AdTra, Inc. Agriculture, Engineering & Energy, Transportation and Commerce
P.O. Box 19291, Sacramento, CA 95819-0291.•USA
PH: (916) 971-1586 • FX: (916) 484-6330

July 23, 2019

Chairman Mary Nichols
California Air Resources Board
1001 I Street
Sacramento, CA 95814

RE: The Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals

Dear Chairman Nichols:

AdTra is pleased to submit comments on the California Air Resources Board's workshop on the Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals. AdTra appreciates the work that CARB is doing in this area.

AdTra comments cover five areas below. Our comments are based on in-depth analysis of carbon intensity implications for possible policy options such as increased electrification of the industrial sector as a path to achieving California's carbon neutrality outcomes. The comments also relate to Transportation Electrification and Buildings Electrification policy options for decarbonizing the state's economy. *AdTra finds that to capture the benefits of electrification, the implications of CO2 emissions from California wildfires on transmitted electricity are a critical consideration as California agencies pursue widespread electrification in the transportation, buildings and industrial sectors.*

1) Fire-caused attributable indirect greenhouse gas emissions

Since the U.S. Department of the Interior found that the 2018 California wildfires released 68 million tons of CO2 to the atmosphere as much as the state's electricity sector for 2016, AdTra has conducted research to understand what impact, if any, CO2 emissions from wildfires attributed to California grid electrical equipment, might have on the carbon intensities of California grid electricity pathways. Multiple entities such as CAL FIRE and a federal court have established that utility equipment were ignition sources of multiple fires in California. AdTra characterizes ghg emissions effects from wildfires linked to utility electrical equipment as "fire-caused attributable indirect ghg emissions" (*ficai ghg emissions*). Drawing on earlier work in the literature and the clearly established link between some wildfires and electric grid equipment, it is our professional judgment that this is an informed treatment of these types of emissions.

With this in mind, AdTra analyzed California electricity pathways using the Energy Commission's AB 1007 Full Fuel Cycle Analysis and selected electricity pathways of the Air Resources Board's CAL GREET 3.0 to assess how pathways carbon intensities would change as adjusted for ficai ghg emissions. CAL GREET 3.0 is another iteration of the AB 1007 Full Fuel Cycle Analysis.

Ficai ghg emissions are nontrivial, with profound implications. AdTra research suggests ficai ghg emissions impacts are non-trivial. For example, AdTra analysis shows that, based on modeled attribution levels of 25 to 50 percent for ficai ghg emissions, 19.2 to 38.4 grams CO2e/MJ should be added, as an indirect component, to direct carbon intensities of California electricity pathways. *The implications of this finding are profound and wide-ranging because electricity is a major input to*

many fuel pathways. We raise this issue for consideration by the relevant California agencies, especially the California Energy Commission and the California Air Resources Board.

From 174 electricity pathways evaluated, we present one set of our results (AdTra Insights 2j) in the attachment for the Energy Commission's consideration in the agency's present and perhaps future studies. This result also shows carbon intensities for battery-stored (*retransmitted*) electricity pathways for often cited condition of energy storage of excess renewables (solar, wind) generation.

Potential Impacts. To further understand the impacts of the ficai ghg emissions on California's decarbonization efforts, we evaluated how the Buildings Electrification, Transportation Electrification and Industrial Electrification outcomes envisioned by different California policy objectives would express. We present one set of our results in the attached AdTra Insights 2k, 2l and 2m for the ARB's consideration.

In general, AdTra analysis suggests that in the 2035 to 2050 period, when ficai ghg emissions are accounted for in California electricity pathways, about 218 million metric tons of CO2 emissions (AdTra Insights 2n) are added to the state's ghg inventory with the levels of industrial sector electrification as modeled by the Electric Power Research Institute (EPRI) and presented at the ARB's July 8, 2019 Carbon Neutrality workshop; Buildings Electrification as modeled in the Energy Commission's E3 study on decarbonizing the natural gas system, and relevant California transportation electrification studies. For comparison, the added ghg emissions exceeds the "transportation fair share" ghg emissions reductions (176 million metric tons) required for California to meet its 80 percent reduction target below 1990 levels, plus other sectors. Ficai ghg additions are also more than 50 percent of California's 2016 ghg emissions inventory (429 million metric tons CO2e) reported in the staff presentation at the workshop. The ARB staff presentation at the workshop showed a state ghg emission inventory of 86 million metric tons CO2e if different policy outcomes are realized. When ficai ghg emissions are considered, California's 2050 ghg inventory level rises to 304 million metric tons which is only 30 percent below the 1990 levels target.

Ficai ghg emissions need to be duly considered. Based on our analysis, it is our view that any credible assessment of policy actions and measures to decarbonize California's economy cannot ignore fire-caused attributable indirect ghg emissions. And although the AdTra research continues in this pioneering area and new insights might unfold, it is our professional judgment the information developed so far suggests ficai ghg emissions warrant a closer look by the California agencies. AdTra respectfully recommends that the California Air Resources Board gives the information and analysis supplied due consideration.

2) Truck portfolio (Low-NOx HD natural gas engines/trucks and battery electric trucks)

In light of ficai ghg emissions and the added transportation electrification ghg burdens (AdTra Insights 2l), AdTra finds that a balanced emphasis on low-NOx natural gas heavy-duty trucks powered by blends of renewable natural gas is an attractive option for decarbonizing California's economy. Rising energy costs means commercial fleets should retain fuel choice flexibility. In its evaluation of options to meet zero-emission transit bus requirements, a Los Angeles County Metropolitan Transit Authority contractor assessment found that RNG supplies could be sourced at 78 cents per diesel gallon equivalent under appropriate contract structures making low-NOx natural gas transit buses and trucks economically attractive.

3) Price of renewable natural gas versus *transmitted electricity* prices

The Energy Commission's E3 study suggests relying on low carbon RNG may be a costly option to decarbonize buildings. We assume, by implication, the assessment might apply to the industrial sector as well since costs factors might be similar. We find market data exist that indicate under innovative business models and contract mechanisms, RNG can be supplied at competitive price points which make RNG blends serving buildings, and by extension, industrial facilities and processes, can be economically attractive. Furthermore, in consideration of rising electricity costs in California, the Energy Commission's contractor study does not persuasively establish that, for *transmitted electricity* or grid-sourced electricity, that Buildings Electrification is necessarily economic. For the industrial sector, EPRI's initial analysis presented at ARB's July 8, 2019 workshop suggests a high CO2 cost-effectiveness of $1,260/ton which exceeds various upper bound estimates of CO2 abatement costs (for example $200/ton). AdTra envisions other scenarios where economic, Buildings Electrification and industrial sector electrification may be realized. ARB staff and buildings and industrial sectors stakeholder communities can explore lower cost scenarios in future work.

4) Methane leaks

On-going concerns about methane leaks and associated global warming potential are acknowledged as one driver of electrification. Studies of methane leaks (fugitive methane emissions) have found that keeping such emissions below 2% of production volume should be an effective solution even as more innovation is implemented to further reduce methane leaks. Therefore, we do not find that methane leaks, or concern about methane leaks as a driver of Buildings Electrification and industrial sector electrification, is sufficient.

5) Renewables Portfolio

The state's substantial reliance on its renewables portfolio comes with risks that many analysts have identified. The state is addressing these risks to make resilient, a California electricity grid dominated by renewables.

Potential new risks. We identify a new risk of potentially overstating the benefits of the state's renewables portfolio where impacts of ficai ghg emissions for *transmitted electricity* are not properly considered and accounted for. An additional risk is the uncertainty that failure to account for ficai emissions might introduce into ghg emission reduction outcomes from various California decarbonization policies.

During my time at the Energy Commission, I was privileged to lead the work that customized the U.S. Department of Energy's GREET model for use in California's Low Carbon Fuel Standard, the selection of Purdue University's GTAP model for indirect land use change emissions modeling, as well as early use of carbon intensities for projects ghg performance evaluation and program funding. Following adoption by the Energy Commission, CAL GREET was transferred to the Air Resources Board for LCFS implementation. The Energy Commission also sponsored GREET training of Air Resources Board staff as part of the handover and agencies' collaboration. This background and experience also inform the AdTra comments here.

It is hoped that the California Air Resources Board's and the Energy Commission's leadership in full fuel cycle analyses will be exercised in addressing non-trivial effects of fire-caused attributable indirect ghg emissions on the carbon intensities of fuels as both agencies evaluate strategies to achieve California's Carbon Neutrality goals and decarbonize the state's economy.

The AdTra team is available to provide additional insights to ARB staff on these topics. I can be reached by email at adtra.us@att.net.

Respectfully,

McKinley

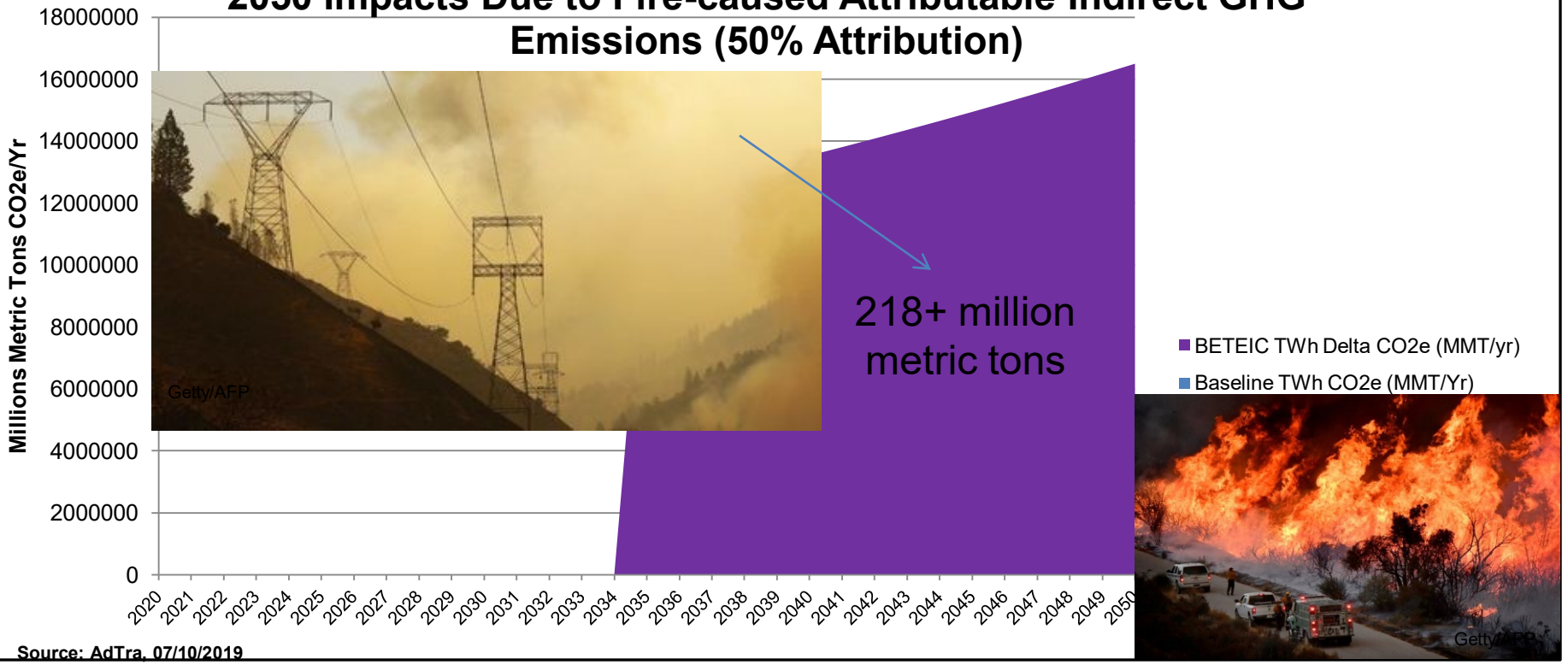
McKinley Addy, P.E.
Vice President

CC: Chairman David Hochschild, California Energy Commission
Commissioner Andrew McAllister, California Energy Commission
Mr. Tim Olson, California Energy Commission
Mr. Guido Franco, California Energy Commission
Dr. Susan Fischer-Wilheim, California Energy Commission
Dr. Daniel M. Kammen, University of California, Berkeley

Attachments: (1)

AdTra Insights: Full Fuel Cycle Analysis

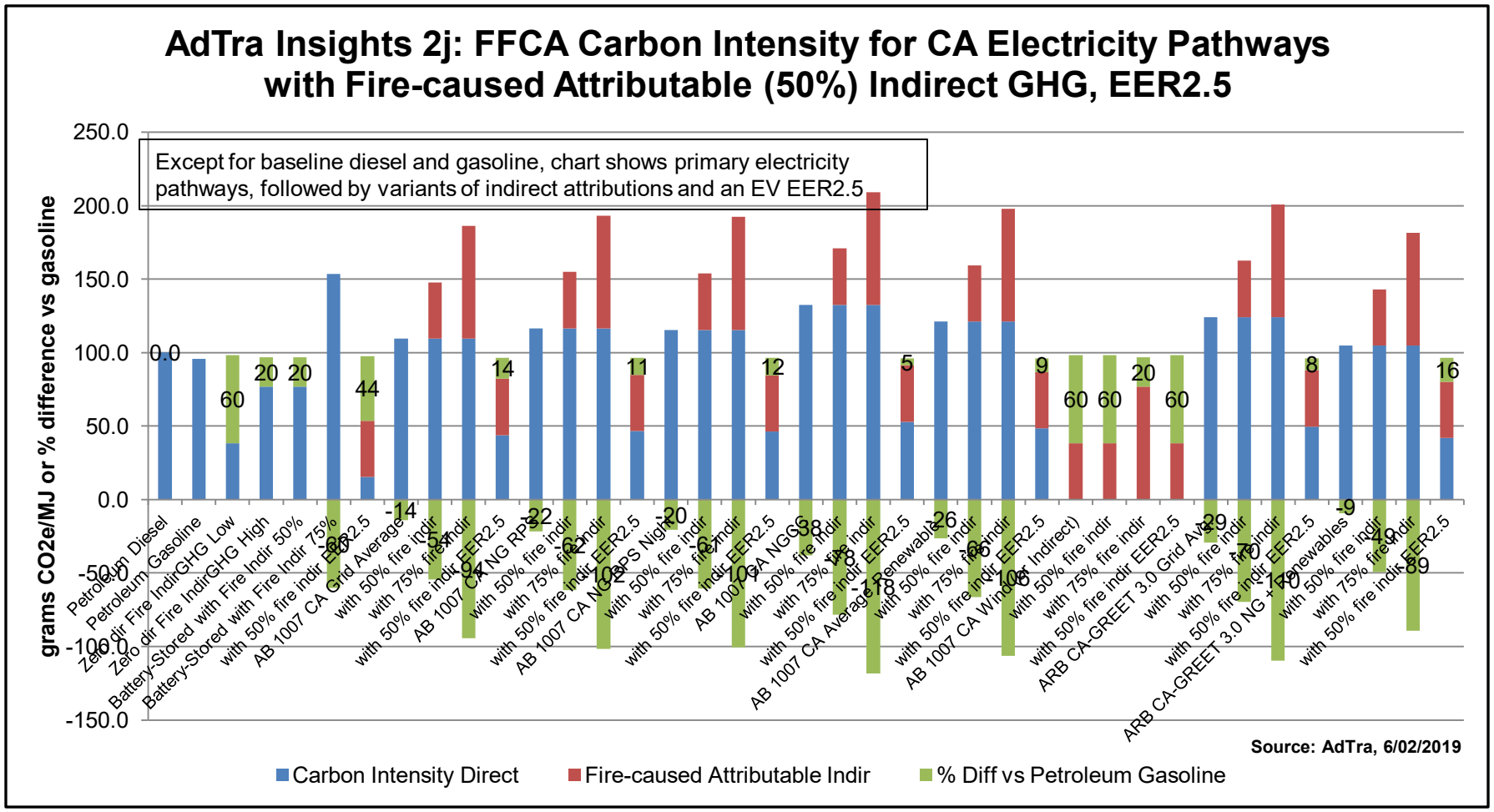
AdTra Insights 2n: California Buildings, Transportation & Industrial (BETEI)Sectors Electrification Possible Incremental GHG 2035 to 2050 Impacts Due to Fire-caused Attributable Indirect GHG Emissions (50% Attribution)



Source: AdTra, 07/10/2019

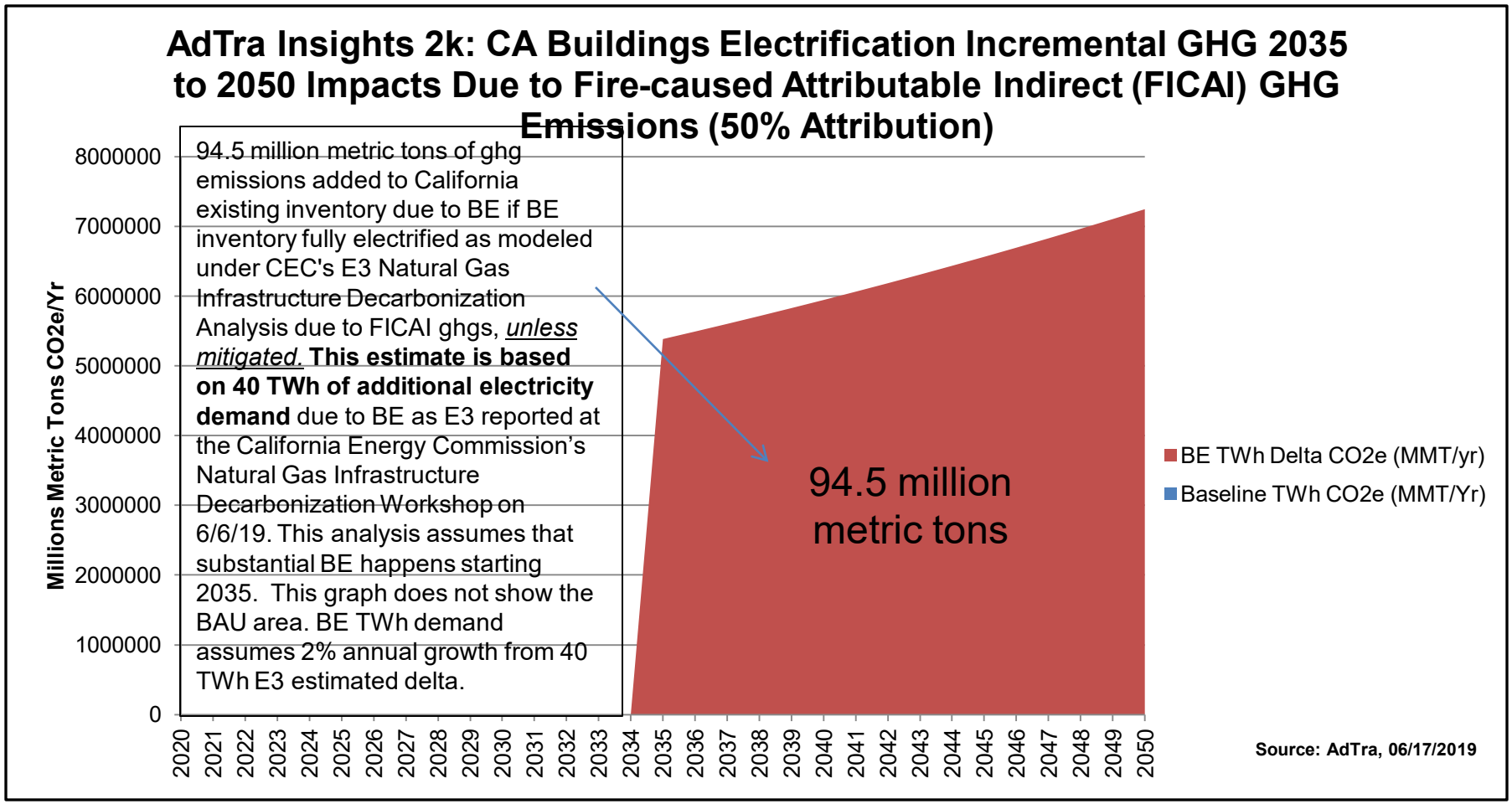
218 million metric tons of ghg emissions added to California existing inventory due to BETEI if BETEI inventory fully electrified as modeled under various state agencies & industry sector electrification analyses. **This AdTra estimate is based on 90 TWh of additional electricity demand** due to BETEI elements reported at the California Energy Commission's Natural Gas Infrastructure Decarbonization Workshop (6/6/19) and California Air Resources Board Workshop on Carbon Neutrality (7/8/19). This analysis assumes that substantial BETEI happens starting 2035. This graph does not show the BAU area. BETEI TWh demand assumes 2% annual growth from 90TWh estimated delta.

AdTra Insights: Full Fuel Cycle Analysis



Note: Results based on AdTra modeling of carbon intensity of fuels indicated using California Full Fuel Cycle Analysis models. AdTra adapted the California Energy Commission's AB 1007 GREET Model to include effects of fire-caused attributable indirect ghg emissions to direct ***transmitted electricity*** ghg emissions. It is assumed ghg emissions due to California wildfires with ignition sourced to grid electrical equipment need to be accounted for in the full fuel cycle analysis. Such attributable indirect ghg emissions cannot be zero. Two indirect ghg values are estimated and used to show a lower bound and upper bound. 20-year horizon used per IPCC. Such indirect ghg emissions are not likely to apply to on-site generation. Notice, there is not much difference between the ARB GREET 3.0 values and the AB 1007 GREET values.

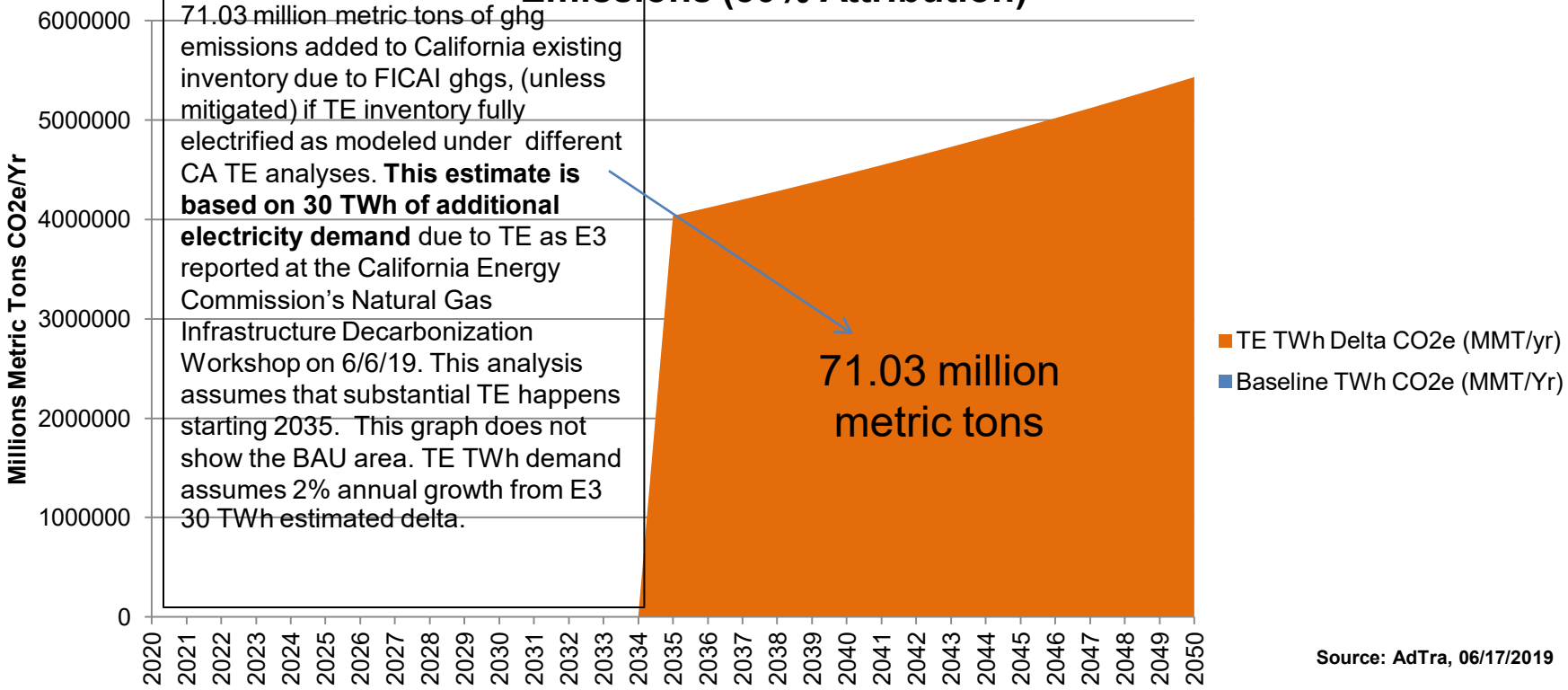
AdTra Insights: Full Fuel Cycle Analysis



Note: Results based on AdTra modeling of carbon intensity of fuels indicated using California Full Fuel Cycle Analysis models. AdTra adapted the California Energy Commission's AB 1007 GREET Model to include effects of fire-caused attributable indirect ghg emissions to direct ***transmitted electricity*** ghg emissions. It is assumed ghg emissions due to California wildfires with ignition sourced to grid electrical equipment need to be accounted for in the full fuel cycle analysis. Such attributable indirect ghg emissions cannot be zero. Two indirect ghg values are estimated and used to show a lower bound and upper bound. 20-year horizon used per IPCC. Such indirect ghg emissions are not likely to apply to on-site generation. The incremental plot indicated is above baseline or Business-As-Usual buildings sector electricity ghg.

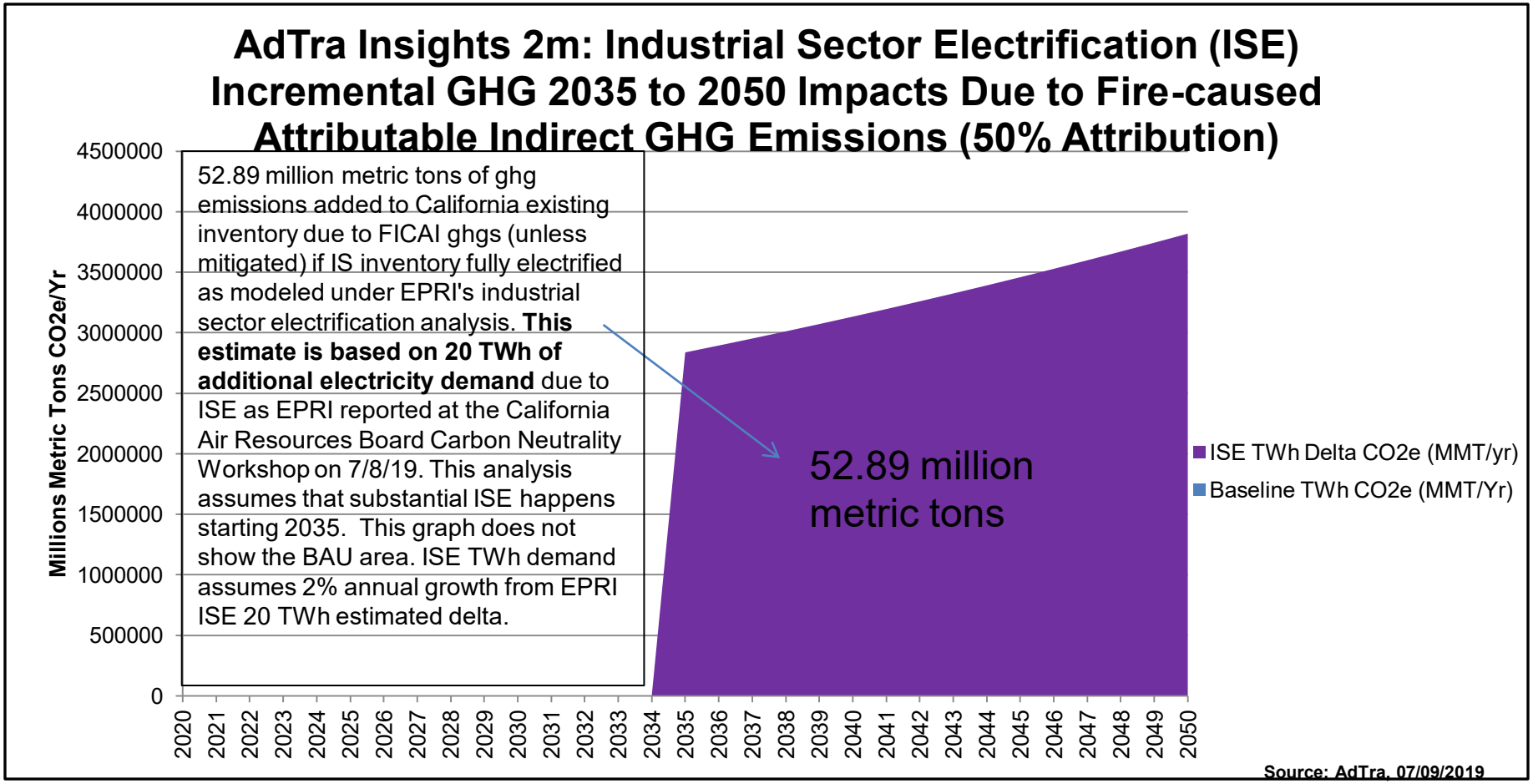
AdTra Insights: Full Fuel Cycle Analysis

AdTra Insights 2I: Transportation Electrification Incremental GHG 2035 to 2050 Impacts Due to Fire-caused Attributable Indirect (FICAI) GHG Emissions (50% Attribution)



Note: Results based on AdTra modeling of carbon intensity of fuels indicated using California Full Fuel Cycle Analysis models. AdTra adapted the California Energy Commission's AB 1007 GREET Model to include effects of fire-caused attributable indirect ghg emissions to direct ***transmitted electricity*** ghg emissions. It is assumed ghg emissions due to California wildfires with ignition sourced to grid electrical equipment need to be accounted for in the full fuel cycle analysis. Such attributable indirect ghg emissions cannot be zero. Two indirect ghg values are estimated and used to show a lower bound and upper bound. 20-year horizon used per IPCC. Such indirect ghg emissions are not likely to apply to on-site generation. The incremental plot indicated is above baseline or Business-As-Usual transportation sector electricity ghg.

AdTra Insights: Full Fuel Cycle Analysis



Note: Results based on AdTra modeling of carbon intensity of fuels indicated using California Full Fuel Cycle Analysis models. AdTra adapted the California Energy Commission's AB 1007 GREET Model to include effects of fire-caused attributable indirect ghg emissions to direct ***transmitted electricity*** ghg emissions. It is assumed ghg emissions due to California wildfires with ignition sourced to grid electrical equipment need to be accounted for in the full fuel cycle analysis. Such attributable indirect ghg emissions cannot be zero. Two indirect ghg values are estimated and used to show a lower bound and upper bound. 20-year horizon used per IPCC. Such indirect ghg emissions are not likely to apply to on-site generation. The incremental plot indicated is above baseline or Business-As-Usual industrial sector electricity ghg.