DOCKETED

Docket Number:	17-IEPR-06
Project Title:	Doubling Energy Efficiency Savings
TN #:	216044
Document Title:	Comments of the Natural Resources Defense Council (NRDC) on the 2017 Integrated Energy Policy Report (IEPR) Workshop
Description:	Workshop is on the 2030 Energy Efficiency Targets
Filer:	System
Organization:	Natural Resources Defense Council
Submitter Role:	Public
Submission Date:	2/15/2017 1:08:29 PM
Docketed Date:	2/15/2017

Comment Received From: Mohit Chhabra
Submitted On: 2/15/2017
Docket Number: 17-IEPR-06

Comments of the Natural Resources Defense Council (NRDC) on the 2017 Integrated Energy Policy Report (IEPR) Workshop on 2030 Energy Efficiency Targets Docket Number 17-IEPR-06 January 23, 2017

Additional submitted attachment is included below.

Comments of the Natural Resources Defense Council (NRDC) on the
2017 Integrated Energy Policy Report (IEPR)
Workshop on 2030 Energy Efficiency Targets
Docket Number 17-IEPR-06
January 23, 2017
Submitted by: Mohit Chhabra, Pierre Delforge, and Lara Ettenson
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I. Introduction and Summary

The Natural Resources Defense Council (NRDC) appreciates the opportunity to offer these comments on the 2017 IEPR Workshop on 2030 Energy Efficiency Targets on January 23, 2017. NRDC is a non-profit membership organization with more than 70,000 California members who have an interest in receiving affordable energy services while reducing the environmental impact of California's energy consumption.

II. Discussion

NRDC greatly appreciates the effort of the Energy Commission staff to establish a thorough and transparent process to develop SB 350 compliant energy efficiency savings targets. NRDC's comments and recommendations are summarized as follows:

- SB 350's targets of doubling energy efficiency should be interpreted as the doubling of cumulative savings forecast for Mid-Additional Achievable Energy Efficiency (AAEE) through 2030 (i.e., doubling the area under the current AAEE forecast).
- Cost-effective energy savings potential to develop SB 350 compliant savings targets (as cumulative savings achieved through 2030) is available in the near-term; long-term uncertainty should not impact how SB 350 is interpreted and limit near-term savings targets.
- NRDC recommends allowing flexibility between gas and electric savings, using a source energy metric that accounts for the state's marginal generation mix. Flexibility between natural gas and electricity savings will maximize cost-effective energy savings and greenhouse gas (GHG) reduction, increasing the likelihood that SB 350's doubling energy savings goal can be achieved cost-effectively.
- NRDC recommends that the California Energy Commission (CEC) expand the current Assembly Bill 758 proposal to establish a collaborative group to also include overseeing the implementation of SB 350 targets.
- NRDC urges the CEC to publish the complete Publicly Owned Utilities (POU) potential study to determine if the proposed goals are aligned with SB 350.

A. **NRDC recommends that the SB 350 energy efficiency savings target be interpreted as doubling of the cumulative savings *through* 2030, not *in* 2030, per the intent of the law.**

SB 350 states that the CEC should establish savings targets to achieve a cumulative doubling of statewide, economy-wide energy efficiency by 2030.[1] The CEC, in their recently developed staff paper,[2] defines complying with SB 350's energy efficiency savings goal as the doubling of AAEE cumulative savings estimate *in* 2030 *only*. This is problematic as SB 350 states that the cumulative energy savings targets should be based on a doubling of the AAEE savings estimates from 2015 to 2025 (extended to 2030 using an annual growth rate) and not solely on doubling of final year cumulative savings estimate. NRDC supports flexibility in how the overall savings are achieved (e.g., there may be more than doubling of the area under the forecast in some years and less than doubling in others) as long as the cumulative savings targets through 2030 - as described above - are met.

Moreover, climate impact mitigation is the primary objective of SB 350. Climate impacts are driven by cumulative emissions, not by emissions in any one year, and therefore SB 350 compliant savings targets should maximize cumulative emission reduction by setting energy efficiency savings targets per NRDC's recommendation.

SB 350's intended doubling goal of the cumulative savings identified by the AAEE scenario *through* 2030 can be visualized as doubling the area under the curve of the current mid-case AAEE scenario. Setting the energy savings targets as the CEC proposes (doubling AAEE cumulative savings estimate *in* 2030 only) may leave significant savings - approximately 205,000 GWh and the resulting GHG emission reductions - on the table (green area in Figure 1). Figure 1 illustrates one possible implication of the current CEC interpretation of SB 350.

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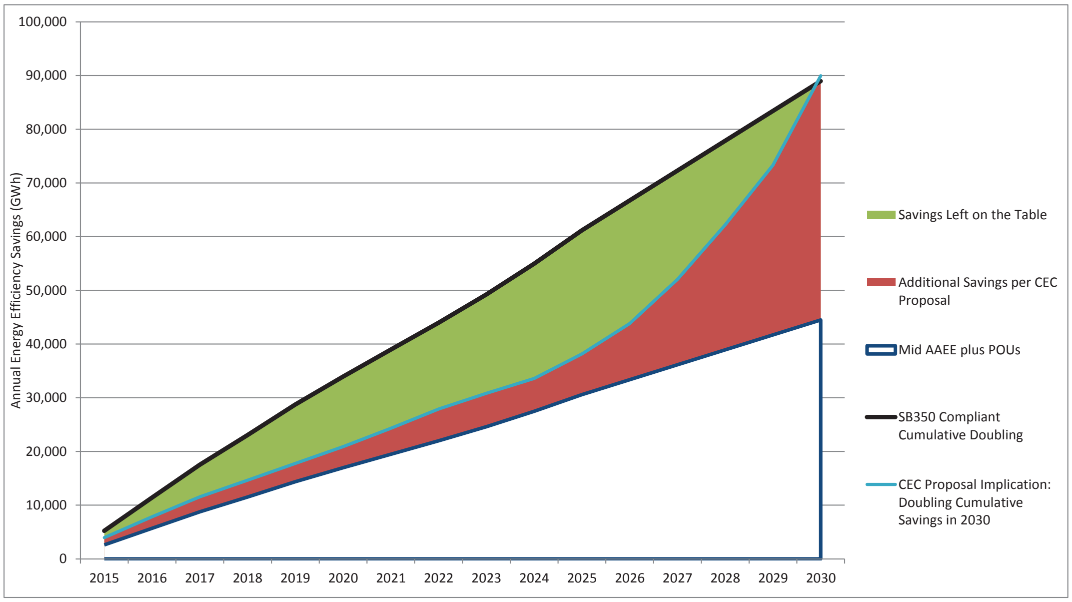
[1] Senate Bill 350: Cal. Public Resources Code § 25310(c)(1) : "*[The commission] . . . shall establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030. The commission shall base the targets on a doubling of the mid-case estimate of additional achievable energy efficiency savings, as contained in the California Energy Demand Updated Forecast, 2015-2025, adopted by the commission, extended to 2030 using an average annual growth rate, and the targets adopted by local publicly owned electric utilities pursuant to Section 9505 of the Public Utilities Code, extended to 2030 using an average annual growth rate, to the extent doing so is cost-effective, feasible, and will not adversely impact public health and safety*"

[2] *"…"cumulative" energy efficiency savings to mean the cumulative savings realized in 2030…*" Framework for establishing the Senate Bill 350 Energy Efficiency Savings Doubling Targets: California Energy Commission, January 2017.

Figure 1. Possible Implication of the CEC's Interpretation of SB 350[3]



The CEC interpretation does not take into account all the cumulative energy savings that should be realized between 2015 and 2025 (and extended to 2030) as the law states. To comply with the law the CEC should set savings targets as doubling of the cumulative AAEE savings *through* 2030.

Finally, NRDC agrees with the CEC that energy savings targets be set in commonly-used units for each fuel (i.e., kilowatt-hours for electricity and therms for natural gas). Once fuel targets are set, flexibility between fuel targets will be important as energy savings potential studies are updated, a more refined view of energy savings potential is developed, and the potential for beneficial fuel-substitution develops.

B. **Cost-effective potential to develop SB 350 compliant savings target is available in the near-term; uncertainty about long-term potential should not limit near-term targets.**

NRDC recognizes that the CEC is bound by the law to ensure targets are "*cost-effective and feasible.*" However, NRDC does not agree with CEC's approach to determine savings targets because of the law's intent and also since there are numerous policy changes already in the works to unlock additional savings in the near, mid, and long-term. The latest potential study

[3] This figure is approximate and illustrative has been created with approximate data and does not represent the exact definition of savings targets that the CEC may propose. However this figure gives an indication of the magnitude of savings that could be left on the table (205k GWh) if SB 350's targets are not interpreted appropriately.

shows more than a tripling of economic efficiency opportunity, implying that there are market and policy barriers that inhibit availability of savings, not that there is a lack of potential.

The final 2015 CPUC Potential Goals and Targets study estimated cumulative Mid-AAEE savings in 2017 to be 10,000 GWh whereas the available cost-effective (economic potential) savings were estimated to be approximately 35,000 GWh[4] in 2017. This does not include the potential savings available in POUs' service territory. Concerns that the CEC may have of long-term availability of cost-effective achievable energy savings potential should not limit what can be achieved in the short-term.

NRDC supports reassessing goals over the years to ensure they are in line with the economic potential but disagrees that initial target setting should be limited from the onset.[5] This strategy allows for compliance with SB 350 and is aligned with the spirit of the bill, which is to set ambitious targets to drive reforms that remove barriers to maximizing cost-effective energy savings without letting uncertainty regarding future cost-effectiveness limit energy savings and resulting GHG reductions.

C. NRDC recommends allowing flexibility between gas and electric savings, using a source energy metric that accounts for the state's marginal generation mix

Staff's white paper proposes to aggregate gas and electric savings using the site energy conversion method. While having the merit of simplicity, this method also has potential negative consequences of increasing GHG emissions versus establishing separate targets. It also does not value the primary energy used to generate and deliver electricity on site. NRDC recommends a California-specific source energy metric that accounts for renewable generation resources that will be built or avoided depending on electricity savings.

Flexibility between electricity and gas savings targets allows the most cost-effective savings to be prioritized, and if structured appropriately can allow for greater GHG emissions reductions and energy and cost savings than fixed separate targets. Flexibility also helps deal with uncertainty of future energy costs and future energy efficiency opportunities. Aggregation

[4] Figure ES-1 "Statewide Technical, Economic, and Cumulative Potential". "*Energy Efficiency Potential Goals and Targets Study for 2015 and Beyond- Stage 1 Final Report"* Prepared for the CPUC by Navigant Consulting (September, 2015)

[5] Long term cost-effective energy savings potential estimates are uncertain as (1) key cost-effective parameters get increasingly uncertain the further-out we try and estimate them, and (2) there is significant uncertainty in our estimate of long-term energy consumption trends.

in this context means the method for converting between gas and electric savings, to enable summing of, and flexibility between, individual fuel savings to meet an overall savings goal.

In the attached paper (see Appendix A), NRDC examined four different methods of aggregation: Site Energy, Source Energy Carbon Content ("Carbon Content" hereafter), Source Energy Captured ("Captured" hereafter),[6] and Time Dependent Valuation (TDV).[7] Fundamentally, these different aggregation methods differ in how an additional unit of savings of one fuel changes the savings target of the other fuel. *NRDC recommends using the Captured method of aggregating electricity and gas savings* or a similar method. This method allows for optimizing GHG emission reductions, cost-effective energy savings, while still valuing energy efficiency in an increasingly clean energy grid.

NRDC further recommends conducting Captured aggregation based on California-specific site-to-source energy conversion metrics that account for renewable generation resources that will be built or avoided in the long run as a result of future electricity savings (the "build margin"). The Carbon Content metric also meets some of these GHG and energy savings optimization objectives, but falls short of the Captured method as it does not value energy efficiency in a clean energy grid. NRDC advocates against Site Energy, TDV, and Source Energy based on 100 percent fossil fuel generation, as these methods would result in higher GHG emissions and may lock in higher carbon building and appliance investments as compared to Captured or Carbon Content Methods.

D. **NRDC urges the CEC to publish the complete POU potential study to determine if the proposed goals are aligned with SB 350.**

While we appreciate having an opportunity to review the final goals produced by the Navigant potential study for POUs, we request the assumptions, and methodology used to develop those goals be publicly available as well. Without reviewing the study's inputs, assumptions, and methodology, the CEC and stakeholders cannot provide adequate feedback on the study and thus determine whether the goals are reasonable.

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[6] As defined by U.S. DOE in their Oct. 2016 "Accounting Methodology for Source Energy of Non-Combustible Renewable Electricity Generation", https://www.energy.gov/eere/analysis/downloads/accounting-methodology-source-energy-non-combustible-renewable-electricity.

[7] While not examined specifically, and based on different principles, a Source Energy metric with all generation coming from fossil resources has a similar source-to-site ratio as TDV and can be interchanged in the context of this analysis.

E. **NRDC recommends that the CEC expand the current Assembly Bill 758 proposal to establish a collaborative group to also include overseeing the implementation of SB 350 targets.**

NRDC strongly recommends establishing an AB 758[8] collaborative group to ensure statewide consistency, cooperative stakeholder engagement to resolve challenges, and leveraging relevant expertise to enable programs to save (substantial) energy while adequately serving customer needs. NRDC further recommends that this group also oversee the implementation of SB 350's doubling goal since the two efforts are related.

In developing such a forum, it is important that the state (1) follow best practices employed by well-functioning forums, and (2) learn from and specifically address the shortcomings of previous such efforts in California and other states.[9] NRDC proposed a forum structure based on these considerations in our report "California's Golden Energy Efficiency Opportunity: Ramping Up Success to Save Billions and Meet Climate Goals," August 2015.[10]

> "This committee would be responsible for implementing the leadership's guidance, including prioritization of programmatic and technical matters. The committee would also assess which existing groups could be leveraged, whether new subcommittees are needed, and if these forums should be used on an ongoing basis (e.g., sector-specific subgroups to help ensure program effectiveness and vet program changes) or for a limited time to resolve a particular issue (e.g., to propose cost-effectiveness methodology updates for consideration by the energy agencies)."[11] (Figure 2)

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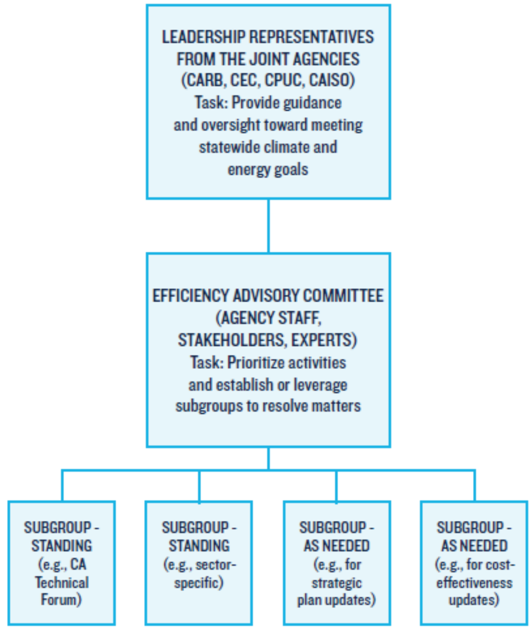
[8] http://www.energy.ca.gov/ab758/

[9] California Technical Forum, Memorandum re: Energy Efficiency Stakeholder Research, May 1, 2014. https://static1.squarespace.com/static/53c96e16e4b003bdba4f4fee/t/54a32e0fe4b034981b42d8c9/1419980303421/Stakeholder+Group+Research+Memorandum.pdf

[10] NRDC, August 2015: https://www.nrdc.org/sites/default/files/ca-energy-efficiency-opportunity-report.pdf

[11] NRDC. "California's Golden Energy Efficiency Opportunity: Ramping Up Success to Save Billions and Meet Climate Goals," August 2015, p.31. https://www.nrdc.org/sites/default/files/ca-energy-efficiency-opportunity-report.pdf

Figure 2. Concept for a Statewide Efficiency Collaborative Forum



This proposed structure builds on the existing Energy Principles forum[12] to prioritize and resolve key issues that inhibit scaling up of energy efficiency efforts.

III. Conclusion

Thank you for your commitment to energy efficiency and for the opportunity to comment on the 2017 IEPR Workshop on 2030 Energy Efficiency Targets. We look forward to working with the CEC staff and stakeholders on the 2017 IEPR and the energy efficiency targets. It is critical to the success of SB 350's doubling of energy efficiency savings goal to set up the right framework, in order to drive the right outcomes regarding energy, GHGs, and costs.

[12] http://energyforum.ca/shared-principles/

APPENDIX A: AGGREGATION OF GAS AND ELECTRICITY SAVINGS TO ACHIEVE THE SB 350 DOUBLING OF ENERGY EFFICIENCY SAVINGS GOAL

IMRAN SHEIKH, PIERRE DELFORGE, NRDC

February 13, 2017

EXECUTIVE SUMMARY

This paper investigates different methods to "aggregate" electricity and natural gas efficiency savings to meet the doubling energy efficiency goal set by SB 350. Aggregation in this context means the summing of individual fuel savings to meet an overall savings goal. The aggregation methods that this paper examines are Site Energy, Source Energy Carbon Content ("Carbon Content" hereafter), Source Captured Energy ("Captured" hereafter),[1] and Time Dependent Valuation (TDV)[2]. Fundamentally, different aggregation methods differ in how an additional unit of savings of one energy type changes the savings target of the other type.

Aggregation is important because it allows for **flexibility between electricity and gas savings targets** so that the most cost effective savings can be prioritized, and if structured appropriately can allow for greater GHG emissions reductions, and energy and cost savings than fixed separate targets. Flexibility also helps deal with uncertainty of future energy costs and future energy efficiency opportunities.

At one extreme, Site Energy allows much more electricity use as additional natural gas is saved. At the other extreme, TDV allows for much more gas use as additional electricity is saved. Aggregation based on Site Energy may lead to larger gas savings and TDV may lead to larger electricity savings, than were separate and non-tradable gas and electricity targets, because both approaches reduce the target for one fuel by a large amount in exchange for small additional savings of the other fuel. Saving additional gas with Site Energy or additional electricity with TDV makes the overall doubling goal easier to meet because they would significantly reduce the savings target for electricity and gas respectively. Therefore, Site Energy and TDV would most likely lead to ***higher emissions*** than using the methods of Carbon Content or Captured Energy because the much lower savings target (for electricity with Site Energy or gas with TDV) would lead to higher net emissions.

NRDC recommends aggregation based on a California-specific source energy metric that accounts for renewable generation resources that will built or avoided in the long run as a result of future electricity savings ("build margin"). The Carbon Content and Captured metrics are two such options. We recommend a California-specific variant of DOE's Captured Source Energy metric, because it account for GHGs and values efficiency even when electricity is generated mostly from renewables.

NRDC advocates against Site and TDV (or 100% Fossil Source Energy), which would likely result in higher GHG emissions and lock in higher carbon building and appliance investments.

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[1] As defined by U.S. DOE in their Oct. 2016 "Accounting Methodology for Source Energy of Non-Combustible Renewable Electricity Generation", https://www.energy.gov/eere/analysis/downloads/accounting-methodology-source-energy-non-combustible-renewable-electricity.

[2] While not examined specifically, and based on different principles, a Source Energy metric with all generation coming from fossil resources has a similar source-to-site ratio as TDV and can be interchanged in the context of this analysis.

INTRODUCTION

SB 350 sets a target of doubling the end-use energy savings from energy efficiency by 2030. This target doubles the savings from the mid-case estimate of "additional achievable energy efficiency" savings[3]. These savings may come from measures or conservation activities that impact gas or electricity use. SB 350 also states that "the commission [CEC] may establish targets… that aggregate energy efficiency savings from both electricity and natural gas final end uses" and that the CEC shall "adopt a methodology for aggregating electricity and natural gas final end-use energy efficiency savings." SB 350 provides that the targets should be adopted "to the extent doing so is cost effective, feasible, and will not adversely impact public health and safety."

The purpose of this document is to describe four approaches that could be used to perform aggregation of electricity and natural gas savings, and show how different methods could impact energy savings, emissions, and costs. Projections of energy use with this doubling goal are shown below for electricity (left) and natural gas (right). Note that savings coming from electricity are proportionally greater than those that come from natural gas (26 percent vs. 11 percent)

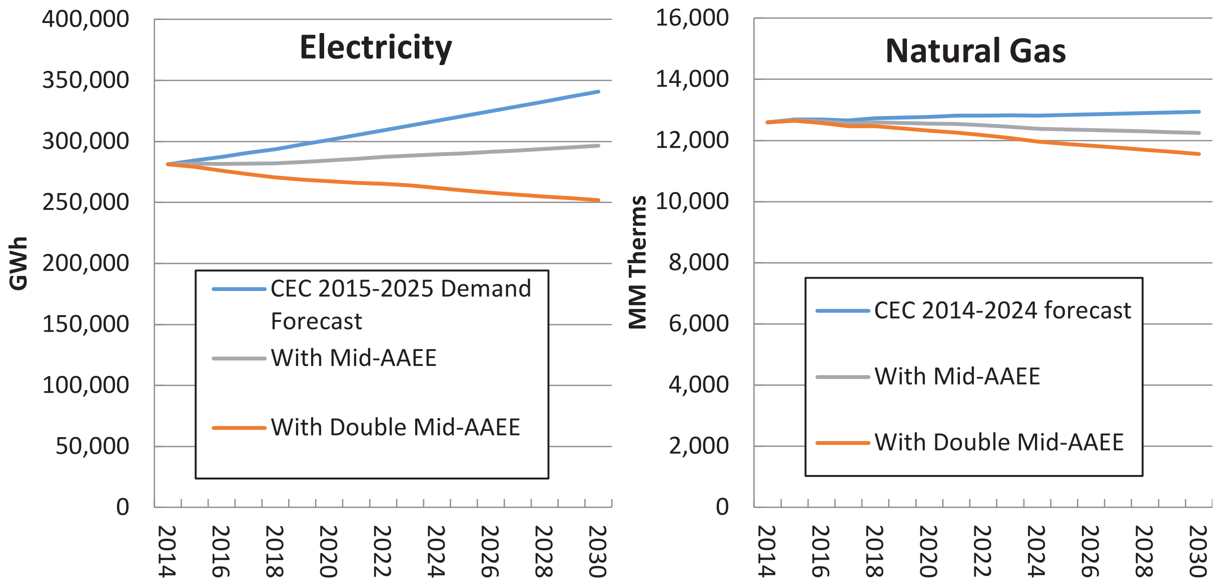

FIGURE 1. ELECTRICITY AND NATURAL GAS FORECASTS UNDER SB 350

[3] Additional achievable energy efficiency are those savings identified in the Potential and Goals study that are possible above those that are included in the demand forecast.

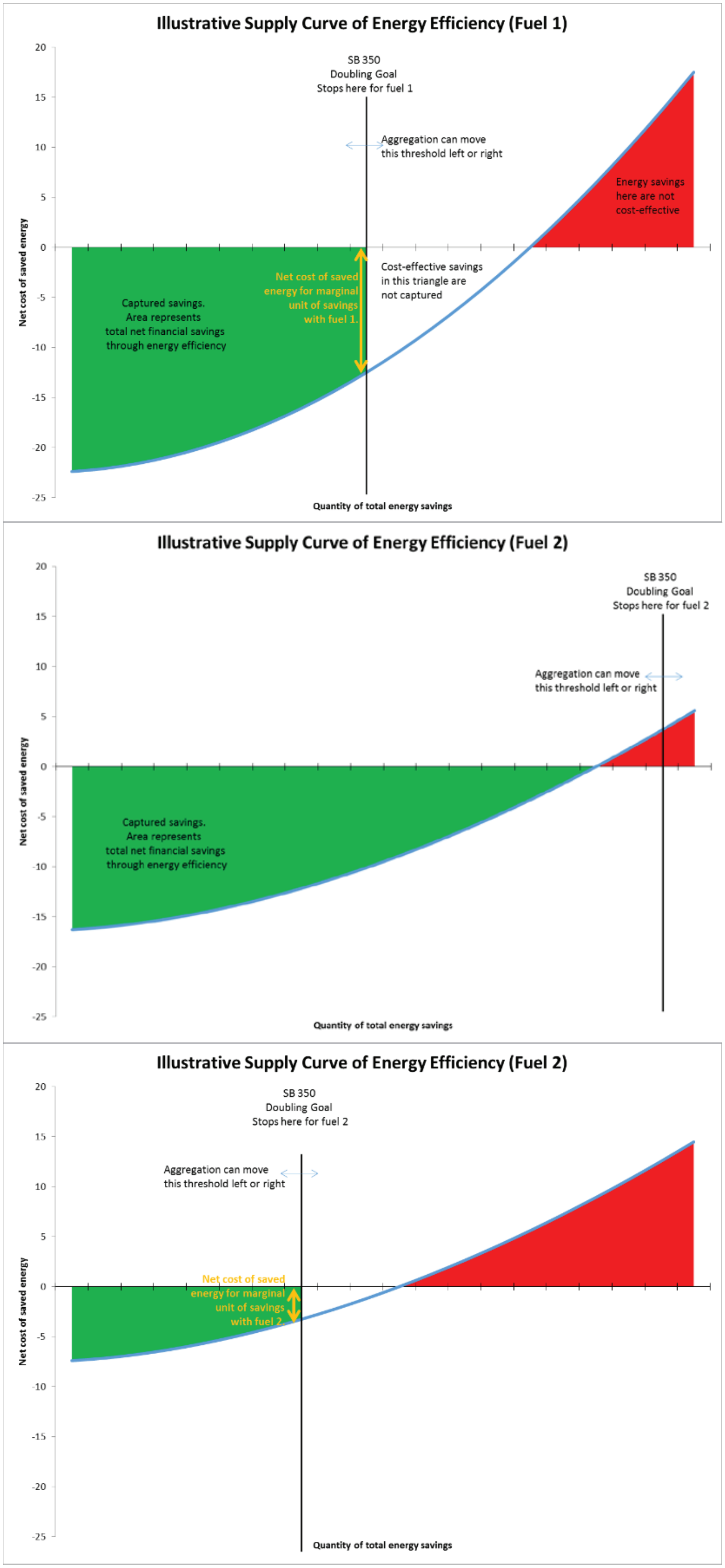

FIGURE 2. ILLUSTRATIVE SUPPLY CURVES OF ENERGY EFFICIENCY FOR 3 SCENARIOS

WHY AGGREGATION IS IMPORTANT

Given that efficiency savings from some fuels may be more cost-effective in some situations than others, and that fuel substitution may occur and be beneficial to meeting climate targets between now and 2030, a method of aggregation is important to develop. Allowing for the flexibility of meeting targets with electricity or natural gas will make it easier to achieve the doubling goal—and may lead to greater system-wide energy, emissions, and cost savings.

There are three fundamental reasons why it is important to allow aggregation of savings between different types of end uses. First, it allows **prioritizing the most cost-effective savings**. Consider the three figures on the left which show three hypothetical supply curves of energy efficiency savings. Costs are shown as net costs; negative values represent net savings (the cost of efficiency measures is lower than the cost of energy). The vertical line shows a hypothetical example of a savings target. The green area represents the total economic savings from efficiency measures that save the given fuel type. The top figure shows that the savings target does not capture all cost-effective efficiency measures. The height of the green area at the savings target (shown in orange) represents the net cost of saving the last unit of energy when the savings target is met.

Now consider a case where the savings target was set higher than the total cost effective potential savings as is illustrated in the middle plot. This highlights the second important reason why aggregation is important: it allows for **greater total energy and cost savings**. In this case, the savings target for Fuel 2 should be set lower and the target for Fuel 1 should be set higher.

Now consider an alternate supply curve of savings of Fuel 2 shown in the bottom figure. While some cost-effective savings also remain for this fuel, the savings from the final unit are smaller for Fuel 2 than Fuel 1. In this case, setting the target higher for Fuel 1 and lower for Fuel 2 would have resulted in a greater net benefit.

The final reason why aggregation is important is because there is **uncertainty about the relative cost effectiveness of efficiency savings between electricity and natural gas**. This is both because the cost of efficiency measures in the future is unknown and because the future cost of energy of the two fuels is unknown. Both factors contribute to the net cost of energy savings. Aggregation allows one to deal with this uncertainty by saving more of the fuel that is more cost effective to save. It delays the decision about how to prioritize savings.

Aggregation using any method can provide the benefits explained here, but the specific method used will have impacts on the total amount of energy saved, GHG emitted, and dollars saved. The aggregation methods differ in how they trade off the savings targets of each fuel. If the target for one fuel shifts to the left by one unit, the target for the other fuel will shift to the right by a number of units that depend on the aggregation method. The economic optimum would occur when the additional savings captured from increasing the threshold for one energy type equaled the loss of savings from decreasing the target of the other energy type. This concept is shown in Figure 3.

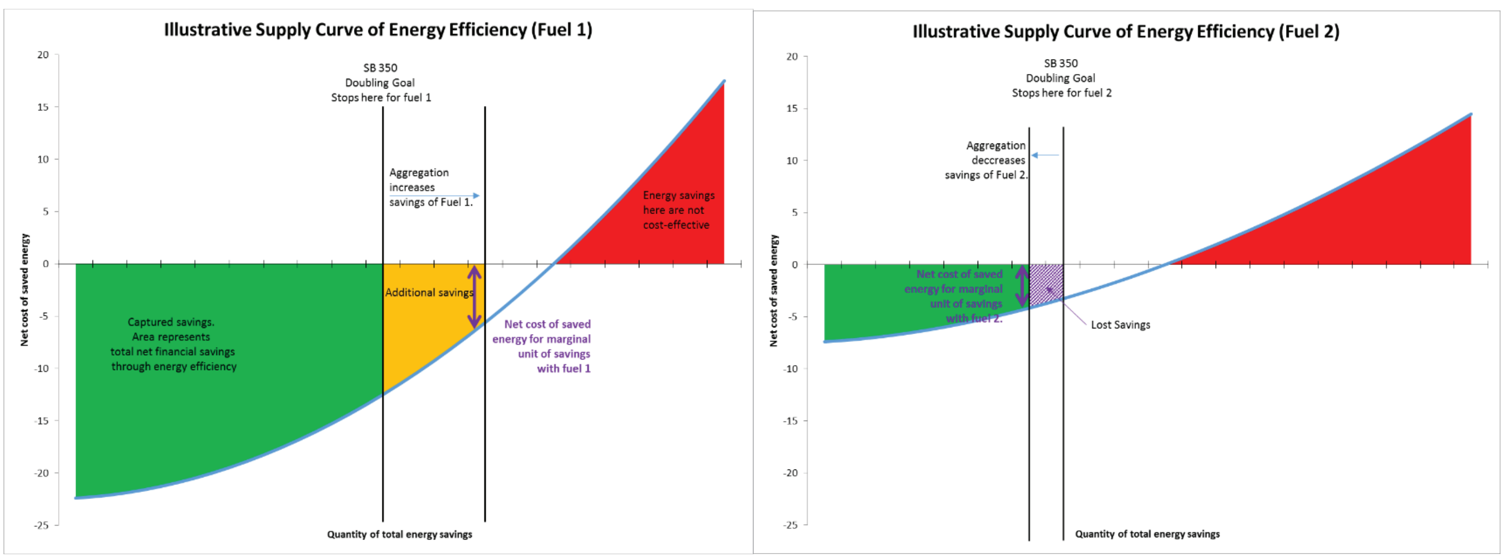

FIGURE 3. THE SAVINGS TARGET OF FUEL 1 WILL REDUCE UNTIL THE NET SAVINGS LOST FROM A MARGINAL REDUCTION EQUAL THE ADDITIONAL NET SAVINGS FROM X-UNITS OF SAVED ENERGY, WHERE X IS DEFINED BY THE AGGREGATION METHOD. THE YELLOW BOX REPRESENTS ADDITIONAL NET SAVINGS THAT COME FROM INCREASING THE SAVINGS TARGET OF FUEL 1. THE PURPLE SHADED BOX REPRESENTS LOST SAVINGS FROM REDUCING THE SAVINGS TARGET OF FUEL 2. OVERALL, THE YELLOW AREA IS LARGER THAN THE PURPLE AREA, LEADING TO NET SAVINGS FROM AGGREGATION.

A different optimum would exist, depending on which aggregation method is used—but given that the supply curves of energy efficiency savings are unknown, we cannot know which aggregation method would result in the largest savings. We also do not know if the savings target for one or both fuels is set above the cost-effective limit, like in the middle chart in Figure 2. To select an aggregation method, we need to think about what metrics are important to us, how important certainty is in various metrics, and how utilities and state agencies may respond to the different methods.

AGGREGATION METHODS

We examine four potential ways of aggregating efficiency savings: Site Energy, Carbon Content, Captured Energy, and Time Dependent Valuation. The aggregation methodology should be consistent with other actions being taken to meet long term climate goals and should avoid lock-in to a higher emissions pathway.

SITE ENERGY

Site electric and gas energy use can be summed using a common unit (one therm equals 29.3 kWh). This total site energy can then be reduced using a combination of electric and gas measures and/or fuel substitution. As electric heating equipment is usually more efficient than gas in site energy terms, this may encourage fuel substitution to meet site energy savings targets. Fuel substitution to resistance heating would be counted as energy efficiency if savings were aggregated using the Site Energy method. This may increase emissions because the emissions associated with 29.3 kWh of electrical energy may be higher than the emissions from burning one therm of natural gas, even when electricity is made up of 50% renewables in 2030.

Using Site Energy aggregation allows for much more electricity use when additional gas is saved. This additional allowable electricity use would have greater emissions, even when it comes from a 50% renewable build margin, as illustrated in Figure 4. For each additional therm saved, there would be 2.8 kg (net) of CO2 emitted because of the increased electricity use. Over time, this will be less of an issue as marginal generation resources get cleaner.

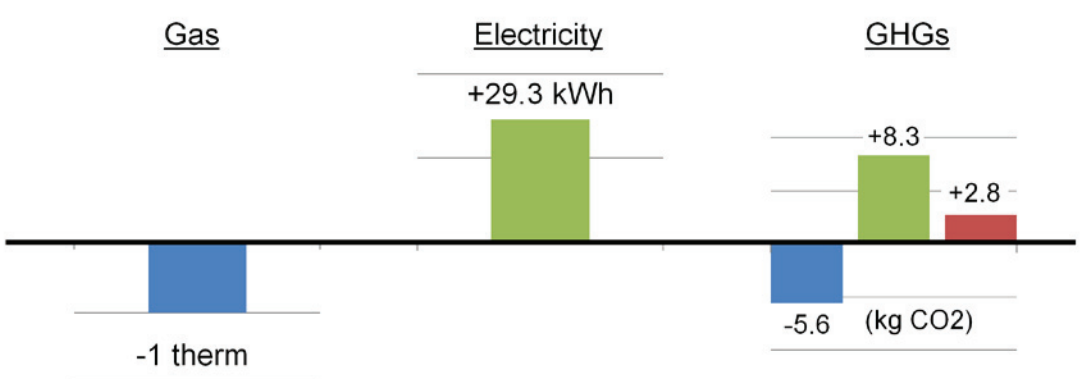

FIGURE 4. THE ADDITIONAL EMISSIONS FROM ALLOWED INCREASED ELECTRICITY USE ARE GREATER THAN THE EMISSION REDUCTION FROM SAVED NATURAL GAS WHEN SITE ENERGY AGGREGATION IS USED.

Carbon Content

Carbon Content aggregation would set a target for primary energy savings from fossil fuel sources entering the electricity and natural gas energy system. Because the SB 350 doubling goal is based on site energy savings, a site-to-source conversion would be required to create this aggregated target. The electricity site-to-source ratio historically used by DOE of 3.14[4] is not appropriate for California because it does not account for the renewable portfolio standard (RPS) and the relatively high efficiency and low carbon content of CA's non-RPS resources. A specific site-to-source ratio for California would have to be developed based on CA current policies. In the analysis presented here, we use a site-to-source ratio of 3.14 for generation that is not part of the RPS and **zero for the RPS component**. Therefore, as the RPS increases in future years, the site-to-source ratio decreases.

This assumes that, on the margin, changing demand by 10 units in 2030 would change fossil generation by 5 units. The long run or "build" marginal generation is more important to consider for this analysis than the short run or "operational" marginal generation, because the most relevant question is how fuel substitution would affect marginal capacity requirement (the build margin). Done right with appropriate control solutions and load-flexibility policies, electrification will require mostly additional off-peak capacity, with some limited additional peaking capacity. So the build margin may be relatively close to the RPS, but this requires further analysis.

With a higher site-to-source ratio, saving a unit of electricity would be relatively more valuable than saving a unit of gas. As a result, with a lower RPS (and therefore higher site-to-source ratio) electricity efficiency measures are encouraged more than they would be with a high RPS. In future years with a high RPS, gas energy efficiency savings would be encouraged more. Care would need to be taken to set this site-to-source conversion carefully. The natural gas and electricity site-to-source ratios could potentially be set in a way that also accounts for natural gas leakage. Doing so would mean that total aggregated efficiency savings would lead to the same GHG reduction, no matter if they came from saving electricity or saving gas. Using carbon content, any fuel substitution that leads to lower GHG emissions would be counted as energy efficiency.

Captured Energy

Captured energy aggregation is the same as Carbon Content aggregation, but treats energy generated from renewables essentially as site energy minus transmission and distribution losses, as proposed by DOE in their Oct. 2016 "Accounting Methodology for Source Energy of Non-Combustible Renewable Electricity Generation" report.[5] As a result, the site-to-source ratio using this method is higher than the ratio used with Source Energy Carbon Content. A higher site-to-source ratio would encourage greater electricity efficiency over gas efficiency relative to the Carbon Content method above. However, the captured energy methodology would lead to greater source energy savings than the Carbon Content method due to the higher site-to-source ratio. This method has been proposed by EIA/DOE, so there may be some benefit to following the same convention[6]. Some fuel substitution toward electricity would likely count as energy efficiency using the Captured Energy method, but less than with the Carbon

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4 https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

5 https://www.energy.gov/eere/analysis/downloads/accounting-methodology-source-energy-non-combustible-renewable-electricity

6 http://www.energy.gov/sites/prod/files/2016/10/f33/Source%20Energy%20Report%20-%20Final%20-%2010.21.16.pdf

Content method. Essentially, while the Carbon Content method focuses primarily on GHG emissions (energy is only counted if it has emissions associated with it), Captured Energy takes both energy and GHG emissions into account. Similar to the Carbon Content analysis, here we also assumed that the long run marginal generation would be 50% renewable in 2030.

Time Dependent Valuation

Another option for aggregation would be to use Time Dependent Valuation (TDV) as the metric. TDV aims to provide a basis for comparing electricity and gas use and savings for different hours of the year. Since the cost of providing energy varies across hours of the year, the use of TDV in Title 24 rewards efficiency measures that save more energy (electricity in particular) during peak hours. Aside from the hourly value of electricity, TDV also provides an equivalency between gas and electricity, based on the average retail rates of each fuel, projected over 15 and 30 years. It is this gas-electric equivalency which is the most relevant in this analysis.

Using TDV as an aggregation method would mean that the dollar value of gross energy savings would be constant, independent of if the savings come from electricity or gas. Note, this does not mean that the net dollar savings is the same (since this metric does not take into account the cost of efficiency measures), it only means the value of the fuel savings would remain unchanged. For example, if the gas savings target was exceeded and as a result an extra $1000 of gas (in TDV terms) was saved, this would allow for an extra $1000 to be spent on electricity (in TDV terms) while still meeting the total target. Since TDV is higher for electricity than natural gas on an energy basis, this metric would favor electricity savings relative to the other aggregation options. The TDV method may encourage fuel substitution *toward* natural gas.

While not explicitly modeled here, the TDV method yields similar results as a case where source energy was the aggregation metric with the assumption that all electricity generation came from fossil sources.

SUMMARY OF AGGREGATION METHODS

Each aggregation method keeps a different metric constant as savings are traded between energy types. The total savings of that metric are also equal to a separate targets case when both of the separate targets are met. To clarify, Site Energy aggregation keeps the total site energy savings constant, Carbon Content approximately keeps the total emissions constant, Captured Energy keeps the total captured energy constant, and TDV keeps the total dollar value of the gross energy savings constant—independent of which direction (gas to electricity, or vice versa) savings are traded.

While each method is based on a meaningful principle, in operation, we can think of each of these methods on a continuum. In Figure 5, we show what would happen as one additional therm is saved, above the separate targets case. Saving an additional therm allows for greater electricity use—and it allows for the greatest additional electricity use when the Site Energy aggregation method is used and the least when TDV is used. Referring to Figure 3, as the savings target for gas moves to the right by one therm, the savings target for electricity will move to the left by the number of kWh shown in Figure 5.

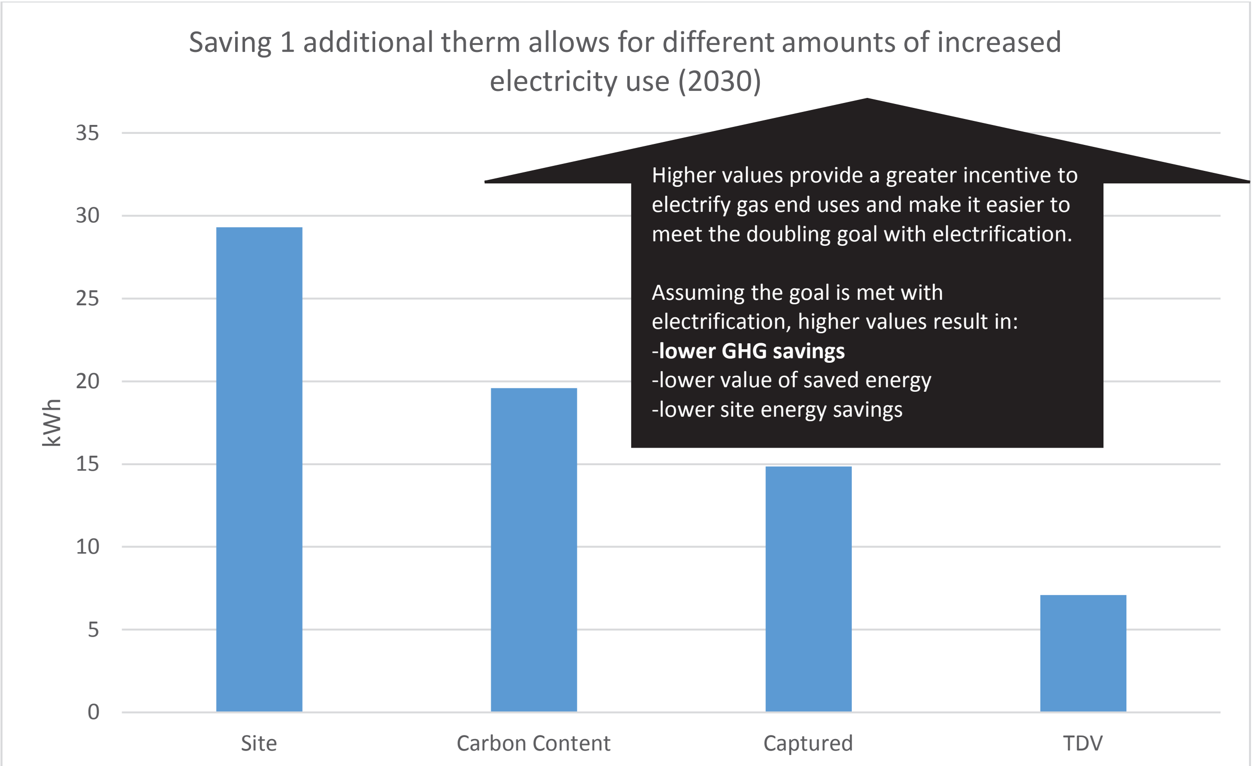

FIGURE 5. SAVING AN ADDITIONAL THERM ABOVE THE SEPARATE TARGET ALLOWS FOR A MUCH LOWER ELECTRICITY SAVINGS TARGET USING SITE AGGREGATION THAN TDV AGGREGATION[7].

As we look forward to post 2030, the difference between Carbon Content and Captured becomes starker. In future years, with more renewable electricity on the margin, Carbon Content would allow much more electricity use than Captured. While SB 350 only looks out to 2030, in the longer term Captured would continue to provide an incentive to save electricity through efficiency while Carbon content would not.

[7] Assumes a fossil site-to-source ratio of 3.14 for electricity and 1.05 for gas. Gas source emissions factor is 5.31 kg/therm. Marginal generation is 50% renewable. TDV values are average annual TDV.

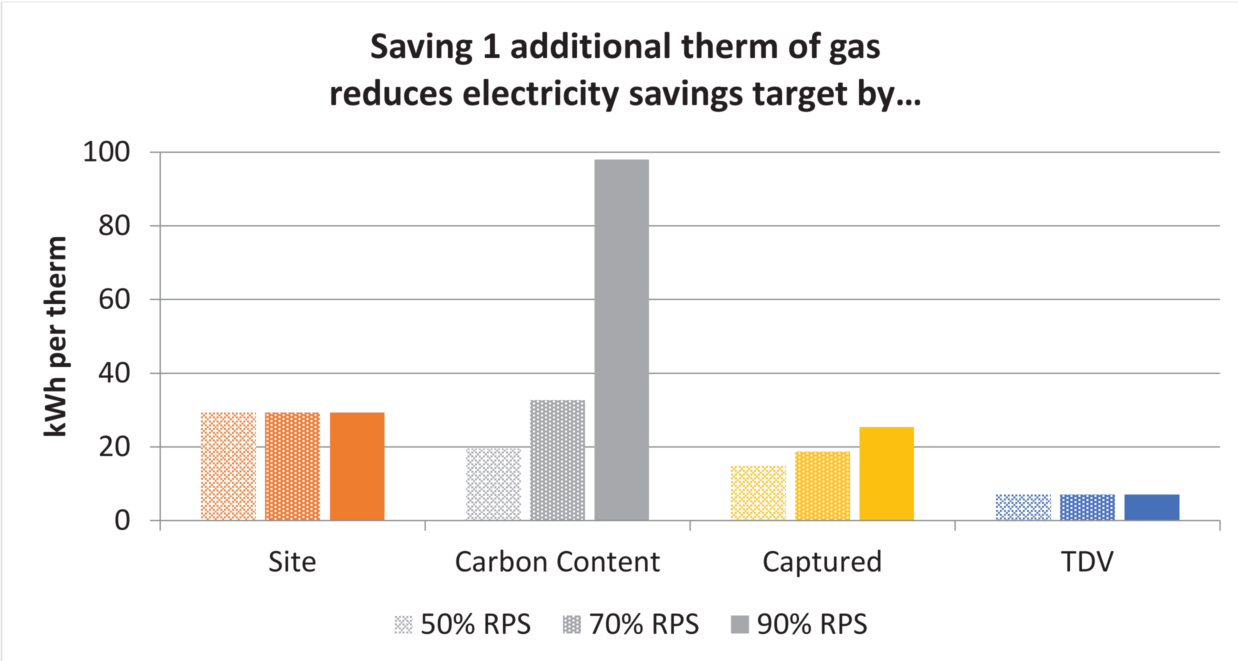

FIGURE 6. CARBON CONTENT ALLOWS MUCH MORE ELECTRICITY USE PER ADDITIONAL SAVED THERM AS THE MARGINAL GENERATION CHANGES. SITE AND TDV REMAIN UNCHANGED.

Relative to the other methods, Site Energy aggregation would incentivize greater gas savings (and potentially fuel substitution toward electricity) and TDV aggregation would incentivize greater electricity savings (and potentially fuel substitution toward gas). For example, using Site Energy aggregation, small additional gas savings would lead to large decreases in required electricity savings. We make three assumptions: cost-effective energy efficiency opportunities are available for both fuels today, capturing those opportunities comes at some cost to utilities (in time, effort, dollars, etc), and without SB 350 efficiency improvements would be smaller than with SB 350. If these assumptions all hold, then it follows that utilities and state agencies setting statewide policies would aim to meet the doubling goal with minimal "cost." A higher multiple (like those shown in Figure 5) incentivizes gas savings because it results in a much lower electricity savings target (which we assume would be attractive because a lower target is easier to meet), but the resulting lower electricity target means that GHG, energy spending, and site energy use would all increase relative to hitting separate targets. On the other end, TDV would incentivize greater electricity savings compared to the other methods because small additional electricity savings would mean the gas target would be much lower. This concept is illustrated in Figure 7.

At the extremes, one type of savings is particularly favored because it makes meeting the target "easier." But, if the target is achieved using the savings type that is "easier" then we expect the emissions to be higher than for the middle two methods. Figure 7 is meant to be illustrative, and it is certainly possible that if very large, cheap gas savings are possible and TDV aggregation is used (or large electricity savings are used with Site Energy aggregation is used) that the GHG reduction would be higher than the GHG reduction using other methods. But, given the great uncertainty of relative cost effectiveness of savings of different fuels, the middle two options (Carbon Content and Captured Energy) are more likely to deliver greater GHG reductions.

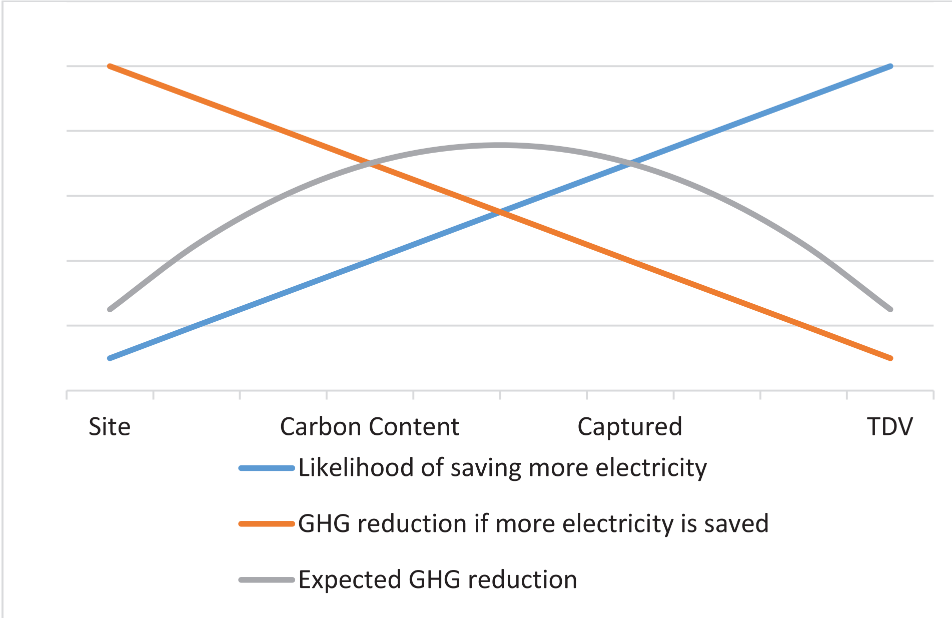

Figure 7. Site Energy makes saving more electricity less likely, but if savings came entirely from electricity, the GHG reduction would be the largest. The middle two may lead to the largest expected GHG reduction.

POTENTIAL OUTCOMES OF AGGREGATION METHODS

Depending on which method above is chosen and which type of savings is prioritized, the outcome could differ in energy savings, cost savings, and emissions reductions. We explore those differences here.

GHG EMISSIONS

Here we compare what the emissions impact would be with different aggregation methods. As a baseline, the separate targets specified in SB 350 would lead to an emissions reduction, though it would depend on the emissions factors for gas and electricity. Here we assume that the emissions of electricity are based on the RPS. Using the cumulative efficiency improvement in 2030, separate targets would lead to a reduction of about 33 million metric tons of CO2 in 2030. The benefit of using the Carbon Content aggregation method is that it has the greatest certainty of emissions reduction (because the aggregation method is closely tied to GHGs). If we assume that gas savings may be larger than the separate targets case then both Captured and TDV methods would lead to greater emissions savings than a separate targets case. But, as discussed in the previous section, TDV in particular may incentivize greater electricity savings. With TDV, meeting the doubling goal may be easier when small additional electricity savings are traded to lower the gas savings target by a large amount. Doing so would lead to a smaller GHG reduction than Carbon Content.

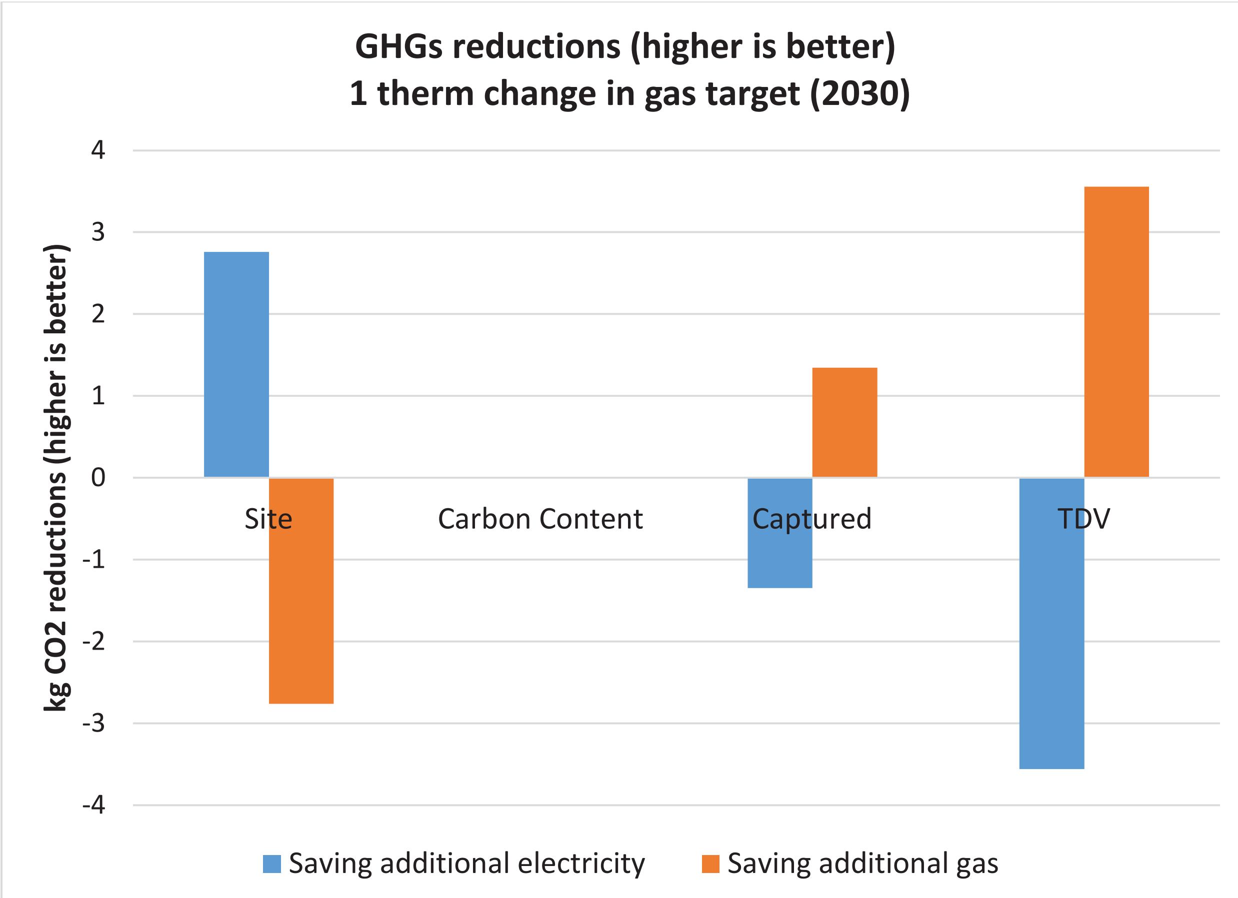

FIGURE 8. THIS FIGURE SHOWS HOW GHG REDUCTIONS VARY DEPENDING ON WHICH AGGREGATION METHOD IS USED AND IN WHICH DIRECTION SAVINGS ARE TRADED. ORANGE BARS REPRESENT GREATER GAS SAVINGS AND LOWER ELECTRICITY SAVINGS RELATIVE TO SEPARATE TARGETS, AND BLUE BARS REPRESENT LOWER GAS SAVINGS (AND HIGHER ELECTRICITY SAVINGS). POSITIVE VALUES DENOTE GREATER GHG REDUCTIONS (AND THEREFORE LOWER TOTAL EMISSIONS). WHEN SAVING MORE NATURAL GAS, THE CAPTURED AND TDV METHODS CAN RESULT IN GREATER GHG REDUCTIONS THAN OTHER METHODS. BUT THERE IS A RISK OF LOWER GHG SAVINGS IF THOSE METHODS ARE USED BUT SAVINGS COME MOSTLY FROM ELECTRICITY. WHEN CARBON CONTENT IS USED, AGGREGATION HAS NO IMPACT ON EMISSIONS.

COST SAVINGS

The net savings from energy efficiency will differ depending on how aggregation occurs, which fuels are favored, and the value of saved electricity and gas. For the four methods that we are comparing, it is difficult to say which would deliver the highest net value in practice. The economic value shown below is the gross value of the energy savings at retail, but they do not take into account the costs of efficiency measures. The relative costs of gas and electricity efficiency measures—and the quantity of savings available—would need to be known to accurately compare the different methods. Here we use the annual average Time Dependent Valuation (TDV), converted to $/kWh and $/therm, to compare the value of gross savings from the aggregation methods below. By definition the value of gross energy savings using the TDV method is unchanged, no matter how savings are traded. If greater savings come from saving gas than the separate targets case, then the value of savings (in TDV terms) would be lower when Site, Carbon Content, or Captured are used. While we use average TDV values for this analysis, they may not represent the actual future electricity and natural gas prices. Additionally, we use the annual average TDV of electricity and gas, but efficiency measures will likely not save energy equally in all hours.

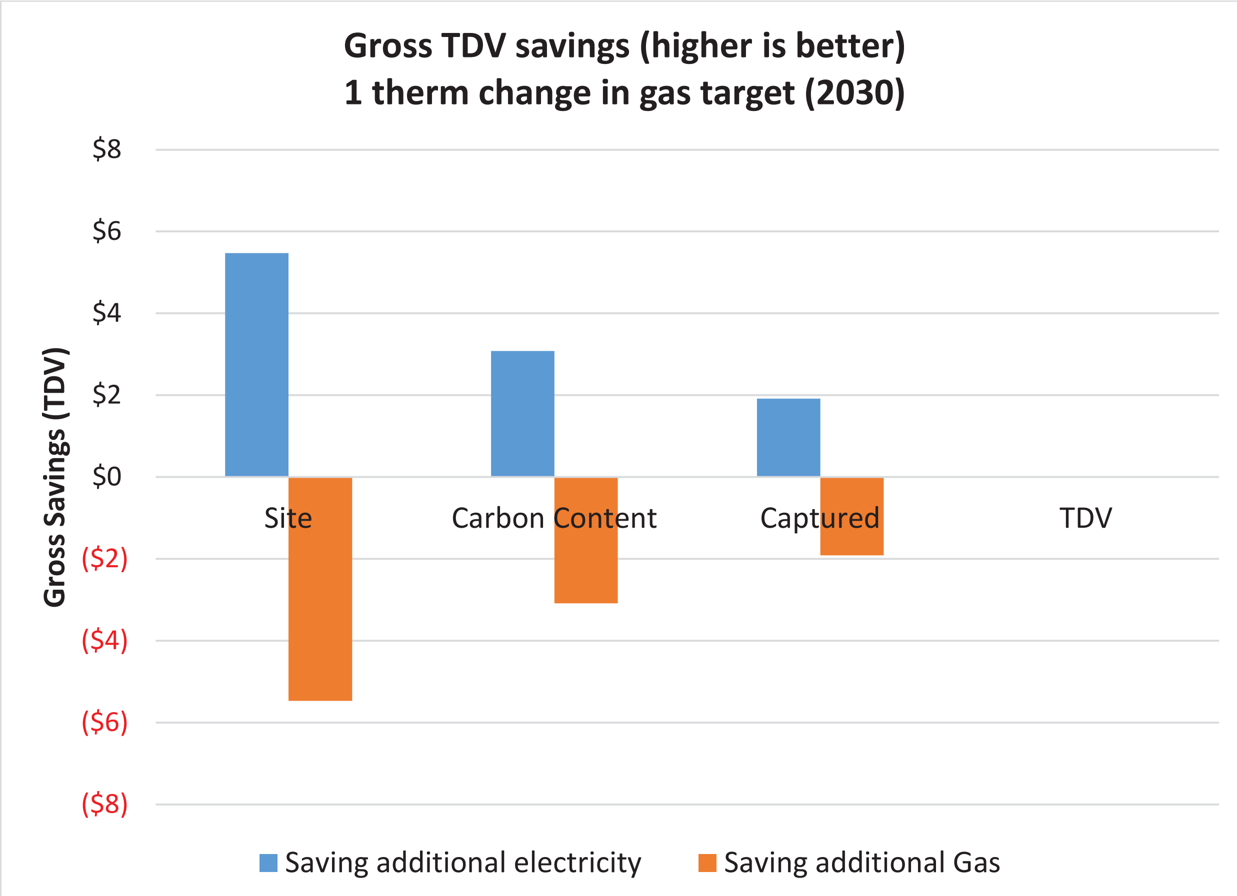

FIGURE 9. THE (GROSS) VALUE OF THE SAVED ENERGY IS CONSTANT WHEN TDV IS USED, AND LOWER WITH THE OTHER 3 METHODS WHEN MORE SAVINGS COME FROM NATURAL GAS.

ENERGY

As the goal of SB 350 is to reduce energy use, we need to be mindful of aggregation methods that lead to smaller reductions in energy use. Separate targets or the site method would lead to 129 TWh-equivalent of site energy savings (no matter how the savings are realized). If savings come more from gas than the separate targets case, the overall site energy savings would be higher with all the other methods.

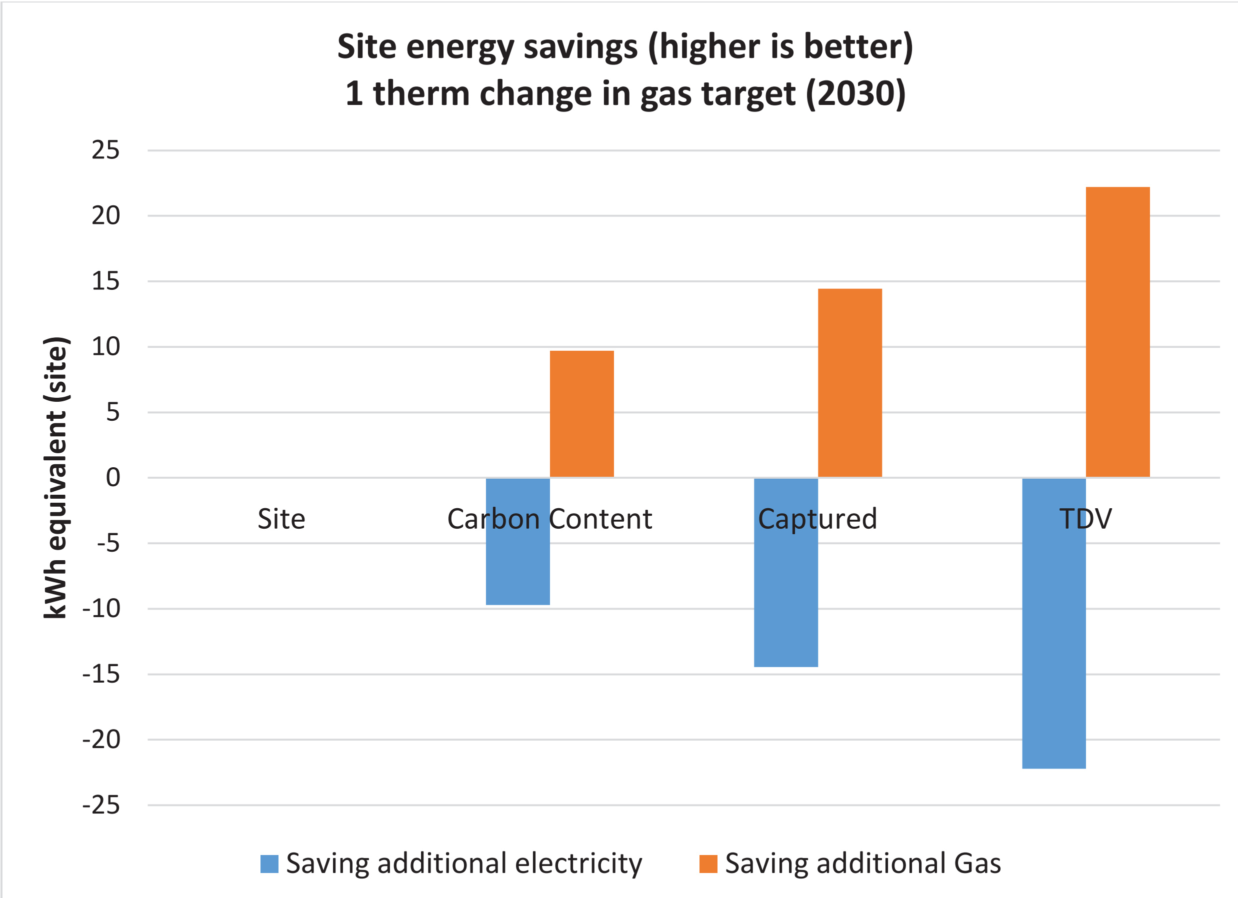

FIGURE 10. THE SITE ENERGY AGGREGATION METHOD KEEPS SITE ENERGY SAVINGS CONSTANT NO MATTER WHERE SAVINGS COME FROM. SMALLER SITE ENERGY REDUCTIONS WOULD OCCUR IF OTHER AGGREGATION METHODS ARE USED AND SAVINGS COME MOSTLY FROM SAVED ELECTRICITY.

SUMMARY

It is impossible to know from this study which approach would be best because it also depends on the economics of the different types of efficiency measures and on how utilities would prioritize gas versus electricity savings under the different methods. Here we have only looked at what the emissions savings or value of saved energy would be, but we have not accounted for the costs of the different types of efficiency measures (or the economics of fuel substitution). We also do not know what the cost of the marginal gas or electric efficiency measure would be, or if gas or electric would hit a cost effectiveness constraint first before reaching the goal. Given these unknowns, the Carbon Content metric provides flexibility that comes from aggregation with the certainty that any trading of savings between fuels would be emissions neutral. The downside of Carbon Content is that the value of electricity savings decreases toward zero as marginal (build margin) resources increase on the grid. Captured Energy aggregation corrects for that, but that comes with a cost of a slightly less certain GHG reduction.

The initial conditions for whatever policy is put in place are a building stock that Title 24 has influenced. The use of TDV in the California building code over the past decade, and of source energy (based on a

100-percent fossil grid mix) prior to that, has influenced many design decisions. Because source energy and TDV values for electricity are much higher than for gas, a significant share of the existing building stock tends to use gas for larger end uses like space and water heating. Continuing to use TDV for aggregation would likely mean that electricity savings continue to be favored, resulting in both higher emissions and higher site energy use than with any of the other three methods. Any of the other aggregation methods would push greater gas reductions (to different degrees). The aggregation policy should, at a minimum, not stand as a barrier to trading savings between fuels when doing so would have a GHG emissions and/or economic benefit. As electricity becomes cleaner, this will mean that GHG benefits will come from larger gas savings than the separate target case.

In order to decide which method is best, we need to think about what metrics we care most about, the value of certainty, where we think savings will probably come from, and what type of savings we would like to encourage. For example, if we care more about GHG reductions, and we are uncertain about where savings would come from, we may choose Carbon Content. Or, if we are quite certain that additional electricity savings will be far cheaper than additional gas savings, and we care the most about gross energy spending, then we would choose Site Energy as the aggregation metric.

While Site Energy aggregation would be a simple way to aggregate savings, meeting the doubling goal using Site aggregation would likely lead to higher emissions than separate targets in 2030.

We believe that there is very high uncertainty about whether gas or electricity savings will be cheaper/easier to achieve or which fuel utilities and statewide policies will focus on most. We also do not know if the savings target for one fuel will be set higher than the cost effectiveness limit. And finally, we do not know what future gas and electricity prices will be or how much efficiency measures will cost. However, we do know that reducing GHG emissions is very important and that SB 350 is an important tool to meet emission reduction goals. Carbon Content and Captured Energy provide the greatest certainty of reducing source energy use from fossil fuels. **We recommend Source Captured Energy because while it provides slightly less certainty than Carbon Content, saving electricity will remain important even as marginal renewable resource become predominant on California's grid, both for economic reasons and to accelerate the transition to a clean energy economy.**

The table below summarizes the main points of each aggregation method.

Aggregation	Fuel Most Likely to be Saved; Strength of Preference	Certainty	Downside
Site	Additional Gas; Strong	High certainty that site energy use will be unchanged through trading	Low electricity savings target, increasing total emissions and energy spending.
Carbon Content	Additional Gas; Medium	High certainty that GHG emissions will be unchanged through trading	Energy spending increases relative to TDV case, but emissions are reduced.
Captured	Additional Gas; Weak	Medium certainty of GHG emissions reduction	Similar to Carbon Content, but with a smaller increase in energy spending.
TDV	Additional Electricity; Medium	High certainty of gross savings of energy spending	Low natural gas savings target, making deep decarbonization goals difficult or impossible to meet.