

This document accompanies a five-page introduction to the overarching strategy or theory of change developed by a team at The Climate Center. In this introduction, we summarize the case that for us to avert climate disaster, climate leaders and advocates must be much more powerful and effective, and that this can happen if we align and collaborate around an overarching strategy. We present our overarching strategy or theory of change in this introduction.

Education

Many organizations and social movements pursue education by itself without a connection to policy objectives. Examples of climate education are plentiful and include school-based programs to introduce youth to climate science, pollution, and ecology; and programs that make information easily accessible to the public about the ecological impacts of food production and consumption, consumer goods, public transit, etc.^{1, 2} For this paper, education also includes efforts such as increasing issue awareness and “consciousness raising.”³

Strategies that prioritize education assume that more information about the climate crisis will cause people to think differently and consequently make more climate-friendly choices, and that these individual choices will add up to prevent catastrophic climate change.

Two arguments follow against the use of education by itself as a primary strategy for achieving rapid, massive greenhouse gas emissions reductions. In sufficient time exists to change humans thinking about climate change rapidly and massively, and proof of a cause-effect relation between knowledge and action is weak.

The article, “Stop Raising Awareness Already” notes that too many organizations concentrate on raising awareness about an issue without translating awareness into behavioral change and getting people to act on their beliefs. “Abundant research shows that people who are simply given more information are unlikely to change their beliefs or behavior...it’s time for activists and organizations...to move beyond just raising awareness. It wastes a lot of time and money for important causes that can’t afford to sacrifice either. Instead, social change activists need to use behavioral science to craft campaigns that use messaging and concrete calls to action that get people to change how they feel, think, or act, and as a result create long-lasting change.”⁴

Psychological complexities and quirks impede the conversion of climate change messages into desired behavior. People generally view the threat posed by climate change as distant, abstract, and questionable. Climate peril lacks the usual signals that mobilize a threat response. Providing

¹ United States Department of Agriculture Forest Service, “About Conservation Education”, *United States Department of Agriculture*. <<https://www.fs.usda.gov/main/conservationeducation/about>>

² National Environmental Education Foundation, “About NEEF”, 2018. <<https://www.neefusa.org/about-neeef>>

³ Meisner, Mark, “Consciousness Raising”, Cengage, 2013. <<https://markmeisner.files.wordpress.com/2014/03/meisner-consciousness-raising.pdf>>

⁴ Christiano, Ann, and Neimand, Annie; Stanford Social Innovation Review; Spring 2018, https://ssir.org/articles/entry/stop_raising_awareness_already

more evidence about the threat does not lead to behavior changes.⁵ To earn the support of someone who does not already think about protecting the climate, one must confront and overcome powerful, inbuilt psychological mechanisms. Moreover, when scientific data contradicts in-group beliefs, the human need for belonging and social inclusion almost always trumps the data. Climate education is a long-term undertaking. But time is the scarcest of all resources when addressing climate, so education does not meet the speed and scale strategy test.⁶

Even if education could quickly change people's minds, this would still be insufficient as a speed and scale solution to address the climate crisis because the system in which we live does not support climate-friendly behavior. "If affordable mass transit isn't available, people will commute with cars. If local organic food is too expensive, they won't opt out of fossil fuel-intensive super-market chains. If cheap mass-produced goods flow endlessly, they will buy and buy and buy."⁷ Education alone does not automatically lead to the needed systemic changes that can mitigate the climate crisis. However, as discussed below, education can be powerful when coupled with other strategic tools that instigate systemic shifts.

Individual Actions

Many organizations, governments, and leaders encourage people to change their individual actions and personal choices as the priority response to climate change. At first glance, this seems appropriate. When the magnitude of global climate change sinks in, people's first instinct is to look within their immediate locus of control – food they eat, waste they recycle, energy they use – for ways to address the problem. For example, a PBS segment called "What Can You Actually Do About Climate Change" emphasizes individual actions such as getting rid of your car, flying less, eating no meat, buying green electricity, and having fewer children.⁸

Individual actions help people foster self-efficacy and live in integrity with their values. These traits are important for building an educated and engaged culture of activism. But personal actions make negligible differences in reducing GHG emissions. Our analysis suggests that the effort to bring about individual lifestyle changes does not justify the gains that come as a result. Like education, individual actions are essential but insufficient, and should not detract from the primary solution to the climate crisis – systemic change through policy.

Bill McKibben, founder of 350.org and an internationally known climate leader, speaks to this:

One's Prius is a gesture. A lovely gesture and one that everyone should emulate, but a gesture. Ditto riding the bike or eating vegan or whatever one's particular point of pride. North Americans are very used to thinking of themselves as individuals, but as individuals we are powerless to alter the trajectory of climate

⁵ Vedantam, Shankar, and Daniel Kahneman, "Think Fast", *Hidden Brain Podcast*, March 12, 2018.

<<https://itunes.apple.com/us/podcast/hidden-brain/id1028908750?mt=2&i=1000406139254>>

⁶ Dyer, Gwynne, *Climate Wars*, Oxford, Oneworld Publications, 2008.

⁷ Lukacs, Martin, "Neoliberalism has conned us into fighting climate change as individuals," *The Guardian*, July 17, 2017.

<<https://www.theguardian.com/environment/true-north/2017/jul/17/neoliberalism-has-conned-us-into-fighting-climate-change-as-individuals>>

⁸ Hot Mess, Video: What Can You Actually Do About Climate Change?, *PBS Digital Studios*, May 17, 2018.

<<https://www.pbs.org/video/what-can-you-actually-do-about-climate-change-kuhhhn/>>

change in a meaningful manner. The five or ten percent of us who will be moved to really act (and that's all who ever act on any subject) can't cut the carbon in the atmosphere by more than five or ten percent by those actions.⁹

McKibben further asserts that organized movements that pursue policy goals are the entities that can implement society-wide change. He exhorts activists to join such movements. They are the only things that can “put a price on carbon, force politicians to keep fossil fuels in the ground, [and] demand subsidies so that solar panels go up on almost every roof.”

Bill McKibben says that the question he gets asked most often is “What can I do?” This is the wrong question, he says. The right question is, “What can *we* do?”

Gwynne Dyer, a journalist and professor, also supports structural change over individual actions:

All the stuff about changing the lightbulbs and driving less, although it is useful for raising consciousness and gives people some sense of control over their fate, is practically irrelevant to the outcome of this crisis. We have to decarbonize our economies wholesale, and if we haven't reached zero greenhouse gas emissions globally by 2050—and, preferably, 80 percent cuts by 2030—then the second half of this century will not be a time you would choose to live in. If we have done it right, on the other hand, then the fuel that runs our cars and planes, like the power that lights our homes and drives our industries, will not produce carbon dioxide or other greenhouse gases.¹⁰

An emphasis on individual actions may expend the social capital organizations and governments desperately need to power structural solutions from theory into reality. In *Don't Even Think About It*, author George Marshall wades through the psychological snares encountered by past efforts to encourage individual actions. He found that when national campaigns attempted to engender personal responsibility for climate change in those who did not already care about the issue, they ended up with neutral outcomes at best.¹¹ In Canada, the “One-Tonne Challenge” tasked citizens with attempting to reduce their carbon dioxide emissions but achieved no reduction in total energy use. In Ireland, the “Power of One” campaign told citizens that they could make a difference, but the message was only absorbed by “those who were already converted.” And in Australia, the “Climate Clever” campaign resulted in a third *fewer* people considering climate change their most important issue after the campaign as before.

When governments attempt to communicate responsibility to the public, and thereby reduce their own, the message registers for many as blame. Blame can create resentment, which widens the chasm between those who accept that a climate crisis exists and those who do not. “For people who doubt that climate change exists, demands to change their lifestyle confirm their suspicion that the real threat comes from the environmental liberals who want to control their lives.”

“Moral license” is another possible negative impact when persuading individuals to take action. People who take a few actions to reduce their carbon footprint often satisfy their conscience and stop,

⁹ McKibben, Bill, “The Question I Get Asked the Most”, *EcoWatch*, October 14, 2016. <<https://www.ecowatch.com/bill-mckibben-climate-change-2041759425.html>>

¹⁰ Dyer, 2008.

¹¹ Ibid.

similar to “single action bias,” mentioned above. Moreover, those actions can create moral license and cause people to increase their carbon footprint. For example, people who buy energy-efficient lights and appliances use them more. People who insulate their houses turn up the thermostat. When residents in a Boston apartment building were sent notes asking them to save water, they used 7 percent less water while using 6 percent more electricity.¹² Like education, individual actions are helpful but do not approach the scale needed for significant climate mitigation.

Research, Development, and Technological Innovations

This category includes two distinct approaches to climate change mitigation: climate science research, and technological research, innovation, and development (referred to as R&D).

How should research, development, and the pursuit of technological innovations to mitigate climate change be prioritized relative to our other three strategies – education, individual actions, and policy? Groups that pursue climate-related research, development, and technological innovations, in general, are fundamentally different from the organizations that pursue the other three strategies. Over 60 percent of research and development (R&D) in scientific and technical fields is carried out by corporations, with universities and governments completing 20 and 10 percent respectively.¹³ Entities that pursue the other three strategies are generally non-profits and governments.¹⁴

Such differences are important and cannot be easily dissolved. For example, Tesla shareholders would not support a focus on climate policy unless it increased the company’s profits. The Sierra Club, a well-known political advocacy and education organization, would have to become an entirely different entity to focus on research and development. However, the Sierra Club easily alternates among the other three categories.

Discussions about the merit of research and technology as a climate mitigation strategy, then, come with the understanding that it mostly resides in a different sphere than the other three categories assessed in this paper. In this case, another economic concept in addition to opportunity cost can provide insight, that of diminishing returns.¹⁵

The value that science in general, and climate science in particular, has provided to humanity is incalculable. Climate science research provides vital insight into the changing global circumstances we face and what we can expect in the future. However, in this paper, we examine climate science research for *its effectiveness as a climate mitigation strategy*.

¹² Tiefenbeck, Verena, “Moral Licensing: Side Effects of an Efficiency Campaign”, *Center for Sustainable Energy Systems Case*, January 19, 2012. <https://www.cse.fraunhofer.org/cleantechnotes_lastupdated052017/2012/01/19/moral-licensing-side-effects-of-an-efficiency-campaign/>

¹³ OECD, “OECD Science, Technology, and Industry Scorecard 2017”, *OECD Library*, November 22, 2017. <https://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2017_9789264268821-en>

¹⁴ Ibid.

¹⁵ “...if one input in the production of a commodity is increased while all other inputs are held fixed, a point will eventually be reached at which additions of the input yield progressively smaller, or diminishing, increases in output.” <<https://www.britannica.com/topic/diminishing-returns>>

Sufficient information exists about climate change and its remedies. More importantly, climate science demands that we must immediately and significantly cease emitting GHGs. More scientific research will not change this imperative. The amount of knowledge about climate change and the level of action taken to mitigate it are independent variables. It is well-documented that information alone – no matter how compelling the data are – does not change minds or behavior.¹⁶

Applying the principles of diminishing returns and opportunity costs, investing in more climate science research at the expense of implementing proven strategies cannot be justified. To drastically, rapidly reduce GHG emissions, investment should move from climate science research to implementing proven technologies and strategies.

Research and development (R&D) – the deployment of technology, and the research, innovation, and development that enables it – has contributed to, for example, the acceleration in renewable energy adoption and the reduction in the price of solar panels. So, going forward, what is the role of R & D in a strategy for delivering speed and scale GHG reductions? It is complicated.

Most scenarios to avoid 1.5 C degrees C of warming or more rely heavily on technologies still in development. For example, a detailed and stringent action timeline from now to 2050 to avoid warming of 2 degrees C, depends on carbon capture and storage (CCS), the process of pulling carbon dioxide out of the air, condensing or alchemizing it, and storing it.¹⁷ In this scenario, CCS would remove 5 gigatons of CO₂ from the atmosphere every year by 2050, double the carbon sequestration rate of all the world’s soil and trees.¹⁸

The trouble with depending on this technology is that it is as-yet unproven and unscaled. Expanding it to the required scale would be an extraordinary feat. Yet other attempts to produce scenarios that avoid 1.5 degrees C of warming without employing CCS have failed.^{19, 20, 21} The authors of the paper cited in the previous paragraph acknowledge this. “Public and private investment in research and development for climate solutions should increase by an order of magnitude between now and 2030.”²² While dozens of CCS facilities are currently being planned, the amount of CCS facilities that are commensurate with the need is in the thousands.²³ Future success in GHG reductions bank on continued technological improvements. Consequently, significant investment in R&D belongs in climate strategies.

¹⁶ Marshall, George, *Don’t Even Think About It*, New York, Bloomsbury USA, 2014.

¹⁷ Rockström, John, Owen Gaffney, Joeri Rogelj, Malte Meinhausen, Nebojsa Nakicenovic and Hans Joachim Schellnhuber, “A roadmap for rapid decarbonization”, *Science*, March 24, 2017. <<http://science.sciencemag.org/content/355/6331/1269>>

¹⁸ Plumer, Brad, “Scientists made a detailed “roadmap” for meeting the Paris climate goals. It’s eye-opening.”, *Vox.com*, March 24, 2017. <<https://www.vox.com/energy-and-environment/2017/3/23/15028480/roadmap-paris-climate-goals>>

¹⁹ International Renewable Energy Agency, “Global Energy Transformation: A Roadmap to 2050”, *irena.org*, April 2018. <<http://www.irena.org/publications/2018/Apr/Global-Energy-Transition-A-Roadmap-to-2050>>

²⁰ Blok, Cornelius, Pieter van Exter and Wouter Terlouw, “Energy transition within 1.5°C”, *Ecofys*, April 23, 2018. <<https://www.ecofys.com/en/news/ecofys-a-navigant-company-presents-decarbonisation-scenario-for-energy-tran/>>

²¹ Van Vuuren, Detlef P., Elke Stehfest, David E. H. J. Gernaat, Maarten van den Berg, David L. Biji, Harmen Sytze de Boer, Vassilis Daioglou, Jonathan C. Doelman, Oreane Y. Edelenbosch, Mathijs Harmsen, Andries F. Hof and Mariësse A. E. van Sluisveld, “Alternative pathways to the 1.5 °C target reduce the need for negative emission technologies”, *Nature*, April 13, 2018. <<https://www.nature.com/articles/s41558-018-0119-8>>

²² Rockström, et. al., 2017.

²³ Hirji, Zahra, “Slowing Climate Change Will Require Vastly More Carbon Capture, Study Says”, *Inside Climate News*, January 30, 2017. <<https://insideclimatenews.org/news/30012017/global-warming-carbon-capture-paris-climate-agreement>>

Yet, we must proceed with caution. Certain technologies carry with them not only climactic but also moral and philosophical risks that make their deployment less obvious. As noted above, no scenario exists where we avoid climate catastrophe and don't rapidly scale CCS. But CCS is an inchoate industry, which presents a moral hazard and imposes dilemmas around its development and deployment. "As a technology of last resort, carbon removal is, almost by its nature, paradoxical. It has become vital without necessarily being viable. It may be impossible to manage, and it may also be impossible to manage without."²⁴ The moral hazard is that not only is it not certain that CCS will ever reach cost-effectiveness and scale, but betting on its future deployment helps rationalize inaction now.

Returning to the underlying question of this chapter, where should science and technology fall as priorities for climate mitigation strategies? Regarding climate science research, we assert that policy implementation warrants more investment priority than research. Technology adds a complex caveat. No climate mitigation scenario can be achieved without sustained or increased investment in technological innovation. But careful attention must be paid to which technologies deserve a primary role. Our analysis suggests that unproven, unscaled, and morally hazardous moonshot technologies like CCS and solar geoengineering deserve study, especially given their prominence in most modeling scenarios that meet global GHG targets, but they should be considered with caution and should not garner the greatest investment. Instead, proven and scaled (or scalable) approaches, like state-of-the-art energy efficiency, batteries, electric vehicles, and clean energy tools like solar panels and wind turbines offer significant, cost-effective, and immediate opportunities for climate mitigation, and thus merit the greatest investment.

R&D will play a crucial role in reducing GHG emissions at speed and scale. Still, we see policy approaches as the top focus for a theory of change. Policy acts as a facilitator or an inhibitor of technological solutions, and so is the primary area for attention. We explore this relationship more in the section, "Relationships Among the Four Strategies."

Policy

Climate change is a complex, intractable, systemic problem. But well-crafted policies and policy-oriented actions have ameliorated other complex problems. They offer evidence that solving climate change through policy is likely to be effective. Well-designed policy orients collective action, making it easier for people to act for the common good. Experts indicate that if policy strategies were used more often and more wisely against complex problems, more progress could be made.²⁵

All levels of government, from local to international, make policy. The appropriate level of government to deal with a problem depends on the problem being addressed and the levers of power that can be used by that level of government. State and national governments have access to powerful levers and resources that local governments do not, but generally these are less

²⁴ Kolbert, Elizabeth, "Can Carbon Dioxide Removal Save the World?" *The New Yorker*, November 20, 2017.

<https://www.newyorker.com/magazine/2017/11/20/can-carbon-dioxide-removal-save-the-world>

²⁵ Gambhir, Samir, Stephen Menendian and Justin Steil, "Responding to Rising Inequality: Policy Interventions to Ensure Opportunity for All," *Haas Institute for a Fair and Inclusive Society*, March 31, 2017.

amenable to change. In contrast, local government is more agile and more accessible to change makers. Local government has information about local demographics, needs, and issues that state and national government may be missing. Additionally, “policy change at the local level can be a catalyst for broader transformation. Regional successes can create pushback against broader state, national, and global forces that reproduce inequities.”²⁶

Examples of the Effectiveness of Policy on Various Complex Problems

Policy’s effectiveness in tackling complex problems is exemplified by its impact on smoking. Fifty-five years ago when the surgeon general first declared that smoking was harmful to health, 42 percent of Americans smoked. Now only 15.5 percent of the adult population in the U.S. smokes.²⁷

“Laws prohibiting smoking in workplaces and public places have contributed significantly to reducing smoking prevalence in California and elsewhere, providing one of the most significant impacts on public health in recent years.”²⁸ Studies have clearly shown that people adhere to smoking bans. Following a ban, hospital admissions for smoking-related complications dropped significantly, even when other factors causing heart attacks and cardiac death (two conditions known to be caused by smoking) increased in the same population. Olmstead County, Minnesota, passed a smoke-free workplace law in 2002, followed by a smoke-free restaurant law in 2007. Following the 2007 legislation, the Mayo Clinic concluded that hospital admissions for heart attacks and sudden cardiac death dropped 33 percent and 17 percent respectively when comparing the 18 months before the law passed and the 18 months after.²⁹ From a medical perspective, this reduction is significant. The proximity between this drop and the smoking ban strongly suggests that the two events are causally related.

Separately, a literature review of 45 studies on 33 smoke-free laws measured success (reduction in hospital admissions or deaths) in four areas of diagnosis often found in smokers: coronary events, other heart disease, strokes, and respiratory disease. The analysis of these studies found that “smoke-free legislation was associated with a lower risk of smoking-related cardiac, cerebrovascular, and respiratory diseases, with more comprehensive laws associated with greater changes in risk.”³⁰ Stanton Glantz, an author of the study and the director at the Center for Tobacco Control Research and Education, argues that smokers experience health benefits when they cannot smoke as frequently. They may also be incentivized to stop smoking if it becomes too difficult to engage in the behavior.³¹ Evidence is clear that policies addressing cigarette use

²⁶ Prevention Institute, “Local Policy”, *Strategic Alliance*. <<https://www.preventioninstitute.org/local-policy/>>

²⁷ Office on Smoking and Health and National Center for Chronic Disease Prevention and Health Promotion, “Current Cigarette Smoking Among Adults in the United States”, *cdc.gov*, February 15, 2013. <https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm>

²⁸ Brunner, Wendel, Julie Freestone, and Tracey Rattray, “The New Spectrum of Prevention: A Model for Public Health Practice,” *Contra Costa Health Services*, April 2002.

²⁹ Crogan, Ivana T., Jon O. Ebbert, Richard D. Hurt, Sheila M. McNallan, Veronique L. Roger, Darrell R. Schroeder, and Susan A. Weston, “Myocardial Infarction and Sudden Cardiac Death in Olmsted County, Minnesota, Before and After Smoke-Free Workplace Laws,” *Archives of Internal Medicine*, November 26, 2012.

³⁰ Glantz, Stanton A. and Crystal E. Tan, “Association between Smokefree Legislation and Hospitalizations for Cardiac, Cerebrovascular and Respiratory Diseases: A Meta-Analysis,” *Circulation*, October 30, 2012.

³¹ Blue, Laura, “Smoke-Free Laws Are Saving Lives,” *Time*, October 30, 2012. <<http://healthland.time.com/2012/10/30/smoke-free-laws-are-saving-lives/>>

caused a direct and measurable improvement in public health outcomes, especially when paired with price increases on tobacco.³²

Income inequality, another complex social challenge, is also impacted by policy, according to the Organization for Economic Cooperation and Development (OECD). They identify policy discrepancies as the primary driver of countries' differing levels of income inequality, and recommend that countries use comprehensive policy measures to enhance economic prosperity.

“Education policies matter. Policies that increase graduation rates from upper secondary and tertiary education and that also promote equal access to education help reduce inequality... Well-designed labor market policies and institutions can reduce inequality. A relatively high minimum wage narrows the distribution of labor income, but if set too high it may reduce employment, which dampens its inequality-reducing effect... Policies that foster the integration of immigrants and fight all forms of discrimination reduce inequality.”³³

One of the most successful international treaties – a form of policy at the international level – demonstrates that policy can produce rapid change. The Montreal Protocol was created in 1987 to stop the emission of ozone-depleting substances, particularly chlorofluorocarbons. The treaty achieved international cooperation, with 197 countries participating. Since the treaty was signed, scientists and political analysts have considered the positive outcomes and the “world avoided” scenarios, highlighting the following:

- “It has fundamentally changed the way certain industries conduct their business, already creating in some countries a complete phase out of certain classes of chemicals.”³⁴
- “[The] global climate would be at least 25 percent hotter today without the Protocol.”³⁵
- “It is found that by the year 2065, changes in the potential intensity of tropical cyclones in the World Avoided are nearly 3 times as large as for the standard scenario. The Montreal Protocol thus provides a strong mitigation of the adverse effects of intensifying tropical cyclones.”³⁶
- The ozone layer is expected to recover by 2050.³⁷

Comprehensive state policy frameworks can also achieve ambitious climate goals. In 2006, California’s legislature passed the Global Warming Solutions Act, Assembly Bill 32. The legislation required the California Air Resources Board (ARB) to “adopt regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions” to bring California’s emissions to 1990 levels by 2020. ARB publishes a scoping plan with its multi-year

³² Chaloupka, Frank J., Ayda Yurekli, and Geoffrey T. Fong, “Tobacco Taxes as a Tobacco Control Strategy,” *Tobacco Control*, 2012; 21:172-180. <<http://tobaccocontrol.bmj.com/content/21/2/172.full>>

³³ OECD, *Economic Policy Reforms 2012: Going for Growth*, OECD Publishing, 2012. <<http://dx.doi.org/10.1787/growth-2012-en>>

³⁴ DeSombre, Elizabeth R., “The Experience of the Montreal Protocol: Particularly Remarkable and Remarkably Particular,” *UCLA Journal of Environmental Law and Policy*, January 1, 2000.

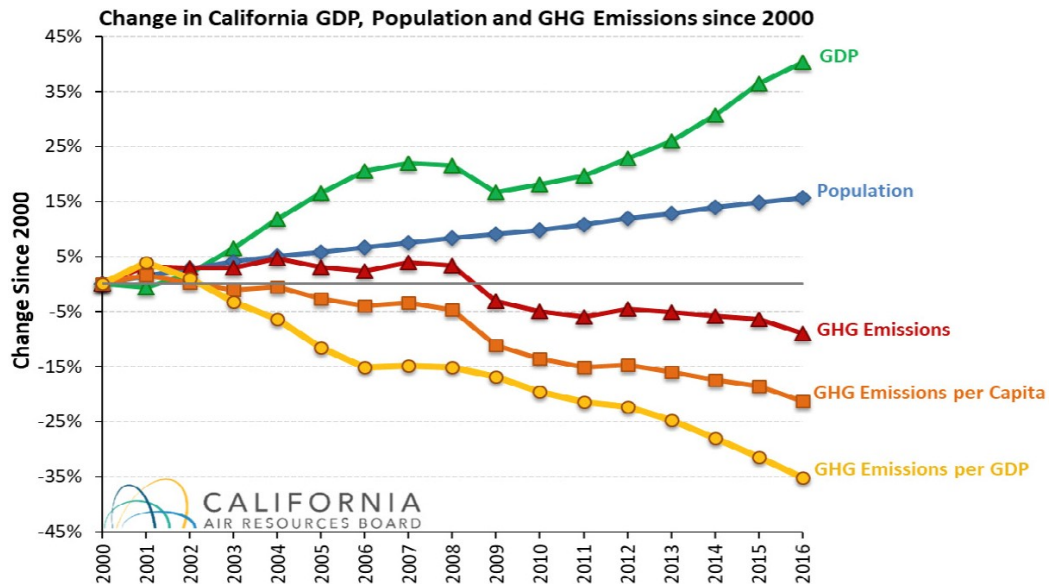
³⁵ Leahy, Stephen, “Without the Ozone Treaty, You’d get Sunburned in 5 Minutes,” *nationalgeographic.com*, September 25, 2017. <<https://news.nationalgeographic.com/2017/09/montreal-protocol-ozone-treaty-30-climate-change-hcfs-hfcs/>>

³⁶ Camargo, Suzana J., Rolando R. Garcia and Lorenzo M. Polvani, “The Importance of the Montreal Protocol in Mitigating the Potential Intensity of Tropical Cyclones,” *Journal of Climate*, March 15, 2016.

³⁷ Leahy, 2017.

strategy in four general categories: advanced clean cars, the renewables portfolio standard, the low carbon fuel standard, and cap-and-trade.³⁸ Each of the categories is associated with target reductions, and the ARB is responsible for facilitating and enforcing political and market transitions to achieve them.

On July 11, 2018, ARB issued its annual report on the state’s GHG emissions. In 2016, the latest year available, emissions dropped 2.7 percent to 429.4 million metric tons – slightly below the 431 million metric tons the state produced in 1990. This means that California not only met the goal required by the Global Warming Solutions Act, but met it early.³⁹



In the northeastern U.S., a regional cap-and-trade system, along with stringent emissions and efficiency standards for vehicles and power plants, led to a 10 percent drop in GHG pollution between 2005 and 2014. These measurable and significant changes are concretely traceable to well-designed policy changes that affect businesses and markets at a systems level.

Another example *Figure 1* http://www.arb.ca.gov/cc/inventory/data/graph/trends/ghg_trends_00-16.jpg

is the reduction in the cost of solar photovoltaic panels. “Policies that stimulate market growth have played a key role in enabling PV’s cost reduction, through privately-funded R&D and scale

³⁸ California Air Resources Board, “Assembly Bill 32 Overview,” *arb.ca.gov*, August 5, 2014.

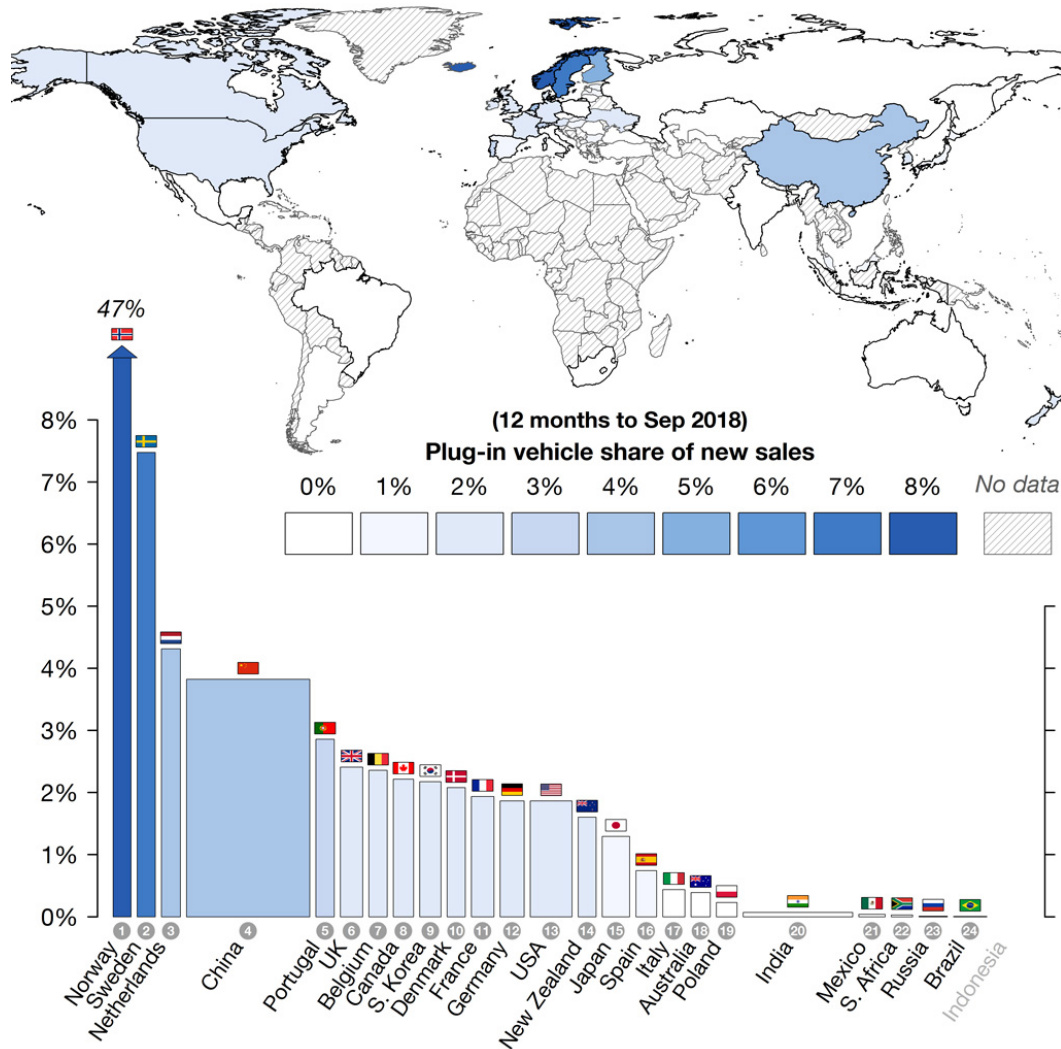
<https://www.arb.ca.gov/cc/ab32/ab32.htm>

³⁹ California Air Resources Board, “California Greenhouse Gas Emission Inventory – 2018 Edition”, *ca.gov*, July 11, 2018.

<https://www.arb.ca.gov/cc/inventory/data/data.htm>

economies, and to a lesser extent learning-by-doing.⁴⁰ In layperson’s terms, what made solar panels so cheap? Thank government policy.”⁴¹

A last example compares electric vehicle (EV) adoption in various countries. Norway is first with 47 percent EV sales of total new vehicle sales, about six times Sweden in second place.⁴²



Norway accomplished this with a mix of policies, for example:

- Exemption from 25% VAT on purchase.
- No import or purchase taxes
- Toll roads and ferry fees waived

⁴⁰ Trancik, Jessika, Kavlak, Goksin, Mc Nerney, James, “Evaluating the causes of cost reduction in photovoltaic modules,” Energy Policy, Vol. 123, December 2018, Pages 700-710

<https://www.sciencedirect.com/science/article/pii/S0301421518305196?via%3Dihub>

⁴¹ Roberts, David, Vox, November 28, 2018, <https://www.vox.com/energy-and-environment/2018/11/20/18104206/solar-panels-cost-cheap-mit-clean-energy-policy?fbclid=IwAR0apkNNKM8LsZpPj78CF3ysFDdJ4kpTIFCKK02QQRFNNGF714ekK060x8>

⁴² www.carbonbrief.org/guest-post-ten-charts-show-how-the-world-is-progressing-on-clean-energy

- Low annual road tax
- Free municipal parking
- 50% reduced company car tax
- Access to bus and HOV lanes
- Exemption from 25% VAT on leasing⁴³

These examples of policy’s impact on complex problems demonstrate that policy is the means for accelerating positive social change, including mitigating the climate crisis.

Experts Support Policy

Experts agree that policy is the most effective strategy to reverse climate change. Research from McKinsey and Company, a global management consulting firm, argues that climate change must be addressed with a multi-sector approach. They suggest policy will be the glue that pulls those sectors together. Their report, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost*, contends that a policy approach will result in “a set of forceful and coordinated actions”, enabling the successful deployment of “high-potential energy technologies” and other tested approaches.⁴⁴ The potential reductions in GHG emissions in the United States are between 3.0 gigatons and 4.5 gigatons annually, with emissions falling 7 to 28 percent below 2005 levels.⁴⁵

The McKinsey report contains two significant lessons. First, energy efficiency savings as high as those projected by McKinsey are not occurring today despite education, individual actions, and other attempts at climate change mitigation and reversal. Governments have the best reach to coordinate systemic emissions reductions through policy efforts.

The second lesson relates to the statement that coordinated policy efforts would help to implement “high-potential energy technologies” and other tested approaches. The report does not suggest a specific policy measure that will best achieve this – it could be carbon caps and taxes, mandates, and incentives – but notes that such implementation will be an important measure in reversing climate change. Admittedly, corporations and institutions could take steps to disseminate high-potential energy technologies in the absence of policy. However, considering the prescription given in McKinsey’s analysis, the government can optimize the dispersal by organizing policy requirements that address every sector in a society. Additionally, implementation can occur with a more complete picture of where those technologies are most needed because governments often have the most knowledge about and influence over barriers, natural resources, and demographics. Policy is a method with which to “better align all stakeholders” in climate change action.⁴⁶

The OECD shares the following result of their analysis on the best strategies to address climate change:

⁴³ Blaney, Brianna, *How Norway Became the Leading EV Market*, February 21, 2018, EV Industry <https://www.fleetcarma.com/norway-became-leading-ev-market/>

⁴⁴ Creyts, Jon, Anton Derkach, Scott Nyquist, Ken Ostrowski, and Jack Stephenson, “Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?” *McKinsey and Company*, December 2007.

<https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability%20and%20Resource%20Productivity/Our%20Insights/Reducing%20US%20greenhouse%20gas%20emissions%20How%20much%20at%20what%20cost/Reducing%20US%20greenhouse%20gas%20emissions%20How%20much%20at%20what%20cost%20Final%20Report.ashx>

⁴⁵ Ibid.

⁴⁶ Ibid.

“... Large reductions in GHG emissions are achievable at relatively low costs, if the right policies are put in place. This includes strong use of market-based instruments worldwide to develop a global price for GHG emissions, accompanied by better integration of climate change objectives in relevant policy areas such as energy, transport, building, agriculture or forestry, and other measures to speed technological innovation and diffusion.”⁴⁷

According to the OECD, governments should implement policies that achieve two ends. First, governments should collaborate internationally to send signals to financial markets through regulation. Ultimately, those signals will result in a settled price on carbon that discourages carbon emissions, causing emission reductions on a global scale. Second, policymakers, cabinet members, and independent agency officials must work together to ensure adoption and execution across all sectors. The government’s task is to determine which regulations are required for agencies, ranging from utilities to business to nonprofits, to oversee of their own area of expertise.

There is strong evidence from historical precedents, recent research, and expert opinion that well-designed and multisectoral policy is the tool most up to the task of addressing climate change. We therefore consider it the critical component of an effective TOC.

Criteria for Climate Policy

Given the array of policy solutions available and the need for significant measurable results, the Center for Climate Protection developed criteria for narrowing down and identifying potential policy solutions to support.

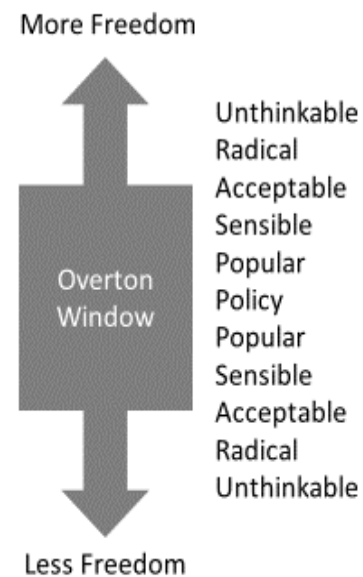
- *Significant GHG emissions reductions.* Policies should demonstrate clear potential to reduce GHG emissions at the speed and scale demanded by the scientific consensus around climate change.
- *Cost effective.* Policy should unleash market forces in favor of GHG reductions. For example, cap-and-trade mechanisms create market pressure that financially rewards reduced GHG emissions, and financially penalizes excess GHG emissions.⁴⁸ By unleashing market forces, business, one of the most powerful engines of change, is mobilized. As prices for climate-friendly products out-compete climate-unfriendly products, people’s behavior starts shifting in response to these economic signals they receive from the market.⁴⁹

⁴⁷ Organization for Economic Cooperation and Development, “Climate Change Policies,” *oecd.org*, August 2007. <http://www.oecd.org/env/cc/39111309.pdf>

⁴⁸ California Air Resources Board, “Cap-and-Trade Program”, *arb.ca.gov*, April 19, 2018. <https://arb.ca.gov/cc/capandtrade/capandtrade.htm>

⁴⁹ Boudreaux, Donald J., “Information and Prices,” <http://www.econlib.org/library/Enc/InformationandPrices.html>

- *Technologically feasible.* The technology required in policy solutions should be proven and scaled, or close to scalable. For example, California mandating solar panels on new home construction is feasible because a mature solar market exists in the state.⁵⁰ Policies contingent upon unproven technologies, such as bioenergy with carbon capture and storage (BECCS), are likely risky and therefore not worth advocating for. This is not to say that technologies like BECCS are not necessary and will not play a vital role in preventing climate catastrophe, as many climate change reversal strategies rely on negative emissions.⁵¹
- *Politically feasible.* Implementing policy that fully meets the scientific imperative for a life-sustaining climate is currently too radical and thus not politically feasible. Politics is the art of the possible, as Otto von Bismarck, a nineteenth century German chancellor, observed. The range of possible policy solutions is represented by the Overton Window.⁵² Policies that are too radical will not garner sufficient support to become law. To reduce GHGs while building the political will and muscle to implement policy that meets the scientific imperative, we must focus on politically feasible solutions.
- *Movement-building.* Policies should be understandable, bold, exciting, even verging on revolutionary, so that they attract supporters' time, attention, and money. For example, at the beginning of 2018 climate advocates supported a bill in the California state legislature that would have permitted only new zero-emission passenger vehicles to register in the state starting in 2040, effectively phasing out new internal combustion engines.⁵³ This dramatic proposal excited passions, both positive or negative. Andrew White, the seasoned legislative director for the bill's author, said, "I've spent more time talking about this bill than anything in my life."⁵⁴ While this criterion may seem to contradict "political feasibility," the excitement behind a bold solution can lead to more vocal political will and support, and make the solution more politically feasible as a result.
- *Match for capacity.* In selecting solutions to focus on and advocate for, an organization (or coalition of organizations) should have the needed capacity to implement the effort successfully.



⁵⁰ Penn, Ivan, "California Will Require Solar Power for New Homes", *New York Times*, May 9, 2018. https://www.nytimes.com/2018/05/09/business/energy-environment/california-solar-power.html?em_pos=small&emc=edit_clim_20180509&nl=&nl_art=0&nlid=64536696c%3Dedit_clim_20180509&ref=healthline&te=1

⁵¹ Rockström, Johan, et. al., "A roadmap for rapid decarbonization", *Science*, March 24, 2017. <http://science.sciencemag.org/content/355/6331/1269>

⁵² Lehman, Joseph, G., "An introduction to the Overton Window of political possibility," *Mackinac Center for Public Policy*, April 8, 2010. <http://www.mackinac.org/12481>

⁵³ Duong, Jessica, "Assemblymember Ting Introduces Clean Cars 2040", *Assemblymember Phil Ting District 19*, January 3, 2018. <https://a19.asmdc.org/press-releases/20180103-assemblymember-ting-introduces-clean-cars-2040>

⁵⁴ Fehrenbacher, Katie, "What's behind the California bill to ban internal combustion car sales by 2040?" *Greenbiz.com*, March 29, 2018. <https://www.greenbiz.com/microsite/100061/article/whats-behind-california-bill-ban-internal-combustion-car-sales-2040>

Carefully evaluating policy solutions is crucial because not all policies are equal. For example, as noted above, income inequality exists to the extent it does not because of a policy vacuum, but because of bad policy. Similarly, economists call climate change “the greatest market failure ever seen.”⁵⁵ Existing policies support the persistence of this market failure.⁵⁶ Policies that thwart the public good demand that we mobilize for new and better policies.

In *Ecology and the Politics of Scarcity*, William Ophuls offers a valuable distinction for policymakers seeking to identify and design good climate policy.⁵⁷ He says that legislative regulations operate along two dimensions, constraints and freedom, which occur on two scales, the macro and the micro. A macroconstraint is one that feels remote and impersonal while a microconstraint feels coercive and personal. Macrofreedoms and microfreedoms allow for wide-ranging, unregulated personal choice or a smaller set of choices, respectively. Ophuls notes that most legislation creates microconstraints which can produce pushback or even rebellion because people feel personally targeted by them. He argues that optimal policy has macroconstraints that permit microfreedoms.

Carbon pricing, recognized as the top policy to reduce GHG emissions, fits Ophuls’s prescription because it would be reflected uniformly across almost all purchases and would target no specific group. This macroconstraint still allows for microfreedoms; individuals are free to purchase whatever they like within this new economic context. Higher prices of fossil fuel-based products and services nudge people to make different lifestyle and consumption choices. Policymakers can anticipate and mitigate many of the potentially painful effects of carbon pricing by, for example, pairing it with a carbon dividend.⁵⁸

To solve problems without creating new ones, policies must be carefully scrutinized before enactment and carefully tracked afterward. Unexamined and unverified assumptions must be surfaced to avoid negative consequences. Bad policy can worsen the problem it attempts to solve. Moreover, we must be aware of policy’s potential for unintended and counterintuitive impacts, as noted above.⁵⁹ For example, transportation planners commonly assume that expanding highways reduces vehicle congestion.⁶⁰ Instead, due to the phenomenon of induced

⁵⁵ Steele, Paul, “Why Adaptation is the Greatest Market Failure and What This Means for the State”, *World Resources Institute*, 2010. <<http://www.wri.org/our-work/project/world-resources-report/why-adaptation-greatest-market-failure-and-what-means-state>>

⁵⁶ Abraham, John, “Fossil fuel subsidies are a staggering \$5 tn per year”, *The Guardian*, August 7, 2017. <<https://www.theguardian.com/environment/climate-consensus-97-per-cent/2017/aug/07/fossil-fuel-subsidies-are-a-staggering-5-tn-per-year>>

⁵⁷ Ophuls, William, *Ecology and the Politics of Scarcity*, San Francisco, W.H. Freeman and Company, 1977.

⁵⁸ Demeter, Meghan, “Talking cap and dividend with Peter Barnes”, *Center for Climate Protection*, July 28, 2015.

<<https://climateprotection.org/talking-cap-and-dividend-with-peter-barnes/>>

⁵⁹ Forrester, Jay W., *Counterintuitive Behavior of Social Systems*, Cambridge, Alumni Association of the Massachusetts Institute of Technology, 1971.

⁶⁰ Stromberg, Joseph, “The ‘fundamental’ rule of traffic: building new roads just makes people drive more”, *Vox.com*, May 18, 2015. <<https://www.vox.com/2014/10/23/6994159/traffic-roads-induced-demand>>

demand, expanding highways consistently *increases* congestion.^{61, 62} In contrast, mechanisms such as congestion pricing can effectively reduce congestion.⁶³

Selecting and supporting the climate policies that will optimize resources and talent in the climate movement requires careful analysis and consideration. If done correctly, these policies offer us the best chance of preserving a stable climate and prosperous future.

Policy-based solutions head our list among the four strategy categories. Policy can alter the landscape of rules that govern the economy, energy, business, infrastructure, and transportation. Policy solutions are not the only approaches that should be leveraged, but their history of efficacy warrant the greatest attention from climate organizations.

Can policy processes be trusted to be our primary strategy? In a democracy, policy is the product of either voting by the public or decision-making by elected officials. Unfortunately, individuals and interest groups have found ways to corrupt and manipulate legislative, electoral, and regulatory processes for personal gain or to achieve goals born out of bigotry or ideology. The system is not always fair, nor does it always reflect the best or most-desired outcome. We live in societies plagued by inequality, and so it is likely that processes that bring policy to life can and do fail, in addition to other factors that exacerbate inequality. Several well-known studies continue to explore how best to understand and target the issue of elite influence over the legislative process.⁶⁴ While the vulnerabilities of policy-making is a complex issue, it is not impossible to overcome. Moreover, we must work with the political system that exists. Our evidence points to past policy successes, and we have indicated many opportunities in the future that would benefit from good policy.

RELATIONSHIPS AMONG THE FOUR STRATEGIES

While we elevate policy solutions as the top strategy among the four we have described for dealing with the climate crisis, we recognize that the other three have important roles to play. This chapter discusses the relationship between policy and education, policy and individual action, and policy and research, development, and technological innovation.

Policy and Education

Education by itself is unlikely to produce the systemic changes needed to mitigate the climate crisis. Policy, however, is a tool designed to do just that. The elegance of smart policy is that it reformulates the rules of the game so that acting in self-interest and acting in the collective interest are one and the same. Systemic changes are more capable of such social restructuring than education. Together, though, they are a potent combination.

⁶¹ Litman, Todd, “Generated Traffic and Reduced Travel: Implications for Transport Planning”, *Victoria Transport Policy Institute*, April 24, 2018. <<http://www.vtpi.org/gentraf.pdf>>

⁶² Barragan, Bianca, “405 Commutes Now a Minute Worse Than Before Carpool”, *Curbed Los Angeles*, October 9, 2014. <<https://la.curbed.com/2014/10/9/10036932/405-commutes-now-a-minute-worse-than-before-carpool-lane>>

⁶³ Litman, Todd, “London Congestion Pricing”, *Victoria Transport Policy Institute*, November 24, 2011. <<http://www.vtpi.org/london.pdf>>

⁶⁴ Matthews, Dylan, “Remember that study saying that America is an oligarchy? 3 rebuttals say it’s wrong.” *Vox.com*, May 9, 2016. <<https://www.vox.com/2016/5/9/11502464/gilens-page-oligarchy-study>>

According to our TOC, to achieve speed and scale GHG emission reductions, we require a small but powerful group of activists who focus on advocating for and enacting climate policy solutions as well as on electing representatives who vote for good climate policies. To be successful, activists must be educated, and in turn, must educate others, including policymakers. Policy and education synergize as education focuses on enacting specific proposed climate policies. Policy solutions are the orienting force, supported and enabled by public support that is built through education and heightened issue awareness.

As described in the discussion of the Overton Window above, when public support and policy shift together, ideas once viewed as radical gain traction. For example, the rapid change in public opinion regarding gay rights was dramatic, perhaps unprecedented.⁶⁵ Changes in public opinion were closely followed by changes in the law. In 2003 gay marriage was supported in one state, and by 2015 it was legalized in all 50 states.⁶⁶

Views of the relationship between education and policy may be evolving among leaders of environmental organizations. The “The Story of Stuff” video, seen by more than 5 million people, shows the damage inflicted by consumerism, materialism, and our resource-intensive economy.⁶⁷ The video’s purpose is solely educational: to raise awareness about unexamined consumptive habits and provide information about the destructive machinery of mainstream economics. The video spawned several follow-up videos as well as an organization that supports ongoing projects.

One of the more recent videos from the organization is “The Story of Change.”⁶⁸ This video distinguishes between education and individual choices on the one hand, and systemic social change on the other. It states that positive behavioral changes such as shopping green, recycling, and voting with your dollars are not enough. Further steps are required to effect change. It exhorts viewers to focus their efforts on policy changes to demand rules that work. In this case, even a fundamentally educational organization endorses structural change through better policy as its TOC.

Similarly, Mark Meisner, author of a chapter in the book *Achieving Sustainability*, acknowledges that the “challenge for engaging people in consciousness-raising is integrating it into larger advocacy campaign strategies. Almost all campaigning involves some element of consciousness raising, but by itself, it is inadequate.”⁶⁹

Meisner and The Story of Stuff reflect a growing recognition that sharing information and raising awareness alone are insufficient. Educational efforts should be included in a larger strategy that organizes and leverages individual support towards policy demands.

⁶⁵ Wilkens, John, “What’s behind gay rights attitude shift?” *San Diego Union-Tribune*, April 4, 2015.

<<http://www.sandiegouniontribune.com/sdut-public-attitudes-gay-rights-2015apr04-story.html>>

⁶⁶ Cillizza, Chris, “How unbelievably quickly public opinion changed on gay marriage in 5 charts”, *Washington Post*, June 26, 2015. <https://www.washingtonpost.com/news/the-fix/wp/2015/06/26/how-unbelievably-quickly-public-opinion-changed-on-gay-marriage-in-6-charts/?utm_term=.8f1150b2984d>

⁶⁷ The Story of Stuff Project, “The Story of Stuff”, April 22, 2009.

<<https://www.youtube.com/watch?v=9GorqroiqgM&t=1s>>

⁶⁸ The Story of Stuff Project, “The Story of Change”, July 16, 2012. <<https://www.youtube.com/watch?v=olQdYXCKUv0>>

⁶⁹ Meisner, Mark, “Consciousness Raising”, *Cengage Learning*, 2013.

<<https://markmeisner.files.wordpress.com/2014/03/meisner-consciousness-raising.pdf>>

Being visible and taking the movement to the streets is a strategy in which many activists invest. This can be seen as a form of education. Public education and dissemination of core convictions are primary activities of many social movements. Yet in the absence of clearly defined policy goals, even the most visible and fervent movements can have no concrete results to show for their efforts. Two recent political movements, Occupy Wall Street and the Tea Party Movement, exemplify the disparity of outcomes in the absence and presence of policy strategies to achieve their social change goals.

These two movements emerged around the same time. Occupy started with bombast, but it never built lasting momentum. New York Times writer Joe Nocera explains why:

“Occupy protesters were purposely – even proudly – rudderless, eschewing leadership in favor of broad, and thus vague, consensus. It’s hard to get anything done without leaders. A second [reason] is that while they had plenty of grievances, aimed mainly at the “oppressive” power of corporations, the Occupy protesters never got beyond their own slogans. But the main reason is that, ultimately, Occupy Wall Street simply would not engage with the larger world. Believing that both politicians and corporations were corrupt, it declined to dirty its hands by talking to anyone in power.”⁷⁰

Occupy succeeded in educating and bringing public awareness to economic inequality and corporate influence on government. Without explicit aims and a coherent message, though, the movement eventually unwound. Nocera further states, “Raising the issue is the easy part. The hard part is doing something about it. Without political engagement by those who want to reverse income inequality, it will continue to widen.”

The Tea Party was equally vehement in its outrage. But this was coupled with a specific political strategy which it executed with precision.

“It, too, believed that politicians were venal, but rather than turning away from politics, its adherents worked to elect politicians who believed in the same things they did. Yes, the Tea Party had wealthy benefactors, but their money would not have succeeded without grassroots support. [In 2010], 87 new Tea Party-elected candidates showed up in Washington... they have largely succeeded throwing sand in the wheels of government. That was their goal.”⁷¹

The Tea Party movement understood that by electing officials who would enact policies aligned with its values, it would achieve its social change goals.

Education must be coupled with policy goals for it to create change. And policy goals supported by an educated body of advocates have a better chance of adoption.

Clearly defining change is a consistent theme in successful movements.
--Harvard Business Review

<https://hbr.org/2017/01/how-protests-become-successful-social-movements>

⁷⁰ Nocera, Joe, “Two Days in September”, *New York Times*, September 14, 2012.

<<https://www.nytimes.com/2012/09/15/opinion/nocera-two-days-in-september.html>>

⁷¹ Ibid.

Policy and Individual Actions

Although we argue that attempting to persuade individuals to make lifestyle changes that reduce their carbon footprint is a poor investment of resources, we emphatically discourage messages to individuals that their actions don't matter. The opposite is the case when their actions join with those of others toward systemic reform. "We need people to consume less and innovate low-carbon alternatives – build sustainable farms, invent battery storages, spread zero-waste methods. But individual choices will most count when the economic system can provide viable, environmental options for everyone—not just an affluent or intrepid few."

Systems-level policy reform can reinforce behavior change and make that new behavior the default and therefore the norm. "Choice architecture" is a concept based on designing the decision-making process to dramatically affect behavioral outcomes. One feature of choice architecture is creating the right default option in anticipation of a particular decision while still respecting individual freedom of choice.⁷²

For example, Community Choice Aggregation, a local energy program enabled by state policy, is designed to enroll customers in the program by default unless they opt out. Throughout California, new Community Choice agencies are enrolling the vast majority of customers and delivering to them electricity from sources that produce much less greenhouse gas. In Sonoma County, Community Choice reduced overall GHG emissions in 2016 to below 1990 levels despite an increase in population and economic activity.⁷³ This is an example of policy-induced systemic change that delivers measurable, significant, and rapid results that address climate change. Through the proper use of choice architecture, Community Choice creates macroconstraints with microfreedoms that in turn yield high program enrollment and measurable success.

Activists can bypass the uphill battles of changing minds and behavior person-by-person, and of overcoming perverse price signals that reinforce unsustainable choices. Instead, with smart policy, activists can embed sustainability in the sociopolitical fabric and thus make it easier for people to make climate-friendly choices.

Policy and Research, Development, and Technological Innovations

Given that entities that pursue research, development, and technological innovations, and those that pursue advocacy for climate policy solutions cannot easily exchange strategies, how can these entities and approaches synergize for speed and scale climate solutions?

In 2017, author Paul Hawken released *Drawdown: The most comprehensive plan ever proposed to reverse global warming*. It was the best-selling environmental book of the year. Its technical detail and solutions offer readers a sense of realistic hopefulness. Hawken drew an important distinction between the book's contents and policy. The solutions in his book encompass technology (e.g. onshore wind turbines), techniques (e.g. silvopasture), and ideas (e.g. educating girls) that all have a quantitative ranking about their GHG emission reduction potential. He

⁷² Balz, John P., Cass R. Sunstein and Richard H. Thaler, "Choice Architecture", April 2, 2010. <https://ssrn.com/abstract=1583509>

⁷³ Wells, Ken, "Sonoma County Greenhouse Gas Report for 2016", *Center for Climate Protection*, March 2018. <https://climateprotection.org/wp-content/uploads/2018/03/2016-GHG-Report-Sonoma-Co-FINAL-1.pdf>

commented that if policies were included in the book, a price on carbon would have been number one.⁷⁴ The solutions presented in Drawdown are the raw material that policies can nurture or stifle.

Climate mitigation policies such as mandates, regulations, tariffs, and incentives can create a fertile environment for innovative technologies to prosper and scale. For example, the California Solar Initiative passed by the legislature in 2006 provided incentives for solar installation. From 2006 to 2014, the production of customer-sited solar installation increased twelve-fold, from 156 to 1,891 MW, and the average cost of non-residential systems fell 51 percent from \$8.86 to \$4.32 per watt.⁷⁵

In contrast, policies hostile to climate mitigation technologies impede their development. President Donald Trump's tariff on imported solar panels caused U.S. renewable energy companies to cancel or freeze investments of more than \$2.5 billion in large installation projects, resulting in the loss of thousands of jobs.⁷⁶ Similarly, subsidies for fossil fuels make them more ubiquitous, affordable for consumers, and profitable for industry than they would otherwise be.⁷⁷

Business recognizes that investing in advocacy for favorable policies is a cost-effective means to enhance their bottom line. For the last decade, total spending on lobbying in the U.S. has been more than \$3 billion per year.⁷⁸

Climate mitigation technologies and the industries that support them might mature on their own given a long enough timescale. But the urgency of climate change means that policies friendly to climate mitigation technology should be implemented as quickly as possible to accelerate their deployment.

Optimal solutions are those in which profit and planet align – policies that unleash market forces that make it easier for people to make climate-friendly choices. These market-based solutions create powerful win-win scenarios in which businesses reduce greenhouse gas emissions and make money, too. Policies that accelerate market-based solutions offer the best opportunities for speed and scale GHG emission reductions.

⁷⁴ Hawken, Paul, "Summary of Solutions by Overall Rank", *drawdown.org*. <<https://www.drawdown.org/solutions-summary-by-rank>>

⁷⁵ Hallock, Lindsey and Michelle Kinman, "California's Solar Success Story", *Environment California Research and Policy Center*, July 7, 2015. <<https://environmentcalifornia.org/reports/cae/californias-solar-success-story>>

⁷⁶ Groom, Nicholas, "Billions in U.S. solar projects shelved after Trump panel tariff", *Reuters*, June 6, 2018. <<https://www.reuters.com/article/us-trump-effect-solar-insight/billions-in-u-s-solar-projects-shelved-after-trump-panel-tariff-idUSKCN1J30CT>>

⁷⁷ Coady, David, et al., "How Large Are Global Energy Subsidies?" *International Monetary Fund*, May 18, 2015. <<http://www.imf.org/en/Publications/WP/Issues/2016/12/31/How-Large-Are-Global-Energy-Subsidies-42940>>

⁷⁸ Center for Responsive Politics, "Lobbying Database", *opensecrets.org*, July 24, 2018. <<https://www.opensecrets.org/lobby/>>

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The Climate Center's mission is to deliver rapid greenhouse gas reductions at scale, starting in California. www.theclimatecenter.org