The Challenge Regulating Technology Into Existence

Expected issues with the California Air Resources Board (CARB) proposed in-use locomotive emission rule and Environmental Protection Agency (EPA) response

ALLIANCE FOR INNOVATION AND INFRASTRUCTURE

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Introduction

Regulations in any industry can be a challenge. While the proper role of government regulation is primarily to limit or prevent negative externalities, there are many instances in which the imposition of a new rule creates its own unintended externalities. These can have consequences for existing policy goals, create economic harms, and even stifle innovation. Even when striving for worthwhile goals, it is difficult – if not impossible – to regulate technology into existence.

Recently, the California Air Resources Board (CARB) has taken aim at reducing emissions from the transportation sector and homed in on the rail industry with a new proposed in-use locomotive regulation.[1,2] Due to the importance and scale of railroads, the industry is regulated at the federal level to promote consistency and efficiency of interstate commerce. This requires California to receive an authorization from the federal government to implement its locomotive emission rule, setting up U.S. Environmental Protection Agency (EPA) review.

The regulation in question requires that railroad companies transition their equipment and fleets to entirely zero-emission (ZE) locomotives. The rule sets forth a compressed schedule to begin the transition: starting in 2030 any locomotive operated in the state must be less than 23 years old (from original build date) and any newly purchased switch locomotive must be operated in zero-emission configuration. Starting in 2035, all newly purchased line-haul locomotives must be operated in zero-emission configuration. It also mandates that company funds be set aside for purposes controlled by CARB to effectuate the transition. Finally, underlying the entire regulation is the expectation that the rail industry develop, purchase, and employ a technology that (by CARB's own admission) is not in commercial existence – the required zero-emission locomotive. By mandating this, the agency calls for a specific result that cannot be guaranteed and will likely lead to unintended consequences that undermine the agency's goals.

Competition and necessity create innovation

The adage that "necessity is the mother of invention" invokes the creative capacity of humans when everything is on the line. It applies primarily in three contexts: existential risks, stiff competition, and convenience. These hold for the generation of new technologies and also apply to infrastructure. The problem with applying "necessity" to emissions and climate concern is that it simply does not apply in the same way. Even real risks cannot be considered necessary to address by an individual or company in the short-term if the issues inherent to them will not manifest for a long time or the impacts would be spread across many actors, making their cost to internalize both small and delayed.

By contrast, existential and competitive forces have historically led to high yields in productivity and innovation, while invention for the sake of improving a mundane or arduous task is regularly seen in every sector.

While wartimes include mixed examples, like nationalized industry and government mandate, the pressure to win a war is existential and part of what motivated incredible productivity in munitions manufacture, ship building, and more in the U.S. in the 1940s. Or for contemporary examples, look to the modern nation of Israel in near constant state of war and conflict generating unparalleled innovation across every sector.[3] Likewise, the competitive pressure during the space race with the Soviet Union led to a host of directly applicable and spinoff innovations in use today.[4]

In other contexts, necessity manifests more as convenience, such as the *real McCoy* oil-drip cup making the lubricating process automatic, thus sparing resources and improving efficiency for the then steam engine locomotives. When regular users of a system recognize faults and flaws that can be remedied to be safer, smoother, and more efficient, they often come up with the missing component.[5] Seeing unmet demand or need is where entrepreneurs and innovators thrive. But the government is a poor crucible for forging new ideas.

Few examples – if any – of innovation came about because of government mandate. In fact, while the federal government has been instrumental in aiding innovation, its role has been primarily supportive — not regulatory or through mandates.[6] Providing funds while supporting and conducting research is an entirely different approach from requiring companies to comply with a directive.

From Ford and Tesla, to Apple, Facebook, and Microsoft, new methods, products, and services most commonly emerge from private actors with original ideas applying their own resources. Governments have rarely been capable of seeing the future, expressing demand, and dictating this type of innovation. To the contrary, when the government does dictate an outcome, it is often less efficient than when innovators create something original to fulfill a new purpose.

Prescriptive versus performance regulation

To best encourage innovation, there are two key regulatory schools of thought to assess. Policymakers must evaluate their scope and goals to craft their rule in the way most conducive to innovation and ultimately success.[7] When regulators dictate or prescribe a process or outcome, they put a border around the actor complying to check the right boxes and fit inside the parameters. A prescriptive regulation sets forth not only the outcome but the way to achieve it. This might say: design a vehicle that utilizes a battery and electricity. The regulatory approach that cultivates innovation takes a performance approach: design a vehicle with effective and energy-efficient propulsion.

While these seem similar, the first often tells the industry the specifications with which they must comply. It can come across as regulating technology into existence or restricting future possibilities to existing technology, thereby reducing innovation. The second states a purpose the performance is intended to achieve and leaves everything else open to the innovator's creativity. For instance, a prescriptive rail safety regulation may detail "the frequency and duration of inspections" while a performance regulation may aim to decrease incidents arising from track deficiencies through "effective inspections to uncover risks and deficiencies." The key is to ensure the rule is allocation, labor, and capital agnostic, meaning the rule does not dictate how much or how to spend resources, does not require a task be accomplished by a human, and does

not define technology in or out of the rule by favoring a certain method of achieving a result. To comply with the first, the company must hire, train, and deploy new inspectors. To comply with the second, the company may invest in automatic track inspection technology, deploy drones, or any number or combinations of other approaches.

While "zero-emission locomotives" sounds like a performance goal, the structure of the rulemaking is clearly prescriptive. It also expresses a lack of interest in emissions reductions, only striving for "zero emission" which is an impossibility unless so narrowly defined by emission scope that it simply defines other emissions out of the equation. Making *the perfect* the enemy of *the good* sets unrealistic expectations and ultimately misses out on achieving steady progress.

In California, railroad companies will have to deposit funds they could otherwise spend on unrestricted research and development and use them only on approved expenditures for the *perfect* goal. This leapfrogging strategy creates other externalities, like adding demand for electricity to an already strained grid and ultimately increasing the risk of blackouts and brownouts or the likelihood of requiring hydrocarbons to meet increased demand. These would merely shift net emissions to other sectors.

Policy undermining policy

Immediate concerns with the CARB rule are the disruption to the supply chain and economic cost imposed – costs which by the agency's own calculations would be passed onto consumers and lead to the elimination of smaller railroad companies.[8] Stemming from these immediate concerns are the rippling effects that arise from unintended consequences.

Policy unintentionally undermining policy is not uncommon. Another transportation example can be seen with the interplay between the Highway Trust Fund (HTF) and Corporate Average Fuel Economy (CAFE) standards. The HTF collects the gas tax, which is a proxy for road use collected at the pump by gasoline and diesel users. This tax has not been adjusted in over 30 years. Meanwhile, Congress has mandated that the passenger vehicle fleet continually improve in average fuel efficiency. This, alongside organic innovation (to include hybrid and electric vehicles), has led to significant revenue shortfalls for the HTF for over a decade.[9] It ultimately leads to more road use and less revenue.

Likewise, a policy aimed at reducing emissions will have the effect of increasing net emissions when it sets unrealistic goals and economic burdens that will shift the marginal freight and cargo loads away from rail through diversions onto trucks. There is also a likely emission impact of trains stopping at the state border and switching cargo to other state-compliant vehicles, even if they are other trains.

The requirement to deposit funds into an escrow account only furthers this likely result. By requiring funds, the policy forces inefficient allocation of resources, thereby reducing the likelihood of efficient application to research and development that would achieve the goal of lower emissions, but it also acts as a second prescriptive regulation, mandating the eligible uses of the funds.

Existing locomotive track record and emissions

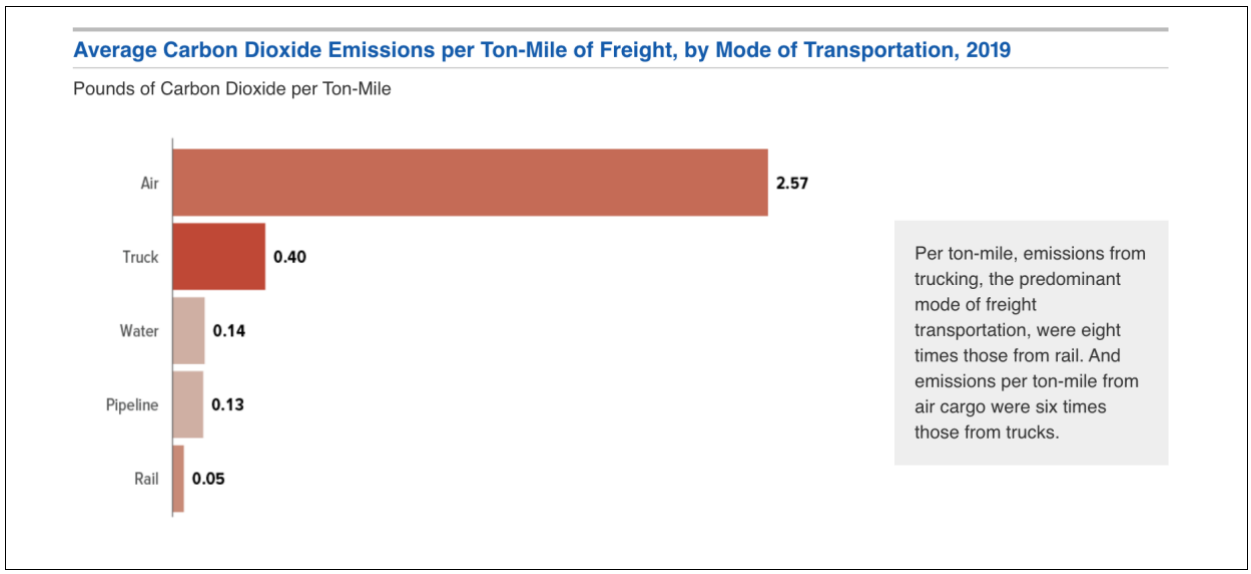
With freight diversions as a likely outcome, it is important to note the role of railroads in the transportation sector and the overall economy. Within transportation, railroads contribute only 2 percent of emissions, while in the overall economy across every sector, rail is responsible for less than 0.6 percent of emissions.[10]

This record is attributed to the scale of operations and innovative configuration of train cars and locomotives, including train length.[11] On average, railroads can move a ton of freight four times the distance of a truck on a single gallon of diesel fuel. Expressed another way, trains will on average move a ton of freight around 500 miles on a single gallon.[12]

Federal research has validated this for decades. Evaluating specific competition in the same corridor and moving the same freight to avoid all-rail and all-truck averaging, the U.S. Department of Transportation concluded that "rail achieved higher ton-miles per gallon than trucks in all scenarios." The findings included that,

> Rail achieved from 1.4 to 9 times more ton-miles per gallon than competing truckload service. Rail fuel efficiency ranged from 196 to 1,179 ton-miles per gallon while truck fuel efficiency ranged from 84 to 167 ton-miles per gallon.[13]

In the time since that study, the average fuel efficiency of both rail and truck have increased marginally, with rail increasing efficiency at a higher overall rate than trucks to date. It remains true that rail has a better fuel efficiency than trucks, leading to lower net emissions, both directly and indirectly. This differential in fuel efficiency is estimated to lead to a disparity in greenhouse gas emissions of 8:1, with trucks emitting eight times more than rail to move the same ton-mile.[14]



Source: Congressional Budget Office.[15]

Trucks are much less fuel efficient, meaning they put out greater direct emissions to move the same ton of freight. Trucks also generate indirect externalities by adding to road congestion (which furthers emissions through idling and traffic), road maintenance issues, and ultimately public safety concerns. Rail-to-truck freight diversions have the potential to affect multiple industries and sectors all stemming from one regulation in one state. This potential is underscored by the fact that the mandated zero emission locomotive technology does not yet exist.

The agency states that "Based on development timelines for new technology, CARB staff estimate that ZE passenger and switch locomotives **will be commercially available by 2030**, and ZE line haul locomotives by 2035."[16,17] Assuming these are correct, they do not speak to viability and cost accessibility. "Commercially available" may address the existence but not the economic considerations of technology or equipment. Moreover, this does not account for how companies must handle existing fleets. High-efficiency diesel locomotives have decades-long useful lives, but the rule sets a threshold that by 2030, no locomotive built more than 23 years prior can be in operation in the state. These companies would have assets with useful life remaining they could not appropriately depreciate. These disrupt economic decisions that further diminish private investment in research and development and reduce the likelihood of innovation.

Overall likely impact

This proposed regulation, if approved by EPA, would likely result in fewer railroad companies, higher rates for shipping, higher consumer good costs, stifled innovation, and greater net emissions.

The importance of pilot programs

Pilot programs are a critical way to test new technology and bring innovation into the field. While the proposed regulation does provide an avenue to use funds for pilot programs, these should be leveraged to a greater degree and not restricted to the terms of the regulation. The inclusion of pilot programs and state grants, while positive approaches that are generally associated with innovation, do not overcome the costs the regulation would impose. The piloting and funds are limited to the purposes outlined in the regulation, which is not conducive to innovation. This functions again as prescription, dictating on how funds and piloting can be used, rather than open-ended offers that provide flexibility and creativity for innovators to invest in, develop, and test new concepts.

Conclusion

Actions like those set forth by CARB and under consideration by EPA are more likely than not to create their own negative externalities. In particular, they will disrupt economic activity and dampen investment in innovation. This type of regulation engages in prescriptive rulemaking whereas performance goals are more appropriate and conducive to innovative technological outcomes. It also sets the stage to conflict with its own intended outcomes by reducing emissions in the rail sector but increasing net emissions elsewhere in the transportation industry. The rule also creates economic requirements that strive for investment in technology but restricts how private actors can use their resources and therefore disrupts the most efficient allocation of resources likely and known to produce innovation.

Citations and Notes

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[2] Rulemaking docket: https://ww2.arb.ca.gov/rulemaking/2022/locomotive.
[3] Roth, E. (2022). *The Committed Innovator: What has made Israel an innovation hub?* McKinsey & Company. https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-committed-innovator-what-has-made-israel-an-innovation-hub.
[4] Spencer, R. (2021). How the Space Race Built Today's Technology. Alliance for Innovation and Infrastructure. https://www.aii.org/how-the-space-race-built-todays-technology/.
[5] Look no further than the ABC television show, Shark Tank, where a disproportionate number of parents, teachers, and blue collar inventors identify common concerns in their own life or activity and create a new product to address it.
[6] Singer, P. (2014). *Federally Supported Innovations: 22 Examples of Major Technology Advances That Stem From Federal Research Support*. The Information Technology & Innovation Foundation. https://www2.itif.org/2014-federally-supported-innovations.pdf.
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[8] "It is likely that these operators will be able to **pass on costs** of the Proposed Regulation **across the nation**. Some smaller Class III locomotive operators in California may face significant compliance costs. If these businesses are unable to pass on the costs of the Proposed Regulation to customers or if there is a significant change in demand for services, it is possible some of **these businesses would be eliminated**." (emphasis added) https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/appb.pdf.
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[17] Bold added for emphasis.

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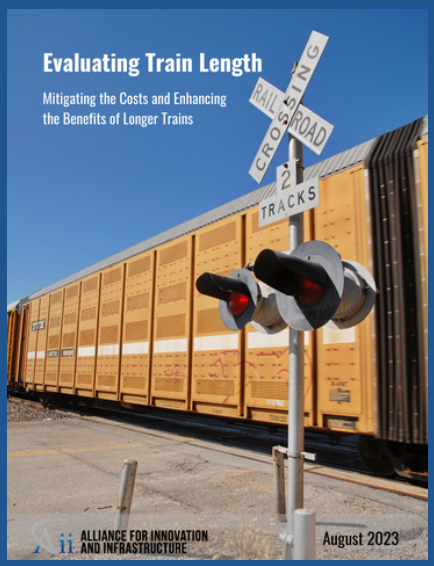

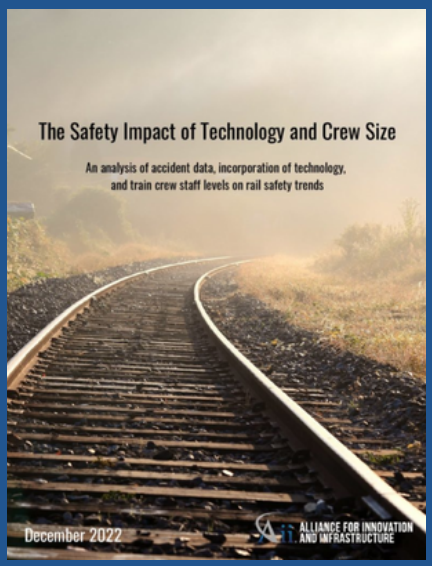

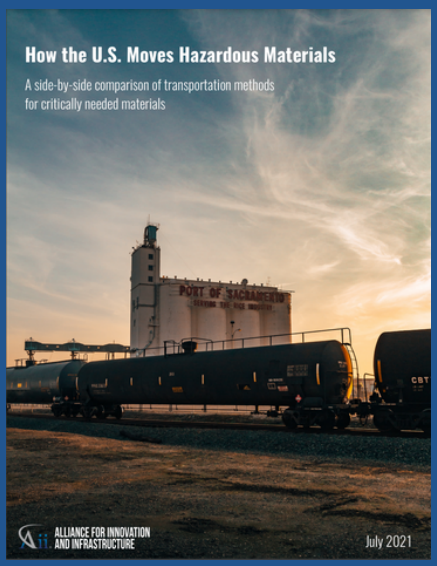

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