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Distributive fairness in paying for clean energy infrastructure

January 2016

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Abstract

Despite the rapid rise in public expenditure on clean energy infrastructure, there has been little discussion about what constitutes a fair distribution of this new spending burden. We examine four ethical principles that speak to different notions of fairness in the way this burden can and should be shared, and use them to produce three normative criteria for pursuing fairness in the clean energy fiscal policy context. We use these criteria to examine the extent to which fairness is being achieved in large clean energy roll-out programs in Australia, California and the United Kingdom. Maintaining a close focus on providing practical guidance for decision makers in similar policy contexts, we find that fairness is more achievable when program design explicitly considers which households should pay for the program and which should be exempt; when the idea of proportionality guides the distribution of the cost across paying households, and when the interests of low-income households are protected, by ensuring that they share in the benefits of the program, for example.

JEL: D63, H23, H54, O2, Q48, Q5

Key words: environmental taxes and subsidies, distributional impacts, equity, energy policy, renewable energy.

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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)

'No solution of a practical problem, relating to human conduct, can be regarded as complete, until its ethical aspects have been considered. It is clear, accordingly, that practical discussions of an economic character cannot be isolated from ethics, except in so far as the aim is merely to point out the practical bearing of economics facts, without any attempt to lay down absolute rules of conduct.' (Keynes 1917: 60-61)

1. Motivation and background

This paper considers how policymakers can ensure greater fairness in the way the large new cost of paying for clean energy infrastructure is distributed across socioeconomic groups.

We start from the premise that the level of clean energy capital spending globally is projected to grow from an estimated USD 214 billion in 2014 to USD 300 billion by 2020 (IEA/OECD 2014) and that very little public discussion has focused on what might constitute a fair distribution of this spending burden. Some modelling work suggests that investment levels would need to reach USD 1.1 trillion annually, in order to achieve mitigation consistent with a 2-degree target (McCollum et al 2014).[1] Distributive concerns are material here because this investment tends to be motivated into existence by government subsidies, and the cost of these subsidies tends in turn to be passed on to either tax payers or electricity utility customers. Evidence suggests that the distribution of the costs and benefits of these subsidies across socioeconomic groups is not being taken adequately into account, including in programs in Australia (Macintosh and Wilkinson 2010), the United Kingdom (Grover 2013) and California (Proctor 2014) that we consider in this paper.

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[1] These types of estimates are static and tend not to account for general equilibrium responses from carbon pricing policies or capital cost changes for example, and the need to account for the final incidence as opposed to the proximate incidence is something we discuss more below.

The question of fairness in sharing this new cost also sits in a context of historically high and rising income inequality (since the early 1900s) in several of the countries leading the clean energy investment charge. These include Germany, Norway and the United States (OECD 2008; OECD 2011; Piketty 2014; Piketty and Saez 2003; US Census Bureau 2011). In line with the quotation from political philosopher Simon Caney (2009) in the header above, it seems to us that policies that succeed in mitigating GHG pollution should not do so in a way that worsens socioeconomic inequality.

This paper extends a growing literature about fairness in distributing the cost of mitigating (GHG) pollution more generally. Climate change economics research has turned to moral philosophy in recent years for guidance in deciding how much the current generation should be asked to pay to mitigate future pollution damages (Nordhaus 2008; Stern 2014; Weitzman 2007). Moral philosophers have at the same time been developing a ‘climate justice’ narrative around the closely related question of who should pay for mitigation or any other action necessary to keep global warming from becoming any more harmful than necessary (Shue 2010, Caney 2009). These theoretical discussions do not always offer tangible guidance for policymakers on how fairness might look in practical terms, however.

A substantial body of applied research has examined the distributional incidence of policies designed to mitigate harm from environmental pollution, including harm arising from GHG pollution (Smith 1992; Grainger and Kolstad 2009; Metcalf et al 2010; Fullerton 2011). Some of this concern with fairness arose in response to the environmental justice research that emerged in the 1980s. This work demonstrated that systematic inequalities exist in who bears the exposure cost of pollution across racial, ethnic, and income groups (Rhodes 2003; Schlosberg 2007), but also in who enjoys the protective benefits of anti-pollution policy (Bullard 1994). In part to guide policymakers on achieving environmentally just outcomes from policy, several ideas have been developed about what constitutes fairness in environmental policy design, including in this journal (Neumayer 2000; Pascual 2010; Pelletier 2010).

This prior work takes us some way to understanding the broad contours of how distributive fairness might look in policy contexts involving environmental policy and pollution, but not all the way to distributing the clean energy infrastructure burden specifically. The question, therefore, that we set out to answer in this paper is, ‘What practical guidance can be drawn from existing principles of distributive justice for fairly sharing the cost of clean energy infrastructure?'

The next section sets up a framework for answering this question in a way that we hope will yield useful guidance for policymakers who work on related policy issues. Section 3 analyses what four established principles of distributive fairness have to say about achieving fairness in the clean energy context. Section 4 derives from the principles three normative criteria for evaluating fairness in policy design. Against these criteria, Section 5 evaluates clean energy roll-out programs focused on household and small-scale deployment in Australia, California and the United Kingdom. Section 6 summarizes and caveats our findings, and recaps how decision makers might apply them.

2. Framework for analysis

Our aim is to establish a practical, implementable moral basis for fairly distributing the cost of just one increasingly common approach to mitigating GHG pollution - deploying new clean energy infrastructure. In discussing how this new cost *should* be shared we are treading on the kind of normative ground that standard approaches in neoclassical economic analysis are not particularly well suited to answering (Stern 2014). In order to establish something akin to widely acceptable prescriptive judgments about the desirability of different distributive outcomes from policy, we therefore need to go beyond a positivist analysis of 'facts'.

To do this we engage with several of the philosophical principles that are coloring the climate change mitigation debate. Our treatment of these principles may seem sparse to scholars of ethics, but for economists and policy-makers who are currently discussing these issues minimally if at all, we expect that a discussion focused mainly on the principles' instrumental value will go some way to raising the standard of that discussion. Those interested in the principles' deeper underpinnings and in principles other than the ones we have identified as most relevant to this normative problem, can consult the references cited.

We have chosen to frame our question mainly in terms of the fair distribution of a new *cost* or *burden* associated at least in part with mitigating GHG emissions, but we are aware that the question could also be framed in terms of fairly distributing the *benefits* of clean energy infrastructure itself. One reason that we chose the costs framing is because we felt that there could be greater consequence for vulnerable social groups to an inequitable distribution of costs than to an inequitable distribution of benefits. New costs seem more likely to affect current welfare levels of these groups in absolute terms. However, in both the discussion of distributive principles and in the evaluation of actual policies, we try to account for how program benefits flow to low-income groups when they do, not least as 'negative costs'. Another reason for our costs-focused approach is that decision-makers in this context typically have greater control over how the cost of clean energy infrastructure policies are spread than over who participates in them and therefore who benefits.

In any discussion of distributive outcomes it is important to distinguish between a policy's proximate (or immediate) impact, and its final (or ultimate) incidence (Fullerton and Metcalf 2002). It is possible, indeed common, for a policy to satisfy common notions of fairness in its immediate impact but result in an unfair final incidence (Kotlikoff and Summers 1987). This can happen when the agents who are directly liable to pay the new cost or tax shift it forward or backward through asset price adjustments and/or because the new cost may cause equilibrium adjustments that alter factor prices themselves (Kotlikoff and Summers 1987). Our view is that decision-makers should aim to achieve a fair *ultimate* incidence in the policies they design, but we also recognize that this is not always an easy ask. Technical aids to policy design like detailed regulatory impact assessment and computable general equilibrium (CGE) modelling will often be necessary to ensure that this outcome is fully achieved over different time horizons and economic sectors. Our primary aim in this paper is to direct decision makers' attention to notions of fairness in the *proximate* distribution of public costs, which we see as an important first step towards realising fairness also in the ultimate sense. We emphasize this and other caveats to policy implementation and design in the conclusions section.

We have limited the scope of our analysis in several important ways in order to place clear boundaries on our question and to produce meaningful guidance for policymakers. We do not address the question of who should bear responsibility for historical GHG pollution or what a fair shouldering mitigating its damage should look like. This is because clean energy infrastructure by definition only mitigates current and future pollution. We also focus on the question of distributive fairness within the current generation rather than the betweengenerations question. This is because inter-generational burden-sharing is well covered in the debate over how to discount avoided climate damages (Arrow et al 2014) and because intra-generational burden sharing is most relevant to the financial scale of the policies we consider empirically. We also limit our discussion to how the cost should be shared across people within individual countries. This is because building clean energy infrastructure has to date been almost exclusively the domain of national or sub-national governments. However, there is considerable overlap between the principles we consider here and the principles that might guide a fair distribution of the GHG pollution mitigation burden across countries (Ringius et al (2002)[2], and there is nothing to prevent our analysis from informing the international burden sharing discussion, particularly insofar as it concerns international transfers to support clean energy deployment.

Our analysis is particularly relevant to questions of cost distribution under clean energy programs insofar as these programs are motivated into existence by GHG mitigation. In practice, governments are rolling out clean energy infrastructure with diverse motivations: to mitigate GHG pollution, to promote innovation and competitiveness, to improve the security and stability of electricity supply through distributed generation, to reduce geopolitical vulnerability by diversifying fuel sources, and for other reasons (DECC 2011, EC 2014). That does not mean that our analysis is irrelevant to questions of fairness where the other motives are present. It means that we see GHG mitigation – whether it be through displacing fossil fuel-fired generation in the near term, or through enabling this to happen in the future by way of stimulating innovation – as the motive that sets clean energy policy apart from other types of energy infrastructure policy, and which therefore invites us to think about how

[2] Ringius et al offer an excellent example of how fairness principles can be used to guide the distribution of GHG mitigation costs in an international climate policy negotiation context. Several of the principles that they find relevant to that discussion are similar in spirit to the ones we consider in this paper. However, there are several reasons why what is deemed a fair distribution of a burden among nations may not be seamlessly transferable to a within-country context where the concern is with distributive fairness among households. First, a prominent argument in the international context is that which appeals to the notion of a historical balance of justice and nations' interest in development and industrialization. This argument suggests that less developed countries should be allowed to enjoy the same emissions levels today that developed countries historically have done. At the level of households within a country this kind of historical comparison is much less relevant. Second, given that the lifetime of nations is typically much longer than that of persons, international burden sharing necessarily takes a longer-term perspective and therefore must include a consideration for climate change damage costs as well as mitigation costs. However, the immediate question for policymakers tasked with distributing the cost of clean energy infrastructure is principally a question about distributing a mitigation costs.

this relatively novel motive may change our ideas about who should pay for this infrastructure.

A final way that we limit the scope of the analysis is by thinking about fairness in this context separately from other policies and programs that are designed to help low-income households specifically, such as fuel bill assistance to elderly households or winterization subsidies for low-income households. One could argue that if one policy is excessively fiscally regressive (infrastructure), and another is excessively progressive (fuel bill assistance), then the score is even all things considered. We do not dispute this point. It may be true that counterbalancing measures already exist outside of the clean energy infrastructure policy context or that it is desirable to create these measures. Our point is that in order to decide whether sufficient compensating measures already exist, or should exist, it is first necessary to have some notion of whether the cost of this new infrastructure is itself being distributed fairly or not.[3]

3. Principles of distributive fairness

Through a review of the distributive justice literature related to climate change and the environment we identified three principles that seemed relevant and flexible enough to address the 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). While GFP is rarely advocated by ethicists or moral philosophers, it is commonly used in GHG control policies to initially distribute the right to pollute (Ellerman et al 2007; Rode 2014). There are certainly other principles that could be brought to bear on the question, but we deemed these four the *most* relevant to distributing an environmental protection-related burden across socioeconomic groups within a country and within a single generation.[4]

[3] This raises the important point that program-level assessments of the distributional impact of clean energy infrastructure are inherently embedded in larger policy decisions about how the national tax burden is shared.

[4] One fairness notion that we considered but did not pursue was the idea of collective moral responsibility. Collective moral responsibility holds that group entities like governments or clans or

For each principle we consider the basic position it holds on who should bear the GHG mitigation burden, major objections or weaknesses to the principle, and how policy and the distributive outcome might look in practical terms if the burden was distributed in line solely with the principle.

3.1. Polluter Pays Principle

PPP holds that an agent who is responsible for emitting pollution should also be responsible for remedying the damage caused by the pollution. The more pollution an agent emits generally, the more they are liable to pay to remedy the damage. The principle generally holds that the sum that a polluter pays should be enough to redress all the harm they cause (IPCC 2001; Schwartz 2010).

An attractive feature of PPP as a principle for distributing the cost of clean energy infrastructure is that it is widely understood among laypeople and commonly applied in policy practice. PPP resonates with numerous everyday situations where those who cause damage are also considered responsible for correcting it, and where it seems fitting that the level of restitution be proportional to the damage caused (Miller 2005).

companies can or should be held responsible for actions committed jointly by their members or for actions committed by one or more individual members (Feinberg 1970). While we do not deny that collective moral responsibility can be invoked in certain situations, we felt this principle was less relevant to our question than the others for several reasons. First, in the advanced industrial societies that are dealing with this new distributive problem, ideas of moral agency, acts, causation, and fault tend all to be aligned in notions of individual rather than collective responsibility. The result is that normative fairness criteria are more likely to find acceptance among likely 'users' if they are based on these more familiar notions of individual responsibility. Second and more pragmatically, collective moral responsibility does not get us a great way off the starting block in terms of dividing up a real, concrete fiscal burden, which is the problem policymakers currently face. If responsibility for a burden is deemed 'collective', then the problem of how to practically distribute it within the given collective entity still remains. Third, there are philosophers who believe in individual responsibility and philosophers who believe in individual *and* collective responsibility, but no-one to our knowledge who believes in collective responsibility *only*. If anything, then, it would be appropriate to treat collective responsibility as supplemental to the principles considered here.

PPP underpins international environmental agreements like the 1992 Rio Declaration on Environment and Development and it currently influences the allocation of mitigation responsibilities in international climate negotiations (Schwartz 2010; UNFCC 1992). PPP is typically embodied in the requirement to purchase GHG emission permits and to pay taxes on GHG emissions (Cramton and Kerr 2002). PPP forms the moral foundation for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA – colloquially, 'Superfund' law) in the US[5] that requires polluters to clean up hazardous waste sites that they were responsible for causing. In the EU, PPP forms the basis for extending the responsibility of product manufacturers for the products they produce, to the point in the lifecycle of those products where they become waste, creating an environmental burden. EU Directives on packaging, electrical waste and end-of-life vehicles are premised on extended producer responsibility (Lindhqvist 2000).

One common objection to PPP is that it does not take into account the issue of excusably ignorant polluters or pollution which occurs in order to meet basic needs. Two modifications can accommodate these concerns (Caney 2005; Miller 2004). In instances where a polluter cannot reasonably be expected to know that her pollution might cause harmful consequences, there is an argument that she should be exempt from paying for the damage caused. Hence, if there was neither an intent to harm others nor willful neglect, the agent's behavior is excusably ignorant and her liability to pay should be reduced or cancelled. However, an appeal to excusable ignorance is unlikely to be compelling, given current levels of awareness of GHG pollution and its possible effects, at least in advanced industrial societies. Second, to the question of meeting basic needs, there is considerable normative force in the idea that for poor and disadvantaged households in particular, some pollution is an unavoidable side effect of the actions they need to perform to uphold an acceptable standard of living. Given that all persons have a moral prerogative to ensure an even minimally decent life for themselves, they should thus be exempt from paying for their pollution.

Another practical objection to PPP is deciding who exactly the polluters are. In the present context, this translates into finding ways to assign responsibility for pollution either to households in their capacity as consumers of polluting goods and services, or to the companies that produce and sell these goods and services. Insofar as this challenge is a

[5] And many others – see Robertson (1996).

practical one, it appears surmountable. While counterfactuals can never be fully known, several technical methods exist for apportioning responsibility for pollution among consumers and/or producers and/or tracing responsibility to agents for discrete pollution flows. These include the 'geographical' approach, the 'consumer responsibility' approach, and the 'carbon emissions added' approach (see Bastianoni et al 2004 in this journal for example). This kind of technical analysis could be applied in policy design and implementation at the level of the individual country or policy.[6]

If the task of distributing a clean energy infrastructure burden were guided solely by the logic of PPP, then the distributional arrangement might look as follows. All entities deemed responsible for pollution would be made to share the cost of the policy in proportion to their current pollution flows, if those exceed what is necessary to meet their basic needs. Practically this could take the form of a direct tax on GHG pollution or it could be proxied for by fuel or energy consumption. Implementation might entail establishing a threshold pollution level below which a household's contribution is reduced.[7] In some country contexts, depending on the level of formal education, an additional threshold for excusable ignorance and basic needs might be established. It remains to be decided who should pay in place of those exempted for either reason.

3.2. Ability to Pay Principle

ATPP holds that the burden of paying for public activities generally should be borne in greater proportion by agents who are best able to contribute (Broome 1984; Dodge 2005). In the context of mitigating pollution damage this means that agents who are most capable of

[6] Indeed it appears that this objection really *must be* dealt with at the policy implementation level, not least because the definition of 'pollution' itself varies across country contexts and time. Strictly speaking, 'emissions' are not the same thing as 'pollution'. Following Alder (1995):

> 'Pollution is the imposition of a harmful waste product or emission onto the person or property of another without that person's consent; it is a 'trespass' under principles of common law. If the trespass is so minor that it creates no impact or inconvenience for the property owner, it will normally be tolerated.'

This means that a marginal unit of GHG emission may qualify as pollution in one country but not in another if the countries have different allowable emission limits.

[7] This is an adaptation of the proposals of Caney (2005) and (Hyams 2009) to allocate a pollution quota to all citizens that is sufficient for meeting basic needs.

preventing pollution should shoulder the cost of doing so regardless of whether they themselves caused or continue to cause it (Caney 2014; Miller 2001).

ATPP forms the theoretical justification for trying to achieve distributive fairness in tax policy through a tax regime that asks the rich to pay more than the poor, in absolute or relative terms (Samuelson 1947). Pigou is often credited with arguing that if tax policy were guided by a principle of 'least aggregate sacrifice' by society, this would effectively lead to the ATPP (1932). Minimizing the aggregate sacrifice (in terms of utility or welfare) associated with raising a particular sum of money requires that, at the margin, everyone make an equal utility sacrifice. Given that the rich suffer less disutility from making payments of a given absolute size, this means that they should pay more. This argument for ATPP therefore rests on the idea of diminishing marginal utility of income: the disutility of paying a certain amount of money is smaller for high-income than low-income agents (Greene and Baron 2001; Samuelson 1937). It also rests on the normative position that mitigation should be done at the lowest possible aggregate disutility (utilitarianism), which implies spreading the marginal mitigation *burden* evenly across agents, but not necessarily the mitigation *cost* (Singer 2010; Stern 2007).[8] The 'burden' is different from the 'cost' because marginal utility decreases with income, meaning the burden (disutility) of paying a certain cost (sum of money) is greater for the poor than for the rich.

In its agnosticism with regards to who actually causes pollution, ATPP may come across as alien to ordinary moral thinking, eschewing, as it does, the notion of taking responsibility for one's own harmful actions. It assigns responsibility on the basis of a pre-existing status or condition - namely an agent's relative wealth, income, or ability - rather than on the basis of agents' pollution-related behavior. However, it is likely that applying the principle in practice would sit comfortably alongside the more intuitively appealing PPP, because richer agents who are more able to shoulder the mitigation burden tend also to emit more.

[8] However, utilitarianism is not the only ethical framework that can support the ATPP. The closely related 'prioritarianism' holds that the ideal cost distribution is one which additionally meets the requirement that the already worst-off (in utility terms) should incur a lesser reduction in their utility levels than the better-off (Broome 2012, Parfit 1984). This yields a version of the ATPP which apportions an even greater share of the cost to the wealthy, relative to the poor. Most versions of egalitarianism would produce similar recommendations.

Applied to the problem of distributing the cost of clean energy, ATPP would assign a minimal cost burden to poor households, even where they were responsible for a large amount of pollution, whereas better-off households would bear greater responsibility solely on the basis that they are better off (more *able* to pay). It would be consistent with ATPP to pay for these projects with funds raised by progressive general taxation. It would not be consistent to pay with funds raised by a flat tax or through a fixed levy on consumer energy bills. Raising the funds through a variable charge linked to energy consumption would be consistent with ATPP to the extent that consumption of these goods increases proportionally with income.[9]

3.3. 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 has arisen in climate policy discussions in response to the idea that the current generation in industrialized countries should not be made to pay for their ancestors' pollution. BPP answers this point by saying that the current generation in industrialized countries *should* pay something for their ancestors' pollution because the current generation has substantially benefitted from that pollution through developmental progress and higher incomes. It says that in situations where PPP breaks down because the polluters are dead (the 'disappearing emitters problem'), the agents who *benefitted* from the pollution should inherit responsibility for correcting the damage caused by it. BPP's core idea is that if an agent accepts the benefits of illegitimate actions then they should also accept responsibility for the costs (Page 2008, 2012).

BPP is distinct because it implies that the beneficiaries are obliged to pay not simply because they are better off than others, but because their wealth was created in a morally dubious manner. Beneficiaries are thus 'free-riding' on the harmful activities of polluters, meaning that they are no more deserving of this windfall than the victims of pollution are deserving of their misfortune (Gosseries 2004). BPP is most salient in the international-intergenerational context discussed above but it can also be brought to bear on the clean energy infrastructure

[9] Empirical studies of energy expenditure in the UK and elsewhere show that household energy expenditure generally increases with income, but that the increase is less than proportional and happens at an uneven rate (OECD 2008; Jamasb and Meier 2010).

distributive problem within just one country and one generation. In such a context, where polluters are still alive, advocates of BPP face two options. The first is to simply defer to PPP and argue that BPP only applies when polluters are dead. The other is to maintain that agents should be made to pay in proportion to how much they benefit from polluting activities, regardless of who is responsible for the pollution.

The relevance of the second option can be illustrated in this narrower context by analogy to theft. Consider that there are three agents in this example: a thief, a victim, and a finder. Say that the thief steals some goods from the victim and then that the third agent, the finder, stumbles across the stolen goods by accident. The finder would benefit from keeping the goods. However, the rightful owner was harmed by having their property stolen, and has a legitimate moral claim to not suffer this harm, and this claim creates a duty for others. If the finder keeps the discovered goods, she may not have harmed anyone because she did not steal anything herself, *but she does have some duty to the rightful owner of the goods and should ideally return them*.

BPP argues that the direct beneficiaries of pollution (the finder) are duty-bound to compensate those who are set to suffer a welfare loss (the victim) due to the actions by a potential third party (the thief) that made the beneficiaries' wealth possible (Baatz 2013). Two points give BPP its normative force. The first is the causal connection it draws between the agent that benefits from pollution on the one hand, and the victim who is harmed by pollution on the other; the benefit and the harm share the same cause. Second is the idea that the balance of justice between the two agents deserves to be restored through compensation (Huseby 2013).[10]

BPP is subject to several criticisms as a principle by which to ensure distributive justice in climate policy generally. The first objection is that the victims of severe misfortune or natural catastrophe should still have their needs seen to 'without relying on the rather accidental connection between the innocent beneficiary and the victim' (Kingston 2014;

[10] This is different from the idea that those who benefit from *mitigation* should pay for it. Having the beneficiaries of mitigation pay polluters not to pollute would be a form of Coasian bargaining (Coase 1960). Under certain restrictive conditions, this could sustain a Pareto efficient outcome (no externalities), but by the Second Fundamental Theorem of Welfare Economics, the welfare distribution in this outcome is contingent on the welfare distribution prior to bargaining. Therefore, the outcome would only guarantee distributive fairness if this was ensured by way of lump-sum transfers before or after bargaining.

Huseby 2013). Sufferers have reason to be compensated for their loss for reasons other than that another agent benefitted from the event that caused it. Second is the objection that some pollution is conceivably not beneficial to anyone, or at least not to any currently living people, such as pollution that results from arson or accidental fires (Butt 2007). BPP gives no clear guidance on who should pay for emissions that do not benefit anyone. Third, there is the practical difficulty of causally linking all or some of an individual's relative wealth or advantage to specific polluting activities, particularly when those activities were performed by an agent other than the beneficiary (Maltais 2010). Unlike PPP, which comes with its own challenges in terms of assigning responsibility for pollution, we are not aware of technical methods that would clearly identify beneficiaries of pollution with enough precision and to the extent that they are different from the polluters themselves. Fourth, because BPP is concerned with *restoring* the balance of justice between victim and beneficiary, it may be better described as a form of *corrective justice with distributional implications* than a principle of distributive justice in its own right (Butt 2009).

In practical terms, distributing the cost of clean energy infrastructure according to BPP alone might look like this. First, a baseline contribution that was perfectly equal across households would be established, by dividing the total cost by the number of households. The per-household contribution would then be increased for households whose income is traceable to verifiably harmful pollution (the beneficiaries) and reduced by the same amount for households who are harmed by that pollution (victims). Assuming that the practical problem of identifying the beneficiaries of pollution could be overcome, BPP might be implemented by asking owners of stocks and shares in pollution-intensive companies to pay above the baseline, or by asking households with employment in pollution-intensive companies to pay more.

3.4. Grandfathering Principle

GFP states that the right to pollute today and in the future should be distributed in proportion to the amount of pollution agents have emitted in the past. Agents who emitted heavily should be allowed to continue to emit at those levels, even for example after new GHG mitigation rules come into force. Generally speaking, 'grandfathering' refers to establishing a two-tiered standard in law where one set of agents is treated differently based on prior status or behavior (Robertson 1996). GFP is different to the previous three principles in that it is concerned with the distribution of *rights* rather than *duties*.

There are numerous examples of GFP being applied in policy practice. Article 10 of the EU emissions trading directive required Member States to allocate at least 95 percent of GHG emission allowances free of charge in the trading period ending 2007, and at least 90 percent in the trading period ending 2012 (Woerdman, Cló and Arcuri 2008). Grandfathering clauses are included in several major US environmental laws including the Resource Conservation and Recovery Act, the Clean Air Act, and various land use and zoning laws (Robertson 1996).

The intuition that underpins GFP is familiar from other contexts where groups or individuals lay claim to public resources through tradition or inheritance. One example is cattle grazing rights on public land. In many countries, grazing rights are commonly allocated in recognition of which populations, groups or families have historically used particular lands for that purpose (Raymond 2003). GFP can be understood more broadly to support the idea that some rights are *acquired* rather than granted, which can be seen as acceptable so long as the tradition or practice which created the claim to these rights was legitimate (Ringius et al 2002). While there are indeed differences between GHG emissions and grazing, not least in that the former is often not traceable to undisputedly legitimate traditions, some argue that the moral case for grandfathering rights has similar contours in both cases (Bovens 2011).

GFP draws some justification from the essentially Lockean idea that past behaviour establishes a claim to a certain way of doing things in the future.[11] It may hence be unfair to agents that previously invested in assets that emit GHGs for a government to change the rules governing the operation of those assets, mid-stream in their economic life and in a way that the agents could not have reasonably anticipated (Menezes et al 2009). Grandfathering provides for such agents to be protected from stranded costs or other economic losses they incur as a result of new anti-pollution rules (Harrison and Radov 2002; Robertson 1996). GFP can be seen as a way to compensate or protect groups or companies who suffer from capricious government behavior.

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[11] This justification is strictly Lockean only to the extent that the past behaviour fulfils certain criteria, such as being beneficial and tangible – see Raymond (2003). In reality, not all proponents of GFP are this restrictive.

A second type of justification for GFP is the *Realpolitik* idea that the generous entitlements provided under grandfathering are needed to secure the approval and participation of the powerful owners of polluting assets in anti-pollution legal frameworks (Gosseries 2004). Giving away pollution rights may not be a just distributive criterion in itself, but its application is tolerated in the short term in order to avoid the much worse long-run outcome of failing to effectively mitigate pollution. Recognizing this, a common modification to GFP is to acknowledge historical claims and the necessity of political feasibility in the short term, but then impose a transitional arrangement whereby historical high-emitters gradually have their pollution rights reduced over time (Bovens 2011).

Since GFP is concerned with the distribution of pollution rights rather than mitigation duties, it needs to be adapted and extended to be meaningful in the context of who should pay for clean energy infrastructure. If we interpret the right to emit pollution in the future as equivalent to the right to not pay for mitigation, this implies that historical polluters should contribute little to current mitigation efforts, and that historically non-polluting agents should shoulder the cost instead. Under a policy 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), certificates could be given away to historical polluters while being sold to historical non-polluters. Alternately, historical polluters could be exempted from participating in the policy at all or compensated outside the framework for the certificates they purchase, for example through adjustments in the broader tax code. Since this outcome would run contrary to many notions of individual and historical responsibility and so risk public non-acceptance (Neumayer 2000), a 'transitional' application of the principle might provide for distributing the cost of mitigation differently once the necessary legal regime for avoiding catastrophic damages had been put in place.

3.5. Summary

Table 1 summarizes how much of the clean energy infrastructure cost burden different groups would pay under each principle. It specifies whether households would pay more, less or the same, relative to a baseline where everyone pays the same amount, depending on whether they are high-polluting, low-polluting, wealthy or poor.

Table 1: Who pays more or less for clean energy infrastructure under each principle

	High-polluting households	**Low-polluting households**	**Wealthy households**	**Poor households**
Polluter Pays	More*	Less*	Same	Same
Ability to Pay	Same	Same	More	Less
Beneficiary Pays	Same	Same	More**	Less**
Grandfathering	Less§	More§	Same	Same

**Except where emissions are a consequence of excusable ignorance and/or the fulfillment of basic needs*

***Provided that wealth differences are traceable to benefits from pollution*

§*Under an interpretation of duties rather than rights*

4. Criteria for evaluating distributive fairness

Here we use the four principles to develop three normative criteria against which to assess clean energy financing mechanisms. Our approach combines all four principles to avoid some of the strongest objections to each principle when taken individually. The practice of combining principles is not uncommon among moral philosophers generally (Berlin 1990) and has several precedents in climate justice discussions specifically (Caney 2005; Miller 2008). We aim to identify fairness criteria that address the practical problem facing decision makers discussed in section 2: how to distribute this new cost burden across households within the current generation, within an individual nation, in a way that the public understands and supports.

In developing the fairness criteria we focused on how decision makers might distribute the burden across *households.* This is because households tend to be the social unit governments use to monitor the degree of socioeconomic inequality in many countries and so make a sensible unit for thinking about the impact of new distributive decisions. Households are also the most relevant social group in the three clean energy roll-out programs in California, Australia and the UK that we apply the fairness criteria to below, both in terms of program participants and in terms of payers (either as electricity bill payers or tax-payers). This provides a certain symmetry across agents, payers, and beneficiaries. That symmetry that lets us focus on how the burden should be shared across rich and poor households, which we see as the main practical question facing decision makers today, as opposed to the deeper but perhaps less urgent political economy question of how such a burden might be shared across households and corporate entities (firms, governmental entities, other groups).

Proceeding with the fairness criteria, a first problem decision makers face is deciding which households should be payers and which households should be non-payers, or stated another way, whether there are households that should be excluded from paying anything at all. PPP and ATPP give the clearest guidance of all the principles on how to define the relevant group of payers for a burden that is pollution-correcting. PPP states that polluters should pay in proportion to their pollution. This implies that households that do not currently pollute should not pay.[12] ATPP states that only those who are financially able to pay should do so, thus exempting those who are considered unable to shoulder the costs.

GFP can also be invoked to separate non-payers from payers, though the number of affected households is likely to be small. GFP implies that some households have 'acquired' the right to continue to pollute and by extension that they should be excused from paying, due to past decisions they took in relation to pollution. This could be the case for households that previously installed polluting electricity generation equipment at their residences under the reasonable belief that they would not be asked one day to contribute to a clean energy infrastructure program. This exemption would not apply to all households that previously polluted through general electric grid electricity consumption however, because someone else took the polluting investment decision on those households' behalf and so it is someone else that would be harmed by unforeseeable government action. These exemptions would only be

[12] Another possible and considerably narrower interpretation of PPP holds that it would be unfair to ask a household to pay for a policy that reduces a polluting activity (e.g., coal-fired power generation) if said household had no part in this activity (e.g., does not consume electricity). In the clean energy context, this would imply exempting households that are not connected to the electric grid but may have substantial pollution from other activities, such as driving. A problem with this narrower interpretation is that its validity depends heavily on policy context. It may be seen as 'fair' when parallel programs exist to mitigate automobile pollution and driving-only polluters are made to pay for those programs; it could be seen as 'unfair' when those programs are not in place because driving-only polluters 'pollute for free'. This distinction may not be practically important because there are likely to be very few households that cause driving pollution without causing electric grid pollution, meaning the number of exempted households would be very small.

justifiable under an interpretation of GFP that extends a right to pollute to an entitlement to not mitigate.

It could also be justifiable under GFP to *temporarily* exclude some households from paying if this were necessary to secure the political support needed to realize the program. The households excluded under this *Realpolitik* justification would be the politically powerful ones that would otherwise block the program entirely and which require special concession to acquiesce. They would then begin to pay after some mutually-agreed period of adjustment for example.

Together these principles give a basis for circumscribing a group of payer households in the clean energy infrastructure context.

> Criterion A (only financially able polluters should pay): the cost of a clean energy infrastructure program should be borne by the households that consume the goods and services that cause the pollution that the new infrastructure is intended to correct, and are also financially able to shoulder this cost. Households that have zero current pollution or satisfy restrictive conditions under the grandfathering principle may be excluded.

Decision makers also face the question of how to distribute program costs across households with different pollution levels and income characteristics once the relevant group of payers has been established. Again, we can look to more than one principle for guidance. Under PPP, fairness is present when a household's payment is proportional to its current pollution level. The more pollution it causes, the more it needs to pay in order to undo the total pollution damage. Under BPP, fairness is present when a household's payment is proportional to the benefit or windfall it derives from polluting activities. The greater the benefit it enjoys, the more it needs to pay in order to surrender the entirety of the benefit that is traceable to pollution. Under ATPP, fairness is present when a household's payment is proportional to its ability to make the payment. This implies spreading the absolute money cost unequally (i.e., proportionally to unequally distributed income), but the felt burden of making the assigned payment should be similar for all households.

Exactly how payments are linked to these metrics will depend on country context and program-specific factors, and choosing among them and appropriately implementing them in practice is a question for individual decision makers. In practice, all three types of proportionality (pollution, windfall or ability) may produce similar policy outcomes, depending on the correlation between income and consumption of polluting goods and services.

The basic idea of proportionality in household payments is captured in our second criterion.

> Criterion B (proportional payments should be charged to paying households): The program cost should be apportioned among paying households in a variable rather than a fixed manner and in proportion to the level of pollution, the level of benefit derived from that pollution, and/or income or other indicator of ability.

Today's decision-makers are acting in a context of historically high and rising levels of socioeconomic inequality in several countries. They should be sensitive to the risk of worsening the material position of the lowest-income households in absolute terms. ATPP addresses this concern because it imposes a level of payment on the poorest households that does not exceed their 'ability' to pay. Modified versions of PPP state that the level of payment, which is pollution-linked, should be reduced or eliminated to the extent that polluting is necessary to meet their basic needs.

In our research here and elsewhere (Grover 2013) we have found that decision–makers can reach financing arrangements for clean energy infrastructure programs that spread program *costs* across all types of households, but which overlook the distribution of program *benefits*. This is because higher income households tend to participate more in these programs than lower-income households. This means that even if decision-makers achieve fairness in the proximate distribution of program costs, fairness can be eroded on the benefit-distribution side when participation across social groups is variable.

None of the four principles gives clear guidance on the distribution of program benefits but because this is an integral part of the overall incidence of these programs, the third criterion is designed to protect the most vulnerable households, including on the benefit-distribution side..

Criterion C (welfare levels of the lowest-income households should be protected): the program should make concrete provisions to protect low-income households against declines in welfare either by reducing payments where pollution is necessary to meet basic needs, and/or by ensuring that these households share substantially in the benefits of the program, thus offsetting the cost.

We now apply these criteria to clean energy roll-out programs in Australia, California and the UK.

5. Evaluation of clean energy programs

Here we apply the fairness criterion to small scale and household-level deployment programs in California, Britain and the UK. For each of the three programs we describe: aims and design, total expected implementation cost, total expected uptake or participation, the origin of the funds to pay for the program, and any safeguards or provisions that were put in place to promote distributive fairness. We then evaluate each program against the fairness criteria.

We acknowledge that the distributive arrangements behind these programs may not be representative of the arrangements behind commercial and industrial scale programs. The aim of this paper is to broach the fairness issue in this context and to use real examples to illustrate what it means for policy. Elucidation is our objective, more than representativeness. That said, small-scale and household capacity is estimated to account for one-quarter of all annual renewables capacity investment globally in 2015 (USD 73 billion) (UNEP and BNEF 2015).[13]

Table 2 summarizes the main features of the programs and our fairness evaluation.

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[13] We also recognise that there are other costs of deploying renewables beyond the capital cost. We are thankful to an anonymous reviewer for pointing out the substantial additional costs related to connecting and distributing electricity produced by this new infrastructure. We note that in the Flanders region of Belgium and in the US states of Arizona and Idaho, specific fees have been imposed on installation owners per kilowatt of installed capacity to cover these costs, and it seems reasonable the issues raised in this paper apply to the distributive arrangements under those programs as well.

Table 2: Summary of fairness evaluation of clean energy roll-out programs

	Expected cost	Number of installations	Criterion A: Only financially able polluters should pay	Criterion B: Proportional payments should be charged to paying households	Criterion C: welfare levels of the lowest-income households should be protected
Australian Photovoltaic Rebate Program (2000-2010)	AUD 1.1 billion	109,634	Not satisfied	Satisfied	Satisfied
British Feed-in Tariff for small scale PV (2010-2015)	GBP 8-10 billion	683,322*	Partly satisfied	Not satisfied	Not satisfied
California Solar Energy Initiative (2007-2014)	USD 2.2 billion	156,704	Partly satisfied	Not satisfied	Satisfied

*To date (mid-2015).

5.1. The Australian Photovoltaic Rebate Program

Australia initiated the Photovoltaic Rebate Program (PVRP) in 2000 to promote the uptake of solar PV installations.[14] Program 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 Department of the Environment 2006; Australian National Audit Office 2010).

The PVRP pursued these aims by providing a cash rebate to individuals who registered PV installations under the program. The level of the incentive changed over time, 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 paid the rebate directly to individual applicants.

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 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 into existence 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 the following allocations (Lyster and Bradbrook 2006):

[14] 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.

Partly to deal with over-enrollment problems, the Government introduced a means test for participation in May 2008, which limited eligibility to households with a combined annual taxable income of less than AUD 100,000 (Australian Department of the Environment 2006). 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 in 2010.

We now evaluate the cost distribution arrangements underlying the Australian PVRP against the three distributive fairness criteria. [15]

To evaluate Criterion A we looked for evidence that the program cost was allocated mainly to well-off polluters. We do not find strong evidence of this. The PRVP was paid for out of general fund revenues raised by the Australian government through general taxation, meaning there was no deliberate link drawn in program design between paying and polluting households. Nor do we find evidence of deliberate exemptions under the program for non-

[15] Several studies have identified concerns about the distribution of the benefits of the Australian program 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.

polluting households or for households financially unable to pay. We do not find evidence that Criterion A was fulfilled.

Under Criterion B we looked for household payment levels that were proportional to ability, pollution or benefit from pollution. Because the program was paid for by the Australian government through general tax revenues, and because the Australian tax system is regarded as one of the most progressive in the OECD (Australian Government 2015; Paturot et al 2013) in part because of the relief it provides for poor households, we count this as evidence of a distributive arrangement consistent with the idea of proportional payments, particularly ability. We find that criterion B was fully fulfilled.

For criterion C we looked for program provisions that protected the welfare levels of the lowest-income households, including on the benefits-distribution side of the program. We find that this outcome was achieved by funding the program through general tax revenues and also by implementing the means test, which concentrated more of the benefits of the program on lower-income households, thus reducing their net payments. We find that criterion C was fully fulfilled.

5.2. The British Feed-in Tariff for small scale installations

The British Feed-in Tariff (FiT) encourages uptake of small-scale clean energy installations including PV. It aims to fulfill the requirements of the EU Directive on Electricity Production from Renewable Energy Sources (2001/77/ED), which requires the UK to produce at least 15 percent of gross electricity consumption from clean sources by 2020 (DECC 2011).

The program began in April 2010 and guarantees a regular payment to installation owners for the clean energy they produce. The payment varies by installation size and type but a typical household installation received around GBP 0.38 per kWh in the first year of the program and was receiving around GBP 0.10 at the time of writing. Program records show that 683,322 installations had registered at the time of writing (July 2015). Ninety-one percent of installations are PV and 97 percent are installed at domestic premises. The total cost of the program over its 25-year program life is estimated at between GBP 8 and 10 billion (DECC 2009).

The program is paid for by electricity customers through electricity bill levies. A key distributive decision in program design was to allow the electricity suppliers to decide how to distribute this cost across their customer bases. By doing so the government relinquished control over deciding how much different household types pay.

Under fairness Criterion A we looked for evidence that the program cost was allocated mainly to financially able polluting households. We find that the funding method, which links households' payments to their consumption of a polluting good (main-grid electricity), is likely to link paying households to polluting households more closely than a strategy of funding the program through general tax revenue. However, we do not find any evidence of exemptions for households that are financially unable to pay. This outcome arises at least partly from the program design decision to allow the electricity suppliers to decide how to the program cost is passed on, with apparently little or no government oversight. We therefore find that criterion A is only partly fulfilled.

Under Criterion B we looked for evidence that program costs were spread across households in a way that was proportional to their ability to pay, pollution, or benefit from pollution. Again, the decision to allow electricity suppliers to determine how payments were spread across households creates, at the very least, opacity around how much households of different types pay. We do not find evidence that Criterion B was fulfilled.

Under Criterion C we looked for program provisions that protect the lowest-income households. We find no evidence of this on either the cost- or benefit-distribution side of the program. Even if the electric utilities decided to distribute the cost across households according to income or some proxy for it, this would have happened in spite of the program design, not because of it. We do not find evidence that Criterion C was fulfilled.

5.3. The California Solar Energy Initiative

The California Solar Energy Initiative (CSI) aimed 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). It started in 2007 and is winding down at the time of writing.

The program uses two separate incentives to achieve these aims. The first is a feed-in tariff-like payment made to installation owners for each kWh of electricity produced. This incentive supports 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. Under the second incentive the installation owner receives a single upfront payment for each watt installed, ranging from USD 2.75 to 0.37, again depending on the level of program installed capacity (CPUC 2013).

Program data shows that 148,894 installations had registered under the program by February 2015 for an estimated 1,900 MW of installed solar PV capacity (California Solar Statistics 2015). 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 program on electricity customers' bills be cost-neutral, meaning it be, in the Legislature's words:

> '. . . 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 program explicitly supports participation by low- and very low-income households. The legislature set aside 10 percent of the total USD 2.167 billion program 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 geographic-area mean can qualify for highly or fully subsidized PV systems, respectively. The California Public Utilities Commission estimated that 5,000 low-income households and 1,800 very low-income households would be eligible for these systems through incentives, tax credits and other financing mechanisms. The program facilitates low-interest loans for any remaining system cost.

We find that Criterion A was partly fulfilled because the California legislature took a decision to spread the cost across electricity-using households, which as discussed above draws a closer link between payers and polluters than funding the program through general taxation. However as under the UK program we do not find that there was a provision in place to ensure the program cost was born by *financially able* households. We also recognize the California Legislature's intent that electricity bill payers *as a group* recover the program investment through lower electricity rates, making the program cost neutral overall, but we find no evidence that this arrangement nullified the contribution of households that were financially unable to pay, either in intent or in practice.

Under Criterion B we looked for household payment levels that were proportionally linked to household ability to pay, pollution, or benefit from pollution. Despite looking through a wide range of policy design documents concerned with fiscal aspects of the program we do not find any evidence of this. We therefore do not find evidence that Criterion B was fulfilled.

Under Criterion C we looked for program design decisions that deliberately protected the absolute and/or relative welfare levels of the lowest-income households. We find clear evidence of this in the form of the decision to ring fence 10 percent of the total program budget for participation by low- and very-low income households. We find fairness Criterion C fully fulfilled.

6. Conclusions: towards fairness

Globally, subsidies for clean energy deployment represent a large new public spending burden with potentially important implications for distributive fairness across households within countries and within the current generation. Our contributions in this paper have been to identify established principles of distributive fairness that are relevant in this new policy context, to adapt and apply these principles to yield three normative fairness criteria, and to use the criteria to illustrate in the context of three real deployment programs when fairness may and may not be present. Throughout, our aim has been to produce tangible insight and guidance for decision makers on this new issue.

Our message for policymakers is that distributive fairness under these programs is a legitimate concern that becomes more important in a context of historically high levels of within-country economic inequality. Decision makers can begin to address this concern by holding up program design decisions against the normative fairness criterion we developed here, to examine the distributive implications of those decisions. We have shown that program designs may be fairer, or less unfair, if decision makers consider which agents should be payers and which should be non-payers, if they are guided by the principle of proportionality in how they distribute the cost across paying households, and if they also include provisions to protect the lowest-income agents, including on the benefit-distribution side of these programs.

It remains to point out several caveats to our findings for users of this research. The first is that our aim has not been to discuss intra-generational fairness in any generality, but rather to provide specific and practical guidance to policymakers who are interested in spreading the cost of clean energy infrastructure fairly, particularly in situations where households are expected to shoulder the cost.

The second is that clean energy deployment programs can be motivated into existence by policy aims other than mitigating GHG emissions, such as energy security and economic development. Our findings are most relevant to guiding distributive decisions insofar as these programs are motivated by GHG mitigation. That does not mean that our findings are irrelevant to distributive decisions in programs motivated by other reasons, but rather that there may be different nuances to notions of distributive fairness under other policy aims. The presence of other aims emphatically do not nullify the need for a fair distribution of costs.

A third caveat is that the proximate distributive incidence of a program may be different to the final distributive incidence, and that decision makers should ultimately be concerned with the latter. One way to address this issue is by focusing on the distributive impact on households as we have done here, as these agents may have fewer options for passing on the cost to other entities. Still, decision makers can take steps to avoid unintended distributive outcomes by, for example, using computable general equilibrium analysis to model and anticipate these impacts, and adjust their design decisions accordingly.

A final caveat relates to the degree of transparency decision makers decide to adhere to in the financing arrangements that underpin these programs. While we have given limited attention to notions of *procedural* fairness in this paper for reasons discussed in section 3, we see strength in the argument that the best arrangement is one where payers are aware both of how much they are paying and of *why* they are paying what they are paying. The moral-philosophical and more pragmatic reasoning behind cost distribution decisions are not always easy to convey to a public audience, but we hope that our 'applied' discussion and application of these principles to a concrete policy context will go some way to easing that burden.

7. References cited

Adler JH. 1995. Making the Polluter Pay. The Freeman, 1 March 1995. Available at http://fee.org/freeman/making-the-polluter-pay/. [Retrieved 3 October 2015.]

Arrow KJ, Cropper ML, Gollier C, Groom B, Heal GM, Newell RG, Nordhaus WD, Pindyck RS, Pizer WA, Portney PR, Sterner T, Tol RSJ and Weitzman RL. 2015. *Review of Environmental Economics and Policy* 8(2): 145-163.

Australian Department of the Environment, Water, Heritage and the Arts. 2006. The Australian Government Photovoltaic Rebate Programme: Guidelines for Applicants – Effective January 2006. Melbourne: Sustainability Victoria.

Australian Government. 2015. Re:think: Tax discussion paper. Commonwealth of Australia. Available at http://bettertax.gov.au/files/2015/03/TWP_combined-online.pdf. [Retrieved 3 October 2015.]

Australian National Audit Office. 2010. Administration of Climate Change Programs. Barton, ACT: Commonwealth of Australia. Audit Report No.26 2009–10.

Baatz C. 2013. Responsibility for the past? Some thoughts on compensating those vulnerable to climate change in developing countries. *Ethics, Policy and Environment* **16**(1): 94-110.

Baer P. 2002. Equity, Greenhouse Gas Emissions and Global Common Resources. In Climate Change Policy: A Survey, Schneider SH, Rosencrantz A, Niles J (eds): 393-408. Island Press: Washington, DC.

Bastianoni S, Pulselli FM and Tiezzi E. 2004. The problem of assigning responsibility for greenhouse gas emissions. Ecological economics 49(3): 253-257.

Borenstein S. 2013. The California Solar Initiative is ending. What has it left behind? *The Berkeley Blog*. June 18, 2013.

Bovens L. 2011. A Lockean Defense of Grandfathering Emission Rights. Chapter 6 in The Ethics of Global Climate Change, Ed Arnold DG. Cambridge: CUP.

Broome J. 1984. Uncertainty and Fairness. Economic Journal 94(375): 624-632.

Broome J. 2012. Climate matters. London: WW Norton.

Bullard RD. 1994. Unequal protection: Environmental Justice and Communities of Color. San Francisco: Sierra Club Books.

Butt D. 2007. On benefitting from injustice. Canadian Journal of Philosophy 37: 129.

Butt D. 2009. Rectifying International Injustice: Principles of Compensation and Restitution Between Nations. Oxford University Press: Oxford.

California Solar Statistics. 2015. Online database of California Solar Initiative program statistics. Available at http://californiasolarstatistics.ca.gov/. Accessed February 2015.

California State Legislature. 2006. Senate Bill No. 1, Chapter 132. Page 83.

California Public Utilities Commission (CPUC). 2013. California Solar Initiative Program Handbook. April. San Fransisco, CA: CPUC.

California Public Utilities Commission (CPUC). 2014. California Solar Initiative Annual Program Assessment. June.

Caney S. 2005. Cosmopolitan justice, responsibility and global climate change. *Leiden Journal of International Law* **18**(4): 747-775.

Caney S. 2009. Justice and the distribution of greenhouse gas emissions. *Journal of Global Ethics* **5**(2): 125-146.

Caney S. 2014. Two kinds of climate justice: Avoiding harm and sharing burdens. *The Journal of Political Philosophy* **22**(2): 125-149.

Coase R. 1960. The Problem of Social Cost. *Journal of Law and Economics* **3**(1): 1-44.

Cramton P and Kerr S. 2002. Tradeable Carbon Permit Auctions: How and why to auction not grandfather. *Energy policy* **30**(4): 333-345.

Department of Energy and Climate Change (UK). 2009. Impact Assessment of Feed-in Tariffs for Small-Scale, Low Carbon, Electricity Generation, London: DECC. URN 09D/703.

Department of Energy and Climate Change (UK). 2011. UK Renewable Energy Roadmap, London: DECC. URN 11D/698.

Dodge JM. 2005. Theories of Tax Justice: Ruminations on the Benefit, Partnership, and Ability-to-Pay. Tax Law Review 399.

Ellerman, AD, Buchner BK, and Carraro C (Eds). 2007. Allocation in the European Emissions Trading Scheme: Rights, Rents and Fairness. Chapter 1, pages 3-12. Cambridge, UK: CUP.

European Commission. 2014. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A policy framework for climate and energy in the period from 2020 to 2030. Brussels: EC. COM/2014/015.

Feinberg, J. (1970) 'Collective Responsibility', in Doing and Deserving: Essays In The Theory of Responsibility. Princeton: Princeton University Press pp. 222- 251.

Fullerton D. 2011. Six Distributional Effects of Environmental Policy. NBER Working Paper 16703.

Fullerton D and Metcalf GE. 2002. Tax incidence. NBER Working Paper 8829.

Gosseries A. 2004. Historical Emissions and Free-riding. *Ethical Perspectives* **11**(1): 36-60.

Goulder L and Williams RC. 2012. The Choice of Discount Rate for Climate Change Policy Evaluation. NBER Working Paper 18301.

Grainger CA, Kolstad CD. 2009. Who pays a price on carbon? NBER Working Paper 15239.

Green J and Baron J. 2001. Intuitions about declining marginal utility. Journal of Behavioural Decision Making 14: 243-255.

Grover D. 2013. The British feed-in tariff for small-scale renewable energy systems: Can it be made fairer? Policy paper. London: Center for Climate Change Economics and Policy and Grantham Research Institute on Climate Change and the Environment.

Harrison D and Radov DB. 2002. Evaluation of Alternative Initial Allocation Mechanisms in a European Union Greenhouse Gas Emissions Allowance Trading Scheme. National Economic Research Associates (NERA).

Huseby R. 2013. Should the beneficiaries pay? *Politics, Philosophy & Economics* **23**: 1-17.

Hyams K. 2009. A Just Response to Climate Change: Personal Carbon Allowances and the Normal-Functioning Approach. *Journal of Social Philosophy* **40**(2): 237-256.

International Energy Agency and Organisation for Economic Cooperation and Development. 2014. World Energy Investment Outlook. Paris: OECD.

Intergovernmental Panel on Climate Change (IPCC). 2011. Decision-making frameworks. Chapter 10 in Climate Change 2001, contribution by Working Group III: Mitigation. Geneva: IPCC.

Jamasb T and Meier H. 2010. Household Energy Expenditure and Income Groups: Evidence from Great Britain. University of Cambridge Electricity Policy Research Group, Working Paper 1003.

Keynes JN. 1917. The Scope and Method of Political Economy. London: Batoche Books.

Kingston E. 2014. Climate justice and temporally remote emissions. *Social Theory and Practice* **40**(2): 281-303.

Kotlikoff, LJ and LH Summers (1987) 'Tax incidence', Chapter 16 in Handbook of Public Economics, vol. II, AJ Auerbach and M Feldstein Eds. North-Holland: Elsevier.

Lindhqvist, T. 2000. Extended Producer Responsibility in Cleaner Production. Unpublished PhD Thesis, Lund University.

Lyster, R and Bradbrook A. 2006. Energy Law and the Environment. Pages 85-87. Cambridge: CUP.

Macintosh A and Wilkinson D. 2010. The Australian Government's solar PV rebate program: An evaluation of its cost-effectiveness and fairness. Policy Brief No. 21. Page 9. Australia National University Centre for Climate Law and Policy and the Australia Institute.

Maltais A. 2010. Failing International Climate Politics and the Non-ideal Duties of Leadership. Department of Government working paper, Uppsala University, Sweden.

McCollum D, Nagai Y, Marangoni G, Calvin K, Pietzcker R, van Vliet J, van der Zwaan B. 2014. 'Energy investments under climate policy: a comparison of global models.' *Climate Change Economics* **4**(04): 3-32. DOI: 10.1142/S2010007813400101

Menezes F, Quiggin J and Wagner L. 2009. 'Grandfathering and greenhouse: The role of compensation and adjustment assistance in the introduction of a carbon emissions trading scheme for Australia'. *Economic Papers, 28* 2: 82-92.

Metcalf GE, Mathur A, Hassett KA. 2010. Distributional impacts of comprehensive climate policy package. NBER Working Paper 16101.

Miller D. 2001. Distributing responsibilities. *Journal of Political Philosophy* **9**(4): 453-471.

Miller D. 2004. Holding Nations Responsible. *Ethics* **114**(2): 240-268.

Miller, WI. 2005. Eye for an Eye. New York: CUP.

Miller D. 2008. Global justice and climate change: how should responsibilities be distributed? *The Tanner Lectures on Human Values, delivered at Tsinghua University, Beijing*: 119-156.

Nelson T, Simhauser P and Kelly S. 2011. Australian Residential Solar Feed-in Tariffs: Industry Stimulus or Regressive form of Taxation? *Economic Analysis & Policy* **41**(2): 113-129.

Neumayer E. 2000. In defence of historical accountability for greenhouse gas emissions. *Ecological Economics* **33**(2): 185-192.

Nordhaus W. 2008. A Question of Balance: Weighing the Options on Global Warming Policies. Yale University Press: New Haven, CT.

Organisation for Economic Cooperation and Development. 2008. Environmental Outlook to 2030. Organisation for Economic Co-operation and Development (OECD). Available at: http://www.oecd.org.

OECD. 2011. Divided We Stand: Why Inequality Keeps Rising. Paris: OECD Publishing.

Ofgem. 2013. Updated household energy bills explained. Factsheet 98. London: Ofgem.

Page E. 1999. International justice and climate change. *Political Studies* **47**(1): 61-66.

Page E. 2012. Give it up for climate change: A defense of the beneficiary pays principle. *International Theory* **4**(2): 300-330.

Parfit D. 1984. Reasons and Persons. Oxford: Clarendon Press.

Pascual U, Muradian R, Rodríguez LC and Duraiappah A. 2010. Exploring the links between equity and efficiency in payments for environmental services: A conceptual approach. Ecological Economics 69: 1237-1244.

Paturot D, Mellbye K and Brys B. 2013. Average Personal Income Tax Rate and Tax Wedge Progression in OECD Countries. OECD Taxation Working Paper 15.

Pelletier N. 2010. Environmental sustainability as the first principle of distributive justice: Towards an ecological communitarian normative foundation for ecological economics. Ecological Economics 69: 1887-1894.

Pigou AC. 1932. The Economics of Welfare. 4th edition. London: Macmillan.

Piketty T and E Saez. 2003. Income Inequality in the United States 1913-1998. Quarterly Journal of Economics CXVIII (1): 1-39.

Proctor RJ. 2014. Fixed-Cost Recovery, Renewables Adoption and Rate Fairness. The Electricity Journal 27(5): 42-53.

Raymond LS. 2003. Private rights in public resources: equity and property allocation in market-based environmental policy. Washington, DC: Resources for the Future.

Rhodes EL. 2003. Environmental Justice in America. Indiana University Press: Bloomington, IN.

Ringius L, Torvanger A and Underdal A. 2002. Burden Sharing and Fairness Principles in International Climate Policy. International Environmental Agreements 2(1): 1-22.

Robertson HG. 1995. If Your Grandfather Could Pollute, So Can You: Environmental “Grandfather Clauses” and Their Role in Environmental Inequality. Catholic University Law Review 45(1): 131-179.

Rode A. 2014. Rent-seeking over tradable emissions permits: Theory and evidence. AEA Conference Proceedings 2015 and working paper, Department of Economics, University of Chicago.

Samuelson PA. 1937. A Note on Measurement of Utility. The Review of Economic Studies 4 (2): 155-161.

Schlosberg D. 2007. Defining Environmental Justice: Theories, Movements, and Nature. London: OUP.

Schwartz P. 2010. The polluter-pays principle. Chapter 12 in Research Handbook on International Environmental Law, Eds Fitzmaurice M, Ong CM and Markouris P. Cheltenham: Edward Elgar.

Shue H. 2010. Subsistence Emissions and Luxury Emissions. In Climate Ethics: Essential Readings, Gardiner SM, Caney S, Jamieson D, Shue H (eds): 200-214.

Singer P. 2010. One Atmosphere. In Climate Ethics: Essential Readings, Gardiner SM, Caney S, Jamieson D, Shue H (eds): 181-199.

Smith S. 1992. The distributional consequences of taxes on energy and the carbon content of fuels. *European Economy, Special Edition no. 1:* 241-267.

Stern N. 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press: Cambridge.

Stern N. 2014. Ethics, equity and the economics of climate change paper 1: Science and philosophy. *Economics and Philosophy* **30**(3): 397-444.

Stern N. 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press: Cambridge.

Stern N. 2014. Ethics, equity and the economics of climate change paper 1: Science and philosophy. *Economics and Philosophy* **30**(3): 397-444.

UNEP. 2015. Global Trends in Renewable Energy Investment. Frankfurt: Frankfurt School-UNEP Centre and Bloomberg New Energy Finance. Available at http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2015. [Retrieved 3 October 2015.]

United Nations Framework Convention on Climate Change (UNFCCC). 1992. http://unfccc.int/resource/docs/convkp/conveng.pdf [Retrieved 14 February 2014].

United States Census Bureau. 2011. Share of Aggregate Income Received by Each Fifth and Top 5 Percent of Households. Available at: www.census.gov/hhes/www/income/data/historical/household/index.html.

Weitzman ML. 2007. A review of the Stern Review on the Economics of Climate Change. *Journal of Economic Literature* **45**(3): 703-724.

Woerdman SC, Clò and Arcuri A. 2008. European emissions trading and the polluter-pays principle: assessing grandfathering over allocation. In Faure M and Peeters M (Eds). 2008. Climate Change and European Union Emissions Trading: Lessons for Theory and Practice. Cheltenham, UK: Edward Elgar.

Wood G and Dow, S. 2011. What lessons have been learned in reforming the Renewables Obligation? An analysis of internal and external failures in UK renewable energy policy. *Energy Policy*, **39**(5), 2228-2244.

Young HP. 1990. Progressive taxation and equal sacrifice. *American Economic Review*

80(1): 253-266.