Carbon Budgets and Carbon Prices on Campus

Sarah Jacobson, February 2019[1]

Climate change is the existential threat of the modern era, and colleges and universities want to reduce their emissions of greenhouse gases for a variety of reasons: to be part of the solution, to conduct their work ethically, or to inculcate concern for climate change into students, for example. Schools sometimes talk about setting a limit on (or budget for) the amount of greenhouse gases they want to allow to be emitted from campus operations, and sometimes about using a carbon[2] price to make decisions. This document demonstrates that any carbon budget implies a particular price for emissions, and that any price yields a specific amount of emissions. As a result, these two routes cannot be pursued independently: you can have a carbon budget or a carbon price, but not both (unless one is derived from the other). In this document, I will write about direct reductions on campus under the assumption that we want to reduce our own emissions without using offsets, and then I'll mention offsets at the end, as well as special points about reducing emissions to zero.

First, let's note that these are both analogies of pollution control policies used by governments to reduce emissions at the lowest cost possible: a carbon budget is like cap and trade and a carbon price is like a tax. The key to both is that there are many different ways to reduce emissions, and some of them are cheap and easy in terms of cost incurred for the amount of emissions reduction, while others are expensive and difficult. If we can get a given emissions reduction amount in a low-cost way, why would we use a higher-cost way? These policy tools, instead of dictating who does what to reduce emissions, provide incentives that should ensure we get our emissions reductions at the lowest cost possible.

Now, how does a carbon budget work? A school decides how much emissions it wants in a year, and typically sets a target that declines over time; perhaps these caps are linked to targets set by the government (e.g., in the case of Williams College, Massachusetts's targets of 25% below 1990 levels by 2020 and 80% by 2050[3]) or outside bodies (e.g., the IPCC suggestion of net zero emissions by 2055[4]). Then how do we implement a budget? The school has many ways that emissions are generated and therefore many ways that emissions can be reduced. We want to prioritize the lowest-cost ways of reducing emissions. And we have to think of cost broadly: upgrading a building to reduce its heating-related emissions has an explicit cost, while reducing faculty travel has an opportunity cost relating to the scholarly or policy work that the faculty member would be prevented from doing, and we need to take that cost just as seriously.[5]

---

[1] This is just a rough draft; please send me comments and suggestions! saj2@williams.edu

[2] Greenhouse gases comprise carbon dioxide as well as a bunch of other things; I say "carbon" here to comport with the colloquial usage of the word to represent greenhouse gases overall, represented in CO2-equivalent units.

[3] https://www.mass.gov/progress-towards-reducing-greenhouse-gas-emissions

[4] https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/

[5] We should avoid actions that push off emissions onto another entity, which is great for our carbon budget but doesn't help the world. Two examples: shut down campus for winter so students, faculty, and staff are heating their homes more instead of causing campus to be heated; closing the college altogether so students and faculty go to a different college where they will be generating emissions.

So if we set a budget, we should identify how much we could reduce emissions from each of the different emissions reductions opportunities, and then we should rank those in terms of (broadly-considered) costs, and then we should implement all the lowest-cost opportunities up to the point where we reach our budget. Let's use the phrase "cost threshold" to refer to the per-unit-of-emissions cost that's right at that threshold between the reductions we choose to do and those we don't choose to do.

Let's now consider a carbon price. A common approach here is to derive a price from some estimate of the damages that a ton of CO2 equivalent greenhouse gases causes by way of climate change; the shorthand for this estimate is the "social cost of carbon," and values in the $40's are commonly used, though estimates range from $1 to over $200. The latest estimate by the Obama administration (based on an assessment of research) suggested a 2020 cost of about $52 in current dollars.[6] The idea is that we weigh the costs of reducing emissions (the abatement or mitigation costs) against the costs those emissions will impose; we want to make only (and all of) those changes where the costs of the reduction are worthwhile in the sense that they yield climate-related benefits greater than the costs we'll incur.

So, once again, we line up all the costs of reducing emissions; this time, we draw the line at the carbon price we've chosen, and we do all the reduction options that are cheaper (per unit of emissions) than that and don't do the rest. This gets us an amount of emissions reduction.

Notice that a carbon budget gives us a cost threshold where we reduce emissions in all of the ways that are cheaper than that threshold, and a carbon price gives us a total amount of emissions reduction by comparing emissions reductions costs to that price. In other words, a carbon budget yields an implicit price and a carbon price yields an implicit budget. This is why I say that you can't independently set a budget and a price. If you want to set a budget and then figure out what price that implies, and use that implied price to weigh options for emissions reductions, that's fine; so is vice versa. But if you independently set both a carbon budget and a carbon price, you're working toward two mismatched goals at once; it's simply not intellectually coherent.

Of course, in a campus setting, some of the emissions reductions options are big and chunky and the timelines for doing them may be driven by new construction or the need to replace existing physical plant components. For example, a new major building project's heating system must be designed at the time when that project is built, and the entire heating system for the campus at some point will have to be switched from being fossil fuel-based (burning natural gas on campus) to some other system. The timelines on which these must be done may be driven less by where they rank in terms of emissions reductions costs, and more by these physical plant-related concerns. In these cases, if we have a carbon budget or price that currently would advise the less green option (e.g., putting a new building on steam heat, or replacing an aging natural gas boiler with another of the same), we must be aware that that choice locks us into higher emissions for the life of that asset. As a result, it might be wise to choose the greener option even if, for a time, it makes us spend more than our current carbon price or cut our emissions below our carbon budget.

---

[6] https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf

One important difference between a carbon budget and a carbon price is what things it gives us certainty about. If we set a budget, we have certainty about what amount of emissions we get (if we stick to our budget), but we have uncertainty about how much it will cost us. If we set a price, we have more certainty about how much it will cost us, but we have less certainty about how big our emissions will be. Which kind of uncertainty is worse depends on whether we think we are more hurt by unexpectedly high abatement costs or unexpectedly high emissions. Since climate change is caused by accumulation of gases over time, one could argue that having emissions a little higher in one year isn't so bad as long as we can observe that and adjust our price accordingly to compensate; but there are different perspectives.

This is just one reason we shouldn't think of this as a static problem where we make a decision once and stick to it. We will learn about our costs and reduction opportunities as time evolves, so we need to update our goals as we do so. At the same time, costs of different emissions reduction opportunities will decline over time as technology develops, so we need to keep abreast of the current actual costs of emissions reductions. As emission reduction becomes cheaper, we should shift our carbon budget to be smaller or our carbon price to be higher.

Now, if we were to set a target of zero direct emissions on campus, then at some point there are no decisions to make between a higher-cost and a lower-cost emissions reduction options: we have to take advantage of all of the emissions reduction options, period. Even so, we couldn't get to zero emissions immediately; we must always set intermediate targets, and we should meet those by prioritizing the lowest cost options first. Still, some forms of emissions are extremely costly to directly reduce given the world we live in, if we are to continue to meet our scholarly mission and if we're to be honest and not just push emissions off onto other entities. Thus, it's not clear to me that zero direct emissions is a reasonable goal in the near term.

Offsets are one solution to this problem and perhaps to other issues. A carbon offset is a way of reducing emissions (relative to some baseline) somewhere else, under the conception that climate change only depends on the total amount of net emissions and not where they come from. I will not address the pros and cons of offsets here, but instead I'll just note that some people think offsets are just generally bad and to be avoided, while others think that (if done correctly) offsets are the only way to truly get lowest cost emissions reductions.

Offsets can be bought on offset markets for a variety of prices.[7] In a perfect theoretical world, the price of offsets becomes equilibrated to the social cost of carbon, but that's not the case at the moment. So we could use the price of offsets as a carbon price, and we could choose to do all on-campus emissions reductions that are less costly per unit than this price. However, with the current low offset prices, and many people's ambivalence about (or strong valence against) offsets, that approach is unattractive. So unless the goal is to absolutely minimize costs with no considerations as to where or how emissions are reduced, I wouldn't recommend using the price of offsets as a carbon price. (Though as carbon markets evolve and the world starts to get serious

[7] Offsets can also be generated on campus or by the school somehow. While generating them ourselves can yield some pedagogical benefits, I find this an unconvincing way to generally get offsets. Since one of the biggest issues with offsets is how trustworthy they are, why should we trust our own processes and estimates? Our incentives are to overstate reductions achieved. Isn't it more accountable to buy offsets that are verified by a third party?

about regulating greenhouse gases, the available offsets should become more robust and reliable, and the price of offsets should rise, so eventually this could be a good approach.)

One way to thread this needle might be to set a price or budget for on-campus reductions based a target as discussed above, and then buy offsets to offset the remaining direct emissions. The school could even keep a "carbon savings fund" as the difference between what the remaining emissions really cost society (based on our chosen or implicit carbon price / cost threshold) and what we have to pay to offset them (the offset price). For example, imagine we buy 1,000 offsets at $10 each but we're using a carbon price of $52; that gives us a fund of ($52 - $10 = $42) times 1,000 = $42,000. Maybe we could use that for other environmental initiatives.