Climate-Stabilizing Light-Duty Vehicle (LDV) Requirements

SIERRA CLUB

- **A subset of two, merged presentations**
  - **Overview of Problem and Solution**
  - **Focus: a Parking Mitigation Measure**

- **930 words**

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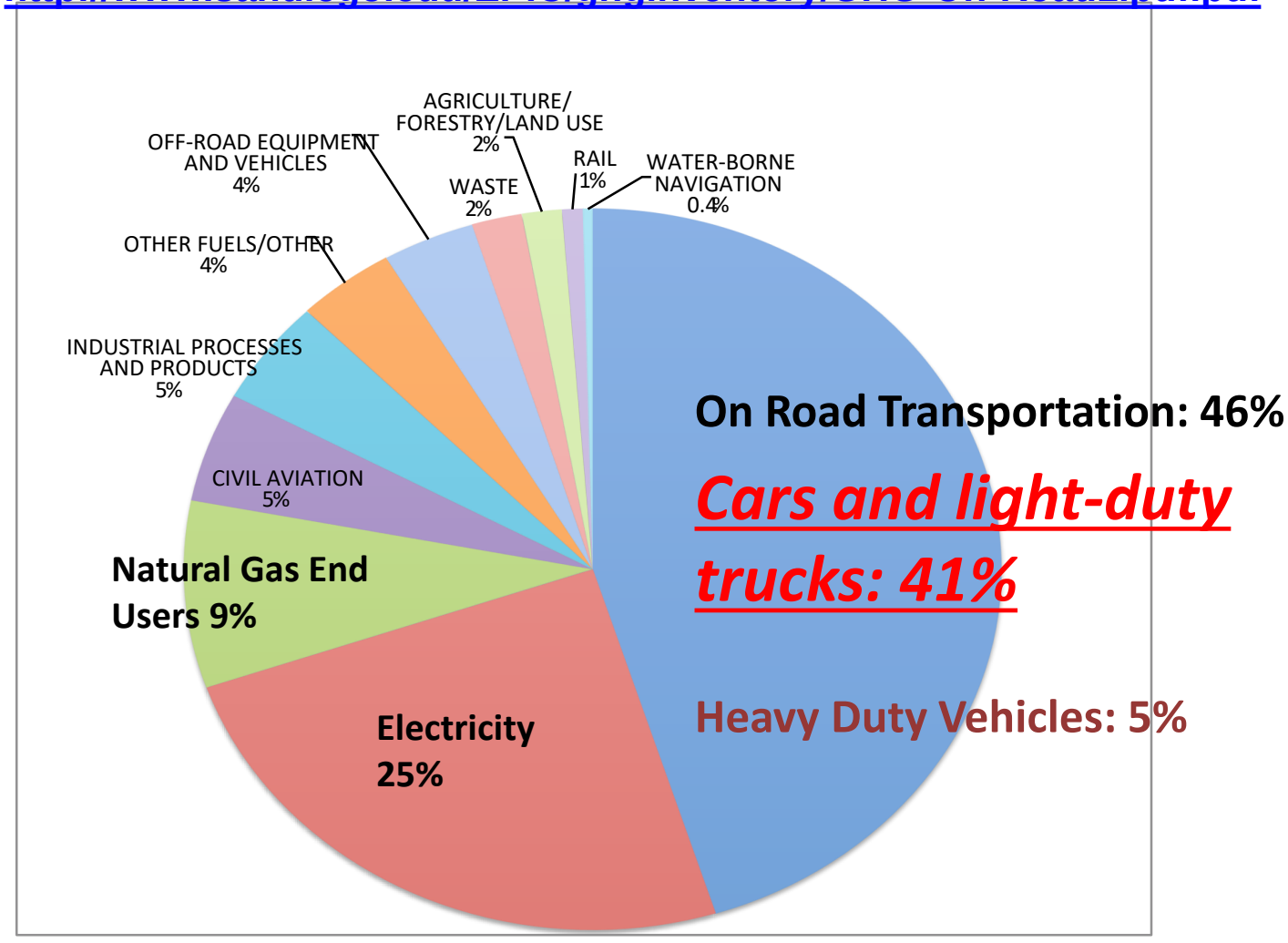
Greenhouse Gas (GHG) Emissions, SD County

Source: Energy Policy Initiatives Center (EPIC, USD)

http://www.sandiego.edu/EPIC/ghginventory/GHG-On-Road1.pdf.pdf



How Bad Could It Get?

Governor Brown to the Pope:

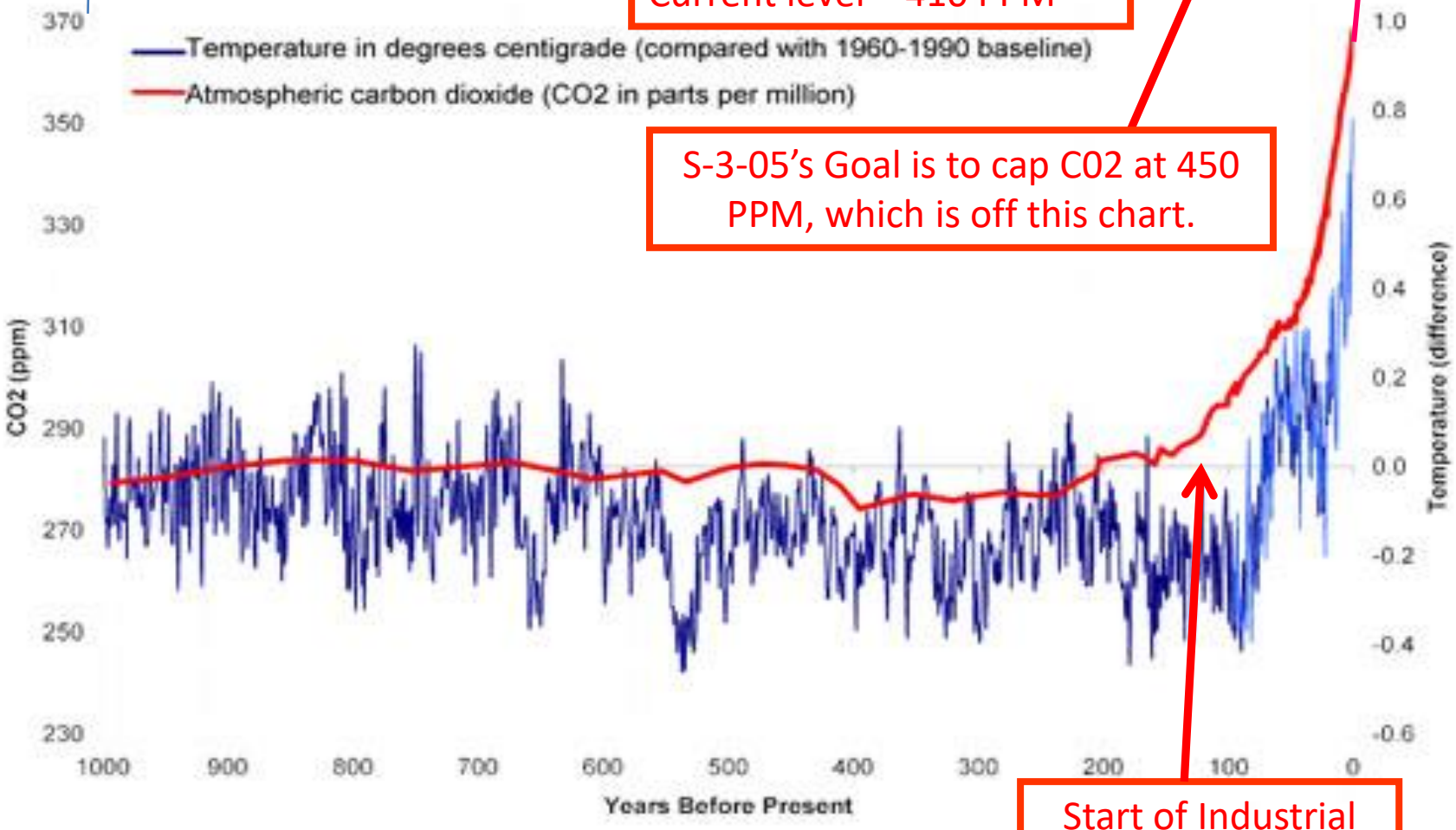
Humanity must

Reverse Course* **or** ***Face Extinction***

* ***Must be quantified***

Our Climate Crisis

- Earth & Space Research (ESR) website: http://www.esr.org/outreach/climate_change/mans_impact/man1.html



Fixing the Problem

We must stabilize the value of the earth's atmospheric CO2_e

CO2_e Emissions | **Sequestration (Photosynthesis)**

$E_N + E_A + E_{WFB}$ > → Positive Slope

$E_N + E_A + E_{WFB}$ = → Zero Slope

$E_N + E_A + E_{WFB}$ < → Negative Slope

S

Natural: rotting, fire, digestion. respiration

Anthropogenic: combustion of fossil fuel, methane, other

Warming **F**eed **B**ack: such as methane from melting permafrost

Growth of plants on Earth

The Warming Feed Back term is the wild card. It must not become dominant.

If Anthropogenic emissions were to be sufficiently low (80% below 1990 levels has been allocated to developed countries), the slope would be zero, thus capping the value of the Earth's atmospheric CO2_e

From the 2016 California Democratic Party (CDP) Platform

From: http://www.cadem.org/our-california/platform/2016-platform-energy-and-environment

- **Demand Regional Transportation Plan (RTP) driving-reduction targets, shown by science to support climate stabilization**

- **Demand a state plan showing how cars and light-duty trucks can hit climate-stabilizing targets, by defining enforceable measures to achieve the needed fleet efficiency and per-capita driving**

Variables

Definitions	
e_k	LDV Emitted C02, in Year "k"
L_k	Low Carbon Fuel Standard (LCFS) Factor that reduces the Per-Gallon CO2 emissions, in Year "k" (k is denotes Year 2030)
C_k	LDV CO2 emitted per mile driven, average, in Year "k", not accounting for the Low Carbon Fuel Standard (LCFS) Factor
c_k	LDV CO2 emitted per mile driven, average, in Year "k", accounting for the Low Carbon Fuel Standard (LCFS) Factor
p_k	Population, in Year "k"
d_k	Per-capita LDV driving, in Year "k"
D_k	LDV Driving, in Year "k"
M_k	LDV Mileage, miles per gallon, in Year "k"
m_k	LDV Equivalent Mileage, miles per gallon, in Year "k" accounting for the Low Carbon Fuel Standard (LCFS) Factor, so this is M_k/L_k
N	Number of pounds of CO2 per gallon of fuel but not accounting for the Low Carbon Fuel Standard (LCFS) Factor

Fundamental Equations

Future Year k: $\boldsymbol{e_k} = c_k * d_k * p_k$

Base Year i: $\boldsymbol{e_i} = c_i * d_i * p_i$

$$\frac{\boldsymbol{e_k}}{\boldsymbol{e_i}} = \frac{\boldsymbol{c_k}}{\boldsymbol{c_i}} * \frac{\boldsymbol{d_k}}{\boldsymbol{d_i}} * \frac{\boldsymbol{p_k}}{\boldsymbol{p_i}}$$

To work with mileage: $\dfrac{\boldsymbol{m_i}}{\boldsymbol{m_k}} = \dfrac{\boldsymbol{c_k}}{\boldsymbol{c_i}}$

Solution Overview

"k" denotes Year 2030
"i" denotes Year 2005

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From existing and predicted population

$$\frac{e_k}{e_i} = \frac{m_i}{m_k} * \frac{d_k}{d_i} * \frac{p_k}{p_i}$$

From the known 1990-to-2005 factor and the **Climate-Stabilizing-Target, which is the factor of 2030 emissions to 1990 emissions**

The Independent Variable
It becomes the ***required per-capita driving reduction with respect to 2005 driving***

Fractions of Fleets Sold in California that are Zero Emission Vehicles AND Required Driving Reduction, For 2 Different Cases

Zero Emission Vehicle (ZEV) Fleet Per-Cent
& Required Driving Reduction, Per-Cent
"Heroic Measures" Case Versus the "Extra Heroic Measures"

Year	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*
Heroic Measures	4%	7%	12%	18%	24%	34%	48%
Extra Heroic Measures	4%	12%	24%	40%	62%	90%	93%

Year	2023	2024	2025	2026	2027	2028 to 2030
Heroic Measures	62%	76%	90%	95%	98%	99%
Extra Heroic Measures	96%	97%	98%	99%	99%	99%

	% Reduction in Per-Capita Driving, with Respect to 2005
Heroic Measures	**32%**
Extra Heroic Measures	**0%**

Measures to Get 32%

Estimated Reduction

- Predictions, Regional Transportation Plans 10%
- Stop expanding most roads and all freeways 2%
  - No need, Eliminate congestion with less driving
- Reallocate freeway-expansion $$$ to **transit** 2%
- **Pricing**, to increase fairness & choice
  - Demonstration projects: unbundle parking cost
  - **Legislation**
    - Unbundle the cost of most "free" or underpriced parking 8%
    - Equitable and environmentally-sound road-use fees 8%
- **Smarter growth**, complete streets, bike classes 2%

32%

From the 2016 California Democratic Party (CDP) Platform

From: http://www.cadem.org/our-california/platform/2016-platform-energy-and-environment

- Work for **shared**, convenient and **value-priced** parking, operated with a system that **provides earnings** to those paying higher costs or getting a reduced wage, due to the cost of providing the parking

A *Dividend-Account Parking System* for Oceanside

A System to Eliminate the Harm of Bundled-Benefit Car Parking for City Employees

300 North Coast Highway

- Overview
- Calculations
- Who gets to use the system and how
- Overcoming problems and perceptions
- Outcomes of a new incentive

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Overview

- Fully-automated parking operated as a business for the financial gain of employees
  - Earnings = revenue minus expense
  - All earnings go to employees
- Price is cost per minute
  - Such as 2.356 cents per minute (= $1.41 per hour)
- An employee's earnings ("Dividend") is proportional to their time spent at work

Calculations of an Employee's Earnings

- An employee's earning is proportional to time spent at work:

Definitions to Compute an Employee's Monthly Earnings	
$T_{Employee}$	The Employee's Monthly Time at the Work Site
$T_{AllEmployees}$	Total Monthly Time at the Work Site, All Employees
$E_{AllEmployees}$	Total Monthly Earnings from the Employee Parking

$$\text{Employee Earnings} = E_{AllEmployees} \times (T_{Employee} / T_{AllEmployees})$$

Additional Payment so Those that Drive Every Day Will Lose No Money

Note: This is for an individual employee ("Joe")

Joe's Parking Payment =

Joe's Earnings – Price-per-Minute x Minutes Joe Parked + " (Joe's) Add In"

"Add In" is zero, unless it must take on a positive value so that Joe loses no money

Charge, Earnings, Add-In, & Payment for Each Employee

- **Charge**
  - Total Minutes Parked x Cost per Minute
- **Earnings**
  - As shown on earlier slide (proportional to employee's time spent at work)
- **Add-In**
  - Zero, unless **Charge** > **Earnings**
  - If **Charge** > **Earnings**, **Add-In** = **Charge** – **Earnings**
- **Payment** = **Earnings** – **Charge** + **Add-In**

Who Gets To Use Dividend-Account Parking

1. Those driving a car registered in the system
   - There is a person with an account associated with the car
2. Those driving any car, willing to pay a premium (or the standard) cost with a verified credit card

- How?
  - Entrance-Gate opens & entry time collected for
    - Registered car
    - Non-registered car after driver allows credit card to be verified, denoting also that the driver understands the cost and will pay
  - Exit-Gate opens & exit time collected for
    - Registered car
    - Unregistered Car, after driver allows his or her credit card to be charged Rate x Time, with Time in minutes

Discarded Slides

Start Here:

The Whole New Orleans AWMA Presentation

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Climate Literacy

THEREFORE, BE IT RESOLVED, that San Diego County Democratic Party Central Committee wants all high school students to know (1) why we have the problem of climate change; (2) its potential for harm; (3) the difference between stabilizing the climate at a livable level and destabilization; (4) science-based, climate-stabilizing, greenhouse gas (GHG) reduction targets; (5) the primary variables and considerations in identifying those targets and (6) the approximate amount of life style and technology change required to achieve those climate-stabilizing targets.

Climate-Stabilizing California Light-Duty-Vehicle (LDV) Requirements, Versus Air Resource Board Goals

AWMA Paper 881
Mike R. Bullock
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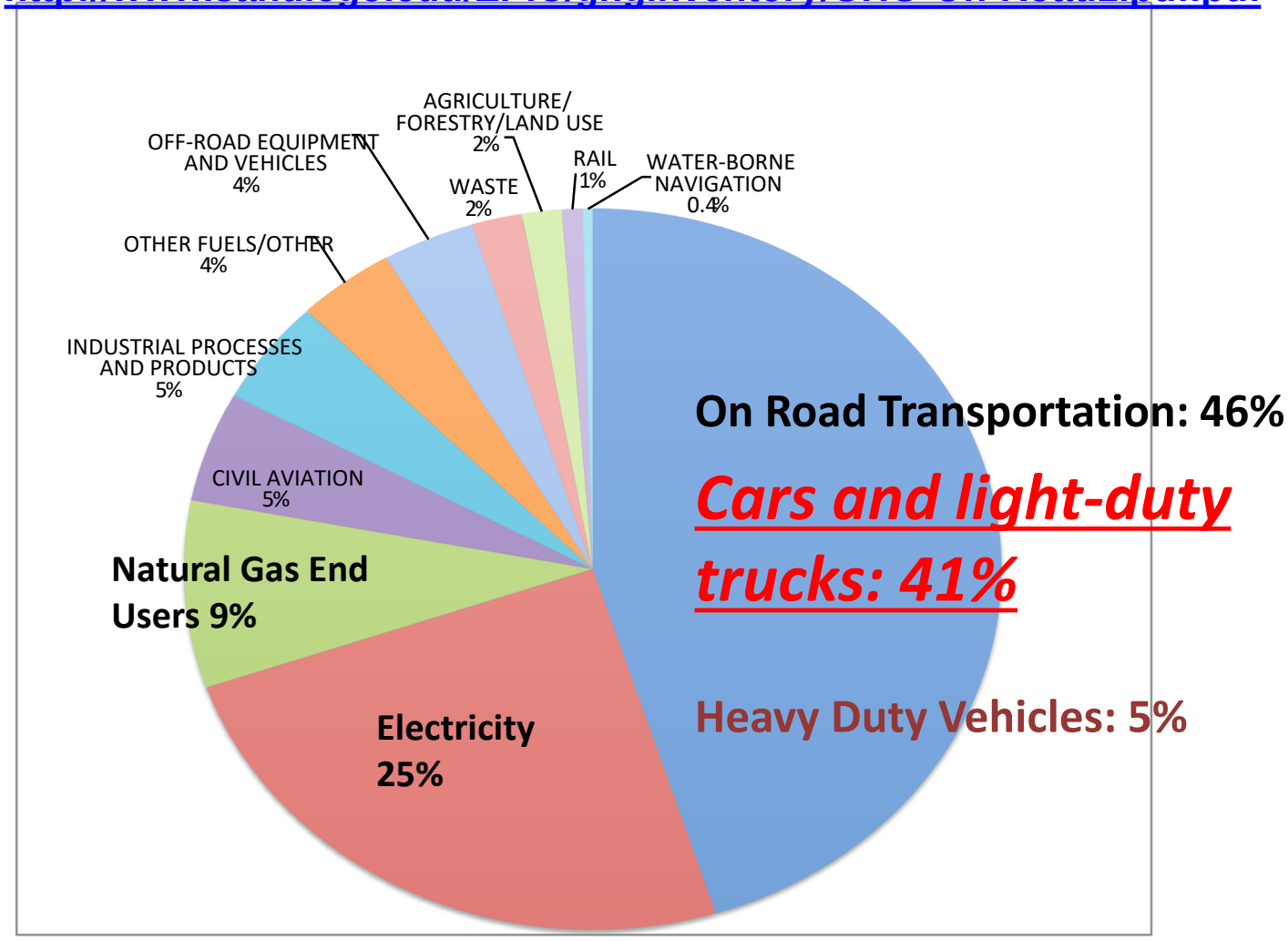


The Climate Problem

Any Earth Science text book* contains the following facts:

- **Atmospheric CO2 traps heat**
  - CO2 Molecules absorb and then emit, in a random direction, infrared radiation, heat given off by the Earth's surface
  - This effect is significant
- **Combustion of fossil fuels adds great quantities of CO2 to our Earth's atmosphere**
  - The amount of C02 in the atmosphere is well known
  - Our yearly emissions are well known

*** For example, Page 539 of *Earth Science*, Tarbuck and Lutgens, Tenth Edition, published by Prentice Hall, 2003.**

How Bad Could It Get?

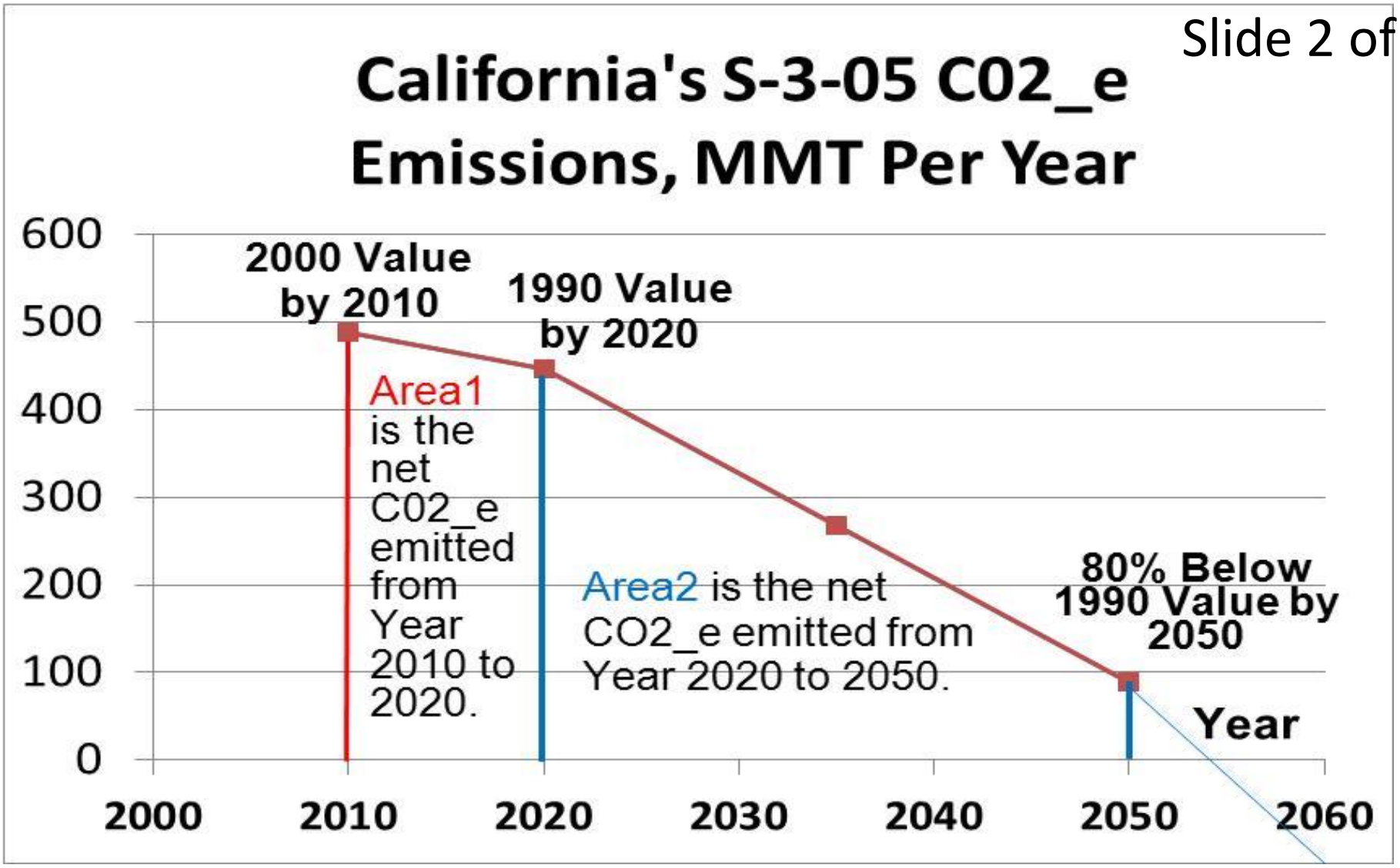
- *Scientific American* June 2008 issue
  - 550 PPM CO2 possible in several decades
  - This could (5% probability) lead to 8 Deg. Celsius of warming
  - 8 Deg. Celsius could lead to "a devastating collapse of the human population, perhaps even to extinction"
- December 24/31 2012 Issue of Nation magazine:

A recent string of reports from impeccable mainstream institutions-the International Energy Agency, the World Bank, the accounting firm of PricewaterhouseCoopers-have warned that the Earth is on a trajectory to warm by at least 4 Degrees Celsius

[4 Degrees Celsius] would be *incompatible with continued human survival*.

Winter, ***UU World*** magazine (p. 57) " Lags in the replacement of fossil-fuel use by clean energy use have put the world on a pace for 6 degree Celsius by the end of this century. Such a large temperature rise occurred 250 million years ago and extinguished 90 percent of the life on Earth. The current rise is of the same magnitude but is occurring faster. We must reduce or eliminate all uses of fossil fuels.

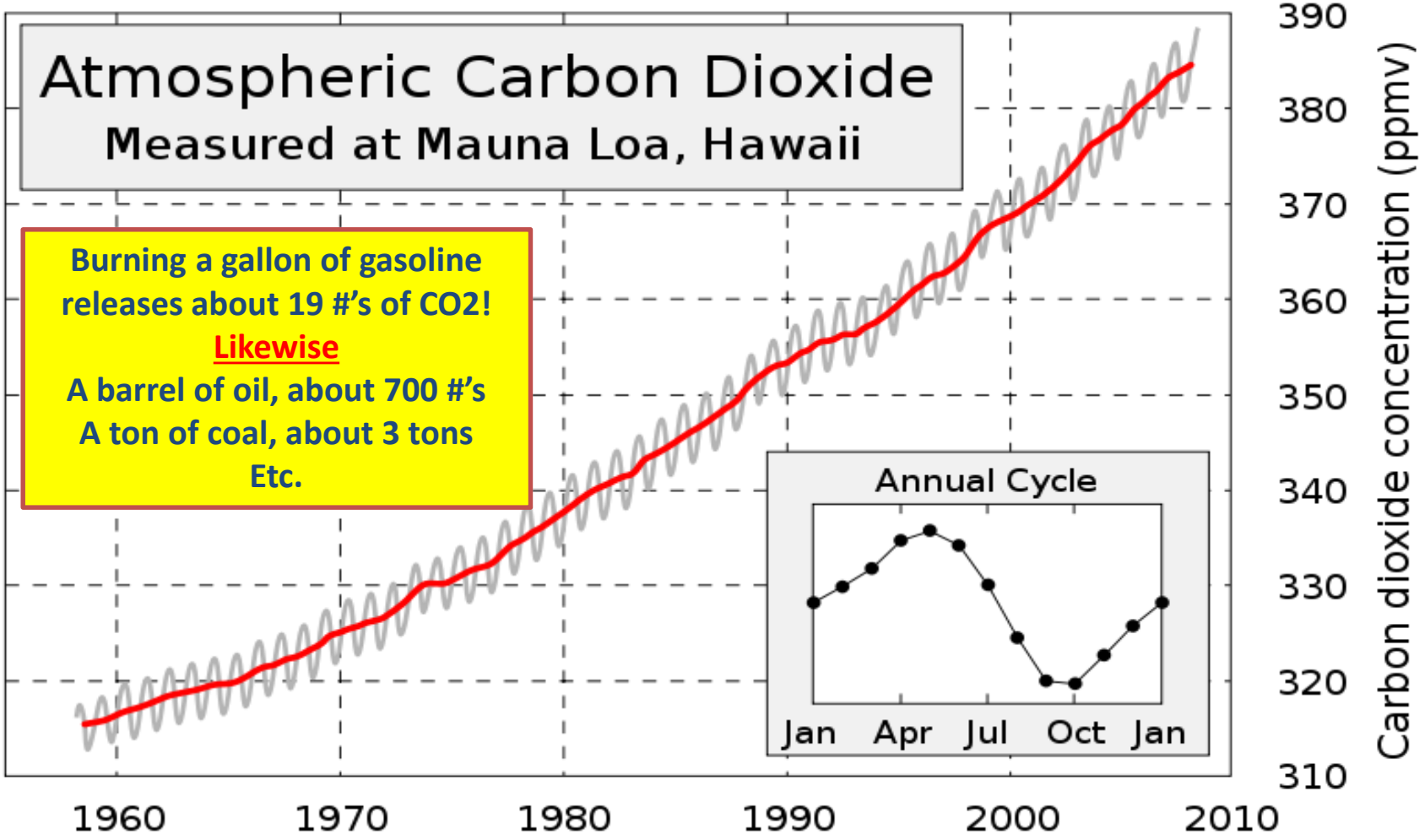
Governor's Executive Order S-3-05



Climate Data

Currently 400 PPM! *

- Keeling Curve:
  http://en.wikipedia.org/wiki/An_Inconvenient_Truth#Scientific_basis



Our Climate Crisis

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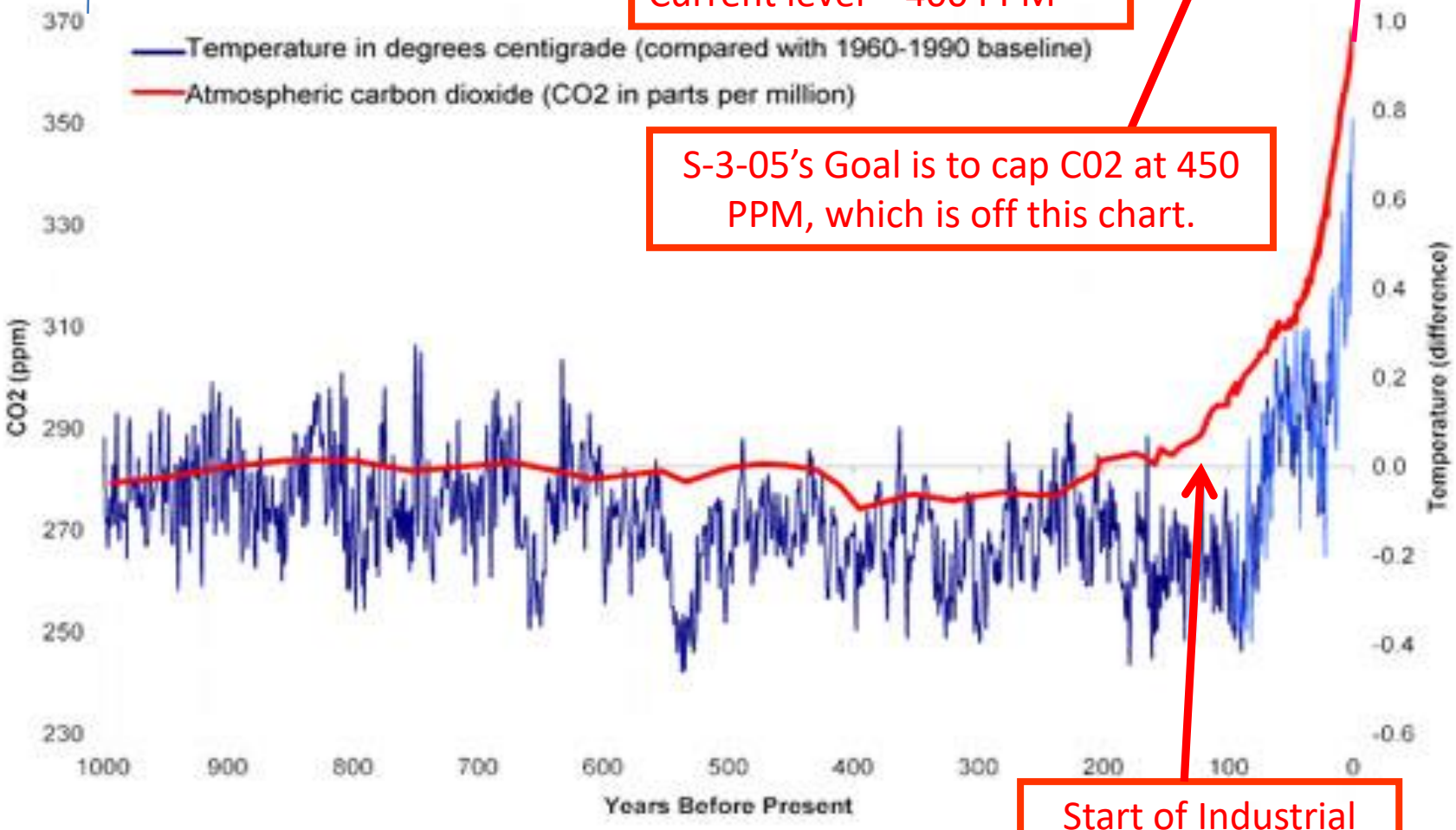

Our Climate Crisis

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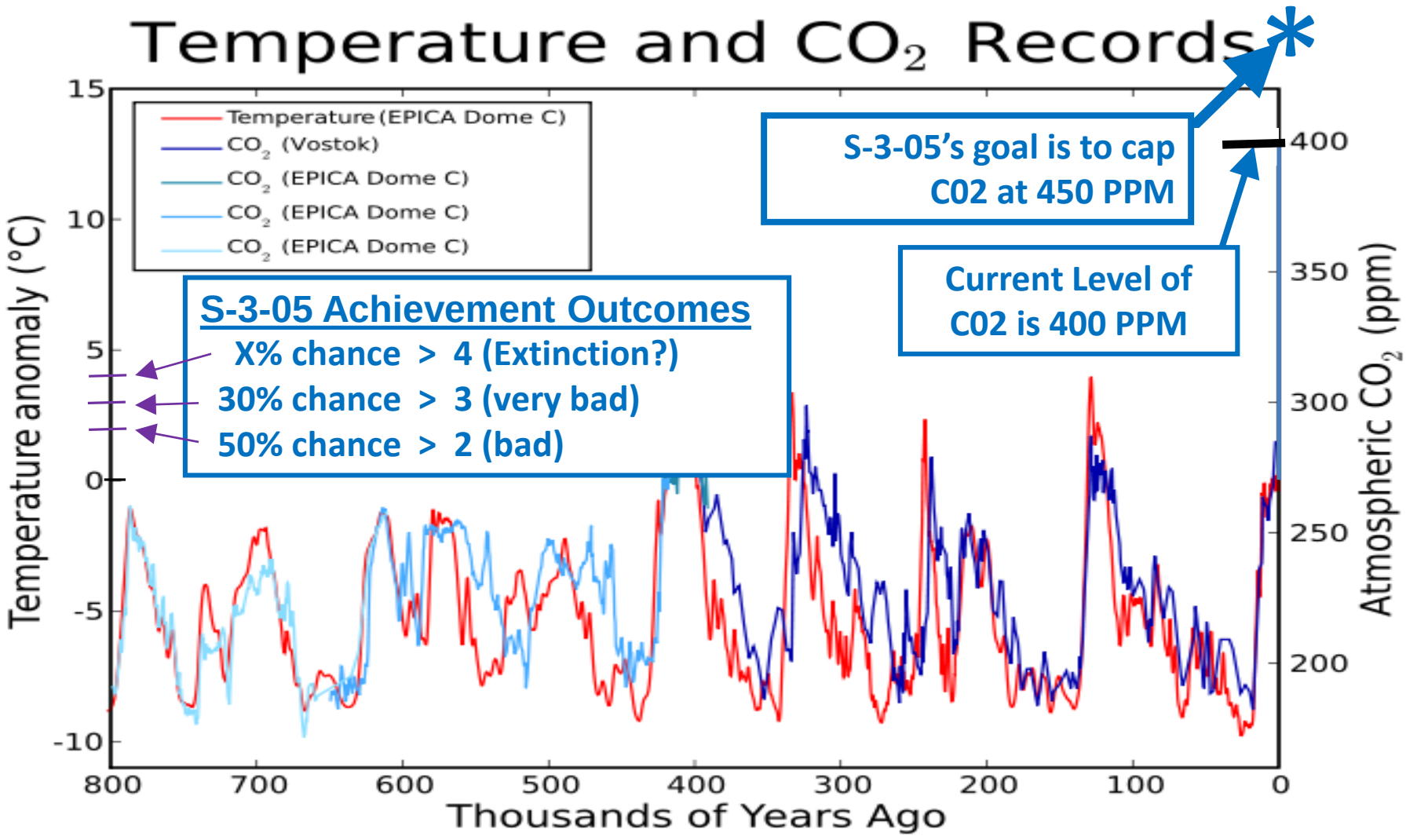


BRIEF OF SCIENTISTS AMICUS GROUP AS *AMICI CURIAE* IN SUPPORT OF PLAINTIFFS-APPELLANTS SEEKING REVERSAL

DANIEL M. GALPERN
Law Offices of Charles M. Tebbutt, P.C.
941 Lawrence St. Eugene, OR 97401-2815

USCA Case #13-5192 Document #1465822 Filed: 11/12/2013

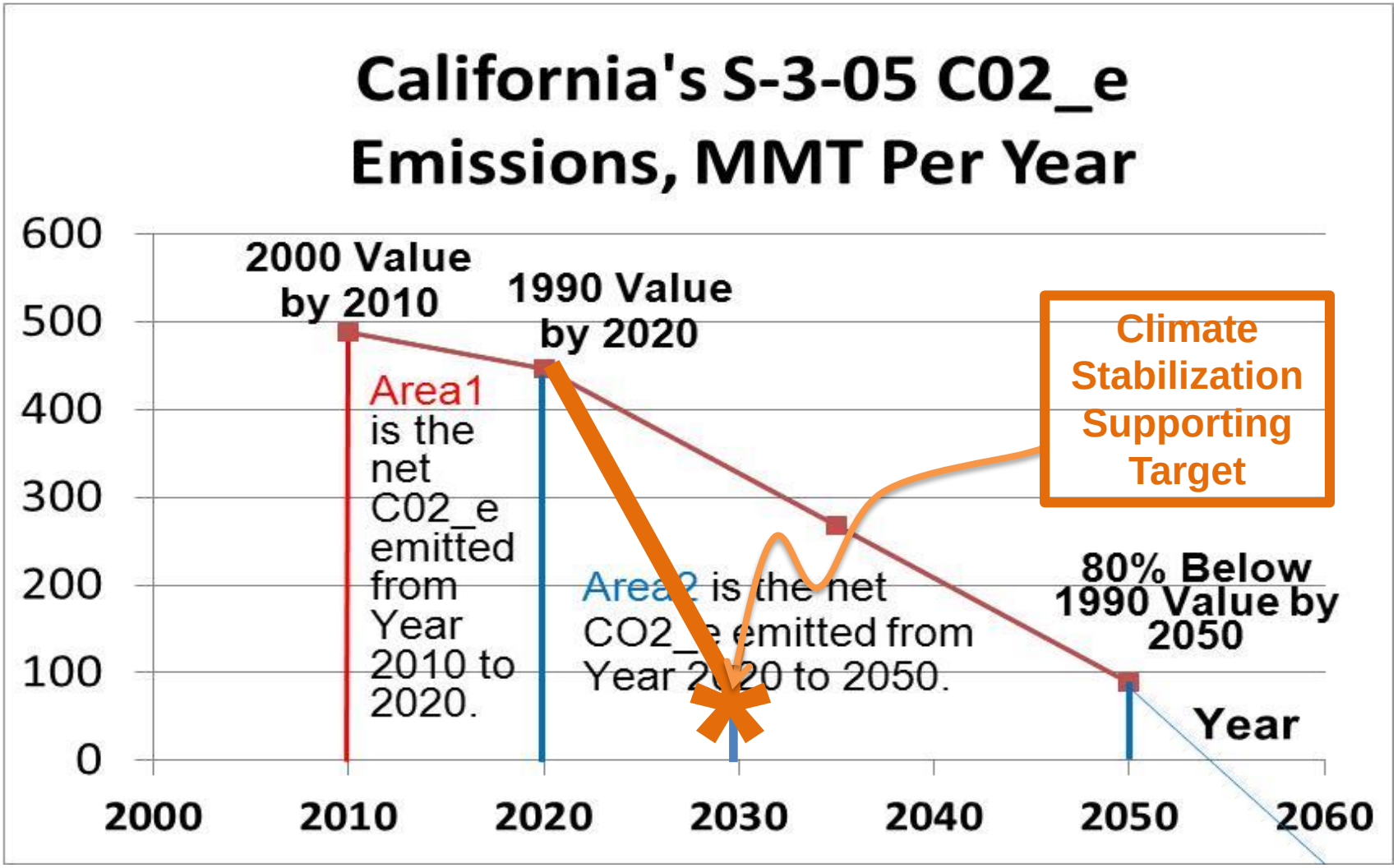
A. Parties and *Amici*. Except for the following, all parties, intervenors, and *amici* appearing before the district court and in this Court are listed in the Brief for Plaintiffs-Appellants. **James Hansen**, David Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Pushker Kharecha, Valérie Masson-Delmotte, Camille Parmesan, Eelco Rohling, Makiko Sato, Pete Smith, and Lise Van Susteren are *amici curiae* in this appeal (referred to hereinafter as "Amici Scientists.").

From the Climate Scientists

From Page 21: . . . the required rate of emissions reduction would have been about 3.5% per year if reductions had started in 2005, ***while the required rate of reduction, if commenced in 2020, will be approximately 15% per year.***

- My math:
  - 15% means a factor of 0.85, year after year
  - Consider the 10 years from 2020 to 2030
  - $(.85)^{\mathbf{10}} = .20$, which is 80% down
  - Other articles, describing Hansen's work: "**decarbonization by 2030**"

New Prescription for Climate Stabilization



***How*, for LDVs:**

The Development of California Light-Duty Vehicle (LDV) Requirements to Support Climate Stabilization: Fleet-Emission Rates & Per-Capita Driving

Paper 2014-A-30793-AWMA

Notes on Methods

- Base year 2005
- Intermediate year 2015
- Car Efficiency Factor from 2005 to 2015
  - Steve Winkelman's data
  - http://www.nrdc.org/globalWarming/sb375/files/sb375.pdf
- Car Efficiency Factor, 2015 to 2030
  - Derived in paper
  - Results in car-efficiency requirements
- Cars last 15 years

From a California law (***SB 375***) giving per-capita driving reduction targets to be achieved in Regional Transportation Plans

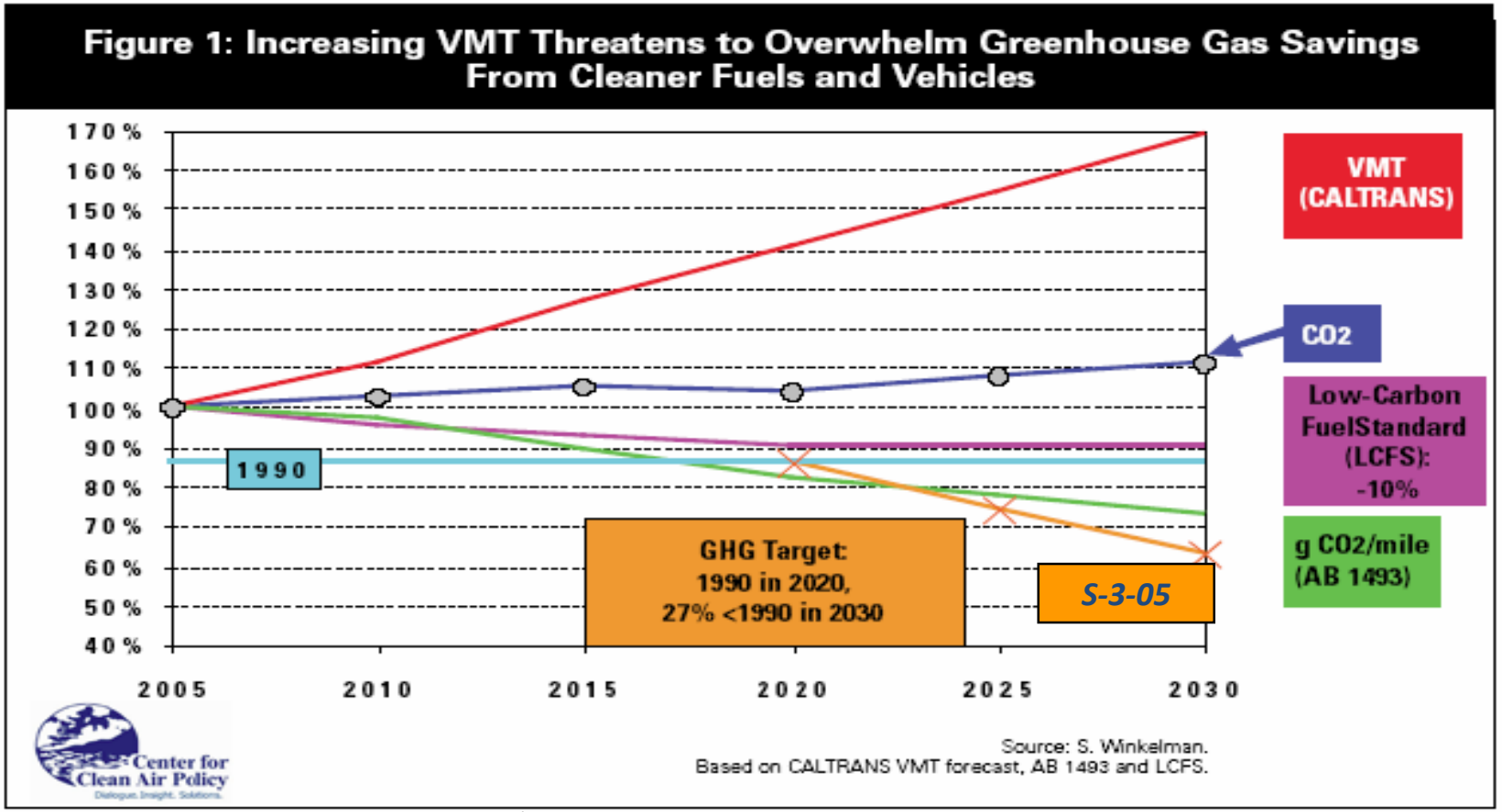
Report on ***SB 375*** See its Table 1.

Older cars are so few in number that they can be ignored.

Data Relating 1990, 2005, & 2015 Data

Purple (Low carbon fuel), Green (C02/Mile), & Gold (S-3-05)

Figure 1, from: http://www.ecovote.org/sites/default/files/pdf/sb375.pdf



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p_k	Population, in Year "k"
d_k	Per-capita LDV driving, in Year "k"
D_k	LDV Driving, in Year "k"
M_k	LDV Mileage, miles per gallon, in Year "k"
m_k	LDV Equivalent Mileage, miles per gallon, in Year "k" accounting for the Low Carbon Fuel Standard (LCFS) Factor, so this is M_k/L_k
N	Number of pounds of CO2 per gallon of fuel but not accounting for the Low Carbon Fuel Standard (LCFS) Factor

Fundamental Equations

Future Year k: $\boldsymbol{e_k} = c_k * d_k * p_k$

Base Year i: $\boldsymbol{e_i} = c_i * d_i * p_i$

$$\frac{\boldsymbol{e_k}}{\boldsymbol{e_i}} = \frac{\boldsymbol{c_k}}{\boldsymbol{c_i}} * \frac{\boldsymbol{d_k}}{\boldsymbol{d_i}} * \frac{\boldsymbol{p_k}}{\boldsymbol{p_i}}$$

To work with mileage: $\dfrac{\boldsymbol{m_i}}{\boldsymbol{m_k}} = \dfrac{\boldsymbol{c_k}}{\boldsymbol{c_i}}$

Solution Overview

"k" denotes Year 2030
"i" denotes Year 2005

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From existing and predicted population

$$\frac{e_k}{e_i} = \frac{m_i}{m_k} * \frac{d_k}{d_i} * \frac{p_k}{p_i}$$

From the known 1990-to-2005 factor and the **Climate-Stabilizing-Target, which is the factor of 2030 emissions to 1990 emissions**

The Independent Variable
It becomes the ***required per-capita driving reduction with respect to 2005 driving***

Solution Using Intermediate Year of 2015

From the **Climate-Stabilizing-Target**, **which is the factor of 2030 emissions to 1990 emissions**

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From Winkelman. It is the product of the factor from the green line and the purple line.

From known and predicted populations

$$\frac{e_{2030}}{e_{1990}} * \frac{e_{1990}}{e_{2005}} = \frac{c_{2030}}{c_{2015}} * \frac{c_{2015}}{c_{2005}} * \frac{d_{2030}}{d_{2005}} * \frac{p_{2030}}{p_{2005}}$$

Taken from the Winkelman data: the known 1990-to-2005 factor of emissions (the light blue line)

The Independent Variable
It becomes the ***required 2030 per-capita driving reduction with respect to 2005 driving***

Putting In the Easy-to-Get Values

From the **Climate-Stabilizing-Target**, **which is the factor of 2030 emissions to 1990 emissions**

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From Winkelman. It is the product of the factor from the green line and the purple line.

From known and predicted populations

$$.2 * .87 = \frac{c_{2030}}{c_{2015}} * [.9 * .93] * \frac{d_{2030}}{d_{2005}} * 1.2305$$

Taken from the Winkelman data: the known 1990-to-2005 factor of emissions (the light blue line)

The Independent Variable
It becomes the ***required per-capita 2030 driving reduction with respect to 2005 driving***

Combining the Easy-to-Get Values, Solving for the Independent Variable, and Changing the 2015-to-2030 Car Efficiency from CO2-Per-Mile to Equivalent-Miles-Per-Gallon

$$.1689 = \frac{c_{2030}}{c_{2015}} * \frac{d_{2030}}{d_{2005}}$$

$$\frac{d_{2030}}{d_{2005}} = .1689 * \frac{c_{2015}}{c_{2030}}$$

$$\frac{d_{2030}}{d_{2005}} = .1689 * \frac{m_{2030}}{m_{2015}}$$

Equivalent Mileage in 2030 is what we make it. **It better be as high as possible, because a large driving reduction will be difficult.**
= "NUMERATOR MILEAGE"

The required per-capita 2030 driving with respect to 2005 driving

2015 Fleet Mileage is computed
= "DENOMINATOR MILEAGE"

Some Requirements Defined to Achieve 2030 Fleet Equivalent-Mileage

- Low-Carbon Fuel Standards (LCFS)
- Corporate Average Fuel Efficiency (CAFÉ) Standards from 2015 to 2030
- Driving Reduction Factors (f_n) for bad-mileage years (Year n)

Both California's existing and extended, "L_k"

Existing, to 2025
Specified to 2030

- For example, 0.75 means 25% less driving
- ***Cash for Gas-guzzlers?***

Three More Requirements Defined to Achieve 2030 Fleet Equivalent-Mileage

- CAFÉ Standards only apply to Internal Combustion Engine (ICE) LDVs
- New Requirement: Fraction of fleet sold that must be ***Zero Emission Vehicles*** (ZEVs)
- In 2030, only 20% of electricity is from fossil fuels

Define "z" to be the fraction of fleet sold that must be ZEVs

Fleet Mileage for Intermediate Year 2015

LDV Set	Years Old	Model Year	CAFE MPG	LCFS Factor L_{Year}	Factor Driven f	Gallons Used Per f*100 Miles
1	14-15	2001	24.0	1.0	1.0	4.17
2	13-14	2002	24.0	1.0	1.0	4.17
3	12-13	2003	24.0	1.0	1.0	4.17
4	11-12	2004	24.0	1.0	1.0	4.17
5	10-11	2005	25.0	1.0	1.0	4.00
6	9-10	2006	25.7	.9933	1.0	3.87
7	8-9	2007	26.3	.9867	1.0	3.75
8	7-8	2008	27.0	.9800	1.0	3.63
9	6-7	2009	28.0	.9733	1.0	3.48
10	5-6	2010	28.0	.9667	1.0	3.45
11	4-5	2011	29.1	.9600	1.0	3.30
12	3-4	2012	29.8	.9533	1.0	3.20
13	2-3	2013	30.6	.9467	1.0	3.09
14	1-2	2014	31.4	.9400	1.0	2.99
15	0-1	2015	32.6	.9333	1.0	2.86
					Sum of Gallons:	54.29
					Miles = 100*Sum(f's):	1500
					MPG = Miles/(Sum of Gallons):	27.3

Computed DENOMINATOR MILEAGE

ZEV Derivation Variables

Variable	Definition
m_z	ZEV Equivalent mileage (miles per equivalent gallon)
m_{zr}	ZEV Equivalent mileage if the electricity is from renewables
m_{zf}	ZEV Equivalent mileage if the electricity is from fossil fuels
r	fraction of electricity generated from sources not emitting CO2
G	Gallons of equivalent fuel used
D	Arbitrary distance travelled
Num	$m_{zr} \times m_{zf}$
Den	$r \times m_{zf} + (1 - r) \times m_{zr}$

ZEV Derivation

$$G = \frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}}$$

$$m_z = D/G = D/\left(\frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}}\right)$$

$$m_z = m_{zr} \times m_{zf} / \left(r \times m_{zf} + (1-r) \times m_{zr}\right)$$

$$m_z = Num/(Den)$$

m_{zr}	m_{zf}	r	1-r	Num	Den	m_z
5000	70	0.8	0.2	350000.00	1056.00	331.44

“Heroic Measures” Assumptions & Mileage

Year	ICE Parameters and Calculations						ZEVs			Yearly Totals		
	CAFÉ MPG	LCFS	Eq. MPG	f	D_i	G_i	z	D_z	G_z	Total Miles	Total Gallons	2030 MPG
2016	**34.3**	0.9267	37.01	0.3	28.8	0.7781	0.04	4	0.012	32.80	0.7901	41.51
2017	**35.1**	0.9200	38.15	0.4	37.2	0.9750	0.07	7	0.021	44.20	0.9962	44.37
2018	**36.1**	0.9133	39.53	0.5	44.0	1.1132	0.12	12	0.036	56.00	1.1494	48.72
2019	**37.1**	0.9067	40.92	0.6	49.2	1.2024	0.18	18	0.054	67.20	1.2567	53.47
2020	**38.3**	0.9000	42.56	0.7	53.2	1.2501	0.24	24	0.072	77.20	1.3225	58.37
2021	**40.3**	0.8500	47.41	0.8	52.8	1.1136	0.34	34	0.103	86.80	1.2162	71.37
2022	**42.3**	0.8000	52.88	0.9	46.8	0.8851	0.48	48	0.145	94.80	1.0299	92.05
2023	**44.3**	0.8000	55.38	1.0	38.0	0.6862	0.62	62	0.187	100.00	0.8733	114.51
2024	**46.5**	0.8000	58.13	1.0	24.0	0.4129	0.76	76	0.229	100.00	0.6422	155.71
2025	**48.7**	0.8000	60.88	1.0	10.0	0.1643	0.90	90	0.272	100.00	0.4358	229.46
2026	**51.2**	0.8000	64.00	1.0	5.0	0.0781	0.95	95	0.287	100.00	0.3648	274.16
2027	**53.7**	0.8000	67.13	1.0	2.0	0.0298	0.98	98	0.296	100.00	0.3255	307.24
2028	**56.2**	0.8000	70.25	1.0	1.0	0.0142	0.99	99	0.299	100.00	0.3129	319.56
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Sum of Miles and then Gallons of equivalent fuel:										**1259.00**	**11.34**	

Equivalent MPG of LDV Fleet in 2030: 111.03

ZEV Miles Driven = 865.0 **Fraction of Miles Driven by ZEVs = 68.7%**

Computed NUMINATOR MILEAGE

Computing the Ratio of Per-Capita 2030 Driving to Per-Capita 2005 Driving

Equivalent Mileage in 2030 is what we made it. It is as high as possible, because a large driving reduction will be difficult.
= "**NUMERATOR MILEAGE**"

$$\frac{d_{2030}}{d_{2005}} = .1689 * \frac{111.03}{27.30} = .68$$

2015 Fleet Mileage was computed
= "**DENOMINATOR MILEAGE**"

The factor of 0.68 means there is a 32% reduction in per-capita driving, from 2005 to 2030.

Calculation of Net Driving Decrease with Respect to 2005 Driving for the Heroic Measures Case

(Per-Capita Driving Factor) x (Population Factor) = Net Driving Factor

This factor corresponds to the 32% reduction in per-capita driving

(.68) x (1.23) = .84

Even though the population will grow 23%, net driving must decrease by 16%.

Therefore, why add highway lanes?

Fractions of Fleets Sold in California that are Zero Emission Vehicles AND Required Driving Reduction, For 2 Different Cases

A&WMA's 109th Conference & Exhibit; June 21, 2016; Paper 881

Zero Emission Vehicle (ZEV) Fleet Per-Cent & Required Driving Reduction, Per-Cent

"Heroic Measures" Case Versus the "Extra Heroic Measures"

Year	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*
Heroic Measures	4%	7%	12%	18%	24%	34%	48%
Extra Heroic Measures	4%	12%	24%	40%	62%	90%	93%

Year	2023	2024	2025	2026	2027	2028 to 2030
Heroic Measures	62%	76%	90%	95%	98%	99%
Extra Heroic Measures	96%	97%	98%	99%	99%	99%

	% Reduction in Per-Capita Driving, with Respect to 2005
Heroic Measures	**32%**
Extra Heroic Measures	**0%**

Comparison With Air Resources Stated Goals

The CARB Plan

Regulations on the books in California, set in 2012, require that 2.7 percent of new cars sold in the state this year be, in the regulatory jargon, ZEVs. The quota rises every year starting in 2018 and reaches 22 percent in 2025. Nichols wants 100 percent of the new vehicles sold to be zero- or almost-zero-emissions by 2030

Year	Air Resources Board Chair *Bloomberg News* [1]	AWMA Report *Climate Stabilizing* *"Heroic Measures" Case* [2]
2016	2.7%	4.0%
2017	2.7%	7.0%
2018	5.1%	12.0%
2019	7.5%	18.0%
2020	9.9%	24.0%
2021	12.4%	34.0%
2022	14.8%	48.0%
2023	17.2%	62.0%
2024	19.6%	76.0%
2025	22.0%	90.0%
2026	37.6%	95.0%
2027	53.2%	98.0%
2028	68.8%	99.0%
2029	84.4%	99.0%
2030	100.0%	99.0%

[1] August 8, 2015

[2] **Requires a 32% reduction in per-capta driving with respect to 2005**

The CARB Plan results in an equivalent 2030 Fleet Mileage of only **69.2 MPG**, which would require a per-capita driving reduction of **58%**, compared to 2005 driving, to achieve the climate-stabilizing target.

Measures to Get 32%

Estimated Reduction

- Predictions, Regional Transportation Plans **10%**
- Stop expanding most roads and all freeways **2%**
  - No need, Eliminate congestion with less driving
- Reallocate freeway-expansion $$$ to **transit** **2%**
- **Payment methods**, to increase fairness & choice
  - Demonstration projects: unbundle parking cost
  - **Legislation**
    - Unbundle the cost of most "free" or underpriced parking **8%**
    - Equitable and environmentally-sound road-use fees **8%**
- **Smarter growth**, complete streets, bike classes **2%**

32%

An Important Pricing Strategy

A Road-Usage-Charge (RUC) Pricing & Payout System

THEREFORE, BE IT RESOLVED, that the Democratic Club of Carlsbad and Oceanside (DEMCCO) supports a road-usage charge (RUC) pricing & payout system that (1) covers all road-use costs, including the environmental & health costs caused by driving; (2) could still include a fuel tax or fee; (3) would mitigate impacts on low-income users; (4) would protect privacy; (5) would include congestion pricing when that technology becomes feasible; (6) would keep the per-mile price incentive to drive energy-efficient cars at least as large as it is with today's fuel excise tax; and (7) would send its earnings to all citizens and institutions that are currently losing money.

Another Important Pricing Strategy

Funding Demonstration Projects of an Equitable & Environmentally-Sound Car-Parking Policy

From : http://www.cadem.org/our-california/platform/2016-platform-energy-and-environment, **the 2016 California Democratic Party (CDP) Platform:**

- ***Work for shared, convenient & value-priced parking, operated with a system that provides earnings to those paying higher costs or getting a reduced wage, due to the cost of providing parking***

THEREFORE, BE IT RESOLVED, that DEMCCO supports funding the development and prototype installation of car-parking systems with at least the last two features (numbered 7 and 8), so as to demonstrate useful feasibility, with the full set of features as follows: (1) have full-cost base pricing; . . . . . **(7) have automatic car detection; and (8) will do efficient mailing of invoices, containing both parking charges and parking earnings.**

Discarded Parking Slides

Start Here

Mike Bullock

mike_bullock@earthlink.net

Employee Behavior

Employees Must Park in Their Parking Lot if they Drive to Work

Measures to Reduce "Cheating" = Parking in the Neighborhood

- Soft, pre-emptive measure: messaging
  - **Perceived integrity** is every employee's responsibility
  - **Insufficient perceived integrity** can cost employees
    - Reduced chance of promotion
    - Smaller pay raises
    - More chance of terminated employment
  - Empty spaces in the employee parking garage cost all employees money
  - Parking free in the neighborhood will not be tolerated
  - The City wants to be a good neighbor: this is the reason for off-street parking ordinances
- Soft, pre-emptive measure: data collection
  - Operate the system for a time, perhaps even a year, before actually collecting or distributing money
  - Non drivers are identified, thanked, and asked to provide details as to how they are getting to work without driving
- Soft, In-Operational Mode: Non drivers are thanked and interrogated
- **Hard: cameras or RFID sensors can identify employees walking into the work perimeter from the neighborhoods**

Hard-to-Not-Drive Example

Fictional, Simplified Case with Pricing and Payout Considered per Day, *Page 1*

- Employment Center (factory and office)
- Outside Hemet, California
- 100 employees; parking lot has 100 spaces
- No Transit, 110 degree temperature with poor roads for biking, culture of not car-pooling
- Before installing
  - 99 drive
  - 1 bikes

Hard-to-Not-Drive Example

Fictional, Simplified Case with Pricing and Payout Considered per Day, *Page 2*

- Dividend-Account Parking charges $10/day
- After installing
  - 99 drive
  - 1 bikes
- Total collected each day: $990
- Each employee gets $9.90 earnings per day
- Each driver loses 10 cents per day
- The “crazy” bike rider gets $9.90 per day extra

Hey, isn’t this an improvement? I would say the “crazy” bike rider is earning his money!

If another employee bikes, the drivers would lose 20 cents per day and the bike riders would get $9.80 per day. If the company president rented out the 2 extra spaces for $10 per day, the drivers would lose nothing and the bike riders would get $10 per day. Biking would increase by 100%! **What’s wrong with that?**

Results of 3 Actions, Including Cash-out

Case (#1), Reference Patrick Siegman's article in Bicycle Pedestrian Federation

- Company: CH2M Hill
  - Location: Bellevue, WA (Seattle suburb)
  - Engineering Firm with 430 employees
- Actions
  - $54/month (1995 $'s), *to not drive*
  - Improved Transit
  - Improved Bike/Ped facilities

CH2M Hill Work Trips		
Mode	***Before***	***After***
Drive Alone	**89%**	**54%**
Carpool	**9%**	**12%**
Bus	**1%**	**17%**
Bike, Walk	**1%**	**17%**
	100%	***100%***

Since these changes are brought about by more than just cashout, this case is not used in the tabulation of cashout results (next chart)

Cash-Out Results

(11 Locations, 3 Groups, 1995 Dollars)

Money Matters !!!!!

- Reference: *How to Get Paid to Bike to Work: A Guide to Low-traffic, High- Profit Development* by Patrick Siegman*. Published in *Bicycle Pedestrian Federation of America*, 1995.
- 3 Largest Responses
  - 38%, 36%, 31%
- 3 Smallest Responses
  - **15%** , 18%, 24%
- Responses are the *change;* car vacancy rates would be larger

*Patrick Siegman, of Nelson Nygaard

Impact of Financial Incentives on Parking Demand			
Location	**Scope**	**1995 dollars per mo.**	**Parking Use Decrease[1]**
Group A: Areas with little or no public transportation			
CenturyCityDistrict, West Los Angeles	3500 employees at 100+ firms	$81	15%
Cornell University, Ithaca, NY	9000 faculty & staff	$34	26%
San Fernando Valley, Los Angeles	1 employer, 850 employees	$37	30%
Costa Mesa, CA		$37	22%
Average for Group		**$47**	**23%**
Group B: Areas with fair public transportation			
Los Angeles Civic Center	10000+ employees, several firms	$125	36%
Mid-Wilshire Blvd., Los Angleles	1 mid-size firm	$89	38%
Washington DC Suburbs	5500 employees at 3 worksites	$68	26%
Downtown Los Angeles	5000 employees, 118 firms	$126	25%
Average for Group		**$102**	**31%**
Group C: Areas with good public transportation			
University of Washington, Seattle Wa.	50,000 faculty, staff & students	$18	24%
Downtown Ottowa, Canada	3500+ government staff	$72	18%
Bellevue, WA	1 firm with 430 employees	$54	39%[2]
Average for Group, but not Bellevue Washington		**$45**	**21%**
Over All Average, Excluding Bellevue Washington			**25%**

[1] **Parking vacancy would be higher!** [2] **Not used, since transit & walk/bike facilities also improved.**

Implementation Example

Since this is a new system, it would be prudent for the City have the vendor take the full responsibility for operating the system, for the first 10 years. This would ensure that the vendor would debug the system and continue to look for operational efficiencies, over the 10 year period. A sliding scale of vendor-compensation could be specified in the contract, as follows: The vendor would operate the system for 10% of the revenue, for the first 5 years; 5% of the revenue, for the next 3 years; and 2% of the revenue, for the final 2 years. For example, if it is assumed that, on average, 600 cars are parked for 8 hours, for 200 days per year, at a rate of 50 cents per hour, then the yearly revenue would be $480,000 per year. The vendor would therefore collect $240,000 over the first 5 years, $72,000 over the next 3 years, and $28,800 over the last two years. Vendor contact information is available. This vendor has stated that the design and installation of a fully-automated system is feasible.

How Bad Could It Get?

- *Scientific American* June 2008 issue
  - 550 PPM CO2 possible in several decades
  - This could (5% probability) lead to 8 Deg. Celsius of warming
  - 8 Deg. Celsius could lead to "a devastating collapse of the human population, perhaps even to extinction"
- December 24/31 2012 Issue of Nation magazine:

A recent string of reports from impeccable mainstream institutions-the International Energy Agency, the World Bank, the accounting firm of PricewaterhouseCoopers-have warned that the Earth is on a trajectory to warm by at least 4 Degrees Celsius

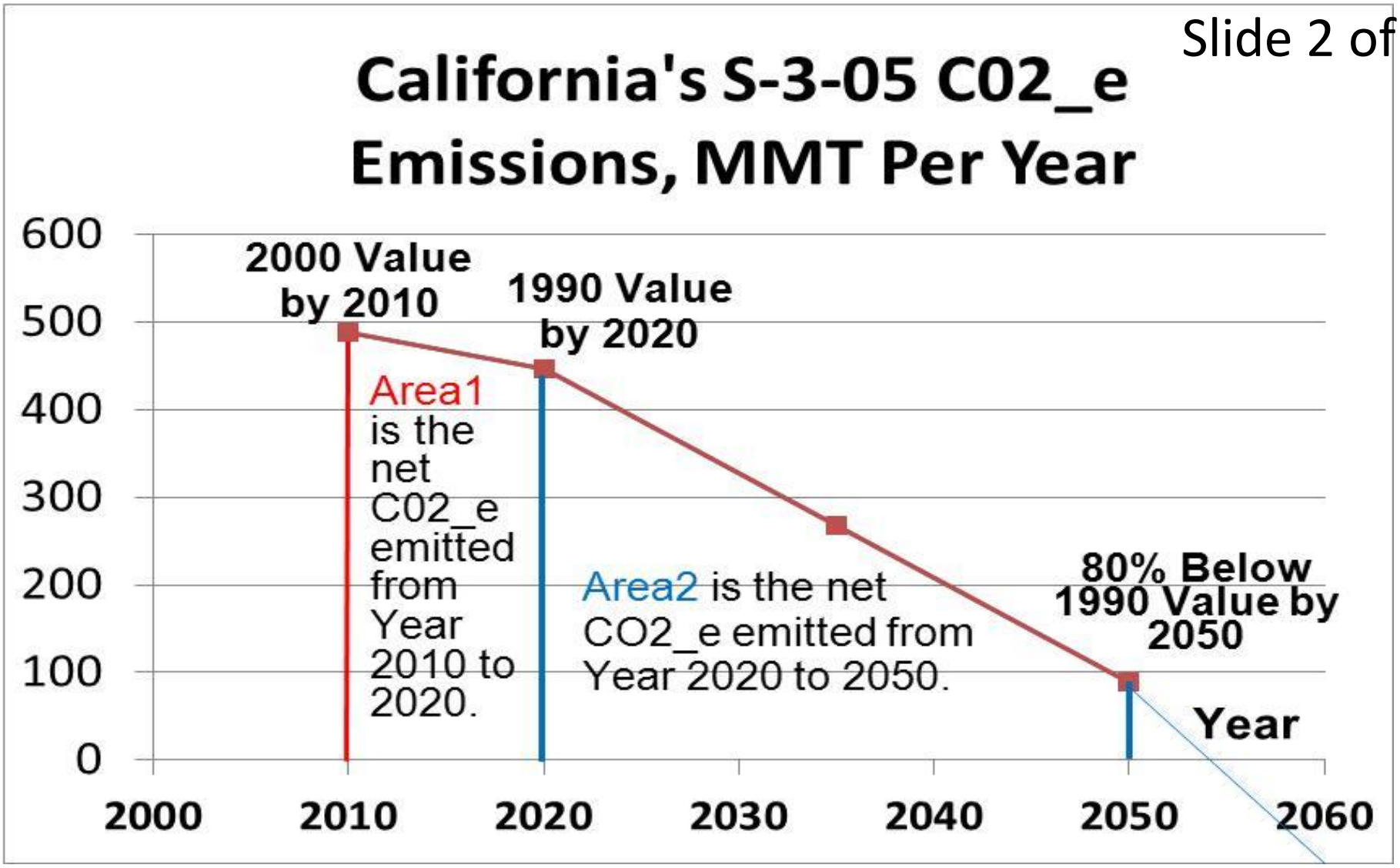
[4 Degrees Celsius] would be *incompatible with continued human survival*.

Winter, ***UU World*** magazine (p. 57) " Lags in the replacement of fossil-fuel use by clean energy use have put the world on a pace for 6 degree Celsius by the end of this century. Such a large temperature rise occurred 250 million years ago and extinguished 90 percent of the life on Earth. The current rise is of the same magnitude but is occurring faster. We must reduce or eliminate all uses of fossil fuels.

California's "Climate Mandate"

S-3-05	2005, Governor's Executive Order, Schwarzenegger, 3 GHG emission targets, one in 2010, 2020, and 2050 The 2050 target was designed to cap CO2_e at 450 PPM
AB 32	2006, Cap and Trade. It caps GHG emissions, by sector, including fuel for vehicles. It ensures achieving the 2nd and 3rd (this is disputed) targets of S-3-05. Tasks CARB with writing "Scoping Plans" to detail how this will be done.
SB 375	2008, Steinberg. Tasks CARB with setting VMT-reduction targets for Metropolitan Planning Organizations (MPOs, such as SANDAG), for cars and light-duty trucks (Light-duty vehicles, or LDVs), for the years 2020 and 2035. These should have been at least sufficient to achieve the climate mandates, but CARB gave the MPOs whatever they wanted.
B-30-15	2015, Governor's Executive Order, Brown, 1 GHG emission target, 2030. This target is the same value as the 2035 target of S-3-05, found by connecting the 2020 and 2050 targets by a straight line.

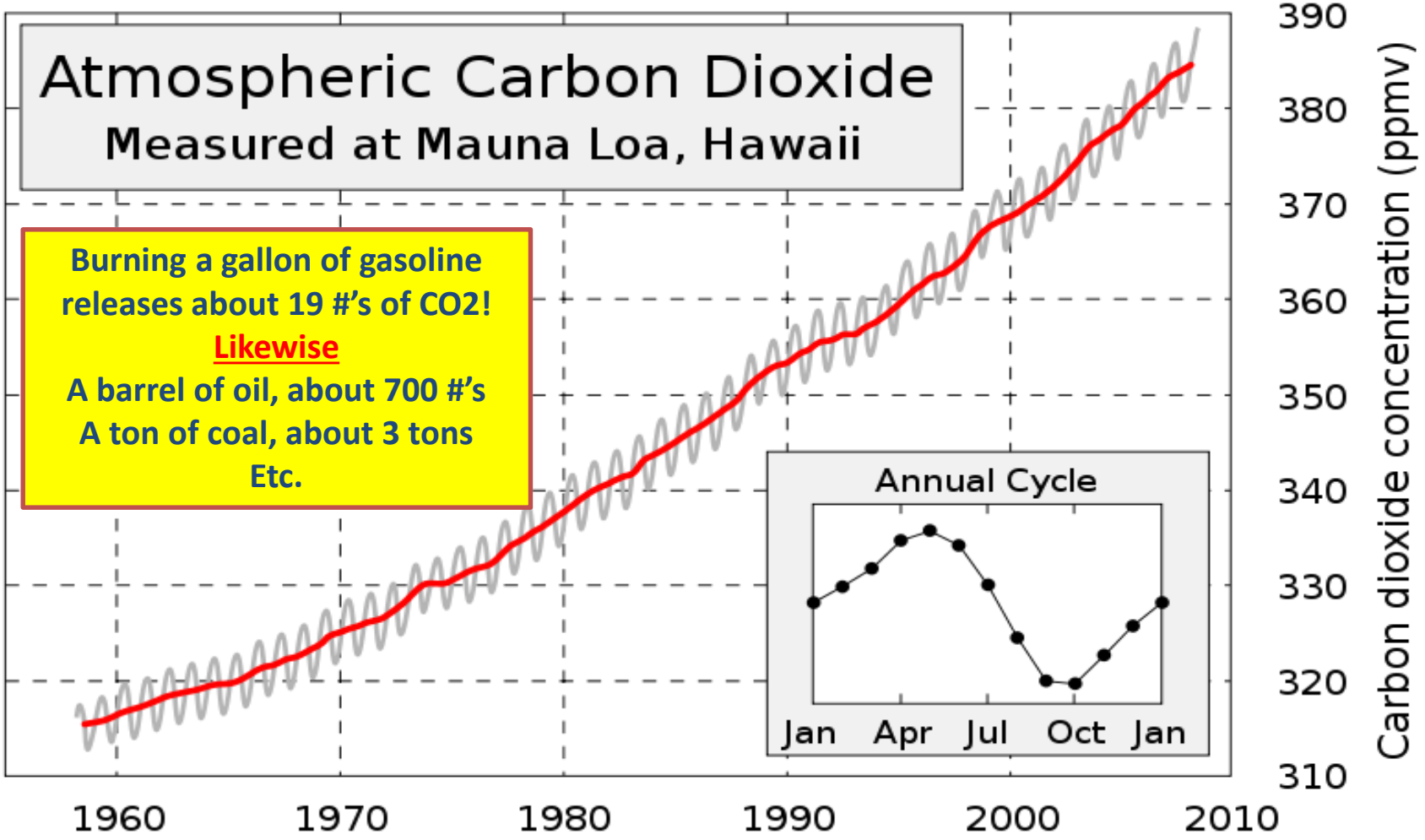
Governor's Executive Order S-3-05



Climate Data

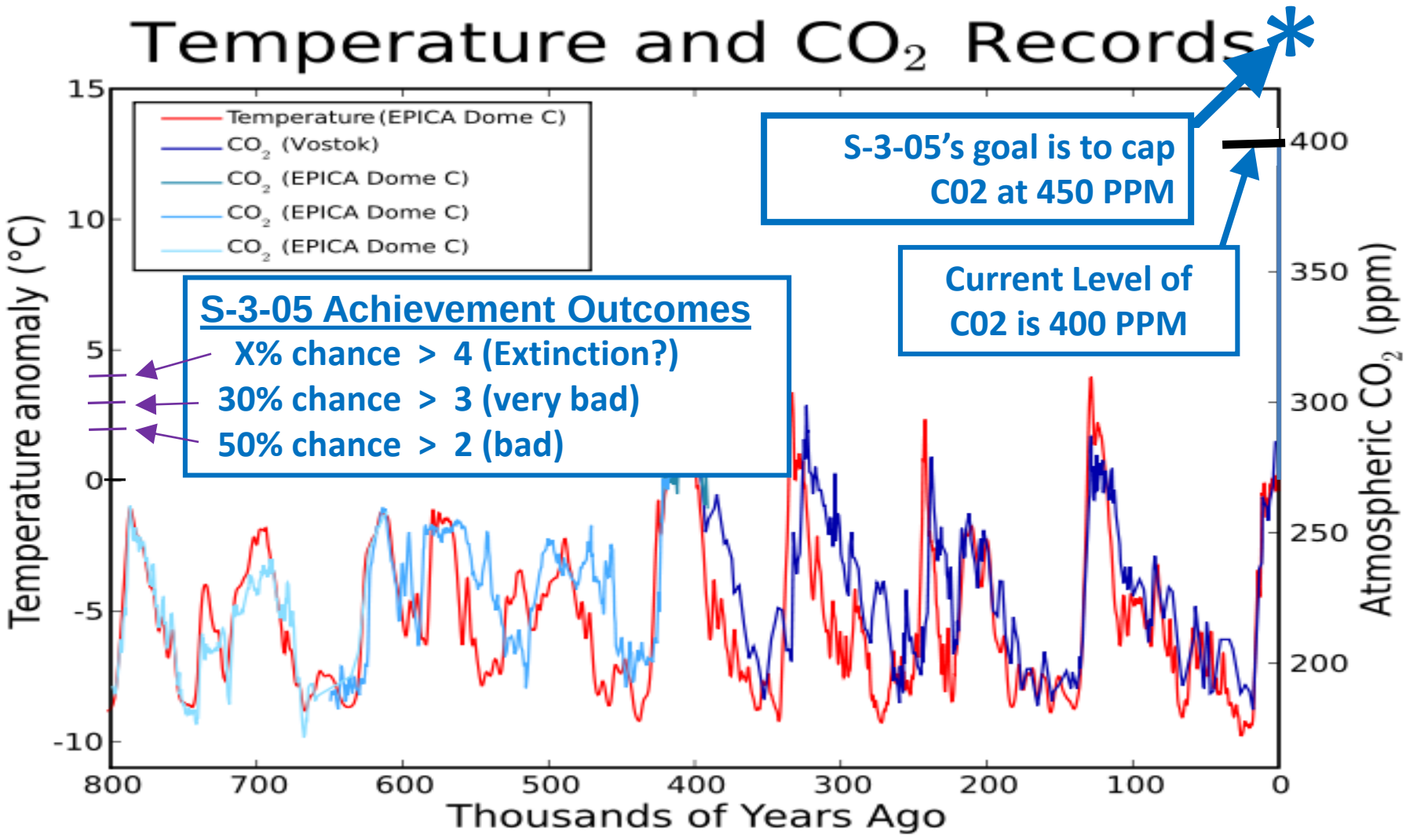
Currently 400 PPM! *

- Keeling Curve:
  http://en.wikipedia.org/wiki/An_Inconvenient_Truth#Scientific_basis



Our Climate Crisis

- From: http://en.wikipedia.org/wiki/An_Inconvenient_Truth#Scientific_basis



Atmospheric Levels of CO2_e

450

400

350

300

450 PPM. California's 2005 Climate Mandate, Executive Order S-3-05, was based on studies suggesting that capping to this value would likely keep the temperature change below 2 degree Celsius[1].

400 PPM. Many studies say that stabilizing here would cause the increase in temperature to be around 2 Degrees Celsius[1]. Atmospheric CO2_e is now over 400 PPM.

350 PPM. Dr. James Hansen said this would be safe; hence the name of internationally-known "**350.org**"

300 PPM. For over 800,000 years, this value was never exceeded, until around 1860, due to our emissions

280 PPM. Pre-industrial-revolution value

[1]From the *First Update to the California Air Resources Board (CARB) work pursuit to California's AB 32 (Cap and Trade law)* ***Climate Change Scoping Plan, Building on the Framework, Subsection "Climate Stabilization"***

http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf

BRIEF OF SCIENTISTS AMICUS GROUP AS *AMICI CURIAE* IN SUPPORT OF PLAINTIFFS-APPELLANTS SEEKING REVERSAL

DANIEL M. GALPERN
Law Offices of Charles M. Tebbutt, P.C.
941 Lawrence St. Eugene, OR 97401-2815

USCA Case #13-5192 Document #1465822 Filed: 11/12/2013

A. Parties and *Amici*. Except for the following, all parties, intervenors, and *amici* appearing before the district court and in this Court are listed in the Brief for Plaintiffs-Appellants. **James Hansen**, David Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Pushker Kharecha, Valérie Masson-Delmotte, Camille Parmesan, Eelco Rohling, Makiko Sato, Pete Smith, and Lise Van Susteren are *amici curiae* in this appeal (referred to hereinafter as "Amici Scientists.").

***How*, for LDVs:**

The Development of California Light-Duty Vehicle (LDV) Requirements to Support Climate Stabilization: Fleet-Emission Rates & Per-Capita Driving

Paper 2014-A-30793-AWMA

Solution Using Intermediate Year of 2015

From the **Climate-Stabilizing-Target**, **which is the factor of 2030 emissions to 1990 emissions**

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From Winkelman. It is the product of the factor from the green line and the purple line.

From known and predicted populations

$$\frac{e_{2030}}{e_{1990}} * \frac{e_{1990}}{e_{2005}} = \frac{c_{2030}}{c_{2015}} * \frac{c_{2015}}{c_{2005}} * \frac{d_{2030}}{d_{2005}} * \frac{p_{2030}}{p_{2005}}$$

Taken from the Winkelman data: the known 1990-to-2005 factor of emissions (the light blue line)

The Independent Variable
It becomes the ***required 2030 per-capita driving reduction with respect to 2005 driving***

Putting In the Easy-to-Get Values

From the **Climate-Stabilizing-Target**, **which is the factor of 2030 emissions to 1990 emissions**

Car Efficiency Factor
From existing mileage requirements and the ***requirements defined herein***

From Winkelman. It is the product of the factor from the green line and the purple line.

From known and predicted populations

$$.2 * .87 = \frac{c_{2030}}{c_{2015}} * [.9 * .93] * \frac{d_{2030}}{d_{2005}} * 1.2305$$

Taken from the Winkelman data: the known 1990-to-2005 factor of emissions (the light blue line)

The Independent Variable
It becomes the ***required per-capita 2030 driving reduction with respect to 2005 driving***

Combining the Easy-to-Get Values, Solving for the Independent Variable, and Changing the 2015-to-2030 Car Efficiency from CO2-Per-Mile to Equivalent-Miles-Per-Gallon

$$.1689 = \frac{c_{2030}}{c_{2015}} * \frac{d_{2030}}{d_{2005}}$$

$$\frac{d_{2030}}{d_{2005}} = .1689 * \frac{c_{2015}}{c_{2030}}$$

$$\frac{d_{2030}}{d_{2005}} = .1689 * \frac{m_{2030}}{m_{2015}}$$

Equivalent Mileage in 2030 is what we make it. **It better be as high as possible, because a large driving reduction will be difficult.**
= "NUMERATOR MILEAGE"

The required per-capita 2030 driving with respect to 2005 driving

2015 Fleet Mileage is computed
= "DENOMINATOR MILEAGE"

Some Requirements Defined to Achieve 2030 Fleet Equivalent-Mileage

- Low-Carbon Fuel Standards (LCFS)
- Corporate Average Fuel Efficiency (CAFÉ) Standards from 2015 to 2030
- Driving Reduction Factors (f_n) for bad-mileage years (Year n)

Both California's existing and extended, "L_k"

Existing, to 2025
Specified to 2030

- For example, 0.75 means 25% less driving
- ***Cash for Gas-guzzlers?***

Three More Requirements Defined to Achieve 2030 Fleet Equivalent-Mileage

- CAFÉ Standards only apply to Internal Combustion Engine (ICE) LDVs
- New Requirement: Fraction of fleet sold that must be ***Zero Emission Vehicles*** (ZEVs)
- In 2030, only 20% of electricity is from fossil fuels

Define "z" to be the fraction of fleet sold that must be ZEVs

Fleet Mileage for Intermediate Year 2015

LDV Set	Years Old	Model Year	CAFE MPG	LCFS Factor L_{Year}	Factor Driven f	Gallons Used Per f*100 Miles
1	14-15	2001	24.0	1.0	1.0	4.17
2	13-14	2002	24.0	1.0	1.0	4.17
3	12-13	2003	24.0	1.0	1.0	4.17
4	11-12	2004	24.0	1.0	1.0	4.17
5	10-11	2005	25.0	1.0	1.0	4.00
6	9-10	2006	25.7	.9933	1.0	3.87
7	8-9	2007	26.3	.9867	1.0	3.75
8	7-8	2008	27.0	.9800	1.0	3.63
9	6-7	2009	28.0	.9733	1.0	3.48
10	5-6	2010	28.0	.9667	1.0	3.45
11	4-5	2011	29.1	.9600	1.0	3.30
12	3-4	2012	29.8	.9533	1.0	3.20
13	2-3	2013	30.6	.9467	1.0	3.09
14	1-2	2014	31.4	.9400	1.0	2.99
15	0-1	2015	32.6	.9333	1.0	2.86
					Sum of Gallons:	54.29
					Miles = 100*Sum(f's):	1500
					MPG = Miles/(Sum of Gallons):	27.3

Computed DENOMINATOR MILEAGE

ZEV Derivation Variables

Variable	Definition
m_z	ZEV Equivalent mileage (miles per equivalent gallon)
m_{zr}	ZEV Equivalent mileage if the electricity is from renewables
m_{zf}	ZEV Equivalent mileage if the electricity is from fossil fuels
r	fraction of electricity generated from sources not emitting CO2
G	Gallons of equivalent fuel used
D	Arbitrary distance travelled
Num	$m_{zr} \times m_{zf}$
Den	$r \times m_{zf} + (1 - r) \times m_{zr}$

ZEV Derivation

$$G = \frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}}$$

$$m_z = D/G = D/\left(\frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}}\right)$$

$$m_z = m_{zr} \times m_{zf} / \left(r \times m_{zf} + (1-r) \times m_{zr}\right)$$

$$m_z = Num/(Den)$$

m_{zr}	m_{zf}	r	1-r	Num	Den	m_z
5000	70	0.8	0.2	350000.00	1056.00	331.44

“Heroic Measures” Assumptions & Mileage

Year	ICE Parameters and Calculations						ZEVs			Yearly Totals		
	CAFÉ MPG	LCFS	Eq. MPG	f	D_i	G_i	z	D_z	G_z	Total Miles	Total Gallons	2030 MPG
2016	**34.3**	0.9267	37.01	0.3	28.8	0.7781	0.04	4	0.012	32.80	0.7901	41.51
2017	**35.1**	0.9200	38.15	0.4	37.2	0.9750	0.07	7	0.021	44.20	0.9962	44.37
2018	**36.1**	0.9133	39.53	0.5	44.0	1.1132	0.12	12	0.036	56.00	1.1494	48.72
2019	**37.1**	0.9067	40.92	0.6	49.2	1.2024	0.18	18	0.054	67.20	1.2567	53.47
2020	**38.3**	0.9000	42.56	0.7	53.2	1.2501	0.24	24	0.072	77.20	1.3225	58.37
2021	**40.3**	0.8500	47.41	0.8	52.8	1.1136	0.34	34	0.103	86.80	1.2162	71.37
2022	**42.3**	0.8000	52.88	0.9	46.8	0.8851	0.48	48	0.145	94.80	1.0299	92.05
2023	**44.3**	0.8000	55.38	1.0	38.0	0.6862	0.62	62	0.187	100.00	0.8733	114.51
2024	**46.5**	0.8000	58.13	1.0	24.0	0.4129	0.76	76	0.229	100.00	0.6422	155.71
2025	**48.7**	0.8000	60.88	1.0	10.0	0.1643	0.90	90	0.272	100.00	0.4358	229.46
2026	**51.2**	0.8000	64.00	1.0	5.0	0.0781	0.95	95	0.287	100.00	0.3648	274.16
2027	**53.7**	0.8000	67.13	1.0	2.0	0.0298	0.98	98	0.296	100.00	0.3255	307.24
2028	**56.2**	0.8000	70.25	1.0	1.0	0.0142	0.99	99	0.299	100.00	0.3129	319.56
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