Using "SIP Currency" Principles to Address Outdated Conformity Emission Budgets

A Preliminary Discussion Paper

UC Davis-Caltrans Air Quality Project
http://aqp.engr.ucdavis.edu/
Task Order No. 29

August 22, 2006

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Prepared in Response to

A Caltrans request to develop new conformity analysis approaches to allow comparisons between emissions estimated using the latest planning assumptions to outdated state implementation plan (SIP) conformity emission budgets

A Companion Paper to

Kear, T. and Niemeier, D. (2005) "Assessing Air Quality Progress Using On-Road Emissions Inventories Updates," *Environmental Science & Technology* 39 (22) 8571-8577

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1. INTRODUCTION

This technical memorandum provides concepts for addressing problems that arise when the latest modeling tools and planning assumptions are used to estimate emissions, and the resulting emission estimates are to be compared to outdated state implementation plan (SIP) emission targets, or budgets. The motivation for this work is the anticipated release of a new version of California's on-road motor vehicle emission model, EMFAC. The California Air Resources Board (CARB) has prepared an update to the existing EMFAC 2002 model; the new release will likely be available by late 2006 or early 2007. In past years, the release of an updated emission model has resulted in a variety of conformity analysis challenges (Eisinger et al., 2002). The purpose of this memorandum is to provide a basis for transportation and air quality agencies to avoid conformity problems that can develop as more up-to-date planning assumptions and modeling tools become available.

1.1 A BRIEF PRIMER ON IMPORTANT CONFORMITY CONCEPTS THAT MOTIVATE THE NEED FOR SIP CURRENCY

An urban area's air quality management strategy is specified in a SIP. SIPs are legal documents that achieve four things. First, a SIP identifies the difference between an area's existing pollutant concentrations and the goals set by the National Ambient Air Quality Standards, or NAAQS. Second, the SIP details the emission reductions required to reduce pollutant concentrations to comply with the NAAQS. Third, the SIP allocates the emission reductions to the various sources that contribute to a region's problem. As part of this step, emission "budgets," or caps, are placed on allowable on-road vehicle emissions. Finally, the SIP defines control measure commitments that ensure emission reductions are achieved on the schedules mandated by federal law. Once approved by local, state, and federal agencies, the SIP becomes a binding commitment to reduce the emissions using the timetables outlined in the SIP. Modification of the SIP is a lengthy process involving input from public stakeholders and detailed analysis of the technical information used to support any regulatory mandates included in the SIP.

The transportation conformity regulations require that transportation agencies periodically document that on-road motor vehicle emissions are in compliance with the mobile source emission targets incorporated in the SIP. Transportation agencies are also required to use the "latest planning assumptions" and modeling tools available when completing their conformity analyses (Wykle et al., 2001). Over time, modeling tools improve and the SIP-modeled estimates, and any control strategies defined by the estimates, can become outdated. Nevertheless, transportation planning agencies must use the most recent models to estimate on-road emissions, and they must compare those modeled results to the SIP emission reduction targets. If new models produce emission estimates that are substantially different than those used to create the SIP, conformity determinations become difficult.

A logical solution would be to simply update the SIP, using the most recent assumptions and models. A SIP recalibrates the relationship between emissions and real-world pollutant concentrations. However, given the political and technical complexities involved with changing a SIP, this solution is often impractical in the short-term. Another solution is to find a scaling method that allows different modeled emissions estimates to be compared to one another. In contrast to SIP modeling, scaling relies on constructing a simplified relationship, typically linear, between two sets of emissions estimates.

This paper outlines a technical solution to the problem of outdated SIPs. We describe a method for scaling, or translating, modeling results from the latest on-road vehicle emissions models, using the latest planning assumptions, into the same "currency" used by the modeling tools that created SIP estimates. Although the approach described here is not as rigorous as a full-scale effort to update the SIP with the latest assumptions and modeling tools, it is a clear improvement over the current approach, which is to directly compare emissions estimated using the latest models, to the outdated emissions goals included in the SIP.

1.2 PROBLEM DESCRIPTION

California agencies use EMFAC (with MOBILE being used everywhere else) to estimate on-road motor vehicle emissions and to establish allowable emissions budgets as part of the SIP process. To demonstrate conformity, transportation improvement programs (TIPs) and regional transportation plans (RTPs) must result in on-road emissions at or below allowable SIP emission budgets. When the emissions budget and the latest emissions estimates are separated by substantial changes in assumptions and modeling algorithms, the practical value in comparing the two sets of numbers is often questionable; however, there has been little technical work done to justify deviating from federal guidance requiring a direct comparison. There is a need to bridge the analytical gap that occurs when using outdated SIPs with conformity analyses that employ more up-to-date assumptions and modeling tools.

1.3 STUDY OBJECTIVE

Caltrans asked U.C. Davis (UCD) to identify conceptual approaches to address the problem of outdated emission budgets. In response, UCD developed basic principles to translate emissions estimates produced by different model versions and assumptions into a common language or "currency." This technical memorandum reports some of the findings from our recent work. A companion article (Kear and Niemeier, 2005) establishes that inventories based on updated model and planning assumptions can establish a different emission-concentration relationship from that underlying the SIP attainment demonstration, and that unless the new inventories can be scaled to the SIP inventories, comparisons with existing SIP budgets are not particularly useful or insightful. The findings discussed here focus on a new approach to complete regional conformity determinations. The approach, called the *SIP Currency approach to conformity determinations*, allows for quantitative comparisons between outdated budgets and emission estimates produced using the latest tools and assumptions. The approach is an interim means of calculating conformity emissions estimates until the SIP can be updated.

1.4 PREMISE

A SIP attainment demonstration is typically premised upon evaluations of historic air pollution episodes that involve actual concentration data measured by monitors and estimates of the emissions contributing to each episode's pollutant concentrations. The SIP models these episodic data so that photochemical and/or rollback models can be calibrated to adequately recreate the observed concentration data based upon the estimated emissions. Then, once the relationship between emissions and observed concentration is understood, the model is used to estimate the emission reductions necessary to bring the region into attainment. The attainment demonstration, and the episodic data which support it, are thus the basis for establishing allowable emission budgets used for transportation conformity.

The episodic emission inventories are a function of the planning assumptions used in developing the SIP (such as estimated vehicle population, mileage accrual, age distributions). Our understanding of how these assumptions impact emissions will change over time. Difficulties arise once the latest planning assumptions and modeling tools modify the episodic emission inventories used to develop the SIP. If the more up-to-date emissions estimates are substantially different than the estimates used in the attainment demonstration, the attainment demonstration itself may no longer be valid. Conformity analyses, even if adherence to SIP emission budgets is demonstrated, may not necessarily ensure that on-road emissions are within the limits needed to achieve air quality standards.

To clarify these relationships, consider an example where subsequent to the approval of a SIP, new planning assumptions change the emission inventories associated with the episodic data (see **Figure 1**). For this example, concentrations were observed during two historic pollution episodes, represented by lines 1 and 2 in Figure 1. Assume that when the SIP was developed, analysts modeled emissions for both episodes, as represented by points A and B in Figure 1. As illustrated in Figure 1, SIP modeling estimated that a 10% emissions reduction resulted in a 10% reduction in pollutant concentrations. Using this emissions-to-concentration relationship, it was estimated that a 30% reduction in the emissions that occurred during the first-episode was needed to bring the region into attainment (Figure 1, point C) and the details of this reduction were outlined in the SIP. Assume that subsequent to SIP approval, a new set of latest planning assumptions or a new version of the emissions model is released. As a result, the inventories, for example carbon monoxide (CO) emissions in tons per day (tpd), for the observed concentration episodes are re-estimated and found to be greater than the original estimates. These new findings are illustrated in Figure 1 by the concentration and emission values plotted as points D and E. Note here that our measured concentrations are not changing, rather, the way in which we model their associated emissions is changing.

Using our new emissions estimates and our historic concentration data, we now find that the original SIP assumption, that a 10% reduction in emissions results in a 10% reduction in pollutant concentrations, no longer holds. Instead, we find that with the latest tools and assumptions, a 20% drop in emissions is needed to achieve a 10% reduction in pollutant concentrations (Figure 1, points D and E). What might account for this change? Perhaps the original model relied on a mischaracterized vehicle fleet or mileage accrual rates that were slower or faster than assumed. Regardless of the reasons, the latest modeling results show that a 60% reduction in first-episode emissions is required to achieve the desired 30% reduction in concentrations for attainment. This is illustrated in Figure 1 by moving from point D to point F.

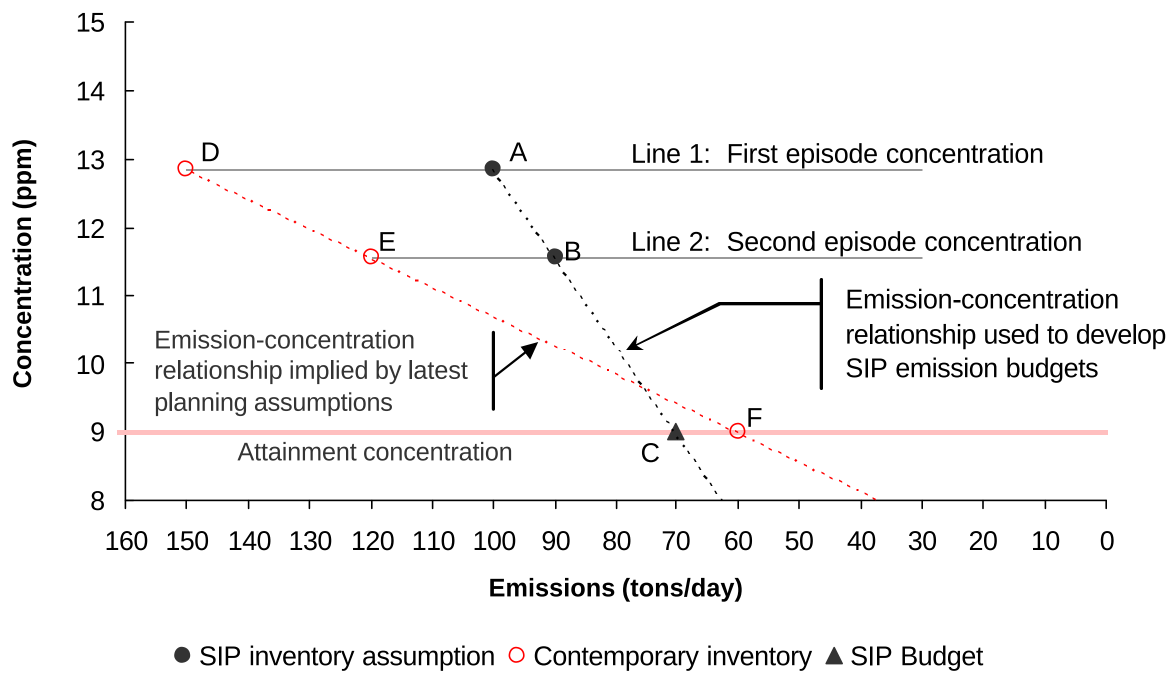

Figure 1. Example altered emission-concentration relationships based on new information. In this example, the SIP emission budget (point C) is more than what the latest modeling tools and assumptions estimate is acceptable.

The new information effectively invalidates the emission budgets included in the SIP. That is, the updated planning assumptions change the emission-concentration relationship (or the currency) used to prepare the original SIP. In this example, meeting the SIP emission budget (Figure 1, point C) without some form of currency correction would not necessarily bring the region into attainment or ensure adequate progress in reducing pollutant concentrations.

Addressing Changes in Currency

There are two ways to address problems that result when new insights shift our understanding of the emissions-to-concentration relationship after SIP approval. The first and most preferable approach is to amend the SIP and modify emission budgets based on the latest modeling tools and planning assumptions. Unfortunately, the SIP amendment process is complex, costly and time consuming, and often lags the development of new modeling tools and particularly the development and update of new planning assumptions, which can occur as often as every year.

The second approach applies to situations that arise where SIP emission budgets cannot be amended in time to facilitate conformity analyses. Under these circumstances, we need to be able to equate emissions estimates produced using the latest modeling tools and planning assumptions to the outdated SIP budgets (that is, find a common currency). Conceptually, this approach is analogous to equating temperature in degrees Fahrenheit to temperature in degrees Celsius, a task accomplished using the formula $^0F = {}^0C * (9/5) + 32$. Much like the Fahrenheit-to-Celsius conversion, the goal of SIP Currency is to enable conversion of updated emission estimates into estimates that can be compared to outdated SIP emission budgets.

The underlying philosophy of SIP Currency is that, by accepting the emission budgets established by the SIP, we are also accepting the emission-to-concentration relationships that those budgets were premised upon. This means that, using the latest tools and planning assumptions, a mathematical relationship has to be established between the new emission-to-concentration relationships, produced using up-to-date estimates and modeling tools, to the old emissions-concentration relationships that are embedded in the SIP.

2. APPLYING SIP CURRENCY

To understand how the SIP currency framework can be applied, we provide three examples. The first example is designed to be a simple application to help explain the SIP conformity concept. This example illustrates how to translate a single year's up-to-date emissions estimate, meaning one based on the latest planning assumptions and tools, into a value equivalent to an already approved SIP emission budget. The need for this might occur when modeling a near-term conformity milestone. In the second example, we walk through how to formulate a mathematical relationship that relates up-to-date emission estimates for any analysis year into an approved SIP-equivalent value. The second approach is more applicable to real-world situations, since most conformity analyses involve multiple analysis years. The first two examples use CO data to illustrate SIP Currency. In the third example, we extend the SIP Currency concept to evaluate ozone precursor pollutants: volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). The currency concepts are applicable throughout the United States, although the examples use California data and modeling tools.

2.1 EXAMPLE 1: A SIMPLIFIED SIP CURRENCY ILLUSTRATION

In this first example, we present a simplified case where the region has already attained the standard and the conformity budget is set to the estimated emissions at the time of attainment. Here, assume a CO SIP was prepared using the now-outdated combination of BURDEN with the EMFAC-7f emissions model (BURDEN-7f) and that following approval of the CO SIP, an updated tool, BURDEN-2002, became available. In this illustration, BURDEN-7f estimated a 27% reduction in CO emissions was needed between 1998 and 2003 to reach 8.85 ppm CO. However, BURDEN-2002, the latest tool, estimates that a 34% reduction in 1998 CO emissions occurred to reach the 8.85 ppm CO goal (**Table 1)**.

Table 1. CO data for SIP Currency examples, based on two sets of "planning assumptions."

Emissions model version used as basis for modeled concentrations	1998 (base year)		2003 (attainment year)		1998-2003
	Emissions (tpd)	Concentration (ppm)	Emissions (tpd)	Concentration (ppm)	Percent emissions reduction needed to reach 8.85 ppm CO
EMFAC-7f	7,400	9.71	5,400*	8.85	27%
EMFAC-2002	14,800		9,768		34%

*SIP emissions budget.

There are two important points to observe about the modeling results presented in Table 1. First, the absolute value of the emission estimates differs from one model to another. BURDEN-7f estimated that 5400 tpd of CO resulted in an 8.85 ppm CO concentration; BURDEN-2002 estimated that 9768 tpd of CO produced an 8.85 ppm CO concentration. Second, the updated assumptions and algorithms included in BURDEN-2002 changed not only the absolute emissions, but also changed our understanding of how much of a percent reduction in emissions was necessary to reach the 2003 CO concentration goal.

Calculating the Currency

Now we know that we need to calculate reductions based on a common currency. That is, a conformity problem has arisen not because there is an air quality problem, but because we have to compare emissions-concentration relationships that were produced using different tools and assumptions. Even though the 2003 CO attainment concentration was 8.85 ppm, the attainment goal, the 2003 BURDEN-2002 emission estimate exceeds the allowable conformity budget (9768 tpd > the allowable 5400 tpd). Although this illustration describes a retrospective analysis, the same analysis problems can occur when looking forward in time during the conformity determination process.

To use the SIP Currency methodology to correct for this modeling artifact, we follow a three-step process for solving the conformity problem represented by the data in Table 1.

- *First*, we assume the latest modeling tools are the best representation available of current knowledge about the emission inventory at the time when the air quality standard was met.
- *Second*, we acknowledge that, even using the latest tools and assumptions, the actual emission inventory at the time of attainment is unknown and each set of tools and assumptions produces only a "best estimate" of actual emissions ("*X*" tpd). We can define the emission estimates from the two models in relation to the actual emission inventory, *X*, at the time of attainment,

  X = the actual emission inventory (unknown) at attainment

  X_{7f} = 5400 tpd estimated from EMFAC7f

  X_{2002} = 9768 tpd estimated from EMFAC 2002
- *Third*, we have established through the air quality modeling process that the target concentration is 8.85 ppm (for this example). Thus, any emission inventory modeled to conform to the SIP requirement of 8.85 ppm (e.g., inventories $\leq$ 9768 tpd from EMFAC 2002, or $\leq$ 5400 tpd from EMFAC7f) should be acceptable. In other words, 9768 tpd from EMFAC 2002 is equivalent to 5400 tpd from EMFAC7f, and both values may be compared to the SIP emission budget ***because they both produce the requisite 8.85 ppm concentration***. Under this construction, any EMFAC 2002-based inventory that was less than 9768 tpd would satisfy the 5400 tpd budget set with EMFAC7f.

This three-step approach effectively translates the EMFAC 2002 emission estimates so that they match the SIP at a point of observed concentration (in this case, 8.85 ppm); this is an appropriate technique when we are concerned only with matching an observed concentration for a single year. If we are concerned with what happens over time (e.g., to demonstrate conformity to multiple milestone year budgets), then we also need to account for any changes in the slopes of the emission-concentration line. In other words, we have translated the emission estimate for a single analysis year into the SIP's currency, but we have not yet provided a mechanism to translate other EMFAC 2002-based emissions into emissions equivalent to those produced by EMFAC7f.

2.2 EXAMPLE 2: CAPTURING CHANGES OVER TIME

In our second example, we show how the SIP Currency process can be used to capture changes in the emissions-to-concentration relationships over time. Here, we develop a mathematical relationship between the emissions-to-concentration relationships created by two different model versions; this allows us to establish a common SIP currency over time. We will use the same data provided in the first example (Table 1). Recall from the previous example, SIP Currency suggests that, using the latest modeling tools and planning assumptions, a 9768 tpd emission estimate is equivalent to the SIP emission budget of 5400 tpd for the attainment year.

Calculating the Currency

Assume the region is now attempting to demonstrate conformity for its 2030 RTP. Using SIP Currency principles, year 2030-modeled CO emissions need to be at or below 9768 tpd to demonstrate conformity, if EMFAC-2002 is used. In this example, we use SIP Currency to create a linear relationship that maps the base year 14,800 tpd (EMFAC 2002) to 7400 tpd (EMFAC-7f) and maps the attainment year 9768 tpd (EMFAC 2002) to 5400 tpd (EMFAC-7f). This relationship can be derived using the general equation for a line, $y = mx + b$, to establish a linear conversion (Eq. 1-3). Eq. 3 represents a line connecting the 1998 and 2003 episode data plotted on a Cartesian coordinate system with the x-axis representing the EMFAC 2002 inventory and the y-axis representing the EMFAC7f inventory.

$$7400 = (m)(14800) + b \qquad [1]$$

$$5400 = (m)(9768) + b \qquad [2]$$

$$y = (0.3975)(x) + 1517 \qquad [3]$$

where,

x = the EMFAC 2002 emissions estimate, and

y = the SIP Currency equivalent

In this example, the analyst would develop the linear conversion given by Eq. 3, and then use it to show that the resulting value of y is less than or equal to 5400 tpd to pass attainment-year conformity. The SIP Currency formula can be used to translate new emission estimates into SIP-compatible numbers across multiple analyses years. **Figure 2** helps to illustrate this concept. For example, if the analyst modeled year 2030 CO emissions of 8000 tpd using EMFAC 2002, SIP Currency would be used to translate that estimate into an EMFAC7f-equivalent 4697 tpd, based on Eq. 3. Note that, in this example, the translated SIP currency value is below the 5400 tpd emission budget and acceptable for conformity, whereas the original 8000 tpd estimate would create a conformity failure.

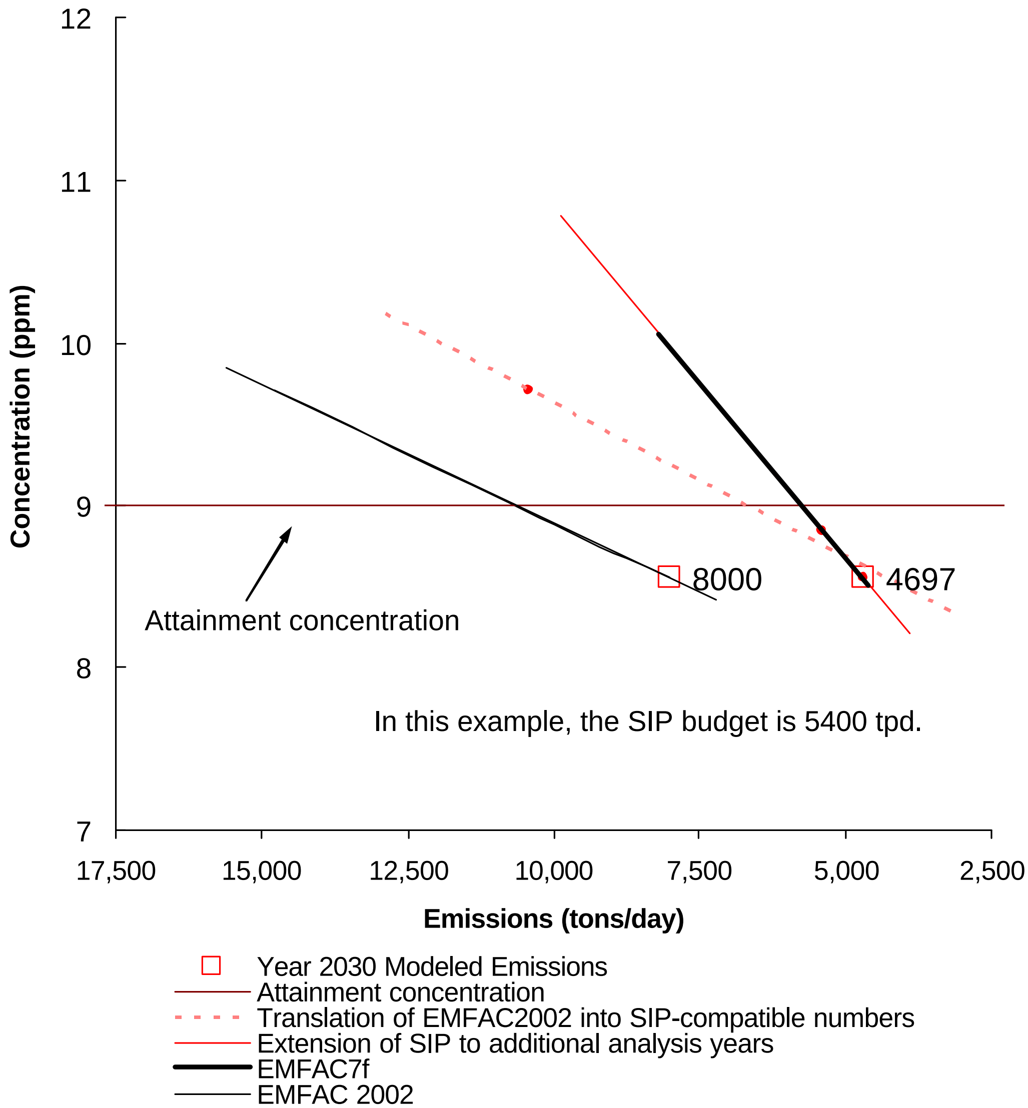

Figure 2. Linear conversion to equate EMFAC7f and EMFAC 2002.

Example 2 assumes the relationship between the two sets of assumptions is linear. This is not unreasonable since many contemporary changes in planning assumptions often approximate a linear change from SIP estimates. For example, if different model versions use different fleet size assumptions, changes in fleet size may linearly affect emission estimates across all analysis years (e.g., the latest assumptions scale the entire fleet upward by 5%). However, linearity is not certain, and the differences between model versions and planning assumptions can vary across analysis years. Although SIP Currency can be used to approximate these changing relationships, a SIP update is still the most robust method for recalibrating emissions-to-concentration relationships.

2.3 EXAMPLE 3: OZONE AND PRECURSOR INVENTORIES

Our third example extends Examples 1 and 2 by applying SIP Currency concepts to NO_x and VOC precursor emissions for conformity to ozone SIP budgets. The example is based on the 1999 and 2001 San Francisco Bay Area Ozone Attainment Plans; where the 1999 plan (BAAQMD, 1999), developed using EMFAC7g, is used to represent the baseline assumptions, and the 2001 plan (BAAQMD, 2001), developed using a beta version of EMFAC 2002, represents the updated planning assumptions. The example also shows how a non-linear relationship can be approximated with SIP currency.

1999 SIP Information: EMFAC7g Creates the Emission Budget

Table 2 summarizes the emission inventory information from the 1999 ozone SIP; Table 2 includes emission inventory information for the 1995 and 2000 calendar years. The 1999 SIP used data from a real-world 1995 high-ozone episode to model the relationship between VOC and NO_x emissions, and ozone concentrations. **Figure 3** illustrates this relationship as an "ozone isopleth" diagram, which is analogous to a topographic map. The contour intervals, or isopleths, depicted in Figure 3 show how ozone concentrations vary with differing VOC and NO_x emission levels. Typically, ozone isopleth diagrams are based on observed, worst-case pollution episodes. Modelers recreate, as best as they can, the emissions inventory and meteorological conditions that contributed to the real-world pollution values observed. Once the episode conditions are replicated, modelers create isopleths by completing sensitivity analyses that vary emission levels.

The upper right hand corner of the isopleth diagram represents the peak ozone value observed during the episode. The contour intervals represent predicted ozone concentrations for various combinations of reduced VOC and NO_x emissions.

During the 1995 ozone episode that is used as the basis for Figure 3, peak ozone concentrations reached 138 ppb. Thus, the upper right corner of Figure 3 is the point at which ozone concentrations are 138 ppb, and the VOC and NO_x emissions (562 tpd and 626 tpd respectively) are those estimated to have occurred during the 1995 episode (see Table 2). For comparison, values over 124 ppb exceed the 1-hour ozone NAAQS.

In the 1999 SIP, the Bay Area modeled the emission reductions needed to reach attainment by year 2000. Table 2 includes the total year 2000 attainment inventory, as well as the on-road portion (175 tpd VOC, 247 tpd NO_x) used to establish mobile source emission budgets for conformity. The on-road mobile source emission numbers included in Table 2 and Figure 3 are based on EMFAC7g.

Table 2. San Francisco Bay Area 1999 ozone attainment plan.

1995 observed 1-hour ozone level of 138 ppb			
	Est. On-road Emissions (tpd)	Other Emissions (tpd)	Estimated Total Emissions (tpd)
VOC	273.7	288.3	562
NOx	326.3	299.7	626
2000 estimates (attainment demonstration; on-road emissions are the conformity budgets)			
VOC	175.2	258.8	434 (78% of 1995)
NOx	247.1	286.9	534 (85% of 1995)

On-road emissions based on EMFAC7g.

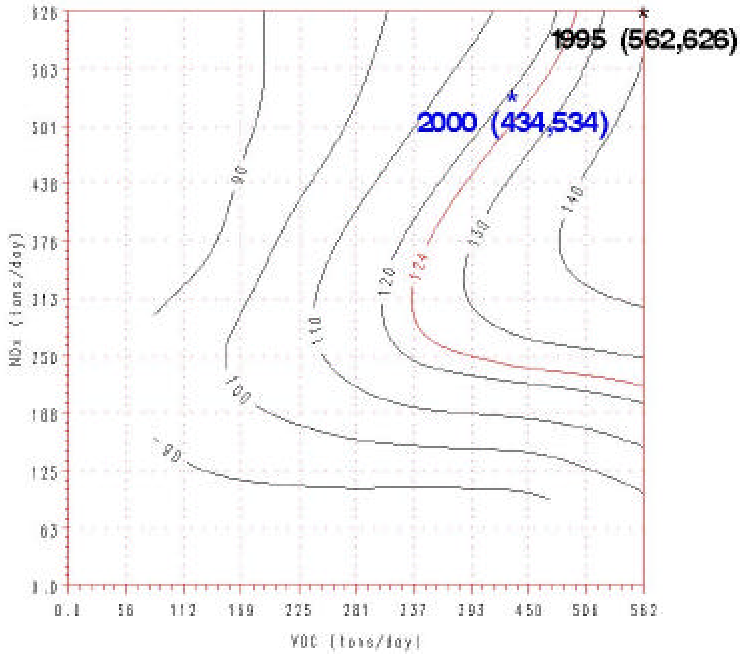

Figure 3. Ozone isopleths from the 1999 Bay Area ozone plan depicting the attainment demonstration for the year 2000 (blue text) and associated VOC and NO_x emissions.

2001 SIP Information: a New Version of EMFAC Models Different Emissions

The Bay Area updated their ozone SIP in 2001 and the on-road inventory was developed using a new version of EMFAC (beta EMFAC 2000). The new version of EMFAC included updated assumptions and algorithms addressing control program effectiveness, new emission standards, fuel composition and other factors. **Table 3** and **Figure 4** show the results from the 2001 ozone plan that correspond to the information shown in Table 2 and Figure 3. The 2001 plan also estimated modeled emissions and concentrations for 2006. In the 2001 ozone plan, the new emission inventory assumptions increased year 1995 VOC and NO_x (peak ozone episode) emissions by 21% and 20%, respectively, compared to the 1999 ozone plan estimates. Figure 4 is a rescaled version of the isopleth chart to account for the new inventories. The upper right hand corner of Figure 4 represents the 138 ppm peak ozone value observed during the 1995 episode, and the updated episode inventory: 681 tpd VOC, 752 tpd NO_x. The VOC and NO_x tpd numbers along the horizontal and vertical axes are 21% and 20% greater, respectively, than the comparable numbers in Figure 3, to account for the updated emission estimates.

The need for SIP currency becomes apparent when one compares the emissions budgets established by the 1999 SIP with the inventory prepared for the 2001 plan. From Tables 2 and 3, it is clear that the VOC and NO_x budgets (175 tpd and 247 tpd, respectively) are exceeded by the calendar year 2000 estimates produced by the later version of EMFAC.

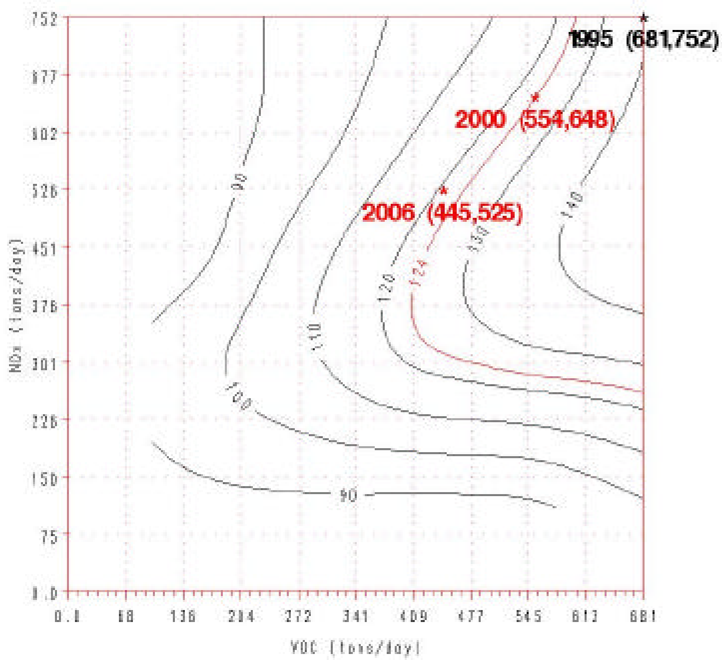

Figure 4. Ozone isopleths from the 2001 Bay Area ozone plan depicting attainment demonstrations for the years 2000 and 2006, and associated VOC and NOx emissions.

Table 3. San Francisco Bay Area 2001 ozone attainment plan.

1995 observed 1-hour ozone level of 138 ppb			
	Est. On-road Emissions (tpd)	Other Emissions (tpd)	Estimated Total Emissions (tpd)
VOC	339.5	341.5	681
NOx	434.2	317.8	752
2000 estimates (attainment demo)			
VOC	238.1	315.9	554 (81% of 1995)
NOx	352.1	295.9	648 (86% of 1995)
2006 estimates (attainment demo)			
VOC	168.5	276.5	445 (65% of 1995)
NOx	271.0	254.0	525 (70% of 1995)
For comparison: conformity emission budgets from Table 2			
VOC	175.2		
NOx	247.1		

The 1995, 2000 and 2006 on-road emissions are based on EMFAC2000(beta), the emission budgets on EMFAC7g.

Calculating Currency

Eq. 4 and 5 capture the relationship between the emission inventories from the two plans. These relationships assume that the ozone concentrations shown on the isopleths must match at the origin (representing natural background) and at the calibration point based on 138 ppb observed in 1995. Note the numerators in Eq. 4 and 5 come from Table 2 while the denominators come from Table 3.

$$(1999 \text{ plan VOC}) = (2001 \text{ plan VOC}) * (562/681) \qquad \text{Equation 4}$$

$$(1999 \text{ plan } NO_x) = (2001 \text{ plan } NO_x) * (626/752) \qquad \text{Equation 5}$$

In this case, we can use the relationships established by Eq. 4 and 5 to translate the 2001 plan's emission inventory into the "currency" of the 1999 SIP. Table 4 presents the translated numbers.

Table 4. SIP currency applied to an EMFAC2000(beta) inventory.

	VOC	NO_x
Given information		
• 2000 on-road inventory, based on EMFAC7g (budget)	175	247
• 2000 on-road inventory, based on EMAC2000(beta)	238	352
Calculated information		
• 2000 on-road inventory, translating EMFAC2000 into EMFAC7g currency [Eq. 4 and 5]	196	293

For our example, if we took the VOC budget at 175 tpd based on the 1999 SIP, the 238 tpd estimated by EMFAC2002(beta) would result in the need to identify an additional 63 tons per day in VOC controls. Adjusting the EMFAC2002(beta) emissions back into the currency of the 1999 SIP cuts this emission reduction shortfall down to 21 tons of VOC per day. It is important to recognize that SIP Currency will not automatically translate to meeting conformity. In this example, conformity was not met; however, the need for control measures was substantially reduced since the excess emissions were scaled to the SIP currency.

Figure 5 shows the isopleths as a fraction of 1995 emissions and plots the projected 2000 and 2006 milestone points. It is interesting to note that both the 1999 SIP and the 2001 air quality plan show calendar year 2000 attainment occurring with about the same percentage reduction in 1995 episode emissions. As illustrated in Figure 5, both plans assume that reducing 1995 VOC emissions by about 20%, and NO_x emissions by about 15%, results in attainment by 2000. The percentage emission reduction similarity between the two plans is in contrast to the absolute numbers representing their attainment inventories (Tables 2 and 3). Reflecting updated planning assumptions and modeling tools, the total attainment inventory in the 2001 plan is 28% greater for VOC, and 21% greater for NO_x, than comparable emissions in the 1999 SIP. Given the overall consistency in the attainment approaches contained in the 1999 SIP and 2001 air plan (as represented by similar percentage emission reduction goals), the Bay Area example helps to illustrate the usefulness of SIP Currency as a tool to translate new emission estimates into numbers comparable to those contained in the SIP.

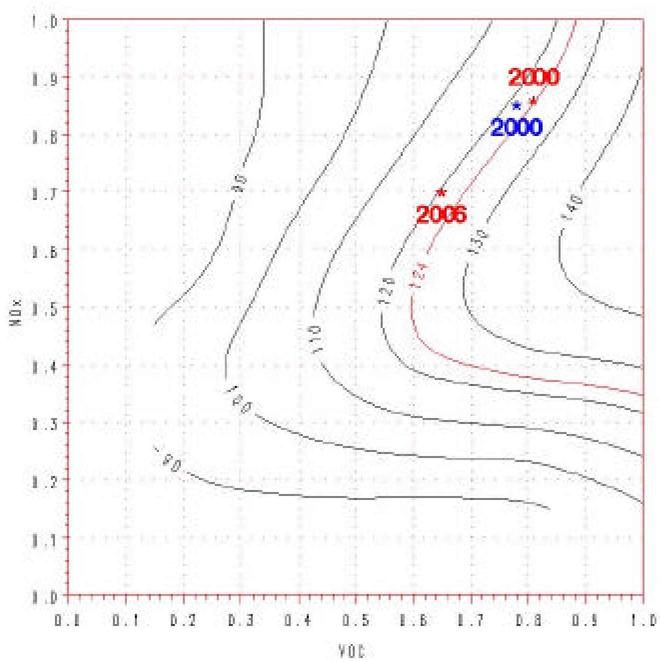

Figure 5. SIP currency comparison between the Bay Area's 1999 ozone SIP (shown in blue) and 2001 ozone plan (shown in red).

3. CONCLUSIONS

The examples provided here are based on creating simplified relationships between SIP budgets that are developed with outdated planning assumptions or models and results produced using more recent models (or planning assumptions). As a companion to this discussion, UCD completed an extensive analysis of the SIP Currency concept. The findings, included in the article, "Assessing Air Quality Progress using On-Road Emissions Inventories Updates" (Kear and Niemeier, 2005), provide an in-depth statistical analysis that demonstrates the need for translating modern modeling results into estimates equivalent to those produced with outdated models and assumptions. The peer-reviewed journal article establishes the theoretical importance of correcting for currency. Together, the peer-reviewed journal article and this discussion paper should foster dialogue on how to best address the conformity implications of model and planning assumption changes.

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