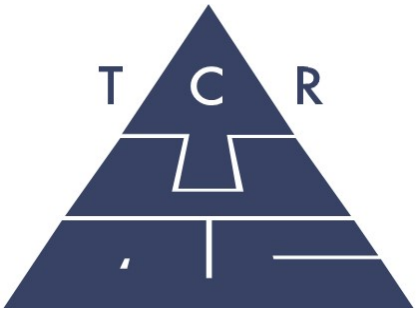

Executive Summary

Strategies for Investing in Clean Energy Technologies

Traditional and Novel Mechanisms for Accelerating Development and Deployment

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EXECUTIVE SUMMARY

The challenge presented by climate change will require the development and rapid scaling of a broad complement of solutions. While key enabling technologies, notably wind and solar power, have already been deployed at scale, achieving an affordable and reliable net zero power grid will require the development of additional technologies. Crucially, this next generation of clean energy technologies will need to progress from demonstration to diffusion at a much more rapid pace than we have seen previously.

Though the public sector may be best suited to support the earliest stages of technical development (e.g., grant funding) and late stages of mass diffusion (e.g., tax incentives, regulatory standards), there is an opportunity for corporates to help bridge the gap between the two. Mid- to late-stage Technology Readiness Level (TRL) technologies benefit from the creation of early markets, commercial demonstrations, and market signals on performance and cost characteristics and may offer the highest leverage opportunities for corporate interventions. In particular, interventions that can catalyze additional investment beyond a sponsor's direct financial commitment may be particularly well-suited to the corporate sector in light of individual firms' more limited ability to fund innovation programs on the same scale as the public sector. While all have unique merits, the selection of an ideal intervention depends on a range of factors, including the characteristics and development stage of the target technology and the sponsor's desired outcome and level of commitment.

This report presents and discusses financial mechanisms corporate buyers can use to support the development and deployment of clean energy technologies. The first chapter discusses two well-established approaches – prizes and purchase commitments. The second chapter discusses more novel approaches, including novel variations on the basic structure of the advanced market commitment, novel financial hedges, new ideas related to tax equity and sponsor equity, and novel ideas designed to support early-stage R&D efforts.

Prizes and Purchase Commitments

Prizes are a useful mechanism to spur breakthrough innovation, stimulate or create new markets, and source solutions for some of the world's most challenging problems. They can take on many forms based on the desired outcome but can typically be bucketed into two general categories: ex-ante prizes, commonly referred to as inducement prizes, and ex-post prizes. Ex-ante prizes are designed to stimulate activity or innovation in a specific field, and awards tend to be established prior to an invention taking place. They typically have longer timelines, are more capital-intensive, and are best suited to encourage innovation. Ex-post prizes are awarded to an existing invention and typically involve government or corporate procurement or patent buy-out of a specific idea or invention.

Prizes are best suited to supporting technologies at TRL 3 to 7 and are most successful when the following criteria are met: (1) a clear and measurable goal, (2) a defined timeline, (3) a large pool of diverse problem solvers, (4) backing by a reputable institution (to bolster publicity and attract more competition and funding); and (5) a diverse and unbiased panel of judges with expertise in the prize's subject area. While successful in many contexts, prizes most often fail when they set unrealistic or unclear goals or when they have prohibitive funding requirements that prevent applicants from either participating or demonstrating success.

A highly successful prize can produce spillover benefits and mobilize large amounts of public and private funding into the prize's field. Among the benefits of prizes are that they are usually open to any participant and tend to attract a wide array of potential problem solvers, they tend to generate publicity and can drive public interest in a particular technology or field, and they only reward success. Several examples of successful and unsuccessful prizes are discussed in section 1.3 of the Full Report.

While prizes are designed to spur innovation or the development of novel solutions, they are not a direct incentive for deployment. Thus, prizes are sometimes used in combination with other mechanisms, such as purchase commitments, where the prize stimulates early-stage technical development and a follow-on purchase commitment provides a path for further development and commercialization.

Purchase commitments are a broadly defined category of mechanisms in which an off-taker (or a group of off-takers) makes a conditional commitment to acquire future output for a specific technology or solution. Purchase commitments can take on a variety of forms, including milestone-based payments, advanced market commitments, bi-lateral contingent purchase orders, and preferred supplier agreements, all of which are discussed in detail in section 1.4 of the Full Report.

Technologies suited to purchase commitments may range from TRL 4 to 9 but ideally share properties of modularity or unitized output, and performance characteristics that are well-understood and observable ex-ante. For earlier stage technologies, purchase commitments are generally structured with broader eligibility and less specific success criteria, both of which may become more targeted when applied to later TRLs. Ultimately, the flexibility of this mechanism makes it a highly useful tool that may be employed across a wide variety of circumstances and easily combined with other mechanisms to maximize impact.

The primary benefit of purchase commitments is their ability to catalyze investment, often far beyond the scale of the contingent commitment, by providing a signal of future market demand. Depending on their size and scope, these commitments have demonstrated the ability to induce investments in manufacturing capacity, develop entirely new markets, and precipitate multi-million-dollar capital raises for market entrants.

While these broad categories of interventions have historically proven effective in many instances, going forward, there is ample opportunity to explore novel approaches that can build on the lessons learned from prior experience.

Novel Strategies

As mentioned previously, the transition to net zero will require the rapid development, demonstration, and deployment of new clean energy technologies. The urgency and scale of this challenge will require a willingness to test novel approaches to support and fund innovation. Chapter 2 of the Full Report describes several less well-understood approaches designed to maximize decarbonization per dollar spent, including novel variations on the basic structure of the advanced market commitment, novel financial hedges, and new ideas related to tax equity and sponsor equity, among others. Though each of these approaches may have merit, the right mechanism will be technology – and TRL – dependent.

Section 2.2 of the Full Report discusses two variations on the basic structure of the advanced market commitment. These more novel conceptions of an advanced market commitment are intended to

provide earlier financial support and greater direction to potential suppliers, with clear incentives and milestones for their research and development over time. For example, one variation that corporate sponsors could offer is an "accelerated" advanced market commitment, in which some portion of the committed funds is prepaid upfront to potential suppliers. These upfront payments provide early-stage companies with, not only working capital, but also a stronger value proposition to leverage with investors in the form of demonstrable revenue. Among other potential benefits for the corporate, providing this early support could give them an opportunity to negotiate favorable terms for future purchases as a concession for taking upfront risk or to influence innovation on specific performance parameters of interest.

Opportunities for the use of novel financial hedges are discussed in section 2.3 of the Full Report. The concepts of forward price contracting and financial hedging are well understood in the energy industry. One form of forward price contracting, the power purchase agreement (PPA), has been used extensively since the 1980s by independent power producers to de-risk projects by locking in a fixed price for future output. Virtual PPAs, introduced in 2015, provide many similar benefits but are purely financial instruments, removing the requirement for physical off-take by the buyer. PPAs are well-suited to situations in which a single commodity is sold with a clear and liquid market for both buyers and sellers. While these agreements have been critical to the development and deployment of wind and solar projects, other financial mechanisms may be better suited to providing market certainty in cases where a single commodity or clear liquid market is not involved. Situations in which more novel hedging mechanisms may be beneficial include market stacking (where several complex value streams exist, as in the case of energy storage); complex regulatory markets where the procured commodity is only part of the revenue; and situations in which the "procurer" does not directly participate in the market. Corporates could help facilitate the creation of these more novel financial hedges by, for example, creating a fund that is used to collateralize derivative contracts. While a single corporate purchaser could do this alone, a consortium of corporations pooling resources would likely be more effective at achieving scale. The consortium could define investment objectives and themes at the inception of the fund to direct investment into projects that best align with their climate or other objectives. This strategy has the potential to provide broader benefits to the market by creating an avenue for projects that do not fit well within the traditional PPA paradigm to secure financing.

Tax equity is one of the key levers provided by the U.S. government to scale up renewable energy, particularly wind, solar, and storage. Two of the largest sources of tax credits are the Investment Tax Credit (ITC) and the Production Tax Credit (PTC), which allow investors in renewable energy projects to claim a credit against their federal income tax based on either the cost of the project (for the ITC) or the electricity generated (for the PTC). A drawback of the tax credit system is that a relatively high tax liability is needed in order to gain value from the tax credits. Many renewable energy developers lack the tax liability to take full advantage of the credits awarded to their projects and, as a result, turn to outside entities to supply capital in exchange for the tax credits. Prior to the recent passage of the Inflation Reduction Act (IRA), only the investors in a renewable energy project were eligible to take advantage of the tax credits associated with that project. However, following passage of the IRA, tax credits can now be monetized and sold to another taxpayer, which opens up alternative sources of capital that are simpler and less risky than traditional tax equity relationships. Section 2.4 of the Full Report discusses two ways a corporate partner could get involved to help make the most of this change in tax law: directly purchasing tax credits and creating a marketplace for tax credits. In the

case of the latter, a company, particularly one with deep software development capabilities, could develop an online marketplace for the purchase and sale of these credits to improve the ease with which these transactions can occur, thereby lowering barriers to renewable funding and deployment. A transparent, liquid market could reduce transaction costs and reflect the full value of the credits by attracting buyers who are in the best position to benefit from purchasing tax credits.

There are additional opportunities for corporates to support clean energy technologies through sponsor equity, which are discussed in section 2.5 of the Full Report. These include through direct investment, through coalition forming, and through fund creation. In the case of renewable energy projects, sponsor equity is often used to fund the initial stages of development and construction. One of the key benefits of sponsor equity in renewable energy projects, which often have a higher degree of uncertainty and risk than traditional energy projects, is that it can help to de-risk the capital stack. By providing a significant amount of sponsor equity, the sponsors can help mitigate some of the risks associated with the project, making it more attractive to other investors. In this way, a corporate could utilize sponsor equity to enable commercial-scale development of a novel technology that might otherwise struggle to get necessary funding. In doing so, a corporate sponsor with a large energy demand could potentially use these relationships to secure net zero energy for its own facilities and thereby contribute to any net zero goals it had set for itself. The corporate sponsor may also benefit from positive public perception of their direct contributions to the energy transition.

Chapter 2 of the Full Report closes with a discussion of several novel ways corporates can support technology research, development, and demonstrations (RD&D). Early RD&D funding is key to a technology's long-term success and ability to bridge the common "valleys of death" that typically appear between the research and proof-of-concept phases, as well as between the demonstration and adoption phases. While traditionally the realm of the public sector, there are opportunities for corporates to accelerate RD&D efforts, including the creation of a testbed, creating an accelerator program, participating in a joint development agreement, and offering low-cost loans. These ideas, and successful examples of each, are discussed in detail in section 2.6 of the Full Report. Additionally, corporations can support other opportunities for researchers and entrepreneurs or experts from different fields to exchange knowledge (learning by interaction) and, in some cases, may be able to build information, modeling, or visualization tools that can accelerate the tempo of innovation.