Sacramento Area Council of Governments
Addendum to 8/10/2018
Technical Methodology for Greenhouse Gas Calculations for the 2020 MTP/SCS

Pursuant to Section 65080 of the Government Code, on August 10, 2018, SACOG submitted to ARB documentation of the technical methodology (TM) intended for use in developing and analyzing the 2020 Sustainable Community Strategy (SCS). At that time, ARB had not yet finalized its SCS evaluation guidelines document, nor had it published or distributed its auto operating cost (AOC) calculator. After SACOG's submittal of its TM, ARB published draft evaluation guidelines (March 2019), posted a draft of its AOC calculator (August 28, 2018), and published an updated version of its AOC calculator (early in 2019). During this period, ARB requested additional information on SACOGs TM submittal, and requested changes to it. The requests for additional information and changes resulted in a significant dialog between ARB and SACOG staff. Appendix A includes emails documenting the dialog, and agendas and meeting notes for some of the conversations between ARB and SACOG staff. The purpose of this submittal is to finalize additions and clarifications to the SACOG TM submittal.

Additions and clarifications are provided for the following specific topics: version of EMFAC to be used; calculation of AOC; approach to report an increment of progress analysis in SACOG's SCS; and approach to analysis of induced travel.

I. Version of EMFAC

At the time of the TM submittal, ARB had provided no firm guidance on the version of EMFAC to be used for SB 375 related greenhouse gas (GHG) estimates. The TM submittal, instead of identifying a specific version to be used, identified significant differences in GHG rates and the share of VMT by passenger vehicles in versions of EMFAC that complicated the process of identifying a version of EMFAC to be used. On 9/11/2018, ARB directed SACOG to: 1) use either EMFAC2011 or EMFAC2014 for SCS forecast years; 2) use EMFAC2007 for year 2005 and prior SCS performance; and 3) use the ARB methodology for adjusting between EMFAC2007 and the more current version of EMFAC. Since that direction, SACOG has used EMFAC2014 for forecast years, adjusting appropriately to EMFAC2007 for prior years to develop the 2020 SCS.

The March 2019 ARB draft evaluation guidelines stated that for third round SCSs, MPOs should use the exact versions of EMFAC utilized for the second round SCSs. For SACOG, that would require using EMFAC2011 instead of EMFAC2014. The stated purpose of using EMFAC2011 instead of EMFAC2014 is for nominal consistency with the second round SCS. SACOG believes the added "incremental progress" analysis, which will be performed as discussed below, is intended to achieve the same goal, of normalizing the evaluation of the second and third round SCSs, and quantifying the impact of substantive changes in land use, transportation, or pricing on the target achievement for the third round SCS.

II. Calculation of Auto Operating Cost

In its TM submittal, SACOG proposed using the same calculation method as used in the 2012 and 2016 SCSs (see memorandum in Appendix B showing the 2016 method and results). For its 2020 SCS, SACOG proposed two changes: 1) updating the fuel price forecasts using the 2017 Department of Energy/Energy Information Administration (DOE/EIA) "Energy Outlook" series; and 2) augmenting the calculation with a separate, VMT-weighted calculation for plug-in electric vehicles.

Appendix B provides the basic update of AOC using the method and sources used by the four large MPOs for the first and second round SCSs. The updates include: updates to DOE/EIA fuel price forecasts; updates to the non-fuel costs per mile based on AAA "Your Costs of Driving"; and updates to the passenger vehicle fleet MPG based on EMFAC2014. The updates convert all costs to year 2017 dollars. The basic comparison on AOC for SACOG, comparing the 2016 SCS to the 2020 SCS, is provided below Note that the application of the method used in SCS1 and SCS2 resulted in a 14 percent reduction in AOC.

Appendix C provides an alternate calculation of AOC, which adjusts the auto operating cost calculation to account for the VMT rebound effect, with respect to vehicle efficiency changes. ARB and SACOG staff have had discussions on recent research[1] showing that the effect of increasing vehicle efficiency (i.e., MPG) on propensity to travel is significantly less than the effect of increasing fuel cost. There is some evidence that the impact of increasing vehicle efficiency has a smaller "rebound" effect than previously thought. Rebound is defined as: the percentage of expected fuel/emissions savings, based on an increase in vehicle efficiency, lost due to increased use of vehicles as a result of reduced AOC. Rebound was thought to be about 20 percent, which would imply that the response to reduction in cost from increased vehicle efficiency was equivalent to the response to reduction in cost from declining fuel cost. More recent research puts rebound at 8 to 14 percent, or 40 to 70 percent of prior expectation.

SACOG has developed an approach to reflect this differential weighting of change in cost due to higher vehicle efficiency, compared to higher fuel cost. A description of the approach was shared with ARB staff for comment on June 7, 2019 and discussed at greater length since then. SACOG prefers to use this approach in combination with the more recent posting of the ARB AOC calculator as an alternative to the approach

[1] Gillingham, Kenneth, "The Rebound Effect and Fuel Economy Standards: Comment on the Saver Affordable Fuel-Efficient (SAFE) Vehicles Propose Rule for Model Years 2021-2026 Passenger Cars and Light Trucks," October 24, 2018.

proposed in the TM submittal. The formula and table below provide an accounting of the approach. Appendix C provides an details of the application and testing to establish a reasonable MPG BETA value.

AOCp (fy) =
NFC(fy) + {FUELCOST(fy) / {MPG(by) + BETA * [MPG(fy) - MPG(by)]}
Where:
AOCp(fy) = Perceived auto operating cost in future year (cents per mile)
NFC(fy) = Non-fuel cost in future year (cents per mile)
FUELCOST(fy) = Price per gallon equivalent of fuel in future year (cents per gallon)
MPG(by) = Fleet average miles per gallon in base year
MPG(fy) = Fleet average miles per gallon in future year
MPG BETA = Weighting factor for fleet MPG change (value <1.0, set through testing)

The advantages of this approach are:

1) It reflects recent research on travel response to changes in vehicle efficiency.
2) It aligns the "rebound" effect in our modeling of the SCS with the analysis reported by ARB for purposes of the SB 375 target resetting.
3) The approach would be explicitly based on the weighted, "multi-fuel" approach published by ARB in August 2018 in draft form, and January 2019 in final form, with AOC average cost based on gasoline, diesel, electric and hybrid vehicles.

The table below provides a comparison of the two approaches to AOC for the 2020 SCS. Based on our discussion on this topic, either is acceptable to ARB for the 2020 SCS submittal. For the "Rebound Adjusted" calculation, as mentioned above, SACOGs proposes to use the ARB AOC calculator, with custom settings for gasoline price (based on the method shown in Appendix B), and for non-fuel costs (based on AAA data, trend-lined to 2035).

2035 Forecasts of Auto Operating Costs--SACOG

Factor	2012 SCS	2016 SCS	2020 SCS (based on 2016 SCS method, updated)	2020 SCS (based on differential weighting of MPG)
Pass. Veh. Fleet MPG	29.4	28.3	39.4	40.5 (29.5 adj.)
Gasoline Price ($ / gallon)	$6.17	$5.41	$5.09	$5.09
Non-0Fuel Costs ($ / mile)	$0.13	$0.10	$0.12	$0.10
AOC ($ / mile)	$0.34	$0.29	$0.25	$0.27

III. Incremental Progress Analysis

At the time of SACOG's TM submittal, ARB indicated a desire to receive an "incremental progress" analysis of SCSs as part of the statewide dialog on the preparation of SCS evaluation guidelines. No requirement for such an analysis was in place at the time of our submittal, and the submittal did not include any proposed methodology for an increment of progress analysis. Based on evaluation guidance published in March 2019, the purpose of the incremental progress analysis is to identify the steps that MPOs are taking to make progress from one SCS to the next. This goal can be achieved in part through a comparative analysis of the policies included in the 2020 SCS, compared to the 2016 SCS, and this comparative analysis will be provided in the documentation of the GHG reduction calculation prepared by SACOG. ARB staff has proposed that a part of this analysis be based on modeling, and that an effort by the MPOs be made to normalize key factors and input assumptions for the current and immediately preceding SCS. SACOG will provide this information. The table below provides the proposed approach for normalizing key factors and input assumptions. The comparison of results of this analysis will be provided at regional level and by community types, and will focus on key transportation metrics (e.g., VMT and trips by mode), and at regional level for passenger vehicle GHG.

Factor or Assumption	Steps to Normalize
Version of SACSIM model	2016 SCS to be modeled w/ SACSIM19
Version of EMFAC	2016 SCS vehicle emission estimated using EMFAC2014
Auto Operating Cost	2016 SCS modeled w/ 2020 SCS AOC method
Interregional travel	2016 SCS modeled with 2020 SCS assumptions
Household Income	2016 SCS to be adjusted to 2020 SCS regional median income

IV. Induced Travel Analysis

For purposes of SACOG's 2020 SCS submittal, induced travel effects fall into two general categories: short-term and long-term. Common to both effects are responses to provision of new roadway capacity, and the potential to increase vehicle travel relative to a prior condition without the new roadway capacity.

Short-term induced travel effects include direct individual or household travel responses to new roadway capacity: taking a different and longer route after a new roadway is built or expanded; choosing a more distant activity location, or a longer pattern of activities in a tour, based on the new or expanded roadway; making more trips in total, with the added trips being vehicle trips, based on the new or expanded roadway; choosing to drive instead of walk, bike or transit to a chosen activity, due to the new or expanded roadway.

Short-term induced travel effects will be analyzed using the SACSIM travel demand model, which captures both the effect of new roadway capacity on increasing travel speed on the new or expanded roadway, and the relative attractiveness of those increased travel speeds on the number and pattern of activities requiring travel, and on destination and mode choice. The approach to testing SACSIM for sensitivity to short-term effects will be to add roadway capacity to the base year scenario, and compare the VMT results to the base year without the added capacity, or to remove roadway capacity from a future year scenario, and compare the VMT results to the future year scenario with the capacity included. The changes in VMT relative to the changes in roadway capacity for both of these scenario comparisons can be compared to a range of short-term elasticities from research literature.

Long-term induced travel effects include more enduring impacts of new roadway capacity: facilitating the relocation of households to higher-than-average VMT areas, due to the access and mobility provided by new or expanded roadways; and encouraging land development in higher-than-average VMT areas due to the access and mobility provided by new or expanded roadways. The SACSIM model alone is not sufficient to account for the long-term effects of induced travel. The long-term effects are captured in the approach SACOG uses to develop its future growth allocation, the phasing approach used for identifying roadway capacity for inclusion to the MTP/SCS, with the combined effects of both approaches evaluated for travel impacts using the SACSIM model. For example, in SACOG's 2012 and 2016 SCS's, a portion of the overall growth was allocated to areas within the region that are above-average in VMT generation, and the transportation phasing approach resulted in a inclusion in the MTP/SCS roadway capacity projects that accommodate that growth. The 2020 MTP/SCS growth allocation will also include a portion of growth in higher-than-average VMT areas, and will also include roadway capacity projects to reasonably accommodate this growth.

The allocation of growth to higher-than-average VMT areas in SACOG's 2012 and 2016 SCS's resulted from rigorous assessments of: the area's capacity to accommodate growth base on zoning and land use policy; readiness of areas for growth based on status of regulatory reviews and capacity to finance needed infrastructure (including transportation improvements); and market potential for growth based on observed historic growth patterns, and the expected housing product demand in the future. In short, allocation of growth to higher-than-average VMT areas was a realistic allocation of growth in prior MTP/SCS's, and this aspect of the growth allocation will be present, to some degree, in the 2020 MTP/SCS, for the same reasons. The portion of growth allocated to these areas is cumulatively less than the historical pattern of growth, and the MTP/SCS in total will result in a significant reduction in VMT per capita. But, the cumulative reduction expected will be the net result of a smaller portion of growth in higher-than-average VMT areas, and a larger portion of growth in lower-than-average VMT areas.

For purposes of the 2020 MTP/SCS submittal, the complex interplay between the growth allocation, transportation projects, and VMT that results in long-term induced travel cannot be directly evaluated with the SACSIM travel model alone, since the model is not integrated with a spatial economic model. SACOG proposes that the 2020 MTP/SCS be evaluated for reasonable-ness in capturing long-term effects of induced travel, that are captured in the SACSIM model in combination with the growth allocation process and transportation project phasing process, using an elasticity-based approach. The base year to future year changes in population, age, income, accessibility, density, costs, and highway capacity are proposed to be part of the elasticity-based analysis of the SCS suggested in the draft SCS Evaluation Guidelines report of March 2019. For purposes of the SCS submittal, a range of elasticities will be applied to the key components of change from base year to future year for the 2020 SCS. Key changes included in this elasticity analysis will be: aging of the population (e.g. 13% of population in aged 65+ years in 2016, increasing to 21% by 2040); change in auto operating costs (cost per mile increasing from 19 cents per mile in 2016 to 25 to 27 cents in 2040); change in regional accessibility (calculation TBA for the 2020 SCS—but 2016 SCS increased regional access to jobs from 380,000 in 2012 to 498,000 in 2016—2020 SCS is likely to have similar order of magnitude change); and change in the lane miles of roadway provided. Other factors could be included in this analysis, subject to: 1) availability of a consensus range of potential elasticities drawn from research literature; 2) good fit between variables on which the elasticities drawn from research literature were observed, and variables feasible to prepare for the SACOG region for the 2020 SCS; 3) and confidence that any variables added are not strongly correlated with other factors in the elasticity analysis, and therefore redundant. The factors mentioned here (aging, cost, regional accessibility, and highway capacity) are likely to meet all three requirements. Any additional factors would also need to meet all three criteria.