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Case Study: Evolution of Proxy Carbon Pricing Implementation at Princeton University

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Synopsis: Since its first Sustainability Plan in 2008, Princeton University has implemented a proxy carbon price to evaluate physical infrastructure decisions for both capital planning and energy conservation projects on its campus. Princeton uses the proxy carbon price as a strategy to bias cost study evaluations toward more energy efficient systems in order to advance carbon reduction goals. The proxy carbon price was put in place first to prepare for what we believed were eventual federal regulatory requirements, during Princeton's first Sustainability Plan (2008-2019), and has evolved to a more aggressive one in order to both study its efficacy and advance the change in infrastructure needed to move the University towards its goal of carbon neutrality or net zero greenhouse gas emissions by 2046.

Timeline: Princeton first started to factor a proxy carbon price into cost analyses in 2008 when the U.S. was considering national carbon tax and cap and trade policies. Those policies were never enacted but Princeton had just made its formal commitment to sustainability and wanted to continue to prioritize energy efficiency to advance its own emissions reduction goals and those of the state of New Jersey.

Current scope: The proxy carbon price is applied to all emissions associated with major construction and renovation projects including campus utilities, building envelopes, materials, and systems such as HVAC systems, and rainwater harvesting and reuse systems. Future scope will likely include embodied carbon of major building materials, and other non-construction procurement areas. Princeton does not actually payout any fees associated with the proxy carbon price. It is only used in the analysis, and its only effect is that in some cases, we purchase a more expensive system than we would have without the proxy price included in the analysis. However, the result is reduced energy costs and lower carbon emissions over the life of the system.

Determining a carbon price: During its first Sustainability Plan, Princeton used a proxy carbon price that ranged from $35 to $45 per metric ton of carbon dioxide equivalent (MTCDE) which was based off of the European price at that time and a cost that our researchers believed a mature carbon-sequestration market would charge.

Because the unit cost of energy was high during the early 2010's, payback periods for major construction and renovation projects both with and without the proxy price were roughly equivalent. As a result, the proxy price only impacted decision-making for one major construction project. In early 2020 at the start of Princeton's second Sustainability (Action) Plan, Princeton decided that it would begin testing a higher proxy price in collaboration with Smith College to document and build upon case studies of internal carbon pricing in higher education (Barron et al. 2020). This decision was inspired by New York City's updated building emission standard (Local Law 97) which uses a carbon price of $268/MTCDE as a fine to incentivize commercial building energy conservation measures. Princeton viewed the NYC case as evidence that a higher cost for carbon is needed in order to meaningfully drive changes in

decision-making at a large scale. Academic studies have also provided support that similar higher prices are more representative of the true social and environmental cost of carbon emissions, including the valuation of the investments needed now to avert the associated damage. As a result, Princeton is moving forward with an analysis to determine an appropriate proxy price to incentive decision-making for its own campus as part of its Campus and Community as Living Lab approach.

Implementation: For both new construction and renovation projects, Princeton runs cost estimates both with and without the proxy carbon price applied. In 2013, the proxy carbon price defensibly favored pursuing a geo-exchange heating and cooling system for the Lakeside Graduate Apartments which were completed in 2015 and certified by the U.S. Green Building Council as LEED Silver. This was one of two capital projects during Princeton's first Sustainability Plan for which the proxy carbon price impacted infrastructure and energy system decisions, justified via life-cycle cost analysis (LCCA). The second project was a library storage facility that was not built. In the current 2026 capital planning period, Princeton is transitioning away from solely conducting LCCA studies and toward a more comprehensive Integrated Design Process (IDP). The motivation for this is that for some sustainable design elements, LCCA does not capture the full value of the investment. While a higher proxy carbon price will bias toward more energy efficient designs and measures, energy and carbon emissions are only two of many inputs that are considered in the IDP decision-making framework. For example, IDP analyses also consider other quantitative measures such as embodied carbon, as well as qualitative measures that are reflective of the University's priorities such as providing meaningful research and education opportunities and creating everyday experiences that foster a sustainability ethos. The IDP framework helps all planning teams set goals and objectives based on these quantitative and qualitative factors which are then continuously re-visited throughout the design process. Life cycle costing is one evaluative tool among several used in decision-making.

In energy conservation projects within existing buildings, the implementation and impact of the proxy carbon price is more straightforward than in capital projects since energy usage is the sole parameter that all projects are compared against during the auditing process and savings analysis. Princeton has and will continue to screen thousands of projects ranging from central plant upgrades to window film, and they are ranked according to their raw payback period. During Princeton's first Sustainability Plan, the portfolio of energy conservation projects was required to achieve a 5-year average payback period. For the current 2019 Sustainability Action Plan (which includes the 2026 Capital Plan), the average accepted payback period is 10 years. This higher average payback period coupled with a higher proxy carbon price will favor projects with a high carbon savings potential relative to the cost. In other words, a heat recovery project that has a 30-year raw payback period but only an 8-year payback period with an effective proxy carbon price, may still get funded and included in the portfolio because the proxy carbon price shows that even though the project may have a long payback time, significant greenhouse gas emissions savings may be realized for a relatively small cost compared to other projects.

Lessons learned: Princeton believes that adopting and applying any proxy carbon price is a worthwhile endeavor because of the internal dialogue it sparks about the nuances of certain decisions. It can encourage discussion about institutional values and long-term objectives in service to humanity and planetary health. For example, how should we account for trade-offs in building materials with different levels of embodied carbon, given that the associated emissions are not traditionally accounted for in a campus's operational carbon footprint? In the Princeton journey, we have determined that we do have an obligation to understand these off-campus indirect impacts in large part because we began discussions about valuing carbon emissions starting in 2008 and have learned to explore them in more nuanced ways ever since. After originally focusing on Scope 1 and Scope 2 emissions, Princeton gradually learned that many

Scope 3 activities that do not appear combustion-related such as concrete manufacturing, are also very carbon-intense and represent a larger portion of our institutional carbon footprint than initially realized. We have also determined that a similar proxy carbon pricing tool may be more broadly applied in daily non-construction related procurement decisions, and plan to engage the campus community in investigating those applications.

References

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