

Clean Energy and Sustainability Accelerator

OPPORTUNITIES FOR LONG-TERM DEPLOYMENT

PREPARED BY

Frank Graves
Bob Mudge
Roger Lueken
Tess Counts

PREPARED FOR

The Coalition for Green Capital

JANUARY 14, 2021



NOTICE

This white paper reflects the perspectives and opinions of the authors and does not necessarily reflect those of The Brattle Group's clients or other consultants.

Where permission has been granted to publish excerpts of this white paper for any reason, the publication of the excerpted material must include a citation to the complete white paper, including page references.

© 2021 The Brattle Group

Summary for Policy Makers: Opportunities for Long-Term Accelerator Deployment

The year 2021 opens with urgent public policy imperatives to 1) address the economic ravages of COVID - 19 in the immediate near term, particularly for low and moderate income (“LMI”) communities that have suffered the most from both the direct and indirect impacts of the pandemic, and 2) concurrently and beyond, to resume efforts to decarbonize the economy within the next three decades. These goals are separate, but materially intertwined and mutually reinforcing, as policy makers have recognized for many years. As described further below, the proposed Clean Energy and Sustainability Accelerator (the “Accelerator”) would be a federally funded, non-profit NGO with a mandate and the necessary financial resources and flexibility to pursue these goals at great speed and at large scale. The Coalition for Green Capital has sought the input of energy industry experts to help develop priorities and approaches that would optimize the Accelerator’s ability to meet its short-term and long-term missions.

The Accelerator will pursue complementary short- and long-term missions in parallel, both beginning immediately. The **short-term mission** will be to provide immediate liquidity for economic recovery via clean energy investments. These investments will be chosen, where possible, to also improve equitable, social justice-restorative participation in the benefits of the clean energy transition (which has often missed LMI communities, upon whom climate and environmental quality burdens fall disproportionately). The short-term mission is described in detail in a complementary white paper prepared by economists at the Analysis Group led by Sue Tierney and Paul Hibbard entitled “Accelerating Job Growth and an Equitable Low-Carbon Energy Transition: The Role of the Clean Energy Accelerator.” Accordingly, the balance of this summary will focus on the Accelerator’s long-term mission.

The Long-Term Mission. The Brattle Group has prepared an analysis and white paper to address the balance of the Accelerator’s mission, entitled “The Clean Energy and Sustainability Accelerator – Opportunities for Long-Term Deployment. This shorter piece gives an overview of its key findings. Though longer run in focus, this mission would be pursued in parallel with the recovery and relief activities identified in the Analysis Group report for the shorter-term mission. It would begin immediately, to accelerate the rate of decarbonization over a period extending

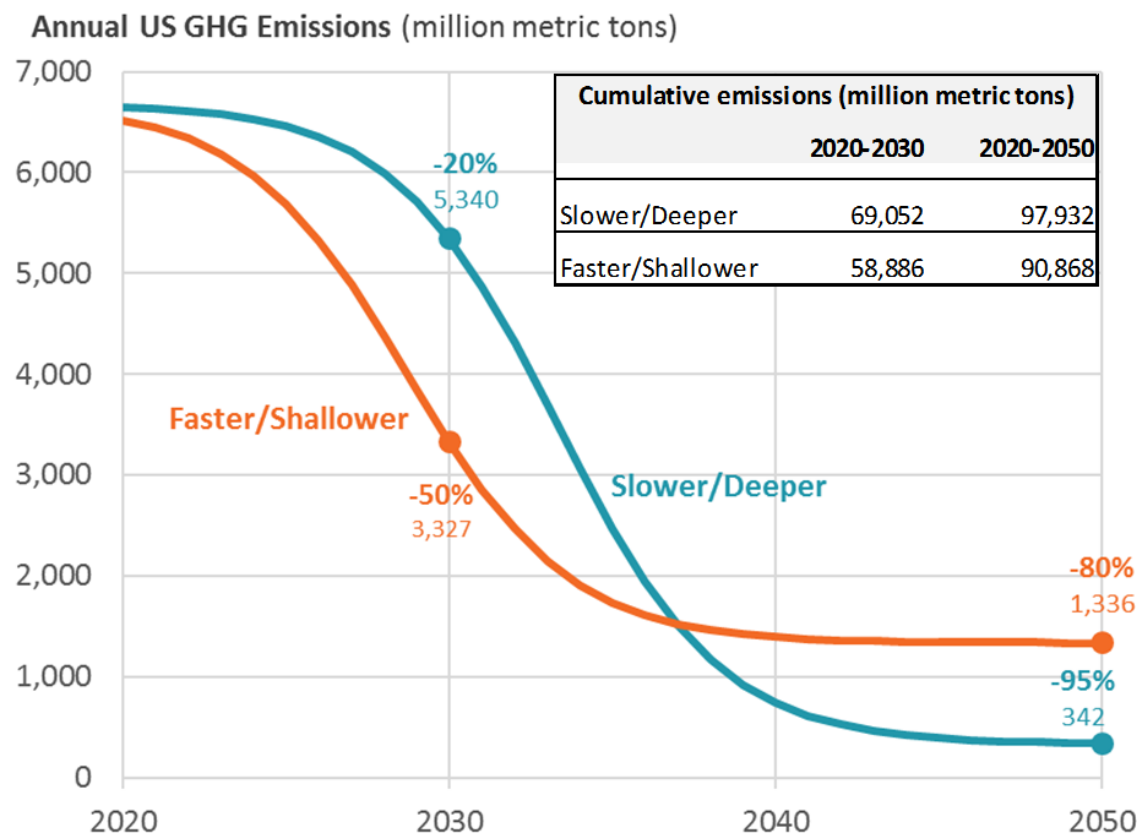
Early reductions in GHG emissions are in many ways more important than eventual depth of reductions, because of the cumulative and persistent nature of GHGs in the atmosphere

from as soon as possible to as many as 10 to 30 years into the future, through targeted financial support and risk-mitigating facilitations of commercially proven clean energy technologies. The logic is that, as the economy returns to “normal”—presumably within a couple of years—and certainly thereafter, the most important thing we can do for decarbonization is rapid adoption of clean energy technologies that quickly reduce GHG emissions. Indeed, early reductions in GHG emissions are in many ways more important than

eventual depth of reductions, because of the cumulative and persistent nature of GHGs in the atmosphere. “Decarbonization” for this mission would also be defined to continue recognizing distributional inequities in environmental conditions and opportunities, hence prioritizing social justice goals over the long term.

While much political debate about decarbonization policy involves setting very long term goals like “80 by 50”, in fact, slowing the rate of climate change depends more on decarbonizing rapidly than on eventually decarbonizing more deeply (though both are important). Cumulative GHGs in the atmosphere are what cause warming, not the rate at which they are emitted in any given year (and they persist in the atmosphere for decades or longer). Accelerating decarbonization by a few years can result in less cumulative emissions for many of the years between now and a “decarbonized” 2050 end state than would be achieved by a slower decarbonization process that eventually resulted in lower annual emissions. Figure 1 below illustrates the differences between early and later acceleration of decarbonization efforts. In this example, the faster but shallower decarbonization results in 7% less cumulative GHG emissions by 2050, even in the hypothetical that it yielded higher emissions rates in the later years.

FIGURE 1: ILLUSTRATING THE BENEFITS OF ACCELERATING DECARBONIZATION

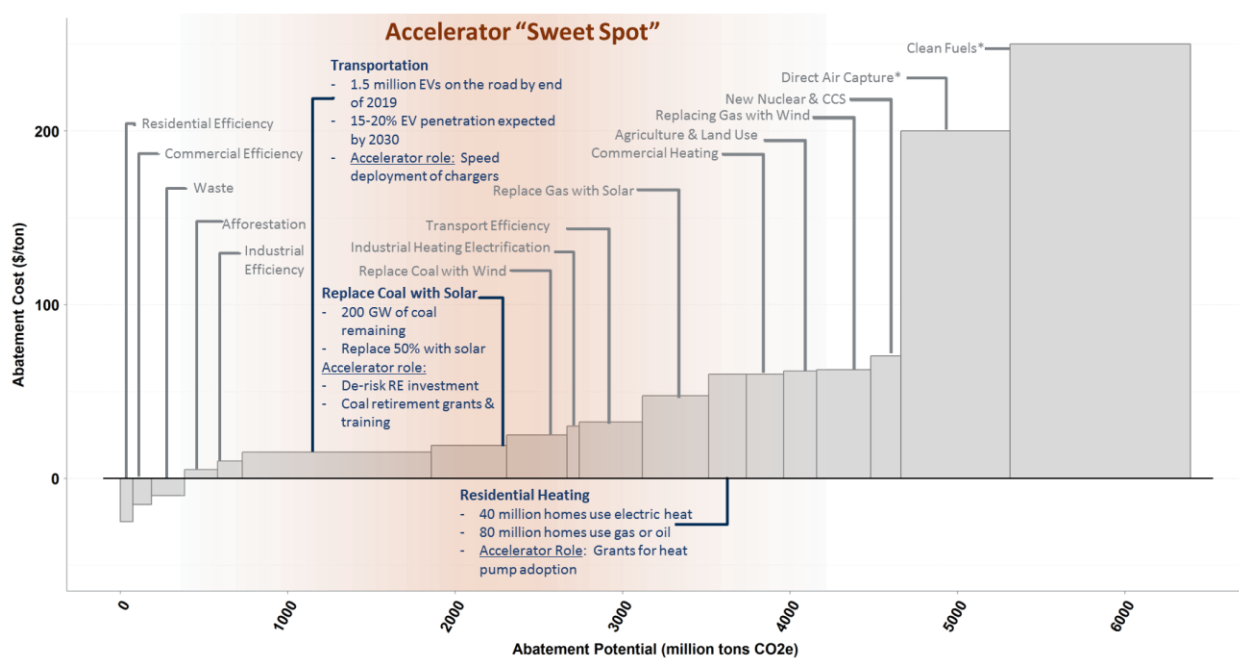


The pressure of time leads to another precept of the Accelerator’s mission: a focus on commercially proven clean energy technologies. Basic research, pre-commercial R&D and the invention/ commercialization of new technologies will undoubtedly play a key role in achieving deep decarbonization. However, by definition, pre-commercial R&D is an uncertain process with little applicability to near- and medium-term decarbonization efforts, and generally not much, if any, near-term economic impact.¹ By contrast, we have much in the way of highly effective clean energy technologies today (or technologies with a readily foreseeable path to commercialization), but we need to deploy them more quickly to obtain the near-term and long-term benefits of accelerated decarbonization. Many technologies are currently available that have a positive expected net present value but are not always being actively deployed and/or are well below the pace and level of adoption that is needed for material decarbonization.

¹ As it turns out, R&D is also already well-supported from an institutional standpoint, such as via the U.S. Department of Energy’s ARPA-E.

The GHG Abatement Supply Curve - To appreciate the diversity of the technology and cost landscape for decarbonization efforts, Brattle has developed a rough supply curve for visualizing the potential opportunities for decarbonization, ordered by cost per ton of abatement, that add up to 96% of the current level of annual US CO₂ emissions (about 6.4GT/year CO₂ from the US, 1/6th of about 38GT/year for the world.) The middle portion of this curve is lightly shaded to indicate abatement measures likely to be in the Accelerator’s “sweet spot” based on being (1) ready for immediate or very near-term deployment, (2) likely to be cost effective in the near term, and (3) significant in scale.

FIGURE 2: ILLUSTRATIVE U.S. GHG ABATEMENT CURVE
ILLUSTRATING THE ACCELERATOR’S “SWEET SPOT” IN SPEEDING DECARBONIZATION



* These technologies have highly uncertain costs, with uncertainty of \$100/ton or more (e.g. clean fuels sometimes estimated at around \$600/ton).

Sources: See appendix for assumptions and sources

Of course, the Accelerator will work along the entire abatement curve according to how opportunities arise from developers demonstrating they are ready to start with additional support.

Institutional and Financial Bottlenecks - Why is the Accelerator needed to accelerate deployment of these promising, commercially proven abatement measures? What is insufficient about conventional investment and financing for them? Although some activity is occurring in these areas, **institutional and financial bottlenecks are often slowing the clean energy**

transformation. As we note in examples presented in our more detailed white paper (and summarized briefly below), several currently available clean energy technologies have sufficient social and even private net benefits to be economically justified, yet they are not being pursued significantly.

To some degree, these impediments are due to classic economic failures (which are ultimately also matters of public policy)—e.g. decarbonization benefits are frequently not priced or even understood. Recent examples include lack of appetite for economy-wide or sectoral carbon taxes and considerable evidence that the automotive customers are not generally aware of the cost and performance benefits of electric vehicles, hence delaying their adoption.

However, there is another class of impediments, which we would propose the Accelerator be focused on addressing, which are situations of under-investment that are more due to institutional and financial barriers that limit how available benefits are perceived or shared or that involve untenable levels of risk relative to the risk tolerances of potential sponsors and private, for-profit financing entities. These types of barriers complicate the realization of the benefits of decarbonization investment, and are amenable to reconfiguration via a sophisticated intermediary like the Accelerator. The Accelerator could help by bearing certain risks that for-profit entities are unwilling to bear, offsetting side-effect transaction costs, and redistributing benefits in new ways, to “debottleneck” private capital investment in otherwise attractive or nearly attractive clean energy projects. Ideally this can be done at a much lower cost than the cost of simply subsidizing the cost to deploy clean energy technologies to the point of them reaching a positive NPV or fast payback. By finding such niche opportunities, the Accelerator can be used to leverage other private capital that is already available and interested but reluctant to dive in.²

Barriers to Accelerated Decarbonization – More specifically, we have identified a number of institutional and financial barriers that we have observed in our energy market consulting experience having the effect of suboptimizing certain categories of clean energy investment, summarized below in Figure 3. These barriers, associated effects, and potential mitigation via the Accelerator are further examined in a series of examples included in the white paper. They are all amenable to relief by flexible and creative uses of an Accelerator and its financial resources.

² Importantly, catalyzing available technology adoption (at industrial and individual scale) will also have continuing early recovery benefits and may facilitate more rapid innovation and cost reductions (e.g., from learning curves and reaching commercial scale) in the underlying technologies.

FIGURE 3: BARRIERS, THEIR DISPERSION ACROSS DECARBONIZATION LANDSCAPE, AND HOW THE ACCELERATOR CAN HELP

BARRIERS	DESCRIPTION	SUBOPTIMIZED CLEAN ENERGY INVESTMENTS	AFFECTED SECTORS	POTENTIAL ACCELERATOR ROLE
1 Limited Risk Tolerance for Full Investment	<p><i>Market volatility outweighs expected benefit.</i></p> <p>End-users or investors may have limited ability to bear risk even if economics make sense. This may result from scale mismatches, lack of hedging or insurance, or exposure to public policy shifts.</p>	<p>Community solar absent long-term subscriptions.</p> <p>Merchant utility scale renewables facing long-term REC and energy value uncertainty.</p> <p>Storage operating in highly volatile market conditions without long-term contracting opportunities.</p>	End-use customers, renewable energy and storage developers, energy service companies, and utilities.	<p>Reduce frictions through acquisition, standardization, and risk-subsidization.</p> <p>Firm up revenue streams; supply credit enhancement; provide low-cost risk bearing capital.</p>
2 Insufficient Liquidity	<p><i>High front-loaded investment requirements.</i></p> <p>Conversion to clean energy technologies can be extremely capital-intensive for residences or small commercial, and government entities. Investment may include building modification as well as equipment itself.</p>	<p>End-use electrification (home or small commercial HVAC and water heating, as well as electric vehicles).</p> <p>Commercial building envelopes/ smart surfaces.</p> <p>Distributed energy resources like rooftop solar, especially for LMI customers.</p>	Residential & small commercial end-use customers; municipal, university, school and hospital (MUSH) sector.	<p>Finance or subsidize upfront costs.</p> <p>Help rationalize (e.g. scale up) equipment supply industries.</p>
3 Misalignment of Benefits and Costs, or Adverse Side-Effects	<p><i>Socialized benefits incur local costs.</i></p> <p>Some green projects have benefits that are diffused or not readily shared with all affected parties, esp. where some of the implementation costs are more localized than the benefits, and/or the attractive project involves adverse side-effects.</p>	<p>Early coal plant retirements.</p> <p>Long-distance transmission for renewables.</p>	<p>IOUs, Coops, munis, commercial customers, transmission developers, end-use customers, affected communities</p> <p>Property owners in intervening territories</p>	<p>Distribute grants to recover stranded costs and mitigate</p> <p>Design programs to redistribute benefits or induce complementary, additional projects that offset adverse side effects.</p>

BARRIERS	DESCRIPTION	SUBOPTIMIZED CLEAN ENERGY INVESTMENTS	AFFECTED SECTORS	POTENTIAL ACCELERATOR ROLE
4 Chicken-or-Egg Problems	<p><i>Critical mass of infrastructure to support adoption.</i></p> <p>Problems arise when multiple types of changes have to occur in order to gain critical adoption, where each of the needed changes is dependent on the others. Investors may not take "build it and they will come" risk.</p>	<p>EV charging infrastructure</p> <p>Distribution system upgrades for extensive DER penetration and improve grid resiliency</p> <p>System upgrades for utility scale renewable interconnections</p> <p>Transmission serving offshore wind</p>	End-use customers, renewable and transmission developers, utilities, governments, engineering technology developers.	Target threshold infrastructure requirement, underwrite initial costs, and transition to market.
5 Underserved Market Sectors	<p><i>Applications that lack economic compensation</i></p> <p>There are likely to be sectors of the customer base that will be bypassed or overlooked by competitive market participants because costs or risks are too high.</p>	<p>Infrastructure (such as EV charging) requiring overbuild, peaking characteristics, or subsidies.</p> <p>Smart surfaces (reducing dark surfaces and adding vegetation in urban "heat islands").</p>	LMI and/or low-density households/ communities.	Grants and subsidies to support investment in LMI communities and for locations that could experience occasional extreme peaks but not much routine traffic
6 Long-Run Value Needing Near-term Market Priming	<p><i>Low-carbon supports for renewable intermittency</i></p> <p>Renewables, even if they produce cheapest energy, are intermittent and tend to produce power at concentrated times of day. As renewables gain more market penetration, this will require developing the best supporting technologies to address renewable downtimes.</p>	<p>Long duration storage.</p> <p>Carbon capture and storage.</p> <p>Renewable natural gas.</p> <p>Repurposed gas delivery infrastructure.</p>	Engineering technology providers, electric utilities, gas LDCs and midstream pipelines, fossil fuel suppliers.	Support to help achieve closer cost parity with renewables and storage today, as well as repurposing infrastructure, taking into account the present value benefits in the future.

The Accelerator Solution - The Accelerator would be a new kind of publicly backed NGO with a defined mission and a finite life (perhaps up to 20-30 years, but with the majority of its projects established in the next few years, followed by administrative monitoring in the out-years). The Accelerator would accomplish its defined mission by providing targeted financing, creating financial guarantees/insurance, fostering complementary projects to offset distributional imbalances, and providing hedging, all aimed at removing bottlenecks and nudging select projects over "tipping points" to unlock private capital for near-term decarbonization opportunities. The goal of the Accelerator would be to 'lever' or 'crowd-in' private capital

investment with targeted funding and support from the Accelerator, rather than just having the Accelerator assume the full or partial cost of a project to improve its economics. That is, projects supported by the Accelerator should have a financial multiplier of sorts, in addition to their other indirect economic benefits. In this way, the Accelerator would be somewhat similar to already existing “Green Banks” at the state and local levels but with key differences, including:

- Much larger scale (perhaps \$100B vs. about \$3B in aggregate Green Bank financing to date), and ability to address multi-state impediments;
- Research capabilities to evaluate marginal, facilitating capital needs (not total project needs);
- Ability to make investments based on whether a project will provide significant public benefits (e.g., reduced or avoided emissions of GHGs and other pollutants harmful to public health); not constrained to earning a return of and on every dollar invested; and
- Some administrative capacity to help price and manage market risks over time (e.g. trading desks)

In particular, while we expect the Accelerator would reinforce and coordinate with the existing role of state and local Green Banks, its distinctive mission would be to dramatically expand beyond the typical Green Bank mandate—in dollars as well as scope—seeking out and promoting larger scale step-changes in clean technology deployment and decarbonization.³

The Accelerator would seek to allocate funds through mechanisms that align with market processes and competition. That is, it would not be in the business of simply picking winners and doling out grants. Rather it would identify bottlenecked processes, as sketched above, and then solicit offers to help remedy these via partial financial assistance and technical support from the Accelerator. In some cases, this may be possible through formal RFPs or auctions, e.g. awarding funds to bidders based on which of them can commit to the greatest amount of GHG reduction per dollar of Accelerator support. In other cases, this simple a mechanism may not be possible or appropriate, because many kinds of beneficial attributes may arise from supported programs that are not amenable to simple ranked bidding. In addition, some of the commitments will not be for simply extending monies, but for risk-backing such as loan guarantees or hedging of long term uncertainties (such as REC prices) that are otherwise discouraging for developers.

³ Most of the activity of existing state and local Green Banks appears to be targeted at the end-use consumer or small project level, which definitely has needs including some, which the Accelerator Fund could also address. However, these applications tend to exclude the larger utility scale, commercial and industrial applications that might give larger GHG impacts sooner. E.g., the New York Green Bank, by far the largest and best funded of the existing Green Banks in the US, has a limit of \$50mm per project. (See New York Green Bank Annual Business Plan 2020-2021 (<https://greenbank.ny.gov/Resources/Public-Filings>).)

Importantly, whether over the near or long term, “decarbonization” would be defined to prioritize social justice goals, such as equitable and diversified support of programs and technologies to benefit LMI communities across the country. Historically, LMI communities have disproportionately borne the adverse effects of climate change while missing the benefits of past green investments.

In sum, the Accelerator is expected to be a powerful mechanism for gaining several kinds of complementary benefits, in economic recovery, decarbonization, social justice, and market enhancement. See the associated white papers for much more detail on how it could work and why it is nicely suited to the current fiscal and financial conditions.

AUTHORS



Frank Graves has over 35 years of experience assisting utilities in forecasting, valuation, and risk analysis of many kinds of long-range system planning and strategic decisions, such as generation and network capacity expansion; supply procurement and hedging; service design, pricing and cost recovery mechanisms; distributed energy resource adoption; renewable asset selection and de-carbonization; and extreme risk resiliency planning.

Frank.Graves@brattle.com



Bob Mudge has played a central role in developing financeable contract structures for large public and private infrastructure projects, numerous power project financings, utility mergers and acquisitions and bankruptcy restructuring. A former banker, he has provided expert counsel on project finance feasibility and/or impact in numerous regulatory, litigation, and arbitration settings.

Bob.Mudge@brattle.com



Roger Lueken has worked with clients throughout the U.S. and internationally, including market operators, investors, regulated utilities, and other market participants. Energy storage assignments include using Brattle's bSTORE model to perform benefit cost analyses of distributed and utility-scale storage in California, PJM, and the Midcontinent ISO (MISO). Dr. Lueken has provided due diligence support on behalf of investors and technology firms evaluating specific storage and solar and storage projects.

Roger.Lueken@brattle.com



Tess Counts is a Senior Research Analyst with a focus on utility financial analysis, cost of capital, and resiliency. She has expertise in Brattle's system dynamics models of long-term electric distribution opportunities and risks, as well as in distressed asset valuations and California wildfire risk assessment. Her background is in economics from Wesleyan University.

Tess.Counts@brattle.com

ABOUT BRATTLE

The Brattle Group answers complex economic, finance, and regulatory questions for corporations, law firms, and governments around the world. We are distinguished by the clarity of our insights and the credibility of our experts, which include leading international academics and industry specialists. Brattle has over 400 talented professionals across three continents. For more information, please visit brattle.com.