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Who should pay for clean energy? Distributive justice perspectives

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Abstract

The question of 'who pays' for clean energy infrastructure sits in a context of rising levels of income inequality within several OECD countries, which risks undermining political support for decarbonisation policies that are found to be regressive or otherwise distributively unjust. Almost invariably, mechanisms such as feed-in tariffs drive up retail prices for electricity consumers, including the poor. Yet, the literature on distributive justice in the context of clean energy deployment is extremely limited. Econometric analyses of the distributional effects of energy policy tend to be far removed from theories of distributive justice. Conversely, several moral philosophers have written extensively on such concepts as 'climate justice', but this has primarily been taken to concern the distribution of emission rights, and often between states. It has not been clear what bearing their theories have on the proper design of renewable energy policy in a national context. In order to judge whether or not the distribution of costs and benefits of clean energy policy is fair, it needs to be clear according to which principles we can plausibly judge fairness in the context of renewable energy policy. We blend analytical techniques from moral philosophy and distributional impact assessment into a framework for evaluating distributive justice in the way countries pay for clean energy infrastructure. We consider four principles of distribution – polluter pays, ability to pay, beneficiary pays, and grandfathering – and use them to formulate a bespoke 'standard' for evaluating distributive justice in this context. We use this standard to evaluate real clean energy roll-out programs in Australia, California and the United Kingdom. We find that fairness is easier to ensure when a program is funded from tax revenues raised in a progressive manner – as was the case with the Australian program - than when the cost is distributed across electricity bill payers.

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'*A policy that averted dangerous climate change would nonetheless be unfair if the duties to mitigate and adapt were unfairly distributed. It is not enough to devise efficient policy proposals for they might be thoroughly unjust in their distribution of the costs*.' (Caney 2009: 127)

1. Motivation and literature

This paper looks at how countries choose to distribute, across socioeconomic groups, the large new cost of paying for clean energy infrastructure, and evaluates these choices in light of several principles of distributive justice. If there is any single recognizable icon of the idea of a 'green economy' then it is surely the apparatus for producing clean energy. Our concern is that the financial structures that underpin the public policies and programs designed to roll out clean energy infrastructure are bound up with a set of moral and ethical issues that arise when one tries to decide how the burden of paying for this infrastructure should be distributed, and what constitutes a fair distribution of this burden among the relevant agents. Our paper question whether the ideals embodied in the 'green economy' narrative will be fulfilled if public policy succeeds in achieving environmental-protection-with-economic-growth at the expense of distributive justice (Raworth et al 2014; Räthzel and Uzzell 2013; Newton and Cantarello 2014).

Our main contribution is to draw practical guidance from the established literature on distributive, climate and environmental justice, for how clean energy infrastructure can be fairly paid for. Theories of environmental justice that emerged in the 1980s engaged with systematic inequalities in the distribution of the health costs of pollution across racial, ethnic, and income groups (Rhodes 2003; Schlosberg 2007). These concerns have been extended in more recent work looking at the distributional incidence of policies designed to mitigate greenhouse gas (GHG) emissions (Smith 1992; Grainger and Kolstad 2009; Metcalf et al 2010) and the mechanisms that spread the costs and benefits of environmental policies unequally across social groups (Fullerton 2011). Writing about 'climate justice', both economists and moral philosophers have debated the extent to which the current generation should make sacrifices to avoid harm to future generations (the so-called 'discounting debate' [Broome 2012; Caney 2008; Nordhaus 2008; Stern 2014; Weitzman 2007]). Others have focused on how the burden of that sacrifice, however large, should be distributed within the

current generation, and argued that the first question that needs to be addressed in the context of climate change is, 'Who should pay for whatever is done to keep global warming from becoming any worse than necessary?' (Shue 2010, Caney 2009).

These literatures are all motivated by interest in ensuring that environmental policy interventions lead to fairer distributive outcomes, but they have tended not to closely examine how actual policy design can be guided by the principles of justice that run through them. That is, it is not obvious what to take from idea that the health impacts of pollution should not be distributed unequally, or from the idea that the protective benefits of environmental policy should be distributed equally, for deciding how the burden of paying for clean energy should be spread across social groups who are all responsible to some extent for the pollution that clean energy investments are designed to mitigate. Therefore, our research question is: 'What reasoning can be drawn from existing principles of distributive justice to guide policy design to fairly distribute the cost of clean energy?'

This question matters in the current policy context for two reasons. The first is that state-led spending on clean energy infrastructure is high and rising. We consider three policy programs that were designed to roll out small-scale photovoltaic (PV) installations in Australia, the United Kingdom and California. Of these, the least expensive (absolute program cost) was around USD 500 million and the most expensive around USD 15 billion. Clean energy spending is likely to rise among European Union countries, which are committed to increasing clean energy penetration to 20 percent by the year 2020. The same is true in the United States, where twenty-nine states now require utilities to produce a minimum fraction of electricity from clean sources (Schmalensee 2011) and where the US Environmental Protection Agency is promoting a role for renewables in cutting US power sector emissions by 30 percent by 2030 (EPA 2014).

This question also matters for policy because the level of socioeconomic inequality in several of the countries that are leading the deployment of clean energy are historically high and rising. Income inequality was higher in the majority of OECD countries in the mid-2000s than in the mid-1980s (OECD 2008; OECD 2011) with Germany, Norway and the United States being among the most affected (Piketty 2014; Piketty and Saez 2003; US Census Bureau 2011). Large state-led clean energy investment programs should not worsen this distributional picture.

We need to limit the scope of our question before explaining how we go about answering it. A key characteristic of paying for clean energy infrastructure is high up-front capital costs that may reduce current and future GHG emissions but do not mitigate historic emissions. For that reason, we place greater emphasis on aspects of distributive justice that deal with flows of current and future emissions rather than with (stocks of) historic emissions, and, by the same token, focus on burden-sharing within the current generation rather than between generations. We further focus our attention on the ways that policy can and should be designed to distribute the *costs* of clean energy. Standard distributional impact assessments should righty consider costs *and* benefits (see Grover [2013] for an example in this context). We focus mainly on the cost distribution side because policymakers tend to have more control in the design of clean energy programs over how the costs are distributed than over who participates and to what extent.

Our research approach is somewhat experimental in the sense that we combine analytical techniques from moral philosophy on the one hand, and distributional impact assessment on the other, into a bespoke framework for addressing our specific (policy) question. In Section 2 we describe four distributive justice principles drawn from the climate, environmental and distributive justice literatures, and examine how 'fairness' in paying for clean energy would look under each. In Section 3 we then synthesize the aspects of the four principles that are most relevant in this policy context into a kind of distributive justice 'standard' by which the fairness of real policy programs might be assessed. In Section 4, we use this standard to evaluate fairness in the design of actual clean energy programs in Australia, the United Kingdom and California. Section 5 explains how our findings can inform the design of future clean energy programs insofar as fairness is concerned.

2. Principles of distributive justice

Through a review of the distributive, environmental and climate justice literatures we identified three distributive principles that seemed relevant and generalizable enough to address the research question. They are the Polluter-Pays Principle (PPP), the Ability-To-Pay Principle (ATPP), and the Beneficiary-Pays Principle (BPP). They are articulated in the literature in different variations and they are possible to combine, but they are also

sufficiently distinct to be treated as separate. We further consider the Grandfathering Principle (GFP). Unlike the others, it is rarely championed by ethicists, moral philosophers or serious theorists, but we consider it in recognition of its popularity in negotiations around the distribution of GHG emission rights. While there are other principles that could be brought to bear on our research question, we chose these for their relevance to the sharing of burdens that a) fall within the jurisdiction of environmental policy, b) are closely linked to pollution mitigation, and c) need distributing across social groups within the same generation.

2.1. Polluter-Pays Principle

PPP simply holds that the agent who is responsible for emitting pollution should also be responsible for remedying the damage it causes. The more an agent has emitted, the more they are liable to pay to remedy the damage. The principle generally holds that the sum that the polluter pays should be enough to offset or compensate for the totality of harm caused (IPCC 2001; Schwartz 2010).

An attractive feature of PPP is that it is widely understood and publically applied. PPP resonates with numerous everyday situations where someone who has caused harm is also considered responsible for correcting it, and where it seems fitting that the level of restitution be proportional to the harm caused (Miller 2005). PPP underpins the 1992 Rio Declaration on Environment and Development and has since held sway in international climate negotiations (Schwartz 2010; UNFCC 1992). Practically speaking, PPP is taken to underpin the 'Superfund' law in the US that requires polluters to clean up hazardous waste sites that they were responsible for causing (Probst and Portney 1992). In the EU, PPP forms the basis for the extension of producer responsibility to the point in their products' life cycles where the products confer a burden on the environment as waste. EU Directives on packaging, electrical waste and end-of-life vehicles are premised on extended producer responsibility (Lindhqvist 2000).

One objection to applying PPP in policy practice is its limited usefulness in assigning responsibility for pollution that was caused by people who are now dead, which includes a large part of the stock of GHG currently in the atmosphere. If the polluters are no longer around to pay, the ability to assign responsibility under the principle breaks down (Page

1999; Page 2012).[1] This objection, however, may have limited bearing on the distribution of the clean energy burden, because clean energy deployment can be said to mainly avoid current and future pollution and not rectify the damage caused by past pollution. The clean energy case therefore invites a conservatively 'forward-looking' application of PPP, which governs the distribution of burdens only in proportion to current and expected future flows of emissions.

To the extent that the objection does carry force, it can potentially be accommodated by regarding states as the agents responsible for rectifying any pollution damage that was caused by their citizens who are no longer alive. If this 'statist' view of moral agency (Page 1999) were applied within the current generation, it might further mean that states assume responsibility for the pollution caused by polluters who are alive but who are unable to pay themselves for other reasons. The unfulfilled responsibilities of subnational entities such as municipalities might also be re-assigned to national governments. This practice would be consistent with a 'forward-looking' assignment of responsibility for rectifying past pollution damage, which is understood in relation to institutional roles, as opposed to 'backward-looking' applications of PPP that merely assign blame [van de Poel et al 2012]).

The most important permutations of PPP take into account the concepts of excusable ignorance and basic needs (Caney 2005; Miller 2004). Plausibly, a polluter should be liable to pay for the damage she has caused, except in the instances where she was excusably ignorant of the harmful consequences of her pollution, meaning that she could not reasonably be expected to know that her actions would harm anyone. In such cases, a modified PPP would say that her liability to pay is reduced or cancelled. This is closely related to the idea that exceptions should be granted under PPP to accommodate basic needs and poverty. For the poor and disadvantaged, some pollution is an unavoidable (if undesirable) side effect of the actions that they need to perform to uphold an acceptable standard of living. If an agent has no other way of meeting her basic needs than to pollute, then she should be exempt from some or all liability to pay. This idea has been formalized in the suggestion that each person should be allocated a pollution quota sufficient for meeting basic needs (Caney 2005; Hyams 2009). Both of these permutations can yield defensible and broadly acceptable versions of PPP.

[1] Page calls this the problem of 'disappearing emitters'.

Here is one way that the distribution of the clean energy burden might look if guided only and closely by a forward-looking PPP. Polluters could be made to share the cost of clean energy infrastructure in proportion to their expected current or future emission flows that exceed what is necessary to meet their basic needs. This would entail establishing a threshold pollution level below which no payment is required. There would be little allowance for exceptions on the basis of excusable ignorance, since the damages are today widely known. It remains to be established who should pay for clean energy in place of those who are exempt from responsibility, like the poor.

2.2. Ability to Pay Principle

ATPP states that the burden of mitigating pollution should be borne by those who can best afford it. It holds that an agent who has the means and capabilities to prevent climate change or other pollution damage should do so, whether or not she has herself caused any pollution (Miller 2001). ATPP can be seen as an alternative to PPP, but it has also been suggested that ATPP be used to determine who should pay for the pollution that was caused by polluters who are either dead, excusably ignorant, or poor (Caney 2014).

ATPP can be seen as an expression of an egalitarian ideal, as it says that the rich should pay more than the poor. It was formalised as early as 1932 by A C Pigou, who argued that it would lead to the 'least aggregate sacrifice' (Pigou 1932). In a similar vein, David Miller sees ATPP as underpinned by a 'principle of equal sacrifice' (Miller 2008). If everyone makes an equal sacrifice, and the rich have a lower marginal disutility from making payments, this means that they pay a larger share of the mitigation costs. This view hence rests in part on the idea of diminishing marginal utility of income, which implies that the burden, in utility terms, of paying a certain amount of money is smaller for high-income than low-income individuals. It also rests in part on the normative position that mitigation should be done at the lowest possible aggregate disutility (utilitarianism), which implies spreading the mitigation burden evenly across individuals, but not necessarily the mitigation cost (Singer 2010, Stern 2007).

ATPP may come across as alien to ordinary moral thinking, as it eschews the notion of taking responsibility for one's own harmful actions. In reality, however, it is likely that ATPP and

PPP coincide in a large number of cases, including within-country situations encompassing current and future pollution. This would imply that richer countries are responsible for a larger share of such pollution than poorer countries (Neumayer 2000). It is less clear to what extent they coincide in a national or subnational context, since fuel and electricity usage are sensitive not just to income and wealth, but also to factors such as geography, household composition, and other socio-demographic variables (Abrahamse and Steg (2009), O'Neill and Chen (2002).

Applied to the problem of distributing the cost of clean energy, ATPP would assign a minimal cost burden to poor households, even if they are high-emitting, whereas wealthier households would bear greater responsibility solely on the basis that they are better off. ATPP removes the liability to pay for emissions-related behavior and makes payment contingent upon judgments about the desirable final wealth or income distribution in a society. A good approximation of ATPP in policy form would be progressive general taxation, whereas a flat tax would not, nor would a consumption levy on electricity and fuel, since consumption of these goods increases less than proportionally with income.

2.3. Beneficiary Pays Principle

BPP states that whoever has benefitted from the pollution that has harmed or will harm others owes compensation to the victims of that harm. The more an agent has benefitted, the more she is liable to pay. BPP proceeds from the observation that, even if the affluent people of today are not responsible for historic pollution, they have benefitted from the activities that did cause it, like industrialisation. Compared to PPP, BPP expands the set of responsible agents to include not just the polluters themselves, but also everyone else who benefitted from their polluting activities (Page 2008, 2012). Importantly, the beneficiaries of pollution are not obliged to pay simply because they are better off than others; rather, they are obliged to pay because their wealth was created in a morally dubious manner and, for non-polluting beneficiaries, made possible by things outside of their own control. They are thus 'free-riding' on the harmful activities of their ancestors, and are no more deserving of this windfall than the victims of those activities are deserving of their misfortune (Gosseries 2004). In this sense, BPP can aptly be described, not as a general principle of distributive justice, but as a form of corrective justice with distributional implications (Butt 2009).

As an analogy, if person A were to stumble across some stolen goods, she might benefit from keeping them. However, the rightful owner, person B, was harmed by having her property stolen. Person A may not have wronged person B because person A did not steal person B's goods, but if possible, she ought to return the goods to person B. Similarly, BPP can be used to argue that direct beneficiaries of pollution within the current generation are duty-bound to compensate the current poor (as well as future generations) for the loss of welfare that resulted from the pollution that made their wealth possible (Baatz 2013).

BPP has been criticized on the grounds that the victims of severe misfortunes or natural catastrophes should still have their needs seen to 'without relying on the rather accidental connection between the innocent beneficiary and the victim'. A principle like ATPP may be better suited to address this concern (Kingston 2014 - Huseby [2013] expresses a similar idea). Another criticism is the practical difficulty of firmly linking wealth or privilege or relative advantage to specific polluting activities. Whether the owners of a mining company should be obliged to pay but not employees, or whether coal-reliant power companies should be obliged to pay but not mining companies, are questions without obvious answers. Further still, BPP is vulnerable to the objection that some past emissions were conceivably not beneficial to anyone, or at least not to any currently living people. BPP is silent on who should pay for those emissions.

Letting BPP alone guide the distribution of clean energy costs might look as follows. It would start with a perfectly equal distribution of the mitigation burden across people within a country. It would then increase the burden on agents whose wealth is traceable to verifiably harmful pollution, and reduce the burden on all non-beneficiaries by the same amount. We do not see this as a very tractable option in practice for the reasons discussed above. Using BPP to govern cost distribution would require definitely establishing the link between particular pollution instances and relative advantage or wealth. Even if such a relationship could be established, causally and beyond reasonable doubt, it is still a different matter entirely to establish the extent of each particular individual's share of the overall benefit and hence duty to pay.

2.4. Grandfathering Principle

GFP states that the right to pollute in the future should be distributed to agents in proportion to their past pollution. It can still be required that an agent reduces her polluting emissions, but the more she has polluted in the past, the more she is entitled to pollute in the future. Given that a certain level of costly pollution reduction must be realized if mitigation action is to be effective, GFP implies that the costs will be borne by those who have polluted relatively little historically. GFP is rarely advocated as the best or most just distributive criterion by serious moral philosophers (Baer 2002; Caney 2009). Yet, in the context of allocating pollution permits, it is often applied in practice and commonly invoked by parties to international climate negotiations.

The distribution of pollution permits under the EU Emissions Trading System (EU ETS) was initially based on GFP, although it has now moved towards an auction-based scheme (Hepburn et al 2006; Anderson and Di Maria 2011). Moreover, every environmental agreement that prescribes pollution reductions that are proportional to an agent's owns historical baseline also reflects GFP to some extent. This is so because it effectively means that those who have polluted more in the past are entitled to continue to pollute more in the future, relative to other emitters (Baer 2002; Caney 2009).

GFP runs contrary to all notions of historical responsibility in denying that those who caused an environmental problem should also be responsible for rectifying it (Neumayer 2000). Arguably, it even rewards historical *irresponsibility* by entitling polluters to continue the same behavior. Moreover, it is insensitive to the legitimate interests that the current poor have in becoming wealthier through polluting activities and energy access (Caney 2009).

One might wonder, then, why grandfathering is so prevalent in actual practice. The first likely reason is that the idea of impartial justice exerts a relatively weak influence on climate negotiation outcomes. The second reason is that there may be a pragmatic rationale for tolerating grandfathering. One can accept that it is unjust, but see it as a necessary first step towards reducing overall emissions, because it alone can secure the participation of the world's largest emitters (Gosseries 2004). GFP may not be the best distributive criterion, this argument goes, but it is the best that we can hope for, at least in the short term.

For GFP to be applied to the clean energy problem, all that is required is that those who have emitted the most in the past (or are currently responsible for the largest emission flows) pay

the smallest share of the clean energy cost. For instance, a scheme like the British Renewables Obligation, which requires certain large electricity users to purchase certificates guaranteeing that a certain quantity of clean energy has been produced (Wood and Dow 2011), could be modified so that certificates are given away freely to large historic polluters while being sold to historic non-polluters. In this vein, under Sweden and Norway's Electricity Certificate Market, large energy-intensive industries are exempt from the obligation to purchase similar certificates (Energimyndigheten 2013).

3. Indicative distributive justice 'standard' for paying for clean energy

Our analysis of the four principles has shown that none is perfectly suited to governing the distribution of burdens under a clean energy roll-out program, across socioeconomic groups and within the current generation. We see it as desirable to combine elements of each to avoid some of their strongest objections individually and to tailor the specific guidance they all offer on the policy question of interest.

Our view is that a combination of PPP and ATPP provides the most defensible grounds for distributing burdens in this context as well as the most practical means for actually implementing the principles in public policy. In this view current and future polluters should be made to pay whenever they are alive, culpable (e.g. not excusably ignorant) and sufficiently financially able to do so. This necessarily leaves some pollution unaccounted for, and ATPP can then be invoked to distribute the remainder of the burden across the agents most able to contribute. Caney (2005), Kingston (2014) and Miller (2008) all agree that these two principles are combinable and advocate, in their own ways, different combinations and permutations.

We translate this integrated, bespoke distributive justice 'standard' into a set of easily observable policy design criteria that can be used to evaluate the three actual clean energy roll-out programs we consider in the next section. We use these criteria to assess whether the burden-sharing dimension of these programs is distributionally fair against our standard. They are:

a. The program design should make a clear, traceable and deliberate connection between the extent of the financial burden placed on participating agents, and the level of the agents' current pollution levels.

b. The program design should make provisions for full or partial exemptions for the excusably ignorant or poor, ideally from paying for the program at all, and as a second best approach by creating restrictions or mandates within the program that ensure that these socioeconomic groups share substantially in the benefits of the program.

c. The program design should apportion costs across agents in a variable rather than fixed manner and ideally do so in a way that is proportional to the ability of agents to pay (for example income) and not just general consumption or consumption of polluting goods and services.

These criteria, and our overall distributive justice standard itself, are unlikely to be definitive, but they do enjoy the key benefits of being grounded in the reasoning underlying the four principles previously considered and of being designed for the specific purpose of evaluating and improving the fairness of the clean energy programs.

4. Evaluation of clean energy programs

Below we describe the aims and design of each clean energy roll-out program, their total expected implementation cost, some indication of total (expected) uptake or participation, the source of program funding, and any safeguards or provisions that were put in place to ensure fairness in the distribution of program costs or benefits. We evaluate each program against the three criteria above.

4.1. The Australian Photovoltaic Rebate Program

In the late 1990s, Australia initiated the Photovoltaic Rebate Program (PVRP) to promote the uptake of solar PV installations.[2] The objectives were to promote the uptake of clean energy at homes and community buildings, to reduce GHG emissions, to spur the development of the Australian solar PV industry, and to increase public awareness and acceptance of renewable energy (Australian Government 2006; Australian National Audit Office 2010).

The PVRP sought to achieve these aims by providing a cash rebate to individuals who registered PV installations under the program. The level of the incentive changed during the 10-year life of the program, but at its peak was AUD 8 per watt of installed capacity up to a maximum of AUD 8,000. This was around 40 percent of the total capital cost of an installation at the time. The government agency administering the program made the full rebate payment directly to individual applicants generally within six weeks of receiving an eligible application.

Program records show that 109,634 PV installations registered and received the rebate over the life of the program (January 2000 to April 2010). Total installed capacity under the scheme was approximately 128 MW which is equivalent to about 1/3rd the capacity of a standard coal-fired power plant. The vast majority of systems were installed at domestic premises.

The Australian National Audit Office estimates the total cost of the program at AUD 1.1 billion (2010). The PRVP was funded by the Australian federal government through a budget allocation secured during budget negotiations in 1999. The allocation was partly motivated by a need to compensate certain groups in respect of changes that were to be made to the national tax system. The PRVP was also motivated by the Australian government's pursuit of AUD 1 billion in voluntary GHG reduction initiatives in lieu of ratifying the Kyoto Protocol. This included establishing the Australian Greenhouse Office (AGO), in 1998, which would come to administer the 'Measures for a Better Environment' package that funded the PVRP. That package included these allocations (Lyster and Bradbrook 2006):

[2] The new Labour government rebranded the PVRP the 'Australian Solar Homes and Communities Program' after it came into power in November 2007.

- AUD 400 million for activities that were likely to result in substantial emissions reductions or substantial sink enhancement especially in the first Kyoto Protocol commitment period (2008-2010).
- AUD 179.9 million to increase the uptake of renewable energy in remote areas and especially to meet the energy needs of indigenous people.
- AUD 34.6 million for the PRVP whose aim was to encourage the long-term use of photovoltaic technology.
- AUD 71.4 million for a program to promote urban emission reductions and air quality improvement through vehicle fuel conversion.
- AUD 26 million to extend a pre-existing renewable energy commercialisation program.

The total value of the package was AUD 711.9 million meaning the remainder of the funds to cover the program must have been made up for by other federal allocations or through other sources.

The program enrollment rate was highly variable over the 10 years of operation. Oversubscription became an issue in the later years. Partly to deal with the oversubscription issue, the Government introduced a means test in May 2008. The means test limited eligibility to households with a combined annual taxable income of less than AUD 100,000 (Australian Government 2008). The means test was partly a response to the government's own decision to double the rebate from AUD 4 to AUD 8 per installed watt in May 2007. The means test was scrapped shortly before the program was terminated.

We now evaluate the cost distribution arrangements underlying the Australian PVRP against the three criteria that define our distributive justice standard. [3]

The first criterion was that the program design make a clear, traceable and deliberate connection between the level of agents' current pollution levels and the extent to which they contribute to the program. We do not find strong evidence that this type of connection was

[3] Several studies have identified concerns about the distribution of the benefits of the PVRP as opposed to the distribution of the costs (Macintosh and Wilkinson 2010; Nelson et al 2011), principally that disproportionate numbers of higher-income households have participated in the program.

made. The PRVP was paid for out of general fund revenues raised by the Australian national government. If there was a link between citizens' pollution levels and program contributions, this was a 'general' link to all earnings and consumption behavior rather than a 'specific' link to pollution-intensive consumption and behavior. This criterion would have been satisfied if monies raised through a national carbon tax for example had been earmarked for the PRVP and used for that purpose.

To evaluate the second criterion we looked for program provisions that lowered the financing burden for the excusably ignorant or poor. Because the program was paid for by the Australian government through tax revenues which we assume to include relief for the very poor and/or ignorant, we count this as provisions that directly influenced the way that the program cost was spread across Australian citizens.[4] The means test that was introduced towards the end of the program also counts towards fulfillment of this criterion.

The third criterion related to the apportionment of costs across agents in a variable rather than fixed-cost manner and ideally in a way that is proportional to ability to pay. Again, the program cost was distributed generally in line with the burden-sharing formulae of the Australian national tax system. We have no reason to believe that that system is not progressive on the whole. We consider that this criterion is satisfied because the likely practical outcome of this is a larger implicit burden on citizens with a greater ability to pay.

4.2. The British Feed-in Tariff for small scale PV

The British Feed-in Tariff (FiT) to encourage the uptake of small-scale clean energy systems (including PV) opened to applications in April 2010. The program aimed to satisfy the requirements of the EU Directive on Electricity Production from Renewable Energy Sources (2001/77/ED), which required the UK to produce at least 15 percent of gross electricity consumption from clean sources by 2020 (DECC 2011). It also aimed to help renew an aging electricity infrastructure, to support and expand the domestic clean energy industry, and to reduce dependence on domestic oil and gas reserves.

[4] The means test, which limited program participation to households with a combined income of less than AUD 100,000 probably improved the overall distributional incidence of the program, but because it acted to ensure distributional equity on the program benefits side rather than the program cost side, we give it minimal weight against this criterion.

The British FiT encourages homeowners, community groups, farmers and commercial establishments to erect clean energy installations at their premises through a guarantee of regular payments for the clean energy they produce. The electricity utility to which the installation is connected pays the installation owner for each kWh produced. The payment varies by the size and type but a typical household-scale installation received around GBP 0.38 per kWh in the first year of the program and currently around GBP 0.15. The installation owner receives this regardless of whether they use their generated electricity or export it to the grid. Installation owners who export electricity to the grid receive an additional payment of around GBP 0.05 per kWh. Payments are index-linked and therefore inflation proof as well as guaranteed by the government for at least 20 years. The expected return on a GBP 10,000 installation in the first year of the program was around 8 percent per year (DECC 2009). This figure has fallen to around 5 percent per year currently, according to the British organisation the Energy Saving Trust.

In terms of uptake, 379,531 installations had registered under the program in the first three years of the program to March 31st, 2013. That is one installation for every 50 households in England and Wales. Ninety-one percent of installations are PV and 97 percent are installed at domestic premises. Total generation capacity of all installations combined is approximately 1,792 MW—equivalent to about three average-sized coal-fired power plants, and 2 percent of total generating capacity in the UK.

Currently, FiT payments of about GBP 500 million are being made to installation owners in England and Wales each year. Payments will be made to eligible installation owners for 20 or 25 years, depending on the time of registration. It is estimated that the total cost of the FiT scheme over this full time period will be between GBP 8 and 10 billion (DECC 2009).

The regulatory framework that established the FiT program allows each electricity supplier to pass the cost of FiT payments on to the electricity customers in its service area. This implies that the program is paid for by electricity customers through electricity bills and not by the general tax-payer. Moreover, electricity suppliers rather than the government decide the exact formula by which the cost of the scheme is distributed. With this arrangement, the government has effectively relinquished the authority to determine who pays for the program and in what proportions. The UK energy markets regulatory authority (Ofgem) estimates that

the FiT program adds approximately GBP 6.00 to the average annual UK domestic electricity bill (Ofgem 2013). The regulatory impact assessment conducted in 2009 estimated this figure at GBP 10.00 (DECC 2009).

We now evaluate whether the British FiT meets the three criteria in our distributive justice standard. The first is that there needs to be a clear, traceable, deliberate link between agent emission flows and agent financial burden. Whether or not this criterion is satisfied depends on one's interpretation of who the 'polluters' are in this context. Electricity consumers may not count as direct polluters in the physical or legal senses but neither are they completely free of responsibility for pollution given that they are final consumers of a polluting good. Moreover, many polluting activities are unrelated to domestic electricity usage, such as driving habits, and this fact is unaccounted for by the program. On the whole, we see the first criterion as partly satisfied. There is a clear and traceable link between who pays for the program and who holds *some* of the responsibility for pollution, but this does not include all agents, nor does it cover all forms of pollution.

To satisfy the second criterion, the program needs to exempt the poor or excusably ignorant or poor from paying fully for the damage of the pollution they cause. We do not find any provisions in the design of the British FiT that would satisfy this criterion. This criterion is especially unlikely to be satisfied because the responsibility for distributing the cost of the program across socioeconomic groups was relinquished by the government to the electricity suppliers and we would not expect electricity suppliers to be motivated to make such provisions.

The third criterion relates to whether the program cost is apportioned at least in some measure in line with ability to pay. This would be indicated by a variable charge on electricity bills in proportion to household income for example, rather than a fixed charge that is insensitive to ability to pay. We do not find any evidence that this criterion is satisfied. Even if the electric utilities themselves decided to distribute the program cost according to customers' ability to pay, this is unlikely to have been prompted by the design of the program.

4.3. The California Solar Energy Initiative

The California Solar Energy Initiative (CSI) began in January 2007 and is scheduled to run until 2017 or until the allocated funding runs out. The program aims to install 1,940 MW of distributed solar PV capacity and to transform the market for solar energy systems so that prices become 'competitive and self-sustaining' (CPUC 2014).

The policy design uses two separate incentives to achieve these aims. The first is similar to a feed-in tariff in that payments are made to installation owners for each kWh of electricity produced, payments to each owner being valid for a period of five years. This incentive is designed to support installations larger than 30 KW. Actual payments range from USD 0.43 to 0.04 per kWh depending on how much capacity has already been installed under the program. The second incentive is a rebate similar to the one under the Australian program. Under the CSI, the installation owner receives a single upfront payment for each watt installed, ranging from USD 2.75 to 0.37 and depending on how much capacity has already been installed under the program (CUPC 2013).

In terms of outcomes, official program data shows that 156,704 installations had registered under the program by spring 2013 for an estimated 1,621 MW of installed solar PV capacity (California Solar Statistics, 2013). Approximately 93 percent of installations are residential or small commercial systems (Borenstein 2013).

In 2006, the California State Legislature set the program budget at USD 2.167 billion for the 10-year life of the program. The legislature specifically authorized the funds to be collected from electricity customers. It also intended that the impact of the CSI on electricity customers' bills be effectively cost-neutral, meaning that the program, in the Legislature's words:

> 'be a cost effective investment by rate payers in peak electricity generation capacity where rate payers recoup the cost of their investment through lower rates as a result of avoiding purchases of electricity at peak rates, with additional system and pollution reduction benefits.' (2006: 83)

The CSI makes considerable provisions to support program participation by low- and very low-income households. The legislature set aside 10 percent of the total USD 2.167 billion CSI budget for this purpose and stated an aim of installing 190 MW of solar PV capacity

within this demographic by 2016. A different and more generous incentive system applies to low-income households and is non-declining over time. Households whose income is less than 50 or 80 percent of the area mean can qualify for highly or fully subsidized PV systems, respectively. The CSI facilitates low-interest loans for any remaining system cost.

The CSI partly satisfies the first of our distributive justice criteria, namely the presence of a clear, traceable and deliberate connection between polluters and burden-bearers. Because the basic funding mechanisms of passing program costs on to electricity bill payers is the same as in the British program, our verdict is the same across both cases. That is, there is a potentially traceable link between who pays for the program and *some* polluters, but not all polluters or all forms of pollution, and the link may not have been deliberate and could certainly be clearer.

The second criterion is about exemptions for the poor or excusably ignorant. We find concrete provisions protecting the interests of low-income households in the distribution of the *benefits* of the program, but fewer and weaker such provisions in the distribution of the costs. One could argue that a more meaningful form of inclusion for low-income households would be the freedom to choose whether to commit household resources to the program in the first place (Sen 1999). Rather than being effectively obliged to commit resources up front then provided the chance to re-claim them on the condition of participation, a more just arrangement might be to allow poor households to opt out of the program from the beginning.[5] Notwithstanding, we consider this criterion partly satisfied because these provisions do go some way to reducing the negative distributional incidence of the program overall, if not exactly in line with the prescription of our distributive justice standard.

The third criterion requires program costs to be apportioned in line with ability to pay. We do not find any evidence that this was the case. As with the British program, even if the electric utilities did voluntarily decide to distribute the program cost through a variable charge in line with ability to pay, this would occur not as a result of the design of the program but despite it. We also acknowledge the program's ambition to be self-financing and

[5] This would be more just on the basis that some part of one's prosperity is bound up in how their wealth is constituted and the power they have to change its composition in line with needs and wants. A low-income household may place more value in transforming scarce household resources into an automobile or further education than a PV installation.

ultimately reduce customer electricity bills, but maintain that this only satisfies the ideal of cost neutrality for *all bill payers as a group*, and is unlikely to hold for individual consumers.

5. Conclusions: towards more fairness

Our main theoretical contribution has been to mine the literature on established distributive justice principles, which are by nature abstract, and extract insights from them that have practical application to the specific problem of how countries should fairly distribute the cost of paying for clean energy. In developing a bespoke 'standard' of distributive fairness in this context and using it to systematically evaluate three real clean energy programs, we have shown that there are different ways of paying for clean energy and that some ways are fairer than others.

We find that the Australian program went the furthest to satisfying the criteria in our fairness standard. This was largely down to the fact that the Australian program was paid for out of tax revenues raised under a generally progressive tax system, rather than by spreading the cost across electricity customers. The California program was the second fairest, as strong provisions were designed-in from the beginning that ensured participation and therefore financial benefit by low-income and very low-income households. We judge the UK program the least fair of the three. A key piece of policy advice that flows from this conclusion is that it seems easier to ensure distributional fairness when the program is paid for with tax monies, including those raised through taxes on GHG emissions, because the cost distribution mechanism can benefit from what are often strong, pre-existing, progressive burden-sharing institutions in the tax system. If there is no feasible option but to spread program costs across electricity customers, then the government or regulatory authority should put cost distribution advice in place for electricity suppliers and enforce it.

One caveat to our findings is that clean energy programs can be motivated into existence by factors other than mitigating GHG emissions, such as energy security and competitiveness of the clean energy sector, which may make it less appropriate to distribute program costs on the basis of philosophical positions related to pollution. One answer to this is that these other issues can be seen as subsidiary to the meta-issue of GHG emissions and climate destabilization such that interest in clean energy sector competitiveness is being drive or at least heightened by the GHG mitigation agenda. Another response is that even if clean

energy deployment were being done entirely for energy security reasons, this would not mean that the distributional issue goes away, and it would not mean that policy should be left to be designed without attention to fairness.

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