

MEMORANDUM

- To: Sang-Mi Lee, Ph.D., Program Supervisor, South Coast AQMD Scott Epstein, Ph.D., Program Supervisor, South Coast AQMD Marc Carreras-Sospedra, Ph.D., Air Quality Specialist, South Coast AQMD
- From: Akshay Ashok, Ramboll Varalakshmi Jayaram, Ramboll Julia Lester, Ramboll
- Copy: Allison Smith, SoCalGas Priscilla Hamilton, SoCalGas
- Subject: Model Issues in the South Coast AQMD's Net Emissions Analysis Tool (NEAT)

Ramboll has reviewed the South Coast AQMD's Net Emissions Analysis Tool (NEAT) Version 1.11 Beta. Related purely to model performance (and separate from issues related to model inputs and assumptions), we found the following inconsistencies and potential errors in model behavior and output.

1) Selection of a Subset of Housing Stock

- We encountered unexpected and conflicting results when running the tool for a subset of the SCAB housing stock (e.g., selecting Climate Zone 6 in the input tab) as compared to running the model for the full housing stock and filtering the results for the same subset (i.e., filtering for Climate Zone 6 in the results tab). The test case we ran was to replace conventional NG water heaters with electric water heaters, using basin-average electricity. All other options were set to their default settings. Results for the former are shown in **Figure 1** below and results for the latter are shown in **Figure 2** below. Note that the following results are different depending on the whether a model subset was run compared to filtering full results for the same subset:
 - Number of modified homes meeting the subset filter (623,036 in the former vs. 665,899 in the latter);
 - Different cost differentials (e.g., the x-axis for the former scenario range between \pm \$581, whereas they range between \pm \$631 for the latter; and
 - Significantly different GHG emission results (all homes showing a decrease in GHG emissions in the former vs. all homes showing increased GHG emissions in the latter).

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Ramboll 350 South Grand Avenue Suite 2800 Los Angeles, CA 90071 USA

T +1 213 943 6300 F +1 213 943 6301

www.ramboll.com





Figure 1: Running NEAT for housing stock in Climate Zone 6. The sample scenario was configured to replace conventional NG water heaters with electric water heaters.



Figure 2: Running NEAT for all climate zones and filtering the results for Climate Zone 6. The sample scenario was configured to be the same as in Figure 1 (replacing conventional NG water heaters with electric water heaters).



2) Missing or Invalid GHG Cost-Effectiveness Results

Cost-effectiveness metrics in the "Results→Cost Effectiveness" tab of the NEAT model are either missing or invalid (i.e., "NaN") for GHG, as seen in Figure 3 below. The test case we ran was to replace conventional NG water heaters with electric water heaters, using basin-average electricity. All other options were set to their default settings. Most of the houses fall under the "Red CO2e" region; however, the tool only calculates a minimum and maximum GHG cost-effectiveness but does not provide values for the mean and median GHG cost-effectiveness.



Figure 3: NEAT cost-effectiveness outputs for replacement of conventional NG water heaters with electric water heaters.



3) Inconsistency between total GHG emissions and GHG Cost-Effectiveness Results

- Cost-effectiveness metrics for GHGs in the "Results→Cost Effectiveness" tab of the NEAT model were found to be inconsistent with the cumulative change in CO2e emissions reported in the "Apply Prescribed Funding" tab. The test case we ran was to replace conventional NG water heaters with solar water heaters with electric backup, using basin-average electricity. All other options were set to their default settings.
- As seen in Figure 4 below, the test scenario we ran resulted in an increase in CO2e emissions
 of approximately 2,700 tons/day from all houses in the basin (this was calculated by setting a
 very high funding amount in the "Apply Prescribed Funding" tab, such that all houses basin-wide
 would be subject to appliance replacement and therefore be included in the cumulative change
 in emissions reported within that tab). The "Apply Prescribed Funding" tab also indicates that
 there is a positive cost to fund all projects (purchase and installation costs) and an average
 increase in annual utility and fuel costs for Homeowner.
- However, the cost-effectiveness results show all homes are in the "Yellow" region for CO2e (see Figure 5). This implies that either costs or emissions are lower in the scenario than the baseline for all houses, which is inconsistent with the information presented in the "Apply Prescribed Funding" tab.

nand Demand Input Summary Power Supply	Economics Computation Results	
alyze Most Recent Results Analyze Saved Results	Select Cost Effectiveness Subset Cost Effectiveness Appliance Mix Apply Prescribed Funding Query Individual Homes	
Filter Homes	Enter Funding Amount [\$] 10000000000 Funding is applied only to households filtered on the "Project" refers to all of the selected retrofits for "Select Cost Effectiveness Subset" a particular home "Cost Shi	are by Homeowner [%]
mate Zones		
6 Coastal 0 10 S. Inland	Description (click on a variable to view histograms)	Value
8 S. Near-Coastal O 15 S. Desert	Approximate Number of Projects Funded	3970864
9 N. Near-Coastal O 16 Mountain	Number of Possible Projects in "Cost Effectiveness Subset"	3970864
 All Climate Zones 	SCAQMD Cost to Fund All Projects in "Cost Effectiveness Subset" (only considers purchase and installation costs)	\$20,966,161,920.00
using Category		
Only Single Family Homes Only Mobile Homes Only Multi Family Homes I All Housing Types	Cumulative Change in NOx Emissions [Ib/yr]	-1.06e+06
	Cumulative Change in NOx Emissions [TPD]	-1.45e+00
	Cumulative Change in CO2e Emissions [lb/yr]	1.99e+09
tural Gas Utilities	Cumulative Change in CO2e Emissions [TPD]	2.73e+03
Long Beach Gas & Oil 🗹 Southwest Gas Corp.		05 000 00
Southern California Gas 🗹 City of Vernon Gas System	Average Incentive Amount Provided to Homeowner to Purchase and Install Appliances, PV (if selected), and Battery (if selected)	\$5,280.00 \$5,280.00
ectric Litilities	Median Incentive Amount Provided to Homeowner to Purchase and Install Appliances, PV (if selected), and Battery (if selected)	\$5,280.00
	Average Cost-Share from Homeowner to Purchase and Install Appliances, PV (if selected), and Battery (if selected) Notifies Cost-Share from Homeowner to Purchase and Install Appliances, PV (if selected), and Battery (if selected)	\$0.00
Azusa Light & Power	Median Cost-Share from Homeowner to Purchase and Install Appliances, PV (if selected), and Battery (if selected) Average Change in Annual Utility and Fuel Costs for Homeowner	\$200.67
Bear Valley Electric Service	Average change in Annual Utility and Fuel Costs for Homeowner Median Change in Annual Utility and Fuel Costs for Homeowner	\$280.42
Burbank Water & Power	metuan change in Amina duniy and rue costs for homewiner Average Change in Amirica Appliance Purchase and Installation Costs Borne By Homeowner Including PV and Battery (if selected)	\$200.42 \$0.00
City of Anaheim Public Utilities Department	Average change in Amorized Appliance Purchase and Installation Costs Borne by Homeowner Including PV and Battery (if selected) Median Change in Amorized Appliance Purchase and Installation Costs Borne by Homeowner Including PV and Battery (if selected)	\$0.00
City of Banning Electric Department	median change in Antonized Appliance Purchase and installation Costs borne by Homeowner including PV and battery (in selected)	30.00
City of Corona Department of Water & Power	No Plot Available No Plot Available	
City of Riverside		
City of Vernon Municipal Light Department		
Glendale Water & Power		
Los Angeles Department of Water & Power	8 0.5	
Moreno Vallev Utility	운 물 문 문 문 문 문 문 문 문 문 문 문 문 문 문 문 문 문 문	
Pasadena Water & Power	2 oh	
Rancho Cucamonga Municipal Utility	eq.	
San Diego Gas & Electric	Ž ₋₀₅ -	
Southern California Edison	-0.3	
46,817 homes meeting filter critera above % of the total homes in SoCAB meet filter criteria	-1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 -1 0 0.1 0.2 0.3 0.4 0.5 0.6	07 08 09

Figure 4: Cumulative change in emissions reported in the "Apply Prescribed Funding" tab of the NEAT model. The results are for replacement of conventional NG water heaters with solar water heaters with electric backups.





Figure 5: NEAT Cost-effectiveness outputs for replacement of conventional NG water heaters with solar water heaters with electric backups.

4) Memory Error

• An Out-of-Memory error was encountered when attempting to run NEAT with replacement of natural gas (NG) primary heat with electric heat pumps for the full South Coast Air Basin (SCAB) housing stock, with the Rooftop Solar PV option enabled.