U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Accounting Methodology for Source Energy of Non-Combustible Renewable Electricity Generation

October 2016

Acknowledgements

The author would like to thank the following individuals for their thoughtful review, comments, and suggestions in the preparation of this document: Madeline Salzman, Joan Glickman, Cody Taylor, and John Cymbalsky of the U.S. Department of Energy's (DOE's) Building Technologies Office; John Agan of the DOE's Office of Energy Policy and Systems Analysis; Barbara Fichman and Nanda Srinivasan of DOE's Energy Information Administration; Alexandra Sullivan, Cindy Jacobs, and Jean Lupinacci of the U.S. Environmental Protection Agency; and Paul Torcellini of the National Renewable Energy Laboratory.

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Intro

As non-combustible sources of renewable power (wind, solar, hydro, and geothermal) do not consume fuel, the "source" (or "primary") energy from these sources cannot be accounted for in the same manner as it is for fossil fuel sources. The methodology chosen for these technologies is important as it affects the perception of the relative size of renewable source energy to fossil energy, affects estimates of source-based building energy use, and overall source energy based metrics such as energy productivity. This memo reviews the methodological choices, outlines implications of each choice, summarizes responses to a request for information on this topic, and presents guiding principles for the U.S. Department of Energy, (DOE) Office of Energy Efficiency and Renewable Energy (EERE) to use to determine where modifying the current renewable source energy accounting method used in EERE products and analyses would be appropriate to address the issues raised above.

Issue

The current *fossil fuel equivalency* approach used in many EERE products and analyses assumes non-combustible renewable electricity (RE) generation has an average heat rate of fossil fuels (9,510 BTU/kWh as of 2015), while an alternate *captured energy* approach uses the heat content of the electricity produced (3,412 BTU/kWh). Neither option is strictly technically more accurate or correct as both are a matter of methodological choice related to particular applications. However, the *fossil fuel equivalency* approach as currently used both within and outside of EERE affects source energy estimates of energy used in buildings and may create inconsistent policy signals as the amount of renewable electricity generation grows. Therefore, the guidelines provided at the end of this document indicate that it can be appropriate for EERE to use the *captured energy* approach in certain applications.

Note that other methodological choices regarding source energy and site-to-source ratio calculations (e.g. geographic resolution of site-to-source ratios, marginal versus average site-to-source ratios, how to account for on-site renewable electricity, nuclear energy and combustible renewable source energy calculations) are not considered here.

Background

Source energy is a concept used to evaluate energy consumption when different types of energy sources need to be accounted for equitably, such as in buildings (e.g. electricity, natural gas, steam, fuel oil) or large sectors of the economy (e.g. coal, natural gas, petroleum).[1] Using source energy allows all of these energy types to be evaluated on a common energy metric. This concept is used in a variety of EERE and related Federal Government products, publications, tools, and reports. Examples are listed below:

EERE products and reports that use source energy:

- Impact Assessments for Appliance Standards
- Market reports (e.g. LEDs)
- Home Energy Score & Asset Score
- Federal Energy Management Program (FEMP) Source Energy Reporting[2]
- Energy efficiency metrics (e.g. Energy Productivity)

Zero Energy Buildings Definition Related Federal Government Products that use source energy:

- ENERGY STAR Portfolio Manager® (EPA)
- Annual Energy Outlook (EIA)
- Monthly Energy Review (EIA)

1 U.S. Environmental Protection Agency, "Energy Star Portfolio Manager Technical Reference – Source Energy." July 2013. Available at: http://go.usa.gov/xjwwT

2 FEMP reports source energy by agency in the Comprehensive Annual Energy Data and Sustainability Performance report, Table T-4: http://go.usa.gov/xZWxQ

3 Energy Information Administration, "Monthly Energy Review." Accessed August 2016. Available at: http://www.eia.gov/totalenergy/data/monthly/

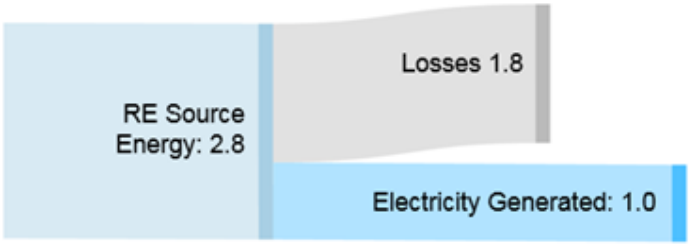
4 Energy Information Administration, "Annual Energy Review 2011", Appendix F: Alternatives of Estimating Energy Consumption, Accessed July 2016. Available at: http://www.eia.gov/totalenergy/data/annual/pdf/sec17.pdf

Most of these examples currently use the *fossil fuel equivalency* approach, and this has been consistent with how Energy Information Administration (EIA) has historically reported source energy using fossil fuel equivalency. However, EIA plans to introduce non-combustible renewable source energy using the *captured energy* in the *Monthly Energy Review*.[3] The details of the two methodologies are outlined below.

It is noted that these are not the complete set of methodological choices possible for non-combustible source energy accounting. Other examples include the incident energy methodology, which would use each technology's efficiency of converting the renewable resource (e.g. wind or solar energy) into electricity to determine source energy,[4] while another method would assume that non-combustible renewable generation consumes no source energy (e.g. 0 BTU/kWh). The request for information (RFI) and research informing this document focuses only on using *captured energy* as an alternative to *fossil fuel equivalence*.

Fossil Fuel Equivalency

This methodology uses the average heat rate of fossil generators and assigns it as the heat rate for non-combustible RE generation – currently 9,510 BTU/kWh, or about 35% efficiency as seen in the figure below. This value represents the source energy value of the fossil generation which is displaced by the RE generation. EIA reported that this methodology was developed in an earlier era when the penetration of RE generation was low, and it was generally displacing the use of fuel oil.[5]



A concern with this approach is that it does not accurately reflect the energy losses associated with different types of energy, as it assumes RE generation has the same energy losses in conversion as fossil generation, and that these losses represent similar economic loss. While RE generators do have losses in converting sunlight or wind energy into electricity, there is no economic value lost because there is no other direct use for the resource that was not captured (e.g. wind or sunlight) as there would be for coal or natural gas that was not combusted. When used for calculated metrics related to determining the efficiency of the power sector and the impact of energy efficiency measures, it introduces distortions due to the fictitious "losses" to the energy system.

Captured Energy

This methodology assumes that the source energy of RE generators is exactly equal to the electricity produced with no energy losses prior to transmission and distribution. This is equal to a heat rate of 3,412 BTU/kWh, or a conversion efficiency of 100%, as shown below.

This approach better shows the economically significant energy transformations in the United States because the "lost" RE energy does not incur any significant economic cost. However, this approach implies that conversion of noncombustible renewable energy is 100% efficient which is not physically true.

3 Energy Information Administration, "Monthly Energy Review." Accessed August 2016. Available at: http://www.eia.gov/totalenergy/data/monthly/

4 Energy Information Administration, "Annual Energy Review 2011", Appendix F: Alternatives of Estimating Energy Consumption, Accessed July 2016. Available at: http://www.eia.gov/totalenergy/data/annual/pdf/sec17.pdf

5 Ibid

Technical Considerations

As mentioned in the introduction, neither option is considered more technically "correct" or more "accurate" than the other, as each option needs to be considered along with its intended use to determine which is appropriate. As discussed by EIA, for their purposes, *fossil fuel equivalency* may be more appropriate when RE generation always displaces fossil fuel generation, and *captured energy* may be more appropriate when RE generation never displaces fossil fuels.[6] There are also additional confounding factors such as Renewable Portfolio Standards and priority dispatch of renewables that would make it extremely challenging to calculate a more representative conversion factor that accurately assesses what fuel source RE generation is displacing.

It is also noted that both methodologies only address the conversion of source energy to electricity generated at the generator. Both methods still need to reflect losses from transmission and distribution when used in a site-to-source ratio as seen in the sample calculation in the appendix.

Impact of Methodological Choice

The choice of methodology makes a difference when used in tools, products, and analyses, and the differences between the methods increase as the penetration of RE generation increases. Table 1 below outlines the quantitative impact on select source energy metrics of switching from the *fossil fuel equivalency* approach to a *captured energy* approach, under projected conditions from EIA's *Annual Energy Outlook 2016* and a hypothetical 50% renewable penetration scenario.

For total source energy, energy productivity, and average site-to-source ratios, increasing RE penetration under *fossil fuel equivalency* has minimal effect by definition as RE source energy has the same heat rate as the fossil fuels used. Instead, fuel switching from coal to natural gas is the primary driver of site-to-source ratio change regardless of RE penetration. As natural gas changes the ratio due largely to higher conversion efficiencies and lower source energy loss, it is inconsistent for the lower economic energy loss associated with RE to not also drive these changes. However, if the *captured energy* approach were instead used, increasing RE penetration causes a further decrease in source energy, an increase in energy productivity, and a decrease in the average site-to-source ratio, beyond the effects of coal to natural gas fuel switching alone.

The analysis shown in Table 1 also shows that the marginal site-to-source ratio would be reduced by ~10% if the *captured energy* methodology was used at current levels of RE penetration. This would likely decrease further in the future as more renewable generation is predicted to come online based on additional factors such as the Clean Power Plan and the tax credit extension which were not included in the modeling scenarios used to evaluate the marginal site-to-source ratio.[7]

The following sections discuss the impact of the methodological choice on specific EERE and other Federal Government programs in more detail.

6 Ibid

7 See note b for Table 1.

Table 1: Projected impact of *fossil fuel equivalency* and *captured energy* methodologies on selected relevant energy metrics, using 2015 data from EIA's *Monthly Energy Review* and future values from EIA's *Annual Energy Outlook 2016*. Note that these values are presented for illustrative purposes only.

Year (RE Generation %)[a]	Fossil Fuel Equivalency	Captured Energy	Impact
Total Economy-Wide Source Energy (Quads)			
2015 (12%)	97.7	94.5	As RE penetration increases, the difference between total economy-wide source energy calculated using *captured energy* and *fossil fuel equivalency* increases
2020 (18%)	100.6	95.9	
2030 (22%)	101.5	95.8	
2040 (26%)	107.2	100.0	
— (50%)	107.4	93.5	
Energy Productivity (GDP 2015 dollar-year$/MMBTU)			
2015 (12%)	$186	$191	Using *captured energy* approach causes RE deployment to increase energy productivity as compared to *fossil fuel equivalency*.
2020 (18%)	$230	$241	
2030 (22%)	$283	$300	
2040 (26%)	$330	$353	
— (50%)	$329	$378	
Average Site-to-Source Ratio			
2015 (12%)	3.00	2.77	RE deployment would cause the site-to-source ratio to decrease in the *captured energy* approach, while the *fossil fuel equivalency* is primarily sensitive to fuel switching from coal to natural gas.
2020 (18%)	2.83	2.49	
2030 (22%)	2.73	2.34	
2040 (26%)	2.71	2.27	
— (50%)	2.72	1.87	
Marginal Site-to-Source Ratio[b]			
2020 (14%)	2.70	2.34	*Captured energy* would decrease the projected source energy savings due electricity energy efficiency measures by ~10% relative to *fossil fuel equivalency*. The difference would increase as RE penetration increased and was more often the marginal generator.
2030 (13%)	2.28	2.10	
2040 (14%)	2.32	2.04	

a The 2015 numbers use data published in the *Monthly Energy Review* [8] and projected future values use data from the *Annual Energy Outlook* (AEO) 2016 reference case.[9] The 50% RE generation scenario uses the generation mix from 2040, but scales generation proportionally so non-combustible renewables accounts for 50% of all electricity generation.

b The marginal site-to-source ratio compares the difference in generation and source energy consumption between the AEO 2014 reference case and the high efficiency technology side case to estimate the marginal impact of reducing demand. AEO 2014 is used as the high-efficiency technology side case for AEO 2016 has not yet been released as of the time of this writing. The renewable penetrations achieved in AEO 2014 are lower than for AEO 2016 due to no Clean Power Plan, higher renewable capital costs, and no renewable tax credit extensions. This approach is similar to one developed by Lawrence Berkeley National Labs and used for assessing the impact of Appliance and Efficiency Standards.[10]

8 Energy Information Administration, "Monthly Energy Review." Accessed August 2016. Available at: http://www.eia.gov/totalenergy/data/monthly/

9 Energy Information Administration, "Annual Energy Outlook 2016." Accessed August 2016. Available at: http://www.eia.gov/forecasts/aeo/tables_ref.cfm

10 Coughlin, K, "Utility Sector Impacts of Reduced Electricity Demand," Lawrence Berkeley National Lab, LBNL-6864E, Accessed July 2016. Available at: http://www.osti.gov/scitech/servlets/purl/1165372

EERE Products and Reports

- **Appliance Standards:** The current methodology uses a marginal full fuel cycle site-to-source ratio to determine the source energy savings for a given unit of site energy reduction in consumption, due to a standard. This is derived from power sector modeling to project the change in power generation mix due to reductions in demand.[11] As shown in the example in the table above for marginal site-to-source ratios, switching to *captured energy* would decrease the total source energy saved due to an electricity-savings measure by ~10% at current levels of RE penetration. The difference between the two methodologies would increase as RE penetration increases as RE would more often be a marginal resource.

  Note that the emissions impacts, electricity consumption savings, and energy cost savings from appliance standards are not affected by the renewable accounting methodology choice. Neither is the assessment on the relative impacts of appliance standards on different electricity generation sources. Only the source energy savings are affected.

- **Energy Efficiency Market Reports:** Market reports, such as *LED Lighting Forecast* published by EERE, project the current and future source energy savings attributed to LED lighting. The *captured energy* approach would decrease current estimates of source energy saved by 7.7% and would continue to decrease as RE penetration increases in the future.

- **Economy-wide Energy Efficiency Metrics:** As seen in the table above, energy efficiency metrics that use source energy are also affected by the methodology choice. For example, energy productivity uses total source energy in the denominator. Under the *fossil fuel equivalency* approach, increasing penetration of RE has minimal effect on energy productivity, while fuel switching from coal to natural gas, or improvements in the heat rate of fossil generators do. Under the *captured energy* approach, increasing the amount of RE generation would also act to increase energy productivity.

- **Building Energy Performance Metrics:** EERE's building energy performance scoring tools — Home Energy Score and Building Asset Score — currently use site-to-source ratios using the fossil fuel equivalency method to estimate the source energy required for a home or building.[12] Changing to the *captured energy* approach would reduce the estimated source energy consumption from electricity use by 7.7%, and this impact would grow in magnitude as RE penetration increased. This would more correctly credit electricity with reduced fuel consumption and associated environmental impacts as RE penetration increases.

- **Zero Energy Buildings (ZEB) Definition**: This definition looks at buildings in terms of the energy flows to and from buildings, and uses site-to-source ratios based on the *fossil fuel equivalency* method to estimate the source energy used for a home or building. Changing to the *captured energy* approach would reduce the estimated source energy consumption from electricity use by 7.7%, and this impact would grow in magnitude as RE penetration increased. This would more correctly credit electricity with reduced environmental impacts as RE penetration increases. The definition calculates on-site renewable generation that is exported to the grid using the *fossil fuel equivalency* approach to properly balance the source energy of grid electricity displaced and allow buildings to achieve net zero status. This could be modified to *captured energy* as well to maintain the appropriate balance with delivered energy.

- **Federal Energy Management Program (FEMP) Reporting:** Since the 1980s, FEMP has been tracking progress toward statutory energy reduction goals in site-delivered energy using the *captured energy* approach for non-renewable energy sources. In general, FEMP reporting uses site-energy metrics, except for *Table T-4: Total Primary (Source) Energy Use in All End-Use Sectors, by Agency published as part of the Comprehensive Annual Energy Data and Sustainability Performance* report,[13] which currently uses *fossil fuel equivalency* for both renewable generation and purchased steam. If captured energy were used instead, the reported source energy use would be reduced by 7.7%, and this impact would grow in magnitude as RE penetration increased.

11 Coughlin, K, "Utility Sector Impacts of Reduced Electricity Demand," Lawrence Berkeley National Lab, LBNL-6864E, Accessed July 2016. Available at: http://www.osti.gov/scitech/servlets/purl/1165372

12 U.S. Department of Energy, "A Common Definition for Zero Energy Buildings," September 2015. Available at: http://go.usa.gov/xjwpH

13 Available at http://go.usa.gov/xZWxQ

Per 42 U.S.C. § 8259(4), when tracking progress toward statutory energy intensity reduction goals, FEMP assumes that on-site renewable generation consumes no captured or source energy (e.g. 0 Btu/kWh). As FEMP uses site-delivered energy as the unit for tracking progress towards energy goals, it also provides a credit to agencies that use combined heat and power plants which bring energy on-site to generate and displace the use of grid-supplied electricity.

Related Federal Government Products and Reports with EERE Equities

- **ENERGY STAR Portfolio Manager® (EPA):** Currently uses site-to-source ratios that use the *fossil fuel equivalency* approach. As shown in the table above, this currently does not capture the displacement of fossil fuel caused by increasing off-site renewable generation. The *captured energy* approach would continue to lower the site-to-source ratio as renewable generation increases.[14]

  EPA's ENERGY STAR Portfolio Manager® calculates on-site renewable generation source energy using the *captured energy* approach.[15] Using the *captured energy* methodology for off-site renewable generation to calculate site-to-source ratios for electricity would treat renewable generation consistently between on-site and off-site generation while still accounting for transmission and distribution losses. EPA has indicated that they plan to transition to the *captured energy* approach for off-site renewable generation in their next update. As indicated above, this will lower a building's total source energy consumption from grid electricity and this impact would increase in magnitude as RE generation increases.

- **EIA Products (Annual Energy Outlook and Monthly Energy Review):** Both of these EIA products employ the *fossil fuel equivalency* approach for reporting historical data and for projecting total source energy into the future, and in all associated products such as the annual energy flow diagram. Use of *captured energy* would show RE generation as a smaller portion of total source energy used in the economy, and would also reduce the reported conversion losses, showing the energy system to be more efficient (i.e. with less losses) as RE penetration increases.

  For projections, the reported total economy-wide source energy consumption is smaller when *captured energy* is used (see Table 1). If not appropriately attributed to fuel-switching, it may appear that the reduction in economy-wide source energy is due to energy efficiency improvements instead of increased RE generation.

  As noted previously, *Monthly Energy Review* will begin reporting both *fossil fuel equivalency* and *captured energy* source energy of RE in future editions.

Additional Impacts and Concerns

- **Stakeholder Confusion:** If the *captured energy* approach replaces *fossil fuel equivalency* in EERE products and metrics then external stakeholders may not fully understand that there are different methodologies behind a metric with the same name, such as site-to-source ratios.

- **Disconnect with Historical Data:** users of products that include a historical series of data and metrics that are impacted by a change in methodology may be burdened when comparing data between before and after the methodology change.

- **Incorrect Impression of Accuracy:** a switch of methodologies may imply that the *captured energy* methodology is more technically accurate than the *fossil fuel equivalency* methodology, whereas, as discussed in the "Technical Considerations" section, the answer is more nuanced.

- **Reduced Perception of Renewable Penetration:** The percentage of source energy for the entire economy provided by renewables is significantly reduced when using *captured energy*, and gives the impression that renewables are not as significant compared to other energy sources. However, reporting of actual electricity generation of renewable sources would be unchanged.

14 U.S. Environmental Protection Agency, "Energy Star Portfolio Manager Technical Reference – Source Energy." July 2013. Available at: http://go.usa.gov/xjwwT

15 U.S. Environmental Protection Agency, "Portfolio Manager and Green Power Tracking." Accessed July 2016. Available at: http://go.usa.gov/xjwfw

Request for Information Response Summary

In response to the request for information (RFI) on this topic,[16] EERE received 7 submissions representing 10 organizations. Responders who agreed to have responses made public were a mixture of electric and natural gas utilities, industry associations, and non-profit organizations (NRDC, NRECA, EEI, APPA, Southern Company, GTI, NPGA, APGA, Laclede Group).[17]

Support of "*captured energy*" methodology: Five responders (NRDC, NRECA, EEI, APPA, Southern Company) fully supported the methodological change of replacing the *fossil fuel equivalency* with the *captured energy* methodology. They noted the changes are needed as the current approach discounts the value of zero emitting renewable resources, and as a result on-site combustion of fossil fuels is valued over off-site generation of renewable resources. They also note that the *fossil fuel equivalency* approach runs counter to DOE energy conservation goals.

Opposition of "*captured energy*" methodology: Two responders (NPGA, Laclede) opposed the methodological change of replacing *fossil fuel equivalency* with *captured energy* methodology. They noted that "*captured energy*" approach does not capture upstream and downstream losses and does not yield an equitable comparison between generation technologies, although this appears to be a misunderstanding of how the change would affect energy accounting for losses.

Neutral comment in support of matching methodology to policy goals: Two responders (GTI, APGA) while neither explicitly supporting or opposing the proposed approach, highlighted the importance of matching the methodology choice with the desired goals or outcomes in order to avoid inappropriately using metrics or leading to perverse incentives. Commenters expressed concern that the proposed approach could be used to promote further electrification.

These commenters noted that the choice used to estimate energy savings from an efficiency measure nationally for accounting purposes would differ from one used to determine the impacts of an energy efficiency measure for a specific building in a specific location for the purposes of making investment decisions. They asserted that the marginal generator displacement methodology is more appropriate for the latter situation. It is noted that the marginal generation displacement methodology is currently used by the appliance standard program when reporting impact assessments.

In addition, four responders (NRDC, NRECA, EEI, APPA) proposed publishing and/or using a fossil-fuel site-source ratio which only includes the source energy from fossil fuel generation, to better match the policy aims of reducing fossil fuel use and greenhouse gas emissions. This would essentially assign no source energy to non-combustible renewable and nuclear energy generation (i.e. 0 BTU/kWh).

Marginal generation emissions factors are most appropriate for individual decisions: Commenters stressed the importance of using regional and marginal emissions factors when determining the impact of specific energy efficiency measures on air pollution. Some also noted that if the *captured energy* approach is used, the marginal factor would underestimate the impact of specific energy efficiency measures on fossil fuel displacement as RE generation is generally not the marginal generator displaced.

Transparency and robustness for values used and calculated and clarity in definitions: Commenters requested that DOE consider creating an annually updated publication which shows all the inputs and calculations used for calculating a site-to-source ratio. (NRDC, NRECA, EEI, APPA) Additional commenters encouraged further transparency and cooperation between DOE and EPA for updating the eGrid regional marginal emission factors. (GTI, APGA)

Support for using full-fuel cycle metrics: Commenters noted that using a full-fuel cycle metric for comparison between fuels is the most equitable methodology, and that the site-to-source ratio only considers source energy consumed at the site of generation and does not account for the embedded "upstream" energy required for mining, processing, and transportation of the fuels in the fuels consumed at the generator. (GTI, APGA, NPGA, Laclede)

16 "Request for Information: Accounting Conventions for Non-Combustible Renewable Energy Use," 81 Federal Register 30, Feb. 15, 2016, pp 7778 – 7779. Available at: http://go.usa.gov/xjw7z

17 Comments available at: http://go.usa.gov/xjwAW

Guidelines on Methodology Choice

As many of the RFI responses noted, it is important to match the methodological choice with the goals of a given policy or metric. After reviewing the impacts of the methodological choices and examining the distorting effect of the *fossil fuel equivalency* methodology in various calculations, the following guiding principles were developed to indicate where it is appropriate to use the *captured energy* methodology.

As noted previously, these guidelines do not address any other aspects regarding source energy or site-to-source ratios (e.g. calculating a site-to-source ratio, marginal versus average site-to-source ratios, accounting for source energy from nuclear and combustible renewable generation, regional versus national accounting, on-site renewable electricity accounting)

1. **Using the *captured energy* methodology when calculating marginal or average site-to-source ratios to calculate source energy savings avoids the fictitious source energy savings and consumption arising from the *fossil fuel equivalency* methodology.** Even though switching to the *captured energy* approach would lower the total amount of projected savings from energy efficiency actions when using the marginal site-to-source ratio, it would be a more accurate assessment of savings and would avoid larger magnitude distortions in the future as RE generation increases both in reality and in modeled projections.

2. **Using the *captured energy* methodology when using site-to-source ratios to score the energy use of buildings provides a policy-consistent signal to building managers that electricity use consumes less source energy as RE generation increases.** This allows more equitable comparisons that better reflect the losses to the energy system associated with different fuel types, including on-site renewables.

3. **Use of the *captured energy* methodology allows increased RE generation to affect derived metrics such as energy productivity.** This approach would allow fuel switching to non-combustible renewable generation to be reflected in metrics such as energy productivity more similarly to fuel switching from coal to natural gas, and better aligned with the economic energy losses of these fuels.

4. **Use of the *captured energy* methodology for off-site renewable electricity generation allows for consistent treatment of conversion to source energy.** For methodologies that account for the source energy of on-site renewable energy production and consumption (i.e. on-site renewable energy is 3,412 BTU/kWh and not 0 BTU/kWh), *captured energy* maintains consistency between the conversion to source energy for on-site and off-site renewable generation.

18 As noted in the *Zero Energy Buildings Definition,* exported on-site RE generation can converted to source energy as if it were grid provided electricity to properly balance out the displaced source energy consumption.

19 See above footnote.

Appendix A: Example Site-to-Source Calculation for 2015

	Generation (GWh)[a]	Conversion (BTU/kWh)[c]		Source Energy (Quads)[d]	
Fossil Fuels					
Coal	1,356,057	10,428		14.14	
Petroleum	28,443	10,814		0.31	
Natural Gas	1,335,068	7,907		10.40	
Other Gases	12,963	—		0.10[e]	
Other Non-Fossil					
Nuclear	797,178	10,459		8.34	
Other	13,239[b]	—		0.19[e]	
Combustible RE					
Wood	42,358	—		0.42[e]	
Waste	21,833	—		0.30[e]	
Non-Combustible RE		**Fossil Fuel Equivalency**	**Captured Energy**	**Fossil Fuel Equivalency**	**Captured Energy**
Hydropower	251,168	9,510	3,412	2.39	0.86
Wind	190,927	9,510	3,412	0.16	0.06
Solar	26,473	9,510	3,412	1.82	0.65
Geothermal	16,767	9,510	3,412	0.25	0.09
			Total Source:	**38.82**	**35.86**

Net Generation of Electricity	4,087,381[f]	3,412	13.95
T&D Losses & Unaccounted	290,564[f]	3,412	0.99
		Total Domestic Generation for End Use:	**12.95**

	Fossil Fuel Equivalency	**Captured Energy**
Site to Source Ratio:	**3.00**	**2.77**

Data Sources:

a *EIA Monthly Energy Review* (MER) Table 7.2a; b *EIA Electric Power Monthly* Table 1.1; c EIA MER Table A6; d Calculated unless otherwise noted; e EIA MER Table 7.3a; f EIA MER Table 7.1; Note that this methodology includes generation from all sectors, and excludes fuel consumption used for useful heat output at CHP facilities. This table is presented as an illustrative example only.

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DOE/EE-1488 • October 2016