Sierra Club Comments on the South Coast Air Quality Control Management District's Net Emissions Analysis Tool

November 28, 2017

The Sierra Club commends the South Coast Air Quality Control Management District (SCAQMD) staff for their leadership in preparing the Net Emissions Analysis Tool (NEAT). Developing this type of analytic software tool is a complex endeavor, and we are grateful for the staff's intention to create a sophisticated, intuitive, and user-friendly platform for the public and policymakers alike.

The Net Emissions Analysis Tool will serve as a first of its kind tool to asses the NOx, GHG, and economic impacts of residential equipment and appliance choices. Designed and used correctly, the tool has the potential to inform policies that drastically cut air and climate pollution, extend the reach of wind and solar into our homes, and lower utility bills.

At this time, we recommend three adjustments to the tool to enhance the ability of policymakers and stakeholders to assess the options for reducing emissions in the buildings sector.

The SCAQMD should:

1. Update the list of appliances included in the Future Technology Mix to include the most efficient appliances available today for water heating, space heating and cooling, cooking, clothes drying, and other end uses.
2. Include thermal storage capabilities for electric water heaters.
3. Specify the energy efficiency rating of each appliance.

We understand that the inclusion of upstream fugitive methane leakage in the CO2e emissions factor is a future task for staff. Please see *Attachment 1* for our recommended methodology to account for methane leakage. Factoring in modest ranges for methane leakage can double the GHG footprint of gas appliances.

I. Update the appliances in the Future Technology Mix to include the most efficient appliances available today.

While it makes sense for the Tool to rely on the 2009 CEC RASS study for the Baseline Technology Mix Parameters, the CEC study is not a suitable source for the Future Technology Mix. The efficiency levels of the appliances captured in the CEC study are 10-30 years old and do not reflect future technology options. Most users will not research and upload their own technology preferences to the Tool. For the Tool to serve as a comprehensive modeling software to estimate future NOx and GHG emissions from buildings, it needs to include a more complete list of appliances and their efficiency levels.

The Tool should include the most efficient appliances that are available today, while also giving users the option to add their own appliances as the efficiency of products available in the market will continue to improve each year. We recommend the following electric appliances be added to the tool:

Appliance category	**Name of appliance**	**Efficiency rating** (metric depends on appliance category)	**Source**
Water heating	Electric heat pump water heater (air source)	Energy Factor: 3.5 or 3.6	EnergyStar link (EF 3.5); EIA link (EF 3.6 - high in 2030)
Space heating and cooling	Variable air source heat pump (split system, packaged, or ducted)	HSPF (heating): 13.5 SEER (cooling): 33.1	EnergyStar link
Clothes dryer	Electric heat pump clothes dryer	Combined Energy Factor: 9.1	EnergyStar link
Cooking	Electric induction stove with convection oven	To be determined	

II. Include thermal storage capabilities for electric water heaters.

In addition to including distributed solar and distributed battery storage in the model, staff should also include distributed thermal storage. Thermal storage is one of easiest methods to lower the cost and emissions content of residential water heating. Electric resistance and electric heat pump water heaters all have the ability to heat water during the day, taking advantage of low-cost solar, and use thermal storage to ride through the evening and morning peak periods. If appropriately sized, storage tanks can store hot water for at least 24 hours to meet a household's hot water needs without exacerbating peak periods, and do so in a manner that heats water with zero-emissions renewable energy sources. NRDC and Ecotope are currently conducting a heat pump water heater load flexibility study which simulates the flexible load based on different sized tanks, temperatures, and climate zones. Results will be available in 2018. Similarly, many developers including Redwood Energy are testing thermal storage in the field and can provide results upon request. Including programmable electric water heaters with thermal storage capabilities is an important option for the Tool, as this will impact the hourly load shapes thus resulting in lower emissions and costs from electric water heating.

III. Specify the energy efficiency rating of each appliance.

The Tool should list the efficiency rating of each appliance. Users are familiar with the standard energy efficiency ratings of appliances as listed on EnergyStar labels and specification sheets. However, most people are not familiar with the Unit of Energy Consumption (UEC) for each appliance. To ensure that the user understands what appliance or technology mix they are selecting in the scenario, it is important that they see the energy efficiency standard for each option. The efficiency rating of the appliance and the energy consumption (which can default to average per climate zone and housing type) can help compute UEC, emissions, costs and other metrics.

Thank you for considering these comments. We look forward to staying engaged in the development of the Tool.

Sincerely,

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Rachel Golden
Senior Campaign Representative
Sierra Club
rachel.golden@sierraclub.org

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Shuba Raghavan
Energy efficiency expert to Sierra Club
Visiting Post-doc Scholar
University of California, Berkeley
shuba.raghavan@berkeley.edu

Attachment 1

Including methane leakage in GHG analysis of household appliances

It is important to factor in upstream fugitive methane emissions as part of an analysis of the GHG emissions from gas and electric appliances. Methane is the principal component of natural gas and a potent short-lived greenhouse gas.[1]

Fugitive methane emissions occur along all stages[2] of the lifecycle of natural gas, although at different rates. Given this, it is key to have specific leakage rates for natural gas that goes from the well to the power plant, and for natural gas that goes from the well to the building end-use. Leakage rates for well to power plant include leakage that occurs at the well-site (exploration + production), processing, and storage and transmission to the power plant. Leakage rates for well to building end use include leakage that occurs at the well-site (exploration + production), processing, storage and transmission, distribution within the city gates, and at the actual end-use as well (i.e. in the building).

Methane leakage varies greatly across the U.S., depending on the location, type of production, and quality and age of equipment used. For our analysis, we used rough national averages, although it is recommended that these estimates are updated with local leakage rates, when sufficient data is available. Similarly, the leakage rates in our analysis are based on average natural gas use, not marginal or incremental changes in natural gas use. An important area for future research is the impact of marginal changes in natural gas use on fugitive methane emissions.

The time-dependent variance in the global warming potential (GWP) of methane can greatly impact the significance of methane leakage and the GHG analysis. The IPCC and EPA specify GWP estimates for methane based on a 20-year and 100-year time horizon, although not for time periods in between.[3] We use the 20-year GWP for methane, particularly because our analysis is of GHG emissions in 2030, i.e. in 13 years.

It is important to note that the leakage rates are the result of analysis of methane leakage in *current conditions*, not projections of future leakage. Some, particularly the natural gas industry, believe that future leakage will be lower than or similar to current rates due to technology improvements in natural gas operations. Others believe, however, that the forecasted large growth in unconventional drilling will result in higher methane leakage rates in the exploration and production stage.[4] This is an important area for future research.

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[1] Zavala-Araiza et. al., Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites, Environment, Science & Technology, July 7, 2015,

[2] Stages include: exploration, production, processing, transmission, storage, distribution, and end-use. For a description of these stages see *Basic overview of stages in the NG system* or US EPA GHG Inventory

[3] IPCC (2014)

[4] Howarth et al., A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas, May 15, 2014; and conversations with Tim O'Connor (EDF)

Our data sources include the U.S. EPA GHG Inventory,[5] academic publications,[6,7,8] and conversations with natural gas experts David Lyon and Tim O'Connor at Environmental Defense Fund.[9]

Variable	**Upstream leakage**
Well-to-power plant: leakage stages included	Production, processing, transmission and storage (total: 2.12%)
Well-to-building: leakage stages included	Production, processing, transmission and storage, distribution, and end-use (total: 3.30%)
Super-emitters: sites with the highest proportional methane loss rates, often the 5% highest emitting sites[10]	Included
EPA 40-45% methane leakage reduction below 2012 by 2025 (for new equipment at production site; voluntary goal)	Not included
Higher leakage rate for projected growth of unconventional drilling	Not included
Global warming potential (GWP)	20 years: 86 GWP
Data source	Academic papers by Marchese (2015), Zimmerle (2015), Lamb (2015), and estimates by David Lyon. Use upper end of 95% confidence interval of academic papers.

5 US EPA GHG Inventory for 2013, Draft 2/22/16

6 Marchese et al. (2015)Methane Emissions from United States Natural Gas Gathering and Processing (data collection in 2012 - high end of 95% confidence interval)

7 Zimmerle et al.(2015) Methane Emissions from the Natural Gas Transmission and Storage System in the United States (leakage in 2012 - uses upper end of 95% confidence interval. Includes "super emitters")

8 Lamb et al.(2015) Direct Measurements Show Decreasing Methane Emissions from Natural Gas Local Distribution Systems in the United States (this is actually less than 2011 EPA GHG inventory and reflects significant upgrades at metering and regulating stations, improvements in leak detection and maintenance activities)

9 Natural Gas Exploration + Production leakage rate - David Lyon conversation (4/1/16) increase EPA GHGI by 50% to include super emitters which are not included in EPA GHGI; Natural Gas end uses in buildings leakage rate - David Lyon conversation (4/1/16) 1% for high end.

10 Zavala-Araiza et. al., Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites, Environment, Science & Technology, July 7, 2015.