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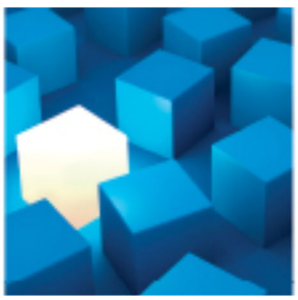
Economic Impacts of the Climate Leadership Council's Carbon Dividends Plan Compared to Regulations Achieving Equivalent Emissions Reductions
Volume I: *Analysis Insights for Policymakers*



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SYNOPSIS

This report compares the relative economic impacts of two different approaches for attaining an equivalent amount of economy-wide CO_2 emissions reduction in the U.S. from 2021 through 2036. They are: (1) application of a uniform carbon fee, and (2) a set of "regulatory" policies that promote carbon-reducing actions on a sector-specific basis without a unifying price signal. The first scenario is based on a legislative proposal by the Climate Leadership Council (CLC) known as the Carbon Dividends Plan (CDP). The second scenario reflects a set of non-pricing regulations typically proposed as alternatives to carbon pricing, which we refer to as the "Regulatory scenario." The economic impacts of each scenario have been projected using NERA's well-known macroeconomic model of the whole U.S. economy, which contains substantial detail on key available and projected future energy technologies.

Because both scenarios attain equivalent CO_2 emissions reductions, their economic impacts can be compared to each other to assess their relative cost-effectiveness. In brief, our analysis finds a very wide gap in cost-effectiveness between the Regulatory and CDP scenarios and we can trace it to specific forms of inflexibility that arise when taking a regulatory approach. More specifically:

- The CDP scenario promises to be far less costly than the Regulatory scenario, whether assessed in terms of gross domestic product (GDP) or consumer-focused metrics such as consumption per household. The gap in economic costs is projected to widen over time as both policies achieve deeper emissions cuts. For example, by 2036:
    - the CDP scenario is projected to have about $420 billion higher annual GDP than the Regulatory scenario, and
    - the CDP scenario is projected to result in about $1,260 more annual consumption per household than the Regulatory scenario.
- The feasibility of applying border carbon adjustments under the CDP scenario further improves its relative cost-effectiveness.
- The CDP scenario also provides more flexibility to mitigate any potentially undesirable distributional impacts on households that could result from the policy. The aggregate easing of impacts due to returning those revenues to households is reflected in the CDP's higher estimated annual consumption per household over the entire period 2021-2036.

The greater cost-effectiveness of a uniform emissions price signal over a patchwork of sector-specific regulatory measures is not a surprising result for policy analysts. This particular study, however, is able to illustrate why this result is reasonable to expect via multiple, specific examples of how the Regulatory scenario's lack of a consistent carbon price signal distorts incentives for selecting the most cost-effective reduction actions from an economy-wide perspective.

BACKGROUND

In 2017, the CLC introduced its proposal for a national, economy-wide Carbon Dividends Plan (CDP) to apply a uniform fee on all U.S. carbon emissions to motivate efficient reductions in U.S. greenhouse gas (GHG) emissions while returning all of the net revenue to American households. The CLC describes its plan as having four key attributes, or "pillars," the dividends being only one. The four pillars that CLC uses to summarize its carbon policy proposal are:[1]

1. *A gradually rising carbon price*: starting at $40 per metric ton of CO_2 (2017$) and increasing at 5% per year above inflation. An "Emissions Assurance Mechanism" is also proposed that would temporarily increase the rate faster if emissions reduction benchmarks are not achieved.

2. *Carbon dividends of all net proceeds*: to be distributed to all Americans on an equal, per-capita basis each quarter.

3. *Regulatory simplification*: preemption of future federal stationary source carbon regulations.

4. *Border carbon adjustments*: a fee applied to imported goods based on the carbon intensity of production in their countries of origin and a rebate to U.S.-produced goods if they are to be exported to other countries without equivalent carbon constraints.

The concept of pricing carbon to reduce U.S. emissions has been gaining interest in federal policy circles in recent years. There are many variants in the proposed designs of such market-based policies, some of which cause them to differ from the four pillars emphasized by the CLC for its CDP. However, there are also many GHG-reduction proposals that steer clear of carbon-pricing approaches. Such non-market approaches are inherently sector-specific in nature, and must instead rely on a combination of subsidies, standards, and other forms of mandates.

CLC retained NERA Economic Consulting (NERA) to use its state-of-the-art economic model, called N_{ew}ERA, to compare the relative potential economic impacts of its economy-wide CDP to those of an illustrative "regulatory" scenario containing the types of sector-specific approaches often proposed as alternatives to economy-wide carbon pricing. To make the comparison fair, the Regulatory scenario was constructed to achieve an equivalent amount of carbon emissions reductions as the same model projects for the CDP scenario, also broadly spread across the U.S. economy. They both therefore can be viewed as having generally equivalent environmental benefits. This analysis design allows a focus on understanding the relative degree of economic impact that can be expected of the two very different policy approaches when achieving large carbon emissions reductions.

In brief, our analysis finds that the CDP scenario promises to be far more cost-effective than the Regulatory scenario. In this report, we leverage specific details of the model outputs to provide insights explaining *why* this finding is a reasonable expectation. This volume of our report provides an overview of the high-level insights obtained from our analysis that are of relevance to policymakers and interested and affected

[1] CLC, *Bipartisan Climate Roadmap,* October 2020. Available at: https://clcouncil.org/Bipartisan-Climate-Roadmap.pdf.

parties. It is supplemented by a Volume II that documents the analysis methods, assumptions, and provides numerical tables of results.

Given economic shifts of the sort experienced during 2020, partly as a result of the covid-19 pandemic, one might question the usefulness of any projection of economic outcomes over a period of decades, as is necessary to assess the impacts of long-term policies such as these. However, while uncertainties in economic baseline conditions drive uncertainty about the absolute costs of a policy, they are much less likely to alter whether one policy approach is more costly than another. Thus, uncertainty about future conditions becomes much less important when comparing the relative impacts of two structurally different policy scenarios, as we do in this study. Differences in the relative costs of the two policies we analyze here reflect fundamental differences in how well their provisions work in concert to guide individual decisions towards cost-effective market outcomes and avoidance of unintended consequences. The value of a model-based economic analysis of two regulatory approaches that would achieve the same environmental objective is to provide insights about *why* one of the approaches is likely to be more cost-effective than the other. The reasons we identify for why the CDP scenario is projected to be more cost-effective than the Regulatory scenario can be expected to remain, to one degree or another, under any potential set of future economic trends.

THE TWO POLICY SCENARIOS COMPARED IN THIS STUDY

The period over which economic impacts and emissions are projected in this study is 2021 through 2036. Although both scenarios are projected to produce equivalent carbon emissions reductions, they do so in a very different manner.

- The CDP scenario relies on a uniform carbon price signal as specified by CLC's proposal, with net carbon revenues returned to households on a per-capita basis each year.[2] It is accompanied by a border carbon adjustment (BCA) system that CLC proposes be designed in a manner consistent with World Trade Organization rules, as it believes can be done given the CDP's direct carbon-pricing feature. The purpose of the BCA is to assess a levy on imports based on the carbon-intensity of the manufacturing processes in their country of origin, and it is to rebate that same cost to U.S. products that are exported. There are no other prescriptive elements to the CDP scenario other than that the net carbon revenues be returned directly to households.[3]

- In contrast, the Regulatory scenario applies a set of sector-specific measures that do not directly assess or create a price on carbon emissions. Our primary objective was to select a set of emissions-reducing measures covering each of the major emissions categories, consistent in form with recent regulatory proposals, and with stringencies generally in line

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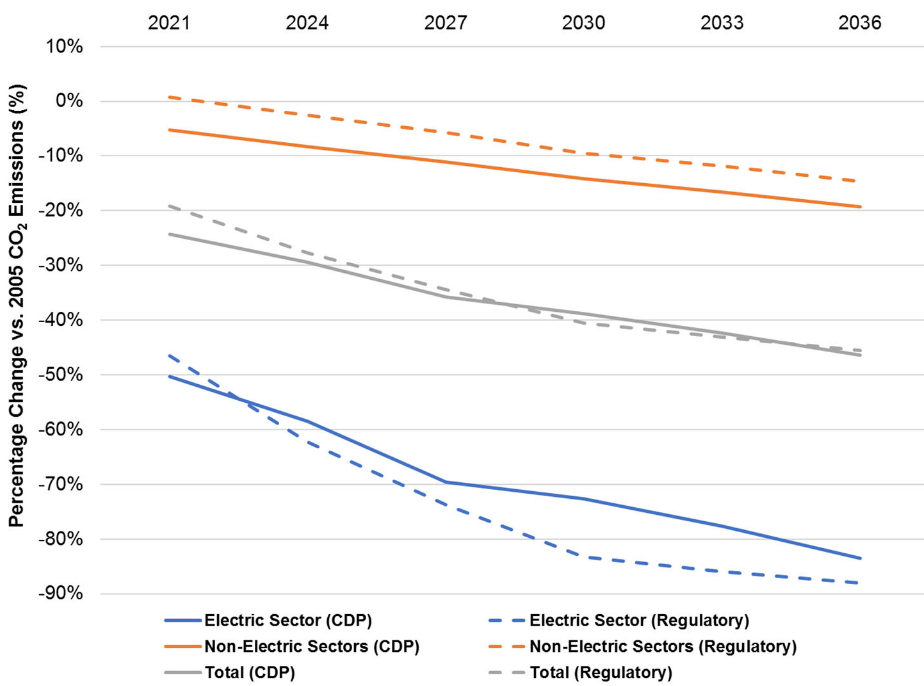
[2] The CDP proposal is to pay out these dividends on a quarterly basis. N_{ew}ERA operates on an annual basis and in this analysis, it returns each year's net revenues as dividends to households in that same year.

[3] This is after removing a 24% fraction that is provided to the U.S. government to offset the potential reductions in existing government tax revenues. 24% is the conventional assumption used in Congressional scoring of new federal legislation related to taxes.

with such proposals.[4] These consist of a mixture of energy efficiency standards (for both stationary sources and on-road vehicles), a clean energy standard for electricity generation, and a subsidy program to accelerate adoption of battery-electric vehicles. Lacking any carbon fees, these regulatory measures do not generate any revenue that can be used to offset potential reductions in existing government tax revenues, nor to return to households. The analysis assumes potential government deficit increases will be defrayed by lump-sum (i.e., non-distorting) increases in personal income taxes. While this may not be the most reasonable assumption if the magnitude of the need to increase government revenues is large, it is an assumption that results in the least economic impact possible for this scenario.

Figure 1 shows the projected U.S. emissions reductions under each scenario relative to 2005 emissions. Although total reductions under each scenario differ somewhat from year to year, both scenarios achieve approximately a 50% reduction in U.S. CO_2 emissions by 2036, as intended by the CDP. Although it cannot be determined directly from the figure, the cumulative emission reductions are nearly the same – with about 1.7% more cumulative emission reductions over the period 2021–2036 accomplished in the CDP scenario than in the Regulatory scenario.[5]

Figure 1: Percentage Change in CO_2 Emissions Relative to 2005 Levels



[4] We adopted the *forms* of regulatory proposals for addressing emissions in each sector but, where possible, avoided the more stringent of the specific *limits* being proposed to avoid creating an unnecessarily costly Regulatory scenario that would achieve emissions reductions equivalent to those projected in the CDP scenario.

[5] Given the great uncertainties about emissions, we consider a 1.7% difference in reductions over an 18 year period to meet the "equivalent" requirement. Minor adjustments to some of the Regulatory scenario to achieve the additional 1.7% of reduction would only increase its projected costs compared to that of the CDP.

Figure 1 also shows the particular Clean Energy Standard (CES) assumed for the Regulatory scenario's electricity sector is more stringent than what the analysis projects would be cost-effective under the CDP's uniform price signal.[6] To keep their total CO_2 emissions equivalent, the Regulatory scenario thus requires somewhat less emissions reductions from the rest of the economy than the CDP. More details of these policy provisions are provided in the technical documentation (Volume II), along with explanations of how they have been implemented in the N_{ew}ERA modeling framework.

HOW THE SCENARIOS HAVE BEEN EVALUATED

NERA has used its N_{ew}ERA model to evaluate the responses of the economy to each scenario. N_{ew}ERA is a dynamic, integrated computable general equilibrium (CGE) model of the whole U.S. economy. Originally designed for evaluation of policies addressing CO_2 emissions, it has substantial technological and physical detail related to energy supply and demand. The model integrates a bottom-up representation of the U.S. electricity sector with a top-down representation of the production, consumption, and investment decisions across the rest of the U.S, economy, including household decisions that affect overall energy use and related GHG emissions. Household decisions include labor supply and savings decisions (given projected future income levels), and what goods and services to consume, including personal vehicle types and usage levels. It offers flexibility to evaluate policies with different sectoral, regional and temporal requirements, and produces impact estimates at that level of detail as well. N_{ew}ERA has been peer-reviewed through participation in several of Stanford University's Energy Modeling Forums, and associated analyses have been described in peer-reviewed journal articles.

The version of N_{ew}ERA used in this analysis has 16 separate economic sectors, five of which are energy sectors (including the very detailed electricity sector unit dispatch module). The other eleven sectors cover all other economic activities in the U.S economy, plus household decisions. Government policies for each scenario are implemented as new constraints (beyond those in the baseline) on any of a number of the economic elements of this framework, including, for example, prices, supply, production processes, and consumer demand, depending on the nature of each policy. Table 1 provides a synopsis of the baseline market and regulatory assumptions that form the foundation for the economic impact estimates in this study. There are no significant differences in the timing of the implementation of the CDP and Regulatory scenarios; both are assumed to start to take effect in 2021 and are smoothly phased in over the remainder of the modeled period. More specific numerical details of the baseline and scenario assumptions are provided in Volume II, as well as full documentation of the underlying N_{ew}ERA model structure.

[6] The CES's requirements for the percentages of annual retail generation that must come from clean energy sources is set at 80% by 2030 (phasing in from baseline levels starting in 2021) and at 100% by 2050 (also gradually phasing in from 80% in 2030). This set of CES targets for the Regulatory scenario was selected to lie within the range of stringencies of various CES proposals that had been circulating at the time this analysis was started. It was not intended to be more stringent than what appears would be optimal under the CDP, but rather for its representativeness of proposals consistent with proponents of a more regulatory approach to climate emissions control.

Table 1: Overview of Baseline Scenario and the Additional Constraints Imposed in the CDP and Regulatory Scenarios

Baseline Scenario	CDP Scenario	Regulatory Scenario
• Projected fuel prices, emissions, and economic output consistent with U.S. Energy Information Administration's *Annual Energy Outlook 2019's* "High Oil and Gas Resources" case • Includes compliance with all existing national and state rules and regulations on energy and environmental outcomes (including the Obama vehicle fuel economy standards through 2025)	**Retains all Baseline policies, plus:** • Carbon price on all U.S. CO_2 emissions starting at $40 per ton (2017$) in 2021 and rising at 5% per year plus inflation • Border carbon adjustment (BCA) for the carbon content of imports and exports for specific industrial sectors • Net carbon revenues returned on per-capita basis to all households in same year as collected	**Retains all Baseline policies, plus:** • Clean energy standard (CES) applied to all U.S. electricity generating units[7] • Requirements for existing coal units to adopt partial carbon capture and sequestration (CCS) by 2035 • Energy efficiency targets for homes, buildings, & industrial processes • Vehicle fuel economy standards tighten after 2025 • Targets for battery electric vehicle (BEV) market share • No new leases to extract fossil fuels on federal lands

SUMMARY OF KEY RESULTS

A. Macroeconomic Impacts

The central question addressed in this analysis is how do the potential economic impacts of the CDP compare to those of a purely regulatory approach that would achieve equivalent CO_2 emissions reductions across the entire U.S. economy? Based on the methods described above, our analysis finds that the illustrative Regulatory scenario would likely have vastly higher economic costs, whether assessed in terms of economic welfare, household consumption, or gross domestic product (GDP).

Economic welfare is what CGE models assume individual consumers maximize in making their consumption, savings, and labor supply decisions, and so this is a key output of an analysis such as this. It

[7] The CES standard in the Regulatory scenario allows nuclear units to earn credits and allows them to remain in operation for 80 years, if economical. (The 80-year potential lifetime assumption is the same in both scenarios and the baseline.) The Regulatory scenario also considered the possibility that other policy pressures would prevent any new nuclear generating capacity being built through at least 2036 (except for completion of 2.2 GW now under construction in Georgia), but this constraint was found to have no effect on the outcomes projected for this scenario given our assumed technology costs.

is equal to consumption plus the monetary value consumers place on discretionary leisure.[8] Stated in 2019$, the **present value of economic welfare** for the period 2021-2036 is projected to be about $2,010 billion higher in the CDP scenario than in the Regulatory scenario, or about 0.8% higher when stated in percentage terms.

Recognizing that policy makers are more interested in economic impact measures that are more empirically measurable and have a more direct financial interpretation, we also compare the impacts to GDP and per-household consumption in Figure 2 and Figure 3, respectively, over time.

- **GDP** is an empirical measure of an economy's economic activity that is more widely used by policy makers but differs from economic welfare. GDP is the sum of consumption, investment, government spending, and net exports. Although consumption is the largest component of GDP (and thus GDP does have ties to economic welfare), inclusion of investment in the measure of GDP can cause it to differ from economic welfare. This is because investment is funded by household saving, which in turn requires a reduction in household consumption. As Figure 2 illustrates, GDP is projected to be lower in the Regulatory scenario than in the CDP scenario. On average across the entire period, GDP is lower by about $190 billion per year (0.7%) in the Regulatory scenario compared to the CDP scenario. The gap is projected to widen over time as both policies achieve deeper emissions cuts, so that by 2036 it is $420 billion per year higher (1.5%) in the CDP scenario than the regulatory one.

- **Consumption** measures how much value in goods and services households actually purchase (i.e., "consume") in each year and thus is more closely related to economic welfare.[9] It can provide useful context for the economic impact measures when stated on a per-household basis. On average across the entire period, per-household consumption is about $840 per year (0.7%) higher in the CDP scenario than in the Regulatory scenario. As Figure 3 shows, the gap for this measure of impact also widens with time, rising to about $1,260 (about 1%) by 2036.

As can be seen in the figures, as the stringency of both scenarios increases over time (to keep reducing emissions), the Regulatory scenario becomes more and more costly relative to the CDP scenario.[10] This indicates that the relative flexibility provided by an economy-wide emissions-pricing approach becomes increasingly valuable as emissions cuts become deeper.

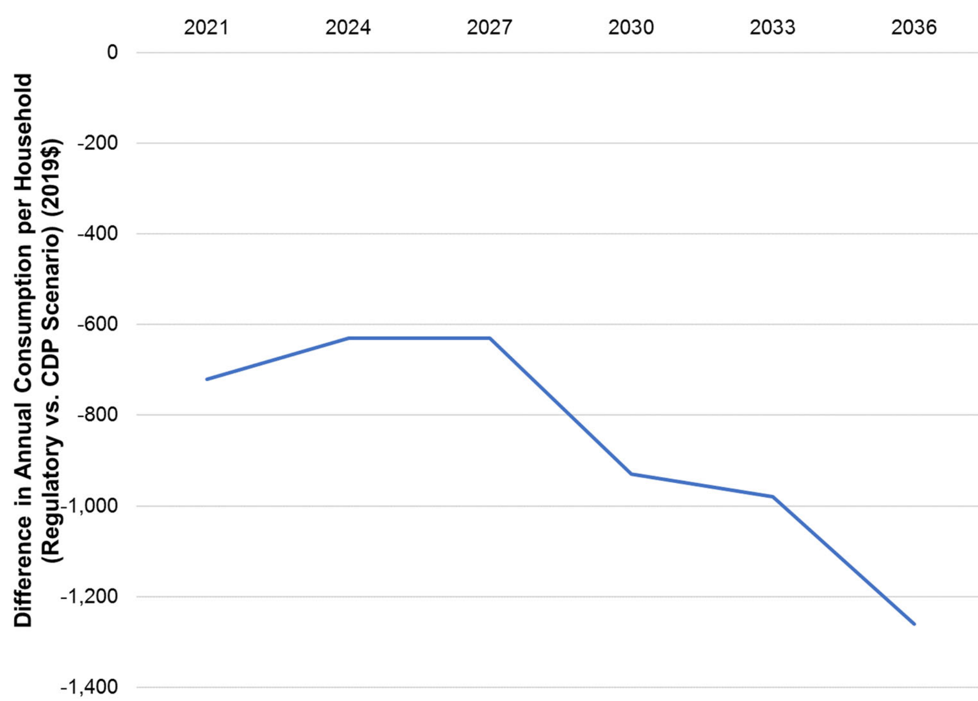
[8] The technical term among economists for our measure of economic welfare is the present value over the analysis period of "equivalent variation."

[9] Changes in value of leisure are a small fraction of changes in economic welfare, hence the similarity of the two separate economic impact metrics.

[10] The slight deviation from this pattern of widening gap between 2021 and 2024 in consumption per household reflects differences in the timing of investments (which decrease consumption) at the start of the scenarios, with the mandates of the Regulatory scenario leading to earlier needs for capital investments compared to the CDP scenario.

Figure 2: Difference in GDP Between Regulatory Scenario and CDP Scenario (2019$ Billions)

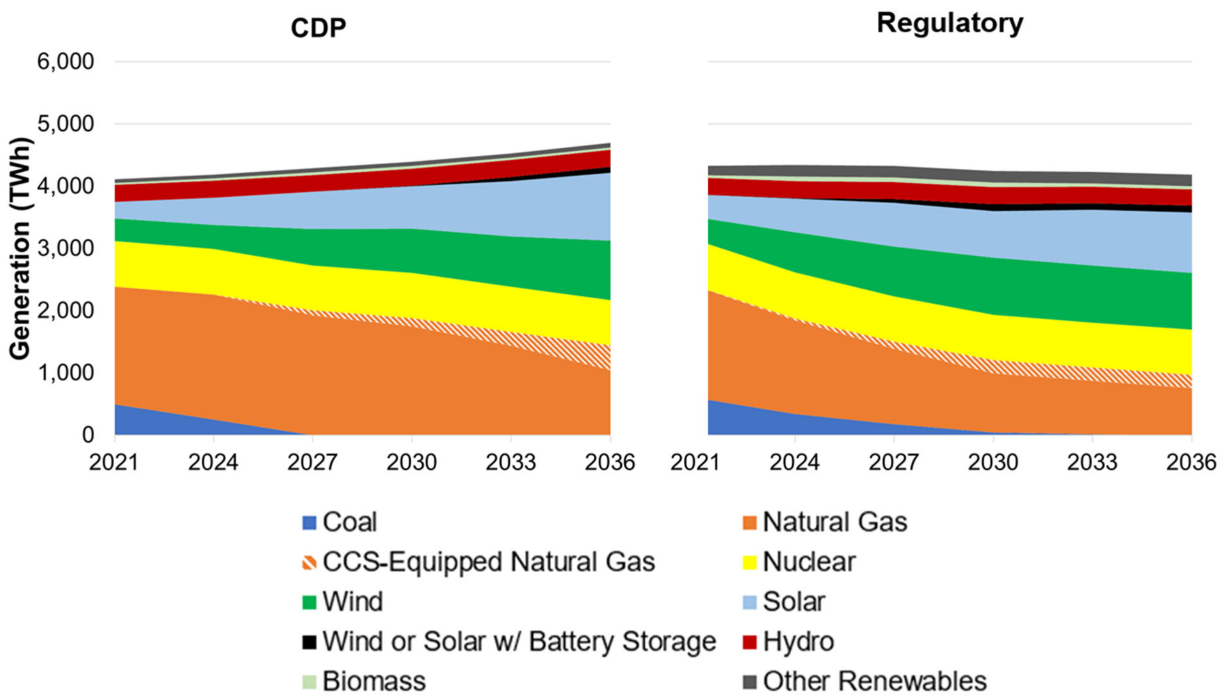
Figure 3: Difference in Annual Consumption per Household Between Regulatory Scenario and CDP Scenario (2019$/household/year)



B. Technological Impacts

Changes in technology stated in physical rather than financial terms provide insights about the general nature of transitional forces associated with a policy. Figure 4 shows the evolution projected in the electricity generation mix over time from 2021 to 2036 for each scenario. The direct carbon price of the CDP scenario motivates a more rapid shift from coal to gas than in the Regulatory scenario. This is because the carbon price imposes a larger disincentive on coal-fired generation than on gas-fired (due to coal's higher carbon emissions rate per MWh), while the CES in the Regulatory scenario (like many CES proposals) disfavors coal-fired and gas-fired generation equally.[11] The figure also reveals a more rapid absolute reduction in natural gas-fired generation in the Regulatory scenario. This is caused by the rigid requirement of the CES that an increasingly small fraction of any fossil-fired generation may remain in the mix as the CES's percentage mandate rises. The CES in our analysis requires that 80% of generation be clean by 2030, then rising each year to reach 100% clean generation by 2050. Our analysis indicates that these CES targets, particularly in the period through about 2033, have a more stringent effect on natural gas-fired generation than would be necessary to achieve comparable economy-wide emissions reductions under a uniform, all-sectors carbon price. The CES requirement for 100% clean energy by 2050 is also seen to hamper the incentive to build natural gas with CCS after about 2030 in the Regulatory scenario, while use of that technology continues to grow through 2036 and beyond.[12]

Figure 4: Projected Gross Generation over Time in Each Scenario, by Unit Type



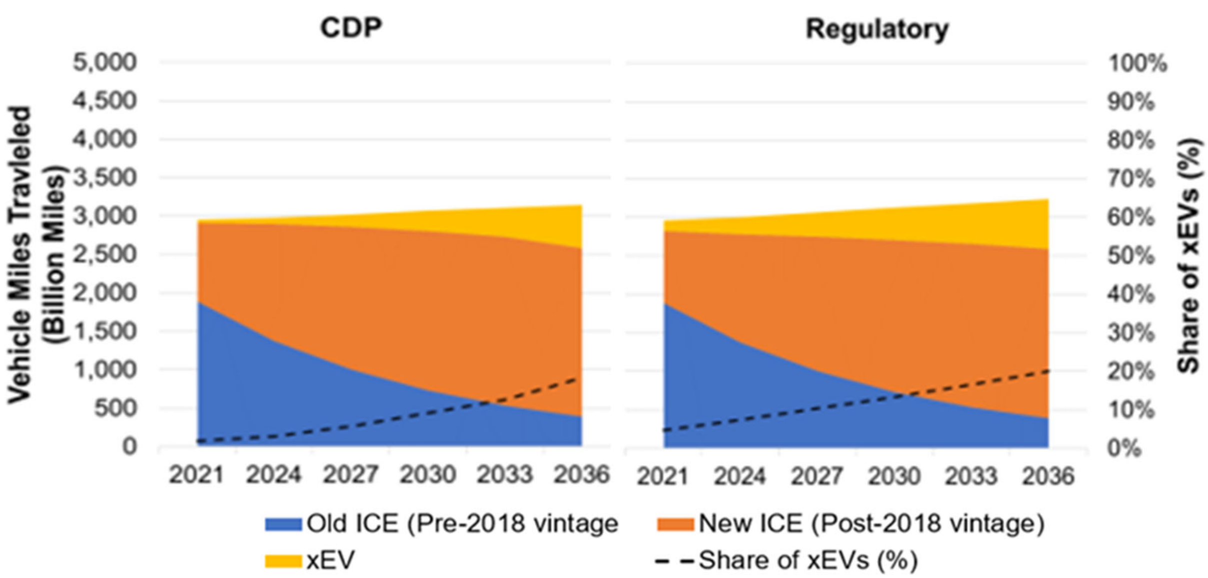
[11] That is, our CES assumes that both natural gas- and coal-fired generators earn zero clean energy credits per MWh generated. (Both types of CCS-equipped generation receive a 90% credit per MWh generated.)

[12] Although the analysis's projection of market outcomes ends in 2036, decisions about new investments in generating units up through 2036 are made considering projected financial outcomes through their full potential useful lives, including years after 2036. The continual tightening of the CES after 2036 to a full 100% by 2050 (which would force closure of all CCS units by 2050) thus undercuts the financial viability of CCS investment even before 2036.

Another difference between the two scenarios visible in Figure 4 is less growth in electricity generation projected in the Regulatory scenario compared to in the CDP scenario. In fact, electricity generation is projected to decline in the Regulatory scenario, but to rise in the CDP scenario. This difference occurs because the energy-efficiency mandates imposed on non-electric sectors in the Regulatory scenario do not create as much incentive for relying on electrification as a decarbonization option as the CDP scenario creates—even though electricity in the Regulatory scenario is being decarbonized more rapidly than in the CDP scenario. That is, the efficiency standards promote only lower energy-intensity in production, whereas a carbon price gives producers the flexibility to shift towards the lower-carbon energy that electricity provides if doing so is more cost-effective than further reductions in energy consumption itself.

Figure 5 presents projected vehicle miles traveled (VMT) for personal vehicles and the shares of VMT met by internal combustion engine (ICE) vehicles versus battery electric vehicles (BEVs) in each scenario. The dotted lines indicate the percentage of all VMT each year that are BEVs (using the axis labels on the right hand side of the figure). The two scenarios differ only slightly, in that the share of VMT as a fraction of total vehicle stock increases to 18% by 2036 in the CDP scenario (which has no BEV mandate) and to 20% in the Regulatory scenario (which mandates this amount). On the other hand, total VMT is lower in the CDP scenario by 2036 than in the Regulatory scenario. Also (not shown in the figure), the fuel efficiency of the remaining ICE vehicles on the road is higher in the CDP scenario than in the Regulatory scenario, so that ultimately the CDP policy motivates more emissions reduction from ICE-vehicle personal transportation with fewer mandates and subsidies than we assumed would be imposed for our Regulatory scenario (-21% vs. -17%, respectively).[13]

Figure 5: Share of Vehicle Miles Travelled by Vehicle Type Over Time



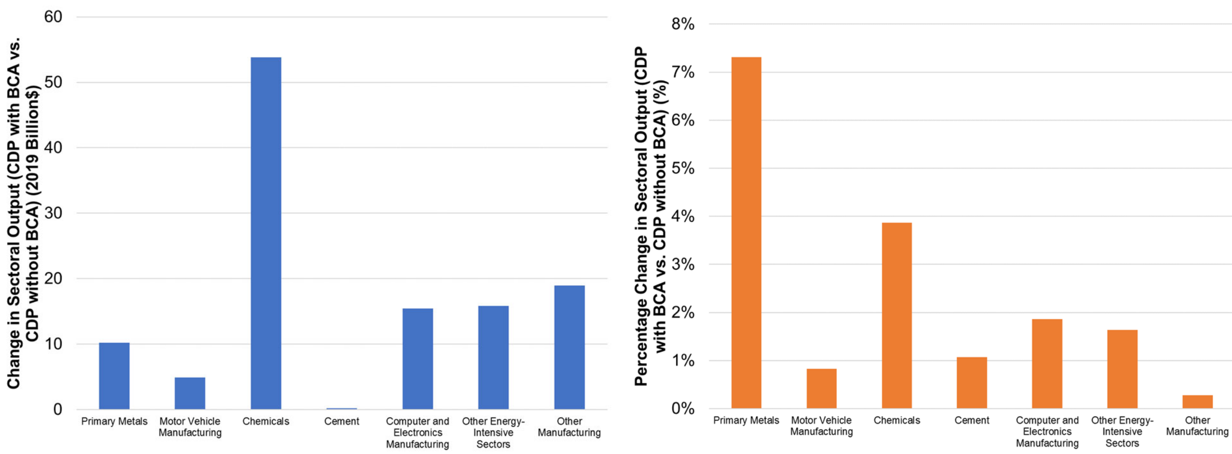
[13] The average fuel economy increases at a faster rate in the CDP scenario purely due to the economic incentives of the carbon price on the cost of gasoline. In contrast, there is no such carbon-adder increase in the cost of gasoline in the Regulatory scenario, and fuel economy increases only as needed to meet the mandated fuel economy standards. This is not as fast as in the CDP scenario, indicating that such a fuel economy mandate likely would not be binding in the face of carbon prices such as those of the CDP. More details supporting this point can be found in Volume II.

C. Border Carbon Adjustment Impacts in CDP Scenario

One of the benefits of a CDP approach is the ability under a carbon-pricing regime to impose a border carbon adjustment (BCA) to help protect trade-exposed industries from competition from production in countries that do not impose equivalently stringent greenhouse gas emissions reduction policies. A BCA is not assumed in the Regulatory scenario for two reasons. First, under a regulatory approach there is no carbon price signal to serve as the basis for calculating appropriate BCA values. Second, it is generally accepted that such BCAs are not legal under WTO rules unless the country imposing BCAs has a direct carbon pricing regime of its own. To obtain insight about the protective benefits of the BCA in the CDP scenario, a sensitivity analysis was conducted in which BCAs were removed from the CDP scenario, leaving all else in the CDP scenario unchanged. Figure 6 presents the absolute and percentage benefits to U.S. sectoral output (in 2036) for the seven manufacturing sectors to which the BCA is applied in the CDP scenario. The figure shows the increases in sectoral output that are achieved by adding the BCA (i.e., the difference relative to the CDP sensitivity case without those BCAs in effect). All seven BCA-protected sectors benefit, some by several percentage points. Overall, across the seven sectors, output is projected to be $119 billion higher per year by 2036 as a result of the CDP's BCA protections.[14]

Additionally, this sensitivity analysis projected that the BCA provisions are projected to improve GDP by 0.2% in 2036 . Details of how the BCAs were calculated for this analysis and implemented in the model are provided in Volume II that supplements this report.

Figure 6: Absolute (left chart) and Percentage (right chart) Differences in Sectoral Output in 2036 for CDP Scenario with BCA Compared to Same Scenario Without the BCA Provisions



INSIGHTS ABOUT RELATIVE COSTS AND ROLE OF UNCERTAINTY

Additional analysis outputs that may be of interest to readers with more specific interests are provided in the supplemental technical volume of this report. Here, we close with a discussion of reasons the CDP

[14] Only energy-intensity differences were used to estimate the BCA price adjustments, even though our CDP scenario also applies the carbon price to process emissions of CO_2. The BCA price adjustments in our analysis were thus understated, and so the benefits of the BCA are also understated. This understatement is highest for the cement sector, which has by far the largest fraction of total carbon fees due to process emissions.

scenario is projected to be more economically efficient than the Regulatory scenario, despite achieving equivalent CO_2 emissions reductions spread broadly across the entire economy. Numerical results supporting the following discussion can be found in the more detailed results in Volume II.

In reviewing our analysis results, and through sensitivity analyses, we have determined that there is no single provision in the Regulatory scenario that drives its costs upward to such a degree. Rather, it is the lack of a unifying carbon price signal that seems to explain most of its economic inefficiencies. A salient example is the energy efficiency standards. These standards do indeed reduce energy use significantly, but they do so in a manner that does not account for the *carbon*-intensity of the current energy sources. When separate natural gas energy and electricity energy efficiency standards are imposed that have equivalent targets, these standards provide no incentive for users to shift away from natural gas and into electricity, even if the electricity might be achieving lower carbon emissions per unit of energy services provided. Efficiency standards are designed to promote energy efficiency, not carbon reductions, making these policies relatively more expensive than a direct carbon price for achieving the same emissions reductions.

The fact that the energy efficiency standards in the Regulatory scenario do not provide incentives focused on *emissions* reductions is further exacerbated because, *relative to the cost of directly using any of the fossil fuels*, retail electricity rates rise in that scenario.[15] Thus, in the absence of a uniform carbon price signal across all energy sources the Regulatory scenario actually creates incentives to avoid one of the most cost-effective forms of emissions reductions—electrification with increasingly lower-carbon electricity. Although other designs of a CES might achieve greater cost-effectiveness in the reduction of emissions within the utility sector itself,[16] improvement in the electricity sector's approach to deep carbon reductions cannot, on its own, replace the economy-wide emissions-reduction incentives that energy-efficiency standards fail to provide.

One way to reduce distortions of incentives in the non-electricity sectors to reduce carbon emissions cost-effectively would be to impose carbon-intensity targets rather than energy-efficiency targets. However, that approach would introduce attributes of carbon pricing that regulatory approach advocates seek to avoid, while failing to provide the single greatest benefit available from a direct carbon pricing approach, which is uniformity in the emissions price signal across all types of sectors and energy end-users. In essence, the Regulatory scenario has higher costs for the same emissions reductions relative to the CDP scenario *because of* its sector-specific nature.

As noted in the discussion associated with Figure 5 above, the Regulatory scenario also is less efficient, albeit much more marginally, at reducing transportation emissions cost-effectively. Those points are not reiterated here but note that they indicate a similar set of distortions arose in the transportation sector when

[15] The CES is projected to cause wholesale electricity prices to fall, but load-serving utilities must pay for any clean energy certificates that they need to purchase, and that cost is passed through to the retail customers, along with the lower cost of the wholesale energy. The net result is a projected increase in average retail rates.

[16] The more cost-effective CES designs become, the more they become like a carbon-pricing approach for the electricity sector. Although a CES can be devised to have nearly identical emissions-reducing incentives to that of a direct carbon price on generation emissions, it would be more complex to implement than the latter. Additionally, the CES approach will always be subject to temporal price uncertainties that do not exist for the direct pricing approach.

attempting to achieve equivalent emissions reductions without relying on a uniform price signal on all options for reducing transportation-related carbon emissions.

Given our ability to identify specific sources of distortion in the emissions-reducing incentives of the Regulatory scenario's provisions, its gap in cost-effectiveness relative to the CDP scenario is an eminently plausible result. Indeed, the economics literature is replete with references to the substantially greater cost-effectiveness of carbon pricing approaches such as the CDP. Thus, the results of this comparative analysis should not be viewed as surprising, and it is a helpful supplement to more theoretical studies because it provides specific examples of how a uniform emissions price signal can significantly improve the economic costs of carbon reductions compared to regulatory approaches that take a more sector-specific approach and that tend to avoid policies that create overt emissions prices.

Another reason for the relative advantage of the pricing approach is that it will remain less costly no matter what attempts are made to modify the specific provisions of a Regulatory scenario. This is because there is uncertainty in how well any model can simulate real-world conditions. Even if we could alter this Regulatory scenario to represent an "ideal" one that would match all the emissions-reducing responses of the CDP scenario under one set of future market and technology conditions, its costs would increase above those of the CDP scenario under other reasonable assumptions about market and technology futures. A significant advantage of the CDP approach over any regulatory (i.e., non-pricing) approach is its ability to guide the economy to the most cost-effective emissions reduction actions under any set of unknown future market, behavioral, and technology conditions. Although a detailed uncertainty analysis could help demonstrate the latter point, the results from this illustrative but not unrealistic representation of a regulatory approach are informative to policymakers who may be contemplating the merits of the two alternative approaches for achieving significant reductions in greenhouse gases over the coming decades.

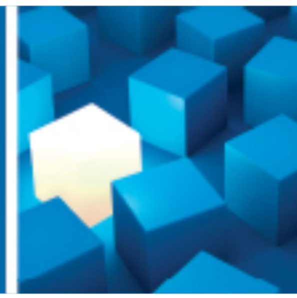
There are a host of other potential designs for market-based carbon pricing and for non-market regulatory approaches that could also achieve comparable emissions reduction to that which we analyze here. With enough analytic resources, they too could be incorporated into this comparative framework. While they would differ in their specific impacts, we consider it likely that alternative types of carbon-pricing scenarios, *if emissions-equivalent*, would generally have aggregate macroeconomic impacts similar to those of the CDP proposal. While the potential aggregate impacts of various alternative *emissions-equivalent* regulatory scenarios would likely vary somewhat more from those of our particular Regulatory scenario, for all of the structural issues discussed above, we are confident that they would remain more expensive than the economy-wide carbon pricing alternatives.

The specific amounts of CO_2 emissions reduction that this model-based analysis projects under the CDP scenario should not be viewed as guaranteed outcomes under the CDP's specific carbon price levels. Similarly, any model-based projections of absolute economic impacts of reducing emissions are highly uncertain. However, inaccuracies arising from the need to select specific input assumptions will generally affect impact estimates for the Regulatory scenario as well. By focusing on comparisons of the relative economic impacts of the two approaches, the importance of these uncertainties for drawing reliable conclusions will be diminished. Thus, the most appropriate use of our analysis results is for comparing the relative economic costs of the two dramatically different policy approaches for reducing carbon emissions.[17]

This is, thus, a cost-effectiveness analysis, not a benefit-cost analysis. Whatever the benefit-cost merits of such large emissions reductions may be, they are greater for the more cost-effective of the approaches. As is evident from the above summary, we find a very wide gap in cost-effectiveness between the Regulatory scenario and the CDP scenario, and we can trace it to specific forms of inflexibility that arise when taking a regulatory approach.

We find that the CDP scenario holds a strong advantage in cost-effective emissions reduction relative to the Regulatory scenario. To justify ignoring this large cost advantage, policymakers would need to identify significantly better anticipated outcomes in some other dimension, such as more equitable distributions of impacts. This study has not conducted a distributional analysis. However, flexibility to alter distributional effects through the new income stream of net carbon revenues is available only under carbon-pricing approaches such as the CDP. The CDP plan to return all net carbon revenues to households on a per-capita basis is specifically designed to counteract unfavorable income distributional effects that can be anticipated of emissions-reduction policies, and thus it is unlikely the regulatory approach could more than offset its large cost disadvantage relative to the CDP plan with any inherent advantage in terms of its distributional impacts to households.

[17] Note, however, that CLC's CDP proposal addresses concerns with uncertainty in how much its fees will actually reduce carbon emissions through an Emission Assurance Mechanism (EAM) provision. If this mechanism were to need to be invoked in an analysis using an alternative set of future market and technology assumptions, it would raise estimated costs of the CDP scenario. However, those same market and technology assumptions also would have to be applied when analyzing the emissions-equivalent Regulatory scenario, which would almost certainly raise its estimated costs as well. Thus, the *relative* cost-effectiveness of the two emissions-equivalent scenarios would be sustained even as the EAM provides assurance of the achievement of the emissions reduction objective of the CDP proposal.



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