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The Northeast / Mid-Atlantic Low-Carbon Fuels Initiative

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MIT-NESCAUM Endicott House Symposium

Dedham, MA

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"What's an LCFS again"?

- Performance-based standard for fuels
- Does not "pick winners" or ban any fuel
- Regulates "carbon intensity" or *lifecycle* GHG emissions from fuels
- Requires displacement of conventional fuels (gasoline and diesel) with low-carbon substitutes, such as natural gas, low-carbon biofuels, electricity from renewables, etc…
- Heating oil could be included
- *NOT A CAP ON TRANSPORTATION EMISSIONS*

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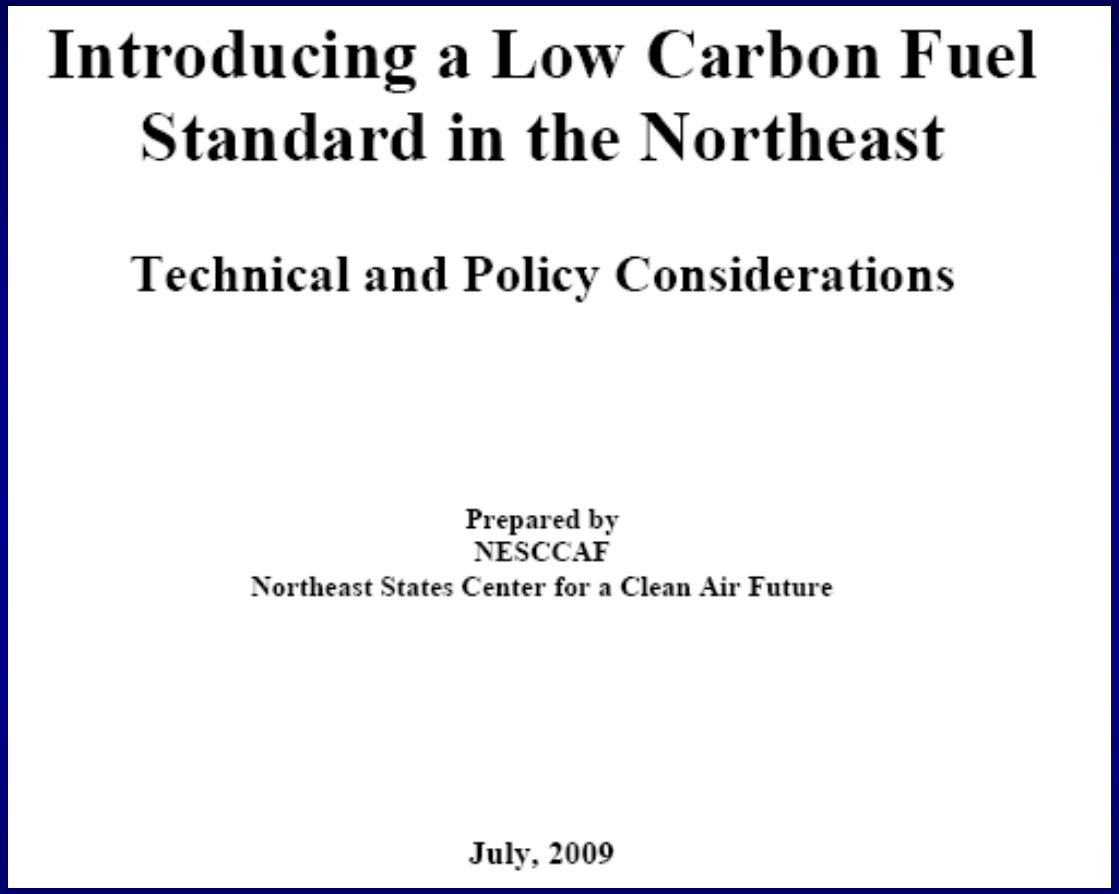

www.nescaum.org/documents/lcfs-report-final.pdf

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Regional LCFS Initiative

- December 2008: Commissioners from 11 Northeast and Mid-Atlantic states signed Letter of Intent to develop framework for regional LCFS

Connecticut	**New Jersey**
Delaware	**New York**
Maine	**Pennsylvania**
Maryland	**Rhode Island**
Massachusetts	**Vermont**
New Hampshire	

- Goal: Memorandum of Understanding for Governors to sign by December 2009

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Regional LCFS Initiative

"The undersigned states believe it is critical to understand the true contribution of renewable fuels to reducing GHG emissions, and to calculate the carbon content of fuels on a full lifecycle basis, including direct emissions and significant indirect emissions, such as those from potential land use changes that may be attributable to fuel production."

-Northeast/Mid-Atlantic LCFS States' Letter of Intent, December, 2008

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Similarities to CA Program

Methodology

- ✓ General program structure (where practical)
- ✓ GREET model for assessment of "traditional" lifecycle impacts
- ? Indirect land-use change: CARB, EPA, other…

Scope

- ✓ All transportation fuels
- ? Heating oil
- ? Other heating fuels…

Stringency

- ? States are not required to adopt CARB's reduction targets
- ? Regionally consistent stringency is preferred
  - Interconnected fuel supply network
  - Facilitate compliance for regulated parties
  - Maximize program effectiveness

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Region-Specific Program Requirements

- ***Space heating***
  - Represents ~50% regional distillate demand
- ***Point of regulation***
  - Most transportation fuel imported to region as finished product
- ***Compliance & Enforcement***
  - 11 states = 11 enforcement authorities
  - Regional credit pool might be desirable
- ***Default CI Values***
  - Lookup table must be specific to region
  - Could include pathways not considered in CA

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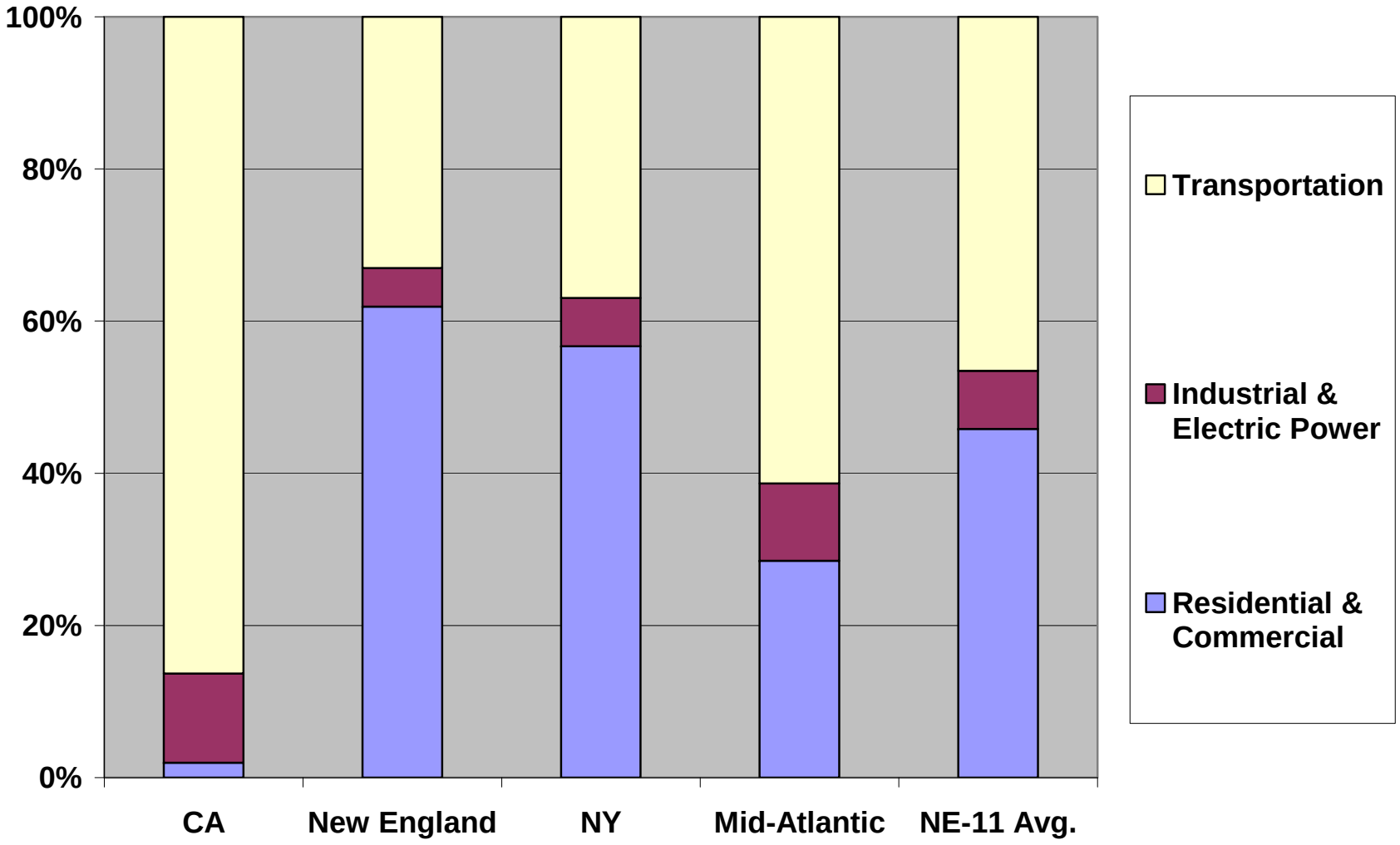
Distillate Oil Consumption, 2007



Source data: EIA, State Energy Data System

Heating Oil

Reasons to include in program

- Large fraction of regional distillate demand
- Potential for “leakage” of high-carbon feedstocks
- Good match for regionally available resources

Potential challenges

- Heating sector more complex than Transportation
- Many more baseline fuels
- How to track and enforce household-level fuel switching?
- How to deal with end-use efficiency?

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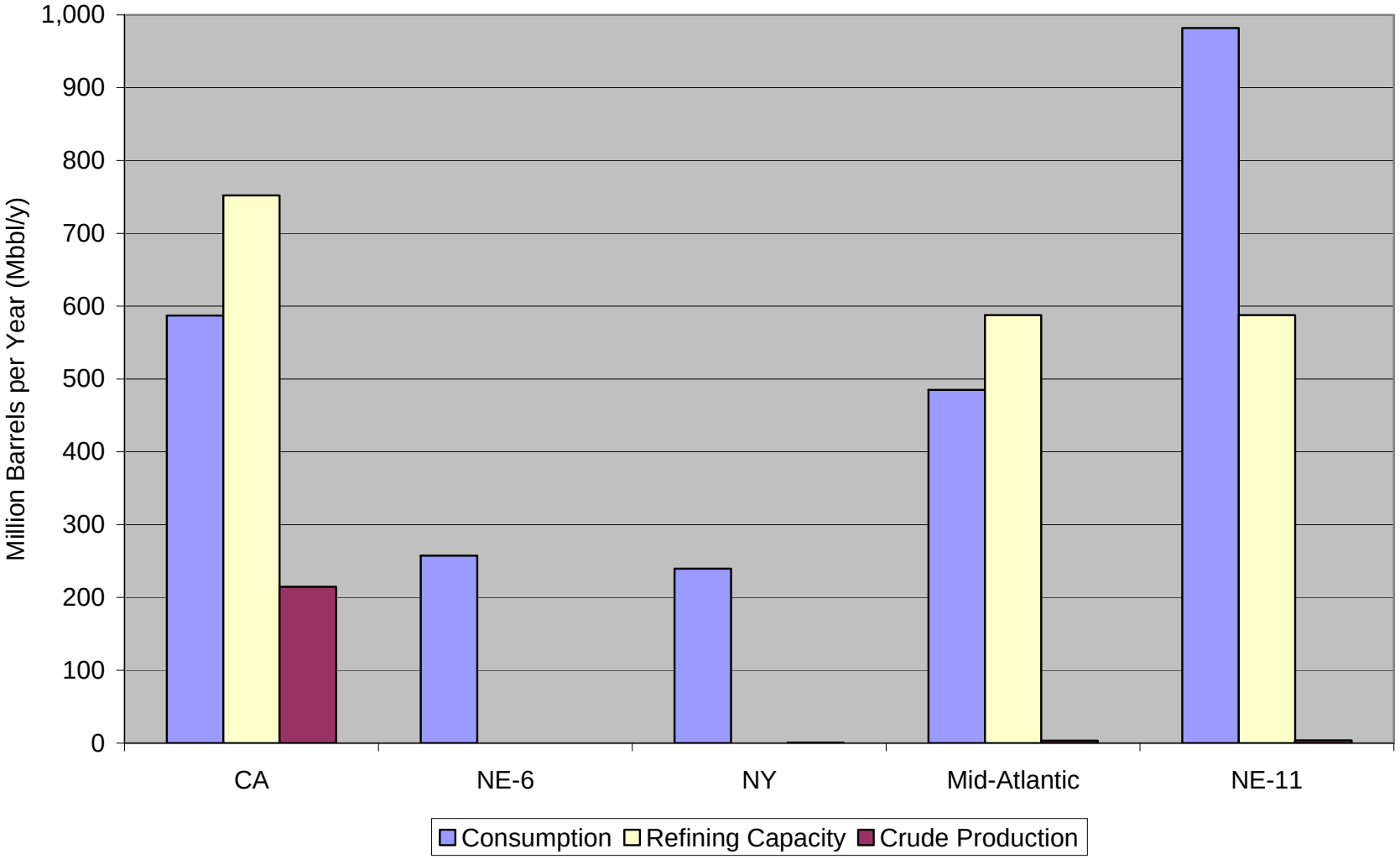
2008 Petroleum Consumption, Refining Capacity and Crude Oil Production



Source data: EIA, Petroleum Navigator

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Regional Feedstocks

- **Municipal Solid Waste**
  - Only items that have reached the end of their use cycle (non-reusable, non-recyclable)
  - The Northeast's most significant resource
  - Less likely to induce additional LUC than virgin feedstocks
- **Woody Biomass**
  - New England has substantial woody biomass but also many existing markets (e.g., pulp and paper, exports)
  - NY and PA combine for approximately two-thirds of total supply
- **Agricultural Residues**
  - New York and Pennsylvania dominate again, approximately 75 to 90 percent of agricultural biomass resources

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Regional Production Potential, 2020

Low-Carbon Fuel	2020 Regional Production	Energy-equivalent volume gasoline or diesel (Mgal)
Electricity from Biomass	1500 MW	1100
Cellulosic Ethanol	440 Mgal	290
Thermal Energy	1,000,000 Homes	630
Biodiesel	8.5 Mgal	7.8

2020 projected business-as-usual demand in 11-state region:

32 Bgal gasoline

15 Bgal distillate

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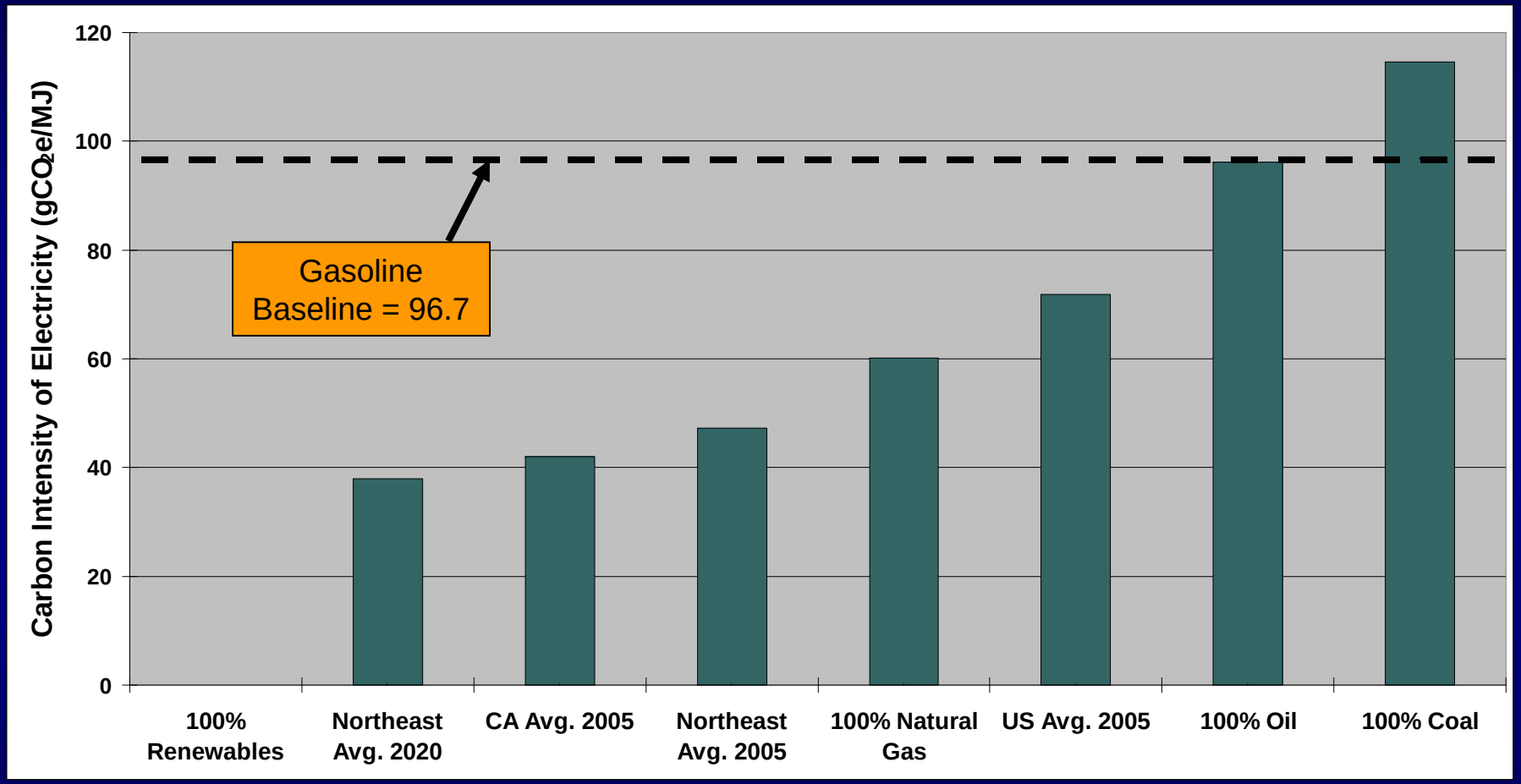
Effect of Grid Resource Mix on Electricity CI (Draft Results)



Assumes Energy Economy Ratio = 3.0. US & CA generation mix based on GREET default; Northeast generation mix based on MARKAL.

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Regional LCFS Initiative: Structure

- State staff from Environment, Energy and Natural Resources Agencies
- NESCAUM facilitates and provides technical analysis
- Steering Committee & 6 Subcommittees:
  - Implementation
  - Sustainability
  - Legal Authority
  - Communications
  - Baseline
  - Economic impacts
- Informed *but not constrained* by similar efforts in other jurisdictions

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Regional LCFS Initiative: Next Steps

- Complete initial LCFS briefings with individual stakeholder groups (Summer 2009)
- Conduct full public stakeholder meetings (beginning in Fall 2009)
- Recommend core LCFS framework to Commissioners (Fall 2009)
- Participating LCFS states sign MOU (December 2009)

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Thank You

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BACKUP SLIDES

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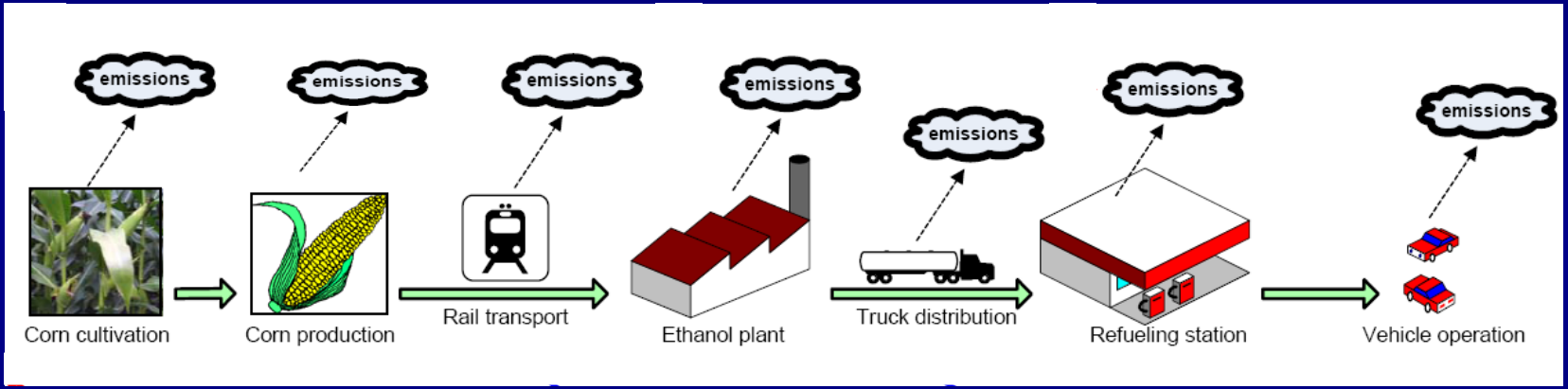
What's "carbon intensity" again?

- A measure of the total CO_2-equivalent emissions produced throughout a fuel's lifecycle



- Measured in grams of CO2-equivalent GHG emissions per unit of energy in fuel

gCO_2e/MJ

Carbon Intensity Calculation: Conventional Gasoline

	Well-To-Tank Carbon Intensity:	**16.9** gCO_2e/MJ
+	Carbon Content of Fuel:	**72.9** gCO_2e/MJ
+	Vehicle emissions of CH4 and N20:	**2.47** gCO_2e/MJ
=	Lifecycle Carbon Intensity:	**92.3** gCO_2e/MJ

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Average Fuel Carbon Intensity (AFCI)

- Measure of compliance for regulated parties
- *Weighted average* of the CI values of every fuel sold
- Example:
  - 100 MJ of gasoline at 95 g/MJ
  - 20 MJ of low-C substitute at 50 g/MJ
  - AFCI = $\frac{(100 \times 95) + (20 \times 50)}{100 + 20} = 88$ g/MJ

CI Values for Selected Fuel Pathways (Draft Results):

Pathway	Carbon Intensity* (gCO2e/MJ)
Conventional Gasoline	**92.7**
Reformulated gasoline blendstock (RBOB)	**96.7**
Oilsand RBOB	**107**
Ultra-Low-Sulfur Diesel (ULSD)	**93**
Oilsand ULSD	**104**
Denatured Corn Ethanol	**72.5**
Soy Biodiesel	**35**
Forest Residue EtOH: (Fermentation)	**1.8**
Forest Residue EtOH: (Gasification)	**15**

* Does not include effects of indirect land-use change

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CI Values for Selected Fuel Pathways (Draft Results):

Pathway	Carbon Intensity (gCO2e/MJ)
Compressed Natural Gas	**73.1**
Liquefied Petroleum Gas (LPG)	**86.9**
Heating Pellets from woody biomass	**19.8**
Electricity for EVs (100% NG)	**60.3 ***
Electricity for EVs (100% Coal)	**115 ***
Electricity for EVs (100% Wind)	**0**

Values adjusted for end-use efficiency.

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LCFS Sustainability Work Group

Goal:

- Recommend a sustainability framework to the Steering Committee for addressing significant adverse impacts from LCFS implementation

First task:

- review relevant work and identify useful approaches:
  - Existing state requirements (i.e., air, water, forestry, waste mgmt)
  - Sustainability frameworks
    - Roundtable on Sustainable Biofuels
    - Council on Sustainable Biomass Production
    - Better Sugarcane Initiative
    - “Montreal Process” for sustainable forestry
    - Roundtable on Sustainable Palm Oil
  - Other state and federal frameworks (e.g., CA LCFS, RFS)

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Estimated Biomass in 2010

Biomass Category		Units	Biomass Quantity
Waste-Based Biomass	MSW (Yard Waste, Paper, Food Scraps, Wood)	tons	20 million
	WWTF and Livestock Waste		6 million
	WWTF Biogas	cubic feet	28 million
Woody Biomass		tons	5-6 million

State	Dry Ton Equivalent
Connecticut	1,072,000
Massachusetts	1,698,000
Rhode Island	193,000
Vermont	2,488,000
Maine	2,288,000
New Hampshire	2,761,000
New York	12,561,000
New Jersey	1,980,000
Pennsylvania	11,689,000

Maximum Woody Biomass is 33 to 37 million dry tons; we conservatively estimate "likely availability" to be 5 to 6 million dry tons.

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Estimated Low Carbon Fuel Production, 2010 and 2020

Resource	2010			2020		
	Electricity Generation Capacity (MW)	Thermal Uses (No. of Homes)	Liquid Fuels (million gallons)	Electricity Generation Capacity (MW)	Thermal Uses (No. of Homes)	Liquid Fuels (million gallons)
Woody Biomass	368	400,000	--	1,000	970,000	315
Ag. Biomass	40	--	--	40	--	124
Waste-based Resources	471	--	--	484		--
TOTALS	**879**	**400,000**		**1,524**	**970,000**	**439** Cell EtOH

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Effects on Grid Capacity of Different PHEV Charging (in GW)

(Assuming 40-mile All-Electric Range and "Low" Penetration)

Time of Initial Charge	Charge Duration	2010	2020
9 a.m.	2-hour	+18	+31
	6-hour	+33	+37
5 p.m.	2-hour	-16	-9
	6-hour	-2	-2
12 a.m.	2-hour	+30	+44
	6-hour	+45	+51

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Distillate Fuel Consumption Estimates by Sector, 2006 (million gallons)

	Residential	Commercial	Industrial	Transportation
CT	542	114	41	321
DE	30	12	20	71
ME	312	110	34	199
MD	142	76	90	623
MA	657	137	67	503
NH	178	48	26	109
NJ	297	88	94	1,055
NY	1,125	655	145	1,234
PA	710	240	306	1,709
RI	121	26	9	68
VT	89	34	21	69
Total	4,203	1,539	854	5,961

Source: EIA State Energy Data System.
http://www.eia.doe.gov/emeu/states/sep_fuel/html/pdf/fuel_use_df.pdf

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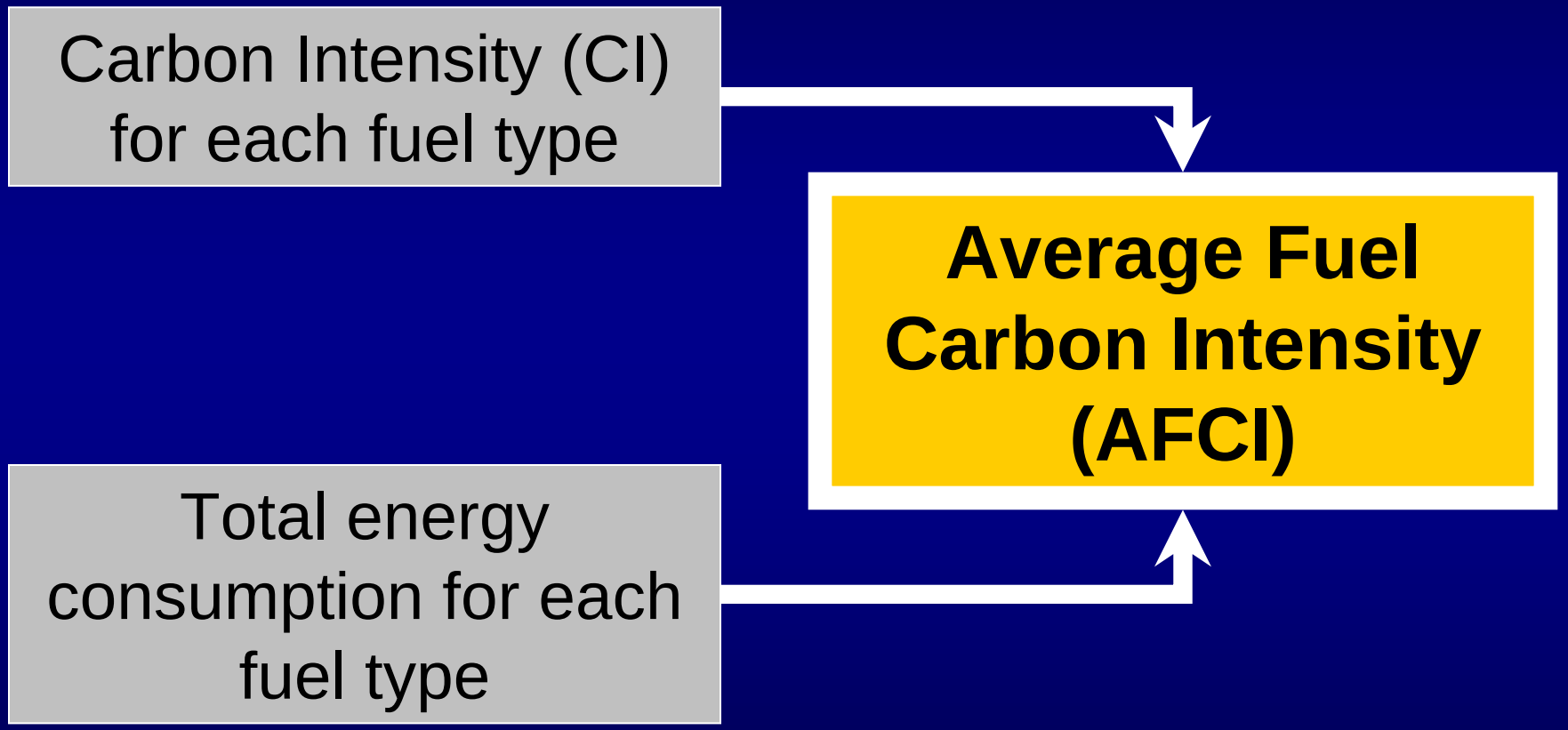
Analytical Methods: Overview



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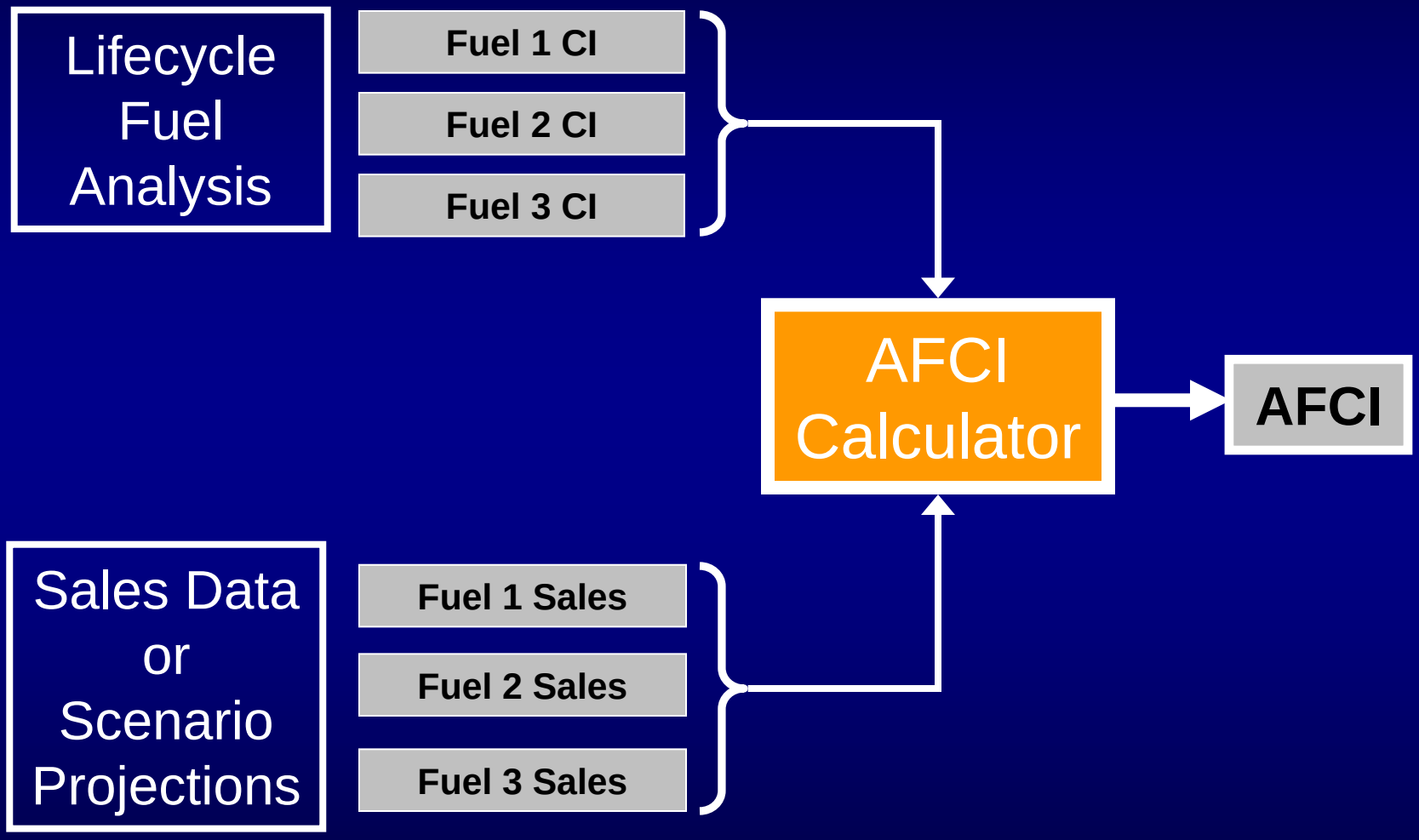

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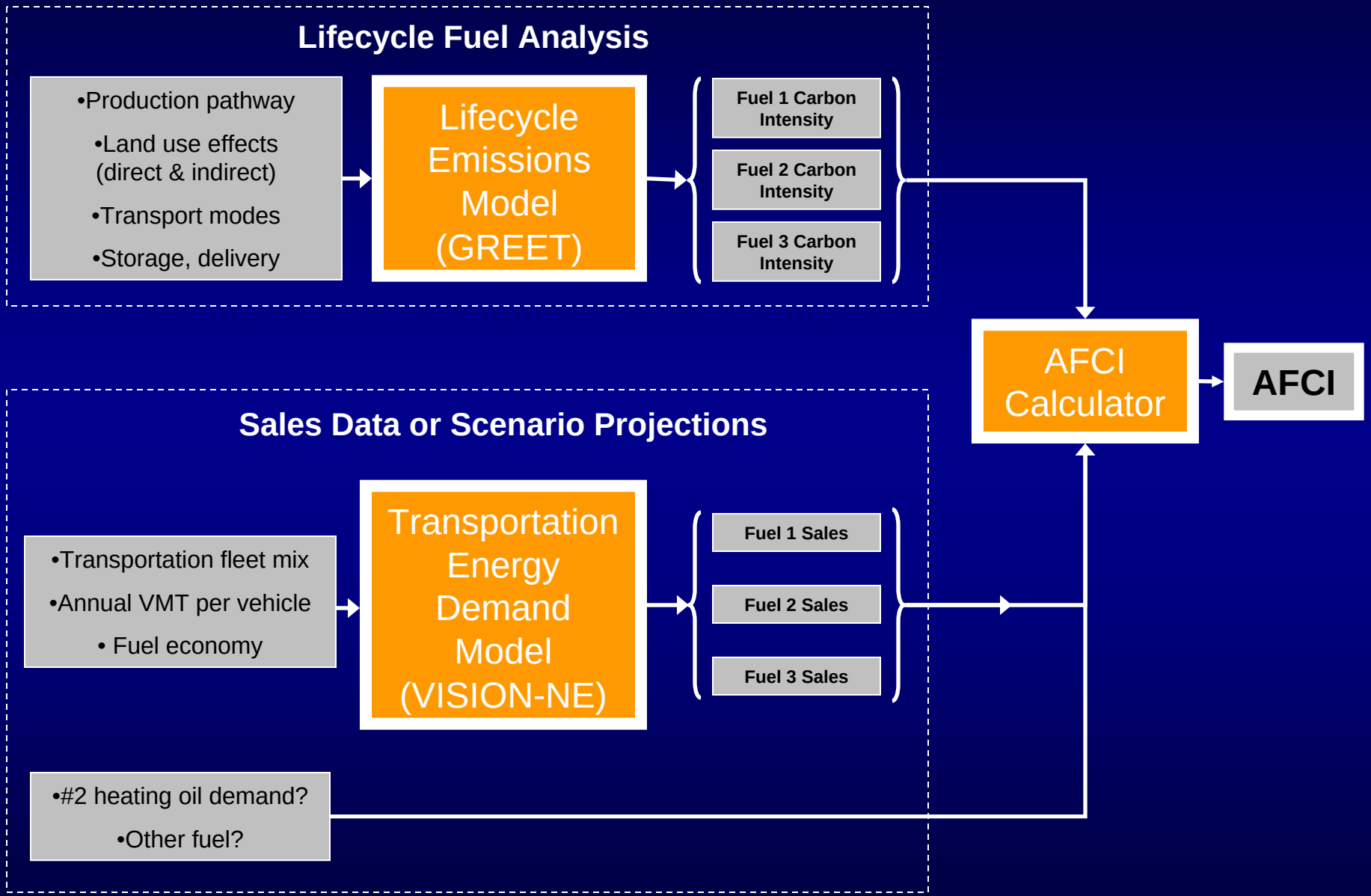
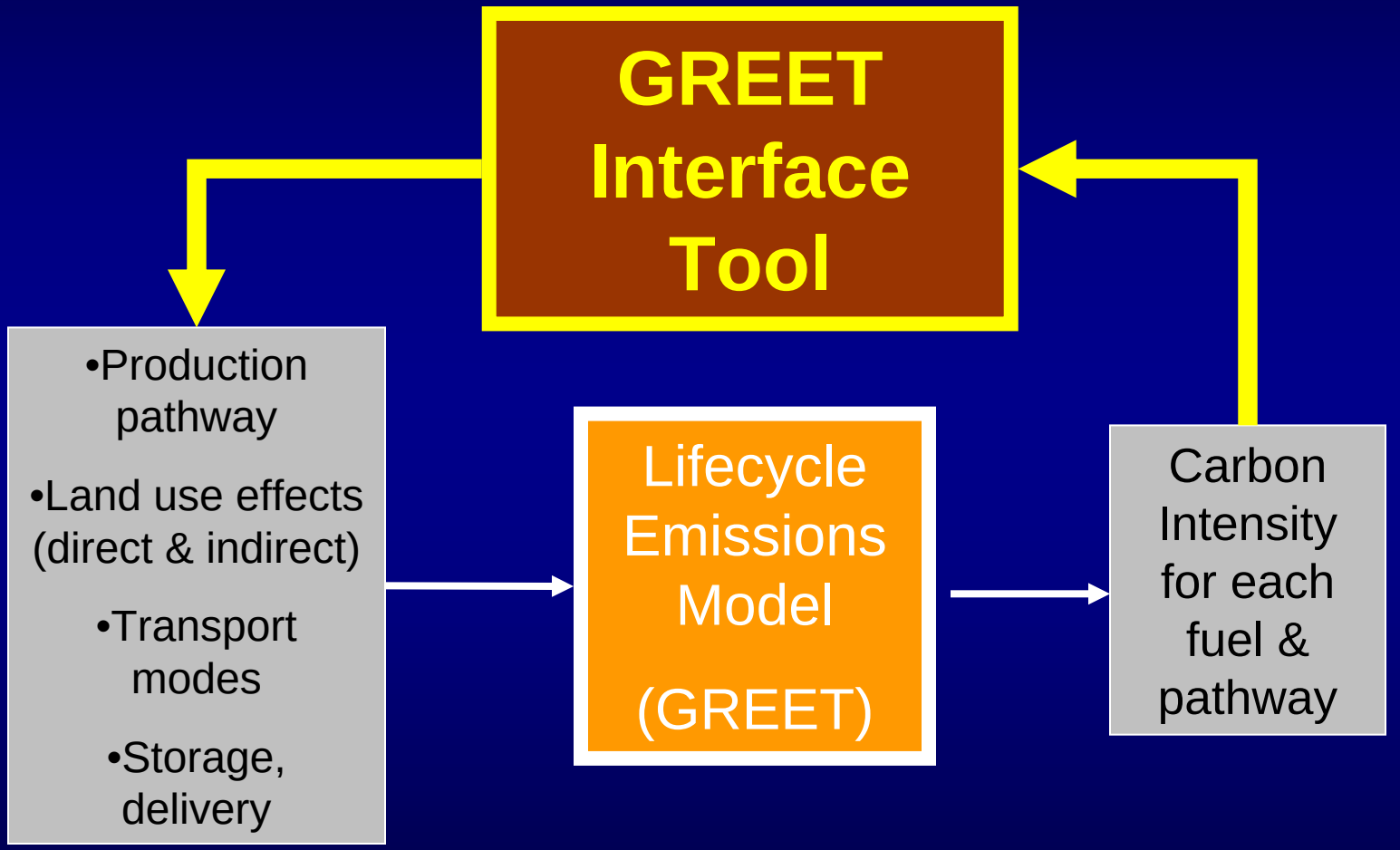


Administration and Compliance: GREET Interface Tool



GREET Lifecycle Model

- **G**reenhouse Gases, **R**egulated **E**missions and **E**nergy Use in **T**ransportation
- Excel spreadsheet model
- Calculates CO_2-equivalent GHG and criteria emission factors (g/mmBtu) for numerous fuel pathways
- Developed and maintained by Argonne National Laboratory (US DOE)
- Basis for CARB and USEPA lifecycle carbon intensity valuation (except for indirect Land Use Change)
- GREET is both a calculation methodology *and* a large set of input data
  - Methodology is valid for any region
  - Many default inputs are national averages; user can substitute state- or region-specific data

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Administration and Compliance: GREET Interface Tool

- GREET is very complicated to use, but:
  - an LCFS program requires modification of only a (relatively) small number of inputs…
  - …and only one key output for each fuel pathway.
- Life Cycle Associates, LLC has developed a GREET interface tool to "poke" the key input parameters into GREET and "peek" at the results.
- This tool can be used as-is to assist states and other stakeholders in assessing CI values for selected fuel pathways.
- Could be expanded for use as a "compliance calculator" for regulatory purposes.

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