EMISSIONS INVENTORY FORECASTING IN CALIFORNIA

2015 International Emissions Inventory Conference

San Diego, California

April 15, 2015

California Environmental Protection Agency

Air Resources Board

Presentation Overview

- Need for emission inventory forecasts
- Emission inventory development in California
- Emission inventory forecasting tools

What is a Forecasted Emissions Inventory?

- Projection of a base year inventory that reflects expected growth or decline in emissions

- Uses growth surrogates based on forecasted trends such as fuel consumption, economic conditions, or population growth

- Reflects effects of existing emission controls and other emission reduction programs

California Environmental Protection Agency
Air Resources Board

Why are Emission Forecasts Needed?

- Primary input to air quality modeling used in attainment demonstrations

- Used in the design of policy concepts, setting of emission reduction goals and evaluation of prospective control strategies

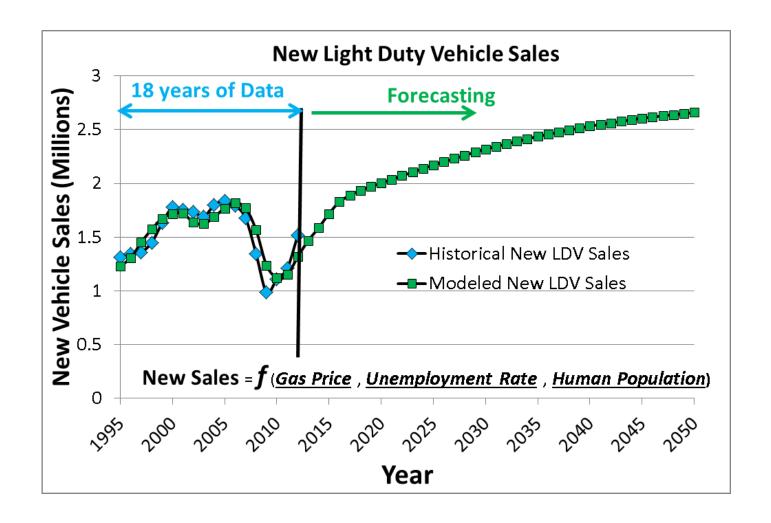- A means to track progress in meeting emission reduction commitments

California Environmental Protection Agency
Air Resources Board

Assessing Program Needs

- Multiple scales and pollutants
- Criteria pollutants:
  - Bottom-up, county/air basin resolution
  - Joint ARB-local air districts responsibility
- Greenhouse gases (GHG):
  - Top-down, statewide resolution
  - ARB has primary responsibility
- Multiple future scenarios
- No single tool can meet all needs

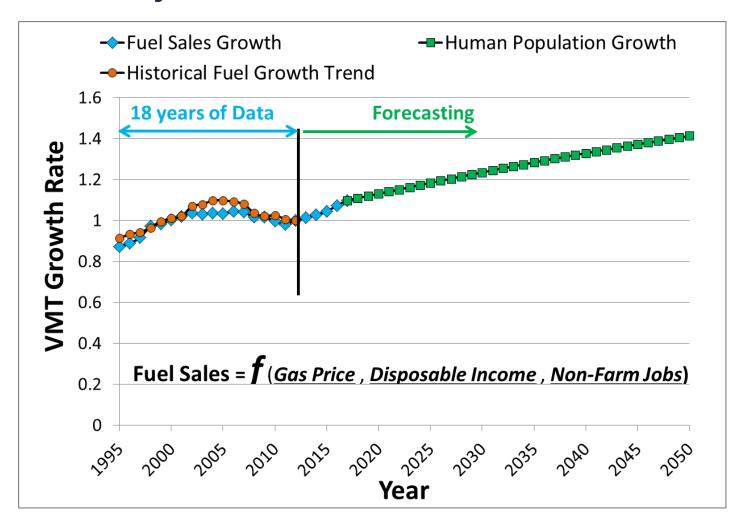California Environmental Protection Agency
Air Resources Board

On-Road Mobile Source Forecasting

- California has developed motor vehicle emissions forecasting models since 1970s

- EMFAC2014 is California's most recent on-road mobile source model

- Incorporates new methodologies to forecast vehicle emissions through 2050

- Key forecasts are new vehicle sales and VMT projections

California Environmental Protection Agency
Air Resources Board

New Vehicle Sales Forecast

New Light Duty Vehicle Sales

18 years of Data

Forecasting

New Vehicle Sales (Millions)

New Sales = f (*Gas Price* , *Unemployment Rate* , *Human Population*)

Historical New LDV Sales
Modeled New LDV Sales

Year

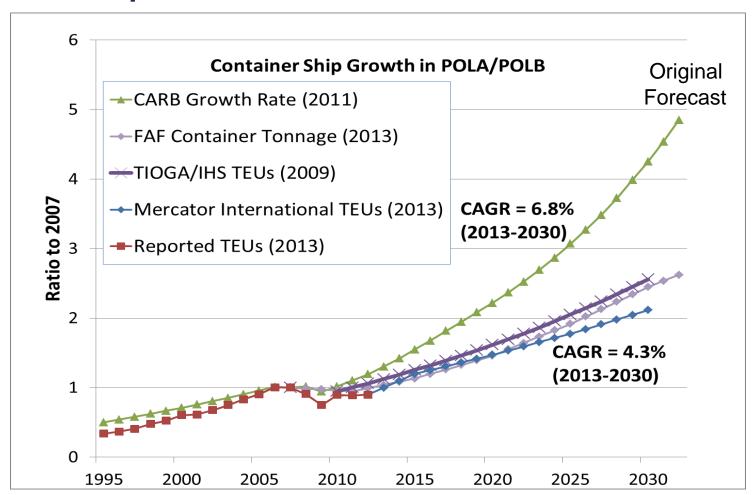California Environmental Protection Agency
Air Resources Board

7

VMT Projections

Off-Road Emission Models

- Until recently, California used a single model for all off-road categories

- New approach is to develop category-specific modules

- Each category has its own unique characteristics (equipment, economics, operations, etc.) that require unique inputs

- Need flexible tools that can be improved individually as needed

California Environmental Protection Agency
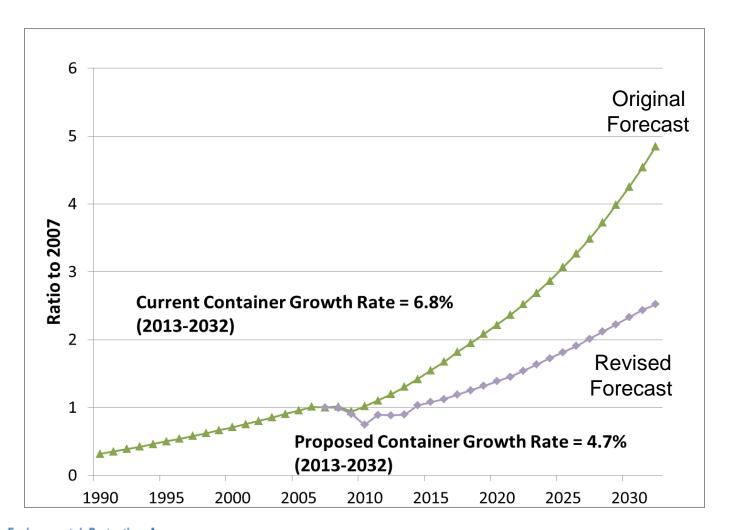Air Resources Board

Sample Off-Road Model Needs

- Locomotives
  - Activity forecasts for individual train types
  - Consistent with ARB's ocean-going vessel and truck growth rates
- Diesel Agricultural Equipment
  - Reflects equipment used on California farms
  - Activity data and growth rates developed by agricultural economists in cooperation with ag community
- Ocean Going Vessels
  - Activity data specific to California ports

Re-evaluating Container Ship Growth Assumptions

Container Ship Growth in POLA/POLB

- CARB Growth Rate (2011)
- FAF Container Tonnage (2013)
- TIOGA/IHS TEUs (2009)
- Mercator International TEUs (2013)
- Reported TEUs (2013)

CAGR = 6.8% (2013-2030)

CAGR = 4.3% (2013-2030)

Original Forecast

Adopted Container Ship Growth Rate

Chart showing "Ratio to 2007" (y-axis, 0 to 6) versus years (x-axis, 1990 to 2030). Original Forecast (green line) rises to about 4.8 by 2032. Revised Forecast (purple line) rises to about 2.5.

Current Container Growth Rate = 6.8% (2013-2032)

Proposed Container Growth Rate = 4.7% (2013-2032)

Stationary Source Forecasting

- ARB has conducted computerized emission inventory forecasting for point and area sources since early 1980s

- Current model is the California Emission Projections and Analysis Model (CEPAM)

- Emission projections out to 2035

California Environmental Protection Agency

Air Resources Board

13

CEPAM Forecasting Algorithm

- Emission projections built around basic algorithm:

$$E_{fy} = E_{by} \times GF_{fy} \times CF_{fy}$$

where

E_{fy} = Future year emissions

E_{by} = Base year emissions

GF_{fy} = Future year growth factor

CF_{fy} = Future year control factor

Emissions Forecasting Example
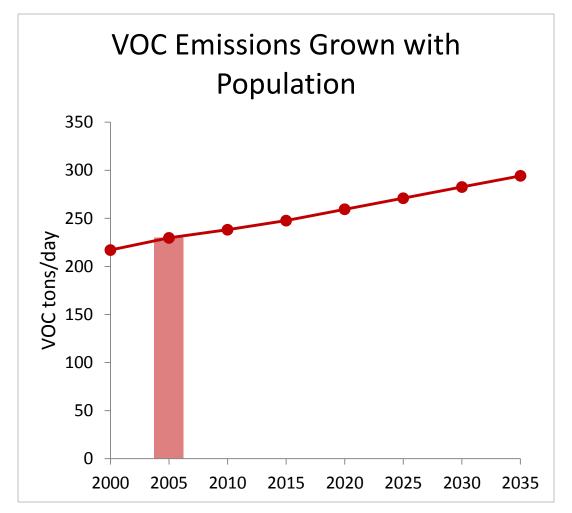
Consumer Products
230 tons/day VOC in 2005

Growth Surrogate:
State Human Population
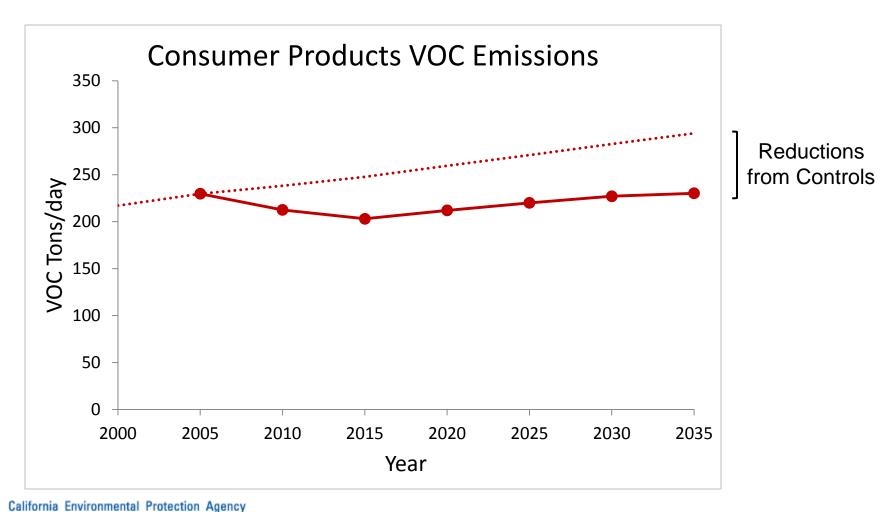

VOC Emissions

Projected Population (Millions)
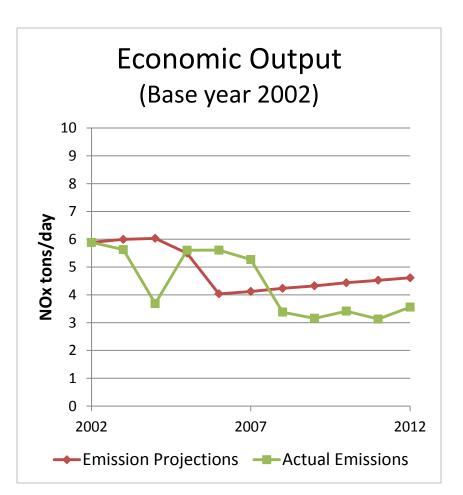
Emissions Forecasting: Grown-Only Emissions

Growth Profile

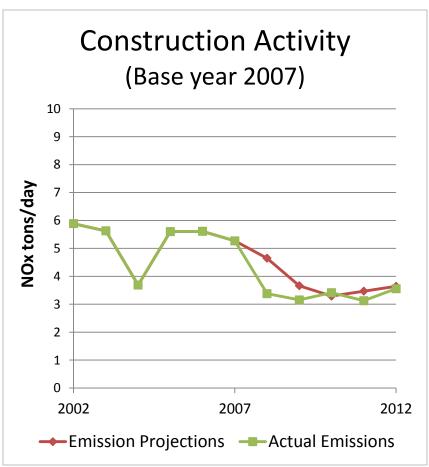| Year	Growth Factor
2005	1.00
2010	1.04
2015	1.08
2020	1.13
2025	1.18
2030	1.23
2035	1.28

VOC Emissions Grown with Population

Emissions Forecasting: Grown and Controlled Emissions

Consumer Products VOC Emissions
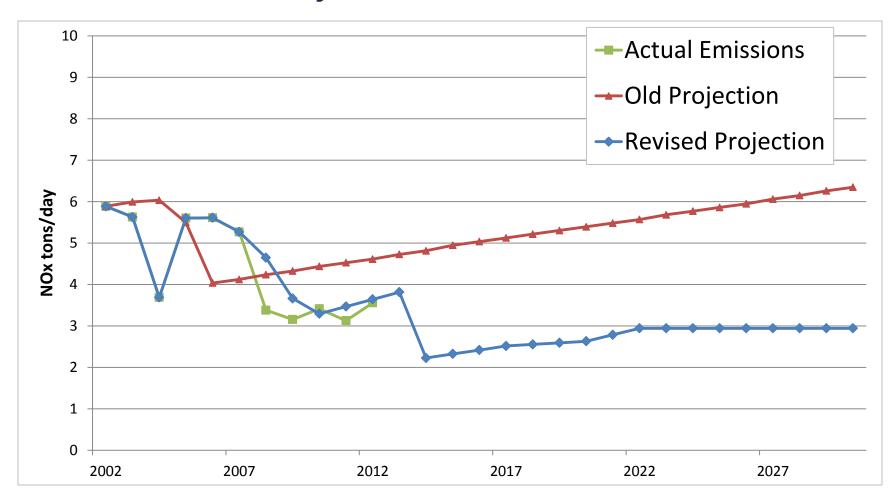
Reductions from Controls

Impact of Growth Surrogate Selection: Glass Manufacturing NOx Projections

Long-term Glass Manufacturing NOx Emissions Projections

GHG Inventory

- AB 32 goal: reduce statewide GHG emissions to 1990 levels by 2020

- ARB given GHG inventory responsibility in 2007

- Current inventory uses 2009-2011 average statewide emissions as baseline

- 2020 business-as-usual (BAU) forecast based on growth without any GHG reduction measures
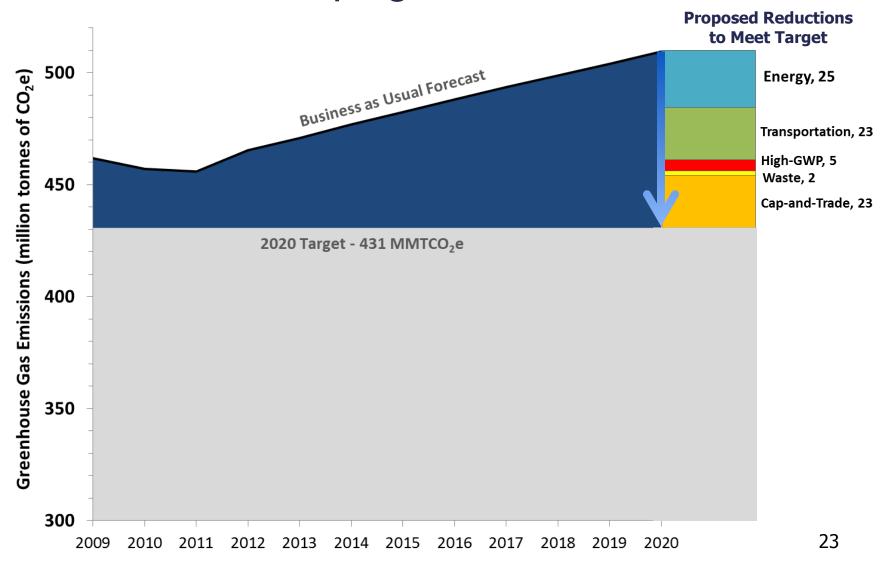
GHG Emissions Forecasting

- About 75 percent of emissions (transportation, power generation, and natural gas consumption) linked to fuel consumption

- Forecast relies on energy demand forecasts by CEC's Integrated Energy Policy Report (IEPR)
  - On-road transportation fuel demand
  - Electricity and Natural Gas demand

- Growth surrogates are compatible with other ARB models

ARB GHG-Specific Models

- GHG-specific tools for landfill emissions and high global warming potential gases

- Landfill Emissions Model – Methane emissions
  - uses CalRecycle waste deposition and waste characterization (organic waste) data

- Fluorinated Gas Model – refrigerants & aerosols
  - Appliances reaching end of life

GHG Reductions from Ongoing, Adopted and Foreseeable Scoping Plan Measures

Proposed Reductions to Meet Target

- Energy, 25
- Transportation, 23
- High-GWP, 5
- Waste, 2
- Cap-and-Trade, 23

Greenhouse Gas Emissions (million tonnes of CO_2e)

Business as Usual Forecast

2020 Target - 431 MMTCO$_2$e

Conclusions

- Forecasting tools must be tailored to meet specific program needs

- Input data must be reliable and high quality

- Tools must be flexible to allow periodic data updates and methodology improvements

Questions?

Gabe Ruiz, Manager

Emissions Inventory Forecasting and Special Projects Section

Air Quality Planning and Science Division

California Air Resources Board

gruiz@arb.ca.gov