of service.	LaCapra Associates. 2003. Alternatives To Velco's Northwest Vermont Reliability Project. January 29 (LaCapra Associates, 2003; Orans, 1989; Orans, 1992).			• The study determined the cost of transmission upgrade and the cost of a smaller upgrade; the difference in those two costs could be used to assess the cost-effectiveness of the alternative resource package	2002–2011	P

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Chapter 4: Air Pollution, Greenhouse Gas, Air Quality & Health Benefits of Clean Energy Programs							
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State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
Connecticut: Economic Impact of Oil and natural Gas Conservation and results of using COBRA	Connecticut worked with EPA and NESCAUM to quantify the economic, air quality, and health benefits of policy options while developing the state's 2005 Climate Change Action Plan. The state specifically analyzed the benefits of oil and natural gas conservation programs that encourage installation of EE equipment. Three scenarios analyzed from 2005-2020: oil program, gas program, combined programs. Program funded by a 3% natural gas and oil-use surcharge. Emissions were estimated through the development of their Climate Change Action Plan. Macroeconomic effects modeled with REMI. Public health effects from avoided emissions estimated with EPA's COBRA model.	Connecticut GSC on Climate Change. 2005. CCCAP. GSC on Climate Change. Connecticut Climate Change Web site, State Action Plan. CT GSC. 2004. 2005 Climate Change Action Plan, Appendix 9: Economic Impact of Oil and Natural Gas Conservation Policies. Connecticut Governor's Steering Committee, prepared by Regional Economic Models, Inc. November.		By 2020: • Oil programs are expected to avoid: 1.89 millions of metric tons of carbon dioxide equivalent ($MMTCO_2e$) • Gas programs are expected to avoid: 2.07 $MMTCO_2e$.	Net benefits from 2005-2020 include ($1996): • 2,092 average annual jobs • $3.1M output • $2.03M GSP • $1.8M real disposable income • An additional $4 to $1 payback of reduced health costs and public health benefits was identified as a result of reductions in criteria air pollutants.	2005–2020	P

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Minnesota: How BenMAP Has Been Used in Clean Energy Analysis: Minnesota Public Utilities Commission	For testimony to the Minnesota Public Utilities Commission about building a new clean energy electricity generating facility, Excelsior Energy compared the air quality and health effects of two proposed 600 MW integrated gasification and combined cycle (IGCC) units with two comparable supercritical pulverized coal (SCPC) units. The 2005 analysis used REMSAD to model Hg and PM air quality changes, and BenMAP to estimate and value the PM-related health effects. BenMAP systematically analyzes the health and economic benefits of air pollution control policy scenarios.	Excelsior Energy. 2005. Air Quality and Health Benefits Modeling: Relative Benefits Derived from Operation of the MEP-I/II IGCCPower Station. December.		Installing IGCC technology would reduce annual emissions by: • 2,600 tons of SO2, • 600 tons of NOx, and • 12 pounds of Hg. In 2012, the IGCC units would avoid: • 12 premature deaths nationally, • 20 heart attacks (infarctions), eight new cases of chronic bronchitis, and • 200,000 work loss days. The study also quantified estimates of other health effects ranging from hospital admissions to asthma attacks.	• The annual value of the one year of reduced health effects was estimated to be $99 million nationally, with $24 million occurring within Minnesota.	2005–2012	P

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Texas: Energy Efficiency/ Renewable Energy Impact in the Texas Emissions Reduction Plan	In 2001, the 77th Texas Legislature established the Texas Emissions Reduction Plan (TERP) with the enactment of Senate Bill 5, which required the Texas Commission on Environmental Quality (TCEQ) to promote EE/RE to meet ambient air quality standards and to develop a methodology for computing emission reductions for State Implementation Plans. To improve Texas air quality, TERP adopted the goal of implementing cost-effective EE/RE measures to reduce electric consumption by 5% per year for five years, beginning in 2002, using a variety of mandatory programs and voluntary financial incentive programs in non-attainment and affected counties. An analysis was performed with data from the TCEQ and EPA, including eGRID, to estimate the energy savings and NOX reductions from energy code compliance in new residential construction.	Haberl et al 2007. Energy Efficiency/ Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP): Volume 1 – Summary Report. Prepared for the Texas Commission on Environmental Quality (TCEQ). August, revised in December.	Annual energy savings in 2006 amounted to: • 498,582 MWh of electricity and • 576,680 BTUs of natural gas	NO_x emissions reduced by: • 346 tons per year in 2004 • 361 tons per year in 2006 • 824 tons per year in 2007 • 1,416 tons per year in 2012 • 2,121 tons per year 2013		2002–2013	R and P
Wisconsin: Focus on Energy Program	*Focus on Energy Public Benefits Evaluation – Semiannual Summary Report.* Prepared by PA Government Services for the Wisconsin DOA. September 27, 2006.	Erickson et al. 2004. Erickson, J., C. Best, D. Sumi, B. Ward, B. Zent, and K. Hausker. Estimating Seasonal and Peak Environmental Emission Factors – Final Report. Prepared by PAGovernment Services for the Wisconsin DOA. May. Department of Administration, State of Wisconsin. 2005. Focus on Energy Public Benefits Evaluation – Semiannual Summary Report. Prepared by PAGovernment Services for the Wisconsin DOA. September.	• From 2001-2006, Wisconsin estimated that its programs saved 1 billion kWhs and nearly 50 million therms in annual energy consumption	These programs have displaced annual emissions from power plants and utility customers by: • 5.8 million pounds of NO_x • 2.6 billion pounds of CO_2 • 11.4 million pounds of SO_x • 46 pounds of mercury	• Add nearly $1 billion in value to Wisconsin's gross state product	2001–2011	R and P

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Chapter 5: Economic Benefits of Clean Energy Programs							
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State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
California: Economic, Energy, and Environmental Benefits of Concentrating Solar Power	This study analyzes benefits of concentrating solar power (CSP) for CA for two deployment scenarios: $7B and $13B invested (2100 MW and 4,000 MW) from 2008-2020. It emphasized in-state impact of employment created from manufacture, installation, and operation of CSP plants. CSP performance and cost analyzed with Excelergy. Displaced emissions estimated with emission factors from California Air Resources Board. Macroeconomic effects modeled with RIMS II.	Stoddard, L., J. Abiecunas, and R. O'Connell. 2006. Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California. Prepared by Black & Veatch for U.S. DOE National Renewable Energy Laboratory. April.	• CSP scenarios avoid between 8%–18% of peak electricity demand growth by 2020 • 4000 MW of CSP avoid $60M per year of natural gas costs in CA	Each 100 MW of CSP avoids (per year): • 7.4 tons of NO_x emissions • 2.6 tons of VOCs • 191,000 tons of CO_2	• Each dollar spent on CSP yields direct and indirect impact of $1.40 to GSP • Each 100 MW of CSP yields 94 permanent jobs	2008–2020	P
Connecticut: Steps in a Macroeconomic Impact Analysis: Oil and Natural Gas Conservation Policies	In 2004, Connecticut analyzed the economic impact of oil and natural gas conservation policies in Connecticut. The state wanted to explore the impacts of fully funding a program between 2005 and 2020 to increase the efficiency of oil and natural gas for residential, commercial, and indus-trial users. Using the REMI Policy Insight model, their analysis showed economic benefits to the state from the increased investment in efficiency and that the natural gas conservation efforts contributed more than the oil programs to the overall benefits of the program. Note: the expected emissions benefits of these oil and gas policies is discussed above under the Chapter 4 case studies	REMI. 2004. Economic Impact of Oil and Natural Gas Conservation Policies. Prepared for U.S. Environmental Protection Agency and the State of Connecticut. November.			Benefits to the State • Employment (Average Annual Increase)*: 2,092 • Output (Mil '96$): 3,094.90 • GSP(Mil '96$): 2,033.01 • Real Disposable Personal Income (Mil '96$): 1,749.42 • State Revenues (Mil '01$): 382.13 *Employment is the average annual increase from the baseline. Employment is not cumulative and is based on output growth.	2005-2020	P

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Georgia: Quantifying the Energy System Benefits of Clean Energy Policies	This study analyzes benefits of energy efficiency improvements from 2005-2015 for three investment scenarios: minimally, moderately, and very aggressive. Analysis included four main parts: collect GA energy profile data; estimate EE potential; estimate benefits; and review policy options to achieve EE potential. EE potential was modeled with ICF's EEPM. Direct energy cost savings were modeled with ICF's IPM. Macroeconomic effects modeled with Georgia Economic Modeling System (GEMS). Public health effects estimated with EPA's COBRA model.	Jensen, V., and E. Lounsbury. 2005. Assessment of Energy Efficiency Potential in Georgia. Prepared for the Georgia Environmental Facilities Authority by ICF Consulting. May.	• Avoided generation in 2010 ranges from 1,207–4,749 GWh; • Regional wholesale electricity costs reduced by 0.5%–3.9% by 2015 • Reduce peak demand 1.7%–6.1% by 2015	All estimates versus 2010 baseline. • CO_2 emission reduced 0.6%–2.4% • SO_2 emissions reduced 0.2%–1.3% • NO_x emissions reduced 0.3%–1.9%	• 1.6 - 2.8 job impact per $1M net benefit • Generate 1500 – 4200 net jobs by 2015 • Increase personal income $48 - $157M by 2015	2005–2015	P
Iowa: The Economic Impact of Energy Efficiency Programs and Renewable Power	This study examined the long-term economic development implications of energy efficiency (EE) programs, energy pricing/ cost changes, and renewable energy (RE) (biomass and wind power) from 1995-2015. Program cost and savings, including RE cost and productivity, estimated using program survey data. Macroeconomic effects (in terms of business output, personal income and employment) were modeled with REMI. Results were distinguished by year over a twenty-year period, and broken down by business type.	Weisbrod, G., K. Polenske, T. Lynch, and X. Lin. 1995. The Economic Impact of Energy Efficiency Programs and Renewable Power for Iowa: Final Report. Economic Development Research Group, Boston, MA. December.	• From 2001-2006, Wisconsin estimated that its programs saved 1 billion kWhs and nearly 50 million therms in annual energy consumption	These programs have displaced annual emissions from power plants and utility customers by: • 5.8 million pounds of NO_x • 2.6 billion pounds of CO_2 • 11.4 million pounds of SO_x • 46 pounds of mercury	REMI model forecasts indicate that, in Iowa over the 1995–2015 period, EE can lead to: • 25 job-years for every $1M invested • $1.50 of disposable income for every $1 invested Biomass can lead to: • 84 job-years per $1M invested • $1.45 disposable income per dollar invested Wind can lead to: • 2.5 job-years per $1M invested	1995–2015	R and P

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Illinois: The Economic and Environmental Impacts of Clean Energy Development	This 2005 study analyzes benefits of Illinois *Sustainable Energy Plan*: RE supplying 8% of generation by 2012, 16% by 2020; Reduce load 16% by 2020 with EE; 1570 MW of CHP by 2020; 2000 MW of IGCC by 2020. Measures analyzed separately and collectively. Emission savings assume displacement coal-fired electricity, and estimated with emission factors and other EIA, EPA, DOE, and EPRI data. Macroeconomic effects modeled with ILREIM.	Bournakis, A., G. Hewings, J. Cuttica, and S. Mueller. 2005. The Economic and Environmental Impacts of Clean Energy Development in Illinois. Submitted to the Illinois Department of Commerce and Economic Opportunity. June.		By 2020, avoid: • 0.4 million tons per year (mtpy) of SO_x • 0.2 mtpy of NO_x • 90.1 mtpy of CO_2	The study estimated the plan by 2020 would directly lead to: • $7 billion net increase in economic output • $1.5 billion net increase in personal income • 43,000 net new jobs Combining direct and indirect benefits would achieve by 2020: • $18 billion net increase in economic output (2.12% increase) • $5.5 billion net increase in personal income (1.83% increase) • 191,000 net new jobs (1.85% increase)	2005–2020	P
Massachusetts: Summary of Economic Impacts of 2002 Massachusetts Energy Efficiency Program Activities	The Massachusetts Division of Energy Resources (DOER) produces an annual report analyzing the impacts of ratepayer-based energy efficiency programs in the state. The 2004 report is a retrospective analysis, using the REMI Policy Insight model, of the macroeconomic effects of investments in energy efficiency (EE) made in 2002. DOER also used expenditure and savings data in combination with the Energy 2020 model to project the lifetime energy savings of the 2002 program activities.	DOER. 2004. 2002 Energy Efficiency Activities. Massachusetts Division of Energy Resources.			**Electricity Bill Impacts** *Energy Savings* • Total Program Costs: $138 million • Total Participant Energy Savings: – $21.5 million (M)/year – Lifetime = $249M • Average Cost for Conserved Energy: 4.0 ¢/kWh *Demand Savings* • Total Participant Demand Savings: $1.2M/year *Systems Impacts* • Customer savings from Lower Wholesale Energy Clearing Prices: $19.4 million *Economic Impacts* • Number of New Jobs Created in 2002: 2,093 • Disposable Income from Net Employment in 2002: $79 million	2002-2020	R and P

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State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
National: Redirecting America's Energy: The Economic and Consumer Benefits of Clean Energy Policies	A 2005 study analyzes benefits of two potential policies: national 20% RPS by 2020, and 20% RPS with reallocation of $35 billion of fossil fuel and nuclear subsidies to EE and RE. This analysis used regional forecast data from EIA and other sources, along with IMPLAN to estimate macroeconomic effects.	Nayak, N. 2005. Redirecting America's Energy: The Economic and Consumer Benefits of Clean Energy Policies. Prepared by the U.S. PIRG Education Fund. February.		20% RPS with reallocation avoids by 2020 versus baseline:: • 634M tons of CO_2 • 1.9M tons of SO_2 • 0.8M tons of NO_x	20% RPS with reallocation achieves, by 2020: • 154,589 net annual new jobs • $6.8B net increase in wages • $5.9B average annual net increase in GDP	2005–2020	P
New Jersey: Clean Energy Program: 2005 Annual Report	A 2005 NJ BPU report analyzes benefits of New Jersey's Clean Energy Program, which includes strategies to increase EE and RE. It analyzes annual and lifetime impact of measures installed in 2005. By 2008, program sought to have 6.5% of NJ electricity provided by RE. By 2012, the program seeks to have 785,000 MWh and 0.6 mcf of natural gas saved per year from EE.	NJ BPU. 2005. New Jersey's Clean Energy Program: 2005 Annual Report. New Jersey Board of Public Utilities, Office of Clean Energy.	From 2004 to 2005: • electric energy savings and renewable energy generation grew by over 22% • natural gas savings grew by over 42% Efficient equipment installed and practices put into effect in 2005 will continue to save energy for an average of 15 years. The 5-year program activities resulted in lifetime energy savings of: • over 14 million MWh of electricity • 38 million Dekatherms of natural gas • 788,000 MWh of renewable generation. • The programs have also reduced electric demand by 450 MW.	Avoided emissions from 2005 activities, for 2005-2020: • 13.2M tons of CO_2 • 46,317 tons of SO_2 • 21,813 tons of NO_x	From 2001–2006 new solar owners were estimated to have saved: • $1.1 million annually in total electricity costs	2001–2020	R and P

* P = Prospective; R= Retrospective

Chapter 5: Economic Benefits of Clean Energy Programs							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
New York: Analyzing Macroeconomic Benefits of the Energy $martSM Program	The New York Energy $mart public benefits program, created in 1998, promotes energy efficiency across the commercial, industrial, and residential sectors; advances renewable energy; provides energy services to low income residents of New York; and conducts research and development. As part of a comprehensive evaluation process, NYSERDA produces an annual report detailing the multiple benefits of E$P on both a retrospective and prospective basis. NYSERDA used the REMI Policy Insight model, a macroeconomic model that combines elements of input-output, econometric, and computable general equilibrium models, to conduct the analysis. Outlay and energy savings estimated primarily using actual program data.	New York Energy $mart Program Evaluation and Status Report. NYSERDA. Report to the System Benefits Charge Advisory Group. May, 2006 New York Energy $mart Program Evaluation and Status Report; Year Ending December 31, 2008. NYSERDA. Report to the Systems Benefit Charge Advisory Group, Final Report, March.	From 1999 – 2005: • 1,040 MW reduction in peak demand From 1999-2005: • The number of energy service companies increased from fewer than 10 to over 180 companies	Actions to date avoid (per year): • 1.4 million tons of CO_2 • 3,170 tons of SO_2 • 1,750 tons of NO_x	The model indicated the E$P initiatives from 1999-2008 have: • Created over net 4,900 jobs • Increased personal income by $293 million, • GSP by $644 million • Total output by $1 billion Projecting to 2020, E$P is expected to create 86,400 net job years. From 2008-2017, actions to date yield (per year): • Average of 4,100 jobs • $182M labor income • $244M output	1999–2017	R and P
Nevada: Using REPP Labor Calculator: The Case of Nevada's RPS	As part of its 1997 restructuring legislation, the Nevada legislature established an RPS that included a 5% renewable energy requirement in 2003 and a 15% requirement by 2013. The Nevada American Federation of Labor-Congress of Industrial Organizations (AFL-CIO) used the REPP Labor Calculator to estimate the job diversification effects of the RPS in 2005.	Nevada AFL-CIO. 2003. Comments Submitted to the Nevada Public Service Commission: Procedural Order No. 3 and Request for Comments No. 2. July.	• 5% renewable energy requirement in 2003 • 15% requirement by 2013		From 2003-2013, the RPS would create: • 27,229 total, direct FTE jobs • Of which, 19,138 are manufacturing jobs and • 8,092 would be installation, O&M jobs *excludes indirect or induced effects	2003–2013	P

* P = Prospective; R= Retrospective

Chapter 5: Economic Benefits of Clean Energy Programs							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
Oregon: Economic Impacts of Energy Tax Credit Programs: BETC/RETC	The Oregon Department of Energy asked ECONorthwest to estimate the economic effects of the Business Energy Tax Credit (BETC) and Residential Energy Tax Credit (RETC) programs. These effects include impacts on employment, output, and wages as well as tax revenue in Oregon that resulted from 2006 tax credits and the subsequent spending on measures and labor that these credits create. ECONorthwest also isolated the economic impacts of energy efficiency improvements (i.e., energy savings) that were realized in 2006 in order to estimate the benefits to the economy that accumulate in future years. They used IMPLAN to model the macroeconomic effects.	Grover, S. 2007. Economic Impacts of Oregon Energy Tax Credit Programs in 2006 (BETC/RETC). Prepared by ECONorthwest for the Oregon Department of Energy. May.	• Oregon commercial and residential energy costs decreased by $46 million		The net impacts of the tax credits in Oregon for the year 2006 were an increase in: • Gross state product of more than $142 million • Jobs by 1,240 • Tax revenue of nearly $10 million • Oregon wages by $18.6 million Continued energy savings support the following annual economic impacts in future years: • Increase in Oregon's economic output by $93 million • Continued net impact of 889 new jobs • Additional state and local tax revenues of $10 million	2006–2021	R and P
Southwest: The New Mother Lode: The Potential for More Efficient Electricity Use	The Southwest Energy Efficiency Project (SWEEP) analyzes benefits from $9B invested in EE in homes and businesses in the Southwest from 2003-2020 by comparing a BAU scenario to a "High Efficiency" scenario. "High efficiency" assumes widespread adoption of cost-effective, commercially available EE measures that would reduce electricity consumption by 18% by 2010 and 33% by 2020. Residential and commercial cost-effective energy savings modeled with DOE-2.2. Industrial cost-effective energy savings potential modeled with LIEF. Energy cost savings and avoided emissions modeled with NEMS. Macroeconomic effects modeled with IMPLAN.	SWEEP. 2002. The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest. Southwest Energy Efficiency Project, Report for the Hewlett Foundation Energy Series. November.	By 2020: • Avoids $10.6B capacity investment (thirty-five 500 MW plants) • Avoids $25B electricity supply costs per year by 2020 • Avoids $2.4B end-use natural gas cost per year by 2020	By 2020: • Reduces CO_2 emissions by 26% • Reduces SO_2 emissions by 4% • Reduces NO_x emissions by 5%	• Increase regional employment by 0.45% (58,400) FTE jobs per year versus 2020 baseline • Increase salary income by $1.34B per year versus 2020 baseline	2003–2020	P

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Chapter 5: Economic Benefits of Clean Energy Programs							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
Utah: Using JEDI: The Case of Wind Power in Utah County	Wind power has been proposed in Utah as a way to diversify the state's electricity generation. In 2006 Utah State University used JEDI to inform decision makers about the likely impact of five wind capacity scenarios: 5 MW, 10 MW, 14.7 MW, 20 MW, and 25 MW. This report quantifies the potential economic opportunities created by wind development, including projections for the 14.7-MW project in Spanish Fork Canyon, for Utah County. It uses economic and demographic information from three sources: (1) the Economic Development Corporation of Utah (EDCU); (2) IMPLAN multipliers for Utah county supplied by NREL; and (3) two local wind developers.	Mongha, N., E. Stafford, and C. Hartman. 2006. An Analysis of the Economic Impact on Utah County, Utah from the Development of Wind Power Plants. Renewable Energy for Rural Economic Development, Utah State University. DOE/GO-102006-2316. May.			If the Spanish Fork project (14.7 MW) were built it would produce (using 2005 dollar values): • 46 total new jobs • $1.2 million in wage earnings • $4.2 million in economic output during the construction phase of the project	Not specifed	P
Wisconsin: Focus on Energy Program	Wisconsin's Focus on Energy Program advances cost effective energy efficiency and renewable energy projects in the state through information, training, energy audits, assistance and financial incentives. The Wisconsin Department of Administration conducted an evaluation of the economic impacts of the Focus on Energy Program from its inception in 2002 through 2026. The analysis involved documentation and extrapolation of the net direct effects of the program; application of a regional economic model; and analysis of the implications. The results indicate that the Focus on Energy Program provides net benefits to the State of Wisconsin.	Wisconsin Department of Administration. 2007. Division of Energy. Focus on Energy Public Benefits Evaluation. Economic Development Benefits: FY07 Economic Impacts Report. Final: February 23, 2007.			Between 2002 and 2026, the Focus on Energy Program is expected to: • create more than 60,000 job-years; • generate sales for Wisconsin businesses of more than eight billion dollars; • increase value added or gross state product by more than five billion dollars; • increase disposable income for residents by more than four billion dollars.	2002 - 2026	

* P = Prospective; R= Retrospective

Additional Studies and Programs that Highlight the Benefits of Clean Energy							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
California: The Economics of Solar Power	The Million Solar Roofs initiative seeks to install 3000 MW of solar on CA roofs by the end of 2016. This analysis covers retrofit and new construction applications between 2007-2016 and estimates the multiple benefits of the initiative. Infrastructure and emission savings based on E3 Avoided Cost model. Primary analysis was performed with Million Solar Systems Model, based on solar market data from CEC and CPUC.	Cinnamon, B., T. Beach, M. Huskins, and M. McClintock. 2005. The Economics of Solar Power for California. White Paper. August.	• Avoid $7.1M capacity infrastructure costs (3,000 MW of peak capacity)	• Avoid $5,526M in emission costs, including NOX and CO2	• Additional $0.50 economic activity in CA per $1 invested • 40 FTE jobs in CA per MW	2007–2016	P
Massachusetts: The Public Benefit of Energy Efficiency to the State of Massachusetts	This study analyzes retrospectively the benefits of EE in MA from 1977-1997 and projects future benefits through 2015. Study does not establish a link between actual government EE programs and changes in EE. It uses an econometric model. Changes in energy intensity used to approximate efficiency changes by controlling for sector composition, energy prices, new capital, and climate.	Bernstein, M., R. Lempert, D. Loughram, and D. Ortiz. 2002a. The Public Benefit of Energy Efficiency to the State of Massachusetts. Prepared by RAND Science and Technology.		In 1997, past energy efficiency actions resulted in a reduction of: • 2.0M tons of CO_2 • 11,000 tons of SO_2 • 4,000 tons of NO_x (Versus 1997 baseline)	• From 1977-1997 EE produced $1,644 - $2,562 in per capita GSP • $323 - $2,322 additional per capita gains by 2015	1977–1997; and through 2015	R and P
Midwest: Job Jolt: The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland	This study analyzes benefits of implementing the ***Repowering the Midwest Clean Energy Development Plan*** for a 10-state region in the Midwest that includes reducing electricity demand by 28% by 2020 with EE, and diversifying towards RE and CHP generation over a 20-year period. The analysis is performed with Census and other data, and econometric I-O models developed by REAL at the University of Illinois.	Hewings and Yanai. 2002. Job Jolt: The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland.			By 2020: • Over 200,000 net new jobs • $19.4B increase in regional economic output	2002–2020	P
National: 2002 Energy Efficiency Activities: A Report by the Division of Energy Resources	This study analyzes benefits of $138 million of ratepayer-based EE investments during 2002 and cumulative EE investments from 1998-2002. It analyzes annual and lifetime benefits to participants and all consumers. The energy cost savings, energy system benefits and emission savings estimated with actual program data, ISO-NE data, other data, DOE's Energy 2020, and a bid-stack model. Macroeconomic effects are modeled with REMI.	Commonwealth of Massachusetts Office of Consumer Affairs and Business Regulation. 2004. 2002 Energy Efficiency Activities: A Report by the Division of Energy Resources. Summer.	• $19.4M savings from 1998-2002 ($5.9M for 2002 only) due to lower wholesale electricity prices • 0.5% (48 MW) peak demand reduction in 2002.	2002 emission reductions: • 394 tons SO_2 • 135 tons NO_x • 161,205 tons CO_2; Lifetime effect of 2002 actions: • 5,516 tons SO_2 • 1,890 tons NO_x • 2,256,870 tons CO_2	In 2002: • 1,778 new jobs • $139M in GSP • $79M disposable income Lifetime effect of 2002 actions • 315 permanent jobs, • $22M GSP • $15M in income	1998–2002	R

* P = Prospective; R= Retrospective

Additional Studies and Programs that Highlight the Benefits of Clean Energy							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
National: The Work that Goes Into Renewable Energy	This study analyzes labor requirements for renewable energy deployment in the United States. Labor estimates from construction, installation, and O&M only account for direct effects – indirect multiplier effects no examined. The study is not specific to any particular state and used survey information, not a model. Authors collected primary employment data from companies in the RE and coal sectors. It accounts for jobs in manufacturing, transport, delivery, construction, installation, and O&M and includes a comparison with coal power.	Singh and Fehrs . 2001. The Work that Goes Into Renewable Energy. November.			Job effects: • 35.5 person-years per MW of solar • 4.8 person-years per MW of wind • 3.8-21.8 person-years per MW of biomass co-firing • 5.7 person-years per $1M solar or wind cost over 10 years	2001	R
National: Ancillary Benefits of Reduced Air Pollution in the United States from Moderate Greenhouse Gas Mitigation Policies in the Electric Sector	This study analyzes benefits of GHG and criteria pollutant mitigation, including the value of health impacts from air quality changes. It analyzes various carbon-tax scenarios from 2000-2010. The analysis used the Haiku electricity model to simulate effects on retirement and system dispatch. Emission changes were translated into health effects with damage functions and the TAF atmospheric transport model. Concentration-Response functions were used to estimate health endpoints.	Burtraw et al. 2001. Ancillary Benefits of Reduced Air Pollution in the United States from Moderate Greenhouse Gas Mitigation Policies in the Electric Sector. December.		• NO_x related health benefits in 2010 range from $315 - $408M • NO_x related health benefits per ton of carbon emissions reduced, range from $7.5 - $13.2 dollars		2000–2010	P
New England: Electric Energy Efficiency and Renewable Energy: An Assessment of Existing Policies and Prospects for the Future	This study aAnalyzes benefits of EE and RE in New England from Public Benefits Funds and RPS programs. It assumes that current policies change only as planned, through 2010, and does not cover unplanned scenarios. Authors used actual and estimated data on program expenditures and savings. Air quality and emission benefits were estimated with OTC's Emission Reduction Workbook and macroeconomic effects were modeled with IMPLAN.	Sedano et al. 2005. Electric Energy Efficiency and Renewable Energy: An Assessment of Existing Policies and Prospects for the Future. May.	• In 2004, EE reduced peak demand by 1,421 MW	From 2000 – 2010, avoid: • 31.7M tons (6%) of CO_2 • 34,200 tons of SO_2 • 22,039 tons of NO_x	From 2000 – 2010, net increase of: • $6.1B economic output • $1.04M wage income • 28,190 job years	2005–2010	P
Pennsylvania: Economic Impact of Renewable Energy	This study analyzes benefits of implementing a 10% RPS in PA over the period 2006-2025, which would require $4.68 billion direct investment. A statewide renewable energy supply curve was created to determine the least-cost portfolio. Authors used a simple linear model with publicly available data, and the BEA's RIMS II model to estimate macroeconomic effects.	Pletka, R. 2004. Economic Impact of Renewable Energy in Pennsylvania. Prepared by Black & Veatch for The Heinz Endowments and Community Foundation for the Alleghenies. March.			Over 2006-2015 period: • Increase output $10.1B • Increase earnings $2.8B • Create 85,000 jobs	2006–2025	P

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Additional Studies and Programs that Highlight the Benefits of Clean Energy							
Case Studies			Key Benefits Findings, Results and Activities				
State/Region and Name of Program	Summary of Policy/Program and Analysis	Link	Energy	Emissions, Air Quality, and Health	Economic	Time Period for Analysis	Type of Analysis*
Texas: Increasing the Renewable Energy Standard: Economic and Employment Benefits	This study analyzes benefits of increasing Texas' current RPS (requiring 2.7% of sales from new renewable energy by 2009) to a requirement of 20% renewable energy by 2020. It also analyzes a more modest increase to about 8% renewable energy by 2025. Impacts on electricity and natural gas prices and consumer energy bills were examined using the Department of Energy's National Energy Modeling System (NEMS) model. Macroeconomic impacts were quantified using IMPLAN. Expenditure breakdown and local share data for wind projects were based on NREL's Jobs and Economic Development Impacts (JEDI) model	Deyette and Clemmer. 2005. Increasing the Renewable Energy Standard: Economic and Employment Benefits.	By 2025, the 20% RPS achieves: • 9% reduction in average electricity prices • 3% reduction in natural gas prices • Residential solar heating systems that offset 390 MW of peak capacity	By 2025, the 20% RPS avoids: • 20 million metric tons of CO_2 emissions	By 2020, the 20% RPS achieves: • \$950M additional income • \$440M increase in GSP • 24,650 net new jobs (2.8 times more jobs than with fossil fuels)	2005–2025	P
Washington: The Washington Clean Energy Initiative: Effects of I-937 on Consumers, Jobs and the Economy	This study analyzes the benefits of an RPS that would support 1,300 average megawatts (avgMW) of renewable sources by 2025, along with 1,000 avgMW of cost-effective energy efficiency from 2010–2025. The analysis compares the clean energy initiative with a reference case in which no further energy efficiency and renewable energy investments are made after 2009. Effects on electricity rates, total resource costs, and consumer electricity bills were examined using a spreadsheet model. Macroeconomic impacts were analyzed using IMPLAN. Expenditure breakdown data for construction, O&M of renewable plants was based on a variety of sources, including state and federal agencies, renewable developers, utilities, and NREL's Jobs and Economic Development Impacts (JEDI) model.	Deyette and Clemmer. 2006. The Washington Clean Energy Initiative: Effects of I-937 on Consumers, Jobs and the Economy.	The set of efficiency measures developed under the initiative achieve: • An average savings of \$0.54 cents/kWh due to avoided T&D • Avoided construction of six natural gas power plants, operating at an average capacity of 165 MW each.	By 2025, the initiative avoids: • 4.6 million metric tons of CO_2 emissions	By 2025, the initiative achieves: • \$138M additional income • \$148M increase in GSP • \$30M in income to rural landowners • 1,230 net new jobs in the year 2025 (2.6 times more jobs than would be created using fossil fuels)	2010–2025	P

* P = Prospective; R= Retrospective

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