The Net Emissions Analysis Tool: A Holistic Residential Energy and Emission Model for the Development of Regulations and the Allocation of Incentive Funds in the South Coast Air Basin

Scott A. Epstein, Marc Carreras-Sospedra,

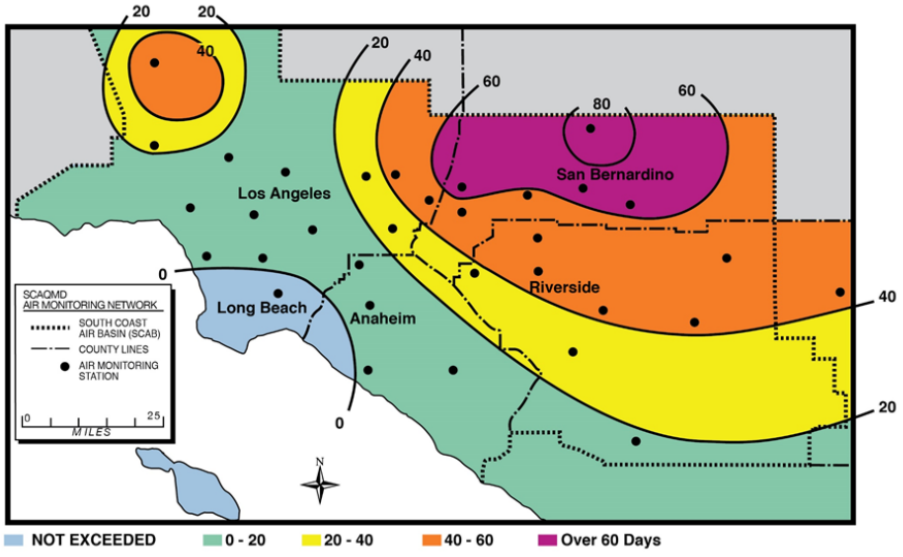
Xinqiu Zhang, and Sang-Mi Lee

South Coast Air Quality Management District

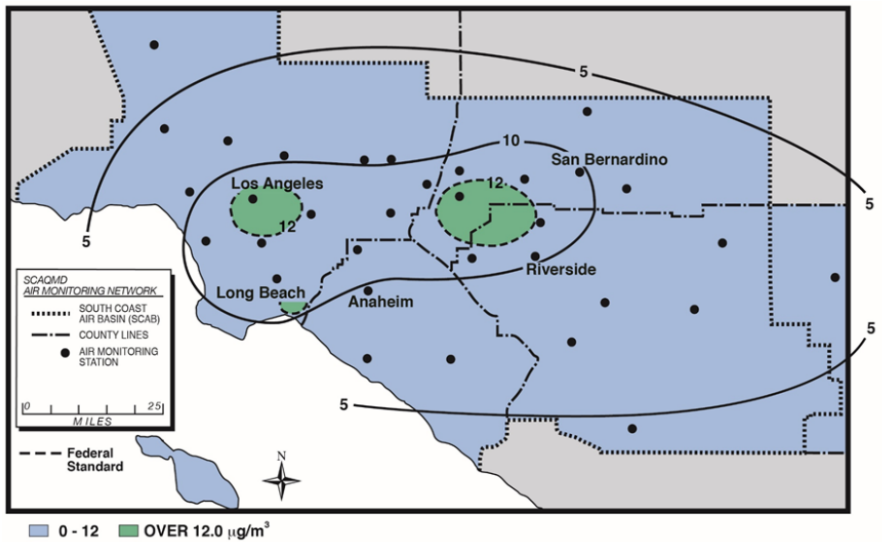
Presented at the 2018 ACEE Conference on Health, Environment and Energy, December 3-5, New Orleans

Despite Improvements in Air Quality, Much Work Remains

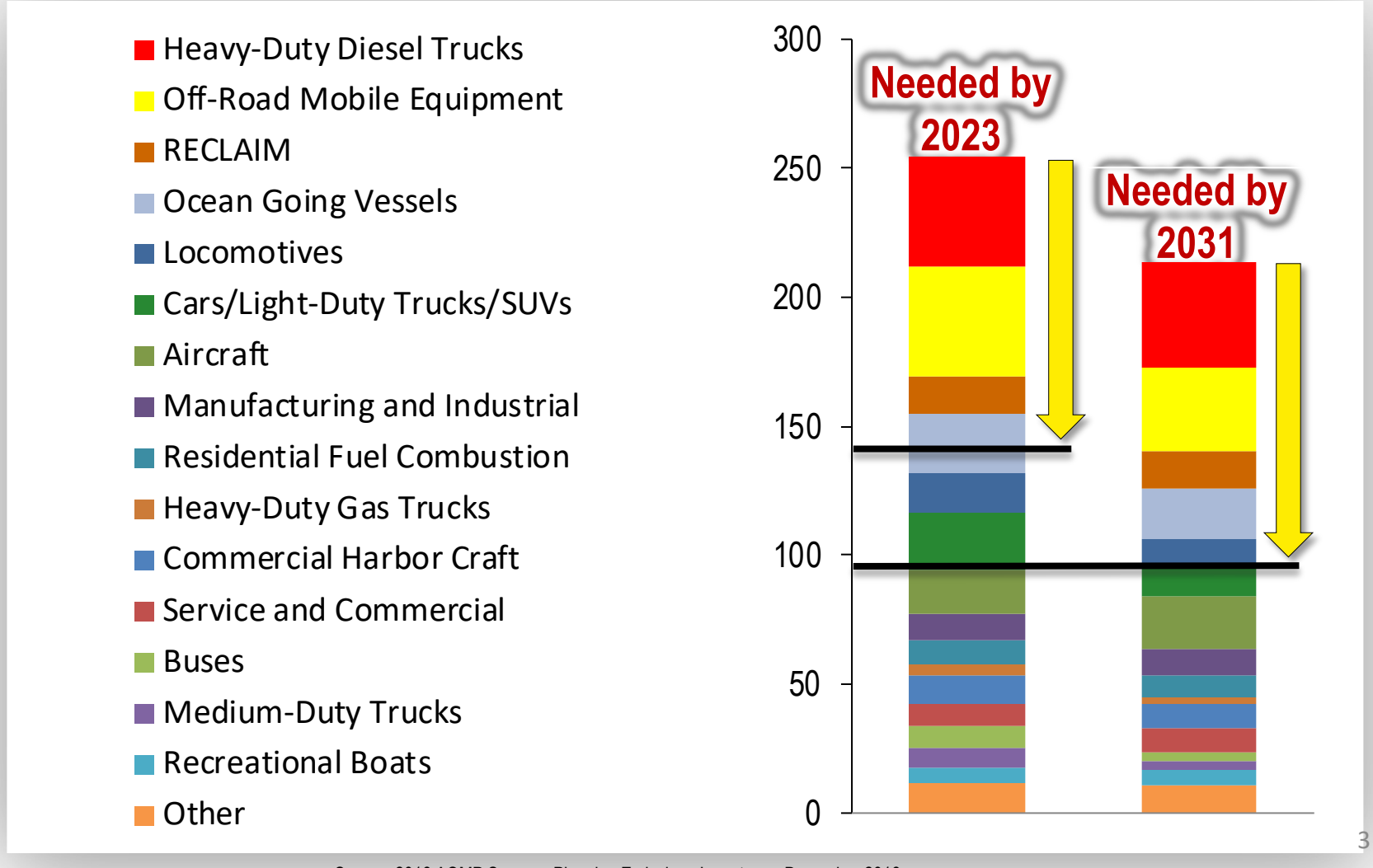
Number of Days Exceeding Federal O_3 Standard (2015)



Annual Average $PM_{2.5}$ Concentration Compared to Federal Standard (2015)

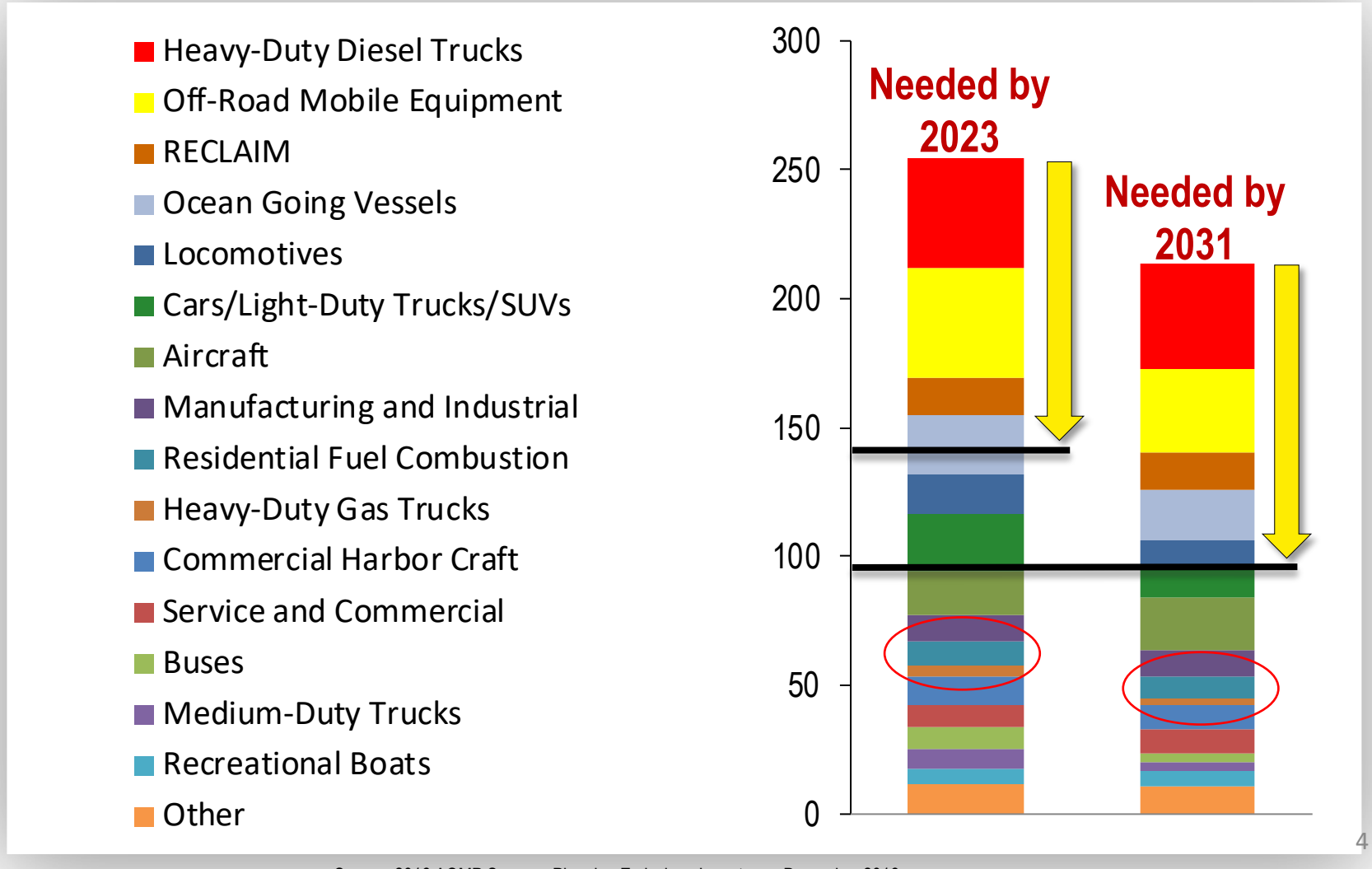


Control Strategy for O_3 and $PM_{2.5}$ Attainment Focused on NOx Reductions



Source: 2016 AQMP Summer Planning Emissions Inventory – December 2016

Control Strategy for O_3 and $PM_{2.5}$ Attainment Focused on NOx Reductions



Source: 2016 AQMP Summer Planning Emissions Inventory – December 2016

2016 AQMP Measures Related to Residential Appliances

	Title	2023 NOx Emission Reductions (TPD)	2031 NOx Emission Reductions (TPD)
CMB-02	Emission Reductions from Replacement with Zero or Near-Zero NOx Appliances in Commercial and Residential Applications	1.1	2.8
CMB-04	Emission Reductions from Restaurant Burners and Residential Cooking	0.8	1.6
ECC-03	Additional Enhancements in Reducing Existing Residential Building Energy Use	1.2	2.1

Source: Final 2016 SCAQMD Air Quality Management Plan

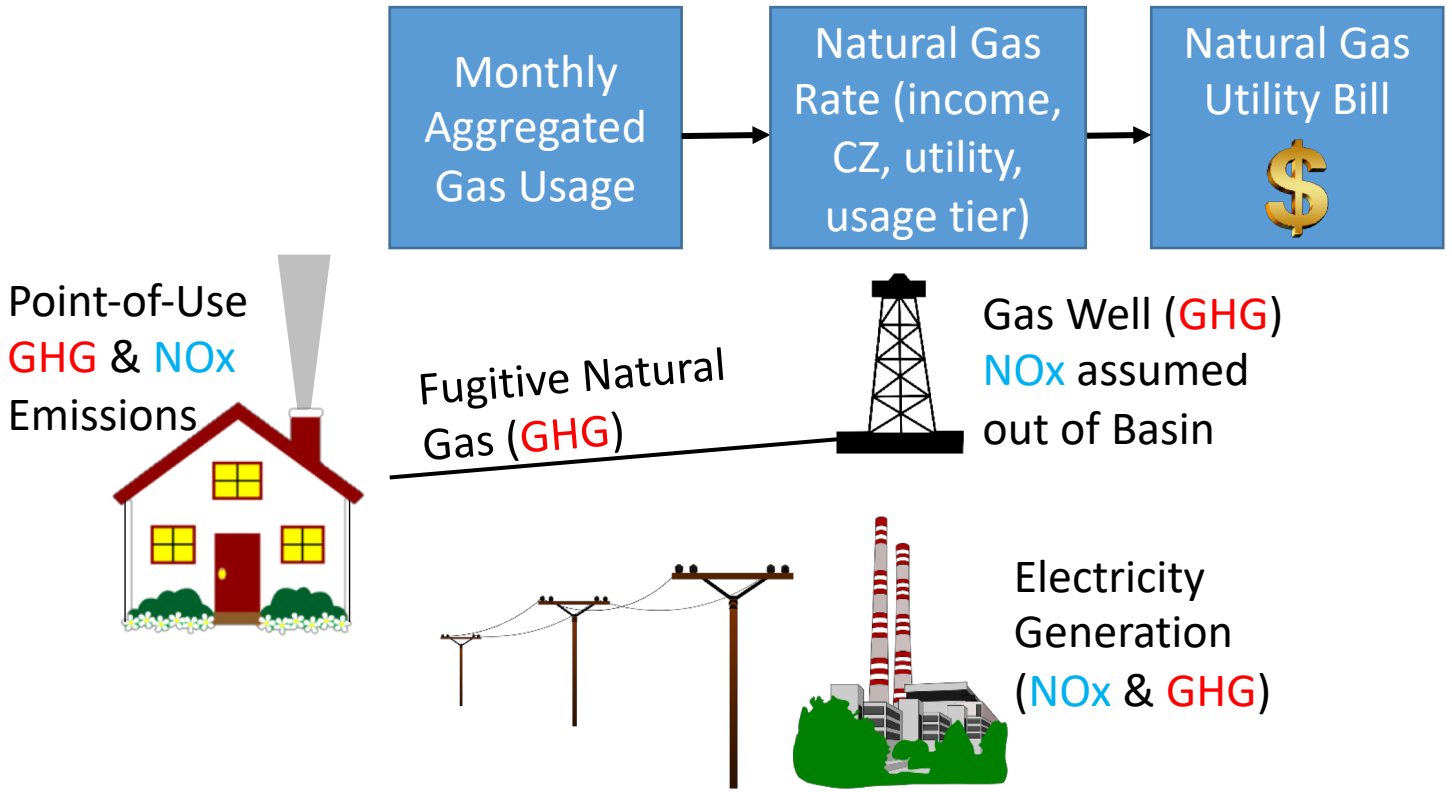
Goals of the Net Emissions Analysis Tool (NEAT)

- Estimate NOx and GHG emission reductions from the residential sector
- Determine the most cost-effective [$/ton] strategies to reduce emissions
- Holistically determine where to allocate incentive funds and develop programs to maximize NOx and GHG benefits and minimize energy costs for the consumer
- Design a publically available graphical tool (GUI) for a wide user-base


Source: sweetclipart.com

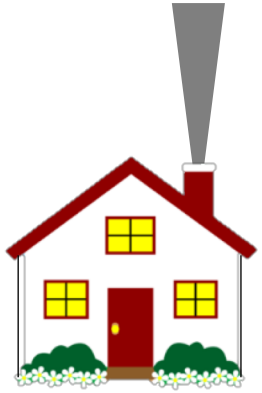
NEAT Calculates Impact of Technology Changes on Emissions and Cost

"Baseline" Case and "Scenario" Case*



*New appliances are purchased and installed in "Scenario" case

NEAT Simulates the Housing Stock in the South Coast Air Basin



5.5 million households in Basin represented by a sample set of homes (up to 225,000 samples)

Properties of each home:

- Climate Zone (6 categories)
- Housing type (single family, multi-family, mobile homes)
- Income level (used to determine eligibility for utility rate assistance programs)
- Gas and electric utility provider
- Baseline Appliance Mix (Defined by 2009 RASS Study)
- “Scenario” Appliance Mix (Defined by user)
- Solar and/or residential battery storage installed in “Scenario”

NEAT is Capable of a Wide Variety of Analyses (independent or in aggregate)

- Emissions and Cost Impacts (separated by climate zone, housing category, gas utility, and electric utility) of:
  - ✓Improving efficiency
  - ✓Fuel switching
  - ✓Switching to zero and near-zero emission appliances
  - ✓Increasing penetration of renewable gas and/or electricity
  - ✓Reducing methane leakage and/or electricity transmission losses
  - ✓Changing rate structures and utility costs (i.e. switching to TOU rates)
  - ✓Net metering
  - ✓Increased penetration of solar, residential battery storage, and/or electric vehicles

NEAT is Capable of a Wide Variety of Analyses (independent or in aggregate)

- Emissions and Cost Impacts (separated by climate zone, housing category, gas utility, and electric utility) of:
  - ✓**Improving efficiency**
  - ✓Fuel switching
  - ✓Switching to zero and near-zero emission appliances
  - ✓Increasing penetration of renewable gas and/or electricity
  - ✓Reducing methane leakage and/or electricity transmission losses
  - ✓Changing rate structures and utility costs (i.e. switching to TOU rates)
  - ✓Net metering
  - ✓Increasing penetration of solar, residential battery storage, and/or electric vehicles

Simple Scenario Demonstration
(Installation of more efficient appliances)

Example Scenario: Replace all Electric Dryers with Heat Pump Electric Dryers

Hot water heating | Kitchen | Laundry | Miscellaneous | Pool | Space heating and cooling | Transportation

BASELINE TECHNOLOGY MIX PARAMETERS

	Fuel	Technology	UEC	NOX EF	CO2e EF	Unit Cost	Install Cost	Lifetime	Penetration
A	Electric	Dryer	615	0	0	750	100	18	0.289
B	Electric	Clothes Washer	82	0	0	850	100	13	0.732
C	NatGas	Dryer	25	0.0136	11.76	800	100	18	0.383

SCENARIO TECHNOLOGY MIX PARAMETERS View Tech Definitions | Show Column Information

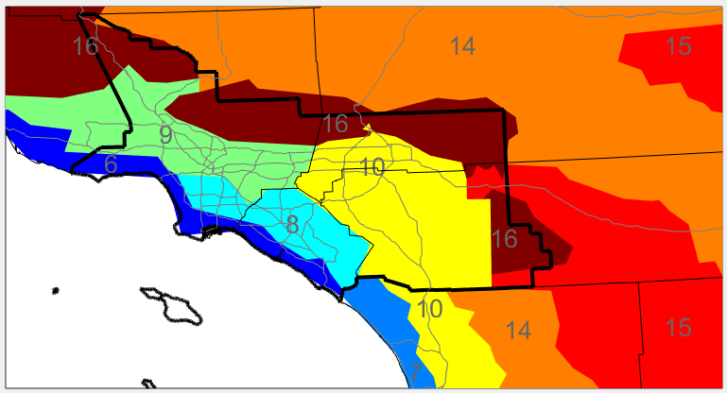
Fuel	Technology	UEC	NOX EF	CO2e EF	Unit Cost	Install Cost	Lifetime
Electric	Heat Pump Dryer	179	0	0	1263	100	18
Electric	Clothes Washer	82	0	0	850	100	13
NatGas	Dryer	25	0.0136	11.76	800	100	18

Baseline parameters calculated from 2009 RASS Study
Scenario parameters calculated from energystar.gov

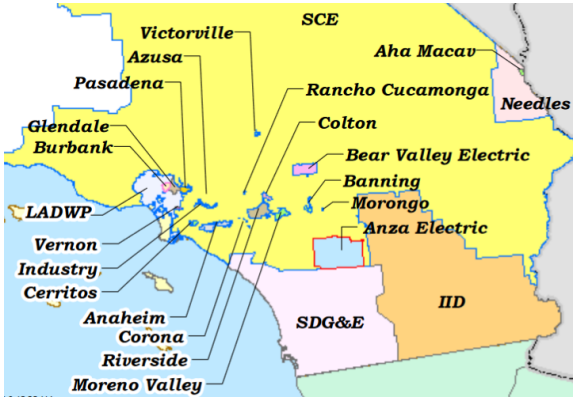
All data is preliminary and for demonstration purposes only. NEAT is currently undergoing comprehensive QA/QC

Determine Subset of Homes to Analyze

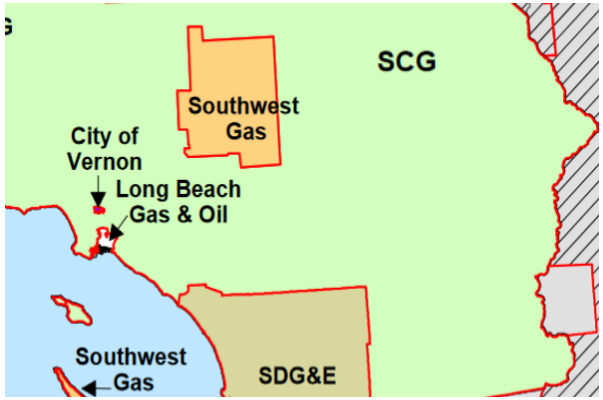
Climate Zones



Electric Utilities



Natural Gas Utilities



Source: www.energy.ca.gov

Filter Homes

Climate Zones

- ○ 6 Coastal
- ○ 8 S. Near-Coastal
- ○ 9 N. Near-Coastal
- ○ 10 S. Inland
- ○ 15 S. Desert
- ○ 16 Mountain
- ◉ All Climate Zones

Housing Category

- ○ Only Single Family Homes
- ○ Only Multi Family Homes
- ○ Only Mobile Homes
- ◉ All Housing Types

Natural Gas Utilities

- ☑ Long Beach Gas & Oil
- ☑ Southern California Gas
- ☑ Southwest Gas Corp.
- ☑ City of Vernon Gas System

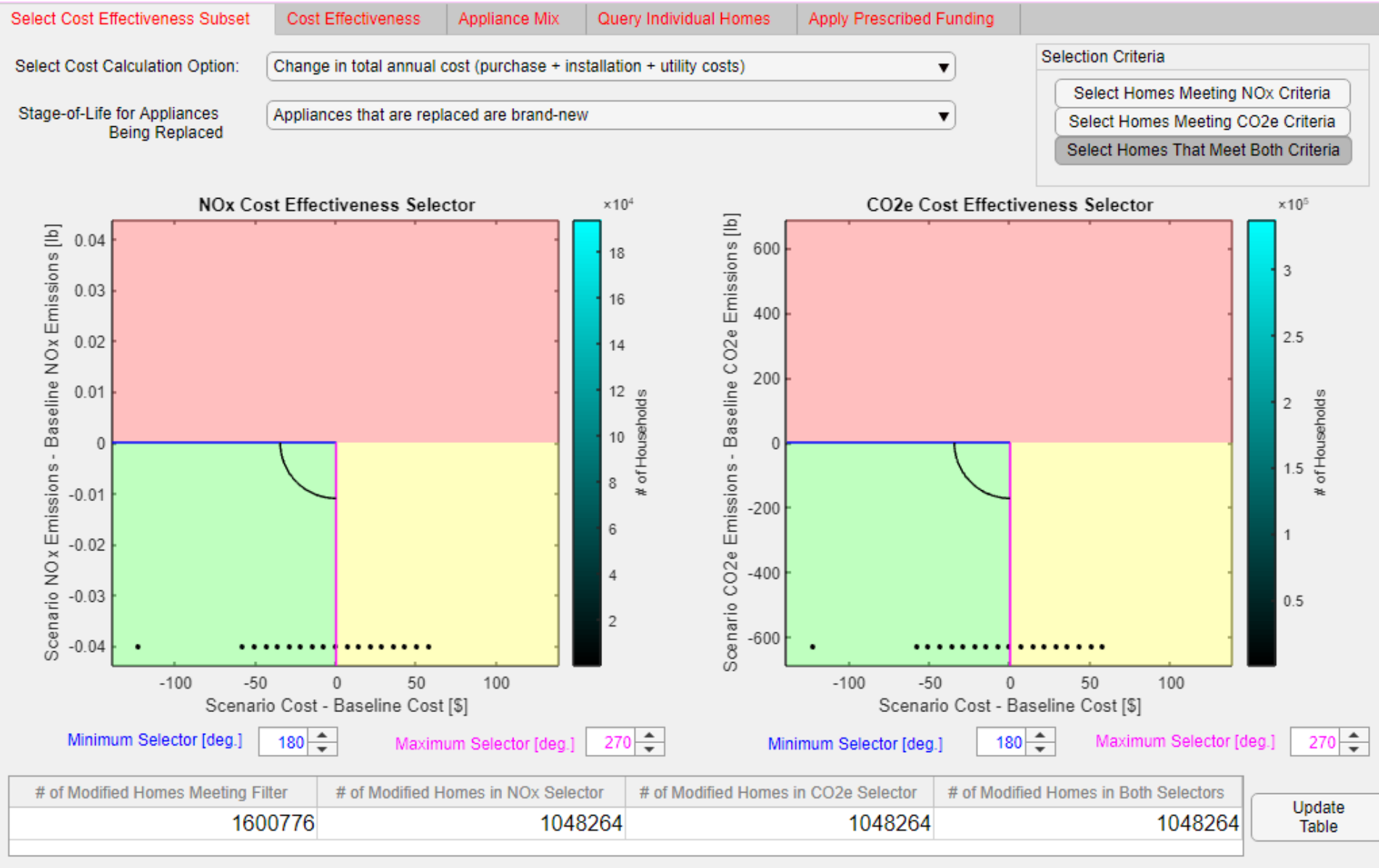
Electric Utilities

- ☑ Azusa Light & Power
- ☑ Bear Valley Electric Service
- ☑ Burbank Water & Power
- ☑ City of Anaheim Public Utilities Department
- ☑ City of Banning Electric Department
- ☑ City of Corona Department of Water & Power
- ☑ City of Riverside
- ☑ City of Vernon Municipal Light Department
- ☑ Glendale Water & Power
- ☑ Los Angeles Department of Water & Power
- ☑ Moreno Valley Utility
- ☑ Pasadena Water & Power
- ☑ Rancho Cucamonga Municipal Utility
- ☑ San Diego Gas & Electric
- ☑ Southern California Edison

5,546,817 homes meeting filter critera above
100% of the total homes in SoCAB meet filter criteria

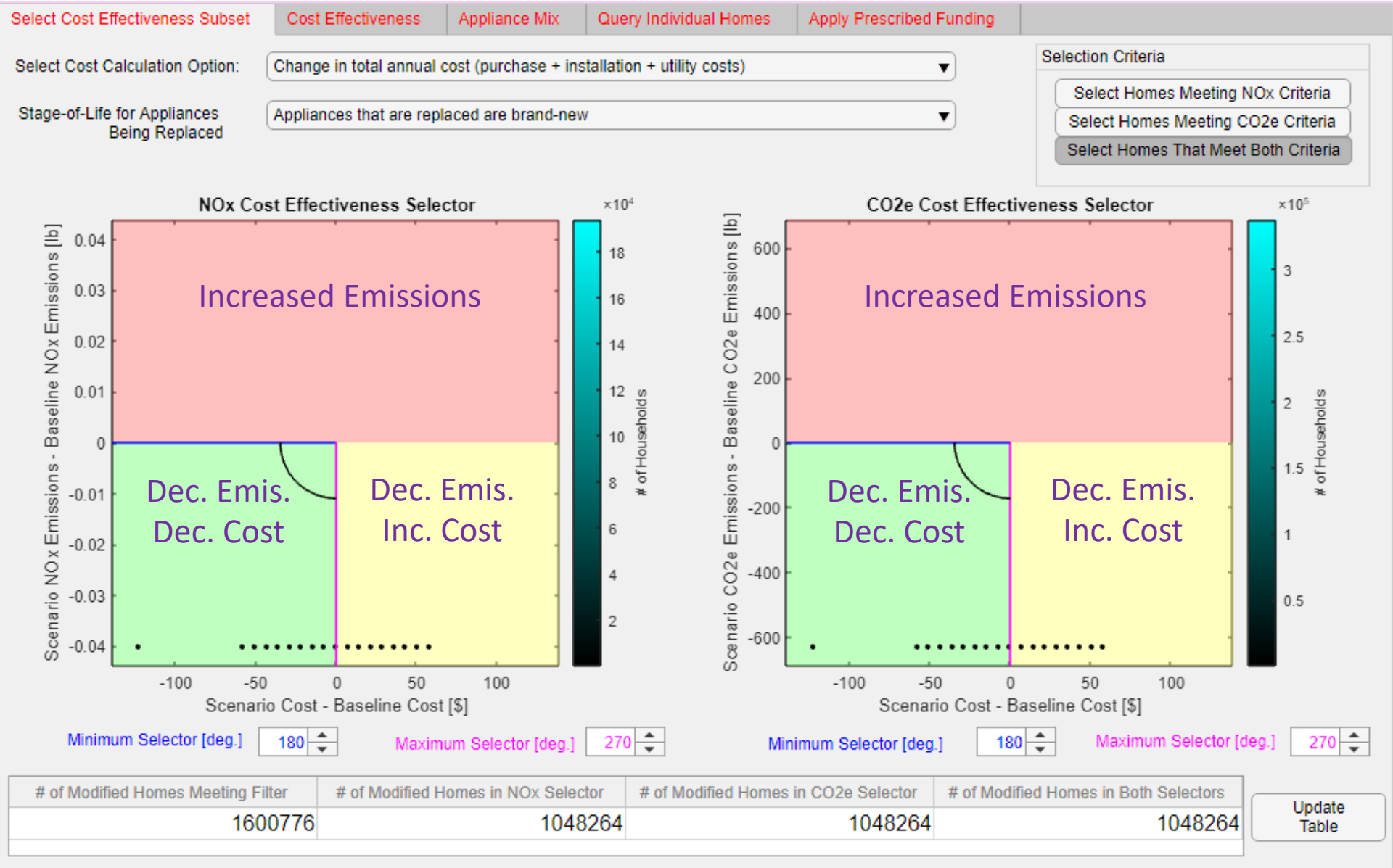
More Information | View CZ MAP | ANALYZE

Cost Effectiveness Analysis Tools



* All data is preliminary and for demonstration purposes only.

Cost Effectiveness Analysis Tools



* All data is preliminary and for demonstration purposes only.

Cost Effectiveness Analysis Tools

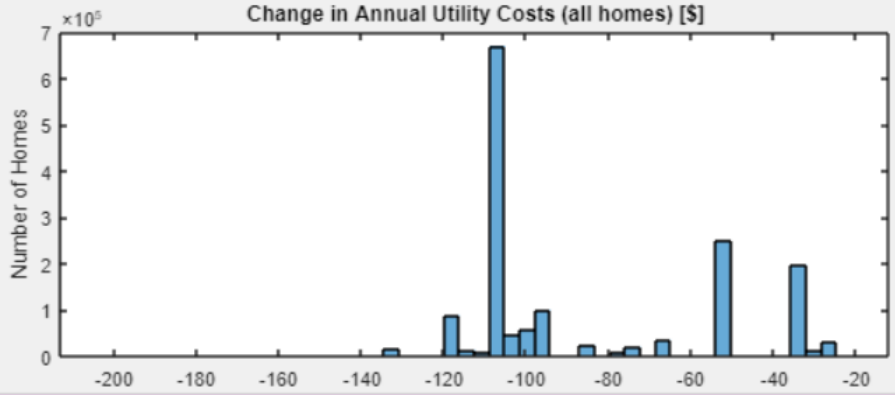
Select Cost Effectiveness Subset | Cost Effectiveness | Appliance Mix | Query Individual Homes | Apply Prescribed Funding

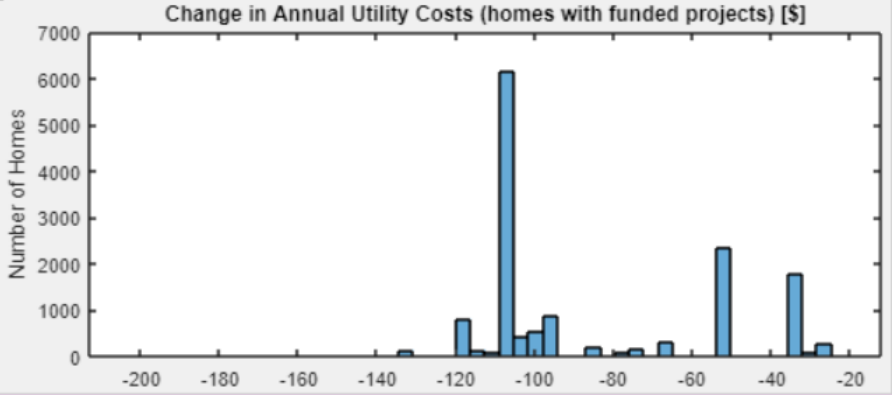
Enter Funding Amount [$]: 10000000 *Funding is applied only to households filtered on the "Select Cost Effectiveness Subset"* Cost Share by Homeowner [%]: 50

Stage-of-Life for Appliances Being Replaced: Appliances that are replaced are at the end of their life

$1,090,928,844 would fund all projects | More Information

Description (click on a variable to view histograms)	Value
Approximate Number of Projects Funded	14673
Number of Possible Projects in "Cost Effectiveness Subset"	1600776
Cumulative Change in NOx Emissions [lb/yr]	-586.29
Cumulative Change in NOx Emissions [TPD]	-0.00080259
Cumulative Change in CO2e Emissions [lb/yr]	-9.1746e+06
Cumulative Change in CO2e Emissions [TPD]	-12.559
Average Incentive Amount Provided to Homeowner [$]	681.5
Median Incentive Amount Provided to Homeowner [$]	681.5
Average Cost-Share from Homeowner [$]	681.5
Median Cost-Share from Homeowner [$]	681.5
Average Change in Annual Utility Costs [$]	-85.389
Median Change in Annual Utility Costs [$]	-105.28
Average Change in Ammortized Appliance Purchase and Installation Costs Borne By Homeowner [$]	14.25
Median Change in Ammortized Appliance Purchase and Installation Costs Borne By Homeowner [$]	14.25





M:\NEAT\software_ver_1_9\DataFiles\AAAR\heatPumpDryerScenario.results loaded.
Run computed at 17-Aug-2018 12:05:26

RETURN TO PREVIOUS | ADVANCE TO NEXT

* All data is preliminary and for demonstration purposes only.

Ongoing Development of NEAT

- https://www.aqmd.gov/NEAT for more information
- Workgroup meets regularly to advise on development
  - Join our workgroup
  - Submit a comment letter
- NEAT will be publicly available for free when complete (expected early 2019)