Hanley Sustainability Institute

Carbon lock-in: an obstacle to campus decarbonization

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Introduction

"Carbon lock-in is an example of the phenomenon of path dependence ... Specifically, carbon lock-in refers to the dynamic whereby prior decisions relating to GHG-emitting technologies, infrastructure, practices, and their supporting networks constrain future paths, making it more challenging, even impossible, to subsequently pursue more optimal paths toward low-carbon objectives." [1]

We hypothesize that carbon lock-in will complicate many institutions' efforts to meet their climate commitments. We provide an intuitive example of carbon lock-in on our campus, and provide a simple aggregate emissions scenario for eight institutions in Ohio through the year 2050. We assess their lock-in risks, and the financial challenges for offsetting these emissions.

Example: campus housing

New designs for UD campus houses save 38% in carbon emissions per capita over existing housing stock (Figure 1). These houses have improved envelopes and more efficient appliances, including natural gas furnaces.

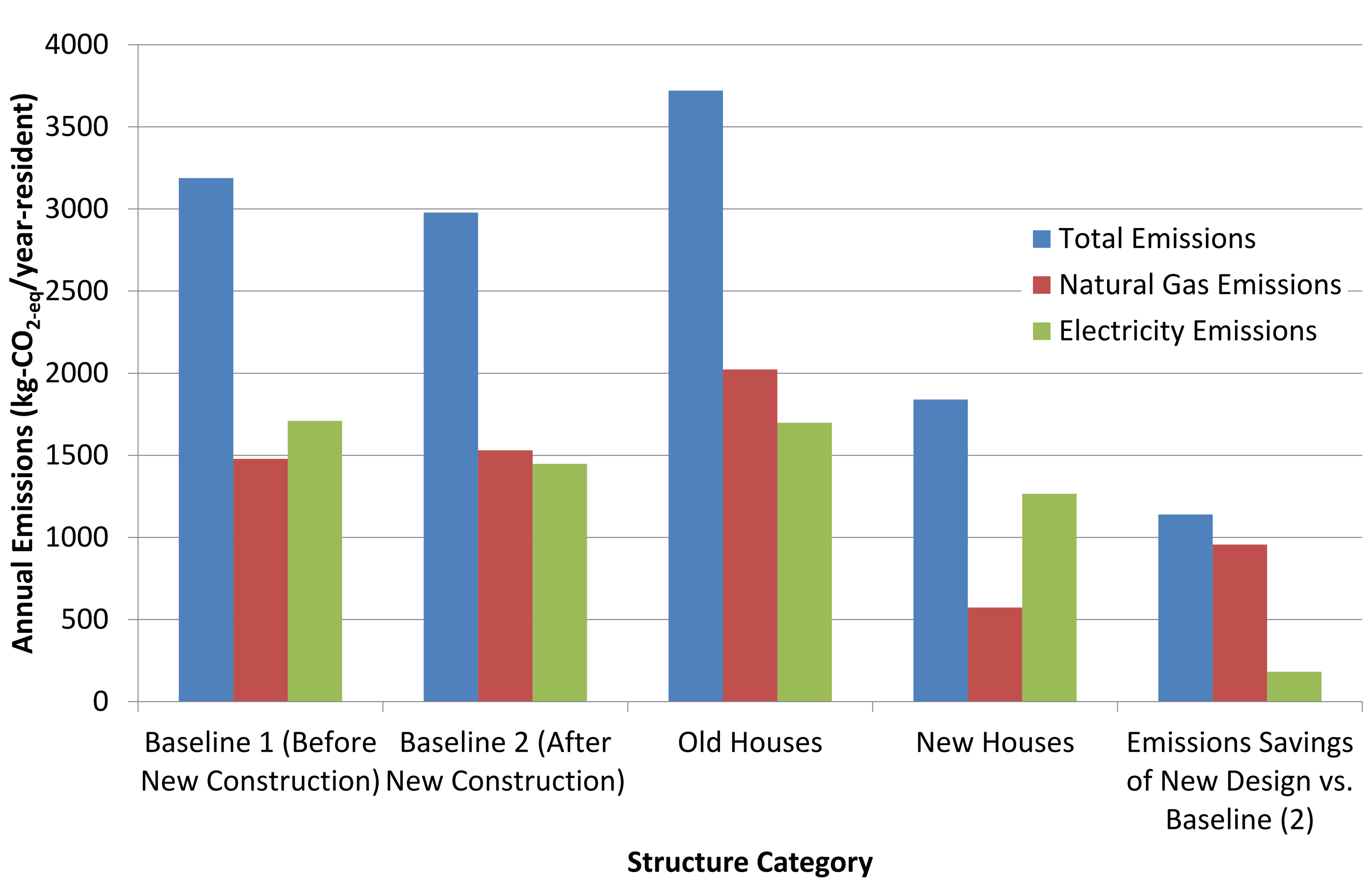

Fig. 1: Per capita emissions by housing type, showing emissions reductions from use of new design

Despite savings, the natural gas appliances and lock-in effects from the electrical grid lead to an over-commitment of emissions. As shown in Figure 2, under three different electricity procurement scenarios, the over-committed emissions (those occurring after the neutrality date of 2050) from the energy-efficient houses range from 12,600 kg-CO_{2-eq} to 40,000 kg-CO_{2-eq} per capita. Even in the net-zero electricity scenario, the over-committed emissions for a household of 5 stand at 63 metric tonnes CO_{2-eq}.

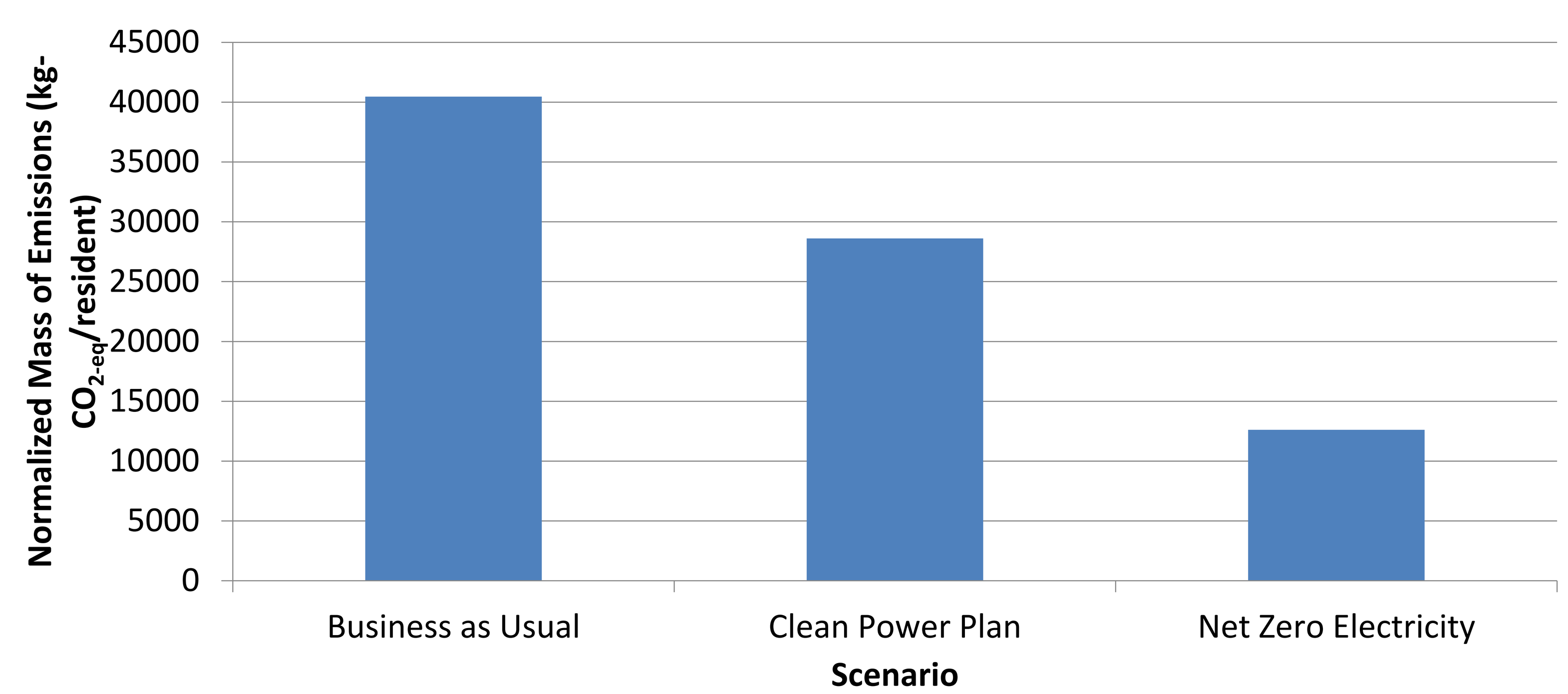

Fig. 2: Per capita over-committed emissions under three electricity scenarios. Grid electricity and natural gas appliances lock in carbon emissions long-term.

Lock-in risks

We constructed an aggregate emissions scenario for the eight Ohio Ph.D.-granting signatory institutions of the American College and University Presidents' Climate Commitment [2]. We then assessed their carbon lock-in risks, as shown in Figure 3.

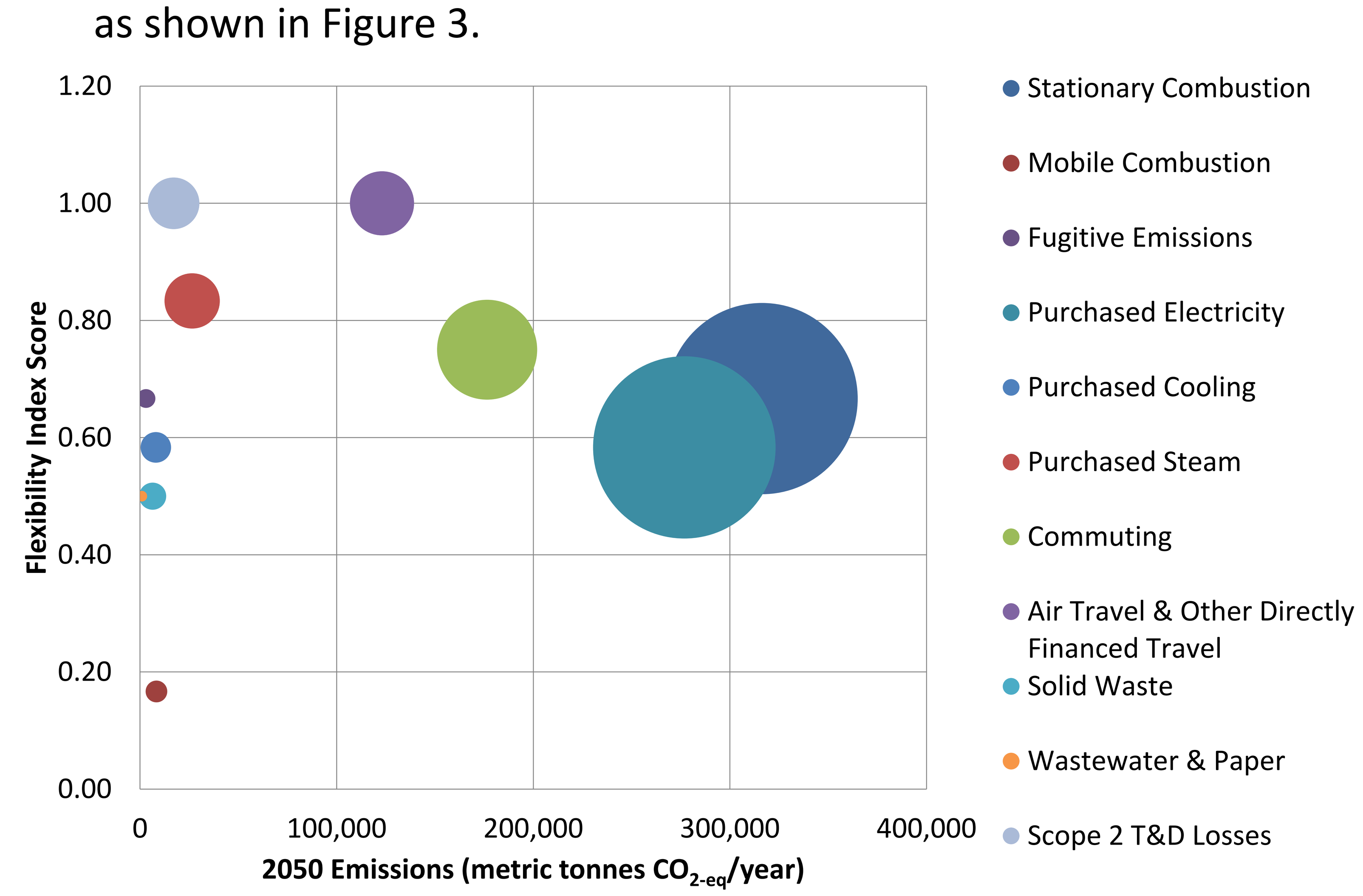

Fig. 3: Emission sources with high flexibility index scores and high 2050 emissions pose a high risk of lock-in. The size of the circle indicates the present size of the emission source.

Costs to offset lock-in effects

We used the EPA's Social Cost of Carbon estimates as a model for carbon offset prices. This value is currently used in cost-benefit analyses of proposed regulations by federal agencies [3]. It also more accurately internalizes the costs of carbon emissions than current carbon offset market prices can. We found that these eight institutions are liable for tens to hundreds of millions of dollars in future social costs of carbon due to lock-in effects. This will mean substantial costs to meet decarbonization goals through carbon offsets.

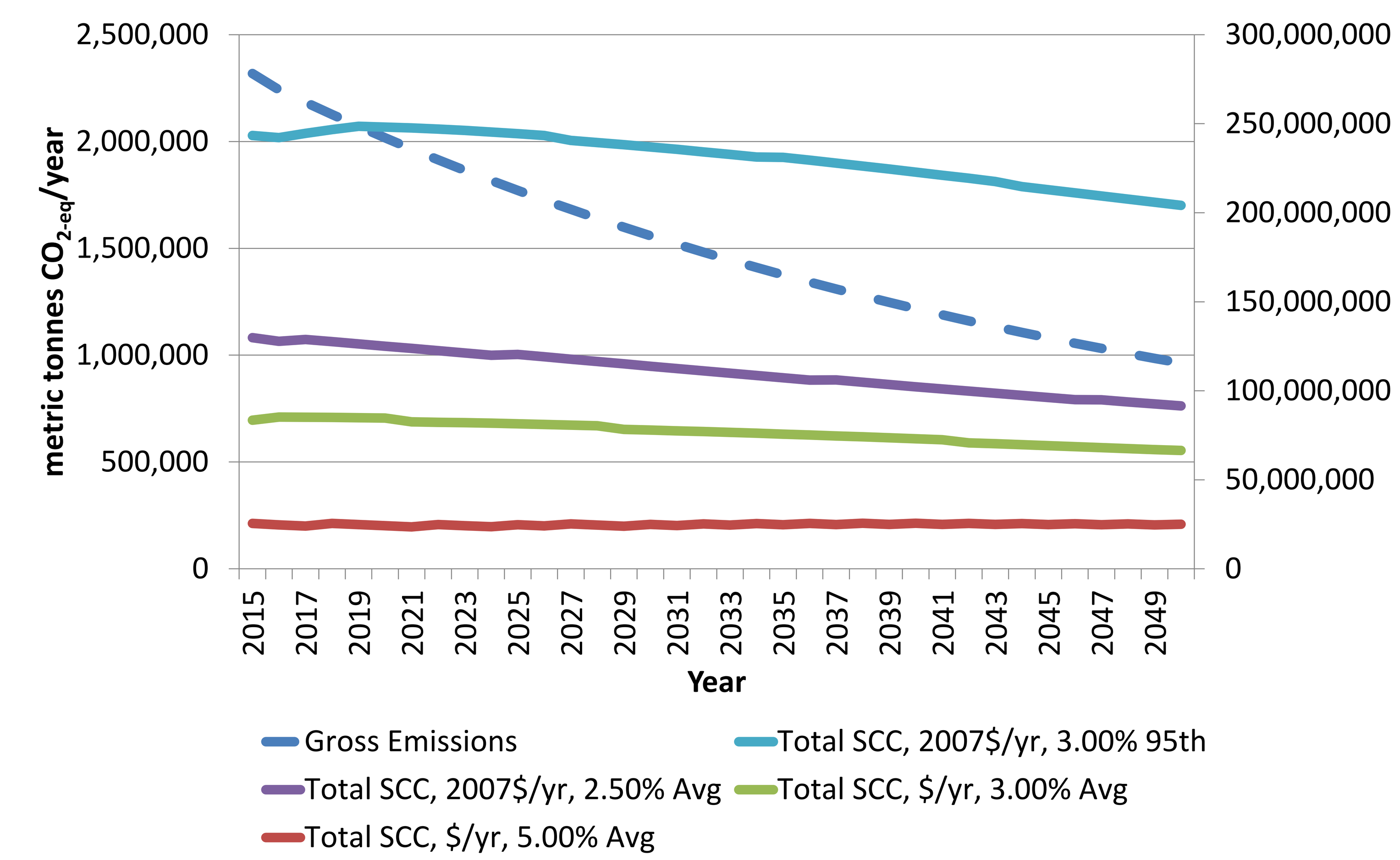

Fig. 4: Despite drastic reductions in carbon emissions over time, carbon offset costs remain high due to the rising social cost of carbon.

Conclusions

The cost of carbon offsets are often overlooked when planning decarbonization efforts. Our scenario shows that plans that rely heavily on carbon offset purchases pose a significant financial liability long term due to carbon lock-in, despite their attractiveness in the near term in the face of low fossil-fuel energy prices.

References

[1] Erickson P, Kartha S, Lazarus M, Tempest K (2015) Assessing carbon lock-in. Environ Res Lett 10:84023. doi: 10.1088/1748-9326/10/8/084023

[2] Reports · Reporting Institutions. In: Second Nat. http://rs.acupcc.org/search/?institution_name=&commitment_type=%3F%3F&carnegie_class=DR&state_or_province=OH. Accessed 23 Oct 2016

[3] Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis.