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In this post, we continue our discussion of California's Low-Carbon Fuel Standard (LCFS), which we introduced in [our post](#) on October 4, 2018.

Because it's a prominent and ambitious policy that will reduce California's reliance on petroleum-based transport fuels, it is unsurprising the Low-Carbon Fuel Standard has attracted forceful attacks. Opponents of the LCFS have advanced [various critiques](#) of the policy, charging that it will be ineffective and too costly. These critiques align to a significant degree with critiques by academic economists who contend that a nuanced, complex policy targeting a particular sector of the economy will always impose unwarranted inefficiencies and transaction costs on economic activity. Here, as in our [longer paper on the LCFS](#), we address these criticisms and find them unpersuasive.

The most obvious enemy of the program is the [petroleum sector](#), since the burdens of the policy fall mainly on oil producers and refiners. The LCFS creates burdens for high-carbon-intensity fuels to subsidize low-CI fuels, and so far gasoline and petroleum-based diesel are the only fuels whose CI is high enough for them to be structurally burdened. In short, petroleum pays the bills. What may be less intuitive is that conventional corn ethanol producers are also not friends of the policy. Corn ethanol initially received a modest subsidy; but as CI targets tighten, first-generation ethanol producers are likely to move into CI deficit range, so - to the extent they are sold in California - those fuels will shift from being benefited to being burdened by the policy.

Both industries—petroleum and corn ethanol—have tried to stop the program in court. In a future post, we'll address the status of the legal challenges, which attack the program as violating the U.S. Constitution as well as California administrative law principles. In this post, we address the major policy critiques of the program.

The policy critiques start from the view, based in simple economics models, that the best policy to address greenhouse gas emissions is a uniform emissions price, imposed across the entire economy, at a level equal to the marginal social cost of climate-change impacts. Estimating this marginal social cost is no easy task, but recent estimates for the damage done by a ton emitted today mostly cluster around \$30 to \$60, with a [total range](#) from less than ten dollars to many hundreds. (Cost estimates depend on many assumptions, particularly the discount rate, and are higher for future emissions.)

The critiques are mostly variants of the observation that any policy other than a uniform emissions price—any policy that is more narrowly targeted, or takes a different form—will

elicit some high-cost emissions reductions, when lower-cost reduction opportunities are available elsewhere in the economy, and would be realized by a uniform emissions price. Replace the other policy by the uniform emissions price, swap the costly reduction for the cheaper one, and you get the same emissions reduction at a lower cost.

The first problem with critiques of this type is that the policy against which the LCFS is measured, the comprehensive, economy-wide emissions-price policy, is an ideal that does not exist anywhere in the real world. No emissions pricing system is comprehensive; all are limited to a subset of sources; and no price-based policy with even moderately broad coverage has a price nearly as high as the best estimates of the social cost of carbon. A few emissions-pricing systems do have impressively high top-line prices, particularly the carbon taxes imposed at national level in a few Nordic and European countries, but these are weakened by large exemptions that typically carve the highest-emitting sectors out of the policy. The emissions pricing systems that cover the most emissions have low prices – despite some promising recent trends, still almost all less than \$30 a ton. California's cap-and-trade program is an example. This program has shown real progress lately, after a period during which allowances didn't sell out even at the price floor, but even this progress still leaves current prices around \$15 a ton – far below the social cost of carbon, and far too low to drive progress toward California's ambitious statewide emissions targets. Even in those jurisdictions most strongly committed to large emissions reductions, like California, it appears to be extremely difficult to enact and sustain policies with broad, visible emissions prices at levels even close to what is needed to achieve the large targeted emissions cuts. This observation is quite distinct from the question of whether such policies, if fully and ideally implemented, would deliver the targeted cuts – particularly, for our purposes, whether they would deliver needed and targeted cuts in all areas, including transportation fuels. On this latter question, theory says one thing (assume enough ideal questions, and of course the answer is yes), evidence is thin and mixed (because these policies don't exist, and every policy sort of like this exists in a complex world with multiple other policies) – so wide disagreement persists, relatively unmoored from data.

Nevertheless, most critiques of the LCFS presume that the alternative is this ideal, nowhere-in-existence, policy. Compared to this ideal, they criticize the LCFS for imposing too high an implied emissions price on a too-narrow set of activities. LCFS [prices in October 2018](#) have ranged from \$160 to almost \$190 per ton CO₂e. Yes, you read that right. Any policy with coverage narrower than the whole economy and high implied emissions prices within that narrower scope, means requiring higher-cost reductions inside the policy's scope when there are cheaper opportunities to cut elsewhere.

These “too-narrow, too-strong” criticisms come at three basic levels, which get more

interesting the further down you drill. The first level is that any policy applicable only to California policy is too narrow and too costly, relative to a uniform emissions-price policy imposed at a higher jurisdictional level that covers more emissions, either the US federal or better still, globally. OK, let's abandon California policies and wait for a strong US federal policy or a uniform, emissions-price-based global deal. Good luck.

The second level of critique is that even within California's economy, the LCFS is inferior to economy-wide carbon pricing because it compels high-cost emission reductions in the transport sector, when cheaper reductions are available elsewhere in the economy - in buildings, electricity, land use, and other sectors. This is surely true, but it presumes that the goal of California's policy is minimum-cost emission reductions right now. It's not. California is aiming for BIG emissions reductions, and has recognized that getting there will require large cuts in every emissions sector - the more difficult and slower to move, as well as the easier and faster to move. Transport is one of the harder sectors, some modes in particular. It will need a technological transformation, or maybe a few of them, so motivating the required changes, or explorations in pursuit of them, takes stronger incentives, more narrowly targeted (precisely so they don't all get directed to cheaper cuts available immediately this year), sustained over time. This is [what the LCFS aims to do](#), along with multiple other transport-specific policies such as vehicle emissions policies, planning and land-use policies, R&D partnerships and subsidies, etc.

The third level of critique says that even within the transport sector, a policy that requires reductions in the emissions intensity of fuels, as the LCFS does, is too narrow and too costly relative to cheaper cuts available at other decision points in the transport system, such as increasing vehicle efficiency, switching to more efficient transport modes, or reducing transport activity. Even within transport, a broader policy that puts uniform incentives on all these decision points - a fuel tax linked to each fuel's life-cycle emissions content - would deliver the same reductions at lower cost. But while the criticism gets more sophisticated as it zeroes in like this, it is still subject to the same rebuttal: the required reductions within the transport sector will not be achieved by efficiency gains and activity reductions alone. They will have to include reduction in fuel emissions intensity. And as the targeted cuts get deeper, fuel emissions intensity becomes increasingly important: vibrant modern economies need transportation (actually, all economies need transportation), and transportation needs energy. New, low or zero-emissions fuel systems will be essential, and they are likely to have higher costs, longer lead times, more severe technical uncertainty, and tighter connections to system and network-level effects than the other decision points. So a sector-wide fuel tax would preferentially motivate the cheaper immediate reductions, and not get started on the innovations needed to deliver large future gains. Once again,

these require narrower policies deploying stronger incentives. The criticism of the LCFS, and the rebuttal to the criticism, are flip sides of each other: it is the same market response to policies that makes the broader emissions-price-based policies cheaper today that makes them ineffective at developing the larger innovations needed for deep future cuts.

Critics at this point will note, fairly, that these arguments in favor of the LCFS presume that regulators know what changes are needed better than market responses to energy prices. Yes, they do presume that - at least insofar as they look ahead and see (presume) that transport, and transport fuels, will have to change to achieve large targeted cuts, and that broad emissions prices direct efforts away from these toward immediate reduction opportunities that are cheaper.

The last major criticism of the LCFS is only partly a criticism for being narrow. It's also, relatedly, a criticism for designing the policy as an intensity standard: a regulatory obligation on the average life-cycle emissions intensity of fuel sold, rather than any measured denominated in terms of absolute emissions. There are several technical criticisms advanced against any regulatory standard defined in terms of intensity, some of which once again note that it will elicit some more costly reductions when cheaper ones are available elsewhere, and some of which identify perverse outcomes that are possible under certain assumptions. These all come from the fact that an intensity standard is equivalent to two linked policies: a charge on fuels whose intensity is above the standard, and a subsidy to fuels whose intensity is below the standard. If you consider the incentive effects of these two components of the policy separately, it is clear that the policy makes two separate incentives for fuels that are above the standard: to reduce their emissions intensity, and to reduce consumption at any given intensity level. For fuels in this region, the policy is a tax: taxes raise consumer prices and thus reduce demand. In terms of emissions, these two incentives both point the same way, to reduce emissions. Great. But the policy also makes two separate incentives for fuels whose emissions intensity is below the standard: to reduce their intensity still more (and so get a bigger subsidy), and to **increase** consumption at any given intensity level. After all, for these fuels the policy is a subsidy, so it lowers their price and induces increased consumption. This reasoning leads, once again, to the same conclusion: the policy cannot be cost-minimizing for a given emissions level, because it embeds this incentive to increase consumption of lower-intensity (but still emitting) fuel. And once again, the rebuttal is the same: that's not the objective of the policy.

There's a further critique of intensity standards that shows it can generate certain perverse outcomes under sufficiently extreme assumptions about response to price changes in the higher-intensity and lower-intensity fuel markets. Roughly speaking, if market response to

the subsidy on the low-intensity fuel is **superstrong** (and the corresponding response to the tax on the higher-intensity fuel is much weaker), it is possible an intensity standard can lead to a net increase - not just in total fuel consumption, but also in emissions. This is indeed a theoretical possibility, but nothing like it has ever been observed in practice - and certainly not in response to the LCFS.

It is true that intensity standards are strange beasts, for which we expect rather complex and mixed behavioral responses. But given the technical characteristics and requirements of reducing transport emissions - and in particular, the fact that reductions in fuel emissions intensity are a necessary, perhaps a large, component of total reductions - any other policy approach that targets total emissions, as the critiques wish, would necessarily target all the decision points that jointly determine total emissions: the transport activity, the mode and vehicle energy efficiency, and the fuel emissions content. And any policy that jointly covers all these decision points will preferentially favor responses at the other decision points. And as we've argued repeatedly, these other responses are cheaper, but they don't do the job that's targeted, and that needs doing.

There are other criticisms of the LCFS, but this covers the major ones. They all miss the mark, for two reasons, one of which it's fair to call mostly political and one mostly economic. They all ignore the seemingly universal reality that the policy they set up as the preferred alternative appears to be politically infeasible, even in the jurisdictions with the strongest commitment to cutting emissions. That's a political observation, so you could respond that these political conditions could change if people got as alarmed and mobilized about climate change as they should be. Yes, that could happen, but there's still the second reason. Even if you could replace the LCFS (and all other sectoral or prescriptive policies) by a comprehensive emissions price at the right level, these critiques all assume away the particularly difficult technical and economic conditions - multiple possible technical alternatives, long lead times, uncertainties, and network and system effects - that motivated the development of the LCFS in the first place. Relative to these conditions - which none of the critics has bothered to engage and rebut - the LCFS targets the problem it's intended to address quite intelligently. As we noted in our [prior blog post](#) about the program:

By targeting transport fuels separately from other emissions sectors, the LCFS enables marginal incentives strong enough to induce the required investments in exploratory, low-carbon alternatives. By controlling the complete fuel life cycle, it avoids creating perverse incentives for fuel switching based on partial benefits that might be offset elsewhere in the life cycle. By being structured as an intensity standard, it requires technical improvements independent of the overall

level of transport activity, i.e., requirements that do not tighten when transport expands and weaken when it contracts. By maintaining internal budget neutrality between the costs and subsidies it distributes among fuels, it reduces consumer price impacts and remains separate from larger-scale political and economic risks associated with the general state budget. And finally, by using a market-based approach based on tradable credits within this structure, it brings the general advantages of market-based policies—flexibility, cost minimization relative to the specified policy goal, and incentives for innovation—into the context of a sectoral rather than an economy-wide policy.

That all these criticisms miss the mark does not, of course, demonstrate that the LCFS is the greatest. It is still possible that the LCFS might be unnecessarily costly, even given the real properties of the market and technology environment it operates in, relative to some truly better-designed and feasible policy. It is also possible that the LCFS might not succeed at eliciting the targeted major innovations in low-emissions alternative fuels. In future posts, we will dig into these concerns, and identify the most plausible ways that the LCFS might not be succeeding at doing what it aims to do - or not succeeding as much as it presently seems to be. But the major existing critiques of the policy just miss the point. They compare it to ideal emissions-price policies that don't exist; and even if such policies do come to exist (and we very much hope they will - soon), they ignore the real characteristics of the transport and fuel system that make the pursuit of deep cuts there so challenging. The architects of the LCFS were not fools, and nor were they—as many of the policy's critics allege—economically illiterate. They were trying to solve a different problem, which actually exists in the world with high stakes. We would love to see some of these critics try to engage with that problem and come up with some ideas that actually might advance the key objective the LCFS attempts to address.