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The Control of Pollution from the Transportation Sector

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Two challenges to transportation pollutant

- Conventional pollution from tailpipes
  - For example:
    - Ozone (O3)
    - Particulate Matter (PM)
    - Carbon Monoxide (CO)
    - Nitrogen Dioxide (NO2)
    - Sulfer Dioxide (SO2)
    - Lead (Pb)
- Greenhouse gases from combustion of fuels
  - For example:
    - Carbon Dioxide (CO2)
    - CFCs

Sources of Transportation Pollution

On Road Sources

Fuels

Off Road Sources

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Clean Air Act Title II

Clean Air Act Title II (42 U.S.C. Section 201 et seq.) addresses numerous categories of mobile sources.

- On-Road Vehicles
  - Cars and Light Duty Trucks
  - Heavy Duty Trucks, Buses and Engines
  - Motorcycles
- Fuels

- Off-Road Sources
  - Aircraft
  - Diesel Boats and Ships
  - Gasoline Boats and Personal Watercraft
  - Nonroad Diesel (farm and construction equipment)
  - Forklifts, Generators and Compressors
  - Lawn and Garden
  - Locomotives
  - Snowmobiles, Dirt Bikes, and ATVs

Development of Pollution Control Laws

- 1950s
  - U.S. and California study pollution
  - California develops air pollution control program
- 1960s
  - U.S. passes Air Pollution Control Act
  - First federal standards take effect
  - Fuel additives required
  - State inspections
- 1970s
  - Federal Clean Air Act

Clean Air Act Strategy

- Dual Approach
  - Federal program for mobile sources
    - Enacts and enforces emission standards for new sources
    - Regulates fuel and fuel additives
  - Joint Federal/State Program for stationary sources
    - Stationary sources
    - In-use vehicles

Approach for Mobile Sources

1970 Clean Air Act

Technology mandated by federal government (with California exception)

- Focus on HC, CO, and NOx
- States could initiate programs to address in-use vehicles

1977 Clean Air Act Amendments

- Inspection and maintenance programs required for CO and ozone
- Regulate heavy duty trucks and motorcycles
- Allow EPA to regulate other pollutants

1990 Clean Air Act Amendments

Included nonroad vehicles

Encouraged development of clean fuel vehicles

Themes

- EPA has broad discretion in setting standards from mobile sources.
  - Unlike other types of pollution sources, Clean Air Act provides broad authority to consider costs and other factors.
- An "endangerment finding" is necessary prerequisite to regulation.
  - EPA must find air pollutant sources "cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare."
- Federal standards preempt states from regulating cars
  - **Except:** California may request a "waiver from preemption," and impose more stringent standards.
  - Other states can adopt the California standards.

Motor Vehicle Emission Standards
Clean Air Act Section 202

- Applicable to vehicles for their "useful life."
- Technology based—must be premised on finding of technological feasibility. Allows costs to be considered.
- Can be technology forcing with adequate "lead time."
- Factors to be balanced:
  - Cost
  - Lead time
  - Impacts on consumers
  - Safety
  - Energy impacts.

Motor Vehicle Controls: Implementation

- Certification
  - Every new motor vehicle or engine is required to have a certificate of conformity.
- Assembly line testing
  - Ensures that production vehicles comply with the standards that are certified.
  - Can be production vehicles or in use vehicles.
- Enforcement
  - Can prevent sales of cars and engines.
- Averaging, Banking and Trading ("ABT")
  - Manufacturers can generate credits within a vehicle or engine category and trade with others.

Non-Road Engines
Clean Air Act Authorities

- Clean Air Act 213(a)(4)
  - EPA establishes pollution control standards for pollutants from nonroad engines and vehicles that contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare.
  - Does not apply to NOx, volatile organic compounds, and CO.
  - Does not apply to locomotives
  - Technology forcing standards.
  - Factors include
    - Costs
    - Noise
    - Safety
    - Energy factors.

Aircraft and Aircraft Engines
Clean Air Act Authorities

- Clean Air Act 231
  - EPA establishes pollution control standards for pollutants from aircraft and aircraft engines that contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare.
  - Technology forcing standards.
  - Factors include
    - Costs
    - Noise
    - Safety
    - Energy factors.
- Clean Air Act 232
  - Federal Aviation Administration, not EPA, enforces aircraft engine emission standards

Non-Road Engines
Clean Air Act Authorities

- Clean Air Act 213(a)(5)
  - Applies to locomotives.
  - Standard is greatest degree of emissions reduction achievable through the application of available technology, given appropriate consideration of cost, lead time, energy, safety, and noise.
  - Does not require endangerment determination.

Fuels
Clean Air Act Authorities

- Clean Air Act 211(c)
  - Authorizes regulation of fuels and fuel additives to protect public health and welfare.
  - Can regulate use of alternative fuels.

- Clean Air Act 211(o)
  - Mandates renewable fuels.

Distinctions between mobile and stationary sources under Clean Air Act

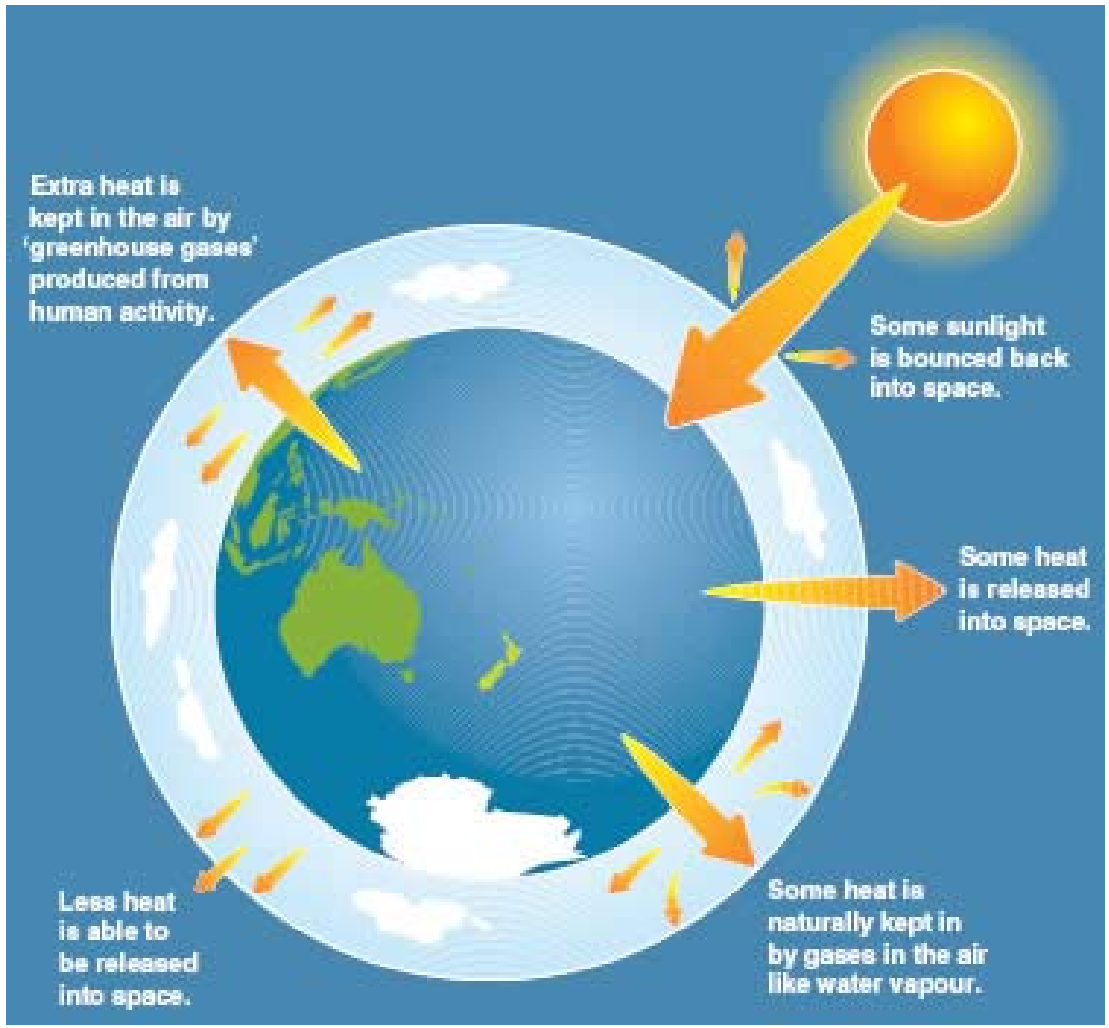
Mobile sources

- Standards set at federal level (with exception of California)
- Broad discretion to consider wide range of factors such as costs
- Certification process

Stationary sources

- States have authority to set standards above federal levels
- Frequently little to no discretion to consider costs and other factors
- Permitting process

Regulation of Greenhouse Gases



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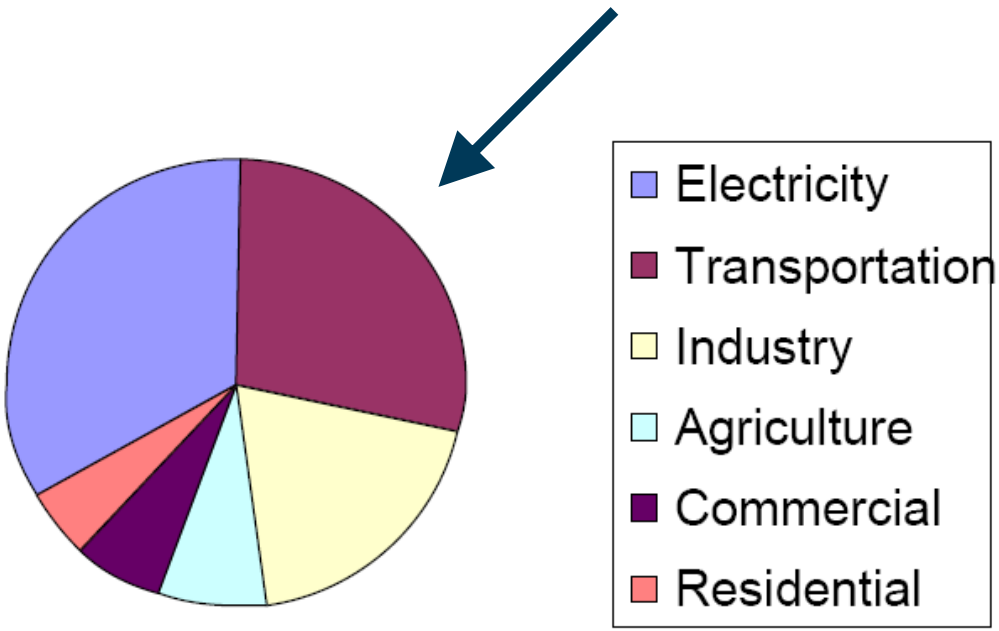
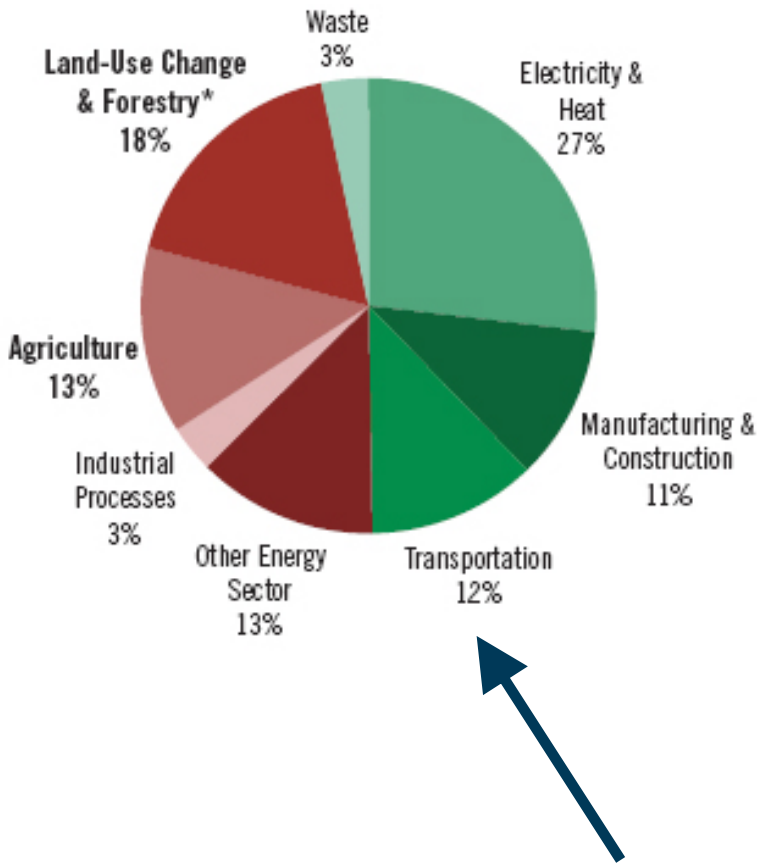
Greenhouse Gas Emissions

United States



Worldwide



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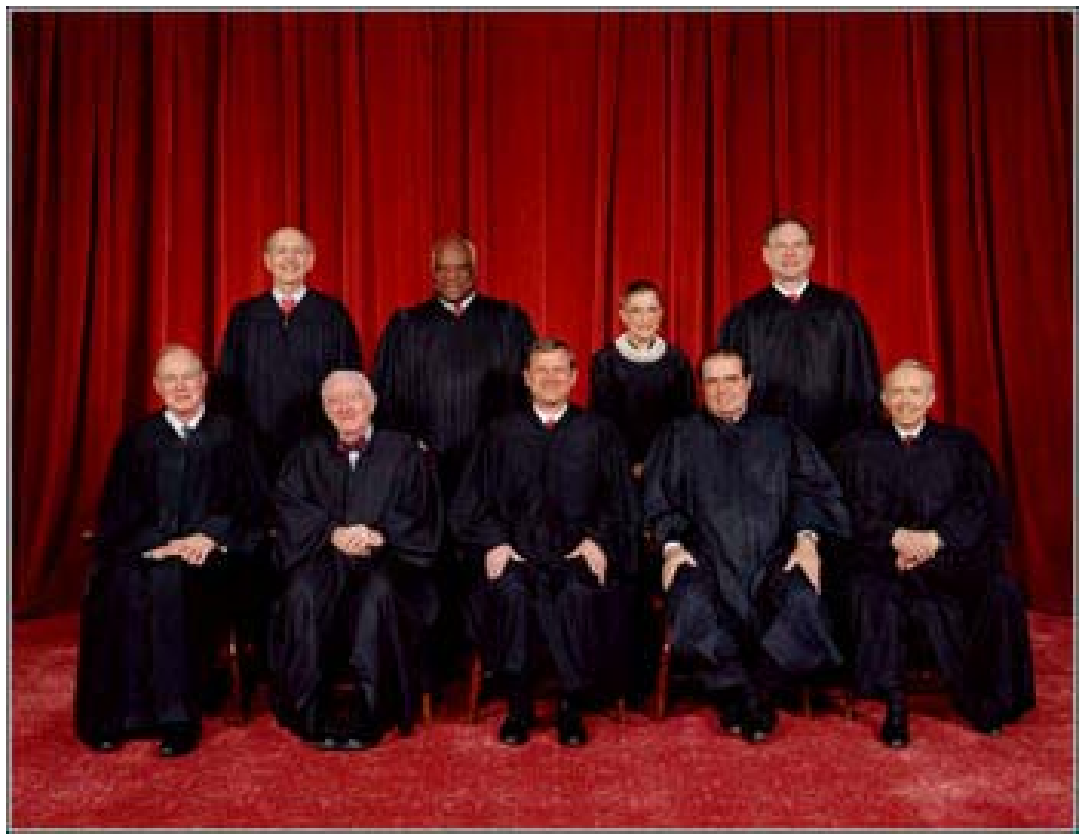
Total GHG Emissions from U.S. Sources, 2006 (and 2030 CO2). (updated 5/9/2008, and 5/16/09 to fix N2O vs CH4 totals & clarify "HFCs"
grown from 2006 using AEO2008, NONROAD2005a, and the C3 ANPRM. See references below.[a]
from supporting analysis for "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006," April 15, 2008
except for non-transportation mobile source CO2, which is from NONROAD2005a

2006 Totals & Percents:

Transportation Sources	CO2 2006	CO2 2030	N2O 2006	CH4 2006	HFCs[d] 2006	Total CO2 equiv All Gases	% of Domestic Transport	% U.S. Transport with International Air and Marine	CO2 % of Mobile Src w/bunkers	CO2eq % of Mobile Src w/bunkers	CO2eq % of Domestic Total	CO2eq % of Domestic+ bunkers Total
On-Road Vehicles	1564.6	1756.0	29.5	1.813	58.1	1653.9	83.8%	78.7%	73.2%	73.8%	23.4%	23.0%
Light-Duty Vehicles	1149.4	1227.3	28.3	1.695	55.6	1235.0	62.6%	58.7%	53.8%	55.1%	17.5%	17.2%
Passenger Cars	*634.5*		*15.6*	*1.0*	*27.2*	*675.4*	*34.4%*	*32.3%*	*29.7%*	*30.3%*	9.6%	9.4%
Light-Duty Trucks	*514.9*		*12.7*	*0.7*	*28.3*	*555.6*	*28.2%*	*26.5%*	*24.1%*	*24.8%*	7.9%	7.7%
Motorcycles	1.9		0.0	0.0	+	1.9	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%
Buses	12.1	13.1	0.0	0.1	0.3	12.5	0.6%	0.6%	0.6%	0.6%	0.2%	0.2%
Medium & Heavy-Duty Trucks	401.3	516.2	1.1		2.2	404.6	20.5%	19.2%	18.8%	18.0%	5.7%	5.6%
Aircraft - Domestic + International	**241.8**	**385.1**	**2.3**	**0.2**	**+**	**244.3**	N/A	**11.6%**	**11.3%**	**10.9%**		**3.4%**
Aircraft - Domestic Only	**170.6**	**271.8**	**1.6**	**0.1**	**+**	**172.4**	**8.7%**	8.2%	8.0%	7.7%	**2.4%**	2.4%
Commercial Aviation - Domestic	142.1		1.4	0.1	+	143.6	7.3%	6.8%	6.7%	6.4%	2.0%	2.0%
General Aviation	13.7		0.1	0.0	+	13.8	0.7%	0.7%	0.6%	0.6%	0.2%	0.2%
Military Aircraft (Domestic)	14.8		0.1	0.0	+	15.0	0.8%	0.7%	0.7%	0.7%	0.2%	0.2%
International Aviation	*71.1*		*0.7*	*0.1*	+	*71.9*	N/A	3.4%	3.3%	3.2%	1.0%	1.0%
Boats and Ships - Domestic + International	**98.3**	**195.9**	**0.8**	**0.2**	**4.9**	**104.2**	N/A	**5.0%**	**4.6%**	**4.6%**		**1.5%**
Boats and Ships - Domestic Only	**42.4**	**50.0**	**0.4**	**0.1**	**4.9**	**47.7**	**2.4%**	2.3%	2.0%	2.1%	**0.7%**	0.7%
Recreational Boats	17.3	21.5	0.1	0.0	+	17.5	0.9%	0.8%	0.8%	0.8%	0.2%	0.2%
Ships - Domestic	25.1	28.4	0.2	0.0	4.9	30.2	1.5%	1.4%	1.2%	1.3%	0.4%	0.4%
Ships - International	56.0	146.0	0.4	0.1	+	56.5	N/A	2.7%	2.6%	2.5%	0.8%	0.8%
Locomotives / Transit Rail	51.0	64.5	0.4	0.1	6.5	57.9	**2.9%**	**2.8%**	**2.4%**	**2.6%**	0.8%	0.8%
Pipelines (not a mobile source)	32.4		+	+	+	32.4	**1.6%**	**1.5%**	--	--	0.5%	0.5%
Lubricants (not a mobile source)	9.9		+	+	+	9.9	**0.5%**	**0.5%**	--	--	0.1%	0.1%
Domestic Transportation Total	**1870.9**	**2142.3**	**31.8**	**2.1**	**69.5**	**1974.3**	100.0%		--	--	26.0%	27.5%
U.S. Trans with International Air and Marin	**1998.0**	**2288.3**	**32.9**	**2.3**	**69.5**	**2102.6**		100.0%	--	--	29.6%	29.3%
SI Recreational Vehicles	7.6	12.3							0.4%	--		
Land-Based Nonroad Diesel	124.1	196.2							5.8%	--		
Small Nonroad SI	30.7	45.0							1.4%	--		
NonHandheld Small SI	*25.6*								1.3%	--		
Handheld Small SI	*2.1*								0.1%	--		
Large Nonroad SI (>25hp)	17.9	24.5							0.8%	--		
Total Non-transportation mobile[b]	**180.4**	**278.0**	**1.2**	**0.3**	**+**	**181.9**			**8.4%**	**8.1%**	2.6%	2.5%
Total US Mobile Sources with Bunkers[c]	**2136.1**	**2566.3**	**34.2**	**2.5**	**69.5**	**2242.3**			**100.0%**	**100.0%**	--	31.2%
All Other Sources	3974.1		334.8	552.9	78.3	4940.2					70.0%	68.8%
Total US - all sectors (domestic = no bunke	**5983.1**		**367.9**	**555.3**	**147.8**	**7054.2**	--	--			100.0%	
Total US - all sectors + Bunkers	**6110.2**		**369.0**	**555.5**	**147.8**	**7182.5**	--	--				100.0%
	0.313					0.260						

[a] **References:**
Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, U.S. EPA, Report #: EPA 430-R-08-005, April 15, 2008.
Annual Energy Outlook 2008, Energy Information Administration, Report #: DOE/EIA-0383 (2008), March 2008.

United States Supreme Court



April 2, 2007 -- Mass v. EPA: Two Key Holdings

- Greenhouse gases are “air pollutants”
  - “Because greenhouse gases fit well within the Clean Air Act’s capacious definition of ‘air pollutant,’ we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles.”
- Agency must consider “endangerment”
  - On remand, the Agency must pursuant to CAA Section 202(a): (1) Make a positive endangerment finding; (2) Make a negative endangerment finding; or (3) offer a “reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do.”

Motor vehicles

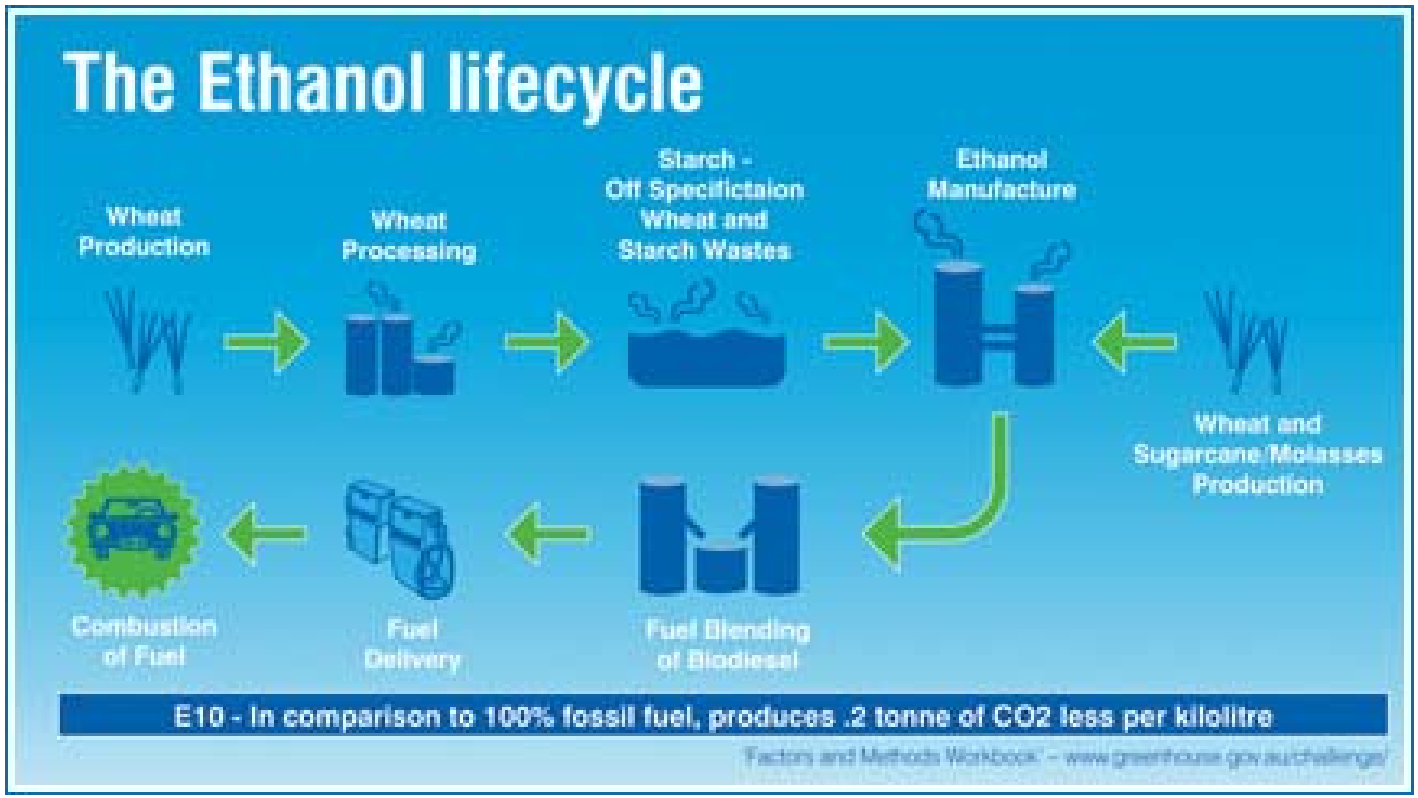
(1) Fuel efficiency

(2) Renewable and alternative fuels

(3) Land use planning/smart growth

Renewable and Alternative Fuels
Energy Independence Security Act (Dec. 2007)

- Fuel Efficiency Standards (DOT)
  - In April, DOT proposed 25 percent increase in fuel efficiency for cars and light trucks ending in 2015 (4.5 percent per year), increasing CAFE from 27.5 mpg to 35.7 mpg by 2015 for cars.
  - Comment period closes in late June.
  - Scoping for CAFE EIS currently ongoing.
- Renewable Fuel Standards (EPA)
  - Provides for 36 billion gallons of renewable fuels by 2022.
  - EPA has indicated publicly it is working on regulations to implement renewable fuel mandates in the EISA.
  - Regulations presumably will include several significant definitions, including “Lifecycle Greenhouse Gas Emissions” and accounting for “indirect impacts”
  - Pursuant to savings clause in EISA, EPA regulation will not trigger GHG regulation under other Clean Air Act provisions.



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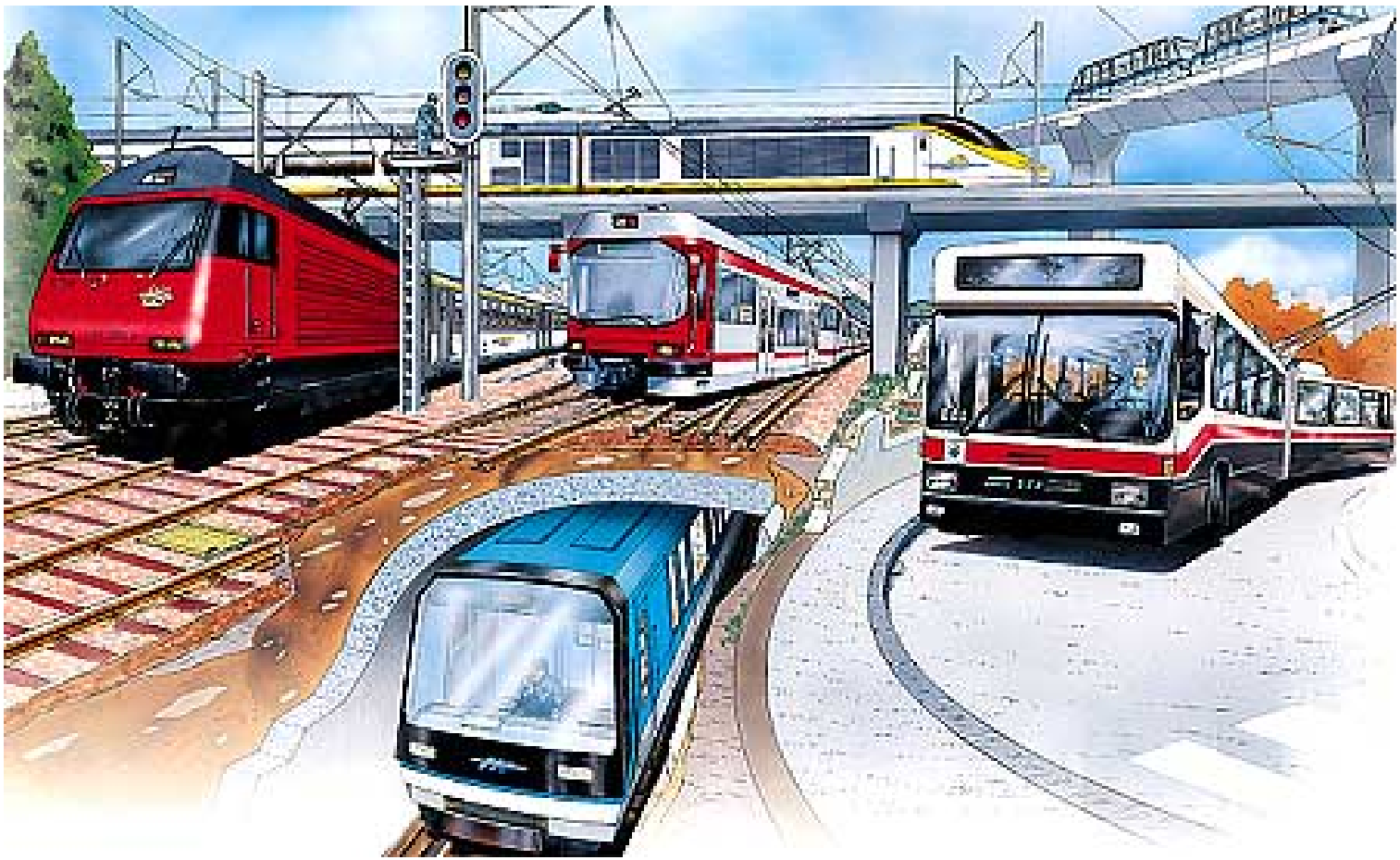

EPA's Greenhouse Gas Proposal for Cars

- EPA proposes to potentially regulate fuel efficiency of cars in addition to the Department of Transportation.

- Issues:

  – How would regulation of greenhouse gases differ than conventional pollutants?

  – Should EPA be required to conform its regulations to the Department of Transportation?

  – Should California be allowed to enact its own greenhouse gas standards for cars?

Realizing GHG reductions

Table I-1. Projected Industry-Wide Carbon Dioxide Emissions, and Annual Reductions, for the Two Analyzed Program Options

CARS	4% Per Year			Model-Optimized		
	CO_2 (g/mi)	[mpg]	% CO_2	CO_2 (g/mi)	[mpg]	% CO_2
2010 (base)	(323)	[27.5]		(323)	[27.5]	
2011	309	[28.7]	-4.3%	301	[29.5]	-6.8%
2012	298	[29.8]	-3.6%	291	[30.5]	-3.3%
2013	286	[31.1]	-4.0%	276	[32.1]	-5.2%
2014	275	[32.3]	-3.8%	268	[33.2]	-2.9%
2015	264	[33.6]	-4.0%	260	[34.1]	-3.0%
2016	254	[34.9]	-3.8%	247	[35.9]	-5.0%
2017	244	[36.3]	-3.9%	244	[36.4]	-1.2%
2018	235	[37.7]	-3.7%	239	[37.2]	-2.0%

TRUCKS	4% Per Year			Model-Optimized		
	CO_2 (g/mi)	[mpg]	% CO_2	CO_2 (g/mi)	[mpg]	% CO_2
2011 (base)	(372)	[23.8]		(372)	[23.8]	
2012	353	[25.1]	-5.4%	348	[25.5]	-6.7%
2013	341	[26.1]	-3.4%	322	[27.6]	-7.5%
2014	327	[27.1]	-4.1%	316	[28.1]	-1.9%
2015	315	[28.2]	-3.7%	312	[28.5]	-1.3%
2016	303	[29.3]	-3.8%	311	[28.5]	-0.3%
2017	291	[30.5]	-4.0%	306	[29.0]	-1.6%

Technologies to reduce GHGs from cars

Table II.D.3-5. Technologies Projected to Be Applied Only During Vehicle Redesign

Discrete or continuous variable valve lift/timing	Dieselization	Integrated starter-generator with idle off
Camless valve actuation	Conversion from overhead valve to overhead cam design	Integrated motor-assist
Stoichiometric direct injection	Continuously variable transmission (CVT)	2-mode hybrid (automatic transmission only)
Lean burn direct injection	Automated manual transmission	Power-split hybrid
Turbocharging and downsizing	6 speed manual transmission	Hydraulic hybrid
Homogeneous charge compression ignition engine	42 volt electrical systems	Plug-in hybrid
Turbocharging and downsizing	Material substitution to reduce weight	Full electric vehicle

Table II.D.3-6. Technologies Projected to be Applied Only During Vehicle Redesign or Refresh

Reduced Engine Friction	5-speed automatic transmission	Electric power steering @ 12 volts
Intake cam phasing	Early torque lock-up	Secondary axle disconnect
Dual or coupled cam phasing	6-speed automatic transmission	Reduced aerodynamic drag
Cylinder deactivation		

Large Car example

Table II.D.3-1. Total CO_2 Reducing Potential and Near-Term Cost for Engine Technologies: Large Car

Basis: Overhead cam gasoline engine with fixed valve timing and lift	CO_2 Reduction Potential	Hardware Compliance Cost
Improved lubricants	0.5%	$3
Reduced Engine Friction	1-3%	$0-126
Intake cam phasing	1%	$119
Dual or coupled cam phasing	4%	$119-209
Cylinder deactivation	6%	$203
Discrete or continuous variable valve lift/timing	3-6%	$246-466
Camless valve actuation	5-15%	$336-673
Stoichiometric direct injection	1-2%	$204-525
Lean burn direct injection *	9-12%	$750
Gasoline homogeneous charge compression ignition engine	10-12%	$390
Turbocharging and downsizing	5-7%	$120
Dieselization (in terms of CO_2 emission)	17-29%	$3045
Dieselization (in terms of fuel consumption)	30-40%	

* Requires a gasoline sulfur content of approximately 15 ppm

Large Car Example

Table II.D.3-2. Total CO_2 Reduction Potential and Near-Term Cost for Transmission Technologies: Large Car

	CO_2 Reduction Potential	Hardware Compliance Cost
For automatic transmissions (base: 4-speed automatic)		
Aggressive shift logic	1-2%	$38
Early torque lock-up	0.5%	$30
5 speed automatic transmission	2.5%	$76-167
6 speed automatic transmission	4.5-6.5%	$76-167
Continuously variable transmission (CVT)*	8.5%	$270
Automated manual transmission	9.5-14.5%	$141
For manual transmissions (base: 5-speed manual)		
6 speed manual transmission	0.5%	$107
All Transmissions		
Integrated starter-generator with idle off	7.5%	$600
Integrated motor-assist (including downsized engine)	25%	$3153
2-mode hybrid (automatic transmission only)	40%	$4655
Hydraulic hybrid	40%	$825
Full electric vehicle	92%	$15,000

* Only considered for vehicles with unibody construction.

Table II.D.3-4. Total CO_2 Reducing Potential and Near-Term Cost for Other Technologies

	CO_2 Reduction Potential	Hardware Compliance Cost
Load reduction related to body style		
Reduced aerodynamic drag	3%	$0-75
Load reduction related to accessories		
Improved efficiency alternator and other accessories	1-2%	$124-166
Electric power steering @ 12 volts	1.5-2%	$118-197
42 volt electrical systems	2-4%	$124-166
Load reduction related to post-transmission drivetrain		
Low rolling resistance tires	1-2%	$6
Secondary axle disconnect	1%	$676

DOT/EPA Conformity

EPA finally argues that it cannot regulate carbon dioxide emissions from motor vehicles because doing so would require it to tighten mileage standards, a job (according to EPA) that Congress has assigned to DOT. See 68 Fed. Reg. 52929. But that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's "health" and "welfare," 42 U. S. C. §7521(a)(1), a statutory obligation wholly independent of DOT's mandate to promote energy efficiency. See Energy Policy and Conservation Act, §2(5), 89 Stat. 874, 42 U. S. C. §6201(5). The two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency.

California Waiver

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Thank you.
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