POLICY FORUM

ECONOMICS

A cautious approach to subsidies for environmental sustainability

Transformational change is possible, but design and implementation must seek to avoid lock-in

By **Kathleen Segerson, Stephen Polasky, Marten Scheffer, U. Rashid Sumaila, Juan Camilo Cárdenas, Karine Nyborg, Eli P. Fenichel, John M. Anderies, Scott Barrett, Elena M. Bennett, Stephen R. Carpenter, Beatrice Crona, Gretchen Daily, Aart de Zeeuw, Joern Fischer, Carl Folke, Nils Kautsky, Claire Kremen, Simon A. Levin, Therese Lindahl, Malin L. Pinsky, Alessandro Tavoni, Brian Walker, Elke U. Weber**

Tackling climate change and biodiversity loss will require government policies to reverse environmental destruction and align economic activity with sustainability goals. Subsidy-based policies feature prominently in current national and international policy discussions about ways to address these challenges. Given this, now is a critical moment to reassess the role of subsidies to ensure that not only their benefits but also their potential drawbacks are at the forefront of discussions about their use and design. We suggest that subsidies can play an important role in protecting people and the planet. However, because subsidies can have considerable drawbacks, we also suggest that subsidies should be used cautiously to ensure that they are, on net, beneficial to society and the planet in the short and long run. Avoiding "lock-in" is paramount and can be achieved through initial design features such as time limits to sunset subsidies.

Subsidies can provide powerful incentives to achieve environmental and sustainability goals. Examples include tax credits or exemptions for certain types of investments or for purchases or production of certain goods [such as electric vehicles (EVs), solar or wind power] and government payments for conservation-related activities or the provision of ecosystem services (such as reduced deforestation or soil erosion). The US Inflation Reduction Act (IRA), which is the Biden administration's signature climate legislation, relies on billions of dollars in subsidies for EVs, renewable energy, and energy efficiency improvements.

Because subsidies involve net positive benefits for the groups engaged in the subsidized activity ("carrots"), they can be politically easier to enact than taxes and regulatory restrictions ("sticks"), which typically face strong political opposition due to the easily identifiable costs they impose on specific groups. Moreover, because of these targeted benefits, subsidies are sometimes used as a political tool to buy support from pivotal interest groups.

At the same time, there have been repeated calls to eliminate (or reform) environmentally harmful subsidies, e.g., to the fossil fuel, agricultural, and fishing industries because they contribute to some of humanity's largest environmental threats, including climate change and biodiversity loss (*1*–*3*). World leaders have committed to phasing out harmful subsidies in these sectors. Over a decade ago, the leaders of the G20 committed to phasing out inefficient fossil fuel subsidies, and recently the World Trade Organization's Agreement on Fisheries Subsidies and the Kunming-Montreal Global Biodiversity Framework committed to reducing harmful subsidies.

Eliminating subsidies is not easy, though. The features that make subsidies easier to enact also make them difficult to undo. Unlike taxes and regulatory restrictions, once enacted, subsidies can create a concentrated and powerful group of beneficiaries with a strong interest in keeping them in place. This can make it difficult to eliminate or reform subsidies even when they are harmful from a broad societal perspective. For example, despite the G20 commitment, estimates indicate that explicit fossil fuel subsidies were $1.3 trillion globally in 2022 (*2*).

NET BENEFITS TO SOCIETY

Subsidizing a given activity can yield net benefits not only for the direct beneficiaries but also for society as a whole—and thus increase overall economic efficiency—when the subsidized activity generates positive, uncompensated, spillover effects ("positive externalities") and the gains from encouraging the activity exceed losses that might arise from funding the subsidy payments. Positive externalities can provide a justification for government subsidies for conservation and some subsidies for transitioning away from fossil fuels. For example, subsidizing research and development (R&D) of new battery storage technologies can be justified on this basis because it generates knowledge that benefits society as a whole and not just the developers. Likewise, subsidizing the adoption of existing technologies such as EV charging stations can be justified if adoption generates network effects that benefit society more broadly (*4*).

By contrast, when a given activity generates negative spillover effects ("negative externalities"), a similar argument implies that it should be taxed instead (or controlled through a cap-and-trade market mechanism). An important question is whether activities that reduce a negative externality, such as renewable energy production and EV purchases that replace gas-powered vehicles, should also be subsidized. If there are no other market inefficiencies, it would be better from an economic efficiency perspective to instead tax the activities that are generating the negative externalities (through, e.g., a carbon tax). However, if this is not possible for political or other reasons, then subsidizing a product that reduces negative externalities might be justified as a "second best" alternative, depending on its overall impact.

When products like automobiles or electricity can be provided in multiple ways (e.g., EVs or gas-powered cars, electricity production from fossil fuels or renewables), subsidizing the more environmentally friendly version can increase the share of the market that is "clean" rather than "dirty." For a given market size, this shift in market shares can generate environmental benefits. The extent of the environmental gain depends, however, on how clean the subsidized product is relative to the alternative. For example, the overall environmental benefits from an increase in the EV market share depend critically on how the electricity used to power those vehicles is generated. Estimates suggest that in most places, EV displacement of gasoline-fueled vehicles would reduce greenhouse gas emissions (*5*). However, in terms of local air pollution, the environmental impacts of switching from gasoline-fueled cars to EVs vary considerably by location. Those impacts are estimated to be

Author affiliations are listed In the supplementary materials.
Email: kathleen.segerson@uconn.edu

beneficial in places like California (where local damages from gasoline vehicles are high and electricity production is relatively clean) but harmful in places like North Dakota (where the opposite is true) (*5*). This highlights the importance of considering the potential interconnectedness of subsidies (here for EV purchases and renewable energy production) when evaluating their impacts to ensure that, for a given market size, a shift to "cleaner" products will generate environmental benefits overall (*6*).

CONCERNS ABOUT USING SUBSIDIES

Although positive spillover effects can justify the use of subsidies, there are important potential drawbacks to their use that warrant careful consideration before subsidies are used.

Expanding market size

Subsidies can affect not only market shares but also market size, which can offset some of the potential gains from subsidies that shift the market to cleaner activities or products. Subsidies tend to reduce market prices, resulting in increased production and consumption. For example, subsidizing electricity production by renewable sources will reduce the price of electricity for consumers and result in an increased demand for electricity. Even if the increase in demand is fully met by cleaner renewables, there will be environmental costs because renewable energy production still has environmental impacts (*7, 8*). Notably, the negative effect of market size would not occur if the market share of renewables were shifted through a tax on fossil fuels rather than a subsidy to renewable energy, because a tax-based policy would efficiently shrink rather than expand the market. Market expansion also would not arise from subsidies that are designed not to "green" the energy supply but rather to reduce energy demand, such as subsidies that increase energy efficiency (e.g., purchases of energy-efficient appliances). Although improving energy efficiency can also trigger an increase in demand or use of a product (the "rebound effect"), evidence suggests that increases in efficiency still lead to overall reductions in energy demand (*9*).

Similarly, subsidizing activities that lead to greater production of EVs will have negative environmental impacts as well, for example, from increased mining of lithium for batteries. In addition, subsidizing EVs will make vehicle ownership less expensive, which can lead to an increase in the demand for vehicles. Increased vehicle use can have many harmful effects beyond those caused by combustion of fossil fuels, such as accidents and congestion. These market expansion effects would not occur if the subsidies were targeted toward public transportation rather than "greening" the vehicle fleet.

Use of public funds and additionality

Subsidies are not cost-free for governments. In some cases, government costs take the form of direct outlays (as in government payments for ecosystem services), while in other cases (such as tax credits), the fiscal costs are foregone revenues. In either case, there are budgetary and associated social costs from increased taxation or government debt, or from the shift of available resources to the subsidized activity and away from alternative uses.

70% of US federal income tax credits for electric vehicle (EV) purchases were estimated to have gone to those who would have purchased an EV even without the tax incentive.

A key consideration when using public funds is ensuring that they are used wisely, which in the context of subsidies means that they incentivize additional investments or purchases in activities that generate positive spillover effects beyond what would have occurred in the absence of the subsidy (a concept known as "additionality"). A recent study (*10*) estimated that more than half of the carbon offset subsidies approved for a sample of wind farms in India went to projects that would likely have been built without the subsidy. Similarly, a study of sales of EVs in the US (*11*) found that 70% of the federal income tax credits for EV purchases went to households that would have purchased an EV anyway. Evidence on the additionality of conservation-related payments to US farmers is mixed, showing very high levels for payments for some practices (such as off-field structural practices) but not others (such as conservation tillage) (*12*). Additionality is not an issue for tax-based policies, because the government is not paying for projects or activities.

Negative environmental impacts

Subsidies to activities that generate negative externalities and promote environmental degradation or overuse of resources cannot be justified on economic efficiency grounds. Such subsidies can impose very large costs and tend to move society in the wrong direction—by increasing activities that cause environmental harm and making it more difficult to achieve climate change and nature-positive goals and by shifting governmental resources away from more beneficial uses.

Subsidies are enacted for a variety of reasons, such as income support, which may have little to do with the environment. Yet they can have large environmental costs. For example, there is widespread recognition that the over $1 trillion worth of explicit global subsidies to fossil fuels (*2*) contribute to greenhouse gas emissions and more rapid climate change. Other sectors, such as agriculture and fishing, are also heavily subsidized in ways that generate adverse environmental impacts. For example, estimates have found that agricultural input subsidies have been responsible for 17% of nitrogen pollution, and subsidies (such as price supports) that promote agricultural production have caused 14% of global de-

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forestation (*1*). Likewise, nearly 70% of the $35.4 billion in global fishing subsidies in 2018 provided support to enhance fishing capacity (for example, through subsidies for fuel purchases, capital investment, or infrastructure) that can directly contribute to overfishing (*3*).

As with any policy, the long-term effects of subsidies on complex evolving social-ecological systems are difficult to foresee. Unanticipated consequences are almost inevitable given the complexities, interactions, and uncertainties in the ecological and socioeconomic systems in which policies operate. As a result, the impacts of subsidies, as well as our understanding of their adverse impacts, will likely change over time, and a subsidy that might have initially been viewed as beneficial for society might eventually be recognized as having costs that greatly exceed benefits.

Barriers to removal ("lock-in")

The arguments against the use of harmful subsidies are widely recognized, but difficult for governments to act upon because of "lock-in." Although unforeseen and negative environmental effects may arise from any government policy, the problem is especially important for subsidies because it is often difficult to remove subsidies once they are in place. For example, in the US, the Biden administration has made repeated proposals to repeal tax breaks for fossil fuels but so far has been unsuccessful in this repeal effort, leading a recent *New York Times* article to refer to these subsidies as the "zombies of the tax code: impossible to kill" (*13*).

A key feature of subsidies that makes them difficult to remove is that they often create a group with a strong vested interest in their continuation. Subsidy benefits are usually concentrated on a specific sector or group of producers or consumers, while the associated costs are diffuse. The concentrated economic interests that benefit from a subsidy are often large firms or wealthy individuals that can exert considerable political pressure to keep the subsidy in place (*1*, *14*, *15*). Moreover, once subsidies are in place, loss aversion by those receiving the subsidies may create even greater resistance to their removal. Whereas the beneficiaries of subsidies tend to be well-organized, the diffuse group of people who bear small individual costs of funding those subsidies tend to have less motivation and coordinating capacity to oppose them. By contrast, taxes have nearly the opposite effect and are generally easier to eliminate.

Another barrier to removal may arise when subsidies lead to lower consumer prices, implying that termination could raise prices (at least in the short run) on important goods, such as energy and food. These price increases may be needed to price these goods to reflect their full social costs but can lead to public protests, such as the mass protests in Ecuador in 2019 that followed plans to remove fuel subsidies and recent protests by German farmers against proposed cuts to diesel fuel tax breaks. The prospect of facing higher short-term prices can serve as a barrier to subsidy removal, unless removal or reform is accompanied by an explicit and trusted mechanism for offsetting these impacts (*14*).

ADAPTIVE DESIGN AND IMPLEMENTATION

When environmental taxes are not politically feasible, subsidies might be the best achievable policy available for incentivizing changes needed to promote societal well-being and environmental sustainability. In the context of climate change, subsidies that focus on encouraging greener production and consumption can address positive spillover effects and shift market shares to clean energy and away from dirty energy, and do not face the stiff political opposition created by carbon taxes. In addition, subsidies that seek to reduce overall energy demand (through, for example, energy conservation) can also offset the negative market expansion effects of using subsidies to promote greener production.

However, because impacts and policy goals evolve over time, when subsidies are used, policy-makers should incorporate plans to avoid possible lock-in. These should include plans for ongoing assessment and reevaluation to facilitate revision, repurposing, or possible termination. Policy-makers can employ time limits or explicit phase-outs or sunsetting (such as the 10-year timeframe for EV subsidies under the IRA) or suspension provisions conditional on meeting certain criteria (e.g., market penetration goals). We note that putting in place prior restraints on subsidy policies can help to avoid future lock-in effects but does not help with the problem of past policy decisions that are already locked in. Here the only way forward is tackling the politically challenging work of overcoming entrenched interests in favor of the wider societal good. The difficulty of this task highlights just how important it is to avoid lock-in going forward.

Subsidy reform or elimination can also be easier if the subsidy policy includes means for addressing the resulting losses that vulnerable groups might incur, which is important both for meeting equity goals as well as for minimizing resistance to change. When possible, tying reform of "bad" subsidies to the promotion of "good" subsidies can provide an opportunity to help those benefiting from current subsidies get retooled to take advantage of the new subsidies, thereby reducing political opposition to subsidy removal.

Although subsidies can be justified in some cases, their potential adverse environmental, social, and economic costs suggest that they should be used with caution, and only after considering alternative feasible ways to achieve policy objectives. The imperative to address climate change and biodiversity loss, however, highlights the urgency of policy reforms. Properly designed subsidies can play an important role in promoting the needed transformational change. A cautious approach to the use of subsidies, with mechanisms built in for possible reform or termination over time, would be an important step toward addressing pressing environmental concerns while at the same time avoiding long-run lock-in of inefficient government subsidies. ■

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SUPPLEMENTARY MATERIALS

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