CAP AND DIVIDEND:

A STATE-BY-STATE ANALYSIS

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Revised November 2010

ABSTRACT

The impacts on consumers of a cap on carbon emissions will vary across income brackets and across the 50 states. This paper provides state-level estimates of these impacts by income decile. We then estimate the net effect of a cap-and-dividend policy in which all carbon permits are auctioned and 80% of the revenue is returned as dividends to the public. We find that inter-state differences are small compared to the differences across income brackets. Within each state, at least 60% of households receive net benefits: the dividends more than offset the impact of higher fossil fuel prices on their real incomes. Differences across states are small in cap-and-dividend compared to inter-state differences in per capita spending for defense and federal farm programs. The high visibility of dividends, coupled with the positive impact on family incomes, could enhance public support for a durable climate policy.

Key words: Climate change; climate policy; fossil fuels; global warming; cap-and-trade; energy policy.

JEL codes: H22, H23, Q48, Q52, Q54, Q58

EXECUTIVE SUMMARY

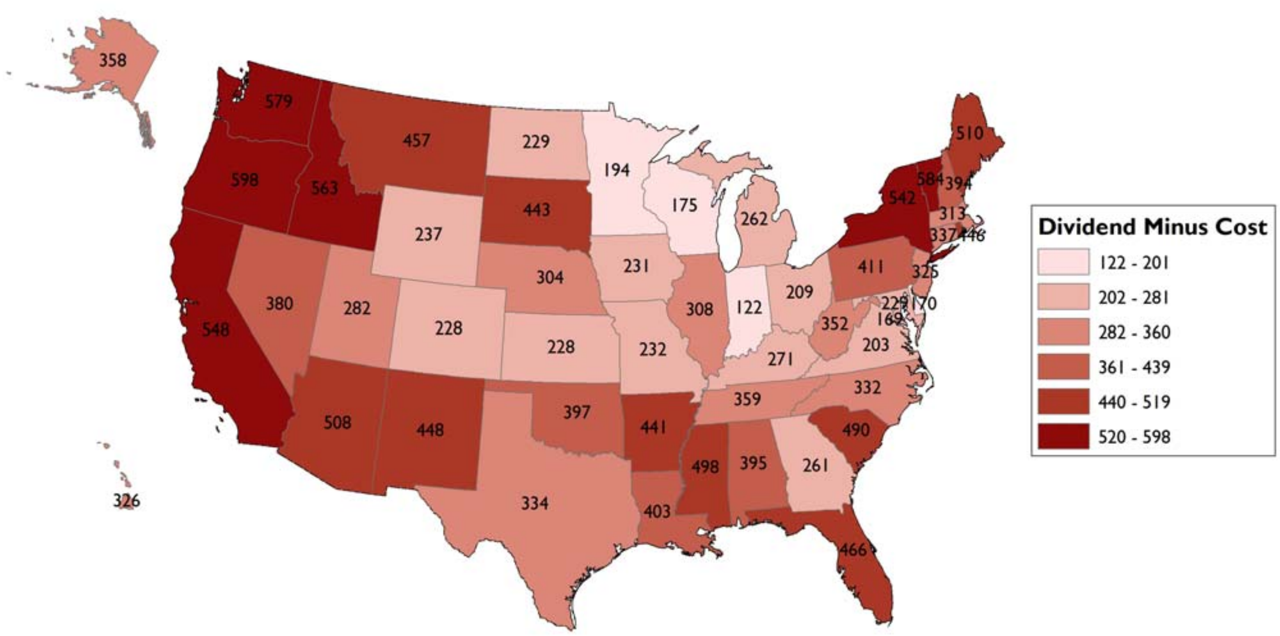
A cap-and-permit system to curb carbon dioxide emissions from burning fossil fuels will raise prices to consumers. Individual carbon footprints will now carry a price tag. The money that consumers pay in higher prices will not disappear from the nation's economy, however: it will be transferred to the owners of the carbon permits.

A cap-and-dividend policy would put this ownership in the hands of the people. It would do so by auctioning the permits and returning most or all of the revenue to the public as equal per-person dividends. If 100% of the permits are auctioned, there is no need for permit trading in secondary markets, no siphoning of revenue into trader profits, and no risk that speculators will manipulate the carbon price. The cap-and-dividend policy would provide incentives for businesses and households to curtail their use of fossil fuels, while protecting consumers from the impact of higher prices on their real incomes.

In this paper, we examine differences in the impact of a cap on carbon emissions across income brackets and across the 50 states. We then estimate the net effect of a cap-and-dividend policy. We find that in every state the majority of families come out ahead: the dividends they receive more than offset the impact of price increases.

Differences across states are shown in Figure A. They are small compared to differences across income brackets. Because dividends are distributed equally to each person, variations in cap-and-dividend's net impact arise solely from differences in carbon footprints. Households who consume more carbon, directly via fossil fuels and indirectly via other goods that are produced and distributed using them, will pay more; those who consume less will pay less. The differences between average carbon footprints in the top 10% and bottom 10% of the income distribution are far wider than differences across the states.

FIGURE A: IMPACT OF CARBON PRICING ON MEDIAN FAMILY OF FOUR ($/YEAR, AT $25/TON CO_2)



The inter-state differences in net benefits from cap-and-dividend are also small relative to those in many other public policies. Figure B compares them to differences in per capita spending on defense and federal farm programs. The ratio between the top ten and bottom ten states is more than 11:1 in the case of defense spending, and 190:1 in the case of farm programs. In the case of cap-and-dividend, it is only 2.8:1.

Cap-and-dividend would return carbon revenue in equal measure to each American. In contrast, the American Clean Energy and Security (ACES) Act, passed by the U.S. House of Representatives in June 2009, would allocate revenues and free permits in a variety of ways with uneven effects across households. The Congressional Budget Office (2009) estimates that under ACES roughly two-fifths of the carbon revenue (or "allowance value") would flow to households in the top quintile of the national income distribution. In Figure C this outcome is contrasted with cap-and-dividend, in which each quintile receives the same amount, 20%, equal to its share of the population.

The visibility of the transfers of carbon revenue to the public may be even more important than the net distributional effects of climate policy. Dividends to the public in the form of checks in the mail or deposits into bank accounts will provide highly tangible benefits to families, against which they can weigh the impacts of higher fossil fuel prices. Transfers to households resulting from ACES – via myriad routes such as capital gains to corporate shareholders and rebates in electricity bills – will be less apparent.

For reasons of both economic fairness and transparency, therefore, cap-and-dividend offers a way to secure durable public support for an effective policy to wean the economy from dependence on fossil fuels. A proactive U.S. policy, in turn, will be a crucial condition for reaching an effective international agreement to confront the global challenge of climate change.

FIGURE B. TOP TEN AND BOTTOM TEN STATES: DEFENSE EXPENDITURE, FARM PROGRAMS, AND CAP-AND-DIVIDEND POLICY

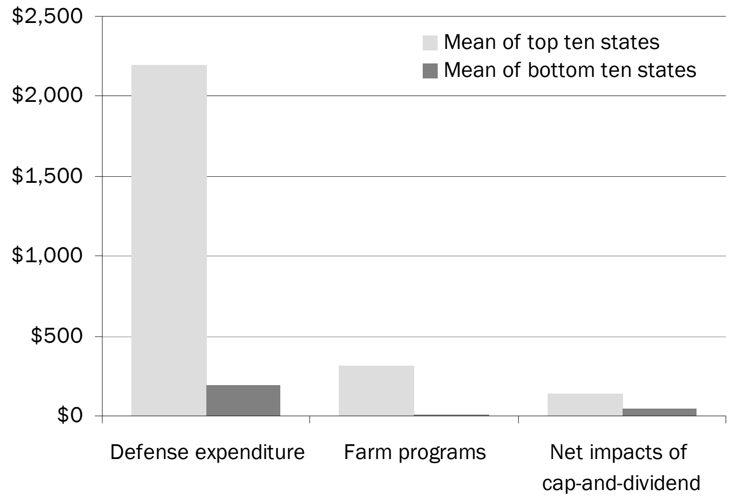
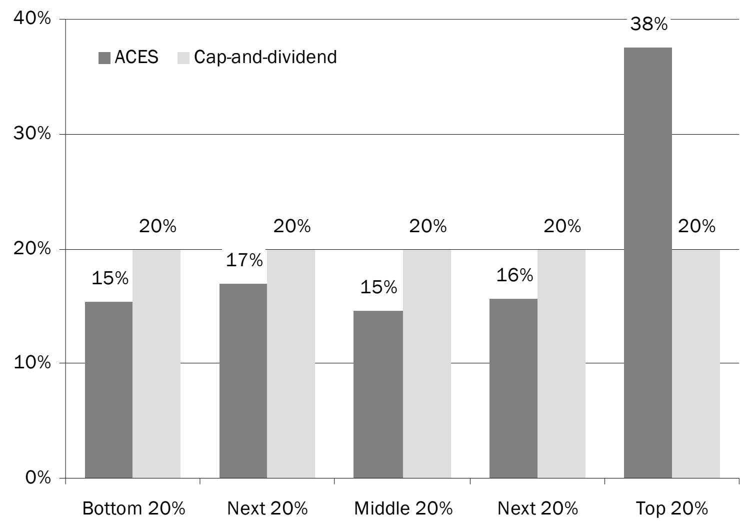


FIGURE C. DISTRIBUTION OF CARBON REVENUES TO HOUSEHOLDS: ACES V. CAP-AND-DIVIDEND POLICIES



I. INTRODUCTION

This paper examines inter-state differences in the impact on households of policies that "put a price on carbon," that is, policies that increase the price of fossil fuels to curtail emissions of carbon dioxide into the atmosphere. In particular, we examine the impact of a "cap-and-dividend" policy that limits the quantity of carbon entering the U.S. economy, auctions permits up to this cap to the firms that supply fossil fuels, and returns all or most of the auction revenue to households in the form of equal per capita dividends.

The paper is organized as follows. Section 2 reviews the basic features of the cap-and-dividend policy, including the rationale for carbon pricing, differences between a cap-and-permit policy and a carbon tax, and how to return auction revenue to the public as dividends.

Section 3 provides a brief overview of the distributional impact of cap-and-dividend at the national level. We examine both the gross impact of higher fossil fuel prices and the net impact when revenues are returned to the public. For the latter calculation, we assume that 80% of the revenues are returned to the public as dividends – a percentage roughly the same as what President Barack Obama proposed in his February 2009 budget. An attractive feature of cap-and-dividend is that the policy delivers positive monetary benefits to low-income and middle-income households, even without counting the environmental benefits of mitigating climate change. At the same time, it rewards households at any income level who reduce their carbon footprints.

Section 4 examines inter-state variations in the impact of higher fossil fuel prices. We analyze three sources of variations: (i) differences in income; (ii) differences in consumption patterns; and (iii) differences in the carbon intensity of electricity consumed. Because the impact varies across the income distribution, we present these results by income decile (tenths of the population ranked by per capita income) as well as for the median household in each state. We then provide a state-by-state analysis of the net impact of the cap-and-dividend policy on a decile-by-decile basis. We show that inter-state variations are minor relative to variations based on income.

Section 5 discusses other, non-dividend uses of carbon revenues. Specifically, we discuss (i) transitional adjustment assistance, the main aim of which is to create jobs in communities adversely impacted by reduced production and use of fossil fuels; and (ii) the mix of uses proposed in the American Clean Energy and Security (ACES) Act of 2009, also known as the Waxman-Markey bill.

Section 6 summarizes our main findings and offers some concluding remarks.

II. CAP-AND-DIVIDEND: THE BASICS

Any policy that limits the supply of fossil fuels will raise their price. The economic logic binding price to scarcity holds true, regardless of the cause of scarcity. When OPEC wants to increase the price of oil, it cuts production. If lawmakers place a cap on carbon emissions from burning fossil fuels, this too will increase their price.[1]

There is a crucial difference, however, between higher prices caused by a carbon cap and higher prices due to other forces. The higher prices from a carbon cap will be a cost to consumers, but not to the economy as a whole. Instead they are a *transfer*. Every dollar paid by consumers in higher fuel prices will go to the holders of carbon permits. Unlike price rises due to market forces or OPEC supply restrictions, the price rise due to a carbon cap simply recycles dollars within the United States.

A key question is: who will get these dollars? There are three possible answers:

Profits to corporations: If permits are given free-of-charge to corporations, they will reap windfall profits. Consumers will pay higher prices, and the firms and their shareholders will get the money. This is a “cap-and-giveaway” policy.

Revenues to government: If permits are auctioned rather than given away, the permit value (the counterpart to the higher prices paid by consumers) will be captured by the government. If this money is used to fund public expenditures or cut taxes, the distribution of benefits to the public will depend on the specifics of these uses. This is a “cap-and-spend” (or “cap-and-invest”) policy.

Dividends to the people: If the revenue from permit auctions is returned to the public as equal per capita dividends, consumers will be partially or fully insulated from the impact of higher prices. Households with small carbon footprints will come out ahead, receiving more in dividends than they pay in higher prices. This is a “cap-and-dividend” policy.

The stakes are high. A carbon cap will bring the greatest allocation of new property rights in the United States since the Homestead Act of 1862. The value of permits under a cap that cuts emissions 80% by 2050 – the goal endorsed by climate scientists and embodied in legislation now before Congress – will amount to trillions of dollars over the next forty years.

The mechanics of cap-and-dividend

A carbon cap will be most efficiently administered “upstream,” by requiring permits (sometimes called “allowances”) to be purchased by the first sellers of fossil fuels into the economy. The cap will reduce supply and raise fuel prices; in this respect it is akin to a carbon tax (for differences between permits and taxes, see the sidebar on page 3). The resulting market signals will spur businesses and households alike to invest in energy efficiency and clean energy.

In a cap-and-dividend policy, the permits are auctioned by the government and all or most of the auction revenue is returned to the public as equal payments per person. This is what economists call a “feebate” arrangement: individuals pay fees based on their use of a scarce resource that they own in common, and the fees are then rebated in equal measure to all co-owners. In this case, the scarce resource is the U.S. share of the carbon storage capacity of the atmosphere; the fee is set by the carbon footprint of the household; and the co-owners are the American people.

One way to disburse dividends is via ATM cards, similar to those used today by many Americans to access Social Security payments. At the ATM, individuals can check on the auction revenue deposited into their accounts and withdraw funds at their convenience.

With auctions, no need for permit trading

In his budget proposal submitted to Congress in February 2009, President Barack Obama affirmed the principle that 100% of carbon permits should be auctioned.

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With 100% auction, there is no need for permit trading. Auctions can be held monthly or quarterly, with the number of permits on offer being reduced gradually as the carbon cap tightens over time. The permit allows its holder to bring a fixed quantity of fossil carbon into the economy in a certain time frame, say over a two-year period from the date of purchase. Firms simply buy the number of permits they want at the auction.

Most permits in our society are not tradable. Driving permits, gun permits, parking permits, landfill disposal permits, and building permits cannot be traded in markets. There is no reason why carbon permits should be different.

The need for tradable permits (“cap-and-trade”) is premised on the assumption that some or all of the permits are given away free-of-charge rather than sold by auction. Such giveaways must

PERMITS VERSUS TAXES

An alternative way to put a price on carbon is by means of a tax. A carbon tax is simply a permit with a fixed price. A cap-and-permit policy sets the quantity of permits (and hence emissions), and lets demand determine the permit price; a carbon tax sets the price, and lets demand determine the quantity of emissions. In both cases, higher prices provide a market signal to encourage energy efficiency and investments in alternative energy.

If policymakers could have perfect foresight as to future demand for fossil fuels – knowing what new technologies will become available, when the economy will boom and slump, and so on – then setting either the quantity of permits or the carbon price could achieve exactly the same result. In reality, there is much uncertainty about future demand, so the relationship between quantity and price cannot be predicted with much precision.

The fundamental aim of climate policy is to reduce emissions to reach the 2050 target. Therefore, a compelling case can be made for "getting the quantity right" by setting the number of permits and letting their price vary with demand, rather than vice versa. Moreover, in the face of uncertainties as to the relation between quantity and price, there may be political pressures to set the carbon tax too low, based on optimistic projections of the resulting emission reductions.

On the other hand, political pressures may also undermine the efficacy of a cap-and-permit policy. This can happen in two ways: first, by setting the cap at a level that is inadequate to achieve the necessary emission reductions; and second, by allowing "offsets," whereby instead of curtailing fossil fuels, firms can get credits for other actions such as planting trees, slowing deforestation, or reducing carbon emissions in other countries.[2]

The case for permits rather than taxes is premised, therefore, on a "tight" cap: one that reduces emissions to meet the 2050 target, without offsets that transform the cap into a porous sieve. If policymakers instead opt for a carbon tax, the question of how to distribute the revenue will remain. The analysis presented in this paper would apply equally to a "tax-and-dividend" policy.[3]

be based on some formula (like historic emissions). Some firms will get more permits than they need, while others will get fewer than they want; trading is necessary to redistribute them from the former to the latter. If 100% of the carbon permits are auctioned, however, permit trading becomes unnecessary.

With non-tradable permits, trader profits do not drive a wedge between the amount paid by consumers in higher prices and the amount of available revenue from permit sales. None of the carbon revenue is siphoned off by speculators or trading firms. Non-tradable permits also safeguard the policy from the perception or reality of market manipulation by players seeking to game the system.[4]

Dividends versus other uses of carbon revenue

Rather than returning 100% of carbon revenues to the public, policymakers could dedicate a portion of the revenues to other uses. In his February 2009 budget, for example, President Obama proposed using 81.4% of projected carbon revenues for the years 2010-2019 for lump-sum tax credits (extending the "Making Work Pay" credits that were initiated in the economic stimulus program) and devoting the remainder to investment in clean energy technologies.[5]

Apart from clean energy investments, other potential uses for carbon revenues include offsetting the impact of higher fossil fuel prices on the purchasing power of federal, state, and local governments; transitional adjustment assistance to workers, communities, or firms adversely affected by the transition away from fossil fuels; and other government expenditures, tax cuts, or deficit reduction.

Following the contours of President Obama's budget proposal, in the following analysis we assume that 80% of carbon permit revenues are returned to the public as dividends, and that the remaining 20% are allocated to other uses. In section 5 we further discuss some of these potential uses.

III. DISTRIBUTIONAL IMPACTS OF CAP-AND-DIVIDEND AT THE NATIONAL LEVEL

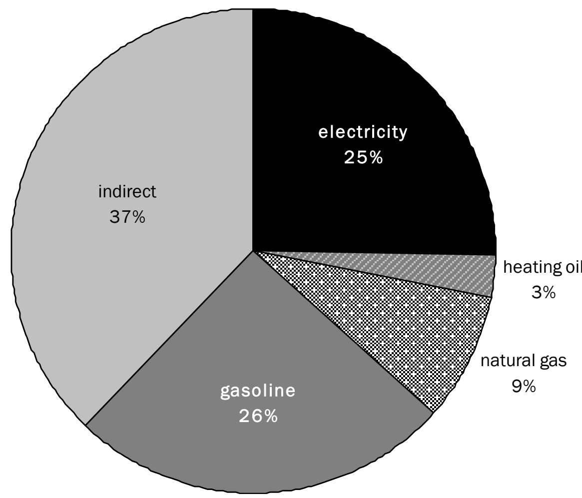
The cap-and-dividend policy will have a progressive impact on income distribution nationwide. Households with smaller-than-average carbon footprints pay less in higher fuel costs than they receive as dividends; households with larger-than-average carbon footprints pay more than they receive. In general, lower and middle-income households will come out ahead, for the simple reason that they consume much less carbon than upper-income households. Overall, roughly three-quarters of American families will obtain positive net benefits in purely monetary terms, not counting the environmental benefits that are the main rationale for a carbon-pricing policy.

To calculate the net impact across income brackets, we first estimate the carbon footprints of households: the carbon dioxide emissions resulting from not only their direct fuel consumption but also the production and distribution of other goods and services that they consume.[6] Data on expenditure patterns are drawn from the Consumer Expenditure Survey conducted by the U.S. Bureau of Labor Statistics. Lower-income households generally devote a larger fraction of their expenditure to direct fuel consumption than upper-income households (in economic parlance, fuels are "necessities" not "luxuries").

Carbon emissions per dollar expenditure for different items are based on input-output data. As one might expect, this ratio varies greatly across expenditure categories. In the case of electricity and household fuels, one dollar of spending generates about 7 kg of carbon dioxide emissions. In the case of services, the corresponding amount is about 0.3 kg.

The distribution of carbon emissions across expenditure categories is shown in Figure 1. Gasoline and electricity consumption each account for about one-quarter of the average household's carbon footprint. Natural gas and heating oil contribute a further 12%. Indirect uses – including consumption of food, industrial goods, services, and other transportation – account for the rest.

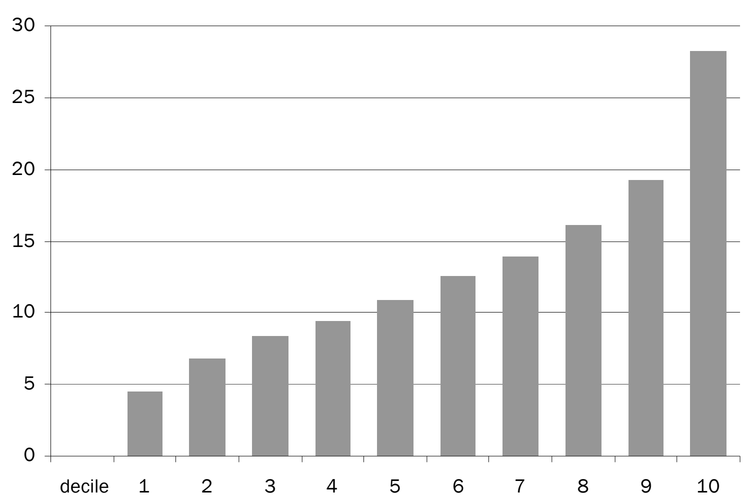
FIGURE 1: HOUSEHOLD CARBON FOOTPRINT BY EXPENDITURE CATEGORY (NATIONAL AVERAGE)



Because low-income households consume less than high-income households, they generally have smaller carbon footprints. Differences across the income spectrum are shown in Figure 2a. In the highest income decile, carbon emissions per capita are more than six times greater than in the lowest decile.

As a *share* of their income, however, the poor consume more carbon than the rich – that is,

FIGURE 2A: CARBON FOOTPRINT BY INCOME DECILE (METRIC TONS CO_2 PER CAPITA)



more carbon per dollar of their income. This is primarily because, as noted above, direct fuel consumption accounts for a bigger fraction of their household budgets: they spend more on necessities and less on luxuries. Carbon per dollar of expenditure is more than twice as high in the poorest decile as in the richest, as shown in Figure 2b. Hence, a price on carbon is regressive in and of itself, hitting the poor harder as a fraction of their incomes than the rich.

The *net* impact of the policy depends, however, on who receives the money generated by the carbon price. If this money is captured by auctioning the carbon permits – rather than giving them away free-of-charge – and if most of the resulting revenue is returned to the public in dividends, the net impact turns progressive.

To illustrate, we assume that the permit price is $25 per ton of carbon dioxide, all permits are auctioned, and 80% of the revenue is returned to the people as dividends. This price is within the range of projections based on current legislative proposals; for example, the Congressional Budget Office (2009) estimates that the Waxman-Markey bill would result in a permit price of $28/t$CO_2$ in the year 2020. A more aggressive policy, with a more ambitious schedule for emission reductions and/or fewer "offsets," would generate a higher price. This would increase the magnitude of the impacts of the cap-and-dividend policy, but it would not alter their distributional incidence.

The impact of the cap-and-dividend policy is shown in Table 1. The annual carbon charge –

FIGURE 2B: HOUSEHOLD CARBON FOOTPRINT BY INCOME DECILE (KILOGRAMS CO_2 PER $ INCOME PER CAPITA)

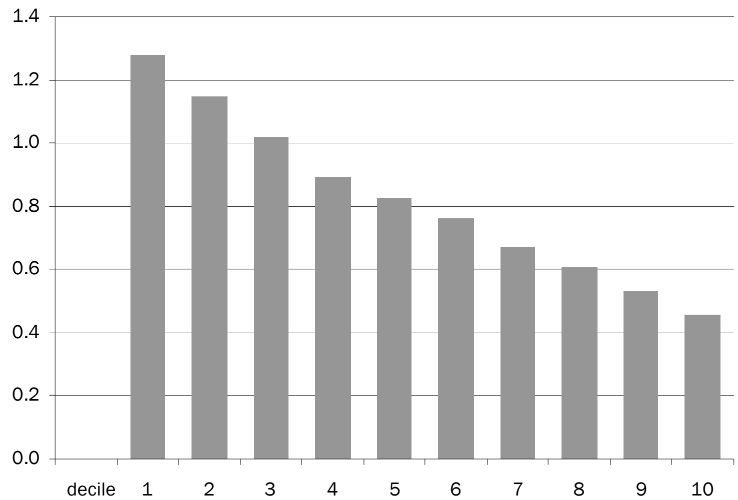


TABLE 1: DISTRIBUTIONAL IMPACT OF CAP-AND-DIVIDEND AT THE NATIONAL LEVEL ($25/T CO2, WITH 80% OF REVENUE DISTRIBUTED AS DIVIDENDS)

Per capita income decile	Per capita income (in 2003 dollars)	Average household size	$ per capita			% of income		
			Carbon charge	Dividend	Net impact	Carbon charge	Dividend	Net impact
1	3844	4.5	135	386	251	3.5%	10.0%	6.5%
2	6538	3.6	177	386	209	2.7%	5.9%	3.2%
3	8968	3.2	209	386	177	2.3%	4.3%	2.0%
4	11544	2.9	238	386	148	2.1%	3.3%	1.3%
5	14481	2.7	267	386	119	1.8%	2.7%	0.8%
6	18034	2.4	299	386	87	1.7%	2.1%	0.5%
7	22623	2.3	337	386	49	1.5%	1.7%	0.2%
8	29120	2.1	385	386	1	1.3%	1.3%	0.0%
9	39942	2.0	457	386	-71	1.1%	1.0%	-0.2%
10	67940	1.7	618	386	-232	0.9%	0.6%	-0.3%
Mean	23657	2.5	317	386	69	1.3%	1.6%	0.3%
Median	16160	2.0	283	386	103	1.7%	2.4%	0.6%

the cost to consumers from higher prices for fossil fuels, and for other goods and services that use them in their production and distribution, ranges from $139 per person in the lowest-income decile to $615 per person in the highest.[7] Each household receives the same per capita dividend, $386. The bottom seven deciles come out ahead, receiving more in dividends than they pay as a result of higher fuel prices; the eighth decile breaks even; and the top two deciles experience a net cost. As a percentage of income, the lowest decile sees a 6.7% gain, while the top decile sees a 0.3% loss.

The monetary winners outnumber the losers for two reasons. The first is that the U.S. income distribution is strongly skewed to high-income people. As shown in Appendix Table A.1, the national mean (average) per capita income in 2003 was $23,657, whereas the median income – that of the "middle American," 50% of the population having higher incomes and 50% lower – was $16,160. Just as mean income is pulled above the median by the high incomes at the top, per capita dividends are pulled up by the outsized carbon footprints of high-income households.

The second reason is that our calculations are based on the assumption that 80% of total carbon revenue is returned to households. Household consumption accounts for only 66% of total carbon emissions in the United States, however, and hence for roughly the same share of total carbon revenues. The remaining emissions come from local, state and federal government (14%), non-profit institutions (8%), and production of exports (12%).[8]

While the results in Table 1 show the broad pattern of distributional impacts from the cap-and-dividend policy, the impact on individual households will depend on their consumption choices. Upper-income households who reduce their carbon footprints well below the norm for their income bracket can derive positive net benefits, too; conversely, lower and middle-income households with disproportionately large carbon footprints can come out behind. Regardless of income level, higher fuel prices provide incentives for energy efficiency and alternative fuels. Those who respond strongly to these market signals fare better than those who do not curtail their consumption of fossil fuels.[9]

REGARDLESS OF INCOME LEVEL, HIGHER FUEL PRICES PROVIDE INCENTIVES FOR ENERGY EFFICIENCY AND ALTERNATIVE FUELS.

In sum, the progressive impact of per capita dividends more than offsets the regressive impact of higher fossil fuel prices. The majority of American families are "held harmless" by the policy: their real incomes are protected, and in many cases increased. This, in turn, protects the nation's climate policy from the political backlash that higher fuel prices could otherwise trigger.

IV. STATE-BY-STATE IMPACTS OF CAP-AND-DIVIDEND

One issue that has received attention in Congress is the differential effects that carbon pricing may have across the states. In a June 2009 interview with *The New York Times*, President Obama alluded to this issue when he described the compromises in the Waxman-Markey bill as having been "necessary to moderate the different effects of greenhouse-gas controls on different parts of the country" (Broder 2009).

Two broad sorts of inter-state differences can be distinguished. The first is on the consumption side of the economy, arising from differences in household use of fossil fuels (both direct and indirect) and hence in the impact of higher prices on consumers. The second is on the production side, arising from differences in how firms and workers are affected by the transition away from burning fossil fuels. In this section our focus is the consumption side.

Impact of higher fossil fuel prices on households

The higher fossil fuel prices that result from any policy that puts a price on carbon will have different impacts on consumers in different states for three reasons:

Income differences: States vary in both average income and income distribution. Just as people in upper-income households tend to have larger carbon footprints than lower-income households (see Figure 2a), people in higher-income states tend to have bigger carbon footprints, all else equal, than their counterparts in lower-income states.

Differences in consumption patterns: Energy use is affected, among other things, by public policies and the weather. In California, for example, policies to promote energy efficiency have paid off by reducing the state's per capita electricity use considerably below the national average. Gasoline consumption varies due to differences in commuting distances, public transportation, and the level of state gasoline taxes. In the northern states, households spend more to heat their homes; in the southern states, they spend more to cool them.

Differences in the carbon intensity of electricity: Some states rely mostly on coal-fired power plants, which generate higher carbon emissions per kilowatt-hour than other electricity sources. Some states rely more on hydroelectric power, nuclear power, or other low-carbon technologies. Electricity accounts for roughly one-quarter of the typical household's carbon usage (see Figure 1); differences in the carbon intensity of electricity affect this component of the impact of carbon pricing on consumers.

Table 2 presents data on the extent of inter-state differences in these respects. Per capita income varies from about $11,500 in Mississippi to about $21,000 in Connecticut.

TABLE 2: INTER-STATE DIFFERENCES IN INCOME AND ENERGY USE

State	Median income (annual per capita)	Expenditure per capita of median household ($)				Carbon intensity of electricity supply (kg CO_2/MWh)
		Electricity	Gasoline	Natural gas	Fuel oil	
Alabama	13,308	416	446	100	23	669
Alaska	18,806	345	481	136	22	546
Arizona	15,544	314	412	126	9	558
Arkansas	12,772	411	437	98	23	630
California	16,616	195	525	106	12	454
Colorado	18,829	332	450	134	9	913
Connecticut	20,964	219	481	107	187	412
Delaware	18,527	330	431	157	69	933
District of Columbia	17,795	453	513	110	25	734
Florida	15,925	384	441	8	6	672
Georgia	15,895	438	487	106	24	708
Hawaii	16,969	392	454	8	7	857
Idaho	14,231	317	422	124	20	459
Illinois	17,521	348	484	212	23	556
Indiana	16,350	341	468	208	23	1,041
Iowa	15,925	304	471	212	14	933
Kansas	16,138	305	473	213	14	918
Kentucky	13,417	321	425	194	21	1,002
Louisiana	12,179	405	426	97	23	745
Maine	15,398	200	418	97	172	455

TABLE 2: INTER-STATE DIFFERENCES IN INCOME AND ENERGY USE, CONTINUED

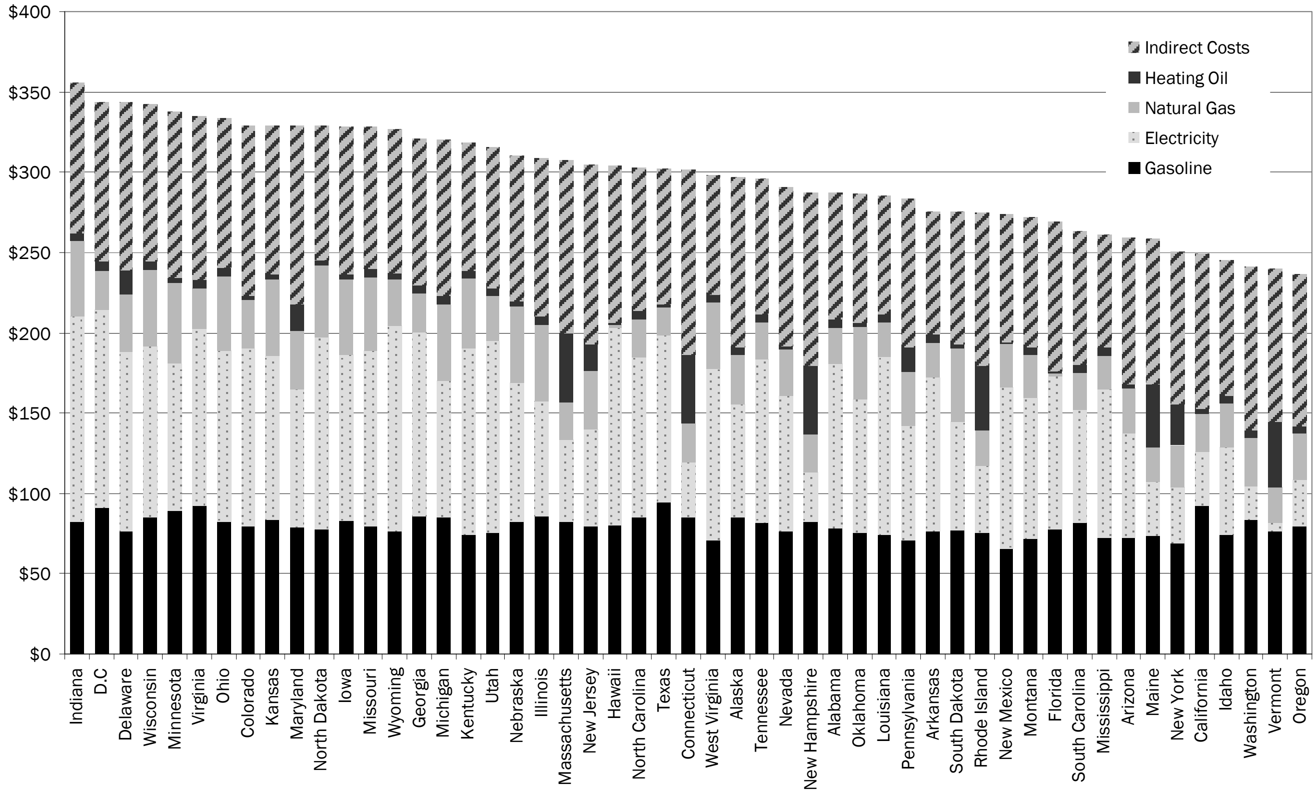
State	Median income (annual per capita)	Expenditure per capita of median household ($)				Carbon intensity of electricity supply (kg CO_2/MWh)
		Electricity	Gasoline	Natural gas	Fuel oil	
Maryland	20,192	339	448	161	71	681
Massachusetts	19,428	214	465	105	184	648
Michigan	17,297	347	481	211	23	666
Minnesota	18,534	318	505	223	14	780
Mississippi	11,531	398	414	95	22	631
Missouri	15,311	334	454	203	22	899
Montana	13,475	312	410	122	20	765
Nebraska	15,722	302	468	212	14	780
Nevada	17,276	324	433	131	9	702
New Hampshire	19,423	214	465	105	184	387
New Jersey	20,330	339	449	162	71	474
New Mexico	12,994	297	377	119	9	935
New York	16,298	212	391	114	112	442
North Carolina	15,512	435	481	105	24	618
North Dakota	14,126	293	444	204	13	1,134
Ohio	16,360	341	469	208	23	852
Oklahoma	13,407	288	432	201	13	790
Oregon	16,395	331	451	130	21	227
Pennsylvania	15,950	316	403	150	66	613
Rhode Island	16,417	203	431	99	175	550
South Carolina	14,305	425	463	102	24	442
South Dakota	13,845	291	440	203	13	631
Tennessee	14,463	426	465	103	24	645
Texas	14,492	388	537	78	8	729
Utah	14,907	322	431	126	20	1,028
Vermont	16,560	204	432	100	176	73
Virginia	18,413	458	521	111	25	645
Washington	18,049	341	472	134	21	160
West Virginia	12,219	312	405	188	21	948
Wisconsin	17,355	347	482	212	23	840
Wyoming	15,237	324	436	127	20	1,099
U.S. average	16,160	312	448	119	38	667

Note: For data sources, see Appendix.

Per capita expenditure on electricity by the median household in each state ranges from $244/year in California to $569/year in Virginia. Variations in per capita gasoline expenditure are less pronounced, ranging from $432/year in New Mexico to $620/year in Texas. Natural gas use is highest in the upper Midwest, and heating oil use is concentrated in the northeastern states.

The carbon intensity of electricity varies widely across the states. North Dakota, a state that is heavily reliant on coal-fired power plants, emits 1134 kg of carbon dioxide per megawatt hour

FIGURE 3: PER CAPITA CARBON EXPENDITURE OF MEDIAN HOUSEHOLD BY COMMODITY GROUP (PRICED AT $25/TCO₂)



(MWh). Vermont, where the main power sources are nuclear and hydro, emits only 73 kg CO_2/MWh.

Taking these differences into account, Figure 3 depicts the impact of higher fossil fuel prices on the median-income household in each state, with a carbon price of $25/t$CO_2$. The results show that inter-state differences are not terribly large, ranging from $237 in Oregon to $356 in Indiana. The map in Figure 4 (page 11) depicts these impacts on a median-income family of four. Table 3 shows the impact on consumers by income decile across the states, with the results expressed as a percentage of income. The dollar

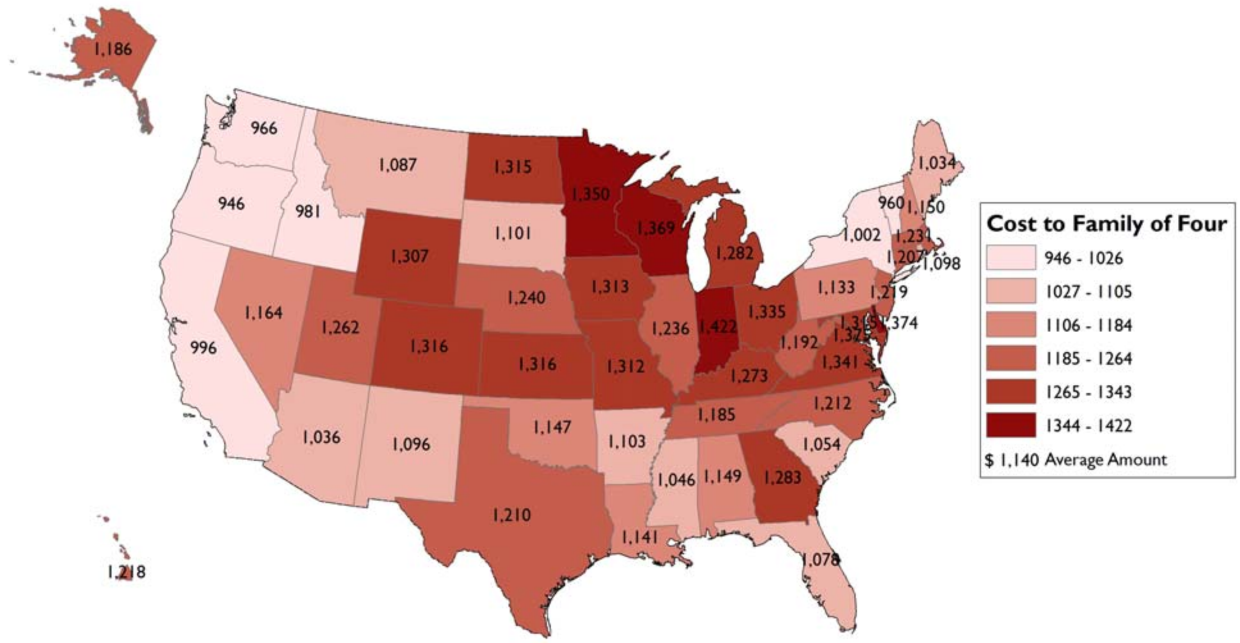
TABLE 3: CARBON PRICE IMPACT BY STATE AND INCOME DECILE (PERCENTAGE OF MEDIAN INCOME)

State	Median	Decile medians (no s)									
		1	2	3	4	5	6	7	8	9	10
Alabama	2.2%	4.3%	3.4%	2.9%	2.6%	2.3%	2.0%	1.8%	1.6%	1.4%	1.1%
Alaska	1.6%	2.7%	2.2%	2.0%	1.8%	1.6%	1.5%	1.4%	1.2%	1.1%	0.9%
Arizona	1.7%	3.1%	2.5%	2.2%	1.9%	1.7%	1.6%	1.4%	1.3%	1.1%	0.9%
Arkansas	2.2%	4.2%	3.3%	2.8%	2.5%	2.3%	2.0%	1.8%	1.6%	1.4%	1.1%
California	1.5%	2.7%	2.2%	1.9%	1.7%	1.6%	1.4%	1.3%	1.2%	1.0%	0.8%
Colorado	1.7%	3.3%	2.6%	2.3%	2.0%	1.8%	1.7%	1.5%	1.3%	1.2%	0.9%
Connecticut	1.4%	2.8%	2.2%	1.9%	1.7%	1.5%	1.4%	1.2%	1.1%	0.9%	0.7%
Delaware	1.9%	3.5%	2.8%	2.4%	2.2%	1.9%	1.8%	1.6%	1.4%	1.2%	1.0%
D.C	1.9%	4.5%	3.3%	2.7%	2.4%	2.1%	1.8%	1.6%	1.4%	1.1%	0.8%
Florida	1.7%	3.3%	2.6%	2.2%	2.0%	1.8%	1.6%	1.4%	1.3%	1.1%	0.9%
Georgia	2.0%	4.0%	3.1%	2.7%	2.4%	2.1%	1.9%	1.7%	1.5%	1.3%	1.0%

TABLE 3: CARBON PRICE IMPACT BY STATE AND INCOME DECILE (PERCENTAGE OF MEDIAN INCOME), CONTINUED

State	Median	Decile medians (no s)									
		1	2	3	4	5	6	7	8	9	10
Hawaii	1.8%	3.4%	2.7%	2.3%	2.1%	1.9%	1.7%	1.5%	1.4%	1.2%	1.0%
Idaho	1.7%	3.0%	2.5%	2.2%	2.0%	1.8%	1.6%	1.5%	1.3%	1.2%	1.0%
Illinois	1.8%	3.4%	2.7%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.2%	0.9%
Indiana	2.2%	4.1%	3.3%	2.8%	2.5%	2.3%	2.1%	1.9%	1.7%	1.4%	1.1%
Iowa	2.1%	3.8%	3.0%	2.7%	2.4%	2.2%	2.0%	1.8%	1.6%	1.4%	1.1%
Kansas	2.0%	3.9%	3.1%	2.7%	2.4%	2.1%	1.9%	1.7%	1.6%	1.3%	1.1%
Kentucky	2.4%	4.8%	3.7%	3.2%	2.8%	2.5%	2.2%	2.0%	1.8%	1.5%	1.1%
Louisiana	2.3%	4.8%	3.7%	3.2%	2.8%	2.5%	2.2%	2.0%	1.7%	1.5%	1.1%
Maine	1.7%	3.0%	2.4%	2.2%	1.9%	1.8%	1.6%	1.5%	1.3%	1.1%	0.9%
Maryland	1.6%	3.1%	2.4%	2.1%	1.9%	1.7%	1.6%	1.4%	1.3%	1.1%	0.9%
Massachusetts	1.6%	3.1%	2.4%	2.1%	1.9%	1.7%	1.5%	1.4%	1.2%	1.0%	0.8%
Michigan	1.9%	3.5%	2.8%	2.4%	2.2%	1.9%	1.8%	1.6%	1.4%	1.2%	1.0%
Minnesota	1.8%	3.4%	2.7%	2.4%	2.1%	1.9%	1.7%	1.6%	1.4%	1.2%	1.0%
Mississippi	2.3%	4.5%	3.5%	3.0%	2.7%	2.4%	2.1%	1.9%	1.7%	1.4%	1.1%
Missouri	2.1%	4.2%	3.3%	2.8%	2.5%	2.3%	2.0%	1.8%	1.6%	1.4%	1.1%
Montana	2.0%	3.8%	3.0%	2.6%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.1%
Nebraska	2.0%	3.6%	2.9%	2.5%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.0%
Nevada	1.7%	3.1%	2.5%	2.2%	2.0%	1.8%	1.6%	1.5%	1.3%	1.1%	0.9%
New Hampshire	1.5%	2.6%	2.1%	1.9%	1.7%	1.5%	1.4%	1.3%	1.2%	1.0%	0.8%
New Jersey	1.5%	2.9%	2.3%	2.0%	1.8%	1.6%	1.4%	1.3%	1.1%	1.0%	0.8%
New Mexico	2.1%	4.1%	3.2%	2.8%	2.5%	2.2%	2.0%	1.8%	1.6%	1.4%	1.1%
New York	1.5%	3.0%	2.4%	2.0%	1.8%	1.6%	1.5%	1.3%	1.2%	1.0%	0.8%
North Carolina	2.0%	3.8%	3.0%	2.6%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.0%
North Dakota	2.3%	4.4%	3.5%	3.0%	2.7%	2.4%	2.2%	2.0%	1.8%	1.5%	1.2%
Ohio	2.0%	3.9%	3.1%	2.7%	2.4%	2.1%	1.9%	1.7%	1.5%	1.3%	1.0%
Oklahoma	2.1%	4.1%	3.2%	2.8%	2.5%	2.3%	2.0%	1.8%	1.6%	1.4%	1.1%
Oregon	1.4%	2.5%	2.1%	1.8%	1.6%	1.5%	1.4%	1.3%	1.1%	1.0%	0.8%
Pennsylvania	1.8%	3.4%	2.7%	2.3%	2.1%	1.9%	1.7%	1.5%	1.4%	1.2%	0.9%
Rhode Island	1.7%	3.2%	2.5%	2.2%	1.9%	1.8%	1.6%	1.4%	1.3%	1.1%	0.9%
South Carolina	1.8%	3.4%	2.7%	2.4%	2.1%	1.9%	1.8%	1.6%	1.4%	1.2%	1.0%
South Dakota	2.0%	3.6%	2.9%	2.6%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.1%
Tennessee	2.0%	4.0%	3.2%	2.7%	2.4%	2.2%	1.9%	1.7%	1.5%	1.3%	1.0%
Texas	2.1%	4.1%	3.2%	2.8%	2.5%	2.2%	2.0%	1.8%	1.6%	1.3%	1.0%
Utah	2.1%	3.9%	3.1%	2.7%	2.4%	2.2%	2.0%	1.8%	1.6%	1.4%	1.1%
Vermont	1.4%	2.5%	2.0%	1.8%	1.7%	1.5%	1.4%	1.3%	1.1%	1.0%	0.8%
Virginia	1.8%	3.5%	2.8%	2.4%	2.1%	1.9%	1.7%	1.6%	1.4%	1.2%	0.9%
Washington	1.3%	2.3%	1.9%	1.7%	1.5%	1.4%	1.3%	1.2%	1.1%	0.9%	0.8%
West Virginia	2.4%	4.9%	3.8%	3.3%	2.9%	2.6%	2.3%	2.1%	1.8%	1.5%	1.2%
Wisconsin	2.0%	3.6%	2.9%	2.5%	2.3%	2.1%	1.9%	1.7%	1.5%	1.3%	1.1%
Wyoming	2.1%	4.1%	3.2%	2.8%	2.5%	2.3%	2.0%	1.8%	1.6%	1.4%	1.1%

FIGURE 4: IMPACT OF CARBON PRICING ON MEDIAN FAMILY OF FOUR ($/YEAR, AT $25/TON CO_2)



amounts from which the percentages are derived are reported in Appendix Tables A.1 and A.2. The impact on the median household is shown in the first column. The biggest impact is in West Virginia, where the costs from higher fossil fuel prices are equivalent to 2.4% of median income. This is mainly due to the state's relatively low incomes: West Virginia's median carbon charge is only 3% above the national median (see Appendix Table A.2), but its median income is almost 25% below the national level (see Appendix Table A.1). The smallest impacts are felt in Washington and Connecticut, states with relatively high median incomes. The regressive impact of carbon pricing is evident in these inter-state comparisons. Within states, the regressive impact of higher fuel prices is even clearer. In every state, the biggest impact as a percentage of income is in the lowest-income decile, and the least impact is in the highest-income decile. The carbon charge as a fraction of income steadily declines from the bottom to the top of the income profile.

Impact of recycling revenue as dividends

The net impact of cap-and-dividend differs markedly from the impact of higher fossil fuel prices alone. The dividends (here assumed to be 80% of carbon revenues) have a strong progressive impact on family incomes, as they represent a larger fraction of income for the low-income households than for high-income households. This outweighs the regressive impact of higher fossil fuel prices. Table 4 shows the net dollar impact by state and income decile. In every state, the median household (shown in the first column) sees a positive net impact: the amount it receives as dividends exceeds what it pays as a result of higher fossil fuel prices. Figure 5 (page 13) depicts these effects for a family of four at the median income level in each state.

IN EVERY STATE, THE BOTTOM SIX DECILES EXPERIENCE POSITIVE NET BENEFITS.

The largest positive effects, as can be seen in Table 4, are consistently in the lowest-income

TABLE 4: NET IMPACT OF CAP-AND-DIVIDEND BY STATE AND INCOME DECILE ($ PER CAPITA)

State	Median	Decile medians (no s)									
		1	2	3	4	5	6	7	8	9	10
Alabama	99	255	210	176	146	115	81	43	-6	-76	-228
Alaska	89	235	191	160	132	104	74	40	-2	-63	-192
Arizona	127	267	226	197	169	142	112	77	33	-31	-170
Arkansas	110	257	214	183	154	125	94	59	14	-50	-187
California	137	284	242	211	182	153	120	83	35	-36	-194
Colorado	57	223	174	139	106	74	39	-1	-52	-126	-285
Connecticut	84	254	205	169	136	102	65	22	-33	-116	-305
Delaware	43	211	161	125	92	60	25	-15	-65	-137	-290
D.C	42	248	191	148	107	65	18	-37	-108	-216	-469
Florida	116	265	222	191	162	132	100	62	14	-58	-216
Georgia	65	234	185	149	116	83	47	6	-45	-120	-281
Hawaii	82	235	190	157	127	97	65	28	-19	-87	-234
Idaho	141	269	232	204	179	154	127	96	57	1	-117
Illinois	77	242	194	159	126	94	59	19	-31	-105	-264
Indiana	30	202	150	113	80	47	13	-27	-76	-146	-291
Iowa	58	218	169	135	104	74	41	4	-41	-106	-241
Kansas	57	223	173	138	106	74	40	1	-48	-117	-262
Kentucky	68	235	186	150	118	85	50	9	-41	-114	-269
Louisiana	101	256	212	179	148	117	83	45	-4	-75	-226
Maine	128	263	223	194	168	141	113	80	39	-20	-147
Maryland	57	223	174	139	107	74	39	-1	-51	-125	-284
Massachusetts	78	245	196	161	128	96	60	19	-34	-112	-283
Michigan	65	230	181	146	114	82	48	9	-40	-111	-261
Minnesota	49	217	166	130	98	65	31	-9	-58	-128	-277
Mississippi	125	268	227	197	168	140	109	73	28	-38	-178
Missouri	58	226	176	140	108	75	40	0	-50	-121	-273
Montana	114	254	213	183	156	128	99	66	24	-36	-163
Nebraska	76	231	184	151	121	91	60	23	-21	-85	-219
Nevada	95	245	201	169	140	110	79	42	-4	-70	-214
New Hampshire	98	244	200	169	141	113	83	48	5	-58	-191
New Jersey	81	246	198	163	131	99	63	22	-31	-109	-282
New Mexico	112	257	215	184	156	127	96	61	16	-49	-188
New York	136	283	242	211	182	152	118	80	29	-46	-219
North Carolina	83	242	195	161	131	99	66	28	-21	-90	-239
North Dakota	57	219	170	136	104	73	40	3	-43	-109	-245
Ohio	52	221	171	135	102	69	34	-5	-55	-126	-277
Oklahoma	99	251	207	174	145	115	83	46	1	-65	-204
Oregon	149	280	242	214	189	163	135	103	62	2	-127

TABLE 4: NET IMPACT OF CAP-AND-DIVIDEND BY STATE AND INCOME DECILE ($ PER CAPITA), CONTINUED

State	Median	Decile medians (no s)									
		1	2	3	4	5	6	7	8	9	10
Pennsylvania	103	253	209	177	148	118	86	50	4	-64	-210
Rhode Island	112	260	217	185	156	127	95	59	12	-56	-204
South Carolina	122	265	224	193	165	137	107	72	28	-36	-173
South Dakota	111	254	211	181	153	125	96	62	20	-41	-167
Tennessee	90	248	202	168	137	106	73	34	-15	-86	-238
Texas	84	248	201	165	133	101	66	25	-26	-99	-257
Utah	70	220	175	143	114	85	55	20	-23	-84	-210
Vermont	146	274	236	209	184	159	132	101	63	6	-114
Virginia	51	224	173	136	102	68	32	-10	-62	-139	-303
Washington	145	279	240	211	185	159	130	97	55	-7	-142
West Virginia	88	246	200	166	135	104	71	33	-15	-84	-229
Wisconsin	44	208	158	123	91	60	27	-11	-58	-124	-263
Wyoming	59	219	171	137	106	75	42	5	-42	-108	-248
U.S. average	101	256	211	178	148	117	84	46	-3	-74	-229

decile. In every state, the bottom six deciles experience positive net benefits; in 41 states, the bottom seven deciles do so.

Table 5 shows these net impacts as a percentage of income. For the median household (first column), the range is from a net benefit of 0.2% of income in Indiana to 1.1% in Mississippi. In the lowest-income decile, where net benefits are greatest, the range is from 4.2% in Maryland to 10.3% in Mississippi. In the top decile, the net cost ranges from 0.2 to 0.5% of income.

Scanning the variations in Table 5 horizontally across columns (by income decile) and vertically across rows (by state), it is clear that the former exceed the latter by a wide margin. Inter-state differences are modest relative to differences across income groups.[10]

FIGURE 5: CAP-AND-DIVIDEND: NET BENEFIT FOR MEDIAN FAMILY OF FOUR ($/YEAR, AT $25/TON CO_2)

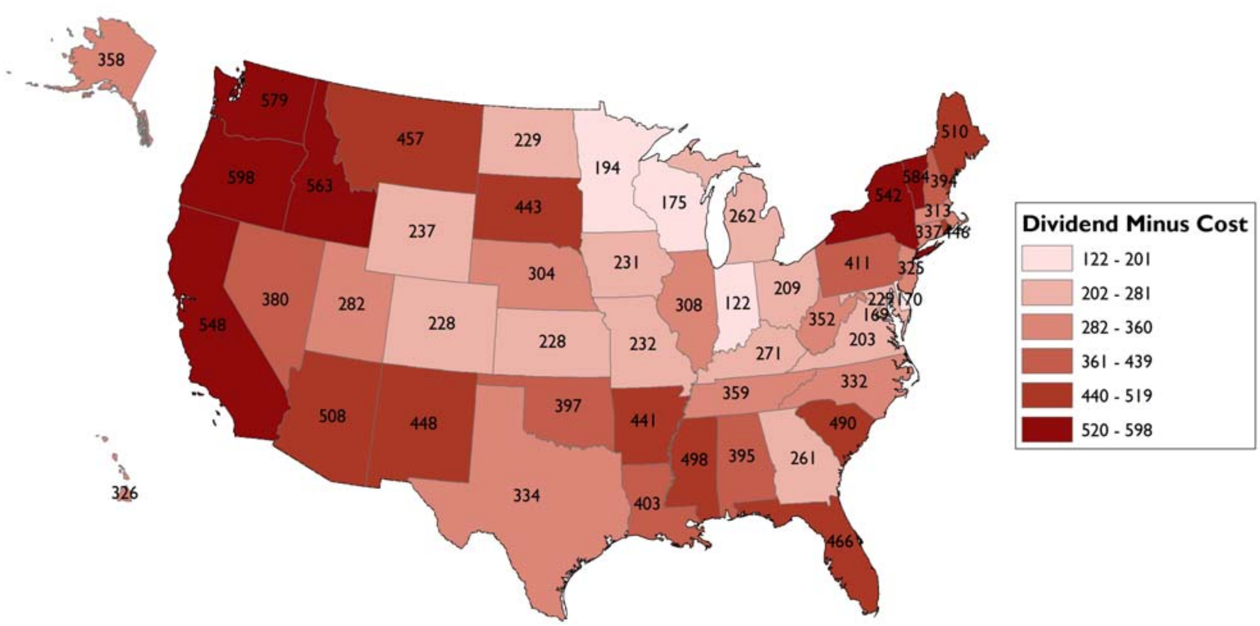


TABLE 5: NET IMPACT OF CAP-AND-DIVIDEND BY STATE AND INCOME DECILE (PERCENTAGE OF MEDIAN INCOME)

State	Median	Decile medians (no s)									
		1	2	3	4	5	6	7	8	9	10
Alabama	0.7%	8.4%	4.0%	2.4%	1.5%	1.0%	0.5%	0.2%	0.0%	-0.2%	-0.4%
Alaska	0.5%	4.3%	2.2%	1.4%	0.9%	0.6%	0.4%	0.2%	0.0%	-0.2%	-0.3%
Arizona	0.8%	6.9%	3.5%	2.2%	1.5%	1.0%	0.6%	0.4%	0.1%	-0.1%	-0.3%
Arkansas	0.9%	8.3%	4.1%	2.6%	1.7%	1.1%	0.7%	0.3%	0.1%	-0.2%	-0.4%
California	0.8%	7.5%	3.7%	2.3%	1.5%	1.0%	0.6%	0.4%	0.1%	-0.1%	-0.3%
Colorado	0.3%	4.6%	2.2%	1.3%	0.8%	0.4%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Connecticut	0.4%	5.3%	2.5%	1.5%	0.9%	0.5%	0.3%	0.1%	-0.1%	-0.2%	-0.3%
Delaware	0.2%	4.3%	2.0%	1.2%	0.7%	0.4%	0.1%	-0.1%	-0.2%	-0.3%	-0.4%
D.C	0.2%	8.0%	3.2%	1.7%	0.9%	0.4%	0.1%	-0.1%	-0.3%	-0.4%	-0.5%
Florida	0.7%	7.2%	3.5%	2.2%	1.4%	0.9%	0.6%	0.3%	0.0%	-0.1%	-0.3%
Georgia	0.4%	6.1%	2.9%	1.7%	1.0%	0.6%	0.3%	0.0%	-0.2%	-0.3%	-0.4%
Hawaii	0.5%	5.3%	2.6%	1.6%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.2%	-0.4%
Idaho	1.0%	7.0%	3.7%	2.5%	1.7%	1.2%	0.8%	0.5%	0.2%	0.0%	-0.2%
Illinois	0.4%	5.7%	2.7%	1.6%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.2%	-0.4%
Indiana	0.2%	4.5%	2.1%	1.2%	0.7%	0.3%	0.1%	-0.1%	-0.3%	-0.4%	-0.5%
Iowa	0.4%	4.9%	2.4%	1.4%	0.9%	0.5%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Kansas	0.4%	5.3%	2.5%	1.5%	0.9%	0.5%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Kentucky	0.5%	7.5%	3.5%	2.0%	1.2%	0.7%	0.3%	0.0%	-0.2%	-0.3%	-0.5%
Louisiana	0.8%	9.5%	4.5%	2.7%	1.7%	1.1%	0.6%	0.3%	0.0%	-0.2%	-0.4%
Maine	0.8%	6.5%	3.4%	2.2%	1.5%	1.0%	0.7%	0.4%	0.1%	-0.1%	-0.3%
Maryland	0.3%	4.2%	2.0%	1.2%	0.7%	0.4%	0.2%	0.0%	-0.1%	-0.3%	-0.4%
Massachusetts	0.4%	5.3%	2.5%	1.5%	0.9%	0.5%	0.3%	0.1%	-0.1%	-0.2%	-0.3%
Michigan	0.4%	5.2%	2.5%	1.5%	0.9%	0.5%	0.2%	0.0%	-0.1%	-0.3%	-0.4%
Minnesota	0.3%	4.3%	2.0%	1.2%	0.7%	0.4%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Mississippi	1.1%	10.3%	5.0%	3.1%	2.1%	1.4%	0.8%	0.4%	0.1%	-0.1%	-0.3%
Missouri	0.4%	5.9%	2.8%	1.6%	1.0%	0.5%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Montana	0.8%	7.2%	3.7%	2.4%	1.6%	1.1%	0.7%	0.4%	0.1%	-0.1%	-0.3%
Nebraska	0.5%	5.4%	2.7%	1.6%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.2%	-0.4%
Nevada	0.6%	5.4%	2.7%	1.7%	1.1%	0.7%	0.4%	0.2%	0.0%	-0.2%	-0.3%
New Hampshire	0.5%	4.5%	2.3%	1.5%	1.0%	0.6%	0.4%	0.2%	0.0%	-0.1%	-0.3%
New Jersey	0.4%	5.0%	2.4%	1.4%	0.9%	0.5%	0.3%	0.1%	-0.1%	-0.2%	-0.3%
New Mexico	0.9%	8.2%	4.1%	2.5%	1.7%	1.1%	0.7%	0.3%	0.1%	-0.2%	-0.3%
New York	0.8%	8.3%	4.0%	2.5%	1.6%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.3%
North Carolina	0.5%	6.3%	3.0%	1.8%	1.2%	0.7%	0.4%	0.1%	-0.1%	-0.2%	-0.4%
North Dakota	0.4%	5.8%	2.8%	1.6%	1.0%	0.6%	0.3%	0.0%	-0.2%	-0.3%	-0.5%
Ohio	0.3%	5.3%	2.5%	1.4%	0.9%	0.5%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Oklahoma	0.7%	7.7%	3.7%	2.3%	1.5%	1.0%	0.6%	0.2%	0.0%	-0.2%	-0.4%
Oregon	0.9%	6.6%	3.5%	2.3%	1.6%	1.1%	0.7%	0.5%	0.2%	0.0%	-0.2%

TABLE 5: NET IMPACT OF CAP-AND-DIVIDEND BY STATE AND INCOME DECILE (PERCENTAGE OF MEDIAN INCOME), CONTINUED

Pennsylvania	0.7%	6.3%	3.1%	2.0%	1.3%	0.8%	0.5%	0.2%	0.0%	-0.2%	-0.3%
Rhode Island	0.7%	6.4%	3.2%	2.0%	1.3%	0.9%	0.5%	0.3%	0.0%	-0.1%	-0.3%
South Carolina	0.9%	7.4%	3.8%	2.4%	1.6%	1.1%	0.7%	0.4%	0.1%	-0.1%	-0.3%
South Dakota	0.8%	6.8%	3.5%	2.2%	1.5%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.3%
Tennessee	0.7%	7.1%	3.4%	2.1%	1.4%	0.9%	0.5%	0.2%	0.0%	-0.2%	-0.4%
Texas	0.6%	7.2%	3.4%	2.1%	1.3%	0.8%	0.4%	0.2%	-0.1%	-0.2%	-0.4%
Utah	0.5%	5.1%	2.6%	1.6%	1.0%	0.7%	0.4%	0.1%	-0.1%	-0.2%	-0.4%
Vermont	0.9%	5.9%	3.2%	2.1%	1.5%	1.0%	0.7%	0.4%	0.2%	0.0%	-0.2%
Virginia	0.3%	4.8%	2.3%	1.3%	0.8%	0.4%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Washington	0.8%	5.8%	3.0%	2.0%	1.4%	1.0%	0.6%	0.4%	0.2%	0.0%	-0.2%
West Virginia	0.8%	8.4%	4.0%	2.5%	1.6%	1.0%	0.6%	0.2%	0.0%	-0.2%	-0.4%
Wisconsin	0.3%	4.2%	2.0%	1.2%	0.7%	0.4%	0.2%	0.0%	-0.2%	-0.3%	-0.4%
Wyoming	0.4%	5.2%	2.5%	1.5%	1.0%	0.6%	0.3%	0.1%	-0.1%	-0.3%	-0.4%
U.S. average	0.6%	6.5%	3.2%	2.0%	1.3%	0.8%	0.5%	0.2%	0.0%	-0.2%	-0.3%

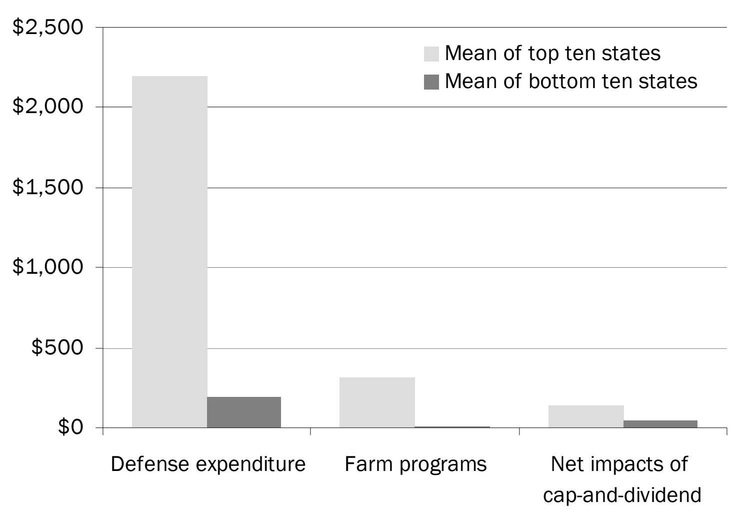
To put these inter-state differences in perspective, we can compare the impact of the cap-and-dividend policy to that of two major items in the federal budget: defense spending and farm programs. Figure 6 depicts per capita spending under these two programs in the top and the bottom ten states, and compares this to the net impact of the cap-and-dividend policy on median households in the top and bottom ten states.[11] In the case of defense spending, the ratio between the top ten and bottom ten states is more than 11:1. In the case of farm programs, it is 190:1. In the case of cap-and-dividend, it is 2.8 :1.

V. NON-DIVIDEND USES OF CARBON REVENUES

A climate policy that incorporates cap-and-dividend is likely to dedicate some fraction of carbon revenues (20% in the preceding analysis) to other uses, while returning the rest to the people as equal dividends. If all the carbon permits are auctioned, then these non-dividend uses are funded by a fraction of the revenue. Alternatively (as in the Waxman-Markey bill), some fraction of the permits may be given away instead of being auctioned; this has an equivalent effect, transferring "allowance value" rather than cash to the recipients.[12]

In this section, we briefly discuss potential non-dividend uses of carbon revenues or allowance value. First, we discuss transitional adjustment assistance to help workers, communities and firms that stand to be affected adversely by the economy's shift away from fossil fuels. Second, we compare the distributional impact of cap-and-dividend to that of H.R. 2454, the American Clean Energy and Security Act passed by the U.S. House of Representatives in June 2009, which proposes a variety of non-dividend uses.

FIGURE 6: TOP TEN AND BOTTOM TEN STATES: DEFENSE EXPENDITURE, FARM PROGRAMS, AND CAP-AND-DIVIDEND POLICY (DOLLARS PER CAPITA)



Transitional adjustment assistance

In addition to its impacts on consumers, a policy to curb carbon emissions will have impacts on businesses and workers.[13] In some sectors – coal mining is an important example – jobs will be lost. In others – for example, building retrofits and the manufacture of clean energy technologies – new jobs will be created.

Since production of renewables and energy efficiency are generally more labor-intensive than production of fossil fuels, job gains are likely to exceed job losses.[14] No automatic economic mechanism ensures, however, that job creation will occur in the same communities and for the same workers who are hit by job losses.

To assist their transition to new livelihoods, a fraction of the carbon revenues initially could be allocated to the states as block grants for adjustment assistance. In the first year of the policy, for example, 10% of permit auction revenues might be dedicated to this purpose, with the percentage gradually phased out over time.

Disbursement of transitional adjustment assistance funds in the form of block grants would allow the states to tailor policies to their own circumstances and priorities. In coal-mining states, for example, funds could be invested in the ecological restoration of landscapes that have been severely degraded by mountaintop removal, strip mining, and disposal of mine tailings and coal ash. In manufacturing-intensive states, funds could be invested in job training and support to "green" industries.

The American Clean Energy and Security Act of 2009

The American Clean Energy and Security Act (ACES) proposes to give away 85% of carbon permits in the initial years of the policy and to auction the remaining 15%. It earmarks the allowance value (free permits and revenues) for a number of different uses. These include free permit allocations to electricity local distribution companies (LDCs), with the expectation that the allowance value will be "passed through" to in-

KEEPING GOVERNMENTS WHOLE

Not only households will be impacted by the higher fossil fuel prices that result from a carbon cap. Government expenditure accounts for about 14% of U.S. carbon emissions. Of this total, 3.6% comes from federal spending and 10.8% from state and local government spending. To keep government whole – to avoid cuts in real government purchasing power – a comparable share of carbon revenues will need to flow to government coffers.

If the dividends paid to the public from carbon revenue are non-taxable, then policymakers will need to allocate a portion of the remaining carbon revenue to this purpose. If they are taxable, we estimate that roughly 24 cents on the dividend dollar will flow back to government in the form of federal and state taxes (Boyce and Riddle 2008). With 80% of the total revenue distributed as dividends, this means that taxes would recycle 19% of total carbon revenue to government, enough to offset fully the impact of higher fossil fuel prices on government purchasing power, with about 5% of total carbon revenues left over for other purposes.

Taxable dividends are preferable to lower, non-taxable dividends from the standpoint of distributional equity. Taxation claims a bigger share of the dividends in upper-income brackets than it does from lower-income and middle-income households. Directly tapping the carbon revenue to obtain the same amount of money, by contrast, reduces dividend payments equally to all, a result equivalent to a head tax, one of the most regressive forms of taxation.

Whatever approach is used to keep government whole, some formula will be necessary to allocate carbon revenues amongst state and local governments. One way to do this, which would be consistent with the principles of cap-and-dividend, is to divide revenue among state and local governments in proportion to their populations, with equal per capita amounts to each jurisdiction. As in the case of dividends paid to individuals, this distribution would protect the governments' purchasing power while giving them incentives to invest in energy efficiency and clean energy.

dustrial, commercial and residential electricity customers; direct payments from auction revenues to low-income households; and allocations to oil refineries and to energy-intensive "trade vulnerable" industries.

The stated rationale for free allocations to LDCs is that this will protect consumers from the impact of higher electricity prices. Insofar as the value of allowances is passed through to consumers, rather than being captured by LDCs as higher profits, this is likely to mask the price signal to economize on electricity use.[15] If so, the burden of adjustment imposed by the carbon cap will fall more heavily on other sectors of the economy, including transportation fuels, pushing up prices in those sectors even more and raising costs to consumers overall.[16]

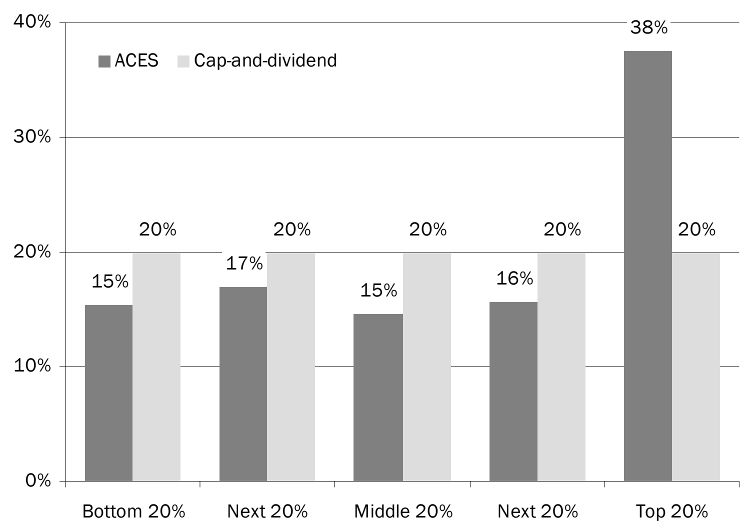
Starting in the 2020s, an increasing share of the permits would be auctioned and the revenues deposited in a "Climate Change Consumer Refund Account" for return to the public on an equal per capita basis. In this sense, ACES can be described as a cap-and-dividend policy with a very slow fuse.

A June 2009 analysis of the distributional impacts of the cap-and-trade provisions of ACES by the Congressional Budget Office (CBO) concludes that 79% of the allowance value would eventually find its way back to American households. However, it would not flow to all households in equal measure. For example, the CBO reckons (page 12) that "about 63 percent of the allowance value conveyed to businesses would ultimately flow to households in the highest income quintile," as a result of higher profits paid out in proportion to corporate stock holdings.

Combining the routes (in some cases rather circuitous ones) by which auction revenues and the allowance value of free permits return to households, the CBO estimates that in the year 2020 nearly two-fifths of the total (37.5%) would go to the top quintile of households in the nation's income distribution. The middle quintile would receive the smallest share (14.6%), with the remaining quintiles getting 15.4-16.9% each.[17]

In Figure 7, this outcome is contrasted with cap-and-dividend, in which each quintile receives an amount equal to its share of the population: 20%.

FIGURE 7: DISTRIBUTION OF CARBON REVENUES TO HOUSEHOLDS: ACES V. CAP-AND-DIVIDEND (PERCENTAGE SHARE)



Visibility of costs and benefits

Leaving aside their distributional effects, a drawback of non-dividend uses of carbon revenues (and free permit allocations) is that their impact on households is less transparent than the cash-in-hand provided by dividends. From the standpoint of public support for the climate policy over the 40-year energy transition, what matters is not only the difference between costs from higher fuel prices and benefits from permit and revenue allocations, but also the *visibility* of these costs and benefits.

On the cost side of the scales, visibility is high indeed. Gasoline prices, for example, are perhaps the single most widely known price in America: 165,000 filling stations across the country announce them in foot-high numbers. Most consumers also are fairly well aware of the size of the numbers on the monthly checks they write to their electricity companies.

On the benefit side, visibility varies greatly amongst policy options. Most of the avenues by which ACES would transfer money to households score low on visibility. Tax credits (although less visible than cash) to low-income households are perhaps the most readily visible avenue. Rebates from electricity local distribution companies (LDCs) may be gleaned from the fine print on monthly utility bills. Paybacks via higher returns to stock ownership (including stocks held in pension plans) will be difficult, if not impossible, to distinguish from the many other economic factors that affect investment returns.

Apart from its simplicity and fairness, an attraction of cap-and-dividend is that the return of carbon revenue to the American people is highly visible: it comes back as cash in their wallets. Cap-and-dividend clearly sends the carbon price signal, while at the same time maximizing public awareness that families can come out ahead no matter how high carbon prices rise. The policy's underlying premise – that we are all equal co-owners of our nation's share of the carbon storage capacity of the atmosphere – is likely to have wider public appeal than the premise that the air belongs to polluting corporations.

The transition to a post-carbon economy cannot happen overnight. It will require decades of sustained policy, including steadily rising carbon prices, to drive it forward. Durable public backing for rising carbon prices is therefore essential. The fact that dividends are highly visible, together with the fact that a majority of American families come out ahead no matter what the carbon price, can provide the political foundation for long-term support for the policy.

This public support will make it possible to tighten the carbon cap and further raise fossil fuel prices to higher levels, bringing billions of dollars in private investment in clean energy and energy efficiency. In this sense, returning carbon revenue directly to the public not only protects family incomes but also is a highly leveraged use of carbon revenue.

VI. CONCLUSIONS

Cap-and-dividend is a policy to manage a scarce resource: our planet's carbon-absorptive capacity. A consequence of any policy to limit use of a resource – to manage scarcity – is the creation of property rights. A cap-and-permit system will raise the prices of fossil fuels and all other goods and services that use these fuels in their production and distribution. Each consumer's carbon footprint will now come with a price. The money that is paid by consumers does not disappear from the nation's economy: it is transferred to owners of the newly created property.

CAP-AND-DIVIDEND CLEARLY SENDS THE CARBON PRICE SIGNAL, WHILE AT THE SAME TIME MAXIMIZING PUBLIC AWARENESS THAT FAMILIES CAN COME OUT AHEAD NO MATTER HOW HIGH CARBON PRICES RISE.

The premise of cap-and-dividend is that this property should belong equally and in common to all. By auctioning permits – rather than giving them free-of-charge to corporations or other politically favored entities – and by returning most of the auction revenue to the public, cap-and-dividend combines price incentives to reduce carbon emissions with protection for consumers from the impact of higher fuel prices on their real incomes. The majority of families come out ahead, receiving dividends that more than offset the price increases. In this paper we have shown that this positive outcome holds not only at the national level but also within each of the 50 states.

The differences across states in the household impacts of cap-and-dividend are small compared to differences across income brackets, and also compared to inter-state differences in defense spending and federal farm programs. Because dividends are distributed equally, variations in the net impact of cap-and-dividend arise solely from differences in carbon foot prints. Households who consume more fossil fuels (and more of the things made and distributed using them) will pay more; those who consume less will pay less. Residents of states that have moved more aggressively to promote energy efficiency, such as California, will do better than average. But the differences in carbon footprints between the top 10% and bottom 10% of the income distribution are far greater than the differences between median households across the states.

Whereas cap-and-dividend returns carbon revenue equally to each person, the American Clean Energy and Security (ACES) Act would allocate revenues and free permits in a variety of ways that would impact different households differently. The Congressional Budget Office (2009) estimates that roughly two-fifths of the resulting income would flow to households in the top 20% of the nation's income distribution – an outcome that would disproportionately benefit upper-income states as well as upper-income individuals.

Perhaps even more politically salient than net distributional effects is the visibility of transfers of carbon revenue (or allowance value) to the public. Dividends in the form of checks in the mail or deposits into bank accounts will provide highly tangible benefits to consumers, against which they can weigh the impacts of higher prices. The transfers in the ACES policy mix, such as rebates in electricity bills and capital gains for corporate shareholders, would be less apparent.

For reasons of both economic fairness and transparency, therefore, cap-and-dividend offers a way to secure durable public support for an effective policy to wean the economy from dependence on fossil fuels. A proactive U.S. policy, in turn, will be a crucial condition for an effective international agreement to confront the global challenge of climate change.

METHODOLOGICAL APPENDIX

Our state-level estimates of the distributional incidence of higher fossil fuel prices on households are based on a carbon charge (i.e., permit price) of $25/ton CO_2 ($92/ton C).[18] We include both direct effects via household energy consumption (i.e., via increases in the prices of heating oil, gasoline, natural gas, and electricity) and indirect effects via impacts on the prices of other goods and services (e.g., food and manufactured goods) that use fossil fuels in their production and distribution.[19]

Following the usual practice, we assume that 100% of the permit cost is passed through to the final consumer. If coal is mined in West Virginia, and used to produce steel in Ohio, that is used to manufacture an automobile in Michigan, that is sold to a consumer in Connecticut, it is the Connecticut consumer who pays the associated carbon charge.

To estimate impacts at the state level, we adjust national-level estimates to account for three variables:

1. interstate differences in income;
2. interstate differences in the carbon intensity of electricity consumed by households; and
3. regional differences in consumption patterns, arising from differences in energy use for heating and cooling, driving behavior, etc.

The first adjustment – for interstate differences in income – is based on data from the 2000 U.S. Census that allow us to measure income inequality within states and to construct state-specific per capita income deciles. For comparability with our expenditure data, we convert these to 2003 figures by adjusting for nominal income growth.

The second adjustment – for interstate differences in the carbon intensity of electricity consumption – is based on the carbon intensity of electricity generated in each state, with adjustments to account for imports of electricity across state lines within interconnected power grids.

The third adjustment - for regional differences in consumption patterns – is based on the region-specific Consumer Expenditure Survey (CEX) measures reported by Burtraw *et al.* (2009) for household consumption of electricity, gasoline, natural gas and heating oil for 11 regions (4 of which are single states: CA, TX, FL, and NY). Regional consumption patterns, adjusted for intra-regional income differences, are used because the CEX sample size does not allow state-level disaggregation.

TABLE A.1: INCOME BY STATE AND DECILE (ANNUAL MEDIAN INCOME PER CAPITA)

State	State mean	State median	Decile medians									
			1	2	3	4	5	6	7	8	9	10
Alabama	19933	13308	3033	5242	7257	9412	11886	14899	18816	24402	33786	58381
Alaska	24833	18806	5516	8682	11373	14109	17124	20653	25065	31097	40732	64117
Arizona	22220	15544	3870	6472	8789	11222	13977	17286	21529	27491	37331	62436
Arkansas	18525	12772	3092	5225	7139	9161	11461	14234	17807	22850	31221	52761
California	24889	16616	3788	6545	9062	11752	14841	18603	23494	30469	42186	72895
Colorado	26356	18829	4887	8048	10830	13728	16986	20873	25827	32738	44052	72553
Connecticut	31525	20964	4745	8220	11399	14802	18714	23484	29692	38554	53464	92628
Delaware	25540	18527	4959	8075	10792	13606	16753	20490	25229	31807	42508	69214
D.C	31408	17795	3082	5895	8671	11801	15564	20346	26833	36521	53716	102747
Florida	23624	15925	3695	6343	8748	11310	14243	17805	22423	28989	39980	68631
Georgia	23183	15895	3808	6460	8847	11373	14251	17729	22215	28560	39113	66357
Hawaii	23589	16969	4465	7316	9815	12411	15323	18791	23200	29337	39356	64489
Idaho	19552	14231	3835	6229	8312	10467	12874	15730	19347	24362	32510	52800
Illinois	25320	17521	4271	7200	9822	12588	15730	19516	24387	31256	42640	71871
Indiana	22353	16350	4452	7203	9591	12055	14803	18058	22175	27873	37111	60046
Iowa	21561	15925	4426	7107	9420	11798	14441	17561	21495	26922	35684	57303
Kansas	22473	16138	4232	6943	9321	11794	14569	17876	22082	27940	37510	61543
Kentucky	19828	13417	3135	5368	7392	9545	12007	14993	18861	24353	33534	57414
Louisiana	18534	12179	2698	4711	6564	8556	10855	13666	17337	22597	31485	54984
Maine	21406	15398	4052	6639	8907	11263	13905	17052	21053	26622	35714	58521

TABLE A.1: INCOME BY STATE AND DECILE (ANNUAL MEDIAN INCOME PER CAPITA), CONTINUED

State	State mean	State median	Decile medians									
			1	2	3	4	5	6	7	8	9	10
Maryland	28071	20192	5313	8706	11679	14769	18234	22361	27607	34910	46832	76739
Massachusetts	28441	19428	4621	7860	10781	13878	17409	21681	27197	35008	48018	81678
Michigan	24294	17297	4458	7361	9920	12590	15595	19185	23763	30159	40643	67109
Minnesota	25423	18534	5012	8130	10841	13644	16772	20481	25178	31685	42250	68533
Mississippi	17373	11531	2600	4511	6261	8134	10290	12920	16345	21237	29473	51130
Missouri	21848	15311	3825	6389	8670	11064	13772	17023	21189	27041	36692	61288
Montana	18796	13475	3521	5785	7772	9840	12162	14929	18452	23362	31388	51563
Nebraska	21494	15722	4281	6926	9222	11592	14234	17364	21323	26802	35685	57738
Nevada	24098	17276	4515	7416	9964	12616	15592	19141	23657	29952	40242	66108
New Hampshire	26131	19423	5471	8742	11553	14436	17632	21397	26135	32655	43154	68952
New Jersey	29596	20330	4887	8280	11331	14558	18232	22669	28390	36476	49915	84573
New Mexico	18916	12994	3124	5292	7242	9305	11653	14489	18146	23314	31904	54055
New York	25632	16298	3407	6078	8578	11295	14461	18368	23517	30967	43700	77972
North Carolina	22255	15512	3835	6431	8746	11182	13942	17260	21521	27514	37420	62747
North Dakota	19473	14126	3781	6157	8228	10374	12773	15623	19236	24251	32411	52772
Ohio	23017	16360	4202	6947	9369	11898	14746	18150	22493	28565	38524	63692
Oklahoma	19338	13407	3280	5521	7526	9640	12039	14929	18645	23881	32554	54801
Oregon	22948	16395	4255	7008	9430	11953	14790	18175	22488	28506	38357	63173
Pennsylvania	22883	15950	3943	6612	8993	11497	14335	17747	22128	28290	38475	64517
Rhode Island	23768	16417	3988	6731	9190	11785	14735	18291	22869	29328	40042	67580
South Carolina	20598	14305	3512	5904	8042	10295	12850	15926	19879	25446	34661	58271
South Dakota	19246	13845	3643	5969	8008	10126	12502	15331	18928	23936	32110	52616
Tennessee	21253	14463	3416	5826	8003	10314	12953	16149	20281	26138	35907	61237
Texas	21498	14492	3363	5772	7961	10292	12962	16203	20406	26381	36382	62455
Utah	19929	14907	4256	6767	8916	11114	13546	16405	19995	24924	32839	52209
Vermont	22603	16560	4524	7311	9727	12220	14997	18285	22442	28192	37507	60610
Virginia	26274	18413	4600	7684	10426	13305	16562	20471	25482	32519	44125	73705
Washington	25176	18049	4717	7748	10410	13180	16290	19997	24716	31292	42042	69067
West Virginia	18057	12219	2855	4889	6732	8692	10934	13654	17176	22178	30539	52286
Wisconsin	23311	17355	4905	7828	10337	12908	15758	19114	23333	29137	38476	61401
Wyoming	20969	15237	4093	6655	8888	11198	13781	16846	20731	26121	34883	56727
U.S. average	23657	16160	3844	6538	8968	11544	14481	18034	22623	29120	39942	67940

We implemented these adjustments by the following steps:

1. Estimate median income by decile in each state: We obtain state-level data on mean income and the Gini index of income distribution from the US census.[20] From these data, we estimate median incomes for each decile by assuming that income distribution has a log-normal distribution – the distribution most commonly assumed in the literature (Kemp-Benedict, 2001). The means and Ginis provide sufficient information to determine a unique log-normal distribution. We take estimated incomes at the 5th, 15th, 25th, etc. percentiles of this distribution as the medians for each decile. The results are shown in Table A.1.

2. Calculate national expenditure on consumption of five categories of goods: electricity, gasoline, natural gas, fuel

oil and other: We use national consumption data from the 2003 Consumer Expenditure Survey to calculate the carbon charge for each household, using the methodology described in Boyce and Riddle (2007), with two further adjustments: (i) we include home ownership expenses as expenditures; and (ii) we use corrected survey weights (which affects the magnitude of expenditure but has little effect on its distribution).

3. Adjust expenditures in response to price increases and dividends: We adjust consumption expenditures to respond to the new price structure, using short-run price elasticities drawn from the literature (see Boyce and Riddle 2007), and to the increase in income in response to dividend payments.

4. Estimate relationship between category-specific expenditure and total expenditure: We use a log-quadratic functional form to estimate the relationship between each category of expenditure and total expenditure for each household.[21]

5. Calculate predicted expenditures in each of five categories for each state and income decile: Incomes (from the Census) do not match perfectly with CEX expenditure data. There are several reasons for this: (i) expenditure differs from income due to saving (or borrowing); (ii) household expenditure does not include tax payments, whereas Census income is pre-tax; and (iii) the CEX data on expenditure may be subject to under-reporting. To apply the relationship between carbon charges and expenditures estimated from the CEX, we must first match the appropriate expenditure level to the census income level for median households in each decile. To do this, we calculate means and Gini indexes for the expenditures from the CEX data, and find the transformation that converts the national Census data on income into a log-normal distribution with mean and Gini that matches the CEX data. We apply this transformation to the decile median income for each state to obtain median total expenditures for each decile in each state. We then apply the relationships from step (4) to estimate the category-specific expenditures for each state.

6. Adjust for regional differences in consumption patterns: We begin with the data presented in Appendices A-D of Burtraw *et al.* (2009) which report region-wise data on household electricity, gasoline, natural gas, and fuel oil consumption in physical units (kWh, gallons, cubic feet) per household. The ratios of regional to national averages from these data are then applied to our national estimates of expenditure in dollars from step (3). These regional expenditure levels on the four fuels are then compared to predicted regional expenditures based on weighted averages of the results by state from step (5). This ratio gives an adjustment factor for each region, which is then applied to all states in the region.[22] Expenditures on other goods are adjusted to make the total expenditure on all five categories for each region remain the same as it was before the regional adjustments.

7. Find carbon intensity of electricity generation by state: Carbon intensities of electricity consumption for each state were calculated by Jesse Jenkins of the Breakthrough Institute. These are based on the USEPA's e-Grid data for the year 2005, combining data on the carbon intensity of electricity generated in each state with adjustments to account for imports of electricity across state lines within interconnected power grids.[23]

8. Apply carbon loading factors to expenditures on each of the five expenditure categories: The loading factors for each fuel, in units of carbon per dollar, are calculated using Input-Output (IO) accounts. We use the 2003 IO tables,[24] with adjustments using the 2002 benchmark IO tables which provided more detailed breakdowns.[25] We assign carbon emissions from coal, oil, and natural gas using emissions data from the U.S. Energy Information Administration (EIA).[26] Using a methodology similar to that described in Metcalf (1999), we trace this carbon through the economy to determine the final carbon content of each commodity category from the IO accounts, including indirect uses. To assign these loading factors to the CEX expenditure categories, we first convert the commodity categories from the IO accounts into Personal Consumption Expenditure (PCE) categories using bridge tables produced by U.S. Bureau of Economic Analysis,[27] and then from PCE categories into CEX categories using the documentation for the National Bureau of Economic Research (NBER) CEX family-level extracts.[28] In the case of electricity, the loading factor is adjusted in each state in proportion to the carbon intensity of electricity generation from step (7). In the case of the "other goods" category of expenditure, the loading factor is derived from the loading factors of the different goods and services that make up this category, which can vary across deciles. We therefore estimate the relationship between this loading factor and total expenditure, and use this to construct loading factors for each decile in each state.[29] Finally, the loading factor for each expenditure category is multiplied by the corresponding expenditures to obtain the carbon footprint.

9. Adjust for consistency with National Accounts data: The carbon content for all categories of expenditure is scaled by a constant factor so that the total carbon content of household consumption is correct in proportion to total U.S. carbon emissions (see Boyce and Riddle 2008).

10. Calculate increased spending on each category of goods: A permit price of $25 per ton CO_2 is multiplied by the carbon content of each expenditure category from step (9) to obtain the impact of carbon pricing on expenditure in each category. The total increase in expenditure is the sum of the increases for each category. The results are shown in Table A.2.

TABLE A.2: CARBON PRICE IMPACT BY STATE AND INCOME DECILE ($ PER CAPITA)

State	State mean	State median	Decile medians (no s)									
			1	2	3	4	5	6	7	8	9	10
Alabama	319	287	131	176	210	240	271	305	343	392	462	614
Alaska	321	297	151	195	226	254	282	312	346	388	449	578
Arizona	288	259	119	160	189	217	244	274	309	353	417	556
Arkansas	304	276	129	172	203	232	261	292	327	372	436	573
California	283	249	102	144	175	204	233	266	303	351	422	580
Colorado	361	329	163	212	247	280	312	347	387	438	512	671
Connecticut	341	302	132	181	217	250	284	321	364	419	502	691
Delaware	373	343	175	225	261	294	326	361	401	451	523	676
D.C	399	344	138	195	238	279	321	368	423	494	602	855
Florida	303	270	121	164	195	224	254	286	324	372	444	602
Georgia	353	321	152	201	237	270	303	339	380	431	506	667
Hawaii	334	304	151	196	229	259	289	321	358	405	473	620
Idaho	269	245	117	154	182	207	232	259	290	329	385	503
Illinois	341	309	144	192	227	260	292	327	367	417	491	650
Indiana	383	356	184	236	273	306	339	373	413	462	532	677
Iowa	354	328	168	217	251	282	312	345	382	427	492	627
Kansas	357	329	163	213	248	280	312	346	385	434	503	649
Kentucky	350	318	151	200	236	268	301	336	377	427	500	655
Louisiana	317	285	130	174	207	238	269	303	341	390	461	612
Maine	284	258	123	163	192	218	245	273	306	347	406	533
Maryland	360	329	163	212	247	280	312	347	387	437	511	670
Massachusetts	343	308	141	190	225	258	290	326	367	420	498	669
Michigan	350	321	156	205	240	272	304	338	377	426	497	647
Minnesota	366	337	169	220	256	288	321	355	395	444	514	663
Mississippi	291	261	118	159	189	218	246	277	313	358	424	564
Missouri	358	328	160	210	246	278	311	346	386	436	507	659
Montana	297	272	132	173	203	230	258	287	320	362	422	549
Nebraska	336	310	155	202	235	265	295	326	363	407	471	605
Nevada	320	291	141	185	217	246	276	307	344	390	456	600
New	314	288	142	186	217	245	273	303	338	381	444	578
New Jersey	340	305	140	188	223	255	287	323	364	417	495	668
New Mexico	303	274	129	171	202	230	259	290	325	370	435	574
New York	288	250	103	144	175	204	234	268	306	357	432	605
North Carolina	333	303	144	191	225	256	287	320	358	407	476	625
North Dakota	355	329	167	216	250	282	313	346	383	429	495	631
Ohio	363	334	165	215	251	284	317	352	391	441	513	663
Oklahoma	315	287	135	179	212	241	271	303	340	385	451	590
Oregon	263	237	106	144	172	197	223	251	283	324	384	513
Pennsylvania	313	283	134	177	209	238	268	300	336	382	450	596

TABLE A.2: CARBON PRICE IMPACT BY STATE AND INCOME DECILE ($ PER CAPITA), CONTINUED

State	State mean	State median	Decile medians (no s)									
			1	2	3	4	5	6	7	8	9	10
Rhode Island	305	275	126	169	201	230	259	291	327	374	442	590
South Carolina	292	264	121	162	193	221	249	279	314	358	422	559
South Dakota	300	275	132	175	205	233	261	290	324	366	427	553
Tennessee	327	296	138	184	218	249	280	313	352	401	472	624
Texas	335	302	138	185	221	253	285	320	361	412	485	643
Utah	339	316	166	211	243	272	301	331	366	409	470	596
Vermont	264	240	112	150	177	202	227	254	285	323	380	500
Virginia	368	335	162	213	250	284	318	354	396	448	525	689
Washington	269	241	108	146	175	201	227	256	289	331	393	528
West Virginia	328	298	140	186	220	251	282	315	353	401	470	615
Wisconsin	368	342	178	228	263	295	326	359	397	444	510	649
Wyoming	354	327	167	215	249	280	311	344	381	428	494	634
U.S. average	317	285	130	175	208	238	269	302	340	389	460	615

NOTES

[1] In addition to carbon pricing, the climate policy package may include regulatory standards and public investment in energy efficiency and renewable energy (Boyce 2009a).

[2] The extent to which offsets reduce atmospheric carbon is often difficult to ascertain. It is hard to say, for example, whether a forest would have been replanted (or cut down) in the absence of an offset deal, or whether a coal-burning power plant in Asia would have been built to different energy-efficiency specifications. Concerns about "additionality" have already surfaced in the voluntary offset market; see, for example, Elgin (2007).

[3] A tax-and-dividend policy is advocated, for example, by James Hansen (2009).

[4] For discussion, see Boyce (2009b). On concerns about the potential for speculative bubbles in carbon derivatives markets, see Chan (2009).

[5] Office of Management and Budget (2009) "Summary Table S-2: Effect of Budget Proposals on Projected Deficits." The budget put the amounts over the decade at $525.7 billion and $120 billion, respectively.

[6] Details of our methods are given in the Appendix.

[7] The ratio between the carbon charges to the highest and lowest deciles is somewhat lower than the ratio of the carbon footprints shown in Figure 2, because the figures in Table 1 incorporate changes in demand due to higher fossil fuel prices (with demand for necessities being less price-elastic than demand for luxuries) and after receipt of the dividend.

[8] For details on the data sources used to calculate these shares, see Boyce and Riddle (2008).

[9] We assume in our calculations that the price elasticity of demand is constant across income deciles. There is some evidence, however, that demand elasticity is greater in the lower-income deciles, in which case the progressivity of the cap and dividend policy would be somewhat stronger than shown in these results. For discussion on this point, see Boyce and Riddle (2007, p. 13).

[10] For this reason, low-income states tend to fare somewhat better under the cap-and-dividend policy than high-income states. In West Virginia, for example, the effect of lower-than-average income outweighs the effect of the state's more carbon-intensive electricity supply: the median household sees a net benefit equivalent to 0.7% of its income, above the national median of 0.6%.

[11] The data for these calculations on military expenditure are from www.statemaster.com/graph/mil_def_con_exp_percap-defense-contracts-expenditures-per-capita. The data on farm programs are from the Environmental Working Group's database, farm.ewg.org/farm/progdetail.php?fips=00000&yr=2006&progcode=total&page=states. We are grateful to Elizabeth Stanton *et al.* (2009) for suggesting these comparisons.

[12] Apart from being less transparent, a drawback of free allocations is that they make permit trading a necessary element of the policy, since those who get the free permits are not identical to those who need them.

[13] A carbon pricing policy will also have impacts on the purchasing power of local, state, and federal governments. For discussion, see the sidebar on page 16.

[14] For discussion of these employment effects, see Pollin *et al.* (2008).

[15] Provisions to separate allowance-value rebates from kilowatt hour-based charges in electricity bills, so as to maintain incentives for electricity use reduction at the margin, will dampen this effect only insofar as consumers read and are able to make sense of the fine print in their monthly bills.

[16] For discussion of these and other problems associated with provision of free allowances to LDCs, see Sweeney *et al.* (2009) and Stone and Shaw (2009).

[17] Calculated from Table 2 in CBO (2009, p. 16). The CBO's results hinge, among other things, on the possibly optimistic assumption that the state public utility commissions will ensure that the full value of free allocations to LDCs is passed to their customers. If not, the distributional impact of ACES could be more inequitable.

[18] The assumed carbon price affects the magnitude of the dollar amounts reported, but not the distributional pattern. The incidence of higher (or lower) carbon prices can be calculated simply by multiplying our numbers by the ratio of the assumed price to ours. For example, a more ambitious target resulting in a permit price of $50/ton CO_2 would double the dollar values we report.

[19] For details, see Boyce & Riddle (2007) where we report estimates by expenditure decile at the national level.

[20] These census data are available at: www.census.gov/hhes/www/income/histinc/state/statetoc.html.

[21] We obtain the following estimates:

ln(electricity expenditure) = 0.774 + 0.670*ln(expenditure) - 0.013*ln(expenditure-squared).

ln(gasoline expenditure) = -13.329 + 3.593*ln(expenditure) - 0.161*ln(expenditure-squared).

ln(natural gas expenditure) = -6.587 + 2.078*ln(expenditure) - 0.088*ln(expenditure-squared).

ln(fuel oil expenditure) = -4.470 + 1.454*ln(expenditure) - 0.058*ln(expenditure-squared).

ln(other goods expenditure) = 1.392 + 0.655*ln(expenditure) + 0.020*ln(expenditure-squared).

[22] We assigned the seven states that are not in any of the regions in Burtraw *et al.* (2009) as follows: Northeast for Vermont, Northwest for Wyoming and Alaska, Mountains for New Mexico, Plains for Iowa and North Dakota, and Florida for Hawaii.

[23] Stanton *et al.* (2009) report a similar state-level measure of the carbon intensity of electricity, using the national average instead of regional power grids to estimate the carbon content of electricity imported across state lines. The correlation between their state measure and ours is 0.98.

[24] US Bureau of Economic Analysis, "1998-2007 Supplementary Make and Use Tables after redefinitions at the summary level," available at www.bea.gov/industry/io_ annual.htm.

[25] US Bureau of Economic Analysis, "2002 Standard Make and Use Tables at the Summary Level," available at www.bea.gov/industry/io_benchmark.htm.

[26] EIA, "International Energy Annual 2006", available at www.eia.doe.gov/iea/carbon.html. Additional data on the small amount of crude oil that does not go to refineries are taken from: EIA, "Petroleum Navigator, US Crude Oil Supply and Deposition" (available at tonto.eia.doe.gov/dnav/pet/pet_sum_crdsnd_adc_mbbl_a.htm), and EIA, "Petroleum Navigator; Refining & Processing; Weekly Inputs, Utilization & Production" (available at tonto.eia.doe.gov/dnav/pet/pet_pnp_wiup_dcu_nus_w.htm).

[27] US Bureau of Economic Analysis, "PCEBridge_2002-2007," available at www.bea.gov/industry/more.htm.

[28] NBER, Documentation for "Consumer Expenditure Survey Family Level Extracts," available at www.nber.org/data/ces_cbo.html.

[29] We again use a log-quadratic function, and obtain the following estimate:

ln(carbon intensity of other goods expenditure) = -6.711 - 0.534*ln(expenditure) + 0.029*ln(expenditure-squared).

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