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Central Appalachia Clean Energy

ECONOMIC IMPACT INVENTORY

Central Appalachian Network

Tennessee Advanced Energy Business Council

Table of Contents

Executive Summary & Recommendations

TAEBC was tasked with compiling an inventory of existing economic impact reports on clean energy that relate to Appalachia. The goal is to take stock of the existing universe of economic data on Appalachia and perform a gap analysis to inform direction for the Central Appalachian Network's forthcoming economic impact report on the region (and provide supporting facts for a communications/messaging toolkit).

TAEBC compiled the following directory of economic impact reports from the known universe of studies and databases touching or focused on the Appalachian region. While not exhaustive, every effort was made to include relevant reports. Not every report analyzed by TAEBC is cited in the gap analysis; when two or more reports contained similar data, the most recent was included in the gap analysis. A complete list of reports collected during this scoping effort is included at the end of this report.

Our conclusion: Clean energy advocates lack comprehensive, current data on the economic impact of clean energy in the Appalachian region.

Existing economic impact reports do not follow an established definition of "clean energy" or "renewable energy," so energy sectors analyzed vary significantly from report to report. There is a wealth of nationwide data on renewable energy and energy efficiency, ranging from economic impact reports to online databases. State-by-state data and data by Census region are also plentiful, though markedly inconsistent in age and focus. The vast majority of reports analyze either energy efficiency initiatives or a specific renewable energy source, rather than clean energy as a whole. State economic reports lean heavily on analysis of hypothetical future scenarios, predicting various outcomes dependent on regulatory actions.

Data on Appalachia is much less accessible. The most recent comprehensive economic analysis of renewable energy in Appalachia is over a decade old. More recent studies focus on energy efficiency initiatives exclusively or are narrowly tailored to a specific energy source, analyzing wind power in southwest Virginia, for example, or the growth of the solar industry in southeast Ohio.

CAN has the opportunity to capitalize upon this data gap and effect real change by commissioning a regional clean energy economic impact report.

Such a report would put a spotlight on the ways in which clean energy is an economic driver in Appalachia. Concrete evidence of current economic benefit would be the single most important tool for advocates to persuade policymakers, business leaders, and the public to support clean energy initiatives and investment. Desire for economic growth is universal – it transcends politics, education-level, prejudice, and industry specialty. A regional clean energy economic impact report would give clean energy practitioners and advocates a means of appealing to officials, investors, and the public across the spectrum in terms they already understand: job creation, business investment, GDP growth, and more. Once economic benefit is established, the support builds on itself: New clean energy programs and initiatives are viewed not with initial skepticism or stereotype but through the lenses of economic opportunity.

To resonate most directly with policymakers and business leaders, TAEBC recommends the following parameters for a regional clean energy economic impact report:

Focus on big-picture, tangible data like job creation and GDP contribution. Research into the minutia of sector-specific debates or extensive hypotheticals will limit the report's usefulness. The target audience for this report is not clean energy experts per se, but government and business leaders who are persuaded by easily digestible, straight-forward facts. We recommend focusing on the following key categories in an Appalachian regional economic impact report:

- Number of jobs,
- Number of business entities,
- Contributions to state GDP,
- Tax contributions,
- Annual average salary, and
- Case studies to provide tangibility to the numbers.

Establish a broad definition of "clean energy" by NAICS code with the help of an economist. This will define the clean energy industry studied, giving the report structure and consistency. It will also capture the complete picture of clean energy's economic impact in Appalachia without muddying the waters with too much specificity. Data such as supply chain impact will be captured in the overall definition and thus in the overall data on job creation, yet the report will avoid getting bogged down in a lengthy analysis of the renewables supply chain. The same goes for advanced manufacturing and energy storage, increasingly vital sectors that are left unexplored in existing economic reports due to their age and should be included in CAN's study. This data can be encapsulated in the broad definition of clean energy.

Be judicious commissioning the report and in its outreach strategy. To the extent possible, it is best to select nonpartisan organizations to run the numbers for a regional clean energy economic impact report, or a variety of left-leaning groups, nonprofits, and conservative groups. If the report is undertaken solely by liberal groups, it taints the data for right-wing policymakers, and vice versa.

In addition to maximizing its influence with decision-makers and investors, an Appalachian clean energy economic impact report that follows these broad, structured parameters could be affordably updated annually or every few years to show the evolution of the relationship between clean energy and the Appalachian economy. It will also supply the foundation for more specialized economic impact reports to be subsequently funded and tackled, such as the impact of power purchase agreements or the potential of distributed versus utility-scale solar. The heavy-lifting – convincing target audiences to view clean energy as an economic opportunity for Appalachia – will have already been done by this broad, regional economic impact report.

Much data exists on Appalachia's natural resources, infrastructure networks, and population. Yet collective knowledge is severely lacking on the role and potential of clean energy in Appalachia, and the ways in which this region is uniquely suited to benefit from clean energy initiatives. CAN has the opportunity to connect these dots and reveal for the first time the reality of clean energy's economic potential in Appalachia.

Gap Analysis of Existing Reports and Desirable Data

JOB CREATION AND WORKFORCE DEVELOPMENT

Job Creation and Workforce Development Synthesis

The clean energy industry's potential impact on employment and workforce development in Appalachia is the most important data to persuade policymakers, community leaders, and the public of clean energy's value. We recommend that job creation and workforce development be the primary focus of CAN's economic research.

Based on existing data laid out below, it's clear that the clean energy industry directly creates and indirectly supports thousands of jobs in Appalachian counties, and likely contributes billions to the region's GDP. With focus and investment, clean energy has the potential to be a major driver of economic growth and job creation in the region. That's critical, because job creation, GDP, tax contributions, workforce development, average salaries, and number of businesses are among the most easily digestible data points for the general population to understand. These are tangible benefits the layperson can see and experience for themselves without specialized knowledge of economics or the clean energy field. These data points are also the most persuasive to policymakers, business and community leaders, and investors.

The forthcoming gap analysis details the dearth of current economic data in this category, to the detriment of clean energy's status in Appalachia. We believe research in this category offers the biggest return on investment for CAN, and should be prioritized.

Existing Report Data

Nationwide Reports

The 2018 U.S. Energy and Employment Report details energy efficiency employment data nationwide.

- Energy efficiency employed 2.25 million Americans[1] as of 2017, in whole or in part in the design, installation, and manufacture of energy efficiency products and services. The sector added 67,000 net jobs in 2017. Energy efficiency employment is defined as the production or installation of energy efficiency products certified by the U.S. Environmental Protection Agency (EPA) ENERGY STAR program or installed pursuant to ENERGY STAR program guidelines or supporting services.

- Electric power generation and fuels[2] directly employed more than 1.9 million workers in 2017, up 15,000 jobs from 2016. In 2017, 55 percent, or 1.1 million, of these employees worked in traditional coal, oil, and gas, while almost 800,000 workers were employed in low-carbon emission generation technologies, including renewables, nuclear, and advanced/low-emission natural gas.

- Transmission, distribution, and storage[3] employed more than 2.3 million Americans, with just over 1 million working in retail trade (gasoline stations and fuel dealers) and another 869,000 working across utilities and construction. This represents a net increase of 50,000 jobs.

- Motor vehicles[4] (including component parts) employed over 2.46 million workers, excluding automobile dealerships, adding 29,000 jobs in 2017.

State Reports

Economic studies on the impact of clean energy exist for eight states within the Appalachian region, as defined by the Appalachian Regional Commission (ARC). The most recent year for this data varies by state, as does each report's definition of "clean energy":

- **Tennessee**,[5] as of 2015
    - Number of jobs in the advanced energy sector: Nearly 325,000
    - Number of business entities: Over 17,000
    - Contributions to state GDP: $33.4 billion
    - Average salary (compared to state/regional average): $48,764
    - Contributions to state and local taxes: $820 million

1 (NASEO & EFI) U.S. Energy and Employment Report, May 2018, pg. 14
2 (NASEO & EFI) U.S. Energy and Employment Report, May 2018, pg. 13
3 Ibid.
4 Ibid.
5 (TAEBC) Tennessee Advanced Energy Economic Impact Report, 2015, pg. 7

- **North Carolina**,[6] as of 2016
  - Number of jobs: 126,440
  - Number of business entities: Not listed
  - Contributions to state GDP: $12.2 billion
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: $1.03 billion

- **South Carolina**,[7] as of 2016
  - Number of jobs: 18,004
  - Number of business entities: 350
  - Contributions to state GDP: $3.8 billion
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: Not listed

- **Pennsylvania**,[8] as of 2017
  - Number of jobs: Nearly 70,000
  - Number of business entities: Nearly 6,000
  - Contributions to state GDP: Not listed
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: Not listed

- **Alabama**,[9] as of 2015
  - Number of jobs: 124,000
  - Number of business entities: Not listed
  - Contributions to state GDP: $13.22 billion
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: $385 million

- **Ohio**,[10] as of 2014
  - Number of jobs: 89,000
  - Number of business entities: 7,200
  - Contributions to state GDP: Not listed
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: Not listed

- **Georgia**,[11] as of 2015
  - Number of jobs: 19,231
  - Number of business entities: 801
  - Contributions to state GDP: $3.3 billion
  - Average salary (compared to state/regional average): Not listed
  - Contributions to state and local taxes: Not listed

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6 (NCSEA) Economic Impact Analysis of Clean Energy Development in North Carolina, 2017, pg. ES-1 & ES-2
7 (SCCEBA) South Carolina Clean Energy Industry Census, 2016, pg. 5
8 (E2 & KEEA) Clean Jobs Pennsylvania, 2017, pg. 3
9(Energy Institute of Alabama) Economic Impact Study, 2016, pg. 1
10 (E2) Clean Jobs Ohio, 2015
11 (Southface) Georgia Clean Energy Industry, 2015

- New York,[12] as of 2016
    - Number of jobs: Approximately 146,000
    - Number of business entities: Not listed
    - Contributions to state GDP: Not listed
    - Average salary (compared to state/regional average): Not listed
    - Contributions to state and local taxes: Not listed

Reports on Appalachia

More recent reports on energy specifically in Appalachia focus on energy efficiency. A comprehensive look at renewable energy sources in Appalachia does not appear to have been conducted since ARC's 2006 report,[13] which explored clean energy in the region:

- **Wind Power**: Underdeveloped in Appalachia
    - Direct employment in wind power is heavily weighted to the construction phase as towers, turbines, power lines, and substations are constructed. Long-term employment is limited to maintenance.
    - Job creation related to wind energy developments looks something like a pyramid; 70 percent of potential job creation is in manufacturing components, 17 percent in installation, and 13 percent in operations and maintenance. New investments in wind technology, in turn, drive new orders for manufacturing related to all components required to build a new wind generator.

- **Biomass**: Considered in 2006 the most likely to generate the largest number of post-manufacturing operations and maintenance jobs.

- **Hydroelectric**: Underdeveloped in Appalachia

- **Biofuels**: All Appalachian states are interested in biofuel. Each state in Appalachia should capitalize on the biofuel which is most abundant in its region to create jobs and income.

- **Hydrogen**: Concentrated generally in Oak Ridge, Tennessee

- **Solar**: Appalachia isn't a particularly good region for solar power compared to the rest of the nation
    - The Appalachian region has moderate to low solar capability, relative to the rest of the country, due to its geography and resulting cloud cover and cooler temperatures. Nonetheless, solar energy still has potential for both thermal use and electricity generation using photovoltaic (PV) panels.
    - The job creation potential of expanded PV energy generation is significant due to the fact that the bulk of new employment occurs in the manufacturing phase of industry development.

12 (NYSERDA) New York Clean Energy Industry Report, 2017
13 (ARC) Energy Efficiency and Renewable Energy in Appalachia: Policy and Potential, 2006

Reports by Specific Renewable Energy Sources

Most reports on specific renewable energy sources focus either nationwide or on narrow regions, such as southwest Virginia or Ohio.

Studies suggest that renewable energy creates more jobs than other energy sources. According to some estimates, given their early stage in the product cycle, renewable energy sources are estimated to generate four times as many new jobs per megawatt of installed capacity as natural gas and 40 percent more jobs per dollar invested than coal. Thus the job development opportunities are potentially substantial.[14]

Solar

- The latest Solar Jobs Census found that 250,271 Americans work in solar as of 2017. This is a 3.8 percent decline, or about 9,800 fewer jobs, since 2016. At the same time, the long-term trend continues to show significant growth. The solar workforce increased by 168 percent in the past seven years, from about 93,000 jobs in 2010 to over 250,000 jobs in 2017.[15]

- About half of Appalachian states showed zero growth in electricity generated from utility-scale solar from 2008-2015.[16]

Biomass/Biofuels

- Bioenergy electric power generation and biofuels employed a total of 116,831 workers in 2017. The generation sector is a small component of the overall bioenergy and biofuels workforce. Only 12,385 of these individuals worked exclusively with bioenergy or biomass electric generation technologies.[17]

Wind

- The U.S. wind industry employs approximately 105,500 men and women across all 50 states.[18]

- Out of the Appalachian states, New York, Pennsylvania, and North Carolina have the most wind power jobs.[19] (1,001-2,000 in each state.)

- Most Appalachian states saw ZERO growth in electricity generated from wind from 2008-2015.[20]

14 (ARC) Economic Development Potential of Conventional and Potential Alternative Energy Sources in Appalachian Counties, 2006
15 (Solar Foundation) National Solar Jobs Census, 2017
16 (NRDC) Clean Energy and Efficiency Can Replace Coal for a Reliable, Modern Electricity Grid, 2017
17 (NASEO & EFI) U.S. Energy and Employment Report, 2018
18 (American Wind Energy Association) Annual Market Report 2017 Executive Summary
19 (American Wind Energy Association) 2017 State Fact Sheets
20 (NRDC) Clean Energy and Efficiency Can Replace Coal for a Reliable, Modern Electricity Grid, 2017

Gap Analysis

- There is no current report that catalogs all economic benefits of “clean energy” in Appalachia.

- There are no state level “clean energy” economic impact reports for Appalachian states of West Virginia, Virginia, Kentucky, Maryland, and Mississippi. The remaining eight states that create Appalachia, as defined by ARC, do have state level economic impact data, although the most recent years for this data varies.

- The universe of data is lacking a regionally accepted definition of “clean energy.” Individual states may select a definition that best fits their state. We encourage CAN to take a broad definition of “clean energy” by NAICS code with the help of an economist. We caution CAN about getting bogged down in the fine details of “what is clean energy.” It’s important that this kind of report is easily replicated year after year (or every three to five years) and not cost prohibitive. If the goal is to educate or influence policymakers, this kind of approach is sufficient.

- Appalachia is a unique area of our country as it relates to our connection to energy and energy’s connection to our culture, economy, and community. Therefore, it would be beneficial to produce and commit to regularly producing reports on the economic impact of “clean energy” in Appalachia, measured against state level reports. State level officials are more inclined to act on state level data, while regional data is best for federal or regional action and/or policymaking as it relates to leveraging clean energy for economic opportunity. The key categories to evaluate in such a report are the ones most important to policymakers at all levels:

    - Number of jobs
    - Number of business entities
    - Contributions to state GDP
    - Average salary (compared to state/regional average)
    - Contributions to state and local taxes
    - Total economic impact

ENERGY COST BURDENS AND HOUSEHOLD SAVINGS

Energy Efficiency Synthesis

Existing data confirms that clean industry could have a substantial impact on easing the energy cost burden of consumers and contributing to household savings in Appalachia.

The catch here is investment: Energy efficiency requires upfront investment in money and time by policymakers, utilities, and businesses. We recommend that energy efficiency and energy cost savings be approached in terms of secondary benefits of clean energy. The primary benefits of clean energy are job creation and workforce development; once policymakers and the public are convinced of clean energy's value in creating jobs, attracting businesses, and training local workforces, it opens the door to highlight the ripple effects of the clean energy industry, namely energy efficiency cost savings.

We advise this approach because clean energy's potential impact on energy cost burdens and household savings isn't as readily visible as in areas such as job creation and workforce development. Consider solar panel installation. Jobs are created in the supply chain manufacturing solar panels, transporting them, and installing them on homes and businesses. A new workforce must be trained in the specifics of solar panel manufacturing, installation, and upkeep, opening up a new field of opportunity for workers and diversifying local economies. It is only after the solar panels are installed that individual households reap the cost-savings benefit. This benefit to households then indirectly benefits local economies, but the payoff is indirect.

Existing Report Data

Data on Energy Burdens

The Home Energy Affordability Gap database tracks the gap between "affordable" home energy bills and "actual" home energy bills.[21] Home energy costs are considered unaffordable if they exceed six percent of household income. Analysis is available by state and by country. Thus it would be possible to calculate the home energy affordability gap across Appalachia, if data on the 420 counties as defined by ARC was compiled.

State data for Appalachian states:

- ***New York:*** New York households with incomes of below 50 percent of the Federal Poverty Level dedicate 28 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up seven percent of income. New York households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to six percent of income.

- ***Pennsylvania:*** Pennsylvania households with incomes of below 50 percent of the Federal Poverty Level dedicate 27 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up seven percent of income. Pennsylvania households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to six percent of income.

- ***Maryland:*** Maryland households with incomes of below 50 percent of the Federal Poverty Level dedicate 31 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up eight percent of income. Maryland households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to seven percent of income.

- ***West Virginia:*** West Virginia households with incomes of below 50 percent of the Federal Poverty Level dedicate 31 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up eight percent of income. West Virginia households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to seven percent of income.

- ***Ohio:*** Ohio households with incomes of below 50 percent of the Federal Poverty Level dedicate 29 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up seven percent of income. Ohio households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to six percent of income.

21 Home Energy Affordability Gap, 2017 data

- ***Virginia:*** Virginia households with incomes of below 50 percent of the Federal Poverty Level dedicate 45 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up 11 percent of income. Virginia households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to 10 percent of income.

- ***Kentucky:*** Kentucky households with incomes of below 50 percent of the Federal Poverty Level dedicate 32 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up eight percent of income. Kentucky households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to seven percent of income.

- ***North Carolina:*** North Carolina households with incomes of below 50 percent of the Federal Poverty Level dedicate 34 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up eight percent of income. North Carolina households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to seven percent of income.

- ***South Carolina:*** South Carolina households with incomes of below 50 percent of the Federal Poverty Level dedicate 25 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up six percent of income. South Carolina households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to five percent of income.

- ***Tennessee:*** Tennessee households with incomes of below 50 percent of the Federal Poverty Level dedicate 29 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up seven percent of income. Tennessee households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to six percent of income.

- ***Georgia:*** Georgia households with incomes of below 50 percent of the Federal Poverty Level dedicate 41 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up 10 percent of income. Georgia households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to nine percent of income.

- ***Alabama:*** Alabama households with incomes of below 50 percent of the Federal Poverty Level dedicate 49 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up 12 percent of income. Alabama households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to 10 percent of income.

- ***Mississippi:*** Mississippi households with incomes of below 50 percent of the Federal Poverty Level dedicate 31 percent of their annual income to home energy bills. Bills for households with incomes between 150 percent and 185 percent of the Federal Poverty Level take up eight percent of income. Mississippi households with incomes between 185 percent and 200 percent of the Federal Poverty Level have energy bills equal to seven percent of income.

Data on Potential Energy Efficiency Household Savings

- Household savings for energy efficiency improvements vary by location. EPA estimates homeowners can save an average of 15 percent on heating and cooling costs (or an average of 11 percent on total energy costs) by air sealing their homes and adding insulation in attics, floors over crawl spaces, and accessible basement rim joists.[22] This estimate is based on energy modeling of cost-effective improvements made to 'typical' existing U.S. homes with a weighted composite of characteristics.

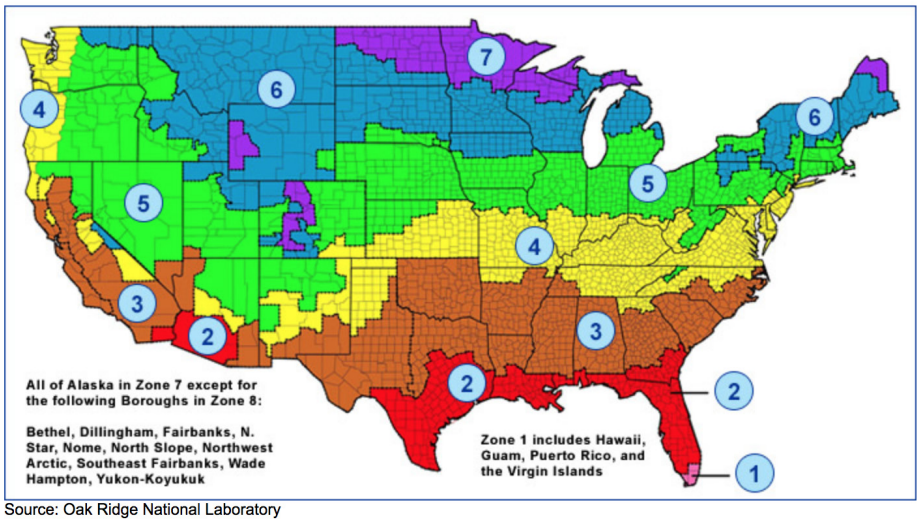
- The Residential Energy Consumption Survey (RECS) from the U.S. Energy Information Administration indicates that a large block of existing U.S. housing stock was constructed after the 1973 oil embargo, when there was an increased awareness of energy use in homes. As a result, EPA based its modeling around the common construction characteristics of homes built in this era as a proxy for a 'typical' existing U.S. home.

- Construction characteristics for homes built during this era (1970 to 1989) were determined based on a review of RECS and data from Lawrence Berkeley National Laboratory, as well as other supporting data, including professional experience of ENERGY STAR staff and stakeholders. Based on these sources, EPA assumed the following characteristics for a house from the 1970 to 1989 era:
    - 1,700 square feet of conditioned floor area;
    - 15 percent window-to-floor-area ratio;
    - 23 percent total system duct leakage;
    - Four bedrooms; and
    - "Stick" construction (wooden studs, joists, and rafters), with batt insulation in walls and blown insulation in attics.

22 ***Energystar.gov***

The following data estimates energy savings from energy efficiency improvements made to the above described 'typical' home. This data is designated by "zones" which EPA outlines on Energystar.gov.[23]

Figure 1: Continental U.S. Climate Zone Map



Source: Oak Ridge National Laboratory

States deemed as part of Appalachia, as defined by ARC, are grouped into:

- ***Zone 3***, which encompasses Mississippi, Alabama, and parts of Georgia with an estimated annual utility bill savings of eight percent for the whole house and 14 percent for heating and cooling only.

- ***Zone 4***, which encompasses Tennessee, Kentucky, North Georgia, North Carolina, Virginia, West Virginia, and parts of southern Ohio with an estimated annual utility bill savings of 12 percent for the whole house and 17 percent for heating and cooling only.

- ***Zone 5***, which encompasses parts of West Virginia, parts of Ohio, parts of Maryland, parts of Pennsylvania, and parts of New York with an estimated annual utility bill savings of 12 percent for the whole house and 16 percent for heating and cooling only.

- ***Zone 6***, which encompasses parts of Pennsylvania and parts of New York with an estimated annual utility bill savings of 14 percent for the whole house and 18 percent for heating and cooling only.

23 Ibid.

Multifamily Housing & Energy Efficiency

There are multiple benefits beyond energy savings for energy efficiency improvements within multi-family housing,[24] including:

- ***Participant benefits:*** Participant non-energy benefits in the multifamily sector include reduced maintenance costs, improved appliance and equipment performance and lifespan, greater property value, increased building durability, and increased tenant comfort, health, and safety.

- ***Utility benefits:*** Customers who have lower, more predictable monthly utility bills are less likely to get behind on payments. A single retrofit to a multifamily building can positively affect many tenants and their accounts, leading to fewer shutoffs, reconnects, customer calls, and debt collection actions.

- ***Societal benefits:*** Reduced energy costs for multifamily households can have a positive impact on local economic activity. Money spent on utility bills is more likely to leave the local economy than money spent on local goods and services.

Energy Efficiency as a Whole

Data finds that promoting energy efficiency is the best way to keep electricity bills low for all consumers.[25]Energy efficiency directly reduces bills by reducing electricity consumption. It also suppresses wholesale electricity and capacity prices by minimizing total energy demand during peak times (e.g., a hot summer afternoon). This reduces the need to dispatch generators with the highest operating costs, lowering the market price of electricity for all customers. And importantly, by targeting low-income households, states can take steps to ensure that these benefits are maximized for those already facing the greatest energy burden.

The projected near-term growth in clean energy could also be an economic boon to states that embrace it.[26]Developers will be deciding where to site projects, bringing with them new jobs and revenues from tax and land lease payments. This would largely benefit rural communities and low-income counties.

An aggressive package of energy efficiency policies implemented throughout Appalachia beginning in 2010 could deliver significant cost-effective energy savings. According to the latest EIA business-as-usual forecast, Appalachia will require 9.2 quads of energy in 2020 and 10.1 quads in 2030. In contrast, a bold energy efficiency initiative could cut that consumption by between nine and 12 percent to 8.2 quads in 2020 and by between 23 and 28 percent to 7.7 quads in 2030.[27]

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24 (ACEEE) Multiple Benefits of Multifamily Energy Efficiency for Cost-Effectiveness Screening, 2015, iii
25 (NRDC) Clean Energy and Efficiency Can Replace Coal for a Reliable, Modern Electricity Grid, 2017
26 Ibid.
27 (ARC) Energy Efficiency in Appalachia, 2009

Household Savings for Solar Installation

How much households save when it comes to solar installation is dependent on a variety of factors including local electricity rates,[28] direct hours of daily sunlight, and size and angle of the roof. Homeowners who buy their panels - instead of leasing them - can claim a federal tax credit worth 30 percent of their purchase cost come tax season, a $6,000 return on a $20,000 home solar system on average.[29]

Multifamily Housing & Solar Installation

In the U.S., nearly 40 percent of households live in rental housing, which includes single family, multi-unit, and other structures. Of those households, more than 60 percent live in multifamily housing.[30]

Shared solar programs can enable multiple customers, including renters in multifamily housing, to share the economic benefits of a single solar power system and receive credits on their utility bills for the electricity generated by that common system. There are 14 active state shared solar programs spread across 11 states and Washington D.C., and there are five other state programs that are in the process of being implemented.[31]

Two potential pathways to enable greater solar access for renters and multifamily residents include: on-site shared solar and off-site shared solar.

Opportunities for on-site shared solar establish direct connection between consumers and building use which creates value within the community and doesn't require finding a separate, suitable project location. On-site shared solar increases consumer access and enhances energy equity, serves underserved markets, and expands environmental benefits of clean energy and supports related goals. Some of the challenges with on-site shared solar include requiring buy-in from multiple entities; possible constraints by net metering limits and core network interconnection issues; potential barriers if rent control measures are in place; and matchmaking requirements with contractors and building owners.[32]

Opportunities for off-site shared solar promote flexibility by allowing customers to take their subscriptions with them when they move and don't require as much buy-in from building owners. Off-site shared solar creates direct economic benefits with energy bill savings occurring over time, is a viable solution tested elsewhere, and creates locational values for certain areas.[33] Challenges for off-site shared solar could include finding a separate, suitable project location and long-term maintenance and management of solar subscriptions. This system could also get complex with important stakeholders not feeling comfortable or familiar with the overall model.

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28 (EIA) Average Price of Electricity to Ultimate Customers by End-Use Sector, March 2018
29 www.dsireusa.org
30 (IREC) Expanding Solar Access: Pathways for Multifamily Housing, 2018
31 Ibid.
32 Ibid.
33 Ibid.

Low-to-Moderate Income Households & Solar Installation

Adoption of rooftop solar in the United States primarily has been concentrated in higher-income households. As technology costs decline and markets expand, however, focus is shifting to increasing solar access in underserved market segments – particularly to low-to-moderate income (LMI) households.

Although LMI households represent about 43 percent of the U.S. population, it is unknown what proportion live in buildings suitable for PV, how this potential is distributed among the buildings they live in, or what fraction of their electricity needs could be met with rooftop solar.

Table ES-1. National Residential PV Rooftop Technical Potential by Income Group

Income Group		Households (millions)	Suitable Buildings (millions)	Suitable Module Areas (millions of m²)	Capacity Potential (GW_{dc})	Annual Generation Potential (TWh/year)
LMI	Very Low (0%-30% AMI)	19.5	9.4	794.4	127.1	160.8
	Low (30%-50% AMI)	11.5	5.7	472.8	75.6	95.3
Non-LMI	Moderate (50%-80% AMI)	18.8	10.4	792.0	126.7	159.8
	Middle (80%-120% AMI)	21.1	12.3	900.4	144.1	180.8
	High (>120% AMI)	46.0	29.4	2,003.3	320.5	403.1
All LMI Buildings		49.8	25.5	2,059.2	329.4	415.9
All Residential Buildings		116.9	67.2	4,962.9	794.0	999.8

A majority of the overall residential potential (683 TWh, 68.4 percent) is situated on single-family buildings, as compared to multifamily dwellings (316 TWh, 31.6 percent), and single-family potential exceeded multifamily potential for each income group. Similar ratios are seen for owner-occupied and renter-occupied buildings as there is a strong correlation between multifamily occupancy and rental status. For LMI households specifically, the largest modality of potential is for single-family owner-occupied buildings (176.8 TWh), followed by multifamily renter-occupied buildings (140.1 TWh). Though deployment of rooftop solar historically has been concentrated on single-family owner-occupied buildings, nearly 60 percent of potential for LMI buildings exists on renter-occupied and multifamily buildings.[34]

34 (NREL) Rooftop Solar Technical Potential for Low-to-Moderate Income Households in the United States, 2018

Gap Analysis

- There does not appear to be a report that catalogs energy cost burdens within the Appalachian region for the residential division, as defined by ARC.

- There does not appear to be a report that defines household savings from solar installation and/or energy efficiency improvements for the Appalachian region for the residential division, as defined by ARC.

- The high concentration of households in poverty or with low-to-moderate incomes in Appalachia, as well as the high volume of multifamily housing and rentals, could be examined in an analysis of the economic potential of energy efficiency initiatives. Existing data confirms that the Appalachian region is uniquely suited to benefit from energy efficiency because of the economic demographics of its population, but that conclusion must be pieced together from various reports and databases. While this type of information is more typically found in policy analyses rather than economic impact analyses, CAN has the opportunity to centralize this data and expand upon it if so desired.

BUSINESS DEVELOPMENT AND ENRICHMENT OPPORTUNITIES

Business Development Synthesis

Existing data on the potential of the clean energy industry to impact business development and enrichment opportunities is all over the map.

We find it's most productive to concentrate research in this category on business creation and opportunities afforded by clean energy for businesses to invest and expand. This data is congruent with the job creation and workforce development category previously discussed and should be included in the primary research focus. It's also the area where clean energy has the potential to make the most substantial economic impact: Clean energy startups and nonprofits directly create jobs and train local workforces, diversifying regional economies. And regions that invest in clean energy increasingly attract corporations like Google and Facebook to invest and build in their communities.

It's less fruitful in our experience to concentrate efforts on analyses of clean energy as cost-savings mechanism for businesses. As noted above, these benefits are singular in the short-term and not as persuasive to the public and decision-makers looking for economic growth.

Existing Report Data

- The energy ecostructure and electricity system is on the brink of disruption. Energy is becoming decentralized,[35]and new technologies are enabling businesses to both produce and consume energy. Many companies are looking at these megatrends to find new ways to save money, meet sustainability goals, and build resiliency.

- There is no evidence that energy codes depress commercial construction activity, as other factors appear to be more influential in determining construction activity levels. Data from 2005-2013 reveals permit numbers are on the rise in the Southeast, and most southeastern states have surpassed their pre-recession peak, despite regionwide implementation of more stringent energy codes.[36]

- Extensive data suggests that buildings which meet or exceed energy codes often create their own market advantage, and tend to be more sought after by knowledgeable buyers and tenants. This is because they are generally more comfortable for their occupants, which correlates to higher productivity, and they are more cost-effective to operate over time. Together, these factors can represent an important competitive advantage.[37]

- A 2016 study found that relying on efficiency and solar energy investments resulted in 14 percent lower average electricity bills by 2030 compared to a natural gas-heavy alternative.[38]

- Businesses who tell their sustainability story and align a company's brand values with the values of its consumers as it relates to the environment will not only better connect with consumers but will also sell more products.[39]

- A GreenBiz Research[40] survey identifies gaps in how firms currently approach and execute energy and sustainability initiatives. And these gaps can limit ROI. This survey also showed evidence that the business community isn't prepared for the seismic shift that's reshaping the energy landscape. Change will only accelerate and intensify, presenting risks and competitive disadvantages for those behind the curve and opportunities for those ahead.

Gap Analysis

We recommend CAN find case studies detailing how Appalachian-located businesses, as defined by ARC, are making the shift to energy efficiency and clean energy. Providing Appalachian-specific case studies, with real faces and names, is the most important resource for informing policymakers. We do not recommend getting so specific as to locate energy-efficient and solar supply chain data as it relates to business development potential within the Appalachian region.

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35 The State of Corporate Energy & Sustainability Programs 2018, Executive Summary, pg. 2
36 (SEEA) The Economic Impact of Commercial Energy Codes in the Southeast, 2014
37 Ibid.
38 (Georgia Institute of Technology) The Clean Power Plan and Beyond, 2016
39 (Shelton Group) Think. Feel. Do. How to win consumer loyalty through sustainability, 2018
40 The State of Corporate Energy & Sustainability Programs 2018, Executive Summary, pg. 2

REGULATORY ENVIRONMENT

Regulatory Environment Synthesis

The clean energy industry can have the greatest impact on the regulatory environment by spotlighting opportunities for job creation, workforce development, and GDP growth afforded by clean energy. Once policymakers and officials have concrete data on these data points, it opens the door for regulatory changes to make a county, city, or state more friendly to the clean energy industry. Without that current data to make the economic case for clean energy, however, the industry must rely on anecdotes and hypotheticals to lobby for energy efficiency policies, which in our experience is a far weaker hand to play.

Existing Report Data

- The American Council for an Energy-Efficient Economy maintains an online database of energy efficiency policies implemented at the state and local levels. It's updated once a year[41] and informs their annual State Energy Efficiency Scorecard. Economic impact data from Appalachian states is spotty and anecdotal.

- A large portion of existing reports proffer a number of potential regulatory scenarios, then predict the future economic impact of each scenario on a location and energy policies. This approach is in part due to the unpredictability of energy policies under shifting governments.

- Coal states are less likely to be urgently seeking renewable or alternative energy through regulation, likely because it's viewed as a competitor.[42]

Gap Analysis

- The presence of Energy Efficiency Resource Standards, Integrated Resource Plans, and voluntary energy efficiency standards is an ever-changing landscape as states adopt, repeal, and update their policies. Many existing reports focused on Appalachia or the Southeast for state energy efficiency policies are thus outdated, as policies have changed.

- The economic impact of state clean energy policy is best conducted on a case-by-case basis as policy is considered or under threat.

- Basing economic analyses too heavily on state energy policies will limit the shelf-life of an economic impact report.

41 ACEEE State and Local Policy Database
42 (ARC) Energy Efficiency and Renewable Energy in Appalachia: Policy and Potential, 2006

COAL

Existing Report Data

Although coal is not "clean energy," taking account of coal's place in the Appalachian energy economy provides helpful context.

The Appalachian coal industry ecosystem is characterized by the relationship and interdependence among coal mining, its supply chain linkages, transportation services, coal-fired power plants, and human capital resources.

Coal retirements around the country offer a unique opportunity to transition to a lower-emitting, more dynamic, cost-effective, and resilient electricity system while delivering economic benefits to households and businesses.[43]

- Coal production fell by nearly 45 percent overall in Appalachia between 2005 and 2015.[44] This is more than double the rate of national decline in coal production of around 21 percent.

- Coal industry employment[45] fell by around 27 percent between 2005 and 2015. These losses were heavily concentrated in Central Appalachia. Further, the counties with the highest dependence on the coal industry tended to be rural counties in Central Appalachia. Overall, many of the counties that had the greatest dependence on the coal industry suffered the greatest losses in coal production and employment.

- Data suggest that the largest declines in railroad tonnage may have already been observed.[46] Geographically, with only a few exceptions, any threats to rail access associated with reduced coal volumes seem to be constrained to Appalachia. While unwelcome, the magnitude of losses to rail access, either in the form of physical proximity or affordability, is not currently predicted to be catastrophic. However, this prediction depends pivotally on rail carriers' abilities to garner adequate revenues from remaining freight traffic. Continued access to eastern ports and the global connectivity they afford depends largely on Appalachian coal's competitiveness in international markets and the markets' future strength.

- Coal has fallen substantially as a fuel for electric power generation in Appalachia.[47] Coal represented around 53 percent of total generation in Appalachia in 2015, down from just over 74 percent 10 years prior. However, Appalachia remains much more reliant on coal for electric power generation compared with the rest of the nation, where coal represents around 35 percent of generation.

43 (NRDC) Clean Energy and Efficiency Can Replace Coal for a Reliable, Modern Electricity Grid, 2017
44 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 2
45 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 3
46 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 7
47 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 9

- Total population has fallen by a small margin in the coal-mining counties of Central Appalachia in recent years, perhaps partly as a result of the decline in the coal industry.[48]Although overall population loss has been relatively modest, the drop has been especially pronounced in the prime working-age population in Appalachia's mining counties. The labor force has declined substantially in Central Appalachian coal mining counties.

- Labor markets within coal communities and the Appalachian region itself are generally depressed relative to other states.[49] The characteristics of these labor markets suggest that there will be difficulties creating robust new employment opportunities in the region.

Gap Analysis

We recommend any discussion of coal be undertaken as a means of describing how its decline opens the door for clean energy opportunities specific to Appalachia. For example, extensive transportation infrastructure exists throughout Appalachia that could be repurposed for clean energy and energy efficiency initiatives.

48 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 3
49 (ARC) An Economic Analysis of the Appalachian Coal Industry Ecosystem, 2018, pg. 12

Economic Impact Report Directory

(NASEO & EFI) U.S. Energy and Employment Report, 2018
(IREC) Expanding Solar Access: Pathways for Multifamily Housing, 2018
(Shelton Group) Think. Feel. Do. How to Win Consumer Loyalty Through Sustainability, 2018
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(AWEA) U.S. Wind Energy State Facts, 2017
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(NY Sustainable Business Council) Clean Jobs New York Report, 2016
(Synapse Energy Economics) Aiming Higher: Realizing the Full Potential of Cost-Effective Energy Efficiency in New York, 2016
(TAEBC) Tennessee Advanced Energy Economic Impact Report, 2015
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(E2) Clean Jobs Ohio, 2015
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(ARC) Energy Efficiency in Appalachia, 2009
(ARC) Economic Development Potential of Conventional and Potential Alternative Energy Sources in Appalachian Counties, 2006
(ARC) Energy Efficiency and Renewable Energy in Appalachia: Policy and Potential, 2006