1

SPEAKING SIGN-IN SHEET

Project:	Concord Public Comment Session	**Meeting Date:**	10/17/17
Facilitator:	Office of Strategic Initiatives	**Place/Room:**	BTLA

Name (Please Print)	Town/City
Julia Steed Mawson	Pelham, NH
Bob Eldredge	Bow, NH
Rick Rasman	Kingston NH
Melissa Birchard	Hopkinton, NH
Don Kreis	Concord, NH
John Gage	Windham, NH
Susan Richman	Durham, NH
3	
Laura Aronson	MANCHESTER

2

SPEAKING SIGN-IN SHEET

Project:	Concord Public Comment Session	**Meeting Date:**	10/17/17
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Name (Please Print)	Town/City
Jennifer J. Smith	Pembroke
Mary Beth Raven	Merrimack
Charles Willing	Concord
Kathy Chapman	Mason
Bret Ingoll	Nurses
Sarah Thorne	Gilmanton IW
Rick MacMillan	Hopkinton
Dick Hemingway	

START →

Concord Public Comments Session – 10 Year State Energy Strategies
October 17, 2017

Julia Steed Mawson

- Continue to consider a diverse portfolio of energy sources;
- Less fossil fuel, more renewable;
- Reference the Paris Climate Accord in the plan;
- Initiate a carbon fee and dividend; support projects to increase energy efficiency (EE);
- Join/create off-shore wind task force;
- Acknowledge the complexities of using renewals; improve education re: EE and its complexities; involve public, youth, educators and public officials in education process; become citizens of energy;
- Look at side effects of using any form of energy;
- Include full analysis of cost benefits of using renewals including human health and safety.

Bob Eldredge – Home Energy Auditor, Bow

- Support EE to reduce the use of foreign energy;
- Supports energy efficient rating label on homes when listed for sale;
- US DOE has Home Energy Score (HES) program; simple process, done by US DOE Assessors (of which he is one);
- Fanny Mae and USDA take HES into account when making loans;
- New energy efficient homes can be designed and built to obtain a HERS rating;
- HES rating would benefit current home owners.

Rick Russman, Kingston

- Supports previous comments:
- Part of problem is importing of fossil fuel;
- Supports keeping the 2014 Plan and adding to it (not starting over with new one);
- Need to increase opportunities for local solutions.

Melissa Birchard, Conservation Law Foundation, Hopkinton, NH

Energy Attorney by trade; also submitting written comments;
Supports a 10 year strategy; encourages taking a longer view;
Recommendations:

1. Strong EE program;
2. Reduce peak-demand, time-of-use rates, and better integration into the Grid;
3. Keep/create local clean energy jobs; invest more RGGI back into State;
4. Volkswagen settlement chance to invest in electric vehicles and infrastructure;
5. Meet climate goals.

Don Kreis, State of NH Consumer Advocate, Concord, NH

- Supports previous comments;
- Has heard the Governor speak poorly of the 2014 Energy Strategy;
- Suggestion of 10 "tweaks" to 2014 strategy:
    1. Need more energy infrastructure related to EE;
    2. Explore joining with neighboring states in EE plans/projects;
    3. Reduce peak electrical demand;

4. Reform statute re: Least Cost Integrated Resource Planning;
5. Define the term "resiliency"; means different things to different people/organizations;
6. NH should be haven for electric vehicles;
7. Assure no one is left behind, persons with limited resources should also be able to make energy efficient changes;
8. Acknowledge electricity is NH's biggest export;
9. Work to reform ISO New England; and
10. Incorporate and nurture consumer cooperatives.

John Gage

- Supports previous comments;
- Science supports data that shows a human threat from the use of carbon fuels;
- Get ahead on clean energy technology;
- Proxy carbon pricing.

Susan Richman, Durham, NH

- Fossil fuels issue is volatile to politics;
- Use of fossil fuels threatens the Great Bay system; creates health issues and is affecting the planet;
- Supports renewables;
- Urges the strategy to follow the Paris Accords.

Jennifer Smith, Member of Town Energy Committee, co-chair public policy

- Need strategy to emphasize EE in community buildings;
- Develop resources available to local communities;
- Supports Electric vehicles but need more charging stations; NH lacks infrastructure to support it;
- Strategy should include energy storage systems– Green Mountain Power in Vermont.

Mary Beth Raven, Merrimack, NH

- Supports the 2014 Strategy, has suggestions;
- Three developments impact Section 1 of the Strategy:
  1. There is more evidence that fossil fuels plays more of a role in climate change;
  2. Cost of solar panels is and continues to decline;
  3. US has developed the first off-shore wind farm off of Block Isle; potential in NH;
- Section 5.1: remove natural or methane gas reference;
- Revise goal from 25% renewables by 2025 to 100% by 2050;
- Section 5.4.4: remove whole section;
- Recommend fuel diversity;
- Add #12 to recommend small scale hydro;
- #13 remove mention of converting to natural gas and remove wording on trucking CNG;
- Recommends establishing committee such as Ocean Energy Management.

Charles Willing, member Concord Energy and Environment Committee

- Concord just passed resolution to be 100% renewables in electricity by 2030 and trans(?) and thermal by 2015;
- Stressed climate change, strengthen RPS, EE and energy storage;
- NH should follow VT and ME in increased use of renewables;
- Recommends making commitment to electric vehicles;
- NH needs to reconnect and recommend more investment in RGGI;
- Supports local committees on EE.

Kathy Chapman, Mason, NH

- Recommends NH join the Climate Accord;
- No new fossil fuel infrastructure be developed;
- Recommends reading the Carsey Institute study which was last updated 2017;
- Fracked gas pipelines have collateral damage such as "taking" of property in order to lay pipe.

Brett Ingold, Warner, NH (Agriculture)

- Concerned about climate change effects on farm; slow emergency;
- NH needs to take steps to address carbon dioxide emissions and methane gas;
- Supports renewals and new resources to support EE;
- Stresses no new fossil fuel energy use.

Sarah Thorne, Gilmanton, NH

- High School teacher of climate and environmental science;
- Students are aware of climate change; its effect on the planet; and are concerned no one is doing anything about it;
- Encourage NH to be courageous and set a goal of 100% renewable by 2050.

Rick McMillan, Hopkinton, NH Solar Installer

- Been doing solar since 1980's;
- Educate people about EE. NH should take a lead;
- Urges NH to take a leadership role and use the "greenness" of NH to generate more revenue;
- NH is tourist state, urges NH to become a green energy state;
- Recited quote, "Solar energy...Over 4 billion years without a shortage."

Laura Aronson , Manchester, NH

- Support previous statements, clean energy, EE , off-shore wind farms, green buildings, green roofs, greenhouse agriculture;
- Encourages strategy take a longer view and embrace renewable energy.

Dick Henry

- Participated in developing 2014 Energy Strategy;
- Recommends adopt stronger, modern, energy code (NH 10 years behind other states);
- PV and solar price dropped and efficiency increased;
- Some communities are considering solar for their town and school buildings; 50-60% reduction in energy costs;
- Financing available for EE i.e. "green" loans for residential and business;
- Removing barriers to EE, and exempt home owners from increased tax on EE/renewables;
- Electric and thermal storage technology increasing and becoming more affordable;
- NH strategy should anticipate newer technology;
- Eliminate using $ amount per kilowatt hour as a measure stick.

Last 15 minutes:

- Education of consumer on solar and EE stressed.
- Gas tax should reflect the cost of running a larger vehicle.
- Put a price on carbon emissions like other countries are doing.

- Michigan – Solar Ready Program http://cec-mi.org/communities/programs/michigan-renewable-energy-tools/solar-ready-community/
- NH 10 year Transportation Plan and NH Energy Strategy should be consistent with on another because they are connected i.e. state owned and operated vehicles and EE. Include a broader look at achieving EE in buses, trucks, construction vehicles the State owns.
- Aggressive plan to monitor leaks from pipelines carrying methane gas.
- Develop a baseline study on the effect of fossil fuel on health and environment.

2

days until
the next CCL NH South Central chapter meeting at the Hooksett Library

Upcoming Events

October 19, 2017 - CCL NH South Central monthly meeting
Time: 6:00 pm - 7:30 pm
Hooksett Public Library
Agenda

October 28, 2017 - NH Local Energy Solutions Conference
Tabling Help Needed - contact John G
Grappone Center in Concord
"NH's premier conference dedicated to achieving clean energy success in the Granite State"
http://www.nhenergy.org/les-conference.html
https://www.nhsea.org/local-energy-solutions-conference

Anytime - Sign an on-line petition

1) **Our Climate**, An organization for young people to advocate for climate solutions - especially putting a price on carbon with a fee and dividend approach: http://www.ourclim.

2) http://putapriceonit.usConc NH 10:00 am - 3:00 pm

CCL NH Energy Strategy

Strategy For A Low Energy Cost, High Economic Growth Future For New Hampshire

Based on Global Greenhouse Gas Emissions Reduction Commitments and Growing Support to Price Carbon Emissions Nationally

http://CCLNHSouthCentral.org/ccl-nh-energy-strategy
John Gage - October 17, 2017

Summary

We continue to vote for fossil fuel options with our wallets, despite the costly problems we know their use and dependence cause. Efforts are underway to fix this market failure at the federal level with a revenue neutral carbon tax. It is growing increasingly likely that Congress will act, because every country in the world but one (Syria) has committed to aggressively reducing greenhouse gas emissions from fossil fuels. The resulting enormous clean energy market opportunity means addressing our energy market failure is a strategic imperative. When Congress does act, states that have prepared for the change will be best positioned to benefit from it.

New Hampshire has a lot to gain from a federal revenue neutral carbon pricing policy. State leaders can further increase our advantage by using proxy carbon pricing in current policy analysis, investing in energy efficiency, promoting smart-grid and electric transportation infrastructure, and can help accelerate the national schedule by endorsing a policy like Carbon Fee and Dividend as some municipalities in New Hampshire, and some other states, have done.

New investments in fossil fuel infrastructure are increasingly likely to become stranded costs due to events out of our state's control. Rather than place bets on a fossil fuel-oriented future, our state should promote businesses that provide clean energy solutions here at home and can be sold into the global clean energy market. New Hampshire's combination of a strong manufacturing base, technically skilled workforce, and proximity to higher education put us in a position of great advantage if we align the state with trends that are beyond our control. We should bet our state's future in the same direction that every other country, and every major reputable scientific organization from around the world, have taken on energy.

Outline

1. Energy market failure
2. Global energy trends and market opportunities
3. National and states' energy trends
4. National carbon pricing options, support, results, and benefits
5. A New Hampshire strategy

Previous Events

- CCL NH South Central Event History

Related Resources

- Our Climate
- Climate Interpreter
- NHSEA Calendar
- NHEnergy.org
- 350nh.org
- ECHO action
- Pipe Line Awareness Network for the Northeast
- FCNL
- Recruiting: Volunteer Match

Join Our Discussion

Join the Discussion

My recent activity

Energy Market Failure

- **Market Failure** occurs when there is an inefficient allocation of resources in a free market. Market failure can occur due to a variety of reasons, such as monopoly (higher prices and less output), negative externalities (over-consumed) and public goods (usually not provided in a free market) - link

- **Negative Externalities** occur when the consumption or production of a good causes a harmful effect to a third party - link

"Climate change is the greatest market failure the world has ever seen." - Nicholas Stern, lead economist and adviser to Prime Minister Tony Blair and a former chief economist of the World Bank, estimated that the costs of climate change, if not addressed, will be equivalent to losing 5 percent (and potentially as much as 20 percent) of the global gross domestic product (GDP) "each year, now and forever." Hundreds of millions of people could be threatened with hunger, water shortages, and severe economic deprivation - link

External costs of using fossil fuels

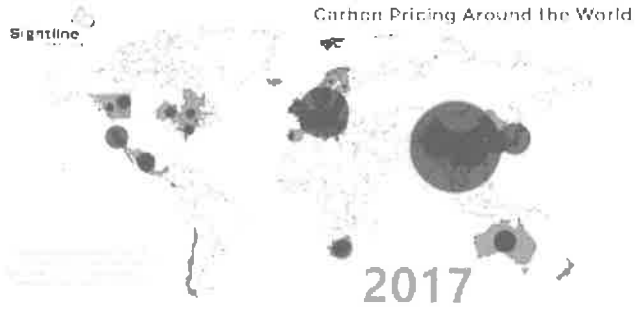
- IMF: $5 trillion in annual external costs of fossil fuel use globally - link
- World Economic Forum - 2016 Global Risks Report - link & link
  - Identified the failure of climate change mitigation and adaptation as the #1 most impactful threat to business in the next decade
  - Climate change will exacerbate water crises, impacting conflicts and forced migrations
  - Food security risks will increase due to climate change
- US Taxes: e.g. $10-30 billion in Middle East military bases & shipping to "protect our oil interests" - link
- US Subsidies: $6 billion in annual direct tax subsidies (oil depletion allowance, federal land lease deals, etc.)
- 10,000 deaths, and hundreds of billions of dollars per year in health care costs and lost productivity in the US from pollution - link
- Property rights losses; energy price instability; national security threat multiplier
- Costs associated with global warming, climate change, sea level rise, and ocean acidification - link
  - E.g. Disaster relief and lost economic potential (e.g. added strength and rainfall in 2017 Hurricanes Harvey, Irma, and Maria = $300 billion) - link
  - Old estimate of cost of carbon emissions in US: $36/Ton CO2e - link & link

Global Trends

Growing world commitment to address global warming from fossil fuel greenhouse gas emissions

- Paris Climate Accord - 196 countries committed to greatly reducing their greenhouse gas emissions
  - Only two countries did not join: Nicaragua had declined because the Accord did not go far enough, but has since joined. Syria is a failed state, and is now **the only country in the world** not in the Accord. The US has stated our intention to drop out but can not for three years (recently this intention has started to waver). No other country has stated such intention.

- Slideshow - 1990 to present - countries that have put a price on carbon emissions (in 2017 these countries make up 25% of the global economy) - link



- Globally, carbon pricing initiatives will play an increasing role, with about 100 Parties - accounting for 58 percent of global GHG emissions - planning or considering these instruments. - link
- France and UK - no new fossil fuel powered cars may be sold starting in 2040 - link
- UK - reduced greenhouse gas emissions by 40 percent since 1990 while growing the economy by over 60%
- European Commission road map - cut greenhouse gas emissions: 40% by 2030, 60% by 2040, and 80% by 2050 (below 1990 levels) - link

International Commerce & Trade Policy Changes

- CORSIA - global aviation fuel market-based carbon pricing - link

China

- 2017 - Planned construction of 100 new coal plants canceled - link
- 2017 - Will invest $361 billion in clean energy over the next three years - link
- 2017 - National auto cap and trade policy planned as part of goal to eliminate fossil fuel powered cars - link
- 2019 - National carbon emissions trading system will cover 25% of industrial emissions - link

Global Market Opportunity

Energy is 8% of global GDP. Who will meet the world's enormous clean energy demand?

China

- Centrally directed economy
- Focused on producing clean energy solutions
- Making significant investments
- Putting a price on carbon this year

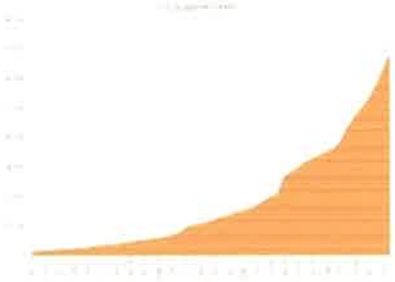
United States

- Direct subsidies: fossil fuel industry $6 billion/year, clean energy $1.3 billion/year
- Hundreds of billions of dollars/year of external costs from the use of fossil fuels
- Energy market failure is causing mis-informed consumer preferences, and short-sighted business investments
- Free market forces are not operating efficiently, which is reducing our potential and therefor our chances for success

National Trends

Momentum is Building to Correct the Energy Market Failure

- Citizens' Climate Lobby - 10 year old grassroots organization, endorsed by James Hansen, George Shultz, etc. - link
  - A national policy solution: Carbon Fee and Dividend - link, (two minute video link)
  - James Hansen's TED Talk - video link
  - CCL: Making Friends and Influencing Congress - link
  - CCL volunteer membership growth from 1000 to 82,000 in four years - link



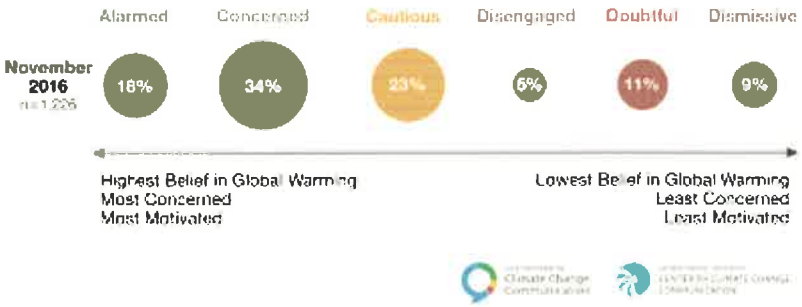
- Climate Leadership Council - new in 2017, endorsed by Ted Halstead, Hank Paulson, James Baker, Laurence Summers, etc. - link
  - The Conservative Case for Carbon Dividends - link
  - Ted Halstead's carbon pricing TED Talk - video link
- State actions (e.g. California: Carbon Fee and Dividend endorsement, Cap & Trade bill passed) - link
- FERC 2017 Technical Conference - pricing carbon emissions is the one thing all attendees could agree on - link
- NESCOE and ISO-NE - do not support carbon pricing (beyond RGGI) at state level, but acknowledge carbon pricing is the efficient solution - link
- Rex Tillerson - the fundamental business logic of carbon pricing - video link
- ExxonMobil - on the benefits of using a revenue neutral carbon fee (like Carbon Fee and Dividend or Carbon Dividends) to address the issue - link

Bipartisan House Climate Solutions Caucus

- Started in 2016, now with 60 members of Congress - 50% Republicans & 50% Democrats - link
- Cracking Washington's Gridlock to Save the Planet - link

Growing Awareness of the Urgency of the Problem

- Funding for Pentagon study of climate change impacts on national defense (46 Rs voted with Ds) - link & link
- Yale Climate Communications - 75% of Americans are Alarmed, Concerned, or Cautious about human-caused global warming - link



- Miami ($400 million bond for pumps), Boston (potential sea wall will cost more than the big dig) - link & link
- General Motors switching to all electric vehicles - link

America's Paris Accord Back-out Reaction

- States are acting (12 in US Climate Alliance - representing 30% of US population, 40% of US GDP) - link
- Cities are acting (369 US Climate Mayors, Cities endorsing Carbon Fee and Dividend, e.g. Portsmouth City Council) - link & link
- Businesses are acting (efficiency measures, proxy carbon pricing)
- ⅔ of Americans want to stay in the Paris Agreement

Carbon Pricing

We can fix the broken energy market by "internalizing the negative externalities". In other words, add the external cost into the cost of production, so that it is reflected in the price of the product downstream, and consumers can make fully informed purchasing decisions. - video link

- Shi-Ling Hsu - The Case for a Carbon Tax (Precis) - link
- US Treasury - Methodology for Analyzing a Carbon Tax - link

Business support for carbon pricing

Reasons for Business Support

- Addresses risk
- Avoids regulation
- Predictable
- Simple, transparent, fair
- Allows each to compete effectively

What O&G Majors Like about Carbon Pricing

- Drive efficiency improvements
- Favor natural gas over coal
- Support carbon capture sequestration
- Enable an orderly and efficient transition

Business Support for a Revenue Neutral Carbon Fee

ExxonMobil, Shell, GM, Johnson & Johnson, Pepsi, P&G, Schlumberger, Unilever, Santander, ...

- Business Climate Leaders - link
- CLC Founding Members - link
- World Bank: Why Business Leaders Support Carbon Pricing- link

The Carbon Fee and Dividend Policy Proposal

A market-based, revenue neutral, federal legislative solution that is viable, beneficial, & global in effect - link

1. A fee based on greenhouse gas emissions is charged on fossil fuels when they enter the economy (at the source of production - well, mine, port of entry), starting at $15/ton CO2e and increasing $10/ton each year

2. All the money collected (minus administration costs) is returned to American households monthly on an equal basis (1 share per adult, ½

share per child up to two children per household)

3. A border adjustment tariff is placed on goods imported from, or exported to, countries without an equivalent price on carbon

- CCL's methodology, growth and impact - link

Carbon Fee And Dividend Benefits

- The Regional Economic Modeling Incorporated (REMI) Report: National results in twenty years - link
  - Environment: 50% reduction of CO2 equivalent emissions
  - Economy: Add 2.8 million jobs (net) and $1.375 trillion to GDP
  - Health: Prevent 230,000 deaths from air pollution from coal
- **Regional benefits** for New England: net gain in jobs, economy and real income - link
  - REMI regional report: **$1000 gain in real personal income in 10 years, $1600 in 20 years** - link
  - Local household impact report: **Benefits to low and middle income families** - link
- Direct the power of efficient free market forces at the problem
- Position US industry to compete in the 21st century global market
- Reduce associated land, air, and water pollution
- Protect citizens' property rights
- Reduce geopolitical tensions (ie. Middle East, Russia), improve national security
- Save hundreds of billions each year in US health care, FEMA, defense costs

NH Strategy

1. Reduce Future Energy Costs Relative to Other States and Countries
   - Prevent stranded costs (e.g. from new natural gas infrastructure)
   - Reduce state carbon footprint in preparation for national carbon pricing
   - Discourage new fossil fuel use
   - Promote (preferably local) clean energy
   - Promote efficiency: to save money, create jobs, incubate products
   - Promote smart grid and storage technology development and use

2. Keep NH Energy Money In-state
   - Reduce spending on out of state resources ($4.9 billion in 2014)
   - Buy less (NH is #21 in energy efficiency - far behind other NE states)

3. Plan For Competitive Advantage
   - Use a proxy carbon price (some other states' PUCs are already doing it)
     - Businesses using Proxy Carbon Pricing - link
     - States using Proxy Carbon Pricing - link
   - Create a state ecosystem for clean energy and efficiency to incubate ideas and products, to create and promote businesses that will be able to sell into the global clean energy market (smart grid, storage, efficiency, etc) and attract a young, educated workforce
     - Encourage clean energy (infrastructure, use, products, and jobs)
     - Encourage energy efficiency (buildings, transportation, and jobs)
     - Job training - efficiency and clean energy deployment, manufacturing, etc.
     - Promote businesses that will meet needs of the global energy market

4. Prioritize Electric Infrastructure Investments
   - Transportation recharging stations
   - Prepare for smart grid deployment
   - No New Natural Gas Infrastructure is Required - NH Carsey Perspectives Report - link

5. Help Enable the US to Prosper
    - Endorse national revenue-neutral carbon pricing to help build the political will to enable Congress to pass Carbon Fee and Dividend Legislation
        - Leaders Letter - link
        - Businesses, local governments endorsement - link

Handouts

1. Shi-Ling Hsu - The case for a Carbon Tax
2. US Treasury - Method for Analyzing a Carbon Tax (page 26: the best results are obtained by returning all the money back to households)
3. Climate Leadership Council - The Conservative Case for Carbon Dividends
4. Citizen's Climate Lobby (CCL) - The Carbon Fee and Dividends Policy (and the CF&D Laser Talk as page 2)
5. REMI Report - National Economic and Environmental Report on the benefits of Carbon Fee and Dividend over 20 years (Macro-economic Study)
6. REMI Report - Regional (New England) benefits of Carbon Fee and Dividend over 20 years (Macro-economic Study)
7. Household Impact Study - National Impact of the first year of Carbon Fee and Dividend (Micro-economic Study)
8. Household Impact Study - Regional Impact of the first year of Carbon Fee and Dividend - NH District 1 & NH District 2 (Micro-economic Study)
9. UNH Carsey Perspectives - New Hampshire's Electricity Future: Cost, Reliability, and Risk
10. Lead NASA Climate Scientist, James Hanson Testifies to Congress in 1988 to Warn about Global Warming from Fossil Fuel Greenhouse Gas emissions
11. Union of Concerned Scientists - Exxon Knew in 1981 Global Warming From Fossil Fuel Greenhouse Gas Emissions Was a Serious Threat - (pages 2-3)
12. Some States are Using Shadow Carbon Pricing to Prepare for a National Policy (aka Proxy Carbon Pricing)

Presentation Format

- **http://bit.ly/CCL-NH-energy-strategy**

History

October 4, 2017 (JG) - NH Senate Energy Committee - Testimony for SB 125
October 2, 2017 (JG) - Discussion with Joe Doiron, Deputy Director & State Energy Program Administrator, Office of Strategic Initiatives
September 28, 2017 (JG) - Discussion with NH Senator Birdsell and Senator Avard about NH energy strategy
September 8, 2017 (JG) - Presentation to BIA's Economic and Fiscal Policy group
July 18, 2017 (JG) - Discussion with Dave Juvet about NH energy strategy

Comments

You do not have permission to add comments.

The Case for a Carbon Tax:
Getting Past Our Hang-ups to Effective Climate Policy
Island Press, 2011

Precis

Shi-Ling Hsu
Professor, Florida State University College of Law

The Case for a Carbon Tax sets out ten reasons to favor a carbon tax over the alternative policies of (1) government subsidies, (2) "command-and-control" style environmental regulation under the older parts of the Clean Air Act, and (3) cap-and-trade.

One: "Government is bad at picking winners, and losers are good at picking governments." The source of this famous saying is surprisingly hard to pinpoint. Its relevance to climate policy is hard to miss. When faced with a problem as large and daunting as climate change, there is a temptation to expect too much from governments. We demand that governments actually *solve* the problem, rather than create the conditions under which a solution is found. In an era of endless political campaigns and promises, voters in democratic countries have gotten accustomed to the idea that government should play the role of "fixer." This is mistaken thinking. Innovation in technology to reduce greenhouse gas emissions is going to have to come from the private sector. Above all, innovation requires a *price signal*. The whole point of a price signal is that it does not pick a winner; it lets markets do that. An appropriate price signal on the emissions of greenhouse gases will unleash a competition among innovators to come up with the best and cheapest technologies to reduce emissions.

Two: Economic efficiency. Not only do we want a competition among innovators and entrepreneurs finding ways to reduce emissions, economic efficiency demands that there be a *fair* competition. Without a "fair" competition, it is not assured that the lowest cost reductions will prevail. For example, regulating under the Clean Air Act does not set up a fair competition because in general, the U.S. Environmental Protection Agency has been politically forced to regulate under the Clean Air Act mostly by making industries just *do their best* to reduce pollution. There is nothing fair about letting coal-fired power plants pollute just because they tried their putative "best" to reduce their pollution. For years, the default regulatory option was to require that coal-fired power plants install scrubbers to reduce sulfur dioxide emissions. Alternative means of reducing emissions have

emerged that suggest scrubbers are not particularly cost-effective. Economic efficiency demands that the ultimate arbiter of environmental performance be the market, and not the E.P.A.

Fundamentally, an economy facing 21st century challenges must *sort* industries, top to bottom, by carbon dioxide emissions. A carbon tax does this. Especially in an era of falling natural gas prices, many older, less efficient coal-fired power plants cannot survive a competition in which carbon dioxide emissions are priced. This is precisely the kind of sorting that cannot be done efficiently by the Clean Air Act which, by commanding and controlling, basically asks each industry to try its best, with EPA's lenience and attentiveness doled out in rough proportion to each industry's political power. The simple genius of a carbon tax is that it aggregates disparate pieces of information throughout the economy, transmitting a price signal at every stage in which there is fossil fuel usage, and transmitting it in proportion to the carbon emissions of the production process.

Three: broader incentives to innovate. The Canadian province of British Columbia has in place a carbon tax of $30 per ton of carbon dioxide. I was a resident of British Columbia during the five-year phase-in period for the B.C. carbon tax. In 2009, with the B.C. carbon tax barely a year old, I undertook a large home renovation to increase living space. What surprised me was that my contractor was very aware of the carbon tax, and was able to tell me in very specific dollar terms what the carbon tax meant for my renovation project. He was thus able to explain how much shorter the payback periods were for energy-efficient options such as high-efficiency furnaces and windows and doors, solar water heating, and combined water and space heating equipment. How did a construction contractor become such an expert on the effects of the carbon tax? He had become an expert on the carbon tax was that he already had clients like me who had inquired and demanded that he do the analysis. This would have been unlikely under other systems with a less clear price signal.

Incentivizing innovation will require a broad price signal that ripples throughout the economy in order to take advantage of as many greenhouse gas reduction opportunities as possible. The strength of a carbon tax is it creates a broad, economy-wide price signal. Greenhouse gas reduction opportunities are diverse, and the only way to tap into all of them is to have a broad price signal. Pricing greenhouse gas emissions into energy prices sends a price signal that ripples throughout the entire economy, scrambling every single business in a search for a lower carbon footprint in the hopes that it can gain a price advantage over competitors.

Furthermore, because of the nature of regulating point sources of emissions, regulation of greenhouse gas emissions under the Clean Air Act can only be applied to a handful of facilities. Although this handful of facilities accounts for most of the greenhouse gas emissions, they are a small fraction of the number of facilities that emit. By regulating under the Clean Air Act, we miss the opportunity to tap into the entrepreneurial energies of that vast majority of emitting facilities.

Four: Deeper and steadier incentives to innovate. Many have already made the argument that command-and-control regulation is inefficient and ineffective. The most fundamental flaw of regulating greenhouse gas emissions command-and-control style under the Clean Air Act is that the price signal favoring low-carbon or non-carbon alternatives is one generated by an administrative process, rather than a market process. I do not revisit those arguments. The economists have won the debate, and almost everyone accepts that a price on carbon dioxide emissions is needed.

While very limited government subsidization of some research and development of renewable and alternative technologies may be warranted. But the most relevant choice is between cap-and-trade and a carbon tax. Cap-and-trade is an instrument whereby an overall limit, or "cap," is set on total national emissions, and emitters can trade amongst themselves in mostly unregulated market transactions to allocate those emissions. Although cap-and-trade and carbon taxes both encourage innovation to reduce emissions, the two are not equal in their ability to induce innovation. There are at least three ways in which a carbon tax will better encourage innovation than a cap-and-trade program. First, a carbon tax introduces a steadier price signal than cap-and-trade. Cap-and-trade sets the quantity of emissions, but lets the price fluctuate according to market demand. Investors interested in lower-carbon or non-carbon alternatives would rather not have price volatility. Second, if a cap-and-trade program is successful in encouraging innovation in greenhouse gas-reducing technologies, the ironic effect is that this innovation will reduce the price of emissions permits and thereby reduce the price incentive to innovate. A carbon tax, by contrast, represents a continuing price signal to find lower-carbon alternatives. Finally, if a cap-and-trade program gives away emissions permits instead of auctioning them – which history suggests politicians would much prefer – then emitters with these free permits will have less incentive to innovate because innovation would reduce the value of those emission permits. The free allocation of allowances creates an asset in the hands of emitters, something that does not happen under a tax regime. The fact that innovation could reduce the value of that asset is a disincentive for those emitters to find cost-saving innovations.

Five: carbon taxes do not subsidize the formation of capital. People seem to think that capital in the form of buildings, facilities, and structures is an unambiguously good thing. Most economists believe that capital accounts for the difference in wealth between developed countries and under-developed countries. But capital has a downside: when we discover that there is something harmful or inefficient about the expensive capital we have acquired, it can be very difficult to get rid of that capital.

The whole problem of climate change should have clued us in to this problem with capital. One reason that addressing climate change is so difficult is because the world has trillions of dollars' worth of coal-fired power plants that cannot be simply unplugged overnight and replaced with other energy sources. How did this happen? The line of thinking that led to the accumulation of excess capital went something like this: cheap electricity is an unambiguously good thing, because it lowers production costs and generally makes life better for the general populace. But cheap electricity requires expensive capital, and so government assistance to help form this capital must be a good thing, too. Coal for electricity generation has thus always been heavily subsidized, enjoying numerous tax benefits. The sale of coal itself can be eligible for taxation at a lower rate or may be deducted from income under a favorable "percentage depletion" method, which allows a deduction that *exceeds* the value of the coal itself. This has all been in the name of cheap electricity, but now we are stuck with all of this capital, and the owners of this capital will vigorously resist change that devalues their capital.

This specious line of thinking continues to haunt energy policy today, as we dream up even more ways to help the "right" technologies flourish, even those that maintain our coal-related physical capital. Unbelievably, the Internal Revenue Code even considers "refined coal" – coal that is treated to have lower emissions – eligible for the renewable energy production tax credit! Only a lawyer could find such an audacious interpretation of "renewable energy" plausible. A carbon tax is the only climate policy that does not subsidize the formation of capital.

Six: Respect for federalism. A carbon tax is the one climate instrument that allows individual states to truly pursue climate policy without interference from the federal government. There was a time when both Congress and a handful of Western states – those that were part of the "Western Climate Initiative" – were pursuing cap-and-trade programs in parallel. Cap-and-trade legislation died on Capitol Hill, and all of the states except California dropped out of the Western

Climate Initiative. But for a time, there was some talk of how the two cap-and-trade programs were going to be reconciled.

Why bother? Why not let states determine for themselves if and how zealously they wish to pursue climate policy? A carbon tax is the one instrument that can be applied at the state or federal level, or at both levels. Furthermore, a properly-designed carbon tax is compatible with other methods of greenhouse gas control.

Seven: Carbon taxes are administratively simpler. We have already dismissed Clean Air Act regulation as poor climate policy. Command-and-control regulation is administratively difficult. It turns out that cap-and-trade is also a headache. Whereas a carbon tax draws on existing tax collection procedures – such as those that already exist at the gasoline pump – cap-and-trade will require the development of a new agency group to monitor emissions permit trades. In the United States, which has already enjoyed, at least by Washington standards, a fairly smooth set-up and execution of the sulfur dioxide cap-and-trade program, the costs of setting up a greenhouse gas cap-and-trade program would be manageable, but non-trivial. A Congressional Budget Office report estimated that a 2007 cap-and-trade bill that passed the Senate Committee on Environment and Public Works would cost about $1.7 billion from 2009 to 2013 to implement, including the cost of hiring up to 400 new employees. This is not a lot of money for the federal government, but the United States is a wealthy country with an agency with experience in conducting cap-and-trade programs. Not only would some countries find a billion-dollar-plus price tag more challenging, some would find the set-up considerably more complicated. Several cases of online thievery have cast some doubt on the ability of even developed countries to maintain market integrity for emissions permits. By contrast, a carbon tax looks administratively very much like the kinds of sales taxes that even under-developed countries are able to implement. A program which has fewer administrative problems can be implemented more quickly, thereby addressing the problem of climate change sooner.

Eight: revenue raising. Even small-government libertarians would have to concede that if the revenues from a carbon tax were truly returned to taxpayers, taxing greenhouse gas emissions is better than taxing labor. In the United States, a carbon tax of $30 per ton would generate $145 billion in annual revenue, which could finance a ten percent cut in personal and corporate income taxes, and then some. How does an income tax cut sound to conservatives? Even if this is not pursued, cash-strapped governments at many levels could no doubt usefully restore funding to primary education, health care, policing, infrastructure, and other pressing needs that have been deferred, or redistribute carbon tax revenues

only to the poorest individuals and households, thereby preventing the carbon tax from being regressive.

Nine: international coordination. Almost every international treaty has sought to oblige signatories to abide in a certain common code of behavior. The Kyoto Protocol is an exception. By acknowledging "common but differentiated responsibilities," the Kyoto Protocol sets out a schedule by which developed countries must reduce their emissions but developing countries do not. The hope was that if the developed countries took the first step, developing countries would follow. This hope has failed spectacularly.

The plain reality is that China and India will not, in any time frame that could avoid climate change, consider quantitative limits on emissions as required by the cap-and-trade programs that the Kyoto Protocol seemed to contemplate. China and India are likely to be more open, however, to a global carbon tax. For one thing, governments get to keep the proceeds from a carbon tax, so that it does not smack of an externally imposed mandate that intrudes onto sovereignty. Also, a global carbon tax, insofar as it really looks more like international treaties that have been successfully negotiated in the past – in which signatories all agree to do the same thing – is a policy that is more likely than Kyoto to gain the kind of international agreement that will be needed to actually solve the climate policy problem. No one disputes that in order for greenhouse gas emissions to be reduced, global cooperation is required. A carbon tax stands a better chance of achieving this than the alternatives.

Ten: Economic efficiency, again. The world's most vibrant economies are fossil fuel-powered. So fundamental is fossil fuel combustion to economic health that it will take a long time, and much willpower, to sufficiently wean economies off of fossil fuels. A widespread and sustained effort to accomplish this is like dieting: as anyone who has ever been on a diet could tell you, it will take long-term resolution and commitment. Dieters will also be able to tell you that some days are better than others, but long-term habits are more important. A consistent carbon tax, annually adjusted for inflation, represents a long-term commitment. It is superior to cap-and-trade because a cap remains fixed no matter what happens in a given year (cap-and-trade programs may allow permit "banking" and "borrowing" across years, but that would only imperfectly simulate the flexibility offered by a carbon tax). In economic downtimes, carbon dioxide emissions fall; in those years having a "loose" cap is a missed opportunity to reduce emissions even more, and perhaps develop some lower-carbon "habits." Carbon dioxide emissions in Europe and in the United States dropped precipitously in 2009, enough to push these Kyoto signatories startlingly far towards meeting their

Kyoto commitments. Such a time of depressed asset prices would have been an excellent time to invest in emissions reductions, but only a carbon tax would have incentivized those investments, not cap-and-trade.

What a carbon tax does, which cap-and-trade and other alternatives do not, is to keep up a consistent and persistent price signal. In a year like 2009, the economic slowdown would have destroyed all price incentives to reduce carbon dioxide emissions. That would have been a year of missed opportunities to lock in some progress. Economic efficiency demands that the opportunities to reduce emissions be taken not just at the places where emissions reductions are the cheapest, but also *when* they are cheapest. A carbon tax allows that to happen, whereas a cap-and-trade program robotically demands the same amount of emissions reduction, year after year, no matter what the economic circumstances. This is not economically efficient.

Those are ten reasons for conservatives to favor a carbon tax.

So why are carbon taxes so politically unpopular? One reason is that we seem to have a political allergy to anything with the word "tax" in it. In fact, some research suggests that if we were to label this policy a "fee," people might be less likely to oppose it.

But euphemizing is not the answer. The answer is to persist in making the plainspoken argument that if emissions reductions are required, it will cost money. Carbon taxes are the *least* costly way of achieving emissions reductions. Politicians talking down to the electorate only reinforce dumb conventional "wisdoms." The dumb conventional wisdom we must debunk is that we can get something for nothing. This is the hidden strategy for politicians that advocate for broad government subsidies, command-and-control regulation ("punishing the polluter," eliding the fact that energy costs often get passed on to consumers), and to some extent cap-and-trade. There must be honest and realistic talk about the increased energy prices that everyone must pay, as well as the economic and social consequences of failure to act. The case must be also laid out for how a carbon tax is the instrument that minimizes that cost and minimizes governmental interference.

Some are also concerned that carbon taxes are regressive, because raising energy and transportation costs would disproportionately hurt poorer households, for whom energy and transportation costs are a larger fraction of their budget. But recycling the revenues from a carbon tax can fix this. A redistribution of just a fraction of carbon tax revenues can make poor households whole. Moreover, even

without such a revenue distribution targeting poor households, a carbon tax would be, on the grand scale of things, one of the smallest insults visited upon the poorest Americans.

Reducing greenhouse gases will require significant changes in the way that we generate and consume electricity. Governments are not very good at orchestrating these kinds of changes. Private enterprises like Microsoft, Google, and Apple Computer are very good at changing large-scale behavior very quickly. Given that some very quick and large-scale ramp-up in renewable energy technologies is needed, the way to support renewable energy is to tax all things carbon, not try to subsidize things non-carbon. Ultimately, trying to subsidize, mandate, or otherwise prop up all things non-carbon has this pushing-on-a-string futility.

Fortunately, opposition to carbon taxes is a mile wide but an inch deep. Resistance to carbon taxes are based on broad but superficial misperceptions which can be broken down with persistent, simple, plain-spoken messaging. The message that needs to be conveyed is that all plans for reducing emissions will cost money. Even if some policies to reduce emissions do not *obviously* cost money, ultimately people pay, be it as taxpayer, automobile owner, electricity user, or just a consumer of goods in a fossil-fuel-powered economy. A "tax" only *sounds* worse than everything else. In reality, a carbon tax is the least costly way of reducing emissions, especially when the revenues are recycled back into the economy. A carbon tax offers the most opportunities to reduce emissions, giving society the chance to choose from the widest variety of ways to reduce emissions, and to choose the least costly ones. Finally, a carbon tax is something that can be easily and quickly deployed, because it can be implemented much like a sales tax, making it feasible for almost any country or any state or province. A carbon tax is the best option for reducing greenhouse gas emissions.

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See chart on page 26 Full dividend yields best economic results

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Methodology for Analyzing a Carbon Tax

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I. Introduction

Treasury's Office of Tax Analysis (OTA) is responsible for estimating the revenue, economic, and distributional effects of current and alternative tax systems, including individual, business, estate, and excise tax systems. The purpose of this technical paper is to document the methodology OTA would use to estimate the revenue and distributional effects of a carbon tax. Carbon taxes have been sufficiently widely discussed that a technical assessment of the issues involved was warranted. In addition to describing the office's methodology, this technical paper lays out several of the tax policy issues that would be involved in implementing such a tax.

The majority of the tax issues involved with a carbon tax are straightforward and would be consistent with U.S. policy experience with other excise taxes in terms of how the tax could be implemented and administered and how OTA would assess its revenue and distributional effects. Other issues involve broader changes to the U.S. tax system and are not part of standard excise tax analysis. In particular, because a carbon tax would raise substantial revenue, at least in early years, and because this revenue is likely to enter general revenue (unlike other excise taxes whose revenues are typically invested in trust funds with specific spending mandates), a carbon tax would allow Congress to reduce other taxes if desired in a so-called "tax swap." Such a reduction in other taxes would raise its own set of tax policy issues in terms of timing, distributional effects, and tax administration.

The analytical and methodological issues can be more readily understood in the context of a specific example. To examine the effects of a sample carbon tax, OTA estimated the 10-year revenue effects of a carbon tax that started at $49 per metric ton of carbon dioxide equivalent (mt CO_2-e) in 2019 and increased to $70 in 2028. We estimate that such a tax would generate net revenues of $194 billion in the first year of the tax and $2,221 billion over the 10-year window from 2019 through 2028. This revenue could finance significant reductions in other taxes. In 2019, this carbon tax revenue would represent approximately 50 percent of projected corporate income tax payments or 20 percent of the OASDI portion of the payroll tax. If the revenue were rebated to individuals it would amount to $583 per person in the U.S. The last section of the paper uses Treasury's Distribution Model to provide distributional analysis of this sample tax and four possible tax swaps. Distributional analysis is particularly valuable in this context for guiding the choice of the tax swap to address possible equity considerations.

Proposals for a carbon tax are often accompanied by recommendations for changes in Federal spending (e.g., research into energy efficiency or renewable energy generation; geoengineering) or changes in environmental regulations. These items are outside the expertise of OTA and are not discussed here.

II. Revenue Estimation and Design Issues

1. The tax base – What would be taxed?

Any assessment of the revenue and distributional effects of a tax must be predicated on a choice of what the base of the tax would be and at which points the tax would be collected. Because the U.S. does not currently have a carbon tax or other excise taxes of a similar scope, some basic assumptions regarding what the base of the tax could be are necessary. This section provides a discussion of the issues in determining the tax base in terms of administrative burden, compliance, and coverage of greenhouse gas emissions.

We divide the potential tax base into three categories:[6] (i) fossil fuel emissions; (ii) non-fuel emissions, including industrial process and product use emissions, emissions of fluorinated gases, and other emissions not counted as fossil fuel emissions; and (iii) biomass fuels such as ethanol. Non-carbon-based energy sources such as nuclear, wind, solar, and geothermal do not emit greenhouse gases and would not be taxed. Although land-use-based and other non-point emissions, such as from soil management, livestock, or deforestation, might eventually be covered in some way by a carbon tax system, this paper does not address the issues that such coverage would involve.

a. Fossil Fuel emissions

Fossil fuel combustion represents roughly 76 percent of U.S. greenhouse gas emissions.[7] Essentially all of these could be covered by an excise tax levied on coal, natural gas, and petroleum at distinct points in the supply chain. A streamlined set of taxable activities and a straightforward taxable unit would give the fossil fuel component of the carbon tax a light administrative burden.

Fossil fuel emissions could be taxed using either a so-called "upstream" or "midstream" approach. The approaches differ on the point in the supply chain at which the fuel's emissions would be taxed: An upstream approach taxes raw fuels while a midstream approach taxes fuels at a designated point further down the supply chain but before they reach final consumers. A hybrid of the two approaches is also possible.

Under an upstream system, an excise tax would be levied on (i) crude oil as it reaches the refinery, (ii) natural gas as it leaves the processor to enter a pipeline system or, for gas that bypasses the processor or pipeline system, arrives at the end user, and (iii) coal as it leaves the mine. To be consistent with a carbon tax focused solely on domestic use, fuel imports would be taxed and exports would be eligible for a refundable tax credit. Aviation fuels used in foreign trade, a designation that includes international flights, would be exempt from the tax. Carbon dioxide captured from a fossil fuel plant or through industrial processes and permanently stored would be eligible for a refundable tax credit.[8]

Fuels or fuel products that are delivered to uses that do not release emissions, such as waxes, lubricants, solvents, or chemical feedstocks, would be exempted from the tax or could claim a credit. An upstream system would need to promulgate rules to govern such exemptions and credits. This issue does not arise to any great degree under a midstream tax, which aims to tax only those fuel products that are destined to be combusted.

Under a midstream system, an excise tax would be levied on (i′) petroleum-based fuels as they leave the refinery or are otherwise sold for use, an arrangement referred to as being imposed at the "terminal rack," (ii′) natural gas as it leaves local distribution centers, and (iii′) fuels used by electric generating facilities or other industrial users that have not been previously taxed. A hybrid upstream/midstream

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[6] Tax categories do not necessarily conform to categories in the Greenhouse Gas Inventory (EPA, 2016a), the Greenhouse Gas Reporting Program (EPA, 2016b), or the Intergovernmental Panel on Climate Change.

[7] OTA estimate based on Environmental Protection Agency (EPA) and Energy Information Administration data.

[8] Treatment of imports, exports, aviation fuels, and captured carbon dioxide is the same under both upstream and midstream approaches.

approach that taxed natural gas and coal upstream and petroleum products midstream is also possible.

Under either upstream or midstream approach, the tax would be based on the imputed carbon dioxide emissions per unit of fuel. Table 1 shows candidate imputed emissions and per-fuel-unit taxes that would apply under the upstream and midstream approaches assuming a tax of $49 per metric ton of carbon dioxide equivalent (mt CO_2-e). A per-unit fuel tax would be cost-effective because each of these fuels' carbon dioxide emissions are essentially invariant to how the fuel is burned:[9,10] A high mileage car emits essentially the same amount of carbon dioxide per gallon of gasoline as a low mileage car, although of course, the high mileage car can go much further on that gallon of gasoline.

The carbon content of coal is more variable than the carbon content of refined fuels or natural gas. Under the imputed-emissions approach shown in Table 1 the tax would depend only on the type of coal and would not distinguish within coal of a given type. We therefore would expect consumers of each coal type to engage in some degree of "arbitrage." Coal consumers of each coal type would likely seek out coal sources that yielded higher amounts of energy per unit of tax, causing average carbon dioxide emissions for different coal types to be greater than the parameters shown in Table 1. We have not attempted to predict how large an effect this might be. To minimize distortions, the Secretary of the Treasury could be provided the authority to update periodically the carbon-content parameters used to construct the coal taxes in a way that reflects changes over time in the carbon content of coal coming to market. In the upstream tax case, similar concerns may apply to variability in the carbon content of crude oil.

Under an upstream system, crude oil would be taxed based on its total carbon content regardless of the fuels and products it is used to produce. This approach is necessary to ensure the tax falls fully on those fuel products that are later used for energy purposes. Fuels and fuel products whose emissions were substantially lower than the Table 1 coefficients would be eligible to claim a credit based on their lower emissions. This treatment may be somewhat challenging for taxation of non-fuel petroleum products that emit greenhouse gases as they breakdown over time. Secretarial discretion would be needed to define which products have emissions that are not accurately reflected in Table 1.

For electric generating facilities and other stationary combustion sources, a midstream approach could instead tax actual emissions, as measured by a continuous emissions monitoring system, rather than the fuel inputs. A measured emissions tax would not presently be possible for transport fuels or natural gas used directly by residences or commercial establishments; for these uses, some form of fuel-based tax would still be required.[11] Under a measured emissions tax, emissions from renewable fuels at electric generating facilities and other point sources would initially be taxed at the same rate as emissions from fossil fuels but they could be made eligible to claim full or partial credit based on the renewable fuel used, depending on how the system wishes to treat renewable fuels.

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[9] Fossil fuel combustion also releases small amounts of methane and N_2O and these are not invariant to the circumstances of combustion. Table 1 taxes are based solely on each fuel's CO_2 emissions. Tax legislation would determine whether the Table 1 parameters should be modified to incorporate non-CO_2 emissions or whether the non-CO_2 emissions would be covered separately as a form of industrial emission.

[10] Under an upstream system, imports of refined fuels would be taxed and exports provided a credit at the midstream rates shown in Table 1.

[11] A measured emissions tax would require writing new tax guidance for emissions measurement. Fuel-based taxes would be able to take advantage of existing guidance on fuels measurement.

Comparison of upstream and midstream approaches. Our assessment is that the upstream, midstream, or upstream-midstream hybrid approaches would tax essentially the same quantity of fossil-fuel-based emissions, with minor differences. One exception is that a midstream system would not readily cover emissions from petroleum fuels burned at the refinery. Under a midstream system, those emissions would presumably be covered instead as industrial (non-fuel) emissions, described below.

Our assessment is further that under any of these approaches the carbon tax could be collected through modest modifications to existing Form 720, the tax form on which existing federal excise taxes are reported. Furthermore, under any of the approaches, the carbon tax could, if desired, readily be imposed on top of existing fuel and energy taxes and those Federal tax revenues could continue to flow to the Highway Trust Fund, Oil Spill Liability Trust Fund, Leaking Underground Storage Tank Trust Fund, Black Lung Disability Trust Fund, and related entities.

Differences between the upstream and midstream approaches arise instead primarily from (i) the time needed to write necessary tax guidance (a function, in part of the number of taxable activities and the availability of existing tax guidance), (ii) the number and sophistication of the taxpayers and the variety of taxable activities involved, which together affect longer-term compliance and administration concerns, and (iii) the number of products or fuel uses that should be exempted from the tax or, conversely, the number of fuel uses that might be missed by the chosen tax point.[12] A midstream approach would entail fewer exemptions for non-emitting uses compared to the upstream approach but would involve a larger number of tax filers. In general, tax administration has historically been able to deal effectively with exemptions to taxable activities; this experience is particularly relevant to the upstream tax approach.

[12] In essence, tax analysis must consider errors of both Type I (fuel uses that would be taxed even though they do not release greenhouse gases) and Type II (fuel uses that would not be taxed even though they release greenhouse gases).

Table 1. CO_2 content and tax rates for fossil fuels @ $49/metric ton of carbon dioxide equivalent (mt CO2-e)		
Fuel	**CO_2 content[1]**	**Tax @ $49/mt CO_2-e**
Natural gas and coal *(Upstream or midstream approach)*[2]		
Natural gas	53.12 kg/mcf	$2.60/mcf
Anthracite	2,578.68 kg/short ton	$126.36/short ton
Bituminous	2,236.80 kg/short ton	$109.60/short ton
Sub-bituminous	1,685.51 kg/short ton	$82.59/short ton
Lignite	1,266.25 kg/short ton	$62.05/short ton
Petroleum		
Midstream approach (representative fuels):		
Gasoline	8.89 kg/gallon	$0.44/gallon
Diesel, home heating oil	10.16 kg/gallon	$0.50/gallon
Jet fuel	9.57 kg/gallon	$0.47/gallon
Upstream approach:		
Crude oil	432 kg/bbl[3]	$21.17/barrel

[1] Source: http://www.eia.gov/environment/emissions/co2_vol_mass.cfm. CO_2 content parameters represent OTA's assessment of tax-relevant emissions and should not be considered definitive for any carbon tax that may be enacted.
[2] For natural gas and coal, upstream and midstream approaches differ in the point in the supply chain at which the fuel is taxed but not the form of the fuel or the per-unit fuel tax at the point of taxation.
[3] Source: https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references

Tax guidance. A variety of existing tax rules and (non-tax) regulations provide language and protocols that could be used to issue the tax guidance necessary for a carbon tax, including definitions of taxable activities.

For an upstream point of taxation for crude oil, the current tax levied for the Oil Spill Liability Trust Fund (OSLTF), described in Internal Revenue Code (IRC) Section 4611, would provide essentially all required guidance, although additional guidance would be required for an export tax credit, which is not currently provided; our assessment is that this credit would be relatively straightforward. Crude oil derived from tar sands is currently exempt from the OSLTF tax but is assumed to be subject to an upstream carbon tax.

For a midstream approach for petroleum-based emissions, which would tax refined fuels, the IRC defines the fuels currently subject to tax as well as establishes the tax rates, relevant taxable events, and exemptions, and imposes registration requirements for blenders, producers, enterers, terminal operators and others. Applicable regulations and other IRS administrative guidance provide further detail and information on taxable fuels.[13] The Leaking Underground Storage Tank (LUST) tax covers all carbon-emitting motor fuels and further includes home heating oil and other refined products not subject to the more prominent taxes that finance the Highway Trust Fund or Airport and Airways Trust Funds, which include exemptions for off-road and non-transport fuel uses, among others. In addition, LUST exempts

[13] IRS Publication 510 (https://www.irs.gov/pub/irs-pdf/p510.pdf) provides a thorough and comprehensive compilation of the rules, definitions and administrative requirements relating to the fuel excise taxes.

(which is used by CBO).[36] The CEX is the only data set with detailed consumption information and it is the common source of data for carbon tax distributions. However, as mentioned above, the CEX has weaknesses as a source of information on total income, especially for families at the lower end of the income distribution. To better measure total consumption, the TDM uses tax data to measure income and taxes and the Survey of Consumer Finances to measure savings. The TDM uses the CEX only to partition the TDM's estimate of total consumption into commodity shares.

Treasury's imputation from the CEX also accounts for family size. The CEX, in its published tables by income decile, does not adjust for family size.[37] Its lowest income quintile has an average family size of 1.7 and its highest income decile has an average family size of 3.2. Family size affects returns to scale in consumption and it affects a family's relative well-being so it needs to be considered both when ranking families and when imputing consumption to families.[38] Without taking family size into account, it is not possible to tell if the larger share of total consumption spent by low-income families on certain carbon intensive goods is because the families are low income or because they have few members and are therefore unable to benefit from returns to scale. In the TDM, we rank families with the same income but more members lower and impute consumption based on both family size and consumption rank so we can better measure consumption shares for low and high income families.

b. Results: Distribution under four tax swaps

Table 6 shows the distributional effects of recycling all of the net revenue from the $49 per metric ton carbon tax. We considered four illustrative options for revenue recycling: (1) providing a fully refundable per person tax credit, (2) lowering the OASDI payroll tax rate, (3) lowering the corporate tax rate and (4) a combination of a per person credit, payroll tax cut and corporate tax cut. Each recycling option is static (assumes no change in family income) and revenue neutral (when combined with the carbon tax) in the first year of the tax. Lowering the payroll tax rate or corporate tax rate may result in shifting income between taxable and nontaxable compensation or shifting income between the corporate and non-corporate sector; these effects are not considered in these tables. The tax swap policies are chosen solely for illustrative purposes.

The first three columns of the table are for reference and show the distribution of families, income and average federal tax rates by income decile. Column 4 shows the carbon tax without revenue recycling, the same result as found in Table 5 and also included for reference. Columns 5 thru 8 show each recycling option. (i) Combining the per person rebate with the carbon tax results in a very progressive change in tax burdens. The TDM estimates that the poorest decile would experience almost a 9 percent increase in average after-tax income compared to a 1 percent decrease in average after-tax income for the top income decile. (ii) Combining a reduction in the OASDI payroll tax rate with the carbon tax would be distributionally neutral with only the very top of the income distribution (the top 1 percent) experiencing an average net decrease in after-tax income greater than 0.5 percent.[39] (iii) Combining a

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[36] When ranking by consumption and following the uses method, Cronin, Fullerton and Sexton (2016) find similar results.

[37] See "Table 1. Quintiles of income before taxes: Average annual expenditures and characteristics, Consumer Expenditure Survey, 2014" available on the Bureau of Labor Statistics website: http://www.bls.gov/opub/reports/consumer-expenditures/2014/home.htm#tableC

[38] See Cronin et. al. (2012) for a discussion of family size adjustments in distributional analysis.

[39] These results are for vertical equity only. As a class each decile is estimated to have only small changes in after-tax income from the combination of a payroll tax cut and carbon tax. Some families within each class, however, may be winners

reduction in the corporate tax rate with the carbon tax would be a regressive change in tax burdens. The bottom 90 percent of families in the income distribution would experience an average decrease in after-tax income but the top 10 percent would experience an average increase in after-tax income. The top 0.1 percent would be expected to increase income by about 6 percent on average under the carbon tax plus corporate rate cut. (iv) Combining the carbon tax with a revenue neutral mix of a per person rebate, payroll tax cut and corporate rate cut gives mixed results. The bottom and top of the income distribution would experience average net increases in after-tax income whereas the middle of the distribution would experience only small average changes in after-tax income.

Table 6: The Distribution of $49/mt Carbon Tax and Revenue Recycling Options

Adjusted Family Cash Income Decile	Number of Families (millions)	Distribution of Cash Income (%)	Current Law Federal Tax Burden as a % of Cash Income (%)	Change in After-Tax Income				
				No Revenue Recycling (%)	$583 Per Person Rebate (%)	Reduce OASDI Payroll Tax Rate (%)	Reduce Corporate Tax Rate (%)	1/3 Rebate, 1/3 Payroll 1/3, Corp Tax Cut (%)
0 to 10	16.4	1.0	-10.3	-0.8	8.9	0.0	-0.5	2.8
10 to 20	17.2	2.1	-4.4	-1.2	4.7	0.0	-1.0	1.3
20 to 30	17.2	2.8	1.4	-1.4	3.1	0.1	-1.1	0.7
30 to 40	17.2	3.7	5.6	-1.5	2.0	0.0	-1.1	0.3
40 to 50	17.2	5.0	9.2	-1.6	1.2	0.1	-1.1	0.1
50 to 60	17.2	6.6	12.3	-1.7	0.6	0.1	-1.1	-0.1
60 to 70	17.2	8.5	15.0	-1.8	0.1	0.2	-1.0	-0.3
70 to 80	17.2	11.2	17.6	-1.8	-0.3	0.3	-1.0	-0.3
80 to 90	17.2	15.5	20.9	-1.8	-0.7	0.4	-0.8	-0.4
90 to 100	17.2	45.1	29.0	-1.5	-1.0	-0.3	1.5	0.0
Total	172.1	100.0	21.0	-1.6	0.0	0.0	0.0	0.0
90 to 95	8.6	11.2	23.3	-1.8	-1.0	0.3	-0.6	-0.4
95 to 99	6.9	15.2	25.5	-1.6	-1.1	-0.2	0.1	-0.4
99 to 99.9	1.5	9.4	32.7	-1.4	-1.2	-0.9	2.1	0.0
Top .1	0.2	9.4	37.7	-0.7	-0.7	-0.6	6.3	1.7

(experience tax cuts) and others may be losers (experience tax increases).

3

CLIMATE LEADERSHIP COUNCIL

THE CONSERVATIVE CASE FOR CARBON DIVIDENDS

How a new climate strategy can strengthen our economy, reduce regulation, help working-class Americans, shrink government & promote national security

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February 2017

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ABOUT THE CLIMATE LEADERSHIP COUNCIL

The Climate Leadership Council is an international research and advocacy organization whose mission is to mobilize global opinion leaders around the most effective, popular and equitable climate solutions. As a central part of this mission, the Council develops and promotes new policy frameworks based on carbon dividends for each of the largest greenhouse gas emitting regions. Currently active in Washington and London, the Council will expand to Berlin, Beijing and New Delhi next. Find out more at www.clcouncil.org.

THE NEED FOR A CONSERVATIVE CLIMATE SOLUTION

Mounting evidence of climate change is growing too strong to ignore. While the extent to which climate change is due to man-made causes can be questioned, the risks associated with future warming are too big and should be hedged. At least we need an insurance policy. For too long, many Republicans have looked the other way, forfeiting the policy initiative to those who favor growth-inhibiting command-and-control regulations, and fostering a needless climate divide between the GOP and the scientific, business, military, religious, civic and international mainstream.

Now that the Republican Party controls the White House and Congress, it has the opportunity and responsibility to promote a climate plan that showcases the full power of enduring conservative convictions. Any climate solution should be based on sound economic analysis and embody the principles of free markets and limited government. As this paper argues, such a plan could strengthen our economy, benefit working-class Americans, reduce regulations, protect our natural heritage and consolidate a new era of Republican leadership. These benefits accrue regardless of one's views on climate science.

THE FOUR PILLARS OF A CARBON DIVIDENDS PLAN

1. A GRADUALLY INCREASING CARBON TAX

The first pillar of a carbon dividends plan is a gradually increasing tax on carbon dioxide emissions, to be implemented at the refinery or the first point where fossil fuels enter the economy, meaning the mine, well or port. Economists are nearly unanimous in their belief that a carbon tax is the most efficient and effective way to reduce carbon emissions. A sensible carbon tax might begin at $40 a ton and increase steadily over time, sending a powerful signal to businesses and consumers, while generating revenue to reward Americans for decreasing their collective carbon footprint.

2. CARBON DIVIDENDS FOR ALL AMERICANS

All the proceeds from this carbon tax would be returned to the American people on an equal and monthly basis via dividend checks, direct deposits or contributions to their individual retirement accounts. In the example above, a family of four would receive approximately $2,000 in carbon dividend payments in the first year. This amount would grow over time as the carbon tax rate increases, creating a positive feedback loop: the more the climate is protected, the greater the individual dividend payments to all Americans. The Social Security Administration should administer this program, with eligibility for dividends based on a valid social security number.

3. BORDER CARBON ADJUSTMENTS

Border adjustments for the carbon content of both imports and exports would protect American competitiveness and punish free-riding by other nations, encouraging them to adopt carbon pricing of their own. Exports to countries without comparable carbon pricing systems would receive rebates for carbon taxes paid, while imports from such countries would face fees on the carbon content of their products. Proceeds from such fees would benefit the American people in the form of larger carbon dividends. Other trade remedies could also be used to encourage our trading partners to adopt comparable carbon pricing.

4. SIGNIFICANT REGULATORY ROLLBACK

The final pillar is the elimination of regulations that are no longer necessary upon the enactment of a rising carbon tax whose longevity is secured by the popularity of dividends. Much of the EPA's regulatory authority over carbon dioxide emissions would be phased out, including an outright repeal of the Clean Power Plan. Robust carbon taxes would also make possible an end to federal and state tort liability for emitters. To build and sustain a bipartisan consensus for a regulatory rollback of this magnitude, the initial carbon tax rate should be set to exceed the emissions reductions of current regulations.

HELPING WORKING-CLASS AMERICANS

President Donald J. Trump's electoral victory stems in large part from his ability to speak to the increasing frustration and economic insecurity that many voters feel the political establishment has failed to address. This frustration has found expression in a growing populist sentiment and yearning for fundamental change. A carbon dividends plan responds to these powerful trends.

Relieving Economic Anxiety

Today's economic insecurity is driven by both technological progress and globalization. As such, it does not lend itself to easy answers. A carbon dividends program provides a rare exception: a simple idea that strengthens the economy and elevates the economic prospects of the nation's disaffected. The Department of Treasury estimates that the bottom 70% of Americans would come out ahead under such a program. Carbon dividends would increase the disposable income of the majority of Americans while disproportionately helping those struggling to make ends meet. Yet these dividends are not giveaways; they would be earned based on the good behavior of minimizing our carbon footprints.

Redirecting Populism

Increasingly, voters feel that the American political and economic system is rigged against their interests. Populism threatens the current policy consensus in favor of liberalized trade and investment. The best remedy is to redirect this populist energy in a socially beneficial direction. Carbon dividends can do just that based on a populist rationale: We the People deserve to be compensated when others impose

> *Carbon dividends would increase the disposable income of the majority of Americans while disproportionately helping those struggling to make ends meet*

climate risks and emit heat-trapping gases into our shared atmosphere. The new ground rules make intuitive sense: the more one pollutes, the more one pays; the less one pollutes, the more one comes out ahead. This, for once, would tip the economic scales towards the interests of the little guy.

STRENGTHENING OUR ECONOMY

Incentivizing Growth & Innovation

An ideal climate strategy would simultaneously reduce carbon emissions and steer America towards a path of more durable economic growth. A carbon dividends plan can do exactly that. A carbon tax would send a powerful market signal that encourages technological innovation and large-scale substitution of existing energy and transportation

> *This plan would steer America towards more durable economic growth by encouraging technological innovation and stimulating new investment*

infrastructures, thereby stimulating new investment. Second, the plan would offer companies, especially those in the energy sector, the predictability they now lack, thus removing one of the most serious impediments to longer-term capital investment. Third, because many regulations would become unnecessary, the plan would give companies the flexibility to reduce emissions in the most efficient way.

The Immediate Impact of Future Policy

A well-designed carbon dividends plan would further contribute to economic growth through its dynamic effects on consumption and investment. Just as central banks rely on forward guidance to influence future market expectations, if investors know that a carbon tax will increase steadily over time, the stimulatory effect of the final tax rate would be felt almost immediately for infrastructure and utility projects, especially ones that have long-term paybacks. In addition, forward-looking households would have an incentive to borrow to make durable purchases that would reduce their carbon footprint. Congress might even consider allowing individuals to borrow against their future dividend income for certain clearly defined purposes, such as higher education or the purchase of an electric vehicle.

SHRINKING THE SIZE OF GOVERNMENT

Less Government, Less Pollution

In order to separate the consideration of carbon taxes from debates over size of government, most carbon tax proposals are now revenue-neutral. This proposal, however, would go one step further by shrinking the overall size of government and streamlining the regulatory state. Eliminating or phasing out an array of energy-related regulations would reduce government bureaucracy, promote economic growth and free up the financial and personnel resources now allocated to administer and comply with these programs. A gradually increasing carbon tax would also eliminate the rationale for ever more heavy-handed regulations of greenhouse gas emissions in future years.

The Essential Link Between Carbon Taxes, Dividends & Regulatory Relief

For the elimination of heavy-handed climate regulations to withstand the test of time and not prove highly divisive, they must be replaced by a market-based alternative. Our policy is uniquely suited to building bipartisan and public support for a significant regulatory rollback. It is essential that the one-to-one relationship between carbon tax revenue and dividends be maintained as the plan's longevity, popularity and transparency all hinge on this. Allocating carbon tax proceeds to other purposes would undermine popular support for a gradually rising carbon tax and the broader rationale for far-reaching regulatory reductions.

STABILIZING AN UNSTABLE WORLD

Our reliance on fossil fuels contributes to a less stable world, empowers rogue petro-states and makes us vulnerable to a volatile world oil market. Carbon dividends would accelerate the transition to a low-carbon global economy and domestic energy independence. Not only would this help prevent the destabilizing consequences of climate change, it would also reduce the need to protect or seek to influence politically vulnerable oil-producing regions. With our electric grids susceptible to cyber attacks, a transition to cleaner power sources combined with new distributed storage technologies could also strengthen national security. Carbon pricing would also encourage domestic nuclear energy, further promoting climate stability and America's energy independence.

> *"Many carbon tax proposals are revenue-neutral. This proposal goes one step further by shrinking the overall size of government and streamlining the regulatory state*

CONSOLIDATING CONSERVATIVE LEADERSHIP

A Popular Solution to a Widely Shared Concern

The opposition of many Republicans to meaningfully address climate change reflects poor science and poor economics, and is at odds with the party's own noble tradition of stewardship. A carbon dividends plan could realign the GOP with that longstanding tradition and with popular opinion. Recent polls indicate that 64% of Americans worry a great deal or a fair amount about climate change, while a clear majority of Republicans acknowledge that climate change is occurring. Meanwhile, one telling survey finds that 67% of Americans support a carbon tax with proceeds returned directly to them, including 54% of conservative Republicans.

Appealing to Younger Voters, Latinos & Asians

Concern about climate change is greatest among Americans below the age of 35, Latinos and Asians. And it is, of course, younger voters who hold the key to the future political fortune of either party. Increasingly, climate change is becoming a defining issue for this next generation of Americans, which the GOP ignores at its own peril. Meanwhile Asians and Hispanics – the fastest growing demographic groups – are also deeply concerned about climate change. A carbon dividends plan offers an opportunity to appeal to all three key demographics, while illustrating for them the superiority of market-based solutions.

POLICY FINE PRINT

A carbon tax should increase steadily and predictably over time so that companies and consumers can plan accordingly, and the previously mentioned economic stimulatory effects can be harnessed. At the completion of a five year period, a Blue Ribbon Panel could recommend whether the tax rate should increase further, based on the best climate science available at the time. Provisions must be established for the unbanked to receive their monthly dividend checks, possibly through commercial services such as PayPal or Western Union. The dividend income should be tax-free. Exports by companies in sectors with greater than 5% energy cost in final value should have any carbon taxes rebated on leaving the United States. Finally, non-emissive fossil fuel products (e.g. asphalt for road use) should be exempt, with a refund for any tax previously paid.

> *With the privilege of controlling all branches of government comes a responsibility to exercise wise leadership on climate policy and promote a solution that showcases the full power of enduring conservative convictions*

THE IMPERATIVE TO LEAD

With the privilege of controlling all branches of the government comes a responsibility to exercise wise leadership on the defining challenges of our era, including global climate change. It is incumbent upon the GOP to lead the way rather than look the other way. Republicans now have a rare opportunity to set the terms of a lasting market-based climate solution that warrants bipartisan, industry and public support. No less important, this is an opportunity to demonstrate the power of the conservative canon by offering a more effective, equitable and popular climate policy based on free markets, smaller government and dividends for all Americans.

CLIMATE
LEADERSHIP
COUNCIL

Real Income:

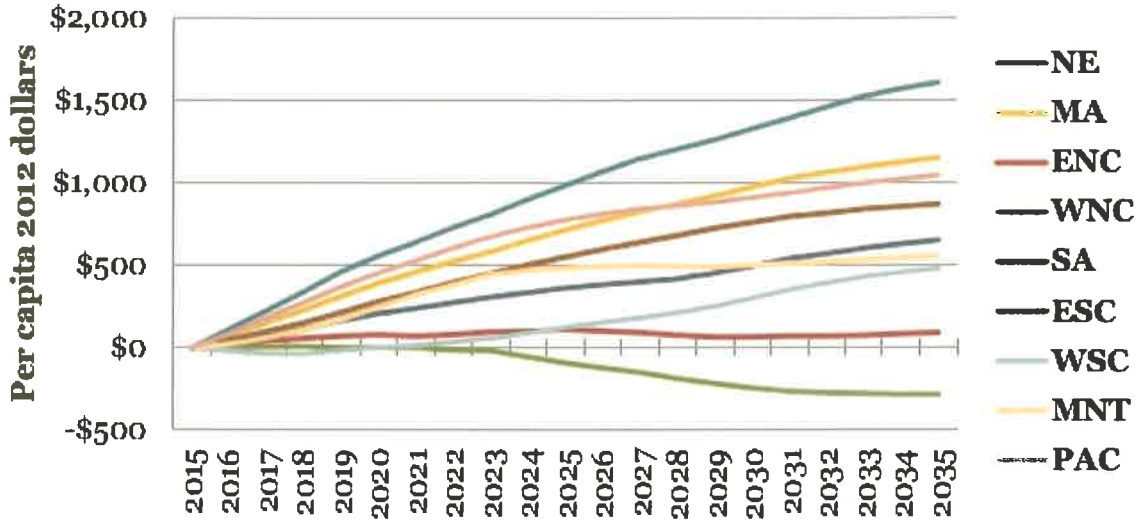


Figure 4: Real Income Per Capita (p. 38). This reflects the increase in income per person after accounting for increased cost of living (up by 1.7% in 2025 (p. 33); the second lowest increase out of 9 regions), increased energy prices (peaking in 2026; p. 34), net of the impact to the labor market, F&D checks, as well as population and demographic trends. NE sees the greatest gains in real income per capita at approximately $1,000 after 10 years and $1,600 after 20 years. This is partly explained by the slight population decreases in this region as a result of the policy (-100,000 by 2025; p.44), and partly by its already high proportion of energy from natural gas. Also worth noting is that the inflation over the entire 20-year period for the region is equivalent to adding one "extra" year of average annual inflation.

Other notable findings:

The main lesson of the study is that the fee lowers investment in capitol-intensive industries (e.g. mining, fossil fuels), and the dividend boosts investment in labor-intensive industries. This is why you get so many jobs created. For example, the biggest growth occupations for the region in 2025 are retail sales workers (+7,000), health diagnosing and treating practitioners (+7,000 jobs), and construction trade workers (+6,000 jobs). The job gain in any one of these industries is more than double the job losses in the three hardest-hit sectors combined.

Conclusions:

Despite the loss of $0.4 billion in the utilities industry, NE still has a net gain of $7.1 billion by 2025, a net increase in jobs, and the highest increase in real income per capita. Overall, Fee and Dividend is a winner for NE!

Full report: http://citizensclimatelobby.org/wp-content/uploads/2014/06/REMI-carbon-tax-report-62141.pdf

Revision 1: Feb. 17, 2015

7

Household impact (Micro study)

Citizens' Climate Lobby

Financial Impact on Households of Carbon Fee and Dividend

Summary by Jerry Hinkle and Daniel Richter

Introduction

In February, 2016, Citizens' Climate Education (CCE) and Citizens' Climate Lobby (CCL) released a working paper that assessed the net financial impact on U.S. households of a $15/ton of CO2 carbon fee in which all proceeds are returned to households on a per-capita basis. The purpose of that working paper (see link at end to download) was to respond to enduring interest from members of Congress in how their own constituents would fare under CCL's Carbon Fee and Dividend proposal. To complete that study CCE and CCL funded Kevin Ummel, an independent researcher at the International Institute for Applied Systems Analysis and author of a separate, earlier study estimating household carbon emissions with zip-code level detail.

The analysis is "static" and does not consider the "dynamic" effects the policy and corresponding price changes would have on the general economy. It is assumed the entire pollution fee is passed through in the form of higher prices "overnight", without changes in production or consumption in response to the price signal.

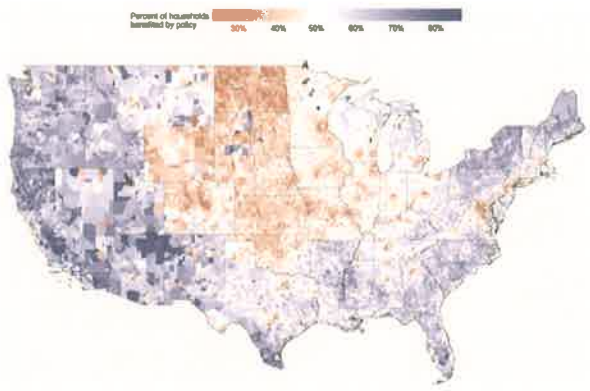


Figure 1: Map of US showing which zip codes have more (blue) or fewer (red) households benefiting with Carbon Fee and Dividend. Overall, 53% of households, and 58% of individuals benefit.

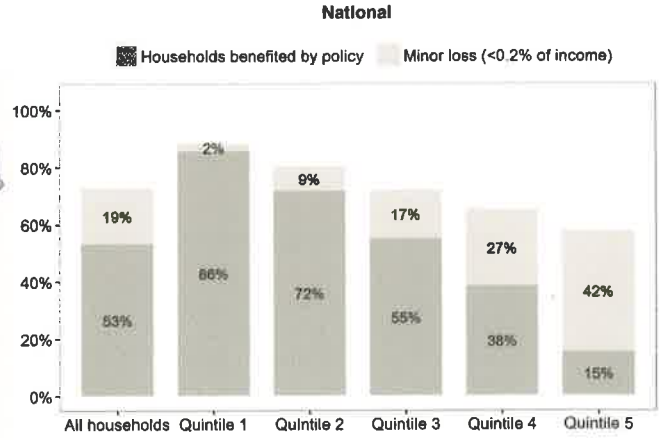


Figure 2: Percent of Households Benefited, by Income quintile. The average household in Quintile 1 sees a net gain of $280 per year, equal to 1.78% of income. Quintile 1 has a median (or typical) income of 95% of the federal poverty level (FPL).

Study Highlights:

- 53% of US households and 58% of individuals receive a net financial benefit as the dividend exceeds the estimated increase in costs of goods purchased (Figure 1). This analysis includes none of the health and environmental benefits that come with the reduction of GHGs.

- The gains are concentrated among those considered "most vulnerable" within our society: those with lower incomes (Fig 2), the youngest and oldest (Fig 3), and minorities (Fig 4). Since the Dividend formula is not means-tested in any way, this effect stems simply from charging for pollution and returning proceeds equally per person; not any type of redistribution.
- Though households with higher incomes generally experience a net loss in this study, the impact would be minimal. 15% of households in the 5th quintile actually benefit, and an additional 42% experience only a minor loss (defined as a loss less than .2% of annual income).

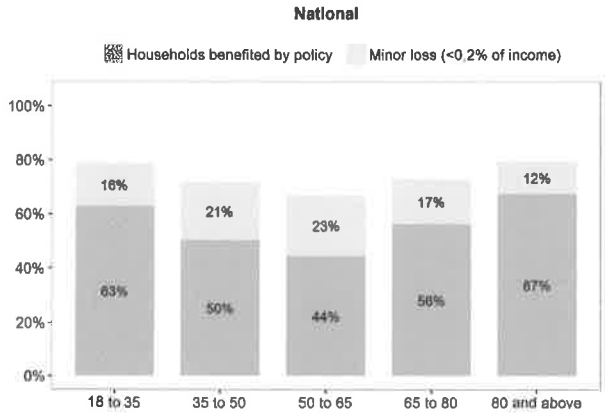


Figure 3: Percent of Households benefited, by age group. Older households do well because they tend to have smaller footprints, reflecting reduced mobility and less consumption as a result of low fixed incomes. Younger households tend to be larger – and therefore benefited by the dividend formula – in addition to having less income/consumption in early career.

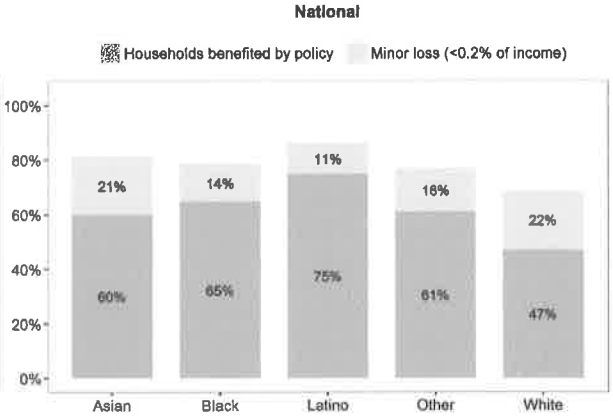


Figure 4: Percent of Households benefited, by race. Minority households do well because on average they have lower income and/or more people per household, both associated with a lower footprint. Since the dividend formula is per capita, households with more members generally see higher net benefit.

Reducing Costs

How can households who experience a net loss reduce their carbon footprint, and thus their pollution costs? There are many avenues for this, from more efficient transportation (e.g., public transit), more efficient living conditions (e.g., higher household density), and careful consumer choices. Being static, with price signals passed on "overnight", this study did not allow for or anticipate any such changes in behavior.

Conclusions

This new study provides a useful look at how every congressional district does in unprecedented detail. Though overall projections for how many households benefit are lower than some previous estimates, the overall progressivity of this policy is highlighted, especially in contrast to other options for addressing climate change.

4

Citizens' Climate Lobby

What is Carbon Fee and Dividend?

Carbon Fee and Dividend is the policy proposal created by Citizens' Climate Lobby (CCL) to put a federal price on carbon-based fuels so that their consumer cost reflects their true costs to society.

It's the policy that both climate scientists and economists say is the best first-step to reduce the likelihood of catastrophic climate change from global warming.

Why Carbon Fee and Dividend?

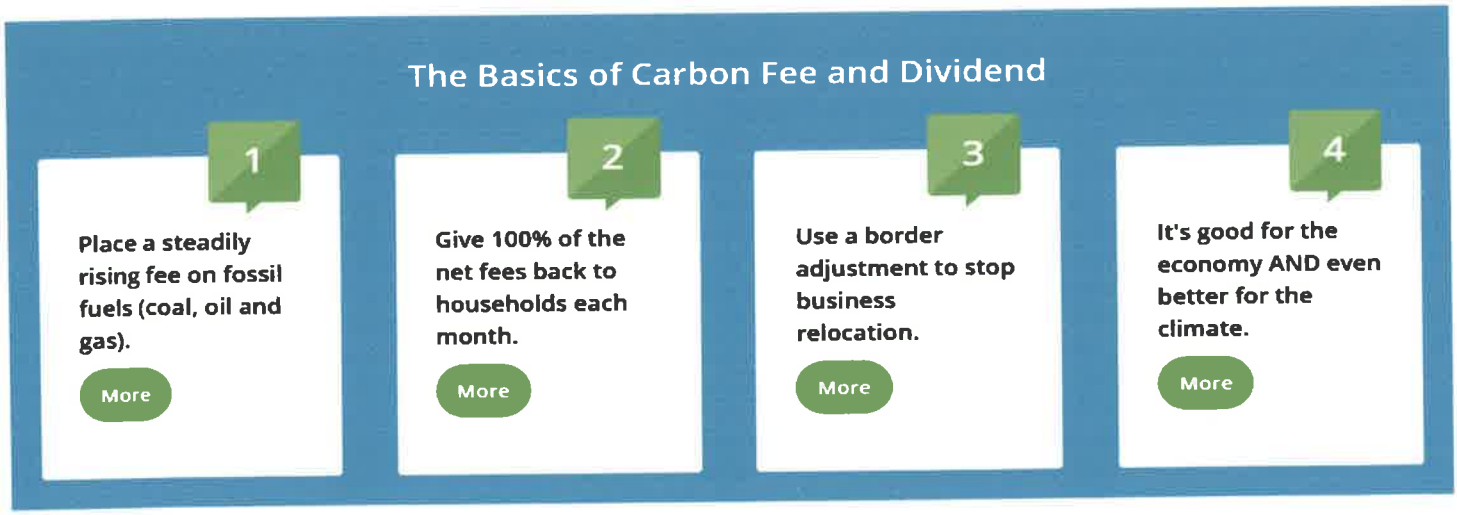
Currently, the price of fossil fuels does not reflect their true costs—including their impact on global climate. Correcting this market failure will require that their price account for the true social costs.

As long as fossil fuels remain artificially inexpensive, their use will rise. Correcting this market failure requires a federal price on carbon that accounts for their true costs.

What Will Carbon Fee and Dividend Do?

Carbon Fee and Dividend will do four things:

1. Account for the cost of burning fossil fuels in the price consumers pay.
2. Cut emissions enough to stay below the 2C threshold for "dangerous" warming.
3. Grow jobs and GDP without growing government one bit.
4. Recruit global participation.



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Citizens' Climate Lobby

Political Will for a **Livable World**

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The Carbon Fee and Dividend Policy

Carbon Fee and Dividend is the policy proposal for federal legislation created by Citizens' Climate Lobby (CCL) to account for the costs of burning fossil fuels. It's the policy that climate scientists and economists alike say is the best first step to reduce the likelihood of catastrophic climate change from global warming.

Our carbon fee and dividend proposal[1] works like this:

1. **A fee is placed on fossil fuels at the source** (well, mine, port of entry). This fee starts at $15 per ton of CO_2 equivalent emissions, and increases steadily each year by $10.

2. **All the money collected, minus administration costs, is returned to American households as a dividend on an equal basis.** Under this plan about 2/3 of all households would break even or receive more in their dividend checks than they would pay in higher prices due to the fee, thereby protecting middle-income households and helping low-income households[2].

3. **A border tariff adjustment is placed on goods imported from, or exported to, countries without an equivalent price on carbon.** This adjustment would discourage businesses from relocating to where they can emit more CO_2 and encourage other nations to adopt an equivalent price on carbon.

A predictably increasing carbon price will send a clear market signal which will unleash entrepreneurs and investors in the new clean-energy economy. Spending enabled by the net income gain of low-income households will boost the economy and GDP, and create millions of new jobs[3].

1. The Citizens' Climate Lobby. "CCL draft legislation for Carbon Fee and Dividend."
2. "Dividends". Last modified: February 12, 2015. The Carbon Tax Center.
3. "The Economic, Climate, Fiscal, Power, and Demographic Impact of a National Fee-and-Dividend Carbon Tax". June 9, 2014, Regional Economic Models, Inc..

The Text of the Carbon Fee and Dividend Proposal:

Therefore the following legislation is hereby enacted:

1. **Collection of Carbon Fees/Carbon Fee Trust Fund:** Upon enactment, impose a carbon fee on all fossil fuels and other greenhouse gases at the point where they first enter the economy. The fee shall be collected by the Treasury Department. The fee on that date shall be $15 per ton of CO2 equivalent emissions and result in equal charges for each ton of CO2 equivalent emissions potential in each type of fuel or greenhouse gas. The Department of Energy shall propose and promulgate regulations setting forth CO2 equivalent fees for other greenhouse gases including at a minimum methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons (HFCs), perfluorocarbons, and nitrogen trifluoride. The Treasury shall also collect the fees imposed upon the other greenhouse gases. 100% of the net revenues are to be placed in the Carbon Fees Trust Fund and be rebated to American households as outlined below.

2. **Methane Leakage:** Methane is a much more potent greenhouse gas than CO2 with both direct and indirect effects contributing to warming. It is therefore important to place a fee on methane that leaks to the atmosphere. Some of this leakage will occur after the fee has been assessed on methane under the assumption that it will be burned to yield the less potent CO2. To ensure the integrity of the program and that markets receive accurate information with regard to the climate forcings caused by various fossil fuels, the carbon fee shall be assessed on such leaked methane at a rate commensurate with the global warming potential ("GWP") of methane including both its direct and indirect effects. Given the importance of tipping points in the climate system, the 20-year GWP of methane shall be used to assess the fee, and not the 100-year GWP. As proper accounting for such leakage is necessary for honest assessment of progress towards program goals, reasonable steps to assess the rate of methane leakage shall be implemented, and leaked methane shall be priced accordingly. The entity responsible for the leaked methane shall be responsible for paying the fee.

3. **Emissions Reduction Targets:** To align US emissions with the physical constraints identified by the Intergovernmental Panel on Climate Change (IPCC) to avoid irreversible climate change, the yearly increase in carbon fees including other greenhouse gases, shall be at least $10 per ton of CO2 equivalent each year. Annually, the Department of Energy shall determine whether an increase larger than $10 per ton per year is needed to achieve program goals. Yearly price increases of at least $10 per year shall continue until total U.S. CO2-equivalent emissions have been reduced to 10% of U.S. CO2-equivalent emissions in 1990.

4. **Equal Per-Person Monthly Dividend Payments:** Equal monthly per-person dividend payments shall be made to all American households (½ payment per child under 18 years old, with a limit of 2 children per family) each month. The total value of all monthly dividend payments shall represent 100% of the total carbon fees collected per month less administrative costs.

5. **Border Adjustments:** In order to ensure that U.S.-made goods can remain competitive at home and abroad and to provide an additional incentive for international adoptions of carbon fees, Carbon-Fee-Equivalent Tariffs shall be charged for goods entering the U.S. from countries without comparable Carbon Fees/Carbon Pricing. Carbon-Fee-Equivalent Rebates shall be used to reduce the price of exports to such countries and to ensure that U.S. goods can remain competitive in those countries. The Department of Commerce will determine rebate amounts and exemptions if any.

More at **citizensclimatelobby.org** and **citizensclimatelobby.org/remi-report**

5

Remi Report:
20 year Macro Study

Citizens' Climate Lobby

Summary of "The Economic, Climate, Fiscal, Power, and Demographic Impact of a National Fee-and-Dividend Carbon Tax" By REMI and Synapse

Summary by Danny Richter, Ph.D.

About the study:

Citizens' Climate Education Corporation (CCEC) and Citizens' Climate Lobby (CCL) contracted a third party, Regional Economic Modeling, Inc. (REMI) to do a nation-wide macroeconomic study on the impact of its Fee and Dividend (F&D) policy. The policy modeled is not a perfect representation of F&D (most obviously, F&D begins at $15 per ton whereas the study began at $10 per ton), but it is quite close, and accounts for the impact F&D's border tariff adjustment would have on the US economy. REMI used three models to do the study: (1) The Regional Energy Deployment System (ReEDS) built by the National Renewable Energy Laboratory and run by Synapse Energy Economics; (2) the Carbon Analysis Tool (CAT); an enhancement of the open-source CTAM model and populated by data from the US Energy Information Administration (EIA); and (3) REMI PI+, a proprietary dynamic model of subnational units of the United States' economy whose methodology and equations are peer-reviewed and available to the public. Output included impacts on 160 industries, nationally and regionally for the 9 "U.S. Census" regions commonly grouped together in a number of federal data sources and in the energy market forecasts from the EIA.

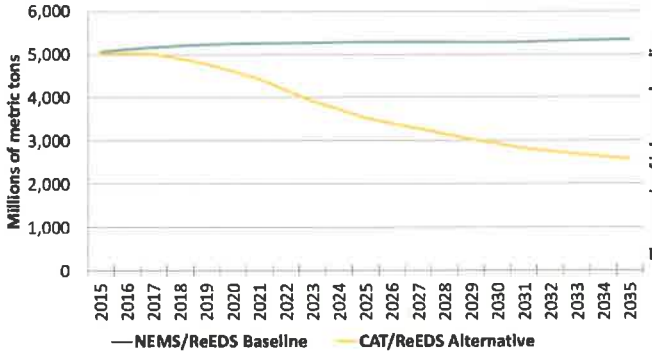


Figure 1: U.S. CO2 emissions under F&D (yellow) and without a carbon tax (blue). F&D reduces US emissions to 69% of 1990 levels by 2025, and to 50% by 2035.

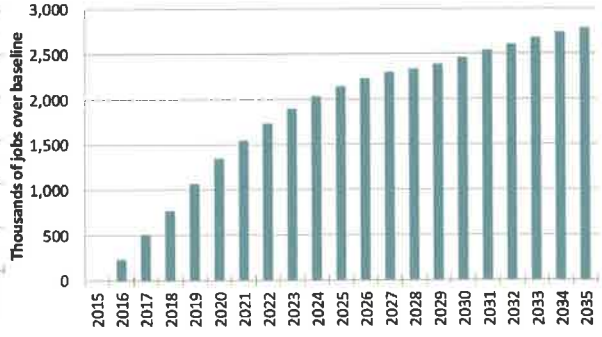


Figure 2: Thousands of jobs created by F&D relative to the case without a carbon tax. Over a million jobs created within 4 years, over 2 million within 9 years.

Model results were able to estimate the effects of the policy on GDP, personal income, employment, prices, carbon dioxide emissions, mortality due to NOx and SOx emissions, revenues, monthly dividend amount, energy generation capacity by technology, energygeneration by type, investment in power, population, and economic migration on both a regional and national level. Income and employment figures for each of 160 industry categories considered are included. These 160 industries encompass the entire economy.

The results are all relative to a baseline case where there is no carbon tax (modeled by using the exact same set-up, with a $0/ton value for the carbon tax). In other words, all three models were run two times. Both times, the set-up was identical except for one thing: the price of carbon was either $0 from 2016-2035 (the baseline), or was $10 per ton in 2016 and increased by $10 every year after that (F&D).

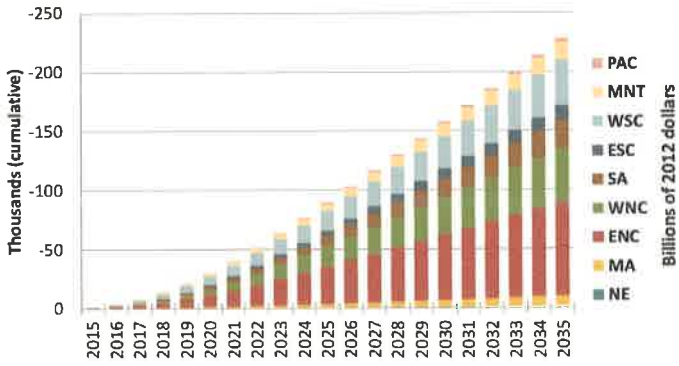


Figure 3: **Cumulative lives saved** from avoided emissions by region under F&D. Region ENC, including Ohio, Indiana, Michigan, Illinois, and Wisconsin, has the most lives saved. 227,000 American lives would be saved in 20 years under F&D.

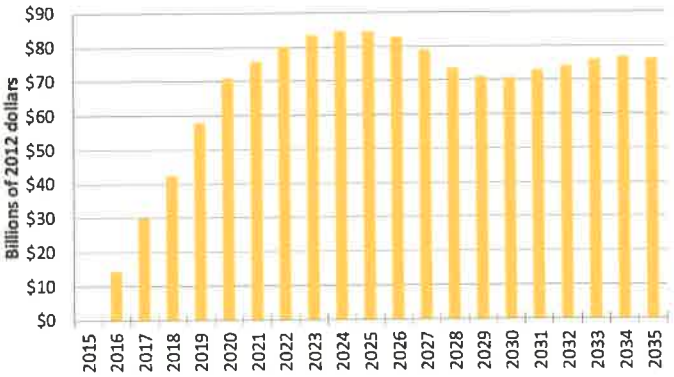


Figure 4: **Annual additional GDP due to Fee and Dividend** relative to no carbon tax. The numbers are positive due to more jobs and more consumer spending with F&D. Over the 20 years considered, GDP is $1.375 trillion higher than without F&D.

Why should we trust REMI?

CCL hired REMI because we are committed to quality data free of ideological taint that you might get from some think tanks. As its name suggests, REMI models regional economics. It does this well. Dr. George Treyz founded REMI in 1980, after working as an academic with Nobel Prize-winner Lawrence Klein and other pioneers in the field of econometric modeling. REMI's modeling products grew from Dr. Treyz's work on one of the first regional macroeconomic models ever created: the Massachusetts Economic Policy Analysis (MEPA) model. Close links to the upper echelons of academia have persisted throughout REMI's 3+ decades of experience, resulting in several academic publications in journals such as the American Economic Review, the Review of Economics and Statistics, and the Journal of Regional Science.

This experience and expertise is why private and public entities from all across the political spectrum have entrusted REMI to do their analyses, and paid them well for that expertise. These former clients include, but are not limited to: the American Gas Association (AGA), the Nuclear Energy Institute (NEI), the National Federation of Independent Business (NFIB), the National Education Association (NEA), the International Brotherhood of Teamsters, Booz Allen Hamilton, EY (formerly Ernst and Young), PWC (formerly Price Waterhouse Coopers), and ICF International. Like CCL and CCEC, REMI is truly nonpartisan.

In that same spirit, CCL and CCEC did not attempt to influence the outcome of the report in any way. In fact, we were excited when we saw that not all the results were positive for every region, because that speaks to the integrity of the analysis. Our first priority is a livable world, and we can't get there without an honest and clear-eyed view of the facts.

Study Highlights:

- CO2 emissions decline 33% after 10 years, and 52% after 20 relative to baseline (Figure 1).
- National employment increases by 2.1 million jobs after 10 years, and 2.8 million after 20 years. This is more than a 1% increase in total US employment we don't get without a carbon tax (Figure 2)!
- 13,000 lives are saved annually after 10 years, with a cumulative 227,000 American lives saved over 20 years (Figure 3).
- $70-$85 billion increase in GDP from 2020 on, with a cumulative increase in national GDP due to F&D of $1.375 trillion (Figure 4).
- Size of monthly dividend for a family of 4 with two adults in 2025 = $288, and in 2035 = $396. Annually, this is $3,456 per family of 4 in 2025 ($1152 per capita--children get ½ dividend) (Figure 5).
- Electricity prices peak in 2026, then start to decrease.
- Real incomes increase by more than $500 per person in 2025. This increase accounts for cost of living increases (Figure 6).
- Maximum cost-of-living increase by 2035 is 1.7-2.5%, depending on region (Figure 7).
- Electricity generation from coal is phased-out by 2025.
- Biggest employment gains in healthcare, retail, and other services (excluding public administration). This is because people have more money in their pockets to spend, and these industries are most boosted by consumer spending.
- Regional Gross Product is steady or rising in 8 of 9 regions.

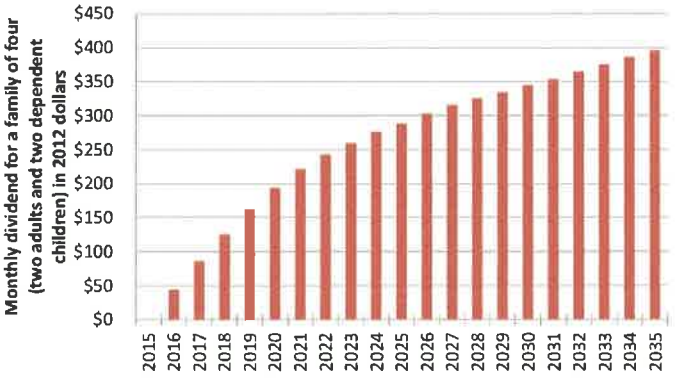


Figure 5: **Average monthly dividend** for a family of four. Each adult gets one full share, and each child one half-share up to two children.

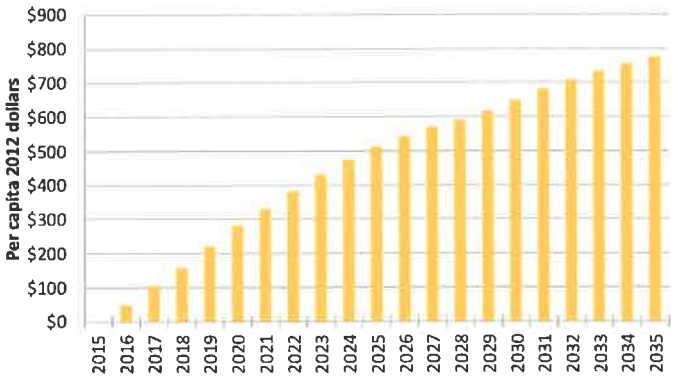


Figure 6: **US Income per capita,** after accounting for cost-of-living increases. This means that even accounting for the increased cost of living, the average American is wealthier *every single year* of the policy.

Why Haven't Previous Studies Found Such Positive Impacts?

The majority of previous reports considering a carbon tax have not modeled a completely revenue-neutral carbon tax, do not envision a policy with such an aggressive rate of increase, do not have the same detail as REMI can provide, do not consider a 100% dividend, and do not report health benefits. Where revenue-neutrality was modeled, a "double-dividend" was often discovered in which carbon emissions were reduced and economic output grew. As these previous studies have highlighted, including a May 2013 study by the Congressional Budget Office (CBO), a carbon tax without revenue-

recycling is a completely different policy from a carbon tax that does recycle revenue. The two policies, revenue-neutral carbon tax and a carbon tax without revenue returned, should not be confused in terms of their effect on the economy.

Failing to consider such a rapid rate of increase in the carbon tax has prevented previous studies from realizing the magnitude of emissions reductions and scale of economic benefit reported in this study. Often, this was because rates of increase were not considered politically feasible. Most other models, run by academics or think tanks, do not have the detail provided by REMI. Over the past 3 decades, REMI's regional modeling techniques have been refined, detail has been added, and functionality improved. Three decades of such work and refinement in the private sector are what have given it an unmatched level of detail and reliability difficult to replicate.

Despite these differences in conception, the results of REMI's work are largely consistent with previous studies in terms a benefit to the economy, industry effects, and emissions reductions. For example, the May 2013 CBO study also stated that a well-designed carbon tax could increase economic output and found a hypothetical $20 per ton carbon tax scenario would result in an 8% reduction in emissions at the national level. If held at that level, REMI's model setup would have found comparable results.

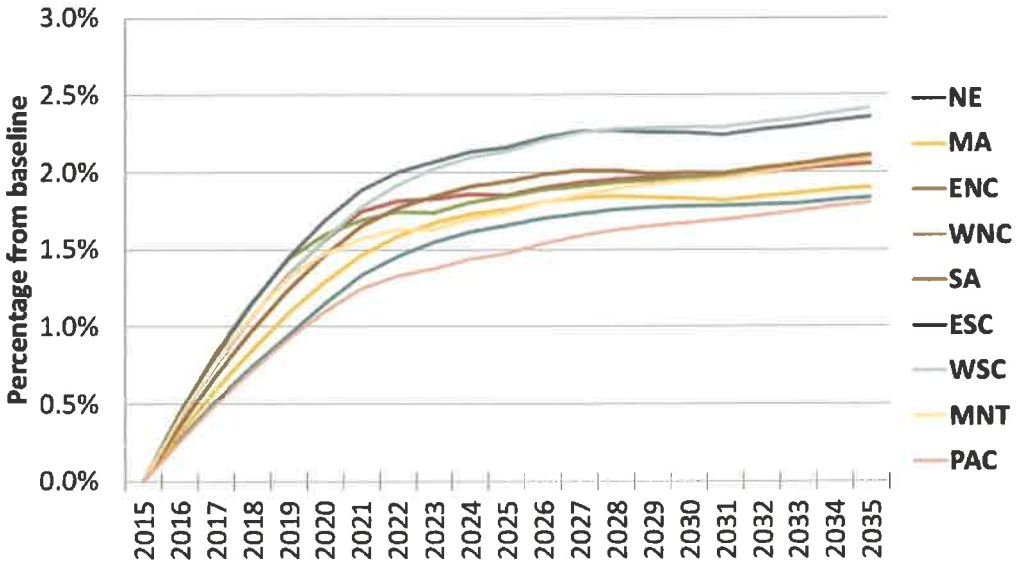


Figure 7: Cost of living increases by region. The lowest cost of living increase is approx. 1.7%, and the highest 2.5% in 2035. The total increase over 20 years is thus about equal to 1 year of average inflation.

Interpreting the Results: Take-home points

The biggest take-home from this study is that there is no economic argument against Fee and Dividend. It creates jobs, grows the economy, saves lives, and makes Americans richer. It does this while also reducing CO2 emissions to 31% below 1990 levels by 2025, and to 50% below 1990 levels by 2035.

F&D therefore sets the new standard for climate and economic policy. Other policies must now compare their climate and economic impact against F&D. To be against doing anything is to be against jobs, against a larger economy, and against saving American lives. We know of no politician who wants to be against these things, and so we hope that this study will clear the way to rapid passage of F&D.

Citizens' Climate Lobby

Regional REMI Summary for the New England (NE) Region (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont)

National Highlights in 2025:

- 2.1 million more jobs with Fee and Dividend (F&D).
- CO2 emissions 31% below 1990 levels.
- 90,000 American lives saved from better air quality.
- $80 - $90 annual billion increase in GDP.

NE-Specific Findings:

Gross Regional Product (GRP):

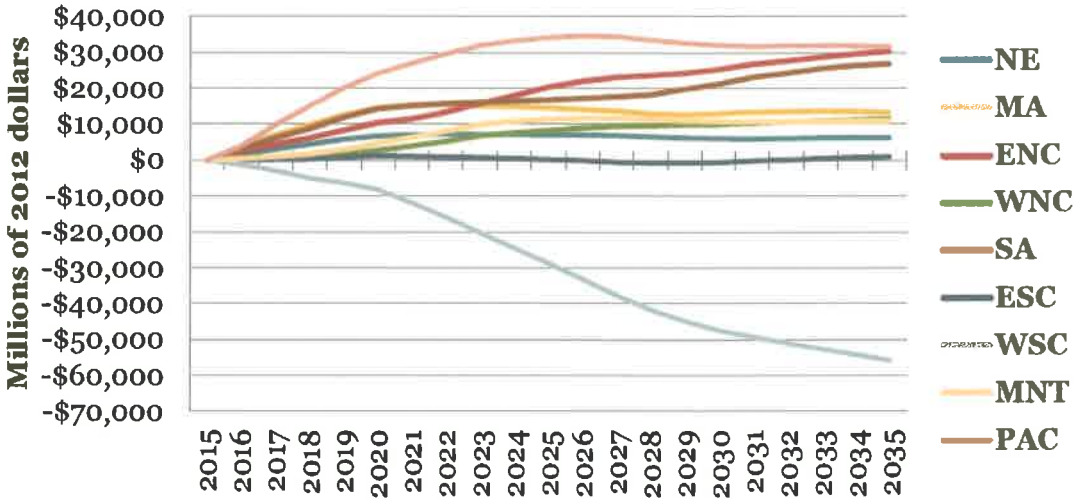


Figure 1: Gross Regional Product (GRP) Changes in the Nine Regions (p. 21). NE sees an increase in GRP after 10 years of $7.1 billion and an increase after 20 years of $6.2 billion (p.70). Ambulatory health care services is the industry that becomes the largest positive contributor to GRP across all time. [Note: all numbers for this graph, and all graphs, are relative to the baseline $0 carbon fee scenario in the full REMI Report.]

2025: Top 3 Industry Winners (GRP)

1) Ambulatory Health Services (+$1.2 billion (b) to GRP)
2) Real Estate (+$1.0b)
3) Retail Trade (+$0.8b)

2025: Top 3 Industry Losers (GRP)

1) Utilities (-$0.4b)
2) Air Transportation (-$0.2b)
3) Computer and Electronic Manufacturing (-$0.2b)

Net of all industries in 2025: +$7.1 billion to regional GRP.
Count of the industries considered in 2025: 43 add to and 22 subtract from GRP. 2 experience no change.

Employment:

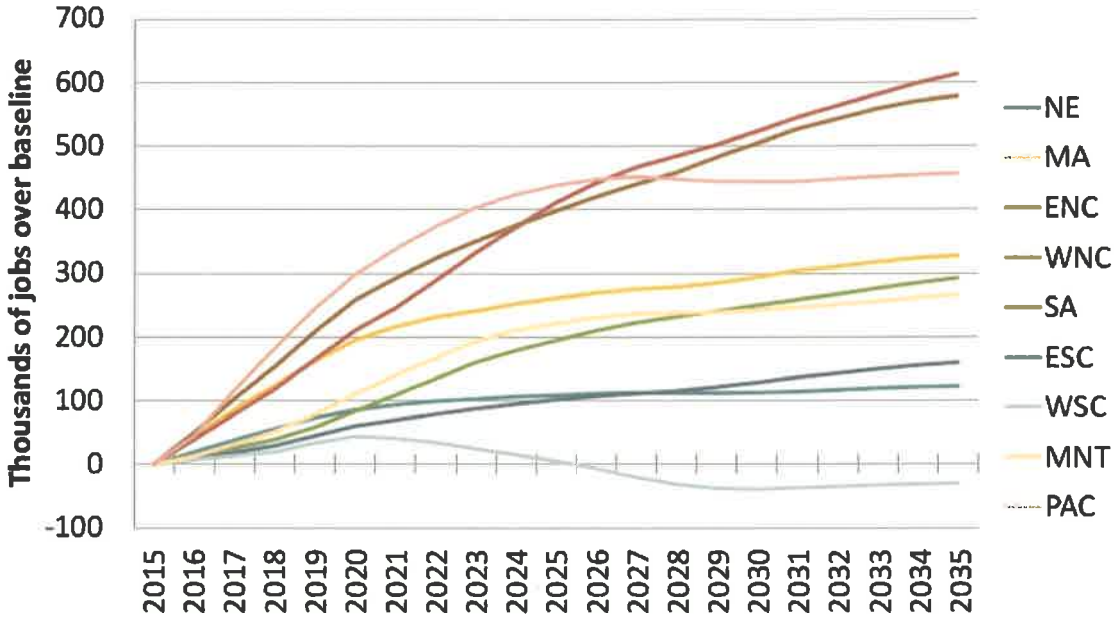


Figure 2: Regional breakdown of employment increases (p. 20). NE sees modest job growth throughout the policy, gaining 123,000 jobs by 2035 (p. 71). These are jobs that do not exist in a $0 carbon fee scenario, but that do exist with F&D.

2025: Top 3 Job Winners	*2025: Top 3 Job Losers*
1) Ambulatory Health Services (+16 thousand (k) jobs) 2) Retail Trade (+12k) 3) Construction (+11 k)	1) Utilities & scenic and sightseeing transp., support activities for transp.; Utilities; Air transp.; and Computer and electronic manufacturing (all -1k)

Net of all industries in 2025: +107,000 jobs.
Count of the industries considered in 2025: 27 add jobs, 4 lose jobs, 36 have no change.

Energy Production:

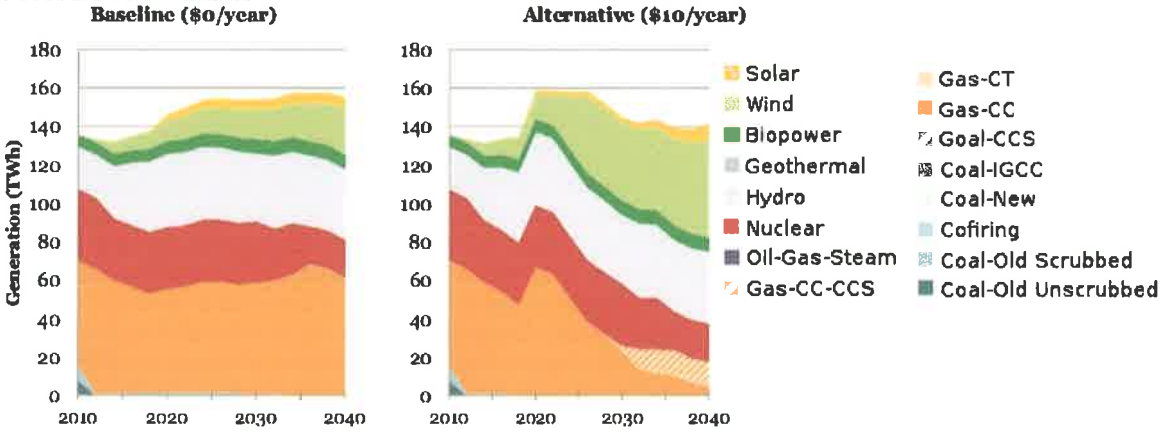


Figure 3: Electrical Power Generation (p. 70). The F&D reduces the share of power generation from gas (or makes carbon sequestration with that gas economical). The most notable change in power capacity is a large addition of wind turbines at the expense of some natural gas capacity. F&D also accelerates the retirement of the last few coal plants in the area by a decade or so (p. 69).

6

Citizens' Climate Lobby

Financial Impact on Households of Carbon Fee and Dividend
Local Impacts in New Hampshire - District 2

Introduction

This study on the impact to households of Carbon Fee and Dividend was funded to respond to concerns expressed by members of Congress that constituents in their district would not benefit under our proposal. Key to the concerns expressed was not only understanding how the average constituent did, but how different groups of constituents fared. Concern for low-income constituents, for instance, is common for members of both parties.

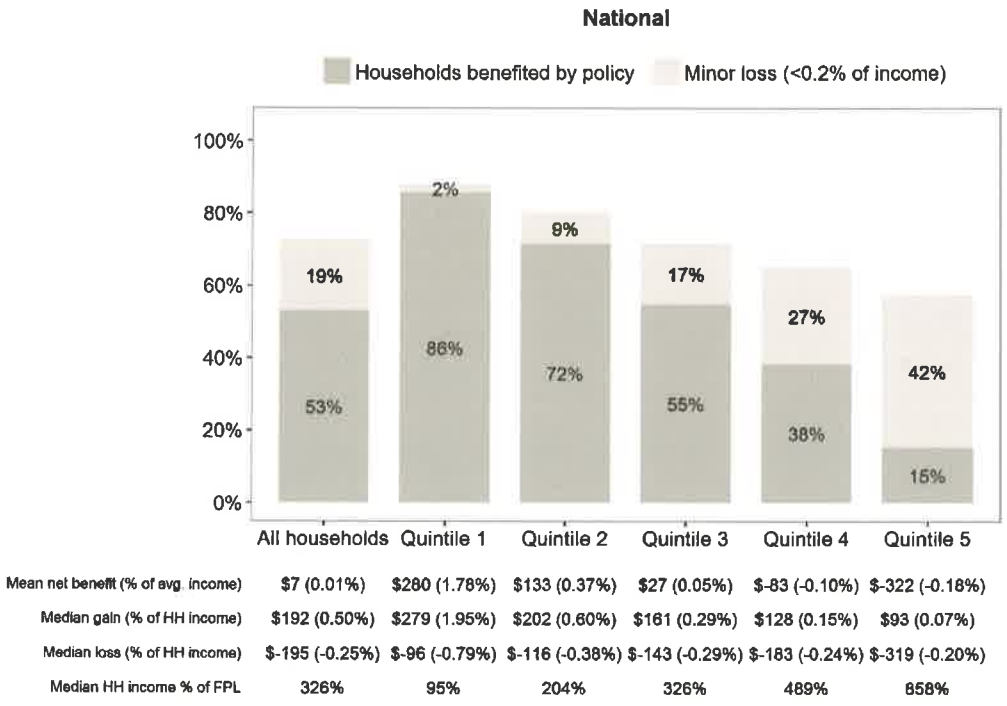
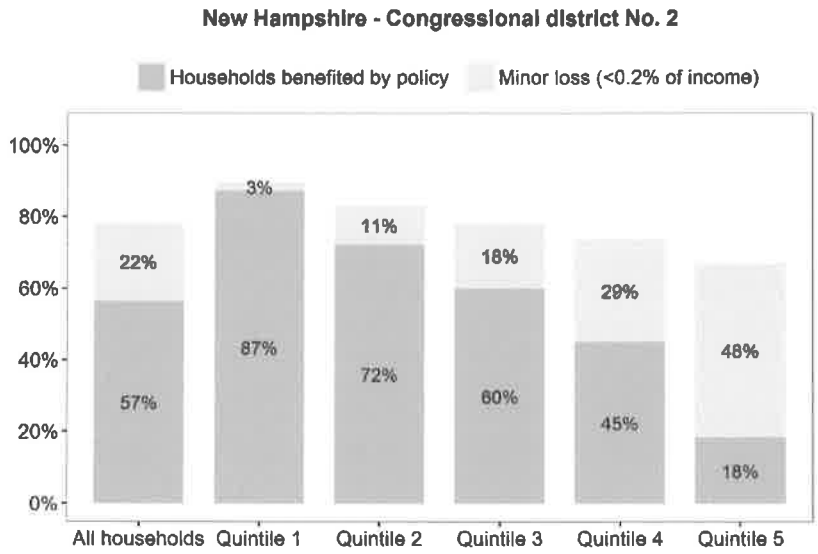


Figure 1: National Averages by Economic Quintile. Note that the three lowest-income quintiles show a benefit for the mean (average) household. The average net benefit for the lowest-income quintile is 1.78% of income, whereas households in the top quintile experience, on average, net losses that are a much smaller percentage of their total income, at just 0.18%.

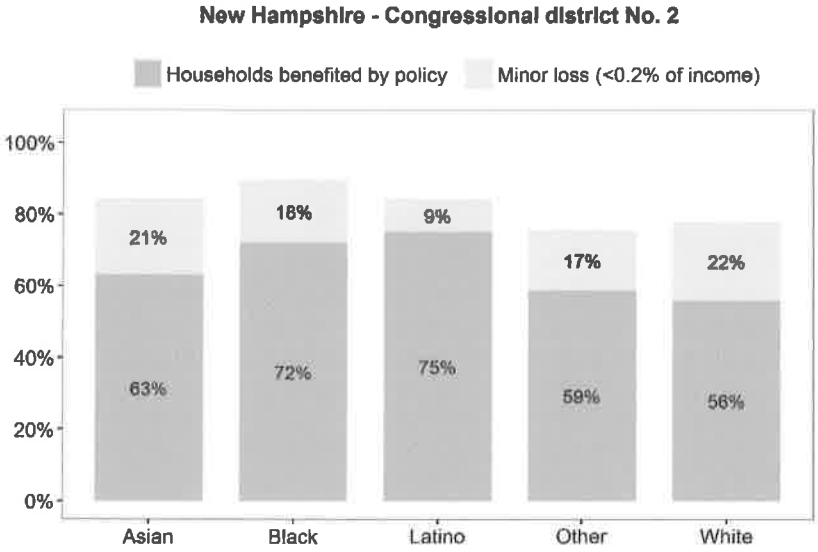
All data is from the 2016 working paper, "Impact of CCL's proposed carbon fee and dividend policy: A high-resolution analysis of the financial effect on U.S. households" by Kevin Ummel, Research Scholar, Energy Program, International Institute for Applied Systems Analysis (IIASA).

Current working paper and summary available at http://citizensclimatelobby.org/household-impact/



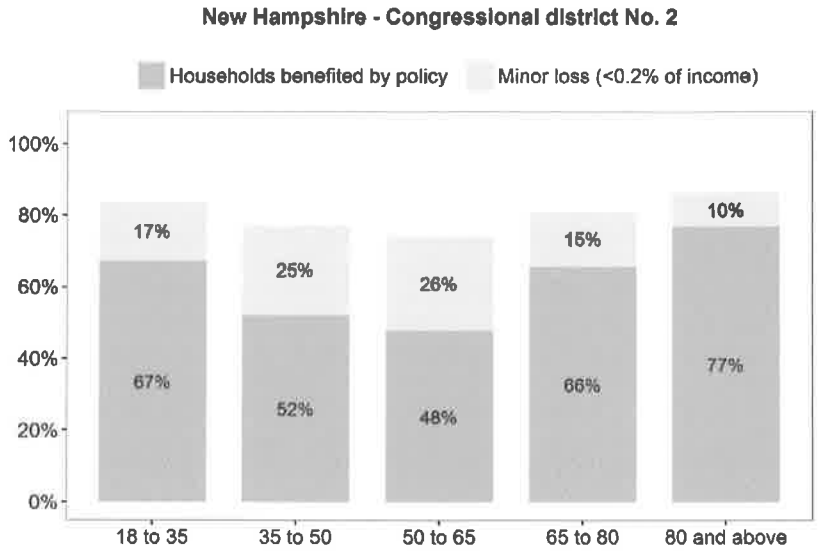
	All households	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Mean net benefit (% of avg. income)	$15 (0.02%)	$231 (1.18%)	$118 (0.27%)	$47 (0.07%)	$-56 (-0.06%)	$-263 (-0.15%)
Median gain (% of HH income)	$181 (0.38%)	$230 (1.38%)	$186 (0.45%)	$174 (0.26%)	$129 (0.13%)	$91 (0.06%)
Median loss (% of HH income)	$-182 (-0.20%)	$-112 (-0.66%)	$-110 (-0.28%)	$-138 (-0.23%)	$-171 (-0.19%)	$-281 (-0.17%)
Median HH income % of FPL	383%	127%	255%	383%	550%	892%

Figure 2: Impact by Quintile for New Hampshire - District 2. Looking at the categories on the bottom of this graph, only the numbers for "Mean Net Benefit" and "Median HH income % of FPL" include all households in a given quintile (FPL = Federal Poverty Line). Only those households who receive a financial gain are included in calculating the "Median Gain" figures, and likewise, only those households which experience a loss are included in calculating the "Median Loss" figures.



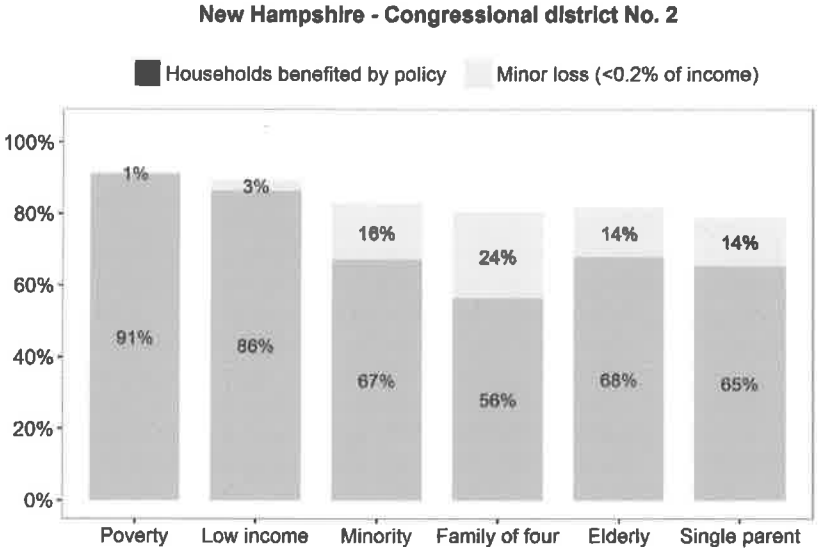
	Asian	Black	Latino	Other	White
Mean net benefit (% of avg. income)	$70 (0.07%)	$92 (0.12%)	$171 (0.29%)	$74 (0.11%)	$10 (0.01%)
Median gain (% of HH income)	$213 (0.28%)	$189 (0.43%)	$262 (0.72%)	$238 (0.54%)	$179 (0.37%)
Median loss (% of HH income)	$-207 (-0.17%)	$-155 (-0.14%)	$-177 (-0.24%)	$-195 (-0.25%)	$-183 (-0.20%)
Median HH income % of FPL	473%	308%	248%	275%	386%

Figure 3: Impact by Race for New Hampshire - District 2. Minority households tend to do better than white households as a result of lower average incomes (associated with lower carbon footprint) and/or more people per household (larger pre-tax dividend).



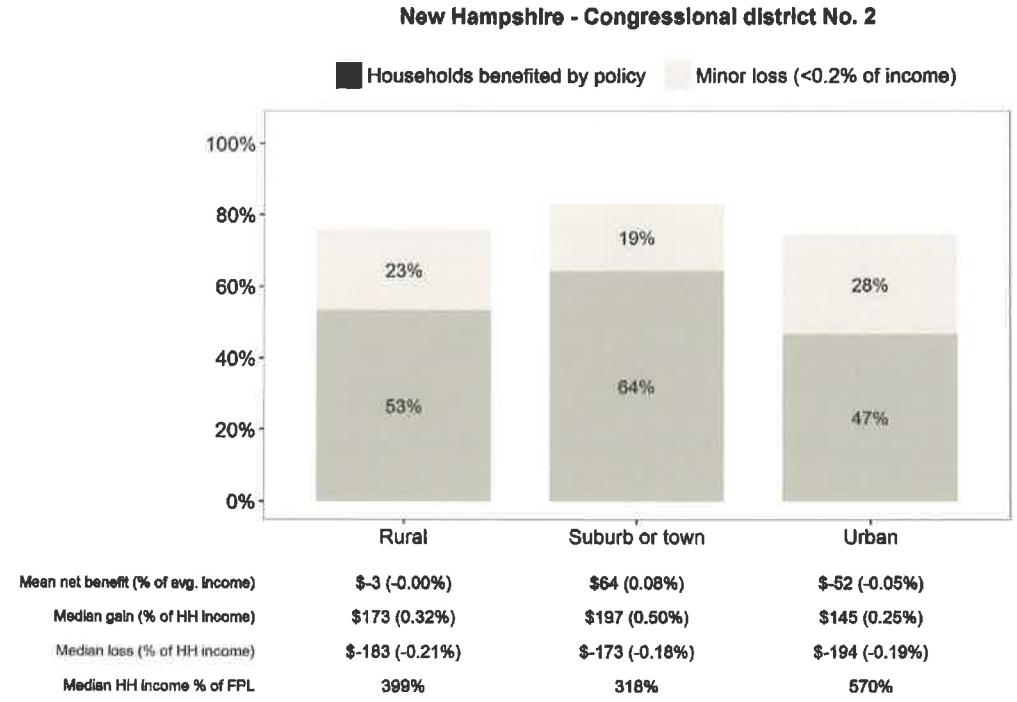
	18 to 35	35 to 50	50 to 65	65 to 80	80 and above
Mean net benefit (% of avg. income)	$99 (0.15%)	$-4 (-0.00%)	$-44 (-0.05%)	$59 (0.10%)	$115 (0.30%)
Median gain (% of HH income)	$203 (0.45%)	$195 (0.31%)	$161 (0.28%)	$168 (0.46%)	$185 (0.80%)
Median loss (% of HH income)	$-150 (-0.20%)	$-196 (-0.19%)	$-195 (-0.20%)	$-147 (-0.23%)	$-140 (-0.26%)
Median HH income % of FPL	321%	419%	474%	304%	198%

Figure 4: Impact by Age Group for New Hampshire - District 2. The pattern of benefits across age groups makes sense given the impact of age on both carbon footprints and dividend received. Older households tend to have smaller footprints, reflecting reduced mobility and less consumption as a result of low fixed incomes. Younger households tend to be larger – and therefore benefited by the dividend formula – in addition to less income/consumption in early career.



	Poverty	Low income	Minority	Family of four	Elderly	Single parent
Mean net benefit (% of avg. income)	$272 (2.71%)	$226 (1.11%)	$109 (0.14%)	$9 (0.01%)	$58 (0.11%)	$63 (0.16%)
Median gain (% of HH income)	$237 (2.72%)	$229 (1.36%)	$219 (0.49%)	$220 (0.27%)	$164 (0.55%)	$193 (0.77%)
Median loss (% of HH income)	$-116 (-1.20%)	$-113 (-0.64%)	$-173 (-0.22%)	$-235 (-0.17%)	$-144 (-0.24%)	$-160 (-0.28%)
Median HH income % of FPL	73%	131%	297%	406%	261%	187%

Figure 5: Impact by Household Type for New Hampshire - District 2. This graph reports data for demographic groups of particular interest to many legislators. "Elderly" households are defined as having a household head age 65 or older, no more than two adults, and no children present. "Poverty" and "Low income" refer to households with income below 100% and 200% of FPL, respectively.



	Rural	Suburb or town	Urban
Mean net benefit (% of avg. income)	$-3 (-0.00%)	$64 (0.08%)	$-52 (-0.05%)
Median gain (% of HH income)	$173 (0.32%)	$197 (0.50%)	$145 (0.25%)
Median loss (% of HH income)	$-183 (-0.21%)	$-173 (-0.18%)	$-194 (-0.19%)
Median HH income % of FPL	399%	318%	570%

Figure 6: Impact by Community for New Hampshire - District 2. This graph breaks down data by "community type" – Rural, Suburb or Town, vs Urban.

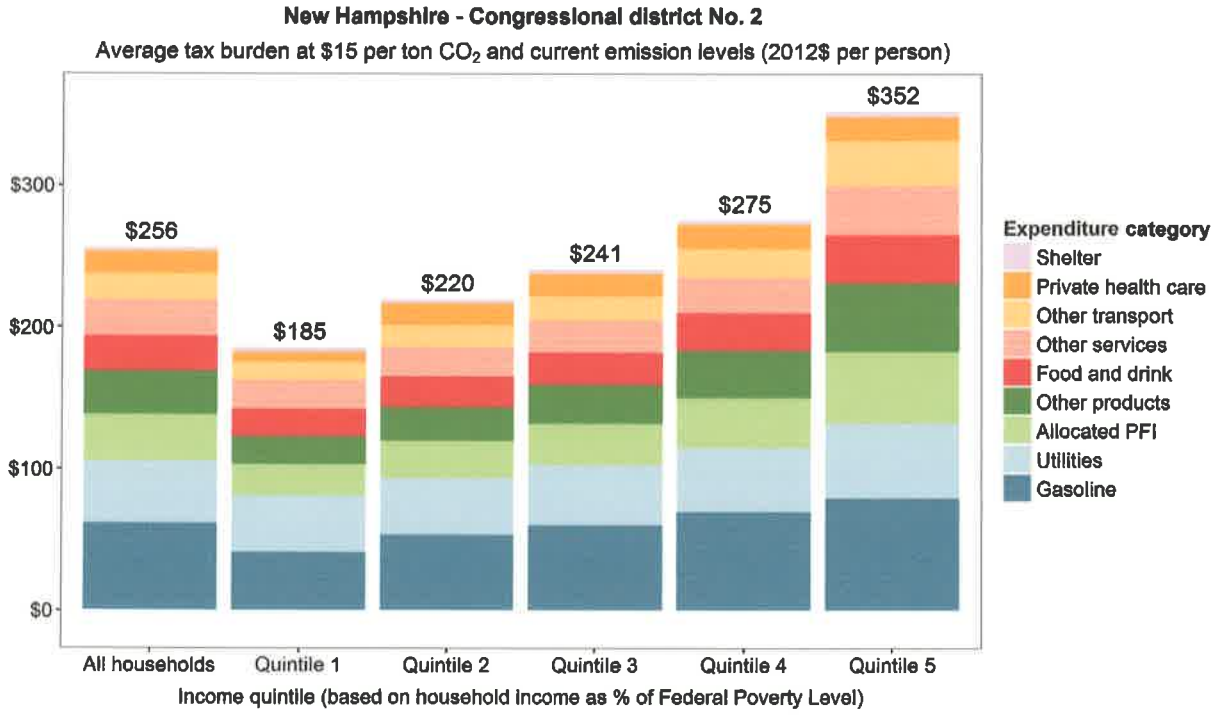


Figure 7: Expenditures by Category for New Hampshire - District 2. Here we show a breakdown of where the carbon fee increases expenses (i.e. before the dividend) for each quintile. Note that direct energy expenditures (gasoline and utilities) represent less than half of the expense for most quintiles with other products and services making up the rest. Quintile 1 shows low expenditure for private health care since most health care for households in this quintile is covered by government programs. Allocated Private Fixed Income (PFI) measures economy-wide spending on fixed assets (e.g. structures, equipment, software, etc.) that are used in the production of goods and services.

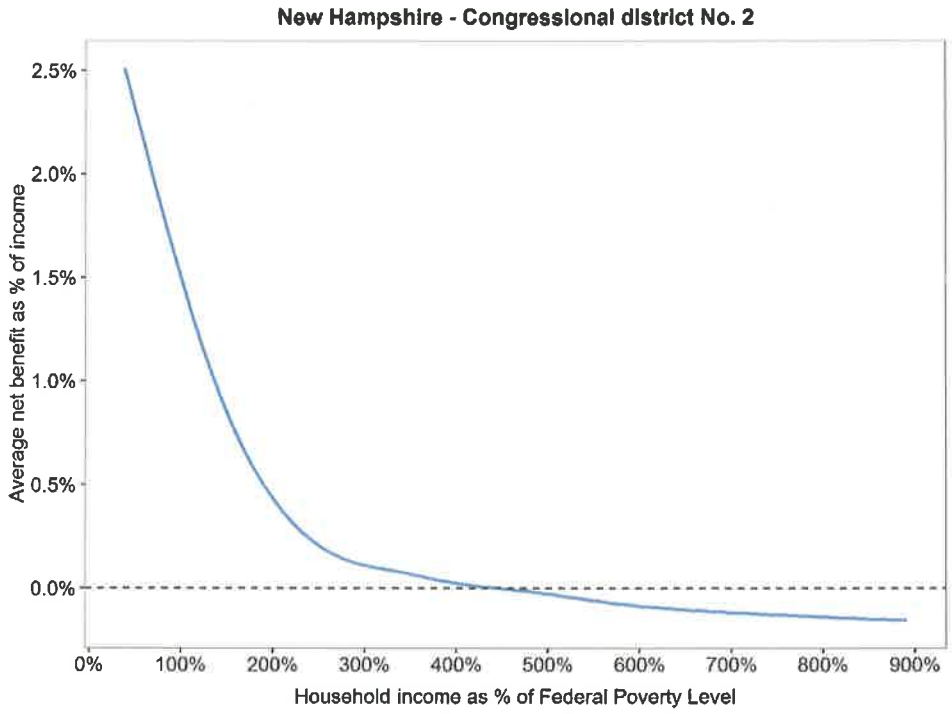


Figure 8: Relationship between benefit and income for New Hampshire - District 2. This line graph shows the relationship between income expressed as a percentage of the Federal Poverty Level (FPL) vs. the average (mean) benefit as a percentage of income for households. Benefits are highest for those at the lowest income levels and generally positive through 200-300% of the FPL. Average loss for those with higher incomes is relatively small as a percentage of annual income. To avoid anomalies from small sample size at the margins, this graph does not include results for households in the bottom 1% of income, nor those above the 90th percentile of income in the district. This graph also does not convey information about how much of the population in the district is at any given point along the line.

University of New Hampshire
Carsey School of Public Policy

CARSEY PERSPECTIVES

March 7, 2017 (updated May 10, 2017)

New Hampshire's Electricity Future

Cost, Reliability, and Risk

Cameron Wake, Matt Magnusson, Christine Foreman, and Fiona Wilson

May 2017 update

PointLogic Energy, a source for natural gas pipeline flow and capacity in the original report, has recently updated its models for calculating natural gas flow in the Tennessee Gas Pipeline in New England. This model update has resulted in significant changes to their previous estimates. Most importantly, data obtained from PointLogic Energy in December 2016 supported the finding that overall net gas flow in the "Tennessee Gas Pipeline: NY to MA" was from Massachusetts to New York from 2013–2016; their revised models indicate a net flow during the same period from New York to Massachusetts. To be conservative, we have removed analysis of natural gas pipeline flow and capacity from this report that relied on the original data obtained from PointLogic Energy. Instead, we use estimates of natural gas pipeline flow and capacity published in a 2014 ICF International report that was commissioned by ISO New England (Exhibit 2-3, pp. 12)[1] and information provided by the U.S. Energy Information Administration.[2]

[1] ICF International, "Assessment of New England Natural Gas Pipeline Capacity to Satisfy Short and Near-Term Electric Generation Needs: Phase II," 2014 (see endnote 14).

[2] U.S. Energy Information Administration, "U.S. State-to-State Capacity," updated 12/31/2015; U.S. Energy Information Administration, "New England Natural Gas Pipeline Capacity Increases for the First Time Since 2010," December 6, 2016 (see endnote 15).

KEY FINDINGS

Economic Growth and Energy Use	New England does not need to increase energy use to continue to grow its economy. From 2005 to 2015, real state GDP in New England grew by 9.7 percent while energy use fell by 9.6 percent (Figure 1). Over the same time period real GDP for the entire U.S. grew by 15.2 percent, while energy use fell by 3.4 percent (Figure 2).
Cost	While the price per kilowatt hour of electricity in New Hampshire has been higher than the national average for decades, the average residential electricity bill is equal to the national average and the average commercial electricity bill is lower than the national average (Table 1). New England has adapted to higher electricity prices via improvements in energy efficiency and a transition to a less energy-intensive economy. The energy intensity of the New England economy is much lower than the national average (Figure 3).
Reliability	New England's electrical grid has proven itself reliable during periods of high energy demand associated with cold winter temperatures, including the extreme polar vortex event of January 2014.
Risk	During this period of rapid transformation in the global and regional energy markets, there is significant stranded cost risk to electricity ratepayers for large infrastructure investments with uncertain return on investment. This includes publicly-funded expenditures for new natural gas capacity.

Introduction

Over the past decade a number of factors have transformed global and national energy markets. Access to low-cost natural gas has been a significant part of this trend. Nationally, natural gas-fired power generation was expected to have exceeded coal-fired power generation for the first time in 2016,[1] and in New England about 50 percent of electricity is now generated from natural gas.[2] With natural gas now such a large part of New England's energy mix, there is a concern that the demand for heating and electricity during cold periods will cause spikes in wholesale electricity prices and that demand may be greater than the available pipeline capacity to deliver natural gas.[3] The region's utility industry has proposed the expansion of pipeline capacity to meet this seasonal increase in the demand for natural gas.

In light of the trends influencing energy markets, this perspectives brief and a related report[4] examine the cost of electrical power in New Hampshire and New England, the reliability of the electrical power system in terms of its ability to

About Carsey Perspectives

Our "Carsey Perspectives" series presents new, innovative ideas and ways of looking at issues affecting our society and the world.

meet demand, and the risk New Hampshire ratepayers might face from various proposals to secure or increase the supply of electricity. We find evidence that near-term levels of demand and supply pose no threat to grid reliability, that current pipeline capacity is adequate, and that better contracting practices and other "soft-infrastructure" changes combined with the promotion of energy efficiency and renewable energy will have at least as large a return on investment as expanded pipeline capacity, without exposing ratepayers to higher electricity rates stemming from expensive infrastructure investments.

Cost of Electrical Power in New Hampshire

In 2015, electricity accounted for approximately 25 percent ($1.7 billion) of all energy expenditures in New Hampshire,[5] and average retail electricity prices in the state, at 18.5 cents per kilowatt hour, were the eighth highest in the country and 47 percent higher than the U.S. average (Table 1). The latter is also the case for New England as a whole. But despite these higher rates, the average monthly New Hampshire residential electricity bill was $115, similar to the U.S. monthly average of $114.[6] New Hampshire residents pay 5.5 percent of their income for overall household energy-related expenses, similar to the overall U.S. resident portion of expenditures at 5.6 percent. In terms of commercial use, the average monthly New Hampshire electric utility bill in 2015 was actually lower than the U.S. average commercial bill, at $529 versus $671.[7]

TABLE 1. AVERAGE PRICE OF ELECTRICITY AND AVERAGE MONTHLY ELECTRIC BILL IN NH AND THE U.S. IN 2015 FOR THE RESIDENTIAL AND COMMERCIAL SECTORS

SECTOR	NH	US
Residential		
Price of Electricity (cents per KWH)	18.5¢	12.7¢
Electric Bill (dollars per month)	$115	$114
Commercial		
Price of Electricity (cents per KWH)	15.0¢	10.6¢
Electric Bill (dollars per month)	$529	$671

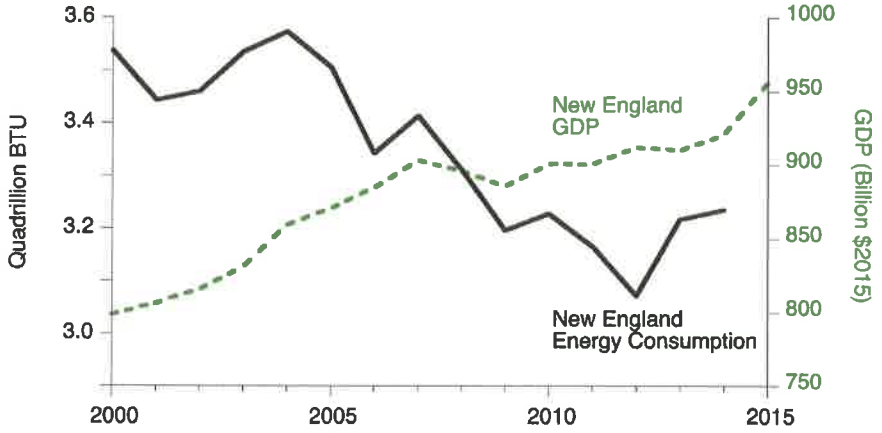
Source: U.S. Energy Information Administration

The relatively higher price of electricity in New Hampshire and New England is a result of several factors,[8] including higher transmission and distribution costs that have resulted from a large number of new transmission projects (over 600 across New England since 2002[9]), wholesale market rules, higher air quality standards, historical investment decisions (and the stranded costs associated with some of those investments), and the lack of indigenous fossil fuel sources that place the region at the "end of the pipeline" for the transport of fossil fuels.

New England has adapted to higher prices through energy efficiency and other energy management investments.[10] Even as the combined gross domestic product (GDP) for all six New England states increased by 9.7 percent from 2005 to 2015, overall energy use declined by 9.6 percent (Figure 1). During the same period, the U.S. GDP grew 15.2 percent while energy consumption fell 3.4 percent (Figure 2). Energy intensity (energy use divided by GDP) in New England is much lower than the U.S. average (Figure 3), demonstrating that New England consumes much less energy per dollar of GDP. In addition, over the past decade, New England's energy intensity has improved by 12.7 percent.

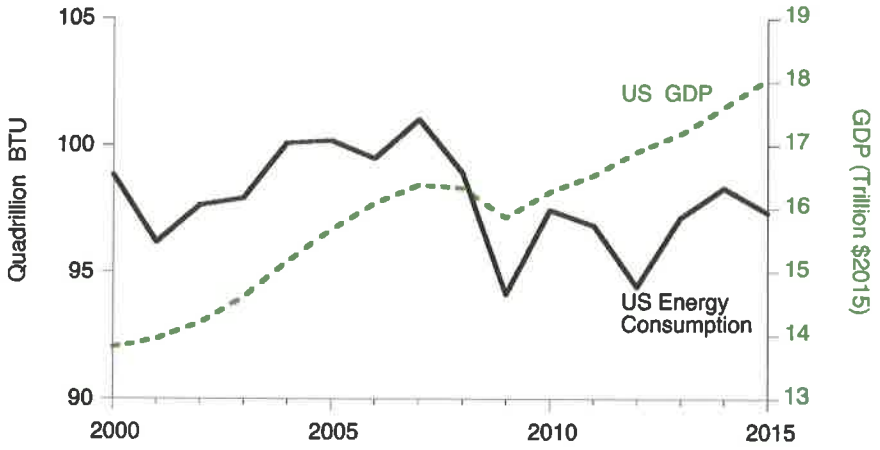
Though New Hampshire residents and businesses pay the same or less for energy as other areas of the country, it is important to prevent further increases in the cost of energy and ideally to reduce the

FIGURE 1. NEW ENGLAND ENERGY CONSUMPTION AND REAL STATE GDP FOR NEW ENGLAND, 2000–2015



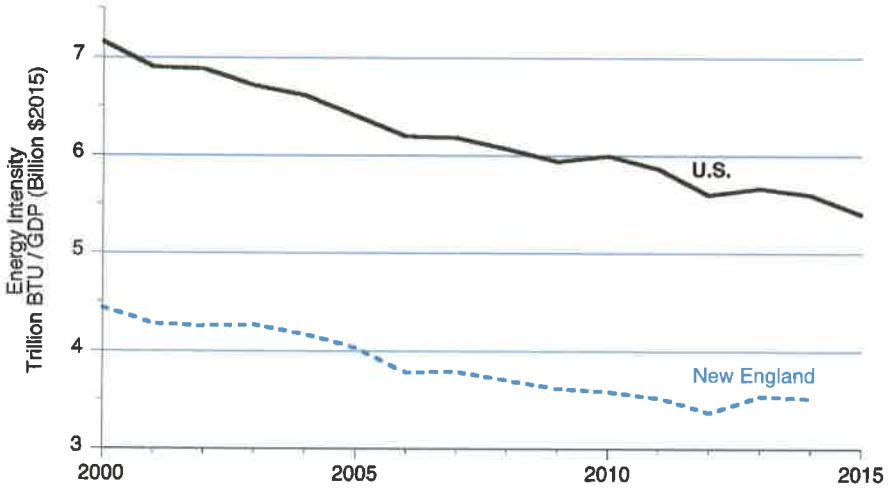
Source: U.S. Energy Information Administration and U.S. Department of Commerce - Bureau of Economic Analysis

FIGURE 2. U.S ENERGY CONSUMPTION AND REAL U.S. GDP, 2000–2015



Source: U.S. Energy Information Administration and U.S. Department of Commerce - Bureau of Economic Analysis

FIGURE 3. ENERGY INTENSITY FOR THE NEW ENGLAND STATES AND THE ENTIRE UNITED STATES FROM 2000–2015



Source: U.S. Energy Information Administration and U.S. Department of Commerce - Bureau of Economic Analysis

overall cost of electricity in New Hampshire. This is especially true for customer groups adversely affected by New Hampshire's relatively high electricity prices, including more intensive commercial and industrial users of electricity, as well as low-income households who pay a greater portion of their income for energy.

Reliability of the Electrical Supply

In New England, the share of electrical power generated from natural gas has grown from 15 percent in 2000 to almost 50 percent in 2015.[11] The region's electric utility industry has expressed concern that the demand for electricity during periods of cold winter weather will be greater than current pipeline capacity to deliver natural gas, resulting in unreasonably high electricity prices and possible power grid instability. ISO New England, the organization responsible for coordinating the region's power grid, has called for new natural gas infrastructure investment.[12]

Several studies conducted between 2012 and 2015 have examined the reliability of the New England power grid, and none of the eight reviewed for this study found that grid reliability is an immediate risk to New England's energy security.[13] Furthermore, while some studies have suggested that grid reliability may be an issue after 2021, the potential challenges are primarily associated with extreme operating conditions. The region's power grid system operator has demonstrated success in managing these extreme conditions and has been proactive in adapting the rules and procedures under which power generators operate to further increase grid reliability.

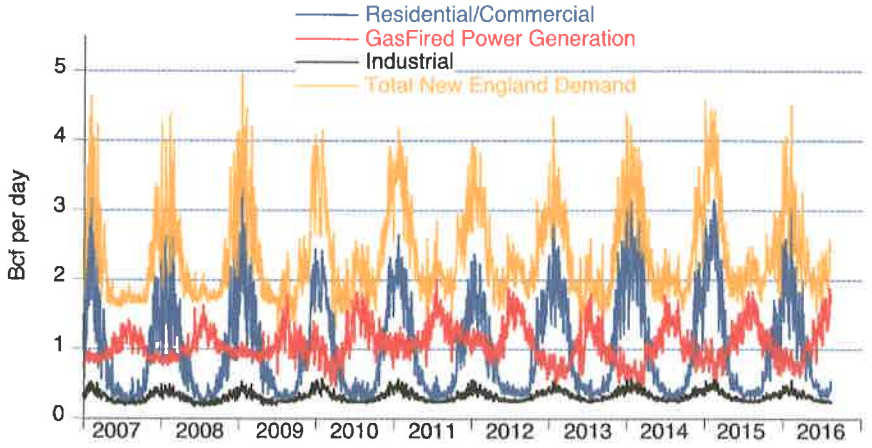
Several lines of evidence support the conclusion that few if any electrical grid reliability problems are likely to emerge before 2021. First, an ICF International report[14] estimates natural gas pipeline capacity in New England at 4.17 billion cubic feet per day (Bcf/d) (Table 2). This, combined with peak shaving capacity (1.45 Bcf/d) and direct LNG import capacity (0.72 Bcf/d), estimates an overall supply capacity of natural gas of 6.34 Bcf/d in winter. This capacity value exceeds recent New England peak winter demand (compare Table 2 values to the peak demand of under 5 Bcf/d illustrated in Figure 4). A separate indicator of pipeline capacity is the sum of state inflow capacities obtained

TABLE 2. ESTIMATES OF NEW ENGLAND NATURAL GAS SUPPLY CAPABILITIES

Natural Gas Source	Winter Supply Capability 2016–17 (Bcf/d)[a]
Pipeline Capacity	4.17
Peak Shaving Capacity	1.45
Direct LNG Import Capacity*	0.72
Total	6.34

Note: * LNG only includes Everett; it does not include LNG from Northeast Gateway or Neptune. **Source:** ICF International. Available online at https://www.iso-ne.com/static-assets/documents/2014/11/final_icf_phii_gas_study_report_with_appendices_112014.pdf.

FIGURE 4. DAILY NATURAL GAS CONSUMPTION BY SECTOR IN NEW ENGLAND FROM 2007–2016 IN BILLION CUBIC FEET PER DAY



Note: Wintertime consumption by the residential/commercial (blue line) and industrial (black line) sectors peaks in winter, while consumption by gas-fired power generators (red line) peaks in summer. **Source:** PointLogic Energy. Available online at https://pointlogicenergy.com/.

from the U.S. Energy Information Administration (U.S. EIA) for natural gas pipelines in New England of 4.96 Bcf/d.[15] This represents an estimate of the total pipeline capacity that exists in New England. However, some pipeline in-flow capacity may not be fully available due to technical capacity constraints within the New England natural gas system.[16] The difference between the state in-flow pipeline capacity and the estimates of pipeline capacity obtained from the ICF study[17] raises the possibility that pipeline capacity may be underutilized and/or that changes in New England internal gas pipeline infrastructure might allow for greater utilization of existing in-flow pipeline infrastructure.

Second, "soft infrastructure" changes (changes to rules, regulations, or policies such as the Winter Reliability Program) can serve as an effective tool for mitigating spikes in wholesale prices. For example, New England electric utilities that purchase gas to generate electricity typically do not contract for firm transportation services[18] to obtain natural gas; instead, they take what is left over. This is a major deliverability challenge and diminishes supply reliability. Specifically, power generators that rely on natural gas to generate electricity do not find it profitable to contract for access to gas under the current New England power system rules because firm gas transportation arrangements are structured as "take-or-pay" contracts.[19] Under these contracts, generators are required to pay for transportation capacity whether or not they are operating, and therefore contracts are not desirable. During most days of the year, generators are able to access gas and use transportation that would otherwise be surplus at far lower cost than contracting for firm transportation. While this contracting structure works for most of the year, during days of high demand it can result in periods when most of the gas is being used by sources who have gas contracts (including natural gas utilities supplying their residential customers and large industrial users). While such scarcity can result in price spikes for natural gas and electricity when demand increases rapidly due to very cold periods or when other major electricity generation stations (such as nuclear power plants) go off-line, they do not appear to impact system reliability. For example, during the high demand for natural gas and related price spikes that occurred in January 2014 associated with the outbreak of the Polar Vortex, not only did the ISO New England power grid provide sufficient electricity to New England consumers during this time period, ISO New England actually assisted the PJM (Mid-Atlantic) energy marketplace by dispatching additional generation units in New England.[20]

Third, electricity consumption in New England is expected to decline by 0.2 percent per year over the next decade.[21] Even with this projected decline, concerns have been raised about the supply impact of the 2014 retirement of the Vermont Yankee nuclear power plant and

the proposed retirement of Pilgrim Nuclear Power in Massachusetts in 2019, as well as the possible closure of several coal- and oil-fired generating plants.[22] Requests from companies to connect electric generation assets to the grid (interconnection requests) are, however, plentiful. Between 2016 and 2020, more than 11,000 megawatts of capacity (35 percent of total existing generating capacity of 31,000 megawatts[23]) have been proposed, and these don't even include plans for transmission lines to import hydroelectric energy from Canada, discussed below. Almost 60 percent of proposed generation is natural gas or dual fuel (natural gas and oil) and about 35 percent is wind, mostly in Maine. While not all projects will necessarily be constructed, the interconnection requests provide a useful indicator that there is a considerable amount of new electrical power production slated to come online in the near future. One report suggests that, from a reliability perspective, the current buildout plan—evidenced by the interconnection requests—is sufficient over the short term.[24]

Plans to build new transmission lines to import hydropower from Quebec into New England include the Northern Pass[25] project, designed to bring 1,090 megawatts through New Hampshire, and the 1,000 megawatt New England Clean Power Link[26] transmission line underneath Lake Champlain and into Vermont. This range of new supply could provide diversity in the source of energy used to power New England's grid, an important hedge in light of rapidly changing global energy markets. There has been insufficient study assessing the energy security risk of increasing New England's dependence on natural gas sourced primarily from one geographic region (Marcellus Shale from the Appalachian Basin). Yet, the natural gas export capacity from that region to other regions of the United States and globally is expanding significantly.[27]

Risks to the Grid and to Ratepayers

The difference between the sum of state in-flow capacity obtained from the U.S. EIA and the estimated available capacity assumed in the ICF study may be evidence of some of the potential risks associated with pipeline investments including that changes in supply and/or demand can result in underutilized pipeline. Demand can end up not matching supply when the pipelines are built, leaving stranded costs that the customer ends up having to pay. (Stranded costs are ones that must be paid by utility ratepayers if infrastructure investments become redundant either through market forces or regulation.) Given the long-term cost recovery period of infrastructure, a poorly informed decision can have a long-term impact on electricity rates.

Previous utility proposals have requested that New Hampshire electric ratepayers fund the costs associated with new natural gas pipelines. But the finding that near-term energy supply is not a threat to power grid stability[28] provides New Hampshire policy makers time (that is, years) to fully consider the costs, benefits, and risks associated with increasing New Hampshire's reliance on one fuel source from one geographic region.

Proceeding carefully and deliberately seems particularly important if the taxpayer (and not private capital) will be funding the new infrastructure.

Proceeding carefully and deliberately seems particularly important if the taxpayer (and not private capital) will be funding the new infrastructure. An example supporting a careful approach is the investment in 2012 of $409 million in new pollution control equipment at the Merrimack Station coal-fired power generation plant in Bow, New Hampshire. Due to changing market conditions, the plant is now valued at just $10 million. New Hampshire ratepayers are paying for all but $25 million of the $409 million through a cost recovery mechanism on electricity bills.[29] This single investment[30] will add 0.4 cents per kilowatt-hour (or about 2.5 to 3.0 percent) to every New Hampshire electric ratepayer's bill for many years to come. If new natural gas capacity results in overbuild, and ratepayers are contractually obligated for the costs, the cost of unneeded capacity will reduce the savings estimated to accrue to electric ratepayers.

Responses from an October 2016 Granite State Poll[31] show that a large swath of New Hampshire residents—58 percent—oppose using ratepayer funds for new pipeline infrastructure. This view was shared by almost half of self-described politically conservative respondents (48 percent) and six in ten liberals (63 percent) and moderates (60 percent).

Historically, New Hampshire has lagged behind the New England region in renewable energy and

energy efficiency investment. For example, in 2015 New Hampshire had both the lowest total ($26 million) and per capita ($19.20) public spending on electric efficiency programs out of the New England states. New Hampshire's per capita expenditure on energy efficiency programs was almost 80 percent less than that of Vermont.[32] However, New Hampshire has made progress in supporting clean energy investment with its participation in the Regional Greenhouse Gas Initiative (enacted in 2008), the Renewable Portfolio Standard (2007), and the recently approved Energy Efficiency Resource Standard (EERS) (August 2016). The New Hampshire EERS takes effect in January 2018 and has established a cumulative goal of 3.1 percent electric savings relative to 2014 kilowatt-hour sales. States that have implemented EERS have experienced three times the energy savings as states without an EERS.[33] This is an example of the type of policy that is expected to help New Hampshire cost effectively meet its energy needs without paying for large infrastructure projects and dealing with the associated stranded-costs risk.

The relative net benefits of pipeline expansion, LNG contracting, and energy efficiency and demand reduction for New England were analyzed in a 2015 Analysis Group report[34] that followed a transparent methodology and made assumptions based on the current state of the energy marketplace. Results showed all three scenarios having a significant positive return on investment for ratepayers (these returns do not include environmental benefits). The LNG contract scenario had the lowest annual cost ($18 million) and the highest anticipated return on investment (150 percent). The energy efficiency scenario had the highest annual cost ($101 million) but a return on investment (145 percent) similar to LNG. Pipeline expansion had an annual cost in between these two scenarios ($66 million), and a lower but still significant return on investment (92 percent). In terms of dollars, the energy efficiency scenario has the highest return on investment of $146 million versus $61 million for pipeline expansion and $27 million for LNG.

A measure of stranded-cost potential was developed by calculating the worst-case scenario for dollars at risk (a measure that indicates the magnitude of risk, not the likelihood). The LNG and energy efficiency scenarios have similar worst-case stranded-cost risk profiles, ranging between $90 million and $101 million. In contrast, the risk for the pipeline was about twenty times higher, at $1,980 million.

In response to a request from New Hampshire energy stakeholders for more New Hampshire-specific information, we developed a spreadsheet model to directly compare the net benefits of pipeline expansion versus expansion of energy efficiency and solar energy. The assumptions used to develop the model are detailed in Section 5 of the full report. The total estimated cost for the natural gas expansion scenario from 2017 to 2030 was $1.3 billion, and wholesale electricity cost savings (based on optimistic industry estimates) totaled $1.6 billion (Figure 5; note the figure shows annual saving). This produces a simple return on investment over the period of $1.30 for every dollar spent. The total estimated cost of the energy efficiency and solar energy scenario from 2017 to 2030 was $1.1 billion and the savings were $2.3 billion (without discounting for future value). This produces a simple return on investment of $2 for every dollar spent.

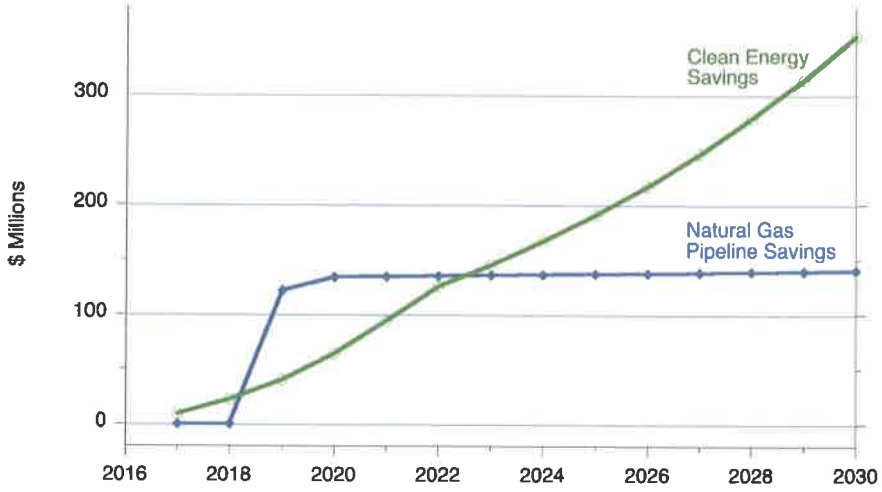
New Hampshire residents favor investment in renewable energy.

New Hampshire residents favor investment in renewable energy. In response to a Granite State Poll question[35] on priorities for energy sources in the future, by almost a 3-to-1 margin respondents gave higher priority to renewable energy sources (67 percent) compared to natural gas (24 percent). Large majorities of self-reported political liberals (88 percent) and moderates (70 percent) preferred increased use of renewable energy sources, while self-described conservatives were as likely to prioritize natural gas (46 percent) as renewable energy (45 percent).

Conclusion

Our findings suggest that there is no immediate need for New Hampshire to expand natural gas pipeline infrastructure. If the state wishes to intervene in the market by obligating ratepayer funds to reduce wholesale electricity costs, additional public investment in major pipeline infrastructure should wait until a rigorous study has been completed that models system wide natural gas flows and prices. This study should lead to an improved understanding of the difference between the technical and economic capacity of the existing system and explore opportunities to access more of the technical pipeline capacity

FIGURE 5. RESULTS FROM A SPREADSHEET MODEL COMPARING *ANNUAL* SAVINGS IN NEW HAMPSHIRE BASED ON INVESTING IN NATURAL GAS PIPELINE(S) VERSUS INVESTMENT IN ENERGY EFFICIENCY AND SOLAR ENERGY



Note: Total projected cumulative savings from 2017 to 2030 are $1.63 billion for the natural gas pipeline scenario and $2.27 billion for the clean energy scenario. **Source:** Wake et al., "New Hampshire's Electricity Markets: Natural Gas, Renewable Energy, and Energy Efficiency," 2017, Section 5, http://scholars.unh.edu/sustainability/6/.

in cost-effective ways. To date, no study of which we are aware has performed the level of rigorous analysis required to justify a major multidecadal contract obligating ratepayers, and moving ahead without such a study would essentially make ratepayers energy market speculators. Policy makers also may want to consider other options that carry less risk and a better return on investment, including better utilization of existing infrastructure and increased investment in energy efficiency and renewable energy.

Contracts for natural gas capacity that are funded by ratepayers should be conducted through a request-for-proposals (RFP) process, as recommended by the Public Utility Commission.[36] This process should examine all avenues of gas supply, including new pipelines, existing pipelines, and LNG capacity. The underlying costs and assumptions from vendor submissions should also be placed in the public domain for review. Since there is evidence that costs may be lower from more effective use of existing infrastructure, an RFP process would allow the least-cost option to be revealed through a fair, open, and competitive bidding process.[37]

Based on the detailed analysis provided in Sections 3 and 4 of the full report, and given the projected low peak-load growth and uncertainty in future energy markets, it is advisable to avoid expensive market interventions or, at minimum, to prioritize investments that have the highest return on investment, lowest projected cost, and lowest risk. This practice will serve to keep rates affordable by reducing spending on expensive utility infrastructure that has been demonstrated in the past to increase rates (for example, Merrimack Station).

The findings of this study suggest that the LNG contract scenario or renewable energy and energy efficiency investment (up to the maximal economic potential estimated by the Vermont Energy Investment Corporation to be approximately 6 percent of the total New Hampshire energy load[38]) will be the most cost-effective alternatives while also representing low financial risk to New Hampshire ratepayers. Furthermore, policies should consider the unintended or disproportionate impacts on the populations most negatively affected by increased energy prices, including large commercial and industrial users and low-income households. In conclusion, we argue that the while the utility companies' stated goal of reducing electricity costs in the State is admirable, that ironically, their strategy of expanded natural gas capacity in the region funded by ratepayers poses a significant risk of raising electricity costs further.

Data

Energy data used in this brief are from the U.S. Energy Information Administration, ICF International, Inc. and PointLogic Energy, and Gross Domestic Product and Price Index data from U.S. Department of Commerce, Bureau of Economic Analysis. We also conducted a review of prior/existing studies that focused on natural gas infrastructure, and energy efficiency and renewable energy implementation. Citations provided in the endnotes and detailed in the full report, http://scholars.unh.edu/sustainability/6/.

10

Global Warming Has Begun, Expert Tells Senate

By PHILIP SHABECOFF, Special to the New York Times

Published: June 24, 1988

WASHINGTON, June 23— The earth has been warmer in the first five months of this year than in any comparable period since measurements began 130 years ago, and the higher temperatures can now be attributed to a long-expected global warming trend linked to pollution, a space agency scientist reported today.

Until now, scientists have been cautious about attributing rising global temperatures of recent years to the predicted global warming caused by pollutants in the atmosphere, known as the "greenhouse effect." But today Dr. James E. Hansen of the National Aeronautics and Space Administration told a Congressional committee that it was 99 percent certain that the warming trend was not a natural variation but was caused by a buildup of carbon dioxide and other artificial gases in the atmosphere.

Dr. Hansen, a leading expert on climate change, said in an interview that there was no "magic number" that showed when the greenhouse effect was actually starting to cause changes in climate and weather. But he added, "It is time to stop waffling so much and say that the evidence is pretty strong that the greenhouse effect is here." An Impact Lasting Centuries

If Dr. Hansen and other scientists are correct, then humans, by burning of fossil fuels and other activities, have altered the global climate in a manner that will affect life on earth for centuries to come.

Dr. Hansen, director of NASA's Institute for Space Studies in Manhattan, testified before the Senate Energy and Natural Resources Committee.

He and other scientists testifying before the Senate panel today said that projections of the climate change that is now apparently occurring mean that the Southeastern and Midwestern sections of the United States will be subject to frequent episodes of very high temperatures and drought in the next

decade and beyond. But they cautioned that it was not possible to attribute a specific heat wave to the greenhouse effect, given the still limited state of knowledge on the subject. Some Dispute Link

Some scientists still argue that warmer temperatures in recent years may be a result of natural fluctuations rather than human-induced changes.

Several Senators on the Committee joined witnesses in calling for action now on a broad national and international program to slow the pace of global warming.

Senator Timothy E. Wirth, the Colorado Democrat who presided at hearing today, said: "As I read it, the scientific evidence is compelling: the global climate is changing as the earth's atmosphere gets warmer. Now, the Congress must begin to consider how we are going to slow or halt that warming trend and how we are going to cope with the changes that may already be inevitable." Trapping of Solar Radiation

Mathematical models have predicted for some years now that a buildup of carbon dioxide from the burning of fossil fuels such as coal and oil and other gases emitted by human activities into the atmosphere would cause the earth's surface to warm by trapping infrared radiation from the sun, turning the entire earth into a kind of greenhouse.

If the current pace of the buildup of these gases continues, the effect is likely to be a warming of 3 to 9 degrees Fahrenheit from the year 2025 to 2050, according to these projections. This rise in temperature is not expected to be uniform around the globe but to be greater in the higher latitudes, reaching as much as 20 degrees, and lower at the Equator.

The rise in global temperature is predicted to cause a thermal expansion of the oceans and to melt glaciers and polar ice, thus causing sea levels to rise by one to four feet by the middle of the next century. Scientists have already detected a slight rise in sea levels. At the same time, heat would cause inland waters to evaporate more rapidly, thus lowering the level of bodies of water such as the Great Lakes.

Dr. Hansen, who records temperatures from readings at monitoring stations around the world, had previously reported that four of the hottest years on record occurred in the 1980's. Compared with a 30-year base period from 1950 to 1980, when the global temperature averaged 59 degrees Fahrenheit, the temperature was one-third of a degree higher last year. In the entire century before 1880, global temperature had risen by half a degree, rising in the late 1800's and early 20th century, then roughly stabilizing for unknown reasons for several decades in the middle of the century. Warmest Year Expected

In the first five months of this year, the temperature averaged about four-tenths of a degree above the base period, Dr. Hansen reported today. "The first five months of 1988 are so warm globally that we conclude that 1988 will be the warmest year on record unless there is a remarkable, improbable cooling in the remainder of the year," he told the Senate committee.

He also said that current climate patterns were consistent with the projections of the greenhouse effect in several respects in addition to the rise in temperature. For example, he said, the rise in temperature is greater in high latitudes than in low, is greater over continents than oceans, and there is cooling in the upper atmosphere as the lower atmosphere warms up.

"Global warming has reached a level such that we can ascribe with a high degree of confidence a cause and effect relationship between the greenhouse effect and observed warming," Dr. Hansen said at the hearing today, adding, "It is already happening now."

Dr. Syukuro Manabe of the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration testified today that a number of factors, including an earlier snowmelt each year because of higher temperatures and a rain belt that moves farther north in the summer means that "it is likely that severe mid-continental summer dryness will occur more frequently with increasing atmospheric temperature." A Taste of the Future

While natural climate variability is the most likely chief cause of the current drought, Dr. Manabe said, the global warming trend is probably "aggravating the current dry condition." He added that the current drought was a foretaste of what the country would be facing in the years ahead.

Dr. George Woodwell, director of the Woods Hole Research Center in Woods Hole, Mass., said that while a slow warming trend would give human society time to respond, the rate of warming is uncertain. One factor that could speed up global warming is the widescale destruction of forests that are unable to adjust rapidly enough to rising temperatures. The dying forests would release the carbon dioxide they store in their organic matter, and thus greatly speed up the greenhouse effect. Sharp Cut in Fuel Use Urged

Dr. Woodwell, and other members of the panel, said that planning must begin now for a sharp reduction in the burning of coal, oil and other fossil fuels that release carbon dioxide. Because trees absorb and store carbon dioxide, he also proposed an end to the current rapid clearing of forests in many parts of the world and "a vigorous program of reforestation."

Some experts also believe that concern over global warming caused by the burning of fossil fuels warrants a renewed effort to develop safe nuclear power. Others stress the need for more efficient use of energy through conservation and other measures to curb fuel-burning.

Dr. Michael Oppenheimer, an atmospheric physicist with the Environmental Defense Fund, a national environmental group, said a number of steps can be taken immediately around the world, including the ratification and then strengthening of the treaty to reduce use of chlorofluorocarbons, which are widely used industrial chemicals that are said to contribute to the greenhouse effect. These chemicals have also been found to destroy ozone in the upper atmosphere that protects the earth's surface from harmful ultraviolet radiation from the sun.

Graph showing the average global temp. through the first 5 months of '88 (source: James E. Hansen & Sergej Lebedeff (NYT); photo of James E. Hansen (pg. A14) (NYT/Jose R. Lopez).

http://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html?pagewanted=all&mcubz=1

See also: https://www.frontiersofknowledgeawards-fbbva.es/galardonado/james-hansen-2/

July 8, 2015
RSS

Former Exxon Employee Says Company Considered Climate Risks as Early as 1981

New Report Finds that Despite Decades of Scientific Warnings, Fossil Fuel Companies Continued to Mislead Public, Policymakers

CAMBRIDGE, Mass. (July 8, 2015)—Exxon employees considered how climate change should factor into decisions about new fossil fuel extraction as early as 1981, according to a former employee's email the Union of Concerned Scientists (UCS) reviewed while researching a new report on fossil energy company lobbying campaigns.

Yet as the new report, *The Climate Deception Dossiers*, chronicles, Exxon and other major fossil fuel companies did not take action to disclose or reduce climate risks in the ensuing years, but instead actively misled the public and policymakers about them.

The new report reviews internal documents related to some of the world's largest fossil fuel companies, including BP, Chevron, Conoco, ExxonMobil, Peabody Energy, Phillips, and Shell, spanning the course of 27 years—memos that have either been leaked to the public, come to light through lawsuits, or been disclosed through Freedom of Information Act (FOIA) requests. The documents show that:

- Companies have directly or indirectly spread climate disinformation for decades;
- Corporate leaders knew the realities of climate science—that their products were harmful to people and the planet—but still actively deceived the public and denied this harm;
- The campaign of deception continues, with some of the documents having surfaced as recently as in 2014 and 2015.

UCS has made the complete collection of 85 internal memos—totaling more than 330 pages—available online.

In the email, the employee explains that, "Exxon first got interested in climate change in 1981 because it was seeking to develop the Natuna gas field off Indonesia." He said the company knew the field was rich in carbon dioxide and that it could become the "largest point source of CO2 in the world," accounting for 1 percent of projected global CO2 emissions.

It is not clear that any other companies were considering the climate effects of projects at such an early time.

Despite these internal deliberations as well as warnings from scientists, the report finds that company lobbyists continued to fight climate rules and spread misinformation about climate science. In 1995, the same former employee helped author one of the key documents highlighted in the report when he later worked for Mobil: a memo sent to the Global Climate Coalition (GCC), a fossil fuel lobbying group. The memo, which was distributed to representatives from member companies, warned unequivocally twenty years agothat burning the companies' products was causing climate change and that the relevant science "is well established and cannot be denied."

Writing in 2014, the former employee, who also served on the Intergovernmental Panel on Climate Change, lamented that he was unsuccessful in "trying to get them to recognize scientific reality."

The email was sent in response to an inquiry from Ohio University's Institute for Applied and Professional Ethics about how companies often fail to account for "un-priced externalities," such as climate change. It

was first published online (see item 3) in October of 2014, but has not received any outside notice until now.

UCS president Ken Kimmell, a former attorney and head of the Massachusetts Department of Environmental Protection, wrote in a blog post about the report that companies missed an opportunity to lead on climate change.

"Many fossil fuel companies haven't been honest about the harms they have caused by extracting and selling products that place our climate in grave danger," he wrote. "Instead of taking responsibility, they have either directly—or indirectly through trade and industry groups—sown doubt about the science of climate change and fought efforts to cut emissions."

Indeed many of those same companies – including BP, Chevron, Conoco, Exxon, Mobil, Phillips, and Shell – were members of the American Petroleum Institute (API) in 1998 when the trade group drafted a plan to secretly support "independent" researchers who would publicly dispute established climate science. The trade group's memo claimed that "victory" would be achieved when "average citizens 'understand' (recognize) uncertainties in climate science."

As the UCS report chronicles, member companies continued to implement API's plans even after they were exposed. For instance, freedom of information requests from Greenpeace and the Climate Investigations Center yielded documents earlier this year that showed how API, ExxonMobil and Southern Company, a utility, continued to fund at least one contrarian researcher – aerospace engineer Wei-Hock "Willie" Soon – for more than a decade through grants to the Smithsonian Institution. The Smithsonian responded to these revelations by promising to revisit policies governing outside research funding.

Other documents in the report highlight deceptive strategies fossil fuel companies have used to undermine climate policy, including forging documents and funding California groups that purport to advocate on behalf of drivers and taxpayers rather than oil companies.

The report's release comes at a time of increased scrutiny on major fossil fuel companies. In response to shareholder pressure, Shell and BP have called for placing a price on carbon and supported resolutions that would require the companies to reexamine their business models to account for climate policy and to embrace greater transparency on climate lobbying. Meanwhile, ExxonMobil continues to reject such resolutions. At a May shareholder meeting, CEO Rex Tillerson also publicly criticized climate models and suggested that humans will simply adapt to climate change.

Fossil fuel companies' support for trade and advocacy groups that dispute and distort climate science has also come under fire. UCS and ShareAction recently called on Shell to follow BP's lead in leaving the American Legislative Exchange Council, a lobbying group highlighted in the report that routinely disseminates misinformation about climate science and policy to state legislators.

The UCS report calls on companies to stop supporting campaigns that spread misinformation about climate science and to end efforts to undermine climate policy. Nancy Cole, a report author and UCS's campaign director for climate and energy, said companies should find more constructive paths forward.

"These companies aren't just trying to block new polices, they're trying to roll back clean energy and climate laws that are working and are widely supported by the public," she said. "Climate change is already underway – and many communities are struggling to protect their residents and prepare for future changes. The deception simply must stop. It's time for major carbon companies to become part of the solution."

https://www.nytimes.com/2017/05/19/opinion/cracking-washingtons-gridlock-to-save-the-planet.html?mcubz=1

Cracking Washington's Gridlock to Save the Planet

David Bornstein MAY 19, 2017

One day, ideally in the not-too-distant future, when Congress finally passes major legislation to curb carbon emissions — to reduce the environmental and economic harm caused by climate change — Americans will owe a big thank you to the perseverance and discipline of the Citizens' Climate Lobby. Special appreciation should go to one volunteer, Jay Butera, a businessman from Pennsylvania who has put intense effort into getting Democrats and Republicans in Congress to begin talking with one another about potential solutions.

The Citizens' Climate Lobby is a network of volunteers who have come together in the last several years to advance climate policy in a bipartisan manner. Its support base has increased fivefold since 2015 to 60,000 supporters; among them, 23,000 are actively working to build political will for a national, revenue-neutral carbon fee-and-dividend system, a market-based approach that aims to reduce carbon emissions while spurring employment.

Over the past year, volunteers have held 1,429 meetings with their representatives' offices, organized 2,597 outreach events, and prompted or written 3,339 editorials, op-ed essays, and letters to the editor. In 2010, the organization's annual conference drew 25 participants; next month, the network expects to welcome 1,200 in Washington.

These activities have strengthened relationships between constituents and their representatives and have been instrumental in two significant developments in the House of Representatives: the introduction, in March, of the Republican Climate Resolution, which now has 20 co-sponsors, and the creation of the first bipartisan Climate Solutions Caucus.

Equally important today, the Citizens' Climate Lobby illustrates how average Americans can work effectively to influence government.

Butera has worked to address climate change for more than a decade and has been a volunteer with the Citizens' Climate Lobby since 2012. In 2013, he met Representative Ted Deutch, a Florida Democrat, whose district was experiencing the effects of global warming. Butera mentioned that

he had a vision to create a bipartisan caucus in the House that would focus on climate solutions. Deutch liked the idea and agreed to work with him and the citizens' lobby toward that goal.

"The kind of meaningful conversation that was taking place in boardrooms and in local governments unfortunately had not really taken place in Congress," Deutch told me.

Butera started visiting offices on Capitol Hill in an effort to get Republicans and Democrats to sit together. At the time, it seemed a fool's errand. "People would laugh," he says now. " 'Good luck with that.' " He was advised to avoid the word "climate." Call it a "resiliency" caucus or a "coastal states" caucus, he was told. The word climate was unmentionable.

Butera and Deutch devised a Noah's Ark approach: The caucus would grow by twos, to keep equality of numbers between Republicans and Democrats. Many Democrats were interested. The question was: How to get Republicans to join?

Butera reasoned that the first movers were likely to come from Florida. "The coastal districts are mainly Republican and the coastline is threatened existentially by climate impacts," he said.

He flew to Miami, timing the trip to coincide with Earth Day 2014. He attended events in southern Florida that focused on climate change; there he met locals and helped them start a Citizens' Climate Lobby chapter.

"I saw that local mayors and county leaders were dealing with the impacts of climate change head on," he said.

Some towns had raised the roads and moved wells miles inland to escape seawater intrusion. In other places, seawater poured into the streets at every high tide. Speaking with congressional staff members in Washington, Butera discovered that many were unaware of the reality on the ground.

"There was a disconnect," he said.

For the next two years, Butera and many other volunteers worked to address that disconnect. Butera organized countless meetings in Florida and Washington. He took videos and photographs of climate effects and shared them with congressional offices. He and others reached out to 55 mayors, county commissioners, presidents of Chambers of Commerce, state representatives and university presidents across South Florida — most of them from Republican-held congressional districts — to sign a letter asking Congress to act on climate change.

It made a difference. The first Republican to step forward was Representative Carlos Curbelo. In February 2016, he joined Deutch and they filed the paperwork for the Climate Solutions Caucus. Shortly thereafter, Representative Ileana Ros-Lehtinen, another Republican, came on board. Butera had earlier brought a contingent of 16 mayors, Chamber of Commerce leaders, and county commissioners to her Miami office to speak about how climate change was affecting their communities. Citizens' Climate Lobby volunteers had also flown from Miami to Washington to join him in meetings with the congresswoman.

Today, the caucus has 38 members — 19 from each party. They're still a long way from having the votes needed to pursue bipartisan climate legislation. But it's worth examining how this progress has been achieved in spite of all the acrimony and mistrust today — and in particular, how it's been led by ordinary citizens. (This episode of the National Geographic Channel's series "Years of Living Dangerously" chronicles their efforts.)

"Most people make the assumption that there's absolutely no point in contacting their representative because it wouldn't do any good," says Tom Moyer, a Citizens' Climate Lobby volunteer from Utah who works closely with his representative, Mia Love, a Republican.

In a 2016 Rasmussen survey, only 11 percent of respondents said that the average member of Congress listens to their constituents. By contrast, in surveys of congressional staff members, more than 90 percent say that "in-person issue visits from constituents" and "individualized email messages" would have 'some' or 'a lot' of influence on an undecided lawmaker.

It's this belief in the power of citizens that animates the citizens' lobby. "People assume of Congress that they're beholden to their campaign contributors and all they can do is work to get them out of office," said Moyer. "We start from the assumption that they want to solve the problem. And we ask: How can we work together?"

The Citizens' Climate Lobby has built an elaborate structure to support its volunteers, with regular training sessions, conference calls, debriefings and gatherings. The group has received extensive guidance and inspiration from the Center for Citizen Empowerment and Transformation, whose founder, Sam Daley-Harris, literally wrote the book on citizens' lobbying.

Volunteers rehearse short presentations called "laser talks." They learn how to frame the climate issue from a variety of perspectives — say, as an issue of health, economic stability or national security. They never get into arguments about science, which they know are doomed from the start. They're trained to show good manners: begin meetings by expressing appreciation, listen with an open mind, follow up with heartfelt thank-you letters.

"It can't be lip service," says Ashley Hunt-Martorano, a former Citizens' Climate Lobby volunteer from Long Island who now works for the organization. "It has to come from a genuine place."

For instance, when Hunt-Martorano and her colleagues first met their representative, Lee Zeldin, a Republican, they expressed appreciation for his service in Iraq and in the State Senate before mentioning anything about climate change. "He interrupted us," recalled Hunt-Martorano. "He said: 'I just have to say, you guys are not normal. You're smiling, you're saying nice things about me. That's not what people like you do when you come into my office.' "

Since then, the volunteers have met with Zeldin or members of his staff 32 times. They understand his interests and passions, and have helped him advance some of his legislative goals. And he became the fifth Republican to join the caucus.

"The Citizens' Climate Lobby is an exceptional group that is pursuing an amazingly productive, substantive way to engage with members of Congress on both sides of the aisle," Zeldin told me.

"We need conversations with Congress, not just sound bites and accusations," he said. "That's how we'll find a way forward."

"Congress is a lagging indicator of public opinion," he added. "It's up to the American people to make their opinions known. If the American people demand action on climate change from Congress, there's no doubt that it will happen."

David Bornstein is the author of "How to Change the World," which has been published in 20 languages, and "The Price of a Dream: The Story of the Grameen Bank," and is co-author of "Social Entrepreneurship: What Everyone Needs to Know." He is a co-founder of the Solutions Journalism Network, which supports rigorous reporting about responses to social problems.

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TEN POSSIBLE TWEAKS TO THE 10-YEAR STATE ENERGY STRATEGY FOR 2017

1. Make clear that the need for more energy infrastructure starts with infrastructure related to energy efficiency, which is the cheapest way to meet the next kilowatt-hour of demand.
2. Explore whether New Hampshire should join Maine and Vermont in creating an energy efficiency utility as opposed to depending on electric distribution and natural gas utilities to deliver ratepayer-funded energy efficiency services to consumers.
3. Focus attention on reducing peak demand because, among other things, other states are doing this and are thereby reducing their share of the region's escalating transmission costs.
4. Reform the statutorily required least-cost-integrated resource planning process to account for restructuring, regionalization and grid modernization.
5. Define "resiliency" with precision since there seems to be consensus that "reliability" is not enough.
6. Make New Hampshire a haven for electric vehicles, because this is what consumers will be purchasing in the future.
7. Act decisively to assure that no one is left behind – particularly Granite Staters of modest means, people who do not own their homes, and citizens who lack the resources to manage their energy use actively.
8. Acknowledge that electricity is one of New Hampshire's leading exports, and therefore get vigilant about the proper use and development of natural gas pipeline capacity around New England.
9. Work with neighboring states to reform ISO New England so that the organization that runs the bulk power transmission system and oversees wholesale electricity markets is responsive and accountable.
10. Incorporate and nurture consumer cooperatives that can deliver the full menu of energy services to ratepayers on a trustworthy and turnkey basis.

My name is Bob Eldredge and I have lived in NH for over 30 years.

I strongly support the State focusing on energy efficiency in order to reduce the amount of money leaving our State to import energy. Many NH homes are heated by imported fuels and energy. We need to focus on making homes and buildings more energy efficient by slowing down the heat loss. The less of this fuel consumed, means more money for home owners to spend locally.

I have worked as a home energy auditor for the past 6 years. Most my customers are recent buyers of single residential homes. Their primary concerns are the high energy bills for heating, ice dam issues, and then the high electric bills.

It interesting we have all sorts of labels to show the energy efficiency rating of appliances, heating systems, light bulbs and of course automobiles - MPG. All this to keep Buyers informed. Imagine buying an automobile without knowing the MPG rating.

As a home is probably the largest investment a person makes, why doesn't it have an energy efficiency rating? – Like cars do, even a 50 cent light bulb does.

There are already a number of Qualified Assessors in NH

Today the HERS rating system is available for Buyers of new construction (Energy Star homes), so the Buyers know the energy efficiency rating of a new home. This is also needed for existing homes - that is something quick, simple and affordable.

There is already a field in the NH MLS for this to assist Buyers looking for energy efficient homes and Sellers to market their homes.

With a favorable Home Energy Score, there are benefits in terms of FHA and Fannie Mae mortgage offerings.

As we are the second most dependent state on heating oil, this will be great way to educating home owners how to reduce their usage, keep their dollars in NH, and then be able to afford those new counter tops.

Thank you for your time.