Allocation of CO_2 Emission Allowances to Achieve Compensation Goals

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Disclaimer (added by EPA)

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Roadmap for Presentation

CO_2 emissions allowance trading would involve a new federally-enforced limited property right.

- How is that property right initially distributed?

Three topics:

1) Free allocation to incumbent firms.
2) Free allocation to electricity consumers.
3) General implications about the assignment of allowance value.

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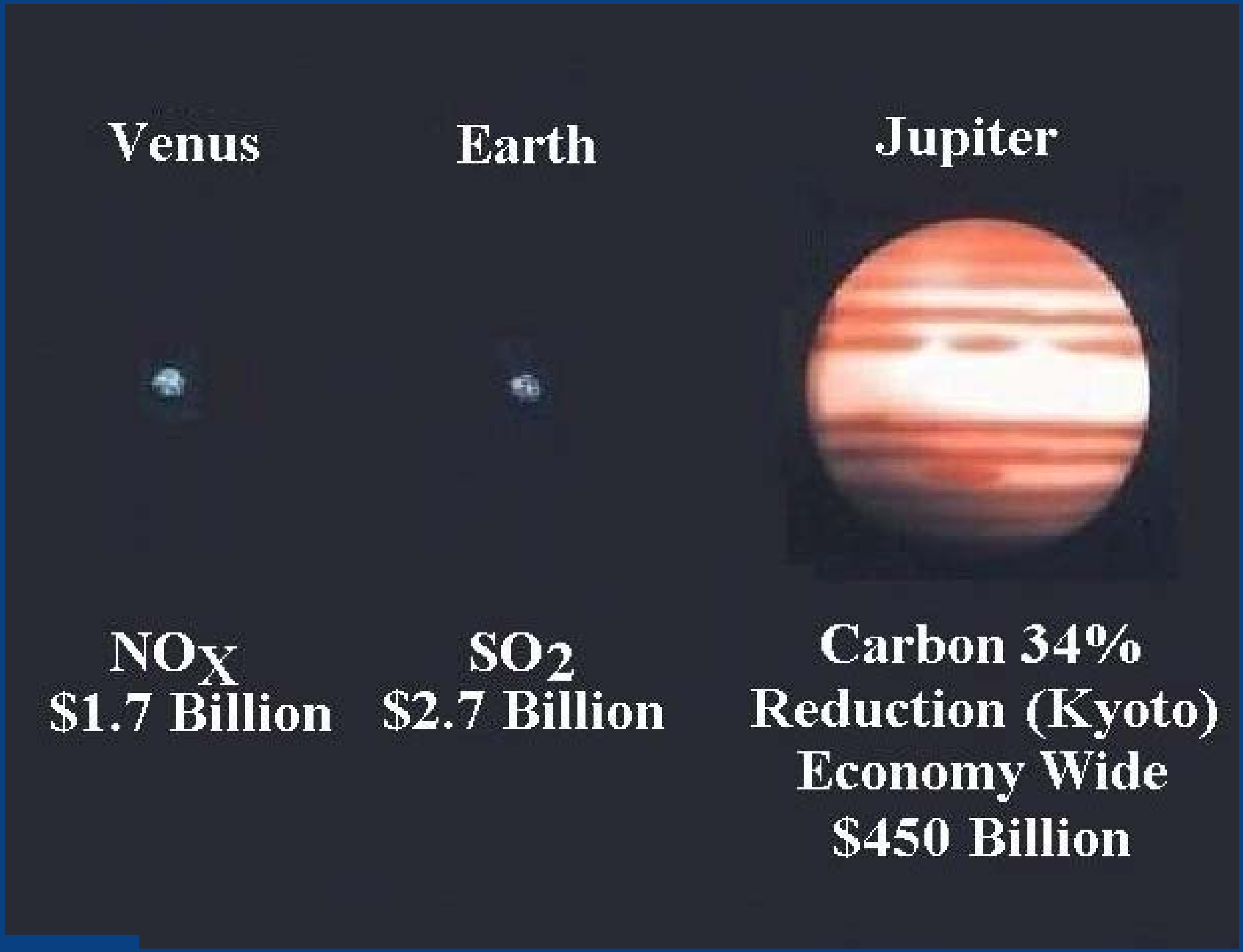
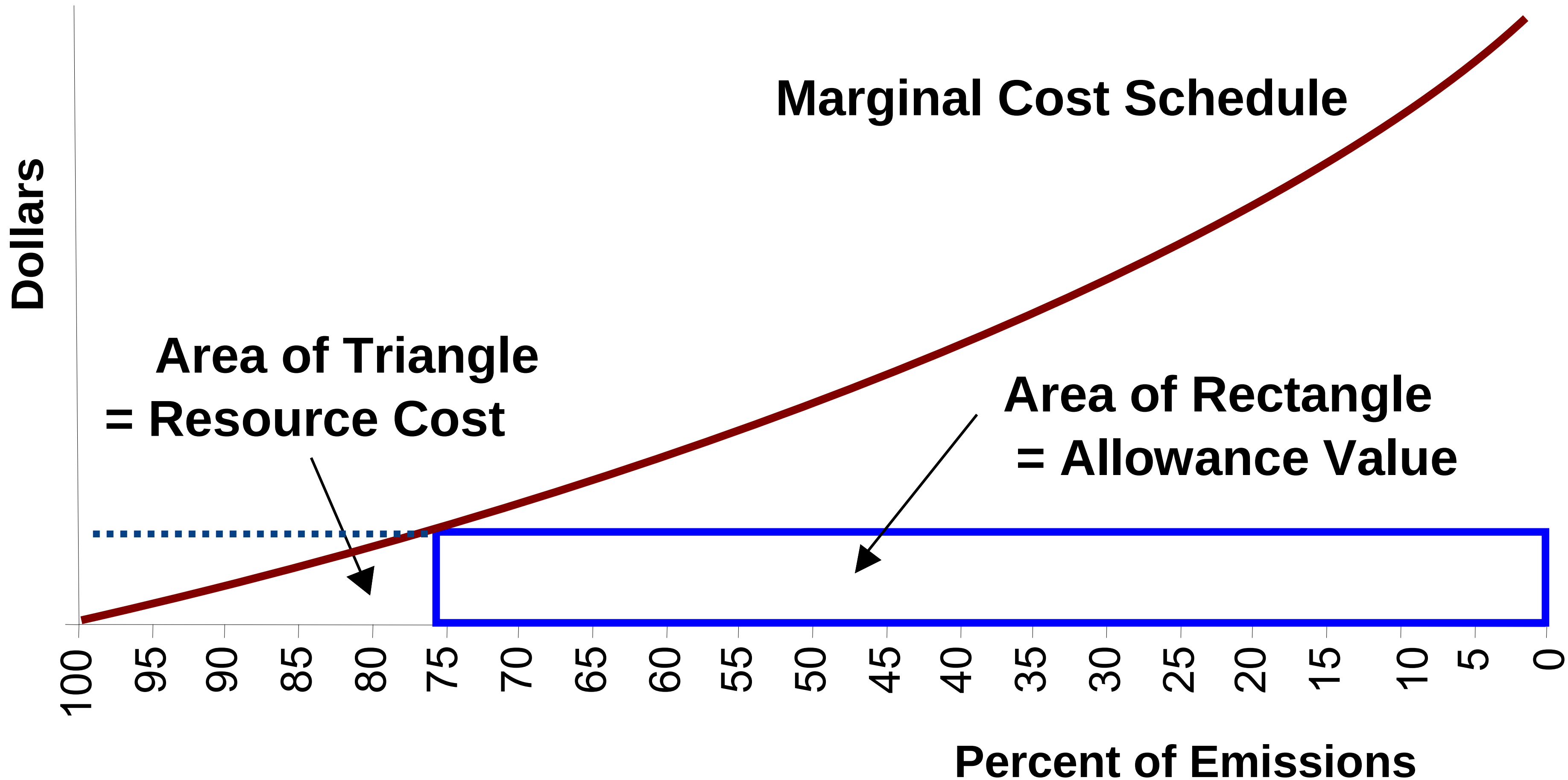
Annual Asset Value of Emissions Allowances



Resource Cost and Property Right Value in a CO_2 Cap-and-Trade Program



Why Not Just Use Prescriptive Regulation?

Prescriptive regulation has:

- Been very effective in many situations
  - Control or reduction options are limited or obvious
  - Control or reduction costs are reasonable
- Established <u>*what*</u> needed to be done
- Prescribed <u>*how*</u> and <u>*when*</u> for each source

Challenge #1: It requires tremendous information.

Challenge #2: Allocational efficiency.

The Limitation of Prescriptive Regulation for Achieving Allocational Efficiency

Damage Function Approach to Benefit-Cost Analysis

EMISSION *(e.g. kg/yr of particulate)* → **DISPERSION** *(e.g. $\mu g/m^3$ of particulates for all affected regions)* → **IMPACT** *(e.g. cases of illness due to particulate)* → **DAMAGE** *(e.g. value of avoiding illness due to particulate)* → **EXTERNALITY** *(e.g. portion of damage not reflected in prices)*

After prescriptive policies are implemented, residual externalities are not recognized

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Internalization of costs

(cents/kWh)	Clean Technology	Dirty Technology (unabated)	Dirty Technology (with abatement)
Private Cost of Production	10	7	7
Private Cost of Pollution Abatement			2
External Cost of Residual Pollution		5	2
Total Private Financial Costs	10	7	9
Total Social Cost	10	12	11

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Allocational Efficiency

Internalization of social cost...

- $P_{kWh} = MC_{kWh} + MC_{abatement} + P_{permit}$

  - Opportunity cost matters

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My motivation is to understand how the assignment of property rights ("allocation") would affect program outcome

Assignment of Property Rights

- *Gratis to incumbent emitters* ("squatters' rights")
  => *windfall profits?*
- *Per capita* ("common pool resource")
- *Public purpose* ("reinforce program goals, promote efficiency, provide compensation")
- Strong regional, economic interests emerge

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Assuming Federal Cap and Trade: Principle Should Guide Allocation (1)

- Emission allowances represent enormous value and present strong incentives for rent seeking.
- Experience with Title IV – notional adherence to a simple rule lessened rent seeking and contributed to success of program.
- Principle rather than contest of self-interest should guide climate policy.

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Principle Should Guide Allocation (2)

Efficiency is one such bedrock principle.

- Overwhelming evidence is that free distribution has hidden cost.
  - Auction preferred when prices of goods and services differ from opportunity costs in:
    - Factor markets (e.g. taxes) (Goulder, Parry, others)
    - Product market (e.g. electricity regulation)(Burtraw and Palmer, Parry)
    - The allocation approach can amplify or diminish the distortion away from economic efficiency.
  - Rent seeking is another source of transaction cost.
- Most expansive environmental policy ever faced; free distribution would multiply the cost dramatically.
- Absent a public policy rationale, there is an economic case against free distribution of any emission allowances.

What is academic advice on the distribution of emission allowances?

- Economics literature broadly finds there are significant efficiency advantages to auctioning emission allowances.

Why give any allowances away for free?

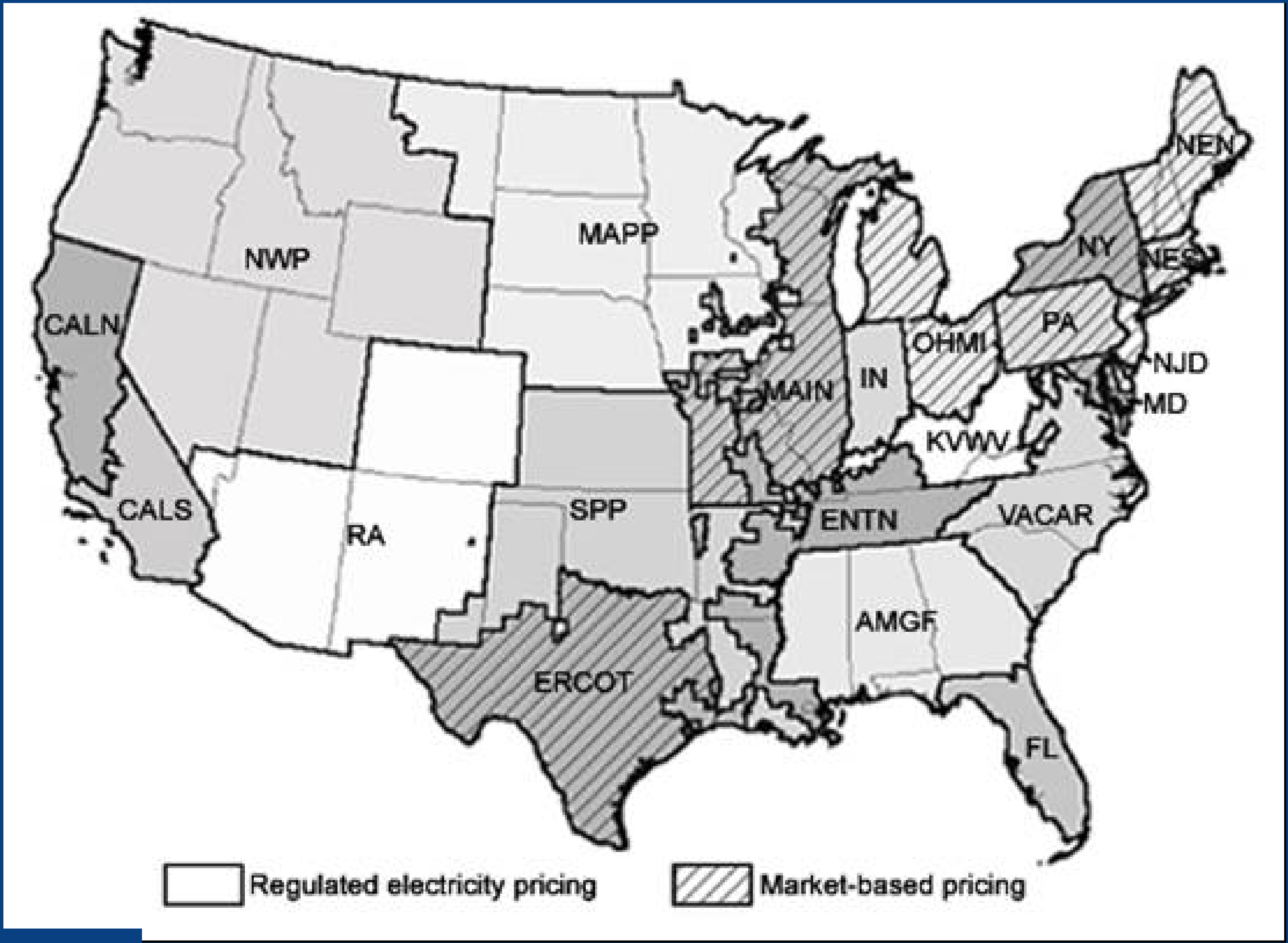
1. Compensation
   - But 100% free allocation can dramatically over-compensate affected firms at expense of consumers raising concerns about equity ("*windfall profits*").
   - Consumers bear 8 times the cost born by producers.
2. Promote Technology/Efficiency Investments/etc.
3. Protect Against Unfair Competition

- All these goals could also be achieved with auction revenue rather than free allowances.

Haiku National Electricity Market Model

- 21 Regions, 3 Seasons, 4 Time Blocks, 3 Customer Classes
- Price Responsive Fuel Supply, Demand
- Capacity Investment and Retirement
- Calibrated to NEMS. Differences:
  - Price responsive electricity demand system
  - Detail about cost recovery
  - Some independent technology assessment
  - End-use efficiency

Haiku Market Regions



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Winners & Losers in Potential US Policy
Example: First NCEP/Bingaman Proposal

- Economy wide cap on CO_2 emissions based on 2.4-2.8% decline in CO_2 intensity per year.
- $7 (nominal) cap on CO_2 allowance price in 2010 increasing at 5% per year till 2025
- Full trading and banking of CO_2 allowances
- Small portion of allowances to be auctioned.

(NCEP's proposal included more than CO_2 cap and trade.)

Regional Differences Are a Huge Challenge to Federal Policy

- Firms are compensated in two ways:
  1. (Maybe) Free allocation of allowances
  2. Change in electricity price
- How costs are recovered depends on regulatory status. Two regulatory settings with large differences for firms and consumers:
  - Cost-of-Service Regulation
  - Deregulated/Competitive Generation Markets

In Regulated Regions

In Principle…

- *One can expect pass through of compliance costs for federally mandated environmental policy.*
- *So, in principle, regulated firms should be indifferent to auction or free allocation.*

In Practice…

- *Regulators under pressure to restrain prices.*
- *When prices increase too much, other cost items come under greater scrutiny.*
- *Allowance price fluctuations could lead to need for spikes in cost pass through.*

In the Long Run…

- *Regulators have to pass through costs or face increasing cost of capital for firms in their territory.*

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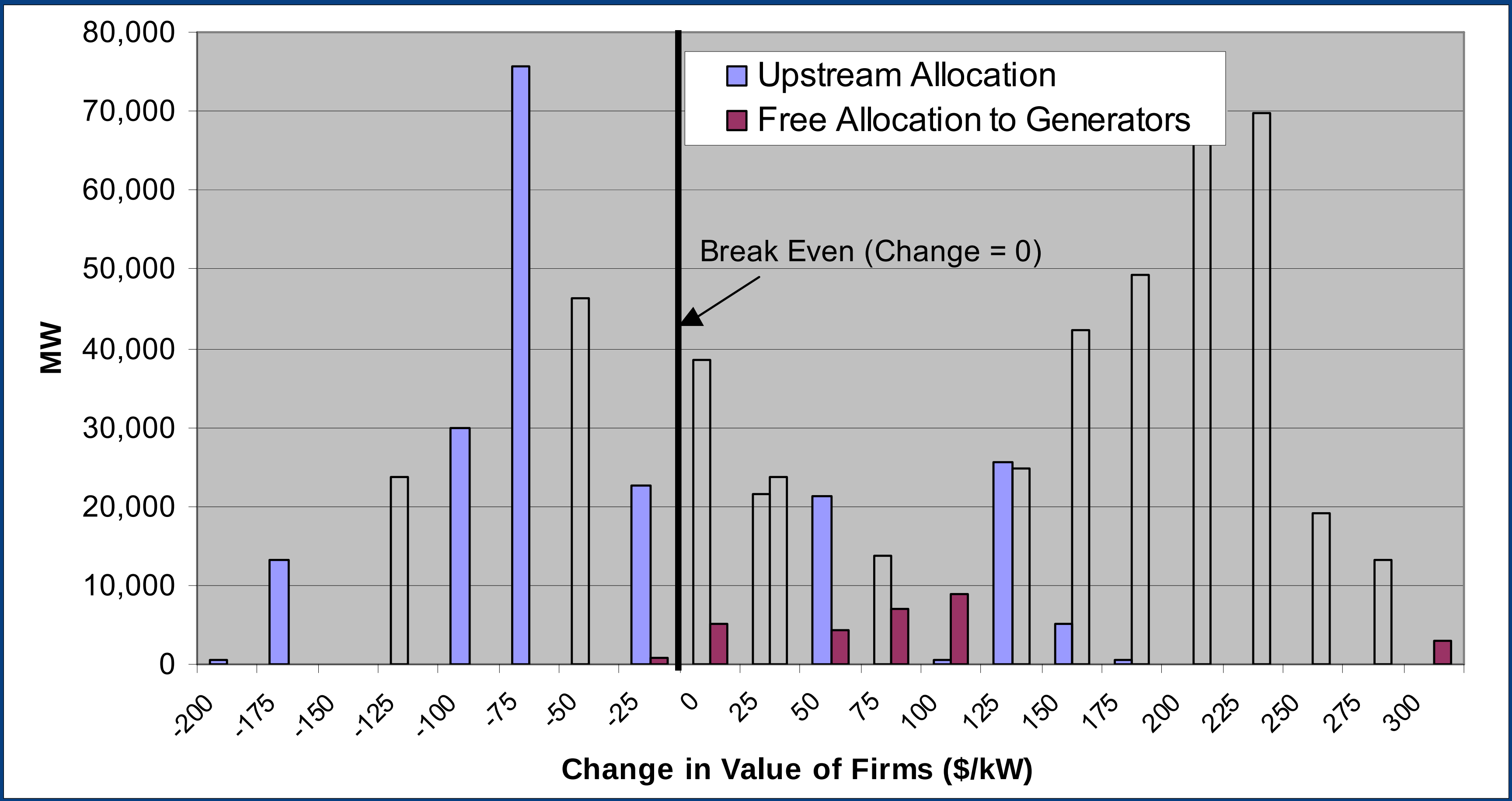
In Competitive Regions: Distribution of Change in Value of Electricity Generating Firms under Original NCEP/Bingaman Proposal



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NPV of CO_2 Emission Allowances = $141 billion

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The Compensation Argument for Free Allocation

- **Consumers** realize greatest loss, but harm is diffuse.
- Measure of "deserved" compensation for **generators** depends on the yard-stick.
  - Industry-level cost is 1/16th (6%) of allowance value in competitive regions (1/8th in competitive regions). But this assumes winners compensate losers.
  - At firm-level, a perfectly precise policy could achieve *full compensation* for **11%** of allowance value, creating $8 billion for winners.

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The Practicality of Compensating Generators (Shareholders)

- Nationally the loss in market value in electricity is ~ 6% of total allowance value. This mixes winners and losers.
- Losses at losing firms total ~ 11% of allowance value.
- The best decision rules we find require over 50% of allowance value, the difference accruing as windfall profits.
- To compensate the last $2.6 billion in harm requires $24 billion in allowance value.

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The cost-effectiveness can be improved by:

- Apportioning to states and applying decision rules at the state level reduces cost by half.
- Incomplete compensation improves cost-effectiveness (reduces portion accruing as windfall profits).
- Nonetheless compensation for firms is problematic and erodes efficiency.

Consumers are most harmed

- Can electricity consumers be compensated directly? Note also…
  - Consumers benefit from broad-based compensation, achieved by an efficient program and careful use of allowance value:
    - Reduce pre-existing taxes
    - End-use efficiency
    - Dividends directly to households
  - Other compelling claims for revenue include investment in R&D, low carbon technologies, and adaptation to climate change.

Analysis of Alternative Allocation Scenarios

- Baseline
  - Calibrated to AEO07 and includes REPTC & CAIR
  - Modeling horizon: 2025
- Policies
  - Identical to baseline, but with Federal CO_2 policy
  - CO_2 caps based on Lieberman-Warner (S. 2191)
  - 5 Allowance allocation methods:
    1) Auction
    2) Grandfathering
    3) Load Based per (a) capita, (b) consumption, (c) emissions

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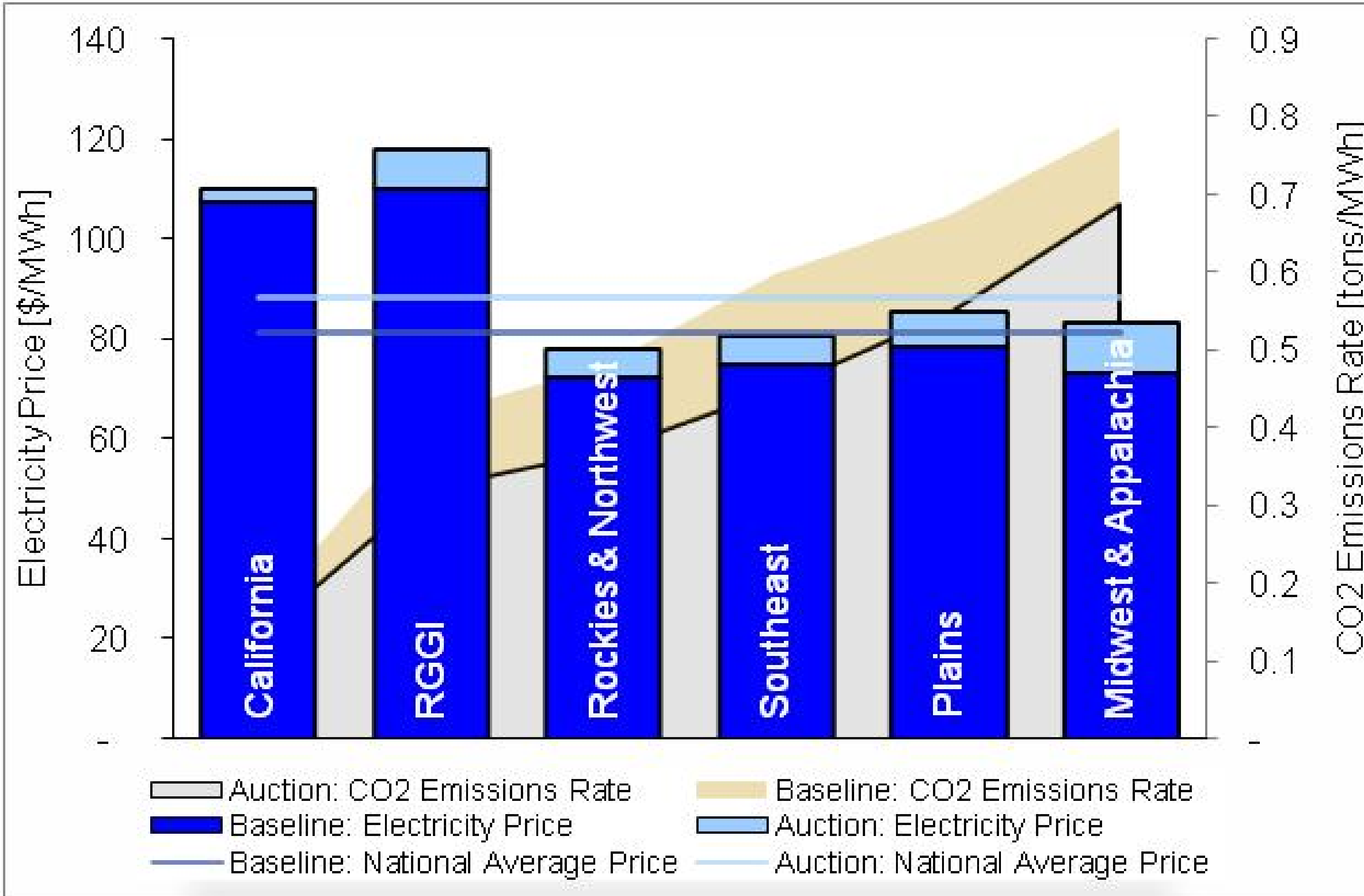
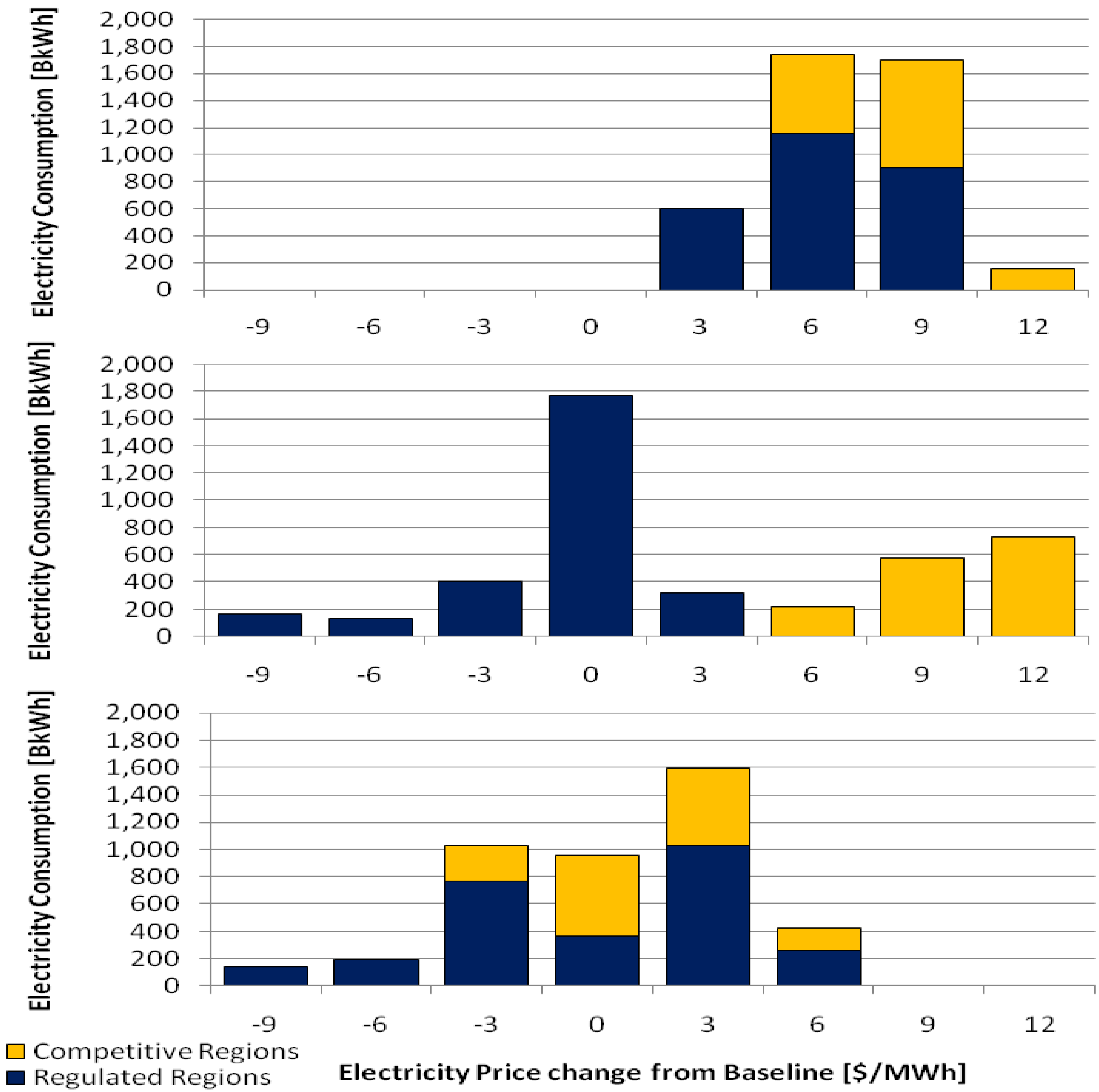
Aggregated Haiku Market Regions

CO_2 Intensity and Electricity Price Effects Associated with an Auction to Achieve L-W Goals



Lieberman-Warner: Electricity Price Effects of Allowance Allocation



Auction

Efficiency Advantage
Lowest Social Cost
but Higher Prices

Free Allocation to Generators

Reduces Price only in Regulated Regions

Free Allocation to Consumers (LDCs)

…But, Allowance Price Increases **by 12-15%** With Subsidy to Elec. Consumption

Results
Auction vs. Grandfathering vs. Load Based

- Electricity Price Increase from Baseline in 2020

Allocation Method	Allocation Method	Regulated Regions	Regulated Regions	Competitive Regions	Competitive Regions	National
Auction	Auction	6.1	Yes	8.5	Yes	7.0
Grandfathering	Grandfathering	(1.0)	Small	9.9	Yes	2.7
Load Based	Load Based	0.0	Small	1.8	Small	0.6

All prices in 2004$/MWh

Results
Auction vs. Grandfathering vs. Load Based

- CO_2 Allowance Price in 2020

Allocation Method	Level	% Increase from Auction
Auction	$14.1	-
Grandfathering	$15.3	9%
Load Based (population)	$15.8	12%

All prices in 2004$/ton CO_2

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The Rules for Apportionment

Change in 2020 Electricity Price by Aggregated Region under Various Approaches to Load-Based Allocation (2004$/MWh)

Region	Load-Based (population)	Load-Based (consumption)	Load-Based (emissions)
RGGI	(1.4)	2.0	5.3
Southeast	0.6	(0.8)	(0.3)
Midwest and Appalachia	4.2	3.5	0.5
Plains	2.3	1.5	0.0
California	(8.5)	(3.6)	2.9
Rockies and Northwest	(2.6)	(2.2)	(2.1)
Competitive	1.8	2.7	2.6
Regulated	(0.0)	(0.6)	(0.7)
National	0.6	0.6	0.4

Free Distribution to Electricity Consumers Can Have a Significant Efficiency Cost

- Allocation to load constitutes a **windfall to consumers** through a subsidy of electricity prices
- The parochial assignment of value as a subsidy to one sector of the economy will:
  - ✓ Lead to different marginal costs and levels of effort across economy
  - ✓ Greatly increase social cost of climate policy

→ Candidate: Allocation to Load as Transition to Auction?

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What is the General Affect on Households of Different Approaches to Allocation?

Methodology: model the effects on households in 2015 of a carbon policy (cap-and-trade) enacted today

- BLS Consumer Expenditure Survey
- Adjust for new CAFE standards in baseline
- Calculate changes in consumption to achieve CO_2 target under various using micro-level elasticities (and Haiku)
- No change in factor markets, technology outside electricity
- 35% of CO_2 value to government
- Account for remaining revenues and policy alternatives
- Measure: Partial equilibrium consumer surplus change

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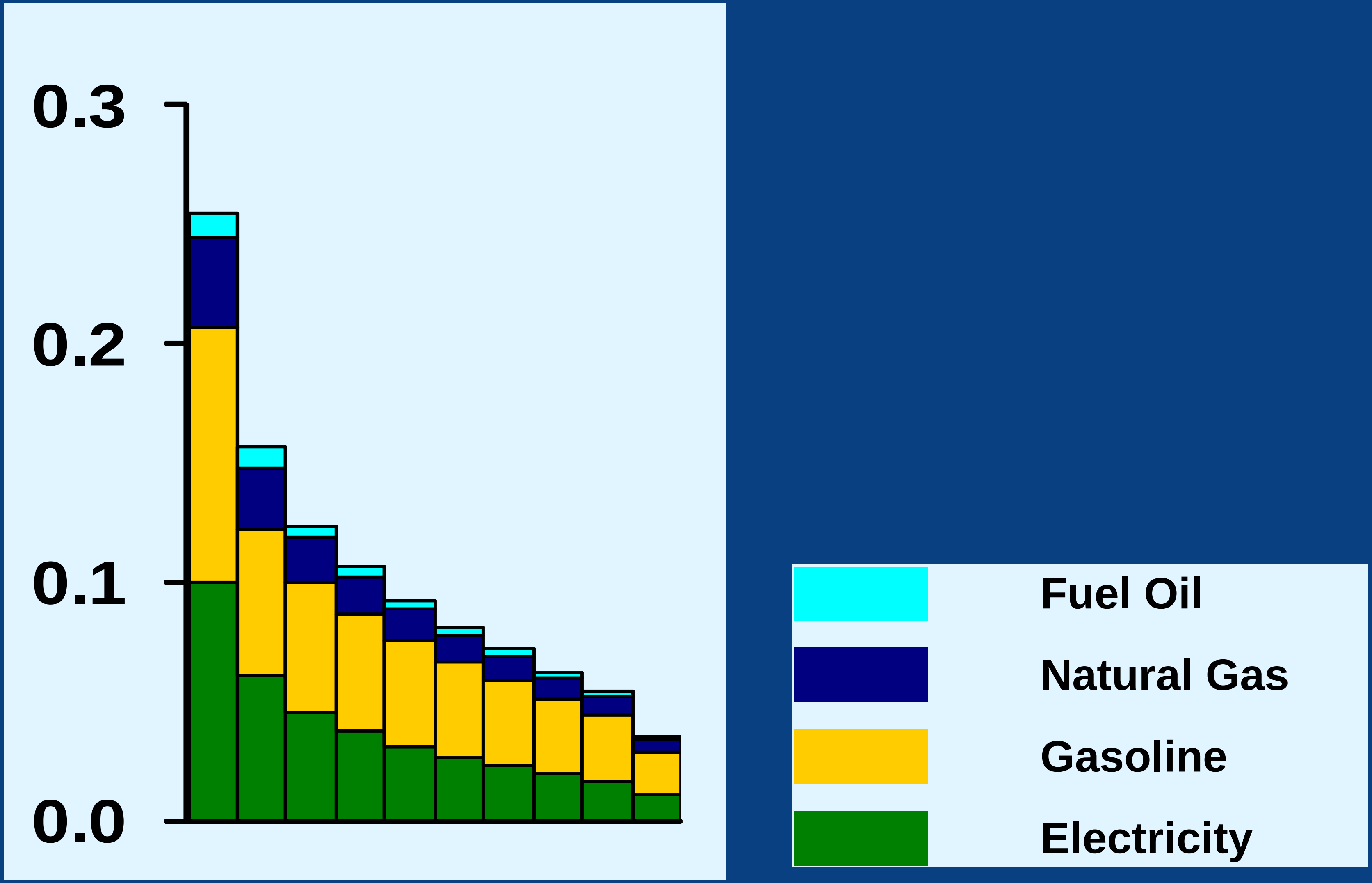
National Direct Energy Expenditures as a Fraction of Income



Note: Consider income rather than consumption (expenditures)

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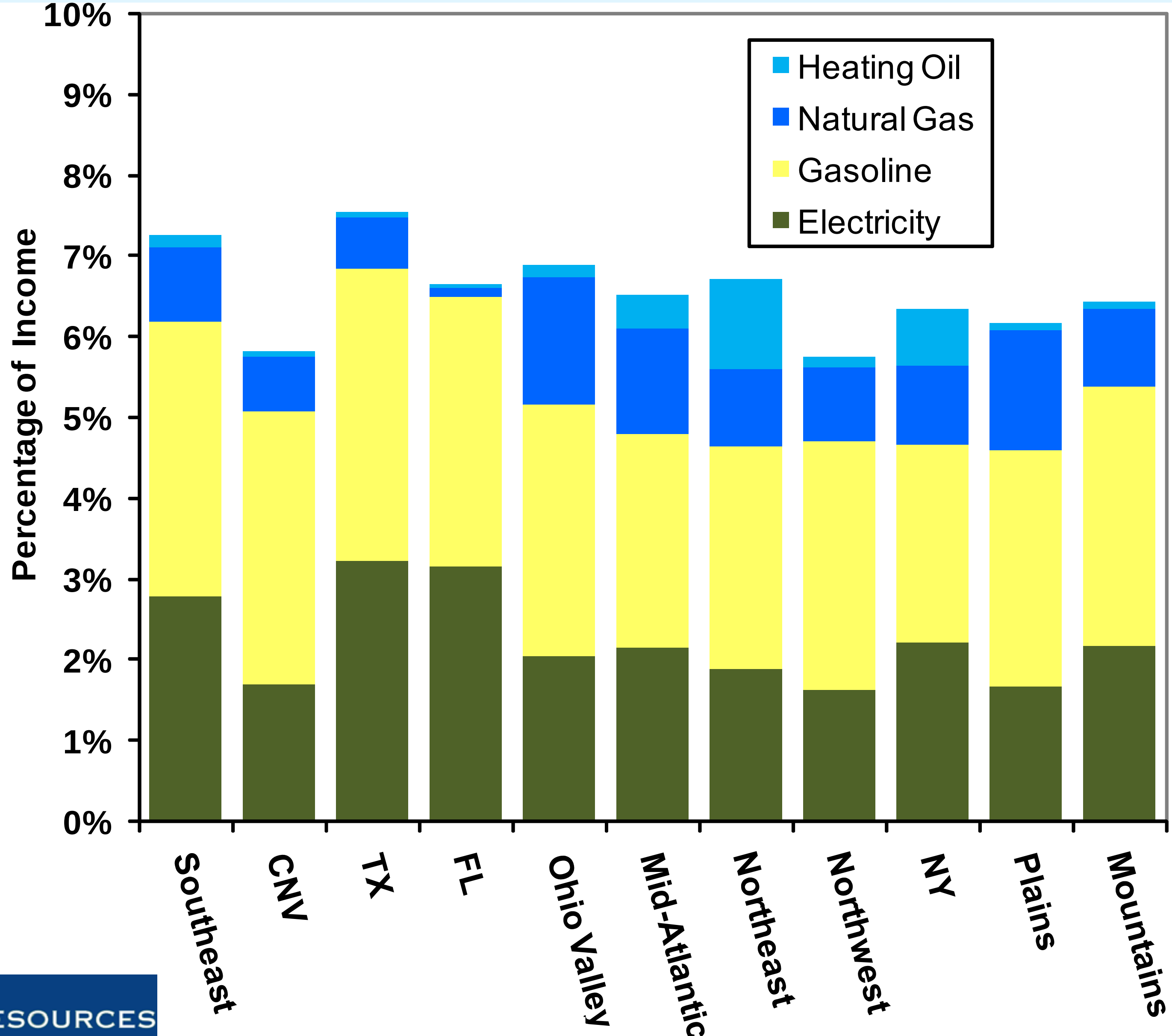
Mean Direct Energy Consumption by Region

	Region	States	Electricity (kWh)	Gasoline (gallons)	Natural Gas (tcf)	Heating Oil (gallons)
1	AEV	AL, AR, DC, GA, LA, MS, NC, SC, TN, VA	17,455	970	36	47
2	CNV	CA, NV	8,516	1,049	37	23
3	ERCOT	TX	16,032	1,125	27	16
4	FRCC	FL	15,897	921	3	13
5	MKIO	IL, IN, KY, MI, MS, OH, WV, WI	13,858	973	73	45
6	MPM	DE, MD, NJ, PA	13,101	863	54	133
7	NE	CT, ME, MA, NH, RI	8,676	932	36	353
8	NWP	ID, MT, OR, UT, WA	13,845	932	45	41
9	NY	NY	8,965	802	39	219
10	PPPP	KS, MN, NE, OK, SD	12,562	976	74	27
11	RA	AZ, CO	13,606	905	48	21
	National		13,289	930	42	76

Average Household Expenditures **by Region** on Direct Fuel Purchases as Percentage of Income



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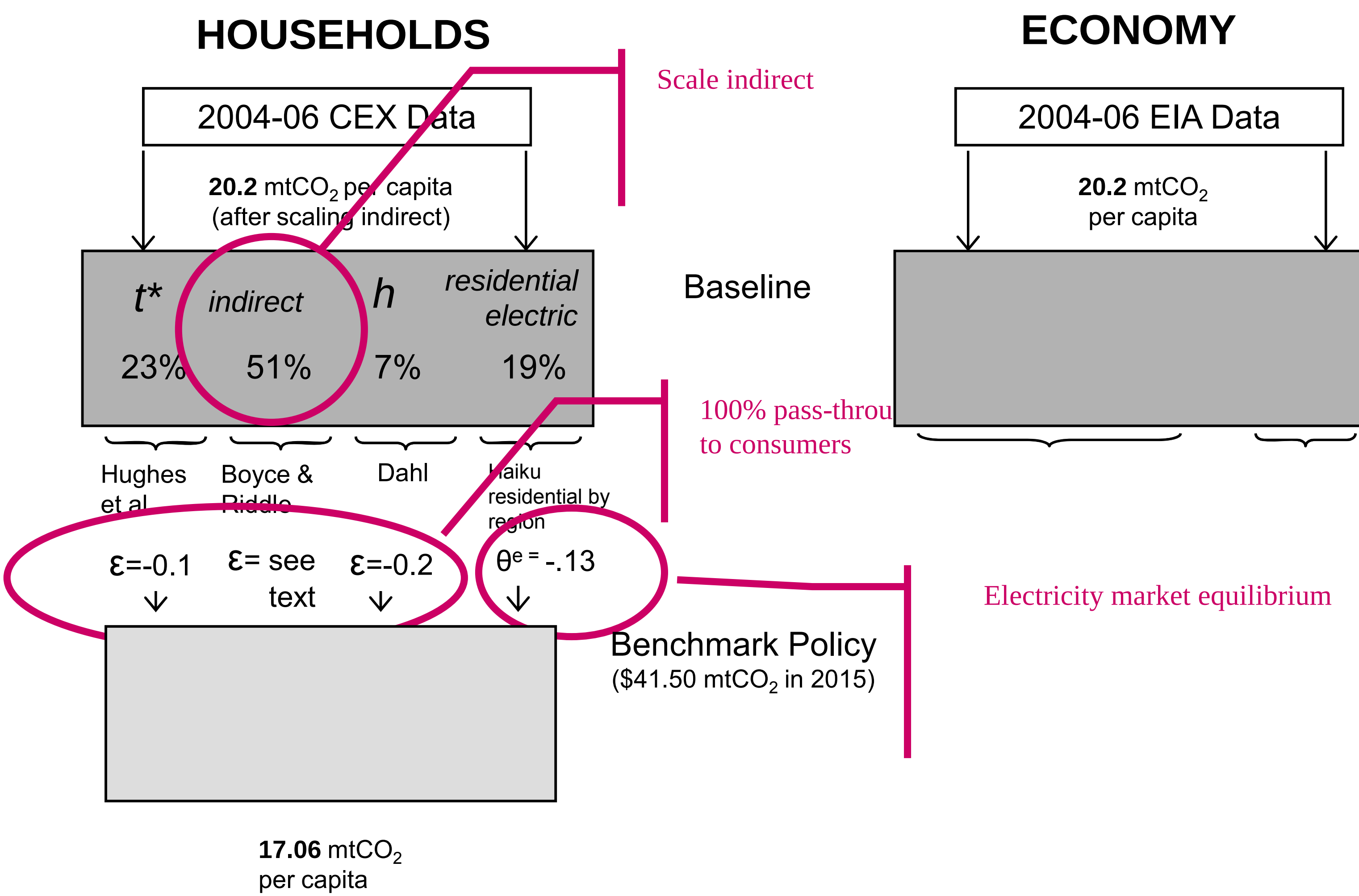
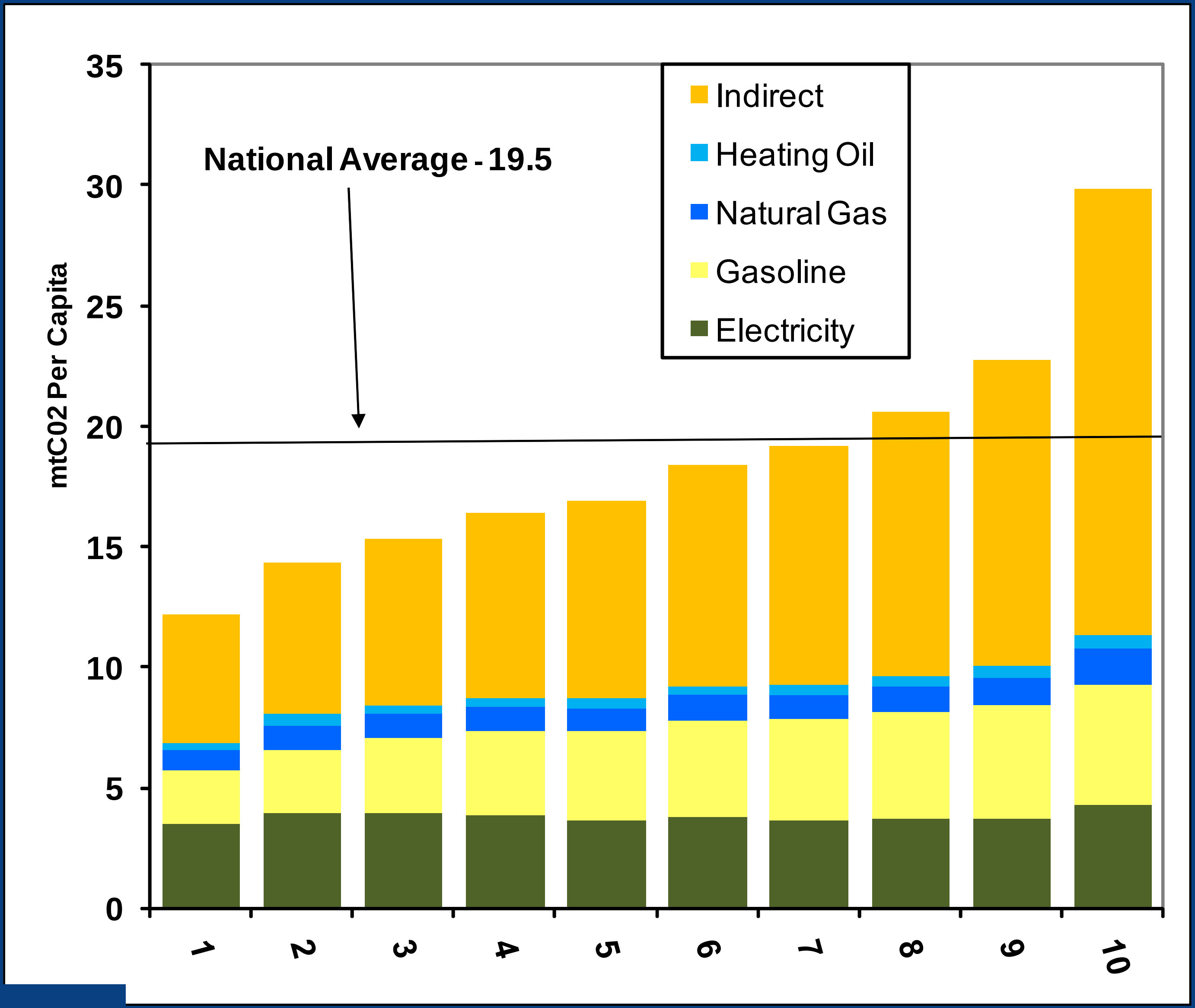
Scaling BLS Data to Match EIA Data



* Baseline total and transportation (*t*) emissions do not reflect CAFE adjustment. Policy case does.

Emissions (mtCO2) per Capita **by Income Decile** for the Nation



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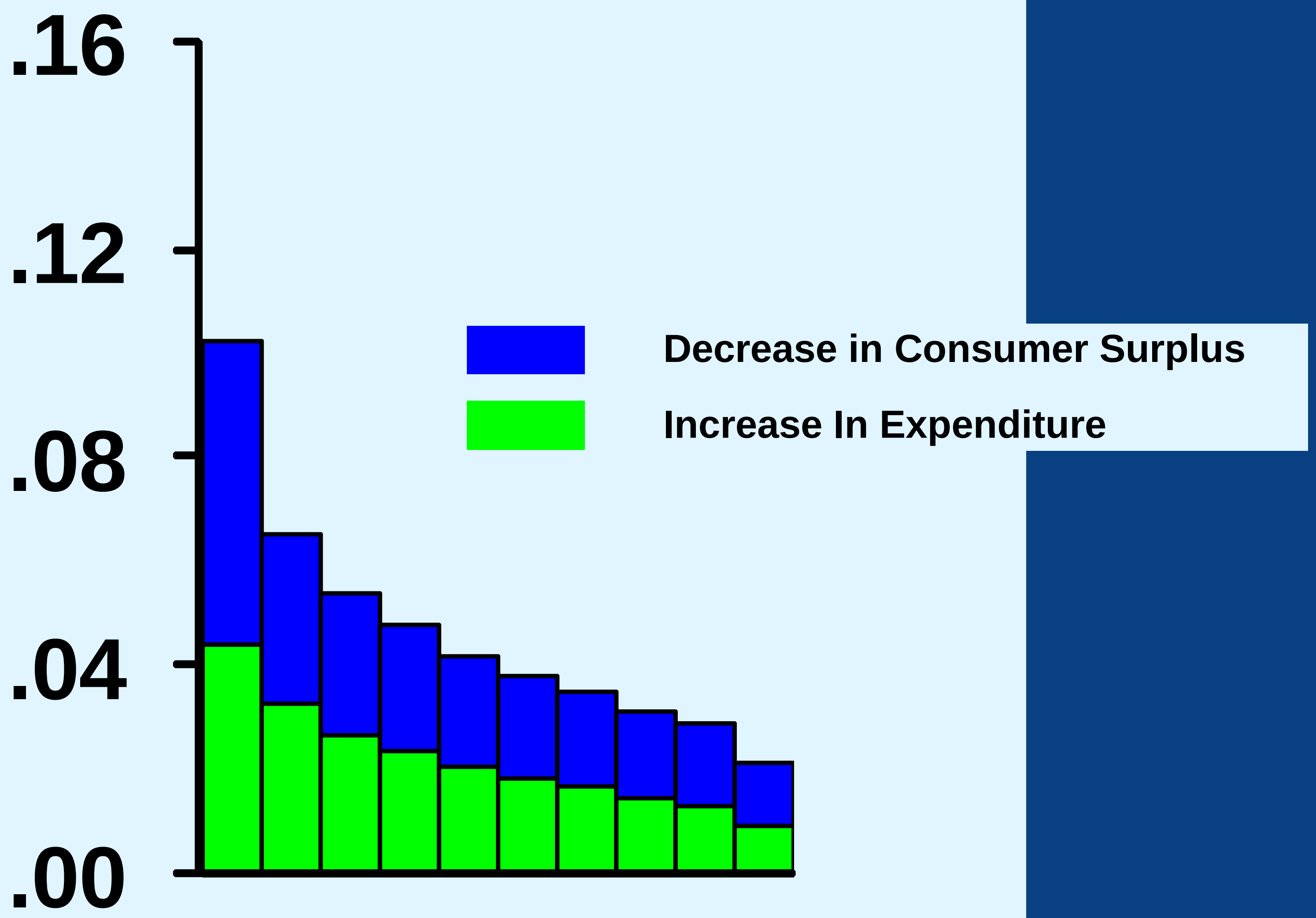
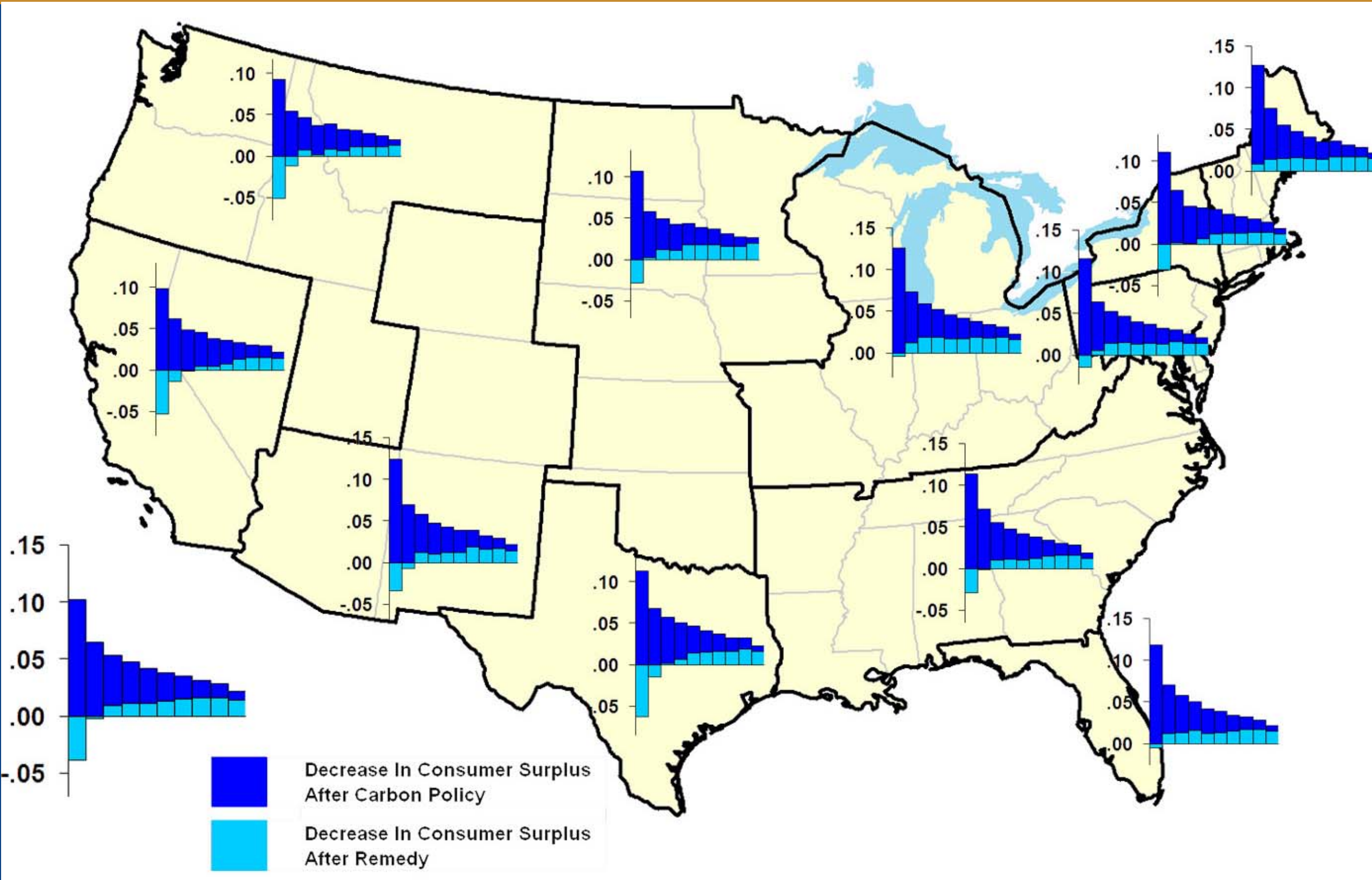
*National per capita average emissions after accounting for CAFE standards.

Expenditures and Consumer Surplus Loss as Fraction of Income

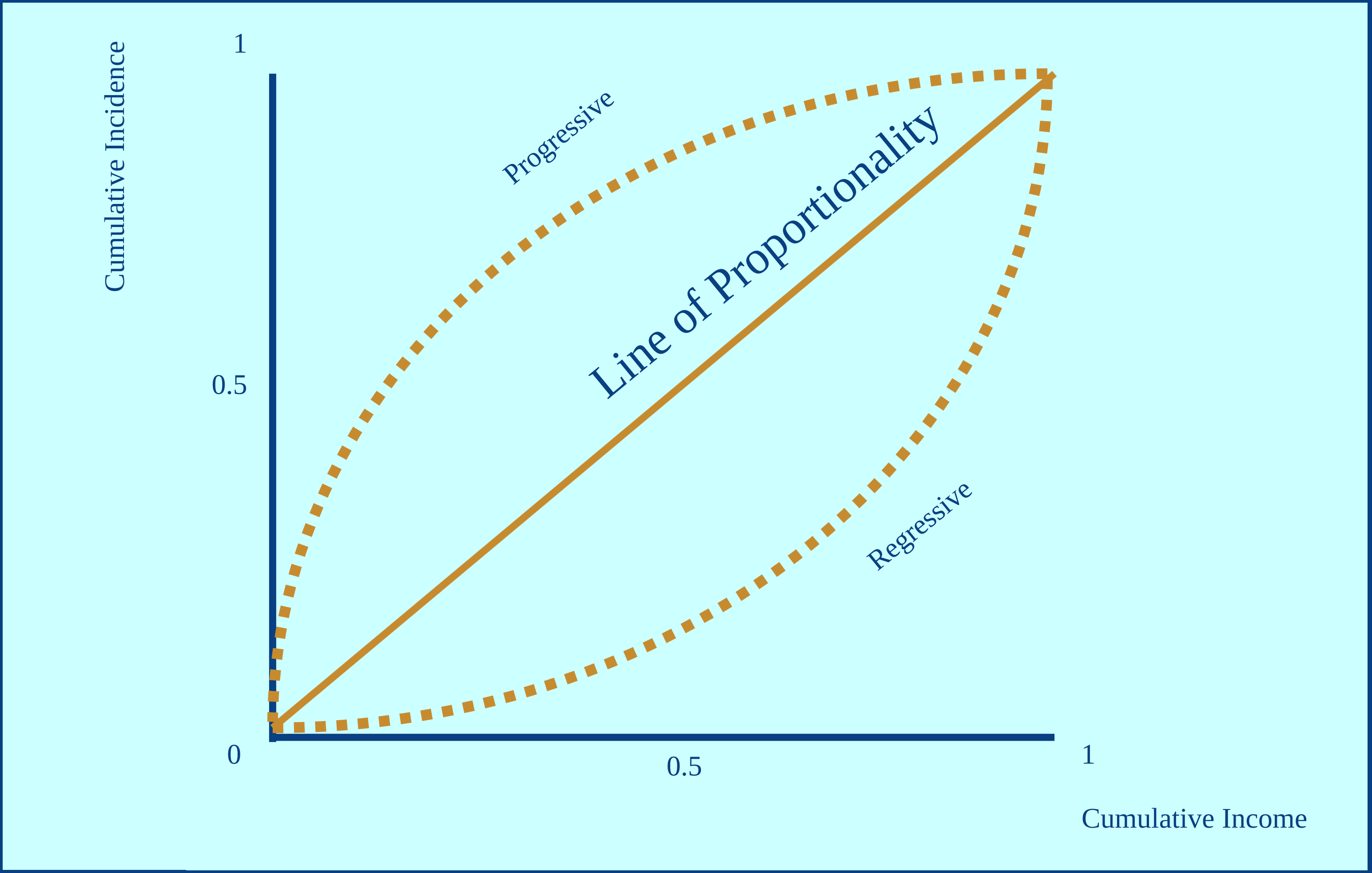


Example: Cap and Dividend (Taxable)



Modified Suits Index:

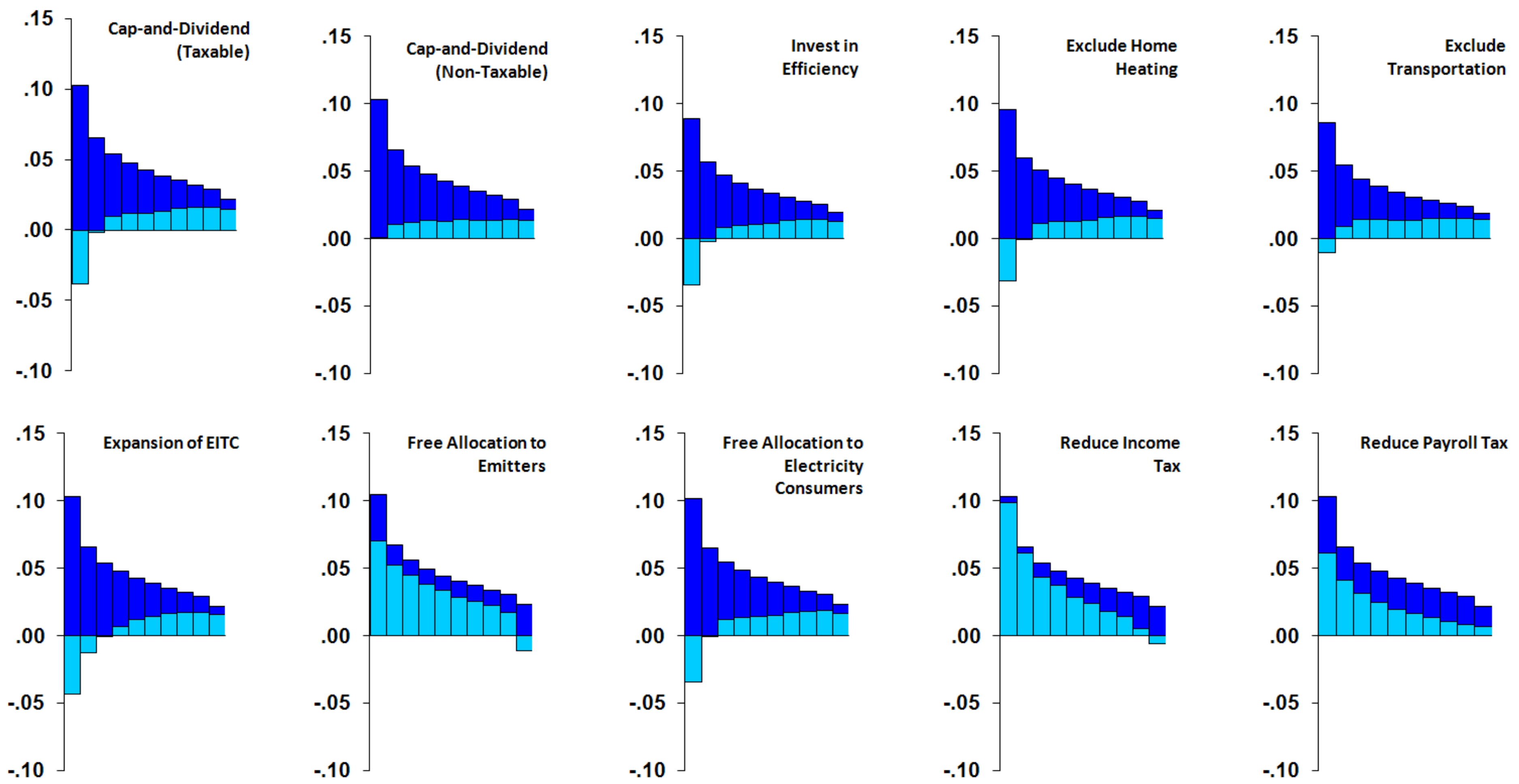
(Area under curve – Area under line) / Area under line



Ten Policy Options

Scenario	Permit Price ($/ton)	Per Capita CO_2 Emissions	MSI After CO_2 Price	MSI After Revenue is Distributed
Cap-and-Dividend (Non-Taxable)	$41.52	17.06	-0.18	0.05
Cap-and-Dividend (Taxable)	$41.52	17.06	-0.18	0.15
Invest in Efficiency	$37.20	17.06	-0.18	0.16
Exclude Home Heating	$42.80	17.06	-0.18	0.13
Exclude Transportation	$43.25	17.06	-0.17	0.06
Expansion of EITC	$41.52	17.06	-0.18	0.23
Free Allocation to Emitters	$45.65	17.06	-0.18	-0.73
Free Allocation to Electricity Consumers	$46.95	17.06	-0.17	0.11
Reduce Income Tax	$41.52	17.06	-0.18	-0.79
Reduce Payroll Tax	$41.52	17.06	-0.18	-0.33

Net Consumer Surplus Loss as a Fraction of Annual Household Income



Conclusions

- Property rights to CO_2 convey tremendous value.
- Policy options have significant efficiency implications and differences for regions and income groups.
- How we resolve this issue will be crucial to our ability to forward with climate policy in the future.

Thank you!

Three relevant papers:

Burtraw, D. and Palmer, K. 2008. *J. Policy Analysis and Management,* 27 (4):81

Paul, A., Burtraw D. and Palmer K. 2008. RFF Discussion Paper 08-25 (July).

Burtraw, D., Sweeney R. and Walls M. 2008. RFF Discussion Paper 08-28 (Aug

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