Economic Impacts of Energy Trust of Oregon's 2017 Program Activities

Final Report

pinnacle economics

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1. INTRODUCTION AND SUMMARY

Pinnacle Economics ("Pinnacle") was retained by Energy Trust of Oregon ("Energy Trust") to estimate the economic impacts of its energy efficiency and renewable energy programs in 2017 on the Oregon economy.[1] These impacts include changes in output, wages, business income, and employment in Oregon that resulted from 2017 program spending and activities. Each year, Energy Trust programs generate energy-efficiency gains (i.e., energy savings) and renewable energy generation that continue into the future. As a result, Pinnacle also analyzed the economic impacts from the current program year that accumulate in following years.

For this analysis, *gross impacts* are calculated and then compared against a Base Case spending scenario, which assumes that funds that were paid to Energy Trust are returned and spent by Oregon ratepayers in the Oregon service territories of Portland General Electric (PGE), Pacific Power, Northwest Natural, Cascade Natural Gas, and Avista Natural Gas. The difference in economic impacts between the gross economic impacts attributed to Energy Trust program spending and the Base Case scenario is referred to as *net impacts*.[2]

In 2017, Energy Trust spending totaled $182.6 million. This is $1.2 million less (-0.7 percent) than in 2016. Spending was primarily focused on program implementation, with $157.0 million for energy-efficiency programs and $15.4 million for renewable energy programs. In addition, the Energy Trust incurred $10.1 million in administrative and program support costs during the 2017 program year. On an annual basis, Energy Trust achieved energy-efficiency savings and renewable energy generation totaling 67.9 average megawatts (aMW) of electricity (594,734 MWh) and 6.8 million therms of natural gas during the 2017 program year.

The gross and net economic impacts for Energy Trust 2017 program activities are shown in Table ES1. The changes in spending and energy savings/generation associated with these programs had the following net economic impacts on the Oregon economy in 2017:

- An increase of $375.6 million in output;
- An increase of $131.9 million in wages and $24.2 million in income to small business owners; and
- 2,652 full- and part-time jobs.

[1] Some projects in these programs also received financial and/or technical assistance through state and federal tax credit programs. Based on evaluations, Energy Trust believes their participation to be critical to these projects.

[2] An analysis of the *net economic impacts* requires that only economic stimuli that are new or additive to the economy be counted, i.e., net impacts consider both the positive economic impacts from investment in energy efficiency and the negative economic impacts of foregone spending associated with program funding. By making adjustments for program funding, net economic impacts provide a more reliable measure of job and income creation. For example, if an impact of five net new jobs is reported, this means that spending on Energy Trust programs resulted in five more jobs relative to what would have occurred had the money been returned and spent by Oregon ratepayers in the utility service territories.

Table ES1: Gross and Net Economic Impacts, 2017

Impact Measure	Gross Impacts	Net Impacts
Output	$588,743,900	$375,619,300
Wages	$194,398,700	$131,905,100
Business Income	$33,138,600	$24,162,600
Jobs	4,260	2,652

Table ES2 reports the net economic impacts for every million dollars in Energy Trust spending.[3] For the 2017 program year, every million dollars in Energy Trust spending is associated with approximately $2.1 million in net new economic activity in Oregon, including $722,500 in wages, $132,300 in business income, and 14.5 jobs.

Table ES2: Net Economic Impacts Per $1 Million in Energy Trust Spending, 2017

Impact Measure	Net Impacts Per $1 Million in Spending
Output	$2,057,300
Wages	$722,500
Business Income	$132,300
Jobs	14.5

The remainder of this report documents the analysis that was completed to develop these economic impact estimates.

[3] These are "fully loaded costs" that include Energy Trust program and administrative costs, as well as incentives paid to program participants.

2. ENERGY TRUST 2017 PROGRAM ACTIVITIES

2.A. 2017 EXPENDITURES

For this analysis, budget information provided by Energy Trust was aggregated into several general categories to facilitate economic impact modeling for similar areas of spending. Table 1 shows the general areas of spending for Energy Trust and reflects actual expenditures for 2017.[4] As shown at the bottom of the table, total spending by Energy Trust in 2017 was $182.6 million.

As a general rule, spending on program incentives goes directly to equipment purchases and labor for installation. Common measures that receive incentives include high-efficiency lighting, high-efficiency HVAC systems, appliances, industrial process efficiency improvements, and home and commercial weatherization. Energy Trust also incurs non-incentive expenses for program delivery. In 2017, program expenditures[5] for energy-efficiency totaled $159.4 million (a decrease of $2.7 million or -1.7 percent from the previous year). In 2017, program expenditures for renewable energy totaled $16.0 million (a decrease of $4.1million or -21.2 percent from 2016).

Table 1: **Energy Trust Program Spending ($ millions), 2017**

Spending Category	Total Program Expenses	Total Support Costs	Total Spending
Energy-Efficiency Programs	$157.0	$2.4	$159.4
Renewable Energy Programs	$15.4	$0.6	$16.0
Other Admin & Program Support		$7.2	$7.2
Total	**$172.4**	**$10.1**	**$182.6**

Source: Energy Trust of Oregon, Statement of Functional Expenses, 2017.
Note: Renewable Energy Program spending and support costs include Solar Low-Medium Income ("LMI").

2.B. 2017 ENERGY SAVINGS AND GENERATION

Table 2 reports the total net energy saved and generated by Energy Trust programs in 2017. On an annualized basis, a total of 67.9 average megawatts and 6.8 million therms were saved or generated as a direct result of Energy Trust program activities in 2017. This includes energy savings for residential, commercial, and industrial energy-efficiency programs, as well as energy generated through Energy Trust's renewable energy program. It also includes the net energy savings attributed to market transformation efforts by the Northwest Energy Efficiency Alliance (NEEA).

[4] This study represents an update of the economic impact study conducted by Pinnacle for Energy Trust's 2015 program year. Energy Trust did not commission a full economic impact study for the 2016 program year. As a result, direct measures of program activity (spending and energy savings) for that year were provided by Energy Trust and the economic impacts for 2016 were estimated using economic impact results from the 2015 study and the level of program spending in 2016.

[5] Program expenditures are based on incentives and allocated support costs.

Table 2: **Annualized Net Energy Savings and Generation, 2017**

Program Sector	Annual kWh	Average MW (aMW)	Annual Therms
Residential Energy Efficiency	203,361,013	23.2	2,877,365
Commercial and Industrial Energy Efficiency	352,079,114	40.2	3,875,181
Energy Efficiency Subtotal	**555,489,508**	**63.4**	**6,752,546**
Renewable Energy	39,293,726	4.5	0
Total Energy Saved or Generated	**594,733,853**	**67.9**	**6,752,546**

Source: Energy Trust of Oregon
Notes: 1) Energy savings are reported on a net basis and have been adjusted by the Energy Trust for free-ridership, i.e., program participants who would have adopted energy efficient measures or renewable energy projects even in the absence of Energy Trust programs. 2) Net energy savings include energy savings attributed to market transformation effects by NEEA.

In total, on an annualized basis, 555,490 MWh of electricity were saved as a result of energy-efficiency programs in 2017. This is 2.2 percent more than in 2016, when Energy Trust energy-efficiency programs saved 543,244 MWh of electricity. Similar to the 2015 program year, the mix of electric energy savings has changed as Energy Trust is generating relatively more electric energy savings from residential energy-efficiency programs and less from commercial and industrial energy-efficiency programs. Historically, residential energy-efficiency programs account for about 30 percent of electric energy savings. In 2017, residential energy-efficiency programs account for 37 percent of total electric energy savings.

Energy Trust energy-efficiency programs also saved 6,752,546 therms of natural gas in the 2017 program year. This is down slightly (-37,785 therms or -0.6 percent) from the 6,790,331 therms saved in the previous program year.

The amount of energy generated by the renewable energy program in 2017 is relatively small compared to the energy savings attributed to the efficiency programs, which is consistent with all previous program years. However, renewable energy projects saw a record year and generated approximately 39,294 MWh of electricity in 2017, representing a 61.4 percent increase from the previous program year.

The energy savings reported in Table 2 result in a loss of revenue to Oregon utilities due to lost power sales, and this loss of revenue is included in the gross economic impacts measured in this analysis.[6] However, utility operations are capital intensive, thus they require less labor and intermediate goods and services than other sectors of the Oregon economy. As a result, the economic impacts on the Oregon economy from utility operations are much less, per million-

[6] For this analysis, it was assumed that utilities did not sell saved power on the spot market, as estimates of the amount of power sold due to energy efficiency are generally unavailable. If utilities can sell conserved power on the market due to the efficiency programs, then there is an additional benefit in the form of increased revenues to the utility sector. As this was not included in this analysis, the results discussed here represent a lower bound for potential utility sector benefits.

dollars of output, than operations of other industry sectors or spending by households. Consequently, the foregone economic activity attributed to lost power sales has a small, negative effect on the gross economic impacts from Energy Trust program spending.

There is an additional long-term benefit from the efficiency gains, as they delay the need for building new power generation. Power generated from new sources will almost certainly be more expensive than existing power resources due to increased costs of capital and issues associated with siting new power plants. In this sense, efficiency gains can be viewed as a means for prolonging the use of lower-cost resources and delaying the need for switching to higher cost power supplied by new generation. By enabling the efficient use of lower cost resources, these programs help the entire Oregon economy run more efficiently. This benefit was not explicitly modeled for this analysis because it is directly addressed in the Energy Trust's benefit/cost analysis. It is nevertheless an important issue and is one of the primary tenets underlying conservation and demand-side management programs.

3. ANALYSIS METHODS

The analysis methods employed in this study are identical to the methods used across all previous studies, dating back to the 2002 program year. Importantly, after a comprehensive survey and review of economic impact methodologies in the United States and Canada, the American Council for an Energy-Efficient Economy ("ACEEE") recommended the hybrid modeling approach developed by Pinnacle Economics and Energy Trust of Oregon for the ex-post verification of economic impacts and job creation of energy-efficiency and renewable energy programs.[7] The findings and recommended modeling approaches from the ACEEE study will be noted throughout this section of the report.

Estimating the economic impacts attributable to Energy Trust programs is a complex process, as spending by Energy Trust—and subsequent changes in spending by program participants—unfold over a lengthy period of time. From this perspective, therefore, the most appropriate analytical framework for estimating the economic impacts is to classify them into the following categories:

- *Short-term* economic impacts associated with changes in business activity as a direct result of changes in spending by Energy Trust programs and participants.
- *Long-term* economic impacts associated with the subsequent changes in factor costs and optimal use of resources.

This analysis estimates the short-term economic impacts of Energy Trust program activities during the 2017 program year. The short-term economic impacts are those attributed to additional dollars accruing to Oregon businesses and households as a result of these programs. The economic modeling framework that best measures these short-term economic impacts is called input-output modeling. Input-output models provide an empirical representation of the

[7] Bell, Barrett, and McNerney, "Verifying Energy Efficiency Job Creation: Current Practices and Recommendations," Report F1501, American Council for an Energy-Efficient Economy, September 2015.

economy and its inter-sectoral relationships, enabling the user to trace the effects (economic impacts) of a change in the demand for commodities (goods and services).

Because input-output models generally are not available for state and regional economies, special data techniques have been developed to estimate the necessary empirical relationships from a combination of national technological relationships and county-level measures of economic activity. These data techniques are packaged into the IMPLAN (for "IMpact Analysis for PLANning") modeling software. Pinnacle Economics relied on the IMPLAN economic impact model and 2016 IMPLAN data for the Oregon economy—the most current data available.[8]

Input-output analysis employs specific terminology to identify three different types of economic impacts.[9] Expenditures made through Energy Trust programs affect the Oregon economy *directly*, through the purchases of goods and services in this state. Direct impacts include Energy Trust's hiring and payroll; participant spending on energy-efficiency installations, audits, or other services; and consumption spending by households as they re-spend their energy savings.

Direct spending will, in turn, generate purchases of intermediate goods and services from other, related sectors of the economy. These *indirect* impacts are often called supply-chain impacts because they represent spending among businesses. The first round of indirect impacts include Energy Trust's spending on Program Management and Delivery Contractors (PMCs and PDCs) who deliver and promote energy-efficiency programs; Oregon manufacturers of energy efficient equipment or, in their absence, Oregon retailers, wholesalers, and distributors of energy-efficient equipment; and a broad range of local manufacturers, farmers, and others who provide the commodities purchased by consumers.[10] The first round of indirect impacts lead to additional indirect impacts as, for example, PMCs rent office space or purchase supplies, manufacturers purchase spare parts or utilities, and local farmers purchase fuels or fertilizers.

The direct and indirect increases in employment and income enhance overall economy purchasing power for Oregon households, which generates consumption-related spending and leads to additional *induced* impacts. This cycle of direct, indirect, and induced spending continues until the spending eventually leaks out of the local economy as a result of taxes, savings, or purchases of non-locally produced goods and services or "imports." The IMPLAN

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[8] Staff at Pinnacle Economics used IMPLAN and the same modeling framework for all of our previous impact analyses for Energy Trust (dating back to 2002), as well as similar analyses conducted for the Bonneville Power Administration, Consumers Energy of Michigan, the Hawaii Public Utility Commission, the U.S. Department of Energy, and the American Council for an Energy-Efficient Economy ("ACEEE").

[9] The direct, indirect, and induced impacts measured in this analysis are wholly consistent with the category definitions recommended by ACEEE. In their 2015 report, ACEEE *"…found that key terms were used differently in various assessments…In our review of studies and methodologies, we found that some studies identified "indirect" job impacts as jobs created as a result of energy savings, regardless of the level at which the jobs were created. To the extent that studies report various categories and levels of job creation, the inconsistent use of terms can create significant confusion*." See ACEEE report page vii.

[10] Consistent with ACEEE recommendations, spending on energy-efficiency services generates direct impacts and spending on energy-efficiency equipment generates indirect impacts.

model accounts for import goods and services through the use of Regional Purchase Coefficients (or "RPCs") for each of the 536 industry sectors in the Oregon model.

The IMPLAN model reports the following economic impact measures:

- *Total Industrial Output (Output)* is the value of production by industries for a specified period of time. Output can also be thought of as the value of sales including reductions or increases in business inventories.
- *Employee Compensation (Wages)* includes workers' wages and salaries, as well as other benefits such as health and life insurance, retirement payments, and non-cash compensation.
- *Proprietary Income (Business Income)* represents the payments received by small-business owners or self-employed workers. Business income would include, for example, income received by private business owners, doctors, accountants, lawyers, etc.
- *Job* impacts include both full- and part-time employment. Over time, job impacts are referred to as person-years of employment.

All of the economic impacts measured in this analysis are transitory and depend on program spending and energy savings in each year. That is, economic impacts for each program year are generated by changes in final demand (spending) that can be directly or subsequently linked back to Energy Trust programs. The mix and level of program spending may change from year to year, or could end in any given year. This means that the economic impacts will also vary from year to year, or could end in any given year. This is particularly important when discussing employment impacts. Although employment impacts are reported as a mix of full- and part-time jobs, they are jobs that occur as spending occurs and should be considered person-years of employment. In addition, it is highly likely that some of the employment benefits accrue to the same individuals over time.

Within this modeling framework, the following terms are used to classify impacts:[11]

- *Gross Impacts* reflect the economic impacts with no adjustment made for impacts that might have occurred in the Base Case scenario. Gross impacts include:
    - *Program operations spending* as Energy Trust purchases labor and materials to carry out its energy-efficiency and renewable energy programs.
    - *Incremental measure spending* by participants in Energy Trust programs.
    - *Reductions in energy consumption* and the associated lower operating costs to businesses and increases in household disposable income.[12] Similar to previous

[11] Both incremental measure spending and energy savings are included on a net basis, i.e., both have been adjusted to account for potential free riders. In energy-efficiency programs, free riders are participants who would have adopted the energy-efficiency measure or renewable energy project even in the absence of the program.

[12] Energy savings include the net energy savings associated with market transformation efforts conducted by NEEA. These effects cannot be measured on a project-by-project basis. Thus, Pinnacle Economics allocated NEEA's commercial and industrial net energy savings on a *pro rata* basis using the distribution of net energy savings, across industry sectors, for the Energy Trust's commercial and industrial programs.

reports, we have assumed that installations occur evenly throughout the year and have used a 50 percent implementation adjustment factor for energy savings in the first program year.[13]

- *Reductions in utility revenues* as households and businesses consume less electricity and natural gas.

- *Net Impacts* are the effects of Energy Trust program activities that have been adjusted to reflect the Base Case scenario. That is, net impacts are those impacts over and above what would have occurred in the Base Case scenario. Net impacts are based on:

  - *Gross Impacts* (discussed previously).
  - *Less foregone household spending* as a result of the public purpose charges that are collected from ratepayers and used by Energy Trust to cover program management and administrative costs, and as incentives in their energy-efficiency and renewable energy programs.

4. GROSS ECONOMIC IMPACTS

The gross economic impacts attributed to Energy Trust programs are based on program costs (including administration costs), and net incremental measure spending and net energy savings of program participants. Incremental measure spending by program participants consists of expenditures on energy-efficiency equipment and services such as appliances, heating, ventilation and air conditioning (HVAC) systems, lighting modifications, weatherization improvements, etc., and spending on renewable energy projects. Incremental measure spending—particularly spending on installations—generally represents the most important driver of economic impacts from energy-efficiency programs.

Incremental measure spending includes *direct* spending on measure installation and the first round of *indirect* spending on equipment. This is important because expenditures on measure installations generally directly benefit local, Oregon contractors. Spending on the measures themselves will generate indirect impacts if the equipment was manufactured in Oregon. Spending on imported energy-efficiency equipment generates no impacts for local manufacturers, though the use of "margining" on equipment sales will generate indirect economic benefits for Oregon retailers, wholesalers, and transporters.[14] As a result, spending on

[13] In the first program year, energy savings occur after energy-efficiency measures are installed, and installations occur over the course of the year. Pinnacle does not have data on when each individual installation was completed. Thus, we have assumed that installations occur evenly throughout the year and have used a 50 percent implementation adjustment factor for energy savings in the first program year. Energy savings in future out-years are reported on an annualized basis, i.e., they describe the economic impacts from energy savings for energy-efficiency measures that were installed in 2017 and operated for an entire year. Both assumptions are consistent with previous economic impact reports.

[14] ACEEE notes, "*Before calculating the direct* [sic, should read "the first round of indirect"] *job implications at the manufacturer level, it is important to allocate a share of the revenues to the retail or wholesale trade sector to account for the fact that the purchase price of the equipment is higher than the production cost to cover sales margins."* ACEEE p. 20.

installation (labor) and equipment will produce substantially different economic impacts for the Oregon economy. Pinnacle received detailed incremental measure spending data from Energy Trust, and mapped this spending to over 60 different IMPLAN sectors.[15]

Energy Trust also supplied detailed energy savings estimates, broken out by fuel type (electricity, natural gas) for program participants. For residences, lower energy costs will increase Oregon households' disposable income. Therefore, the estimated energy cost savings for residential customers were input into a modified consumption function representing the spending pattern of a middle-income household in Oregon, which mapped the spending to over 500 IMPLAN sectors.[16]

Energy savings for commercial-industrial program participants were first mapped to industry sectors using North American Industrial Classification System ("NAICS") codes, and then cross-referenced to 253 different business sectors in the IMPLAN model.[17] From an input-output perspective, energy savings will affect Oregon businesses by lowering their production costs. To estimate the economic impacts associated with these lower energy costs, Pinnacle used an elasticity-based approach to estimate the change in output. That is, this approach assumes that lower energy costs increase the competitiveness of Oregon businesses, allowing them to decrease price, and increase output.[18]

Lastly, the energy savings for households and businesses translate into lower revenues to electric and natural gas utilities. Pinnacle used estimated energy savings, by fuel type, to reduce revenues to utilities.[19] The gross economic impacts of Energy Trust programs for 2017 are shown in Table 3.

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[15] Energy-efficiency measures, and the custom production functions developed by Pinnacle Economics for bio-power and solar renewable energy projects, include a wide range of equipment, parts, and supplies. As a result, Pinnacle used IMPLAN's bridge table with over 18,000 NAICS codes sectors to allocate incremental measure spending to the appropriate IMPLAN industry sector.

[16] This consumption function was modified to exclude spending on electricity and natural gas.

[17] Over time, Energy Trust's commercial and industrial energy-efficiency programs have expanded to more industry sectors. In 2006, energy savings were allocated to 100 industry sectors in the IMPLAN model. In this analysis, energy savings for commercial and industrial program participants are mapped to 265 industry sectors. (This represents an additional 12 industry sectors from the previous study.)

[18] Because we do not have elasticity coefficients for each of the 265 business sectors (and their commodities) that benefited from reduced energy costs, Pinnacle uses unitary elasticity, i.e., a 1 percent decrease in costs translates into a 1 percent increase in output.

[19] ACEEE notes, "…*accurate accounting of the estimated employment impacts requires that losses to energy supply industries also be accounted for. To do this, apply the total net energy savings (not including participant costs) as revenue losses for the energy supply sector and use the appropriate job multipliers to determine the negative employment impact in the energy supply industry, the supply chain, and the broader economy."* ACEEE p. 20.

Table 3: Gross Economic Impacts, 2017

Impact Measure	Gross Impacts
Output	$588,743,900
Wages	$194,398,700
Business Income	$33,138,600
Jobs (person-years)	4,260

Sources: Pinnacle Economics using detailed Energy Trust program data and IMPLAN.

In 2017, the gross economic impacts attributed to Energy Trust's energy-efficiency and renewable energy programs totaled $588.7 million in output, including $194.4 million in wages, $33.1 million in business income, and 4,260 jobs in Oregon. The gross impacts reported in Table 3 do not take into consideration alternative uses of Energy Trust and participant spending related to these programs. These net impacts are addressed in the next section.

5. NET ECONOMIC IMPACTS

All of the economic impacts reported in this section of the report are *net impacts* and reflect economic benefits over and above what would have occurred had Energy Trust programs not existed. To calculate net impacts, the economic impacts of the Base Case scenario are estimated, assuming that the money that is currently spent on Energy Trust programs is instead reallocated to, and spent by, utility ratepayers. The economic impacts resulting from the Base Case scenario are then subtracted from the gross impacts discussed in the previous section to determine net impacts.

Table 4 shows the net economic impacts attributed to Energy Trust programs in 2017. The net economic impacts are positive and (by design) significantly less than the gross economic impacts reported previously. The gross economic impacts include the assumption that revenues to utilities and other providers of energy services decline as a result of the energy savings by households and businesses. To this, we have now included the Base Case spending scenario that assumes that all Energy Trust funds are instead spent by ratepayers of the utilities according to the spending patterns of a typical Oregon household.

For 2017, Energy Trust programs had a net effect of increasing Oregon's economic output by $375.6 million relative to the Base Case scenario. This includes an increase of $131.9 million in wages and $24.2 million in business income within Oregon. Energy Trust programs also had a positive net impact on employment in Oregon, with 2,652 jobs sustained by Energy Trust program activities in 2017. This reflects jobs over and above what would have been created in the Base Case scenario, i.e., in the absence of Energy Trust's energy-efficiency and renewable energy programs.

Table 4: Net Economic Impacts, 2017

Impact Measure	Net Impacts
Output	$375,619,300
Wages	$131,905,100
Business Income	$24,162,600
Jobs (person-years)	2,652

Sources: Pinnacle Economics using detailed Energy Trust program data and IMPLAN.

Originally developed for the previous study and included in this study are the employment impacts for women and minorities in Oregon. On a net basis, Pinnacle estimates that Energy Trust energy-efficiency and renewable energy programs generated 860 jobs for women and 540 jobs for minorities in Oregon in 2017.[20] Minority net job impacts include 50 jobs for Blacks, 250 jobs for Hispanics, 140 jobs for Asians, and 100 jobs for all other races.[21]

Table 5 reports the net economic impacts, by type of impact, and provides additional details to fully understand how the counterfactual spending assumption included in the Base Case spending scenario affects the net economic impacts.

[20] Pinnacle's Gender and Race Employment Calculator was developed using detailed employment data, by gender and race, gathered by the U.S. Equal Employment Opportunity Commission ("EEOC"). The EEOC requires employers to file reports on the composition of their work forces by sex and by race/ethnic category. Key among these reports are the EEO-1, which is collected annually from private employers with 100 or more employees or federal contractors with 50 more employees, and EEO-4, which is collected biannually from state and local governments with more than 100 employees. Through these reports, EEOC provides employment patterns and participation rates by industry sector at a three-digit NAICS code level, for every state. Industry participation rates for Oregon in 2015 were mapped to the 536 industry sectors in the IMPLAN model of the Oregon economy in 2016.

[21] The terminology used by Pinnacle to describe races is identical to that employed by the EEOC. According to EEOC documentation, "Race/ethnic designations as used by the Equal Employment Opportunity Commission do not denote scientific definitions of anthropological origins. For the purposes of this report (EEO-1), an employee may be included in the group to which he or she appears to belong, identifies with, or is regarded in the community as belonging. However, no person should be counted in more than one race/ethnic group. The race/ethnic categories for the EEO-1 survey are as defined in U.S. Department of Commerce, Office of Federal Statistical Policy and Standards' Directive No. 15. Accordingly, the race/ethnic categories reported in this analysis include (EEOC definitions): 1) White (all persons having origins in any of the original peoples of Europe, North Africa, or the Middle East (not of Hispanic origin)); 2) Black (all persons having origins in any of the Black racial groups of Africa (not of Hispanic origin)); 3) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race); 4) Asian (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and 5) All other races (includes American Indian or Alaskan Native, Hawaiian, or persons of two or more races.)

Table 5: Net Economic Impacts, by Type of Impact, 2017

Impact Measure	Direct	Indirect	Induced	Total
Output	$80,024,100	$212,371,800	$83,223,400	$375,619,300
Wages	$21,730,600	$85,718,400	$24,456,100	$131,905,100
Business Income	$5,347,900	$15,292,200	$3,522,500	$24,162,600
Jobs (person-years)	145	1,871	636	2,652

Sources: Pinnacle Economics using detailed Energy Trust program data and IMPLAN.

Net economic impacts consist of: 1) positive economic impacts from program spending, and participant net incremental measure spending and net energy savings, and 2) negative economic impacts from the reduction in utility revenues attributed to participant energy savings and the foregone household spending attributed to public purpose charges collected from ratepayers. The implications from these opposing changes in spending include:

- **Direct net economic impacts that are positive.** This suggests that reductions in utility revenues and foregone household spending offset, to some extent, the increases in economic activity attributed to Energy Trust's own internal operations, participant incremental measure spending on energy-efficiency installations, and the increases in household spending and industry output attributed to energy savings. (Energy savings impacts during the program year are strongly affected by the 50 percent implementation adjustment factor used in this analysis to accommodate the timing of energy-efficiency installations during the year.)
- **Indirect net economic impacts that are significant and positive.** This shows that much of the net economic activity attributed to the Energy Trust's program activities enters the economy through indirect channels. For example, in economic impact terms, Energy Trust expenditures ($56.3 million in 2017) on Program Management and Delivery Contractors, as well as participant spending on energy efficient equipment, represent the first round of indirect impacts. Each of these expenditures will have subsequent indirect impacts on the Oregon economy, as will the Energy Trust's own operations, energy savings impacts attributed to households and businesses, and incremental measure spending on energy-efficiency installations. These positive indirect impacts significantly exceed the reduction in indirect impacts attributed to the loss in utility revenues and foregone household spending.
- **Induced net impacts that are positive.** Induced impacts are attributed to the wages and income that accrue to households and business owners, respectively. The most important factor of the large, positive induced impacts is the significant increase in indirect net wages and business income. To this, we can add the increase in direct net wages and business income. Combined, these positive changes in net wages and business income will generate positive induced net impacts.

Compared to the previous study, changes across the various measures of economic impacts are somewhat mixed, but the gross and net economic impacts reported in this study are about the same as the economic impacts measured in last full economic impact study conducted for the

2015 program year.[22] The major factors contributing to an increase in economic impacts are the increase in energy savings, the increase in incremental measure spending (+$6.1 million or +2.1 percent), and the changing mix of incremental measure spending with 44 percent of incremental measure spending going towards labor or installations in 2017 compared to 34 percent in 2015.[23]

These positive factors are offset by increases in total spending (+$17.2 million or +10.4 percent) and incentive costs (+7.3 million or +7.7 percent) between 2015 and 2017. Increases in spending, especially incentive costs, produce larger contractionary effects in the form of foregone household spending. Furthermore, according to the IMPLAN model, the counterfactual spending associated with lost utility revenues and foregone household spending are all slightly greater in 2017 than in 2015, which amplifies those contractionary effects.

6. Economic Impacts Across All Program Years, 2002 Through 2017

An important dimension of energy-efficiency programs is that energy savings and the associated economic impacts continue to benefit the economy after the first program year, when spending and installations occur, as most measures have estimated useful lives of eight to 20 years, or more. The cost savings from these measures for homes and businesses extend into future years (with some degradation as equipment ages and some increase in savings as rates increase) after the initial purchase. These cost savings continue to benefit the economy, as households spend less on electricity and natural gas and more on other consumer products, and businesses are able to produce goods and services more efficiently. As a consequence, the net effects from the first year when the equipment and program spending occur only capture a fraction of the overall benefit of these programs.

Table 6 shows the annualized economic impacts due to energy cost savings from energy-efficiency measures installed in 2017. These estimates were calculated using the input-output model to estimate the economic impacts of reduced energy costs while setting all other costs (i.e., equipment purchases and program implementation costs) equal to zero. To truly isolate the impact of the energy cost savings, we also assumed that there are no lost utility revenues resulting from the measures installed and that utilities would be able to sell the unused power to other customers. This provides an estimate of energy-efficiency benefits based solely on the reduced energy costs to the economy and excludes any additional benefits due to the spending on these programs and measures.

[22] Although each study uses the same economic impact methodology and the most up-to-date IMPLAN model of the Oregon economy, the industry sectoring in IMPLAN changed between the two study periods. In 2013, the IMPLAN model consisted of 440 industry sectors. In 2017, the IMPLAN model consisted of 536 industry sectors.

[23] This changing labor-to-equipment mix translates into a $30.5 million increase in labor or installation costs compared to the 2015 program year. As discussed previously in this report, labor or installation costs generally have larger RPCs than spending on equipment and, as a result, will tend to have larger multiplier effects on the Oregon economy.

Table 6: Annualized Economic Impacts Due to Energy Savings Alone, 2017

Impact Measure	Impact Due to 2017 Energy Savings
Output	$133,348,400
Wages	$41,473,600
Business Income	$5,046,000
Jobs	1,051

Sources: Pinnacle Economics using detailed Energy Trust Program data and IMPLAN.
Notes: 1) Energy savings impacts are based on both electric and natural gas savings, and include the net energy savings attributed to NEEA's market transformation efforts. 2) Energy savings impacts do not include energy generation attributed to Energy Trust's renewable energy program.

The economic impacts attributed solely to energy savings in 2017 are significantly larger than those measured for the 2015 program year. The main drivers of this increase are:

1. **Increases in both electric and natural gas energy savings between 2015 and 2017.** Electric energy savings increased from 508,471 MWh in 2015 to 594,734 MWh in 2017, or by 17.0 percent. Natural gas energy savings increased from 6.5 million therms in 2015 to 6.8 million therms in 2017, or by 4.0 percent.
2. **Slightly higher prices for both electricity and natural gas in 2017 compared to 2015.**
3. **Increased representation and a different mix of industry sectors for program participants in the commercial and industrial energy-efficiency programs.** The number of industries directly benefiting from Energy Trust program activities increased from 253 industries in 2015 to 265 industries in 2017. In addition, the industry sectors benefiting from energy savings in 2017 have larger direct employment effects and subsequent multiplier effects than in 2015. For example, on a weighted-average basis,[24] the direct employment per $1.0 million in output is 8.77 in 2017 compared to 8.05 in 2015. The weighted average job multiplier for benefiting industry sectors is 2.21 in 2017, compared to 2.02 in 2015.[25]

To be consistent with previous impact reports, the energy savings impacts shown in Table 6 are reported on an annualized basis, i.e., they describe the economic impacts from energy savings for energy-efficiency measures that were installed in 2017 and operated for an entire year.

Energy Trust first introduced its energy-efficiency and renewable energy programs in Oregon in 2002. Thus, the 2017 program year represents the 16th year of program activity in this state. This

[24] IMPLAN's direct jobs per $1 million in output and Type SAM job multipliers were weighted by the energy savings for each industry sector in the Commercial-Industrial Energy Efficiency Program.

[25] It's important to note that Energy Trust program participants are not selected based on their economic development potential. The overall larger direct employment impacts and larger job multipliers for Commercial and Industrial Energy-Efficiency Program participants in 2017 compared to 2015 are positive but unanticipated.

section of the report looks at the cumulative net energy savings and net economic impacts over this 16-year period, and include the following types of impacts:

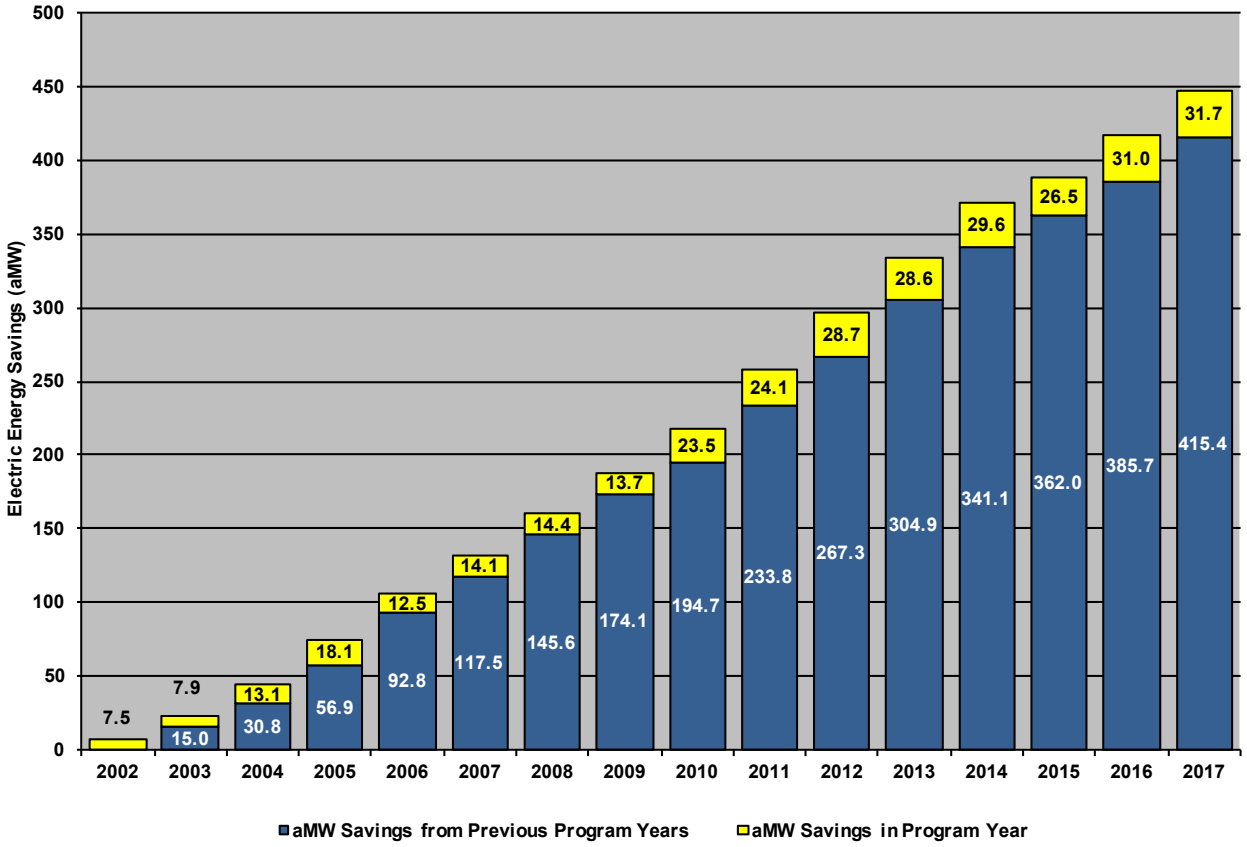
- **Current program year impacts** are based on the net economic impacts associated with energy savings adjusted for measure implementation (i.e., 50 percent of the annualized net energy savings), and program and participant spending in 2017. These net economic impacts represent those reported in the previous section of this report.
- **All previous program year impacts** have been adjusted for Program True Up. Each year, Energy Trust adjusts previously reported energy savings and renewable generation through a True Up process that includes corrections for transaction errors, new data, anticipated evaluation results, and actual evaluation results. Once completed, this True Up process results in the most accurate reporting of energy savings (both electric and natural gas savings) and renewable generation.[26] For example, the initial estimate of net electric energy savings in the 2002 program year was 13.5 aMW. The current Trued Up electric energy savings associated with the 2002 program year is 15.0 aMW.
- **Future out-year impacts**—i.e., those beyond the initial program year—are based on the annualized net energy savings installed in each program year with adjustments for program True Up and the Estimated Useful Life (EUL) of installed energy-efficiency measures. To account for the Estimated Useful Life of installed measures, Energy Trust supplied a matrix of electric and natural gas "die-off" rates for each program year. These die-off rates allow net energy savings in future out-years to be adjusted for the percent of measures still in place. For example, the Energy Trust estimates that none (zero percent) of the electric measures installed in the 2002 program year will be in operation in 2017.[27] As a result, this analysis assumes that the energy savings benefits for the Oregon economy attributed to the Trued Up 15.0 aMW in electric energy savings installed during the 2002 program year have ended.

To illustrate, Figure 1 reports the net electric energy savings (aMW) for energy-efficiency measures installed as part of Energy Trust's energy-efficiency programs between 2002 and 2017.

[26] The True Up process results in increases or decreases in reported energy savings for each program year. In addition, True Up numbers for recent previous years have been revised, thus the cumulative results reported here are not directly comparable to those reported in the economic impact analysis of the 2015 program year. Although the distribution of reported energy savings changes over time as a result of the True Up process, the overall effect on total energy savings attributed to Energy Trust energy-efficiency programs is quite small. Between 2002 and 2016, Trued Up electric energy savings represent 98.7 percent of reported electric energy savings. Similarly, Trued Up natural gas savings represent 99.0 percent of reported natural gas savings between 2002 and 2016. True Up reports that provide detailed information about the adjustments made to energy savings in each annual True Up process are available on Energy Trust's website, energytrust.org.

[27] For comparison, in the previous study for the 2015 program year, the Energy Trust estimated that 33.8 percent of the electric measures installed in the 2002 program year would be in operation in 2015.

Figure 1: Net Electric Energy Savings for Energy Trust Energy-efficiency Programs, 2002—2017

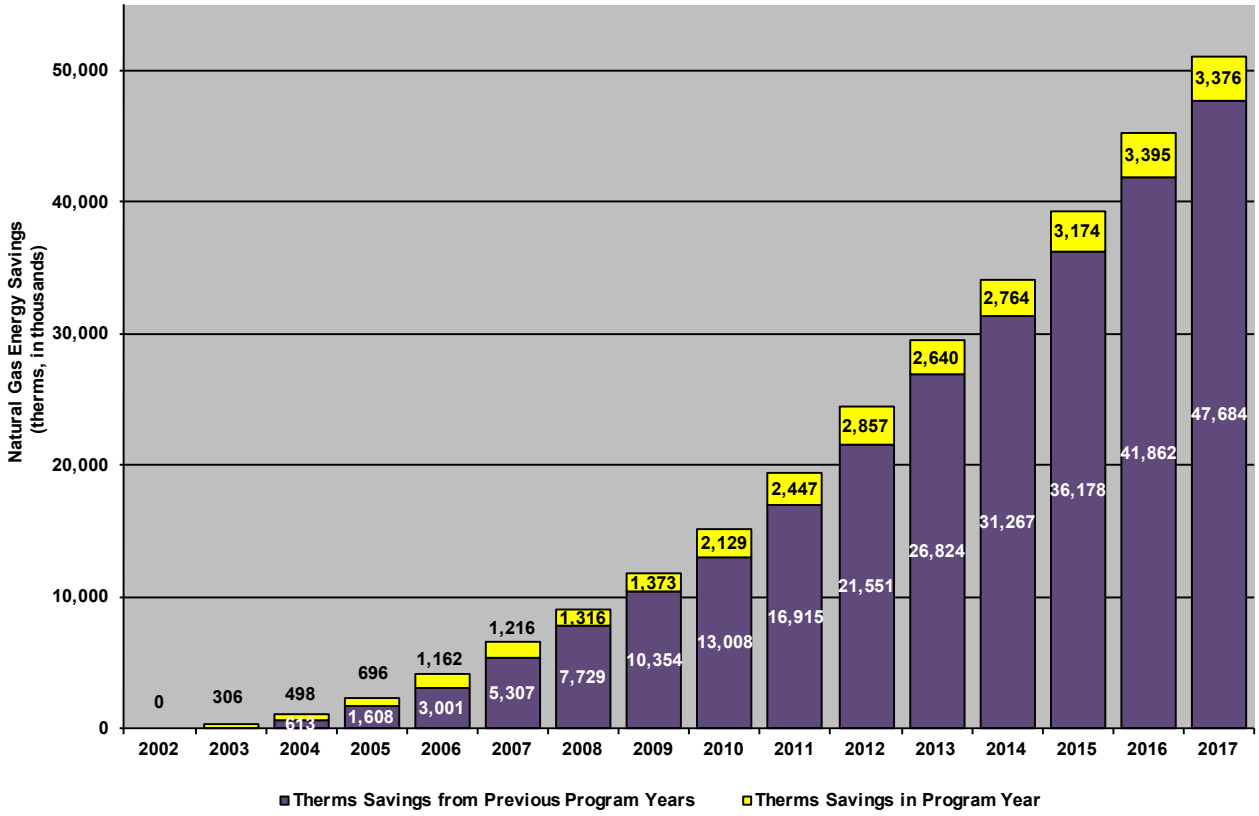


Sources: Calculations by Pinnacle Economics using detailed Energy Trust Program data.
Notes: 1) Net electric energy savings in the current program year have been adjusted using a 50 percent implementation adjustment. Previous program year electric energy savings are annual savings that have been adjusted for True Up. 2) Net electric energy savings in future out-years include adjustments for True Up in the program year and measure EUL or measure die off in out-years. 3) Net electric energy savings include NEEA electric energy savings.

In 2017, Energy Trust's program activities included installation of energy-efficiency measures that would yield an estimated 63.4 aMW of electric energy savings annually. As shown in Figure 1, these energy savings have been adjusted in the first program year to account for actual implementation throughout the year using the 50 percent implementation adjustment factor assumption referenced previously. Between 2002 and 2017, the net electric energy savings attributed to Energy Trust's energy-efficiency programs totaled 3,462.8 aMW.

Figure 2 reports the net natural gas savings (in thousands of therms) for energy-efficiency measures installed as part of the Energy Trust's energy-efficiency programs between 2002 and 2017. Between 2002 and 2017, the net natural gas savings attributed to Energy Trust's energy-efficiency programs totaled 293.2 million therms.

Figure 2: Net Natural Gas Energy Savings for Energy Trust Energy-efficiency Programs, 2002—2017

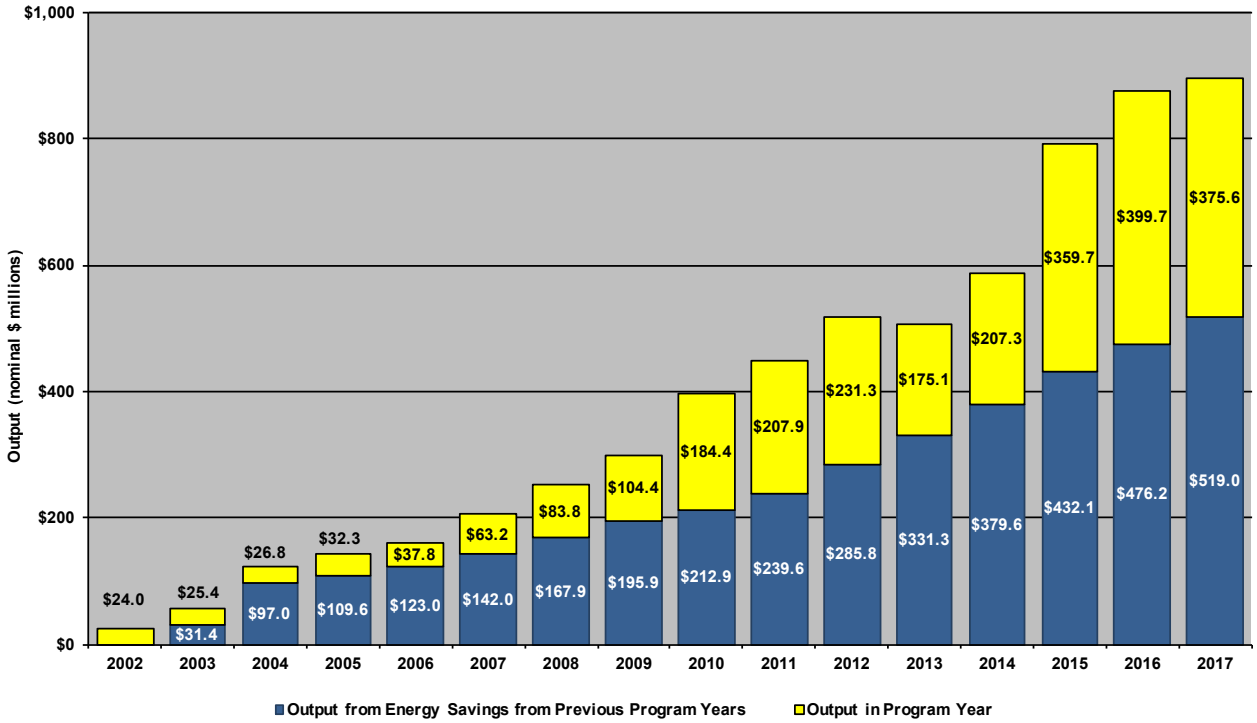


Sources: Calculations by Pinnacle Economics using detailed Energy Trust Program data
Notes: 1) Net natural gas energy savings in the current program year have been adjusted using a 50 percent implementation adjustment. Previous program year natural gas energy savings are annual savings that have been adjusted for True Up. 2) Net natural gas energy savings in future out-years include adjustments for True Up in the program year and measure EUL or measure die off in out-years. 3) Net natural gas energy savings include NEEA electric energy savings.

A similar accumulation effect occurs for the net economic impacts attributed to each program year. For businesses, energy savings lower production costs and enable businesses to increase output. Similarly, less residential spending on energy allows households to spend more on everything else. This contributes to increased employment as spending shifts to other goods and services in sectors that have a greater impact on the Oregon economy. Figures 3 and 4 show the annual output and job impacts, respectively, associated with Energy Trust program activities between 2002 and 2017.[28]

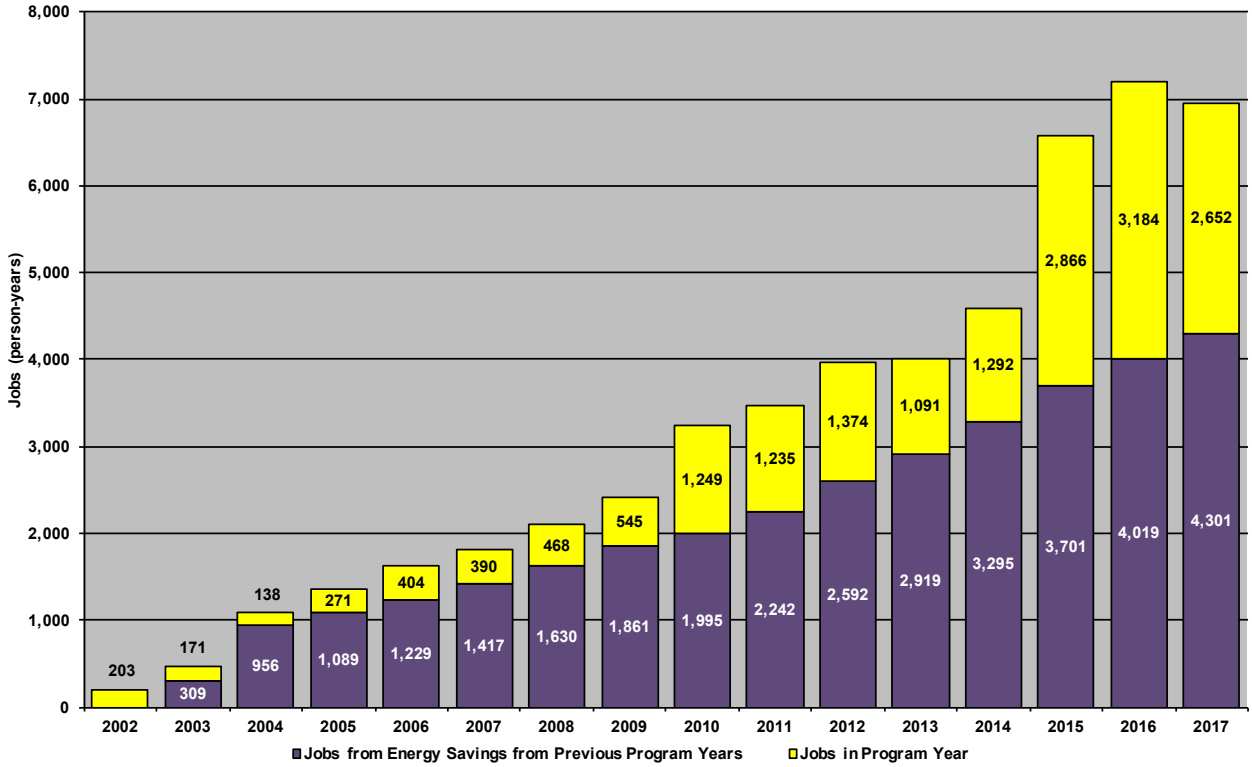
[28] Between 2014 and 2015, there was a large increase in economic impacts while energy savings increased more gradually. The increase in economic impacts is attributed to changes in the level and mix of participant spending on measure installations and equipment. Total incremental measures costs were $206.4 million in 2013 and increased to $289.0 million (+40.0 percent) in 2015. In addition, solar measures in the renewable energy program also experienced significant growth, and solar installations typically include local contractors and labor resulting in large multiplier effects.

Figure 3: Net Output Impacts of Energy Trust Programs, 2002—2017



Sources: Pinnacle Economics using detailed Energy Trust Program data and IMPLAN.
Notes: 1) Economic impacts in the current program year are net economic impacts based on 50 percent of reported net energy savings, and program and participant spending in 2017. (These net economic impacts represent those reported in the previous section of this report.) Net economic impacts from previous program years have been adjusted for True Up. 2) Net economic impacts attributed to energy savings in future out-years include adjustments for True Up in the program year and measure EUL or measure die off in out-years.
3) Economic impacts include both electric and natural gas energy savings, and NEEA electric energy savings.

Figure 4: Net Employment Impacts of Energy Trust Programs, 2002—2017



Sources: Pinnacle Economics using detailed Energy Trust Program data and IMPLAN.
Notes: 1) Economic impacts in the current program year are net economic impacts based on 50 percent of reported net energy savings, and program and participant spending in 2017. (These net economic impacts represent those reported in the previous section of this report.) Net economic impacts from previous program years have been adjusted for True Up. 2) Net economic impacts attributed to energy savings in future out-years include adjustments for True Up in the program year and measure EUL or measure die off in out-years.
3) Economic impacts include both electric and natural gas energy savings, and NEEA electric energy savings.

Table 7 reports the net economic impacts associated with Energy Trust's energy-efficiency programs in Oregon between 2002 and 2017. The net economic impacts are based on spending and actual energy savings in each program year, as well as the annualized energy savings for energy-efficiency measures in future out-years.

Table 7: Summary of Cumulative Net Impacts from Energy Trust Program Activities Between 2002 and 2017 (in millions of nominal dollars)

Economic Impact Measure	Cumulative Net Impacts During Program Years 2002-2017	Annualized Impacts in Future Years
Output	$6,282.2	$652.4
Wages	$1,929.2	$196.0
Business Income	$343.4	$25.2
Jobs (person-years)	51,090	5,350

Sources: Pinnacle Economics using detailed Energy Trust Program data and IMPLAN.

As is shown in Table 7, the spending and energy savings associated with Energy Trust program activities in Oregon between 2002 and 2017:

- Sustained, on a net basis, $6.3 billion in output, including $1.9 billion in wages, $343.4 million in business income and 51,090 person-years of employment over the sixteen-year period.
- Will continue to generate additional energy savings that is linked to $652.4 million in output, including $196.0 million in wages, $25.2 million in business income, and 5,350 person-years of employment annually, albeit at diminishing levels, in the short run.

The cumulative net impacts reported in Table 7 are derived from previous analyses conducted by Pinnacle Economics that rely on a consistent methodology across program years. This methodology measures 1) **gross impacts** based on program spending, net incremental measure spending, net energy savings, and foregone utility revenues, and 2) **net impacts** based on gross impacts less foregone household spending as a result of ratepayer charges used to fund Energy Trust program activities and incentives. Energy savings beyond each program year do not include energy savings from the renewable energy projects, and have been adjusted (reduced) to reflect the EUL of measures installed in each program year.[29]

There are, however, other economic factors that could cause the economic impacts to decline over time in which case the economic impacts reported above would be overstated. Given the static nature of input-output modeling, in general, and the IMPLAN model used in this analysis, cumulative impacts do not take into account changes in production and business processes that Oregon businesses make in anticipation of future higher energy prices and/or increased market pressure from international competition to increase production efficiency. To the extent that Oregon businesses are already adjusting in anticipation of higher costs and/or tougher competition, then cumulative impacts presented here are overstated, as the overall market would become more efficient due to factors outside Energy Trust influence. However, Energy Trust savings estimates do not include the energy savings that program evaluations indicate would

[29] As discussed previously, the energy savings impacts associated with the 2002 program year (the first year of Energy Trust's energy efficiency programs) are assumed to have ended by 2017.

have happened, either immediately or in the very near future, without Energy Trust programs. This possible overstatement, therefore, only pertains to additional, future market-driven increases in efficiency.

The cumulative numbers also rely on the critical assumption that each dollar saved will translate into a dollar of increased economic output for those businesses adopting conservation measures. This assumption is a simplifying assumption made in absence of better information specific to Oregon's economy. This assumption is reasonable in the short run, but in the long run it is likely that a dollar of energy savings will translate to less than a dollar of increased economic output (as reflected in the current economic variables for Oregon used in IMPLAN) if the overall market adopts more efficient production practices in anticipation of increased competition and higher energy costs. Consequently, the cumulative impacts shown here represent an upper bound. Despite these caveats, the ongoing and cumulative effect of conservation due to Energy Trust activities is nevertheless a significant net benefit to Oregon’s economy.