SCAG Air Quality Model

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Modeling Task Force Meeting

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SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

Outline

- Background
- Air Quality Model
- Analysis

Background

Federal and state requirements

- **Required by 1990 CAA**

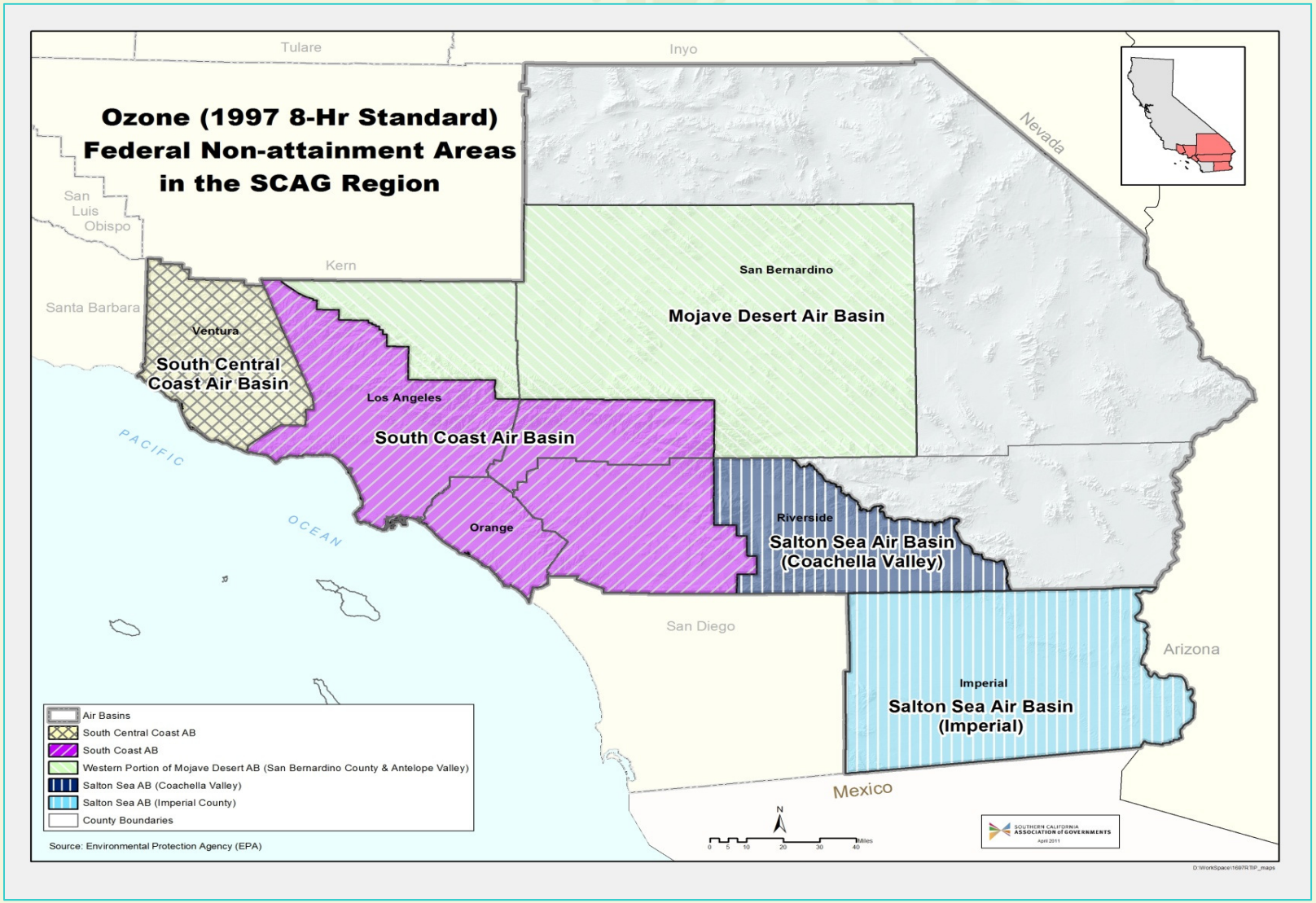
"Federal Clean Air Act Section 176(c) (42 U.S.C. 7506(c)) requires transportation conformity to ensure that federal funding and approval are given to highway and transit projects that are consistent with ("conform to") the air quality goals established by a state air quality implementation plan (SIP)"

- **In a federal non-attainment or maintenance area, RTP and FTIP must comply with the EPA Transportation Conformity Regulations**
  - **SCAG is responsible for the transportation conformity determination**

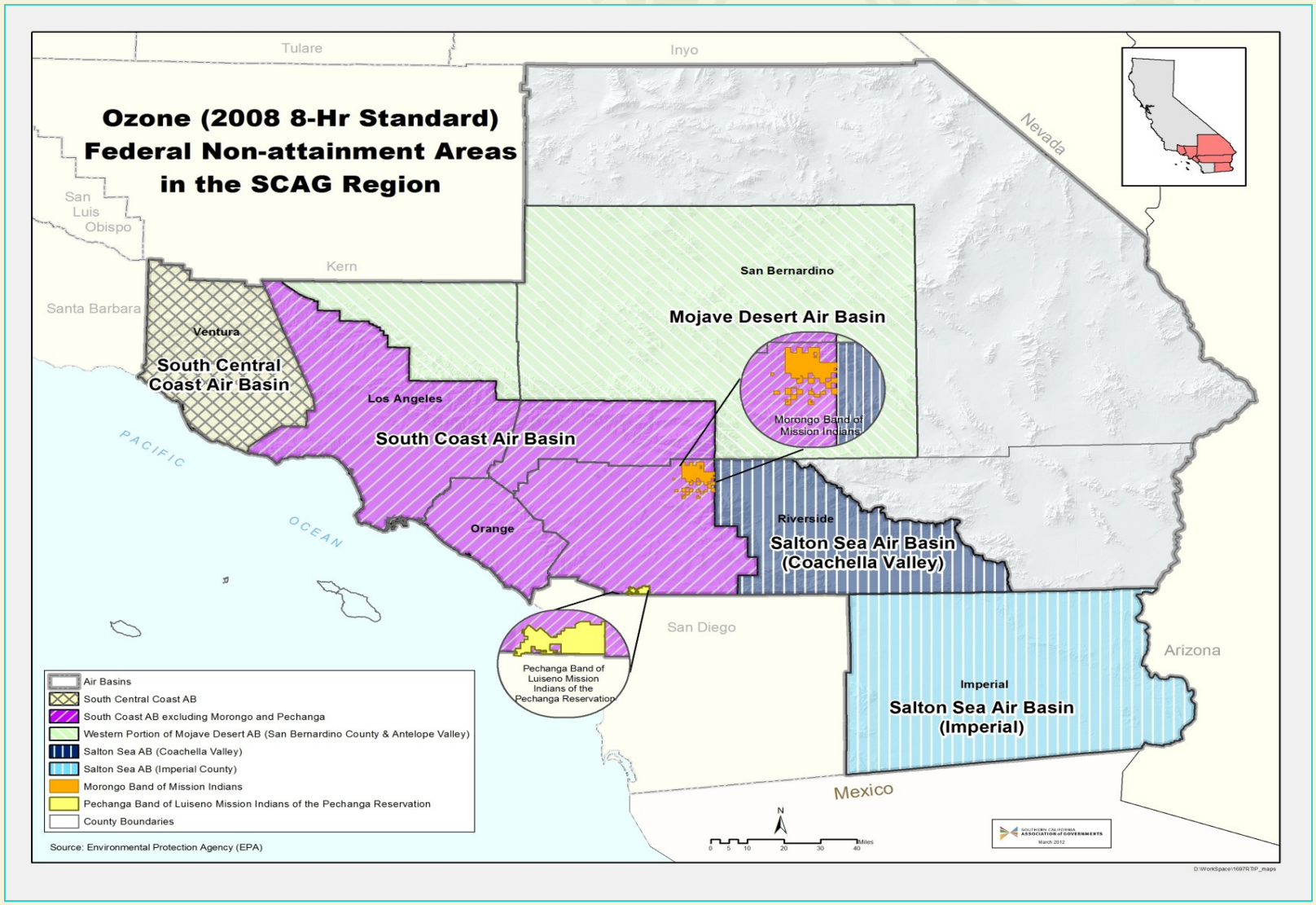
Federal and state requirements (Cont.)

- California Senate Bill 375 (SB 375)
  - Requires "Sustainable Communities Strategy" (SCS)
    - To implement the State's GreenHouse Gas (GHG) reduction goals for cars and light trucks
    - Requires SCAG to meet per-capita GHG emission reduction targets in 2020 and 2035

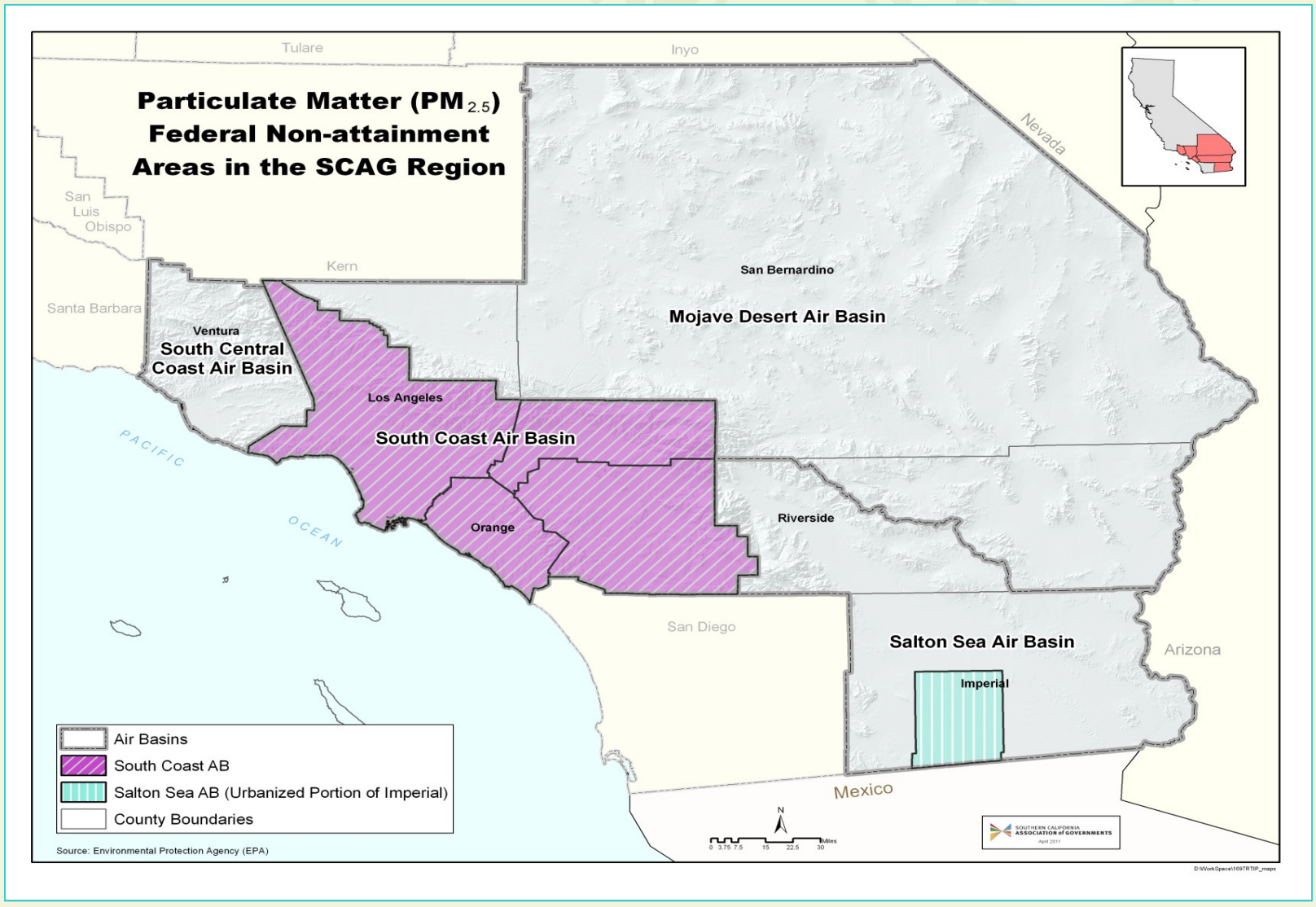
Federal Non-Attainment & Maintenance Areas: 1997 8-hour Ozone



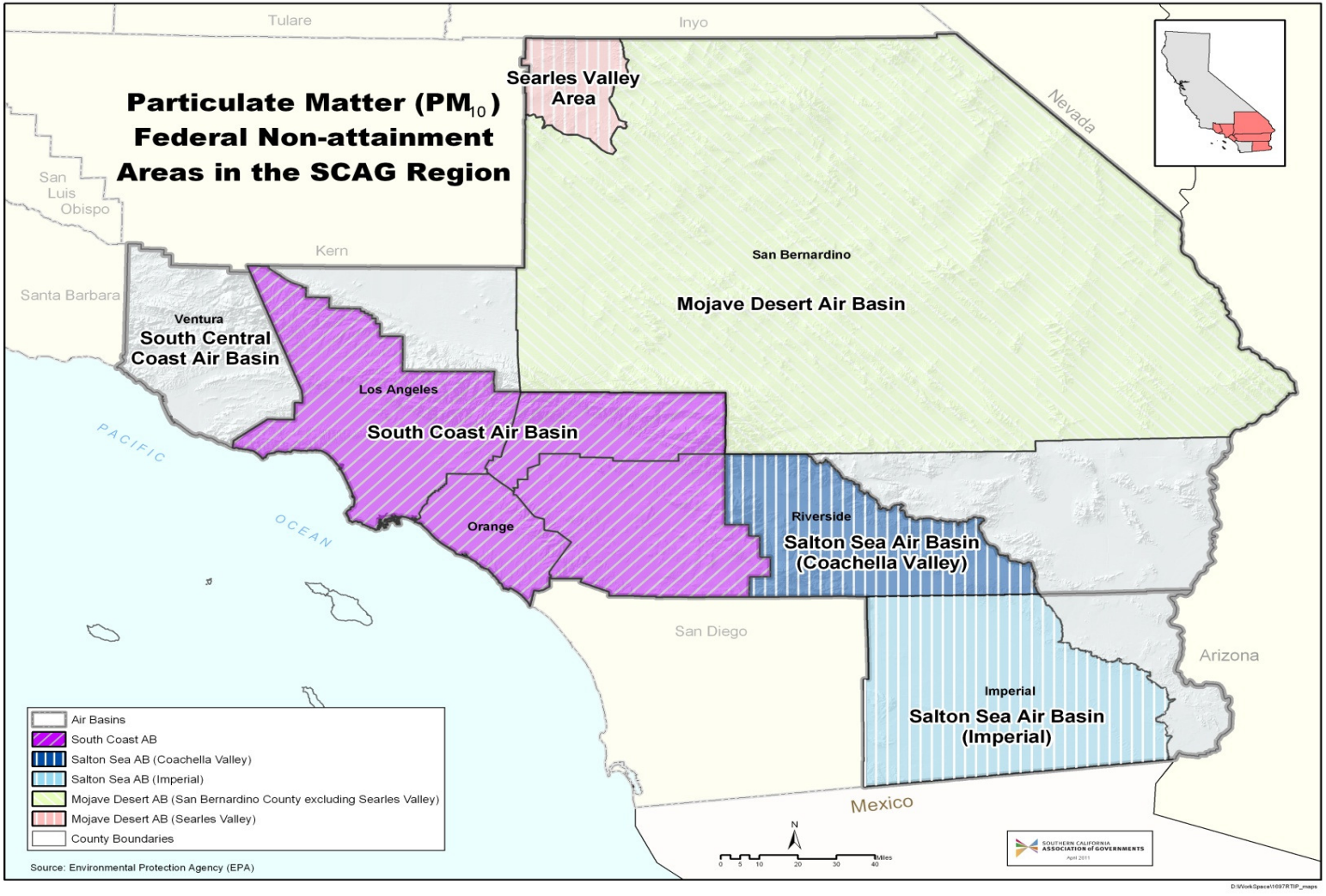
Federal Non-Attainment & Maintenance Areas: 2008 8-hour Ozone



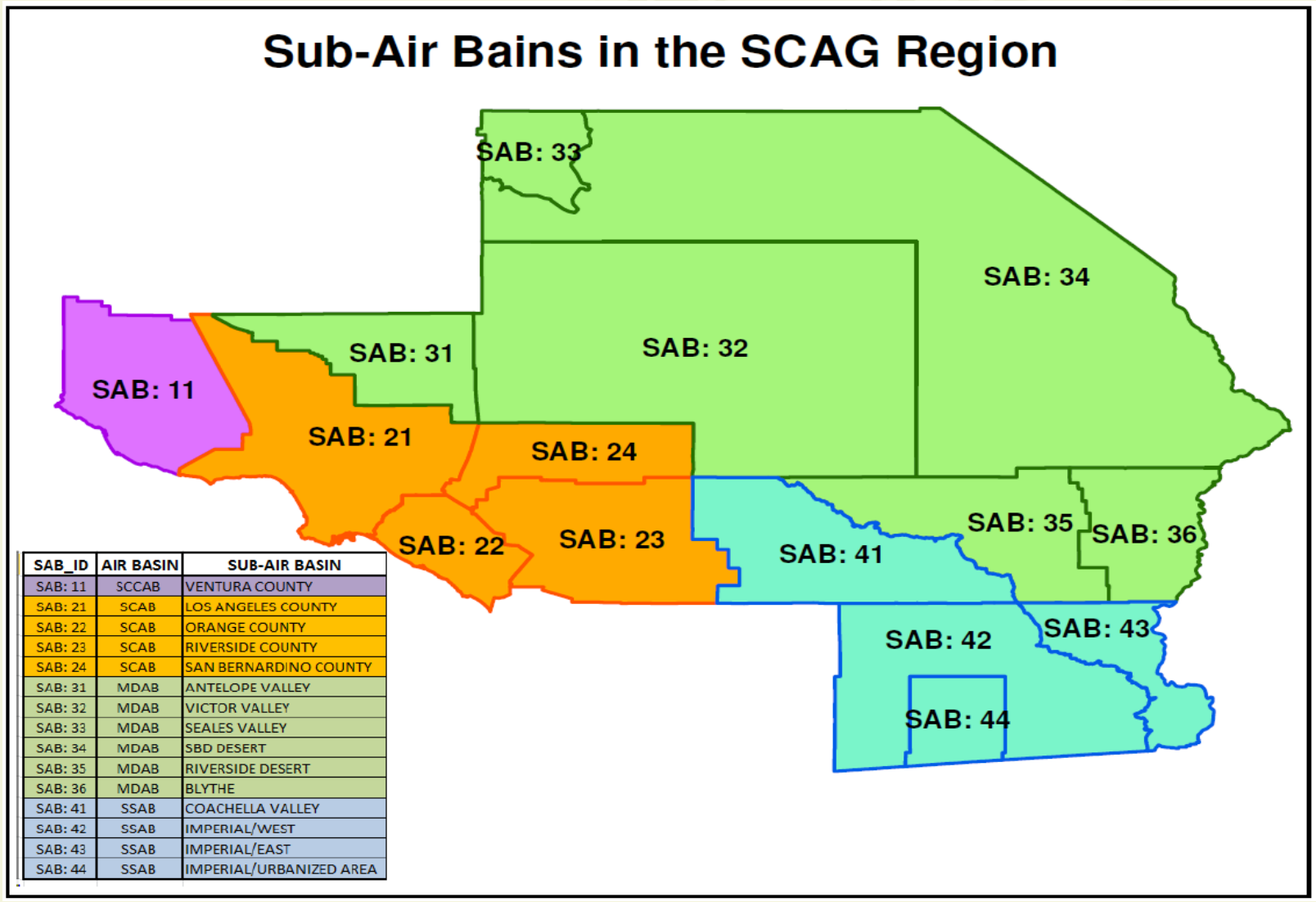
Federal Non-Attainment & Maintenance Areas: $PM_{2.5}$



Federal Non-Attainment & Maintenance Areas: PM_{10}



Basic Geography: Sub-Air Basins



SAB_ID	AIR BASIN	SUB-AIR BASIN
SAB: 11	SCCAB	VENTURA COUNTY
SAB: 21	SCAB	LOS ANGELES COUNTY
SAB: 22	SCAB	ORANGE COUNTY
SAB: 23	SCAB	RIVERSIDE COUNTY
SAB: 24	SCAB	SAN BERNARDINO COUNTY
SAB: 31	MDAB	ANTELOPE VALLEY
SAB: 32	MDAB	VICTOR VALLEY
SAB: 33	MDAB	SEALES VALLEY
SAB: 34	MDAB	SBD DESERT
SAB: 35	MDAB	RIVERSIDE DESERT
SAB: 36	MDAB	BLYTHE
SAB: 41	SSAB	COACHELLA VALLEY
SAB: 42	SSAB	IMPERIAL/WEST
SAB: 43	SSAB	IMPERIAL/EAST
SAB: 44	SSAB	IMPERIAL/URBANIZED AREA

Pollutants & Precursors

- Carbon Dioxide (CO_2) for SB375
- 4 criteria pollutants & their precursors subject to Transportation Conformity
  - Ozone
  - Particulate Matter (PM_{10} and $PM_{2.5}$)
  - Carbon Monoxide (CO)
  - Nitrogen Dioxide (NO_2)

Pollutants & Precursors

Direct and Precursor Emissions

Criteria pollutants

	Direct Emissions	NOx	VOC	Ammonia (NH_3)	Sulfur Dioxide (SO_2)
Ozone (O_3)	—	☑	☑	—	—
PM_{10}	☑	☑	☑	—	—
$PM_{2.5}$	☑	☑	☑	☑	☑
NO_2	—	☑	—	—	—
CO	☑	—	—	—	—

Air Quality Model

Air Quality Model Schematic

INPUTS

1. Base Inputs
1. Area
2. Calendar Year
3. Season

2. Vehicle Miles of Travel (VMT) Profile (for each Base Input Category)
1. Vehicle Category and Technical
2. Daily VMT by Vehicle Category

3. Speed profile (for each base input and vehicle Category)
1. Speed Bin
2. Speed Distribution

4. Emission Rates

5. Vehicle Fleet Compositions

EMFAC

EMFAC2011 LDA

EMFAC2011 HD

EMFAC2011 SG

OUTPUTS

1. Criteria Pollutants Emissions (tons/average weekday)
1. Total organic gases (TOG) emissions
2. Reactive organic gases (ROG) emissions
3. Carbon monoxide (CO) Emissions
4. Nitrogen oxides (NOx) emissions
5. Particulate matter 10 microns or less in diameter (PM10) emissions
6. Particulate matter 2.5 microns or less in diameter (PM2.5) emissions
7. Sulfur oxides (Sox) emissions

2. Greenhouse Gas Emissions (tons/average weekday)
1. Carbon dioxide (CO2) emissions
2. Carbon dioxide (CO2) emissions (including Pavley I and LCFS adjustments)

3. Fuel Consumptions (1,000 gallons/average weekday)
1. Gasoline Consumptions
2. Diesel consumptions

AQM: EMFAC

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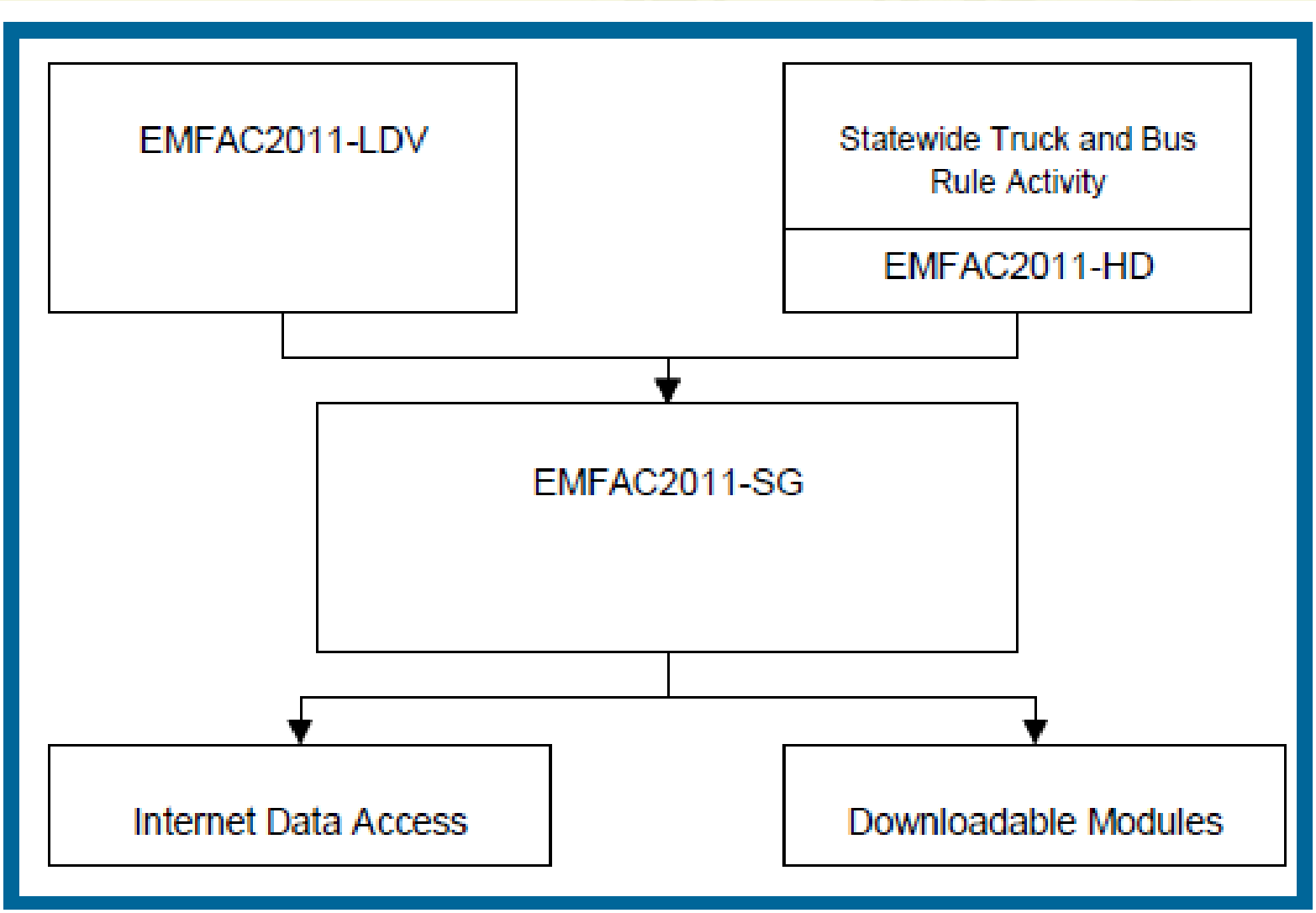
EMFAC

- EMission FACtors model
  - Developed by CARB and is only used in California
  - All other states use EPA's MOVES model
  - Current version EMFAC 2011
  - 2012 RTP & 2013 FTIP: EMFAC 2007
  - 2016 RTP: EMFAC 2011

EMFAC 2011: Model Structure

- **EMFAC-LDV**:
  - Gasoline on-road vehicles, smaller on-road diesel vehicles and transit buses
- **EMFAC-HD**:
  - Heavy-duty diesel trucks and buses
- **EMFAC-SG**:
  - For assessing emissions under different future growth scenarios.
  - Combines emissions factors from EMFAC-LDV and HD; VMT and speeds
  - Incorporates reductions from the Pavley I and Low Carbon Fuel Standard (LCFS) regulations

EMFAC 2011 Schematic



EMFAC 2011 Model updates

- 2009 DMV Data
- Updated truck activity and emissions reductions associated with the 2010 Truck and Bus Rule
- Updated fleet age, vehicle types, vehicle population, and vehicle miles travelled
- New temperature and humidity profiles

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2. Greenhouse Gas Emissions
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1. Carbon dioxide (CO2) emissions
2. Carbon dioxide (CO2) emissions (including Pavley I and LCFS adjustments)

3. Fuel Consumptions
(1,000 gallons/average weekday)

1. Gasoline Consumptions
2. Diesel consumptions

AQM: Inputs

1. **Base Input**
   - **Area:** Sub-Air Basins
   - **Calendar Year:** 1990 - 2035
   - **Season:** Summer, Winter, Annual
2. **VMT Profile**
   - Output from Transportation Model
   - VMT by vehicle category
3. **Speed Profile**
   - Output from Transportation Model
   - Speed distribution by vehicle category

AQM: Inputs (cont.)

4. Emission Rates

- By vehicle category
- By model year
- By speed

5. Vehicle Fleet Composition

- By vehicle category
- By model year

Air Quality Model Schematic

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2. Greenhouse Gas Emissions
(tons/average weekday)

1. Carbon dioxide (CO_2) emissions
2. Carbon dioxide (CO_2) emissions (including Pavley I and LCFS adjustments)

3. Fuel Consumptions
(1,000 gallons/average weekday)

1. Gasoline Consumptions
2. Diesel consumptions

AQM: Outputs

1. **Criteria Pollutants Emissions (tons/day)**
   - Total organic gases (TOG) emissions
   - Reactive organic gases (ROG) emissions
   - Carbon monoxide (CO) emissions
   - Nitrogen oxides (NOx) emissions
   - Particulate matter (PM_{10}, $PM_{2.5}$)
   - Sulfur oxides (SOx) emissions

AQM: Outputs (cont.)

2. Greenhouse Gas Emissions

- CO_2 w/ and w/o Pavley I and LCFS adjustments

3. Fuel Consumption (1,000 gallons/day)

- Gasoline
- Diesel

Analysis

Analysis: Conformity Test

TABLE 29 $PM_{2.5}$ (Annual Emissions [Tons/Day])

Pollutant		2012	2014	2020	2030	2035
ROG	2012 RTP	154.1	137.5	104.9	78.5	70.9
	Adjustment for Adopted State and Local On-road Measures*	-0.4	-0.6	n/a	-1.5	-1.5
	State Strategy-On-road Reductions*	-8.7	-13.6	n/a	-4.8	-4.3
	Sum	145.0	123.3	104.9	72.2	65.1
	Total Emissions	145	124	105	73	66
	Emission Budget	154	132	132	132	132
	Budget — Emissions	9	8	27	59	66
NO_X	2012 RTP	332.3	285.9	183.4	125.5	119.6
	Adjustment for Adopted State and Local On-Road Measures*	-1.4	-1.4	n/a	-0.1	-0.1
	State Strategy — On-road Reductions*	-23.7	-15.1	n/a	-15.1	-11.2
	Sum	307.2	269.4	183.4	110.3	108.3
	Total Emissions	308	270	184	111	109
	Emission Budget	326	290	290	290	290
	Budget — Emissions	18	20	106	179	181
$PM_{2.5}$	2012 RTP	15.6	15.2	14.1	14.0	14.2
	Re-entrained Road Dust Paved	19.1	19.4	19.8	21.4	22.0
	Re-entrained Road Dust Unpaved *	1.0	1.0	1.0	1.0	1.0
	Road Construction Dust *	0.2	0.2	0.2	0.2	0.2
	Adjustment for Adopted State and Local On-road Measures*	-0.1	-0.2	n/a	-0.3	-0.3
	State Strategy — On-road Reductions*	-1.4	-2.8	n/a	-0.5	-0.3
	Adjustment from NO_X to $PM_{2.5}$ Trading**	N/A	N/A	-10.6	-17.9	-18.1
	Sum	34.4	32.8	24.5	17.9	18.7
	Total Emissions**	35	33	25	18	19
	Emission Budget	37	35	35	35	35
	Budget — Emissions	2	2	10	17	16

** The detailed $PM_{2.5}$ emission budgets are provided by ARB on March 8, 2012 (Table 29A).*
*** The Plan $PM_{2.5}$ emissions for years after 2014 are calculated with the NO_X to $PM_{2.5}$ (10 to 1) trading mechanism as approved by EPA on November 9, 2011*

Analysis: Environmental Justice

- **Disclose benefits / burdens of proposed transportation projects on minority pop. and low-income communities**

TABLE 39 Summary of Air Quality and Health Risks by Environmental Justice Population Group

Environmental Justice Demographic Groups	2004–06 Population	2004–06 Average Days Exceeding Ozone Standards	2004–06 Average Daily Ozone Exposure in Excess of National Standards	2004–06 Average Annual $PM_{2.5}$ Exposure	2004–06 Cancer Risk Per Million	2004–06 Respiratory Hazard Risk Index	2007–09 Population	2007–09 Average Days Exceeding Ozone Standards	2007–09 Average Daily Ozone Exposure in Excess of National Standards	2007–09 Average Annual $PM_{2.5}$ Exposure	2007–09 Cancer Risk Per Million	2007–09 Respiratory Hazard Risk Index
Elderly Population	995,023	18.09	0.18	14.20	402.57	4.62	1,234,527	14.18	0.13	12.66	418.36	4.39
Below Poverty	1,802,317	15.51	0.16	15.75	582.94	5.33	1,647,407	14.40	0.14	13.29	562.03	5.17
Minority	7,321,095	13.05	0.14	16.19	588.13	5.54	8,283,746	12.37	0.12	13.65	574.46	5.42
Foreign Born	3,481,079	10.51	0.10	16.06	607.29	5.69	3,638,816	9.36	0.09	13.74	596.85	5.60
Non-English Speakers	509,760	10.93	0.11	16.16	635.23	5.77	619,622	10.59	0.10	13.74	612.15	5.62
Households Without Vehicles	366,398	12.83	0.13	15.92	604.53	5.46	307,565	11.36	0.11	13.51	576.63	5.28
Education Below High School	2,029,516	14.95	0.16	15.75	571.02	5.35	1,897,248	14.11	0.14	13.40	565.48	5.30
Region Total	16,516,006	17.77	0.18	14.76	467.13	4.62	17,737,412	15.03	0.14	12.91	467.13	4.62

- **http://rtpscs.scag.ca.gov/Documents/2012/final/SR/2012fRTP_EnvironmentalJustice.pdf**

Thank you

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