

Harry Granqvist and David Grover Distributive fairness in paying for clean energy infrastructure

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Distributive fairness in paying for clean energy infrastructure

January 2016

Harry Granqvist
London School of Economics and Political Science
harry.granqvist@alumni.lse.ac.uk

David Grover[§]
Associate Professor, Grenoble School of Management
Honorary Research Fellow, University College London
Associate, London School of Economics
d.grover@lse.ac.uk

[§] Corresponding author

45 Abstract

46

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

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

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

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166 *'A policy that averted dangerous climate change would nonetheless be unfair if the duties to*
167 *mitigate and adapt were unfairly distributed. It is not enough to devise efficient policy*
168 *proposals for they might be thoroughly unjust in their distribution of the costs.'* (Caney 2009:
169 127)

170

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

176

177

178 **1. Motivation and background**

179

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

182

183 We start from the premise that the level of clean energy capital spending globally is projected
184 to grow from an estimated USD 214 billion in 2014 to USD 300 billion by 2020 (IEA/OECD
185 2014) and that very little public discussion has focused on what might constitute a fair
186 distribution of this spending burden. Some modelling work suggests that investment levels
187 would need to reach USD 1.1 trillion annually, in order to achieve mitigation consistent with
188 a 2-degree target (McCollum et al 2014).¹ Distributive concerns are material here because
189 this investment tends to be motivated into existence by government subsidies, and the cost of
190 these subsidies tends in turn to be passed on to either tax payers or electricity utility
191 customers. Evidence suggests that the distribution of the costs and benefits of these subsidies
192 across socioeconomic groups is not being taken adequately into account, including in
193 programs in Australia (Macintosh and Wilkinson 2010), the United Kingdom (Grover 2013)
194 and California (Proctor 2014) that we consider in this paper.

195

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.

196 The question of fairness in sharing this new cost also sits in a context of historically high and
197 rising income inequality (since the early 1900s) in several of the countries leading the clean
198 energy investment charge. These include Germany, Norway and the United States (OECD
199 2008; OECD 2011; Piketty 2014; Piketty and Saez 2003; US Census Bureau 2011). In line
200 with the quotation from political philosopher Simon Caney (2009) in the header above, it
201 seems to us that policies that succeed in mitigating GHG pollution should not do so in a way
202 that worsens socioeconomic inequality.

203

204 This paper extends a growing literature about fairness in distributing the cost of mitigating
205 (GHG) pollution more generally. Climate change economics research has turned to moral
206 philosophy in recent years for guidance in deciding how much the current generation should
207 be asked to pay to mitigate future pollution damages (Nordhaus 2008; Stern 2014; Weitzman
208 2007). Moral philosophers have at the same time been developing a ‘climate justice’
209 narrative around the closely related question of who should pay for mitigation or any other
210 action necessary to keep global warming from becoming any more harmful than necessary
211 (Shue 2010, Caney 2009). These theoretical discussions do not always offer tangible
212 guidance for policymakers on how fairness might look in practical terms, however.

213

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

225

226 This prior work takes us some way to understanding the broad contours of how distributive
227 fairness might look in policy contexts involving environmental policy and pollution, but not
228 all the way to distributing the clean energy infrastructure burden specifically. The question,
229 therefore, that we set out to answer in this paper is, ‘What practical guidance can be drawn

230 from existing principles of distributive justice for fairly sharing the cost of clean energy
231 infrastructure?’

232

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

241

242

243 **2. Framework for analysis**

244

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

253

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

261

262 We have chosen to frame our question mainly in terms of the fair distribution of a new *cost* or
263 *burden* associated at least in part with mitigating GHG emissions, but we are aware that the

264 question could also be framed in terms of fairly distributing the *benefits* of clean energy
265 infrastructure itself. One reason that we chose the costs framing is because we felt that there
266 could be greater consequence for vulnerable social groups to an inequitable distribution of
267 costs than to an inequitable distribution of benefits. New costs seem more likely to affect
268 current welfare levels of these groups in absolute terms. However, in both the discussion of
269 distributive principles and in the evaluation of actual policies, we try to account for how
270 program benefits flow to low-income groups when they do, not least as ‘negative costs’.
271 Another reason for our costs-focused approach is that decision-makers in this context
272 typically have greater control over how the cost of clean energy infrastructure policies are
273 spread than over who participates in them and therefore who benefits.

274

275 In any discussion of distributive outcomes it is important to distinguish between a policy’s
276 proximate (or immediate) impact, and its final (or ultimate) incidence (Fullerton and Metcalf
277 2002). It is possible, indeed common, for a policy to satisfy common notions of fairness in
278 its immediate impact but result in an unfair final incidence (Kotlikoff and Summers 1987).
279 This can happen when the agents who are directly liable to pay the new cost or tax shift it
280 forward or backward through asset price adjustments and/or because the new cost may cause
281 equilibrium adjustments that alter factor prices themselves (Kotlikoff and Summers 1987).
282 Our view is that decision-makers should aim to achieve a fair *ultimate* incidence in the
283 policies they design, but we also recognize that this is not always an easy ask. Technical aids
284 to policy design like detailed regulatory impact assessment and computable general
285 equilibrium (CGE) modelling will often be necessary to ensure that this outcome is fully
286 achieved over different time horizons and economic sectors. Our primary aim in this paper is
287 to direct decision makers’ attention to notions of fairness in the *proximate* distribution of
288 public costs, which we see as an important first step towards realising fairness also in the
289 ultimate sense. We emphasize this and other caveats to policy implementation and design in
290 the conclusions section.

291

292 We have limited the scope of our analysis in several important ways in order to place clear
293 boundaries on our question and to produce meaningful guidance for policymakers. We do
294 not address the question of who should bear responsibility for historical GHG pollution or
295 what a fair shouldering mitigating its damage should look like. This is because clean energy
296 infrastructure by definition only mitigates current and future pollution. We also focus on the
297 question of distributive fairness within the current generation rather than the between-

298 generations question. This is because inter-generational burden-sharing is well covered in the
299 debate over how to discount avoided climate damages (Arrow et al 2014) and because intra-
300 generational burden sharing is most relevant to the financial scale of the policies we consider
301 empirically. We also limit our discussion to how the cost should be shared across people
302 within individual countries. This is because building clean energy infrastructure has to date
303 been almost exclusively the domain of national or sub-national governments. However, there
304 is considerable overlap between the principles we consider here and the principles that might
305 guide a fair distribution of the GHG pollution mitigation burden across countries (Ringius et
306 al (2002)², and there is nothing to prevent our analysis from informing the international
307 burden sharing discussion, particularly insofar as it concerns international transfers to support
308 clean energy deployment.

309

310 Our analysis is particularly relevant to questions of cost distribution under clean energy
311 programs insofar as these programs are motivated into existence by GHG mitigation. In
312 practice, governments are rolling out clean energy infrastructure with diverse motivations: to
313 mitigate GHG pollution, to promote innovation and competitiveness, to improve the security
314 and stability of electricity supply through distributed generation, to reduce geopolitical
315 vulnerability by diversifying fuel sources, and for other reasons (DECC 2011, EC 2014).
316 That does not mean that our analysis is irrelevant to questions of fairness where the other
317 motives are present. It means that we see GHG mitigation – whether it be through displacing
318 fossil fuel-fired generation in the near term, or through enabling this to happen in the future
319 by way of stimulating innovation – as the motive that sets clean energy policy apart from
320 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.

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

323

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

335

336 **3. Principles of distributive fairness**

337

338 Through a review of the distributive justice literature related to climate change and the
339 environment we identified three principles that seemed relevant and flexible enough to
340 address the question. They are the Polluter Pays Principle (PPP), the Ability To Pay
341 Principle (ATPP), and the Beneficiary Pays Principle (BPP). They are articulated in the
342 literature in different variations and they are possible to combine, but they are also
343 sufficiently distinct to be treated as separate. We further consider the Grandfathering
344 Principle (GFP). While GFP is rarely advocated by ethicists or moral philosophers, it is
345 commonly used in GHG control policies to initially distribute the right to pollute (Ellerman et
346 al 2007; Rode 2014). There are certainly other principles that could be brought to bear on the
347 question, but we deemed these four the *most* relevant to distributing an environmental
348 protection-related burden across socioeconomic groups within a country and within a single
349 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

350

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

355

356 **3.1. Polluter Pays Principle**

357

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

363

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

369

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.

370 PPP underpins international environmental agreements like the 1992 Rio Declaration on
371 Environment and Development and it currently influences the allocation of mitigation
372 responsibilities in international climate negotiations (Schwartz 2010; UNFCCC 1992). PPP is
373 typically embodied in the requirement to purchase GHG emission permits and to pay taxes on
374 GHG emissions (Cramton and Kerr 2002). PPP forms the moral foundation for the
375 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA –
376 colloquially, ‘Superfund’ law) in the US⁵ that requires polluters to clean up hazardous waste
377 sites that they were responsible for causing. In the EU, PPP forms the basis for extending the
378 responsibility of product manufacturers for the products they produce, to the point in the
379 lifecycle of those products where they become waste, creating an environmental burden. EU
380 Directives on packaging, electrical waste and end-of-life vehicles are premised on extended
381 producer responsibility (Lindhqvist 2000).

382

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

397

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

⁵ And many others – see Robertson (1996).

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

409

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

420

421 **3.2. Ability to Pay Principle**

422

423 ATPP holds that the burden of paying for public activities generally should be borne in
 424 greater proportion by agents who are best able to contribute (Broome 1984; Dodge 2005). In
 425 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.

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

428

429 ATPP forms the theoretical justification for trying to achieve distributive fairness in tax
430 policy through a tax regime that asks the rich to pay more than the poor, in absolute or
431 relative terms (Samuelson 1947). Pigou is often credited with arguing that if tax policy were
432 guided by a principle of ‘least aggregate sacrifice’ by society, this would effectively lead to
433 the ATPP (1932). Minimizing the aggregate sacrifice (in terms of utility or welfare)
434 associated with raising a particular sum of money requires that, at the margin, everyone make
435 an equal utility sacrifice. Given that the rich suffer less disutility from making payments of a
436 given absolute size, this means that they should pay more. This argument for ATPP therefore
437 rests on the idea of diminishing marginal utility of income: the disutility of paying a certain
438 amount of money is smaller for high-income than low-income agents (Greene and Baron
439 2001; Samuelson 1937). It also rests on the normative position that mitigation should be
440 done at the lowest possible aggregate disutility (utilitarianism), which implies spreading the
441 marginal mitigation *burden* evenly across agents, but not necessarily the mitigation *cost*
442 (Singer 2010; Stern 2007).⁸ The ‘burden’ is different from the ‘cost’ because marginal utility
443 decreases with income, meaning the burden (disutility) of paying a certain cost (sum of
444 money) is greater for the poor than for the rich.

445

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

453

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.

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

463

464 **3.3. Beneficiary Pays Principle**

465

466 BPP states that whoever has benefitted from the pollution that has harmed or will harm others
 467 owes compensation to the victims of that harm. The more an agent has *benefitted*, the more
 468 she is liable to pay. BPP has arisen in climate policy discussions in response to the idea that
 469 the current generation in industrialized countries should not be made to pay for their
 470 ancestors' pollution. BPP answers this point by saying that the current generation in
 471 industrialized countries *should* pay something for their ancestors' pollution because the
 472 current generation has substantially benefitted from that pollution through developmental
 473 progress and higher incomes. It says that in situations where PPP breaks down because the
 474 polluters are dead (the 'disappearing emitters problem'), the agents who *benefitted* from the
 475 pollution should inherit responsibility for correcting the damage caused by it. BPP's core
 476 idea is that if an agent accepts the benefits of illegitimate actions then they should also accept
 477 responsibility for the costs (Page 2008, 2012).

478

479 BPP is distinct because it implies that the beneficiaries are obliged to pay not simply because
 480 they are better off than others, but because their wealth was created in a morally dubious
 481 manner. Beneficiaries are thus 'free-riding' on the harmful activities of polluters, meaning
 482 that they are no more deserving of this windfall than the victims of pollution are deserving of
 483 their misfortune (Gosseries 2004). BPP is most salient in the international-intergenerational
 484 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).

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

490

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

500

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

509

510 BPP is subject to several criticisms as a principle by which to ensure distributive justice in
 511 climate policy generally. The first objection is that the victims of severe misfortune or
 512 natural catastrophe should still have their needs seen to 'without relying on the rather
 513 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.

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

528

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

539

540 **3.4. Grandfathering Principle**

541

542 GFP states that the right to pollute today and in the future should be distributed in proportion
543 to the amount of pollution agents have emitted in the past. Agents who emitted heavily
544 should be allowed to continue to emit at those levels, even for example after new GHG
545 mitigation rules come into force. Generally speaking, 'grandfathering' refers to establishing
546 a two-tiered standard in law where one set of agents is treated differently based on prior

547 status or behavior (Robertson 1996). GFP is different to the previous three principles in that
548 it is concerned with the distribution of *rights* rather than *duties*.

549

550 There are numerous examples of GFP being applied in policy practice. Article 10 of the EU
551 emissions trading directive required Member States to allocate at least 95 percent of GHG
552 emission allowances free of charge in the trading period ending 2007, and at least 90 percent
553 in the trading period ending 2012 (Woerdman, Cló and Arcuri 2008). Grandfathering clauses
554 are included in several major US environmental laws including the Resource Conservation
555 and Recovery Act, the Clean Air Act, and various land use and zoning laws (Robertson
556 1996).

557

558 The intuition that underpins GFP is familiar from other contexts where groups or individuals
559 lay claim to public resources through tradition or inheritance. One example is cattle grazing
560 rights on public land. In many countries, grazing rights are commonly allocated in
561 recognition of which populations, groups or families have historically used particular lands
562 for that purpose (Raymond 2003). GFP can be understood more broadly to support the idea
563 that some rights are *acquired* rather than granted, which can be seen as acceptable so long as
564 the tradition or practice which created the claim to these rights was legitimate (Ringius et al
565 2002). While there are indeed differences between GHG emissions and grazing, not least in
566 that the former is often not traceable to undisputedly legitimate traditions, some argue that the
567 moral case for grandfathering rights has similar contours in both cases (Bovens 2011).

568

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

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.

578

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

588

589 Since GFP is concerned with the distribution of pollution rights rather than mitigation duties,
590 it needs to be adapted and extended to be meaningful in the context of who should pay for
591 clean energy infrastructure. If we interpret the right to emit pollution in the future as
592 equivalent to the right to not pay for mitigation, this implies that historical polluters should
593 contribute little to current mitigation efforts, and that historically non-polluting agents should
594 shoulder the cost instead. Under a policy like the British Renewables Obligation, which
595 requires certain large electricity users to purchase certificates guaranteeing that a certain
596 quantity of clean energy has been produced (Wood and Dow 2011), certificates could be
597 given away to historical polluters while being sold to historical non-polluters. Alternately,
598 historical polluters could be exempted from participating in the policy at all or compensated
599 outside the framework for the certificates they purchase, for example through adjustments in
600 the broader tax code. Since this outcome would run contrary to many notions of individual
601 and historical responsibility and so risk public non-acceptance (Neumayer 2000), a
602 ‘transitional’ application of the principle might provide for distributing the cost of mitigation
603 differently once the necessary legal regime for avoiding catastrophic damages had been put in
604 place.

605

606 **3.5. Summary**

607

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

612

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

614

	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

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

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

618 *§Under an interpretation of duties rather than rights*

619

620 **4. Criteria for evaluating distributive fairness**

621

622 Here we use the four principles to develop three normative criteria against which to assess
623 clean energy financing mechanisms. Our approach combines all four principles to avoid
624 some of the strongest objections to each principle when taken individually. The practice of
625 combining principles is not uncommon among moral philosophers generally (Berlin 1990)
626 and has several precedents in climate justice discussions specifically (Caney 2005; Miller
627 2008). We aim to identify fairness criteria that address the practical problem facing decision
628 makers discussed in section 2: how to distribute this new cost burden across households
629 within the current generation, within an individual nation, in a way that the public
630 understands and supports.

631

632 In developing the fairness criteria we focused on how decision makers might distribute the
633 burden across *households*. This is because households tend to be the social unit governments
634 use to monitor the degree of socioeconomic inequality in many countries and so make a
635 sensible unit for thinking about the impact of new distributive decisions. Households are also
636 the most relevant social group in the three clean energy roll-out programs in California,
637 Australia and the UK that we apply the fairness criteria to below, both in terms of program
638 participants and in terms of payers (either as electricity bill payers or tax-payers). This

639 provides a certain symmetry across agents, payers, and beneficiaries. That symmetry that lets
640 us focus on how the burden should be shared across rich and poor households, which we see
641 as the main practical question facing decision makers today, as opposed to the deeper but
642 perhaps less urgent political economy question of how such a burden might be shared across
643 households and corporate entities (firms, governmental entities, other groups).

644

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

653

654 GFP can also be invoked to separate non-payers from payers, though the number of affected
655 households is likely to be small. GFP implies that some households have ‘acquired’ the right
656 to continue to pollute and by extension that they should be excused from paying, due to past
657 decisions they took in relation to pollution. This could be the case for households that
658 previously installed polluting electricity generation equipment at their residences under the
659 reasonable belief that they would not be asked one day to contribute to a clean energy
660 infrastructure program. This exemption would not apply to all households that previously
661 polluted through general electric grid electricity consumption however, because someone else
662 took the polluting investment decision on those households’ behalf and so it is someone else
663 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.

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

666

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

673

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

676

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

682

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

695

696 Exactly how payments are linked to these metrics will depend on country context and
697 program-specific factors, and choosing among them and appropriately implementing them in

698 practice is a question for individual decision makers. In practice, all three types of
699 proportionality (pollution, windfall or ability) may produce similar policy outcomes,
700 depending on the correlation between income and consumption of polluting goods and
701 services.

702

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

704

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

709

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

717

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

725

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

730

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

736

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

739

740

741 **5. Evaluation of clean energy programs**

742

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

748

749

750 We acknowledge that the distributive arrangements behind these programs may not be
751 representative of the arrangements behind commercial and industrial scale programs. The
752 aim of this paper is to broach the fairness issue in this context and to use real examples to
753 illustrate what it means for policy. Elucidation is our objective, more than representativeness.
754 That said, small-scale and household capacity is estimated to account for one-quarter of all
755 annual renewables capacity investment globally in 2015 (USD 73 billion) (UNEP and BNEF
756 2015).¹³

757

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

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.

759

760

761

762

763 **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

764 *To date (mid-2015).

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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.

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

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

811

812 Partly to deal with over-enrollment problems, the Government introduced a means test for
813 participation in May 2008, which limited eligibility to households with a combined annual
814 taxable income of less than AUD 100,000 (Australian Department of the Environment 2006).
815 The means test was partly a response to the government's own decision to double the rebate
816 from AUD 4 to AUD 8 per installed watt in May 2007. The means test was scrapped shortly
817 before the program was terminated in 2010.

818

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

821

822 To evaluate Criterion A we looked for evidence that the program cost was allocated mainly to
823 well-off polluters. We do not find strong evidence of this. The PRVP was paid for out of
824 general fund revenues raised by the Australian government through general taxation, meaning
825 there was no deliberate link drawn in program design between paying and polluting
826 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.

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

829

830 Under Criterion B we looked for household payment levels that were proportional to ability,
831 pollution or benefit from pollution. Because the program was paid for by the Australian
832 government through general tax revenues, and because the Australian tax system is regarded
833 as one of the most progressive in the OECD (Australian Government 2015; Paturot et al
834 2013) in part because of the relief it provides for poor households, we count this as evidence
835 of a distributive arrangement consistent with the idea of proportional payments, particularly
836 ability. We find that criterion B was fully fulfilled.

837

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

844

845

846 **5.2. The British Feed-in Tariff for small scale installations**

847

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

853

854 The program began in April 2010 and guarantees a regular payment to installation owners for
855 the clean energy they produce. The payment varies by installation size and type but a typical
856 household installation received around GBP 0.38 per kWh in the first year of the program and
857 was receiving around GBP 0.10 at the time of writing. Program records show that 683,322
858 installations had registered at the time of writing (July 2015). Ninety-one percent of installations
859 are PV and 97 percent are installed at domestic premises. The total cost of the program over its
860 25-year program life is estimated at between GBP 8 and 10 billion (DECC 2009).

861

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

866

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

876

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

882

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

888

889 **5.3. The California Solar Energy Initiative**

890

891 The California Solar Energy Initiative (CSI) aimed to install 1,940 MW of distributed solar
892 PV capacity and to transform the market for solar energy systems so that prices become
893 'competitive and self-sustaining' (CPUC 2014). It started in 2007 and is winding down at the
894 time of writing.

895

896 The program uses two separate incentives to achieve these aims. The first is a feed-in tariff-
897 like payment made to installation owners for each kWh of electricity produced. This
898 incentive supports installations larger than 30 KW. Actual payments range from USD 0.43 to
899 0.04 per kWh depending on how much capacity has already been installed under the program.
900 Under the second incentive the installation owner receives a single upfront payment for each
901 watt installed, ranging from USD 2.75 to 0.37, again depending on the level of program
902 installed capacity (CPUC 2013).

903

904 Program data shows that 148,894 installations had registered under the program by February
905 2015 for an estimated 1,900 MW of installed solar PV capacity (California Solar Statistics
906 2015). Approximately 93 percent of installations are residential or small commercial systems
907 (Borenstein 2013).

908

909 In 2006, the California State Legislature set the program budget at USD 2.167 billion for the
910 10-year life of the program. The legislature specifically authorized the funds to be collected
911 from electricity customers. It also intended that the impact of the program on electricity
912 customers' bills be cost-neutral, meaning it be, in the Legislature's words:

913

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

918

919 The program explicitly supports participation by low- and very low-income households. The
920 legislature set aside 10 percent of the total USD 2.167 billion program budget for this purpose
921 and stated an aim of installing 190 MW of solar PV capacity within this demographic by
922 2016. A different and more generous incentive system applies to low-income households and
923 is non-declining over time. Households whose income is less than 50 or 80 percent of the
924 geographic-area mean can qualify for highly or fully subsidized PV systems, respectively.
925 The California Public Utilities Commission estimated that 5,000 low-income households and
926 1,800 very low-income households would be eligible for these systems through incentives,
927 tax credits and other financing mechanisms. The program facilitates low-interest loans for
928 any remaining system cost.

929

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

939

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

944

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

950

951

952 **6. Conclusions: towards fairness**

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

961

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

972

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

978

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

987

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

995

996 A final caveat relates to the degree of transparency decision makers decide to adhere to in the
997 financing arrangements that underpin these programs. While we have given limited attention
998 to notions of *procedural* fairness in this paper for reasons discussed in section 3, we see
999 strength in the argument that the best arrangement is one where payers are aware both of how
1000 much they are paying and of *why* they are paying what they are paying. The moral-
1001 philosophical and more pragmatic reasoning behind cost distribution decisions are not always
1002 easy to convey to a public audience, but we hope that our ‘applied’ discussion and application
1003 of these principles to a concrete policy context will go some way to easing that burden.

1004

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1007 **7. References cited**

1008 Adler JH. 1995. Making the Polluter Pay. *The Freeman*, 1 March 1995. Available at
1009 <http://fee.org/freeman/making-the-polluter-pay/>. [Retrieved 3 October 2015.]

1010

1011 Arrow KJ, Cropper ML, Gollier C, Groom B, Heal GM, Newell RG, Nordhaus WD, Pindyck
1012 RS, Pizer WA, Portney PR, Sterner T, Tol RSJ and Weitzman RL. 2015. *Review of*
1013 *Environmental Economics and Policy* 8(2): 145-163.

1014

1015 Australian Department of the Environment, Water, Heritage and the Arts. 2006. The
1016 Australian Government Photovoltaic Rebate Programme: Guidelines for Applicants –
1017 Effective January 2006. Melbourne: Sustainability Victoria.

1018

1019 Australian Government. 2015. Re:think: Tax discussion paper. Commonwealth of Australia.
1020 Available at http://bettertax.gov.au/files/2015/03/TWP_combined-online.pdf. [Retrieved 3
1021 October 2015.]

1022

1023 Australian National Audit Office. 2010. Administration of Climate Change Programs. Barton,
1024 ACT: Commonwealth of Australia. Audit Report No.26 2009–10.

1025

1026 Baatz C. 2013. Responsibility for the past? Some thoughts on compensating those vulnerable
1027 to climate change in developing countries. *Ethics, Policy and Environment* 16(1): 94-110.

1028

- 1029 Baer P. 2002. Equity, Greenhouse Gas Emissions and Global Common Resources. In Climate
1030 Change Policy: A Survey, Schneider SH, Rosencrantz A, Niles J (eds): 393-408. Island Press:
1031 Washington, DC.
1032
- 1033 Bastianoni S, Pulselli FM and Tiezzi E. 2004. The problem of assigning responsibility for
1034 greenhouse gas emissions. *Ecological economics* 49(3): 253-257.
1035
- 1036 Borenstein S. 2013. The California Solar Initiative is ending. What has it left behind? *The*
1037 *Berkeley Blog*. June 18, 2013.
1038
- 1039 Bovens L. 2011. A Lockean Defense of Grandfathering Emission Rights. Chapter 6 in *The*
1040 *Ethics of Global Climate Change*, Ed Arnold DG. Cambridge: CUP.
1041
- 1042 Broome J. 1984. Uncertainty and Fairness. *Economic Journal* 94(375): 624-632.
1043
- 1044 Broome J. 2012. *Climate matters*. London: WW Norton.
1045
- 1046 Bullard RD. 1994. *Unequal protection: Environmental Justice and Communities of Color*.
1047 San Francisco: Sierra Club Books.
1048
- 1049 Butt D. 2007. On benefitting from injustice. *Canadian Journal of Philosophy* 37: 129.
1050
- 1051 Butt D. 2009. *Rectifying International Injustice: Principles of Compensation and Restitution*
1052 *Between Nations*. Oxford University Press: Oxford.
1053
- 1054 California Solar Statistics. 2015. Online database of California Solar Initiative program
1055 statistics. Available at <http://californiasolarstatistics.ca.gov/>. Accessed February 2015.
1056
- 1057 California State Legislature. 2006. Senate Bill No. 1, Chapter 132. Page 83.
1058
- 1059 California Public Utilities Commission (CPUC). 2013. *California Solar Initiative Program*
1060 *Handbook*. April. San Fransisco, CA: CPUC.
1061

- 1062 California Public Utilities Commission (CPUC). 2014. California Solar Initiative Annual
1063 Program Assessment. June.
1064
- 1065 Caney S. 2005. Cosmopolitan justice, responsibility and global climate change. *Leiden*
1066 *Journal of International Law* **18**(4): 747-775.
1067
- 1068 Caney S. 2009. Justice and the distribution of greenhouse gas emissions. *Journal of Global*
1069 *Ethics* **5**(2): 125-146.
1070
- 1071 Caney S. 2014. Two kinds of climate justice: Avoiding harm and sharing burdens. *The*
1072 *Journal of Political Philosophy* **22**(2): 125-149.
1073
- 1074 Coase R. 1960. The Problem of Social Cost. *Journal of Law and Economics* **3**(1): 1-44.
1075
- 1076 Cramton P and Kerr S. 2002. Tradeable Carbon Permit Auctions: How and why to auction
1077 not grandfather. *Energy policy* **30**(4): 333-345.
1078
- 1079 Department of Energy and Climate Change (UK). 2009. Impact Assessment of Feed-in
1080 Tariffs for Small-Scale, Low Carbon, Electricity Generation, London: DECC. URN 09D/703.
1081
- 1082 Department of Energy and Climate Change (UK). 2011. UK Renewable Energy Roadmap,
1083 London: DECC. URN 11D/698.
1084
- 1085 Dodge JM. 2005. Theories of Tax Justice: Ruminations on the Benefit, Partnership, and
1086 Ability-to-Pay. *Tax Law Review* 399.
1087
- 1088 Ellerman, AD, Buchner BK, and Carraro C (Eds). 2007. Allocation in the European
1089 Emissions Trading Scheme: Rights, Rents and Fairness. Chapter 1, pages 3-12. Cambridge,
1090 UK: CUP.
1091
- 1092 European Commission. 2014. Communication from the Commission to the European
1093 Parliament, the Council, the European Economic and Social Committee and the Committee
1094 of the Regions: A policy framework for climate and energy in the period from 2020 to 2030.
1095 Brussels: EC. COM/2014/015.

- 1096
- 1097 Feinberg, J. (1970) 'Collective Responsibility', in Doing and Deserving: Essays In The
1098 Theory of Responsibility. Princeton: Princeton University Press pp. 222- 251.
- 1099
- 1100 Fullerton D. 2011. Six Distributional Effects of Environmental Policy. NBER Working
1101 Paper 16703.
- 1102
- 1103 Fullerton D and Metcalf GE. 2002. Tax incidence. NBER Working Paper 8829.
- 1104
- 1105 Gosseries A. 2004. Historical Emissions and Free-riding. *Ethical Perspectives* **11**(1): 36-60.
- 1106
- 1107 Goulder L and Williams RC. 2012. The Choice of Discount Rate for Climate Change Policy
1108 Evaluation. NBER Working Paper 18301.
- 1109
- 1110 Grainger CA, Kolstad CD. 2009. Who pays a price on carbon? NBER Working Paper 15239.
- 1111
- 1112 Green J and Baron J. 2001. Intuitions about declining marginal utility. *Journal of*
1113 *Behavioural Decision Making* 14: 243-255.
- 1114
- 1115 Grover D. 2013. The British feed-in tariff for small-scale renewable energy systems: Can it
1116 be made fairer? Policy paper. London: Center for Climate Change Economics and Policy
1117 and Grantham Research Institute on Climate Change and the Environment.
- 1118
- 1119 Harrison D and Radov DB. 2002. Evaluation of Alternative Initial Allocation Mechanisms
1120 in a European Union Greenhouse Gas Emissions Allowance Trading Scheme. National
1121 Economic Research Associates (NERA).
- 1122
- 1123 Huseby R. 2013. Should the beneficiaries pay? *Politics, Philosophy & Economics* **23**: 1-17.
- 1124
- 1125 Hyams K. 2009. A Just Response to Climate Change: Personal Carbon Allowances and the
1126 Normal-Functioning Approach. *Journal of Social Philosophy* **40**(2): 237-256.
- 1127
- 1128 International Energy Agency and Organisation for Economic Cooperation and Development.
1129 2014. World Energy Investment Outlook. Paris: OECD.

- 1130
- 1131 Intergovernmental Panel on Climate Change (IPCC). 2011. Decision-making frameworks.
1132 Chapter 10 in *Climate Change 2001*, contribution by Working Group III: Mitigation.
1133 Geneva: IPCC.
- 1134
- 1135 Jamasb T and Meier H. 2010. Household Energy Expenditure and Income Groups: Evidence
1136 from Great Britain. University of Cambridge Electricity Policy Research Group, Working
1137 Paper 1003.
- 1138
- 1139 Keynes JN. 1917. The Scope and Method of Political Economy. London: Batoche Books.
- 1140
- 1141 Kingston E. 2014. Climate justice and temporally remote emissions. *Social Theory and*
1142 *Practice* **40**(2): 281-303.
- 1143
- 1144 Kotlikoff, LJ and LH Summers (1987) 'Tax incidence', Chapter 16 in Handbook of Public
1145 Economics, vol. II, AJ Auerbach and M Feldstein Eds. North-Holland: Elsevier.
- 1146
- 1147 Lindqvist, T. 2000. Extended Producer Responsibility in Cleaner Production. Unpublished
1148 PhD Thesis, Lund University.
- 1149
- 1150 Lyster, R and Bradbrook A. 2006. Energy Law and the Environment. Pages 85-87.
1151 Cambridge: CUP.
- 1152
- 1153 Macintosh A and Wilkinson D. 2010. The Australian Government's solar PV rebate program:
1154 An evaluation of its cost-effectiveness and fairness. Policy Brief No. 21. Page 9. Australia
1155 National University Centre for Climate Law and Policy and the Australia Institute.
- 1156
- 1157 Maltais A. 2010. Failing International Climate Politics and the Non-ideal Duties of
1158 Leadership. Department of Government working paper, Uppsala University, Sweden.
- 1159
- 1160 McCollum D, Nagai Y, Marangoni G, Calvin K, Pietzcker R, van Vliet J, van der Zwaan B.
1161 2014. 'Energy investments under climate policy: a comparison of global models.' *Climate*
1162 *Change Economics* **4**(04): 3-32. DOI: 10.1142/S2010007813400101
- 1163

- 1164 Menezes F, Quiggin J and Wagner L. 2009. 'Grandfathering and greenhouse: The role of
1165 compensation and adjustment assistance in the introduction of a carbon emissions trading
1166 scheme for Australia'. *Economic Papers*, 28 2: 82-92.
- 1167
- 1168 Metcalf GE, Mathur A, Hassett KA. 2010. Distributional impacts of comprehensive climate
1169 policy package. NBER Working Paper 16101.
- 1170
- 1171 Miller D. 2001. Distributing responsibilities. *Journal of Political Philosophy* 9(4): 453-471.
- 1172
- 1173 Miller D. 2004. Holding Nations Responsible. *Ethics* 114(2): 240-268.
- 1174
- 1175 Miller, WI. 2005. *Eye for an Eye*. New York: CUP.
- 1176
- 1177 Miller D. 2008. Global justice and climate change: how should responsibilities be
1178 distributed? *The Tanner Lectures on Human Values, delivered at Tsinghua University,*
1179 *Beijing*: 119-156.
- 1180
- 1181 Nelson T, Simhauser P and Kelly S. 2011. Australian Residential Solar Feed-in Tariffs:
1182 Industry Stimulus or Regressive form of Taxation? *Economic Analysis & Policy* 41(2): 113-
1183 129.
- 1184
- 1185 Neumayer E. 2000. In defence of historical accountability for greenhouse gas emissions.
1186 *Ecological Economics* 33(2): 185-192.
- 1187
- 1188 Nordhaus W. 2008. *A Question of Balance: Weighing the Options on Global Warming*
1189 *Policies*. Yale University Press: New Haven, CT.
- 1190
- 1191 Organisation for Economic Cooperation and Development. 2008. *Environmental Outlook to*
1192 *2030*. Organisation for Economic Co-operation and Development (OECD). Available at:
1193 <http://www.oecd.org>.
- 1194
- 1195 OECD. 2011. *Divided We Stand: Why Inequality Keeps Rising*. Paris: OECD Publishing.
- 1196
- 1197 Ofgem. 2013. *Updated household energy bills explained*. Factsheet 98. London: Ofgem.

- 1198
- 1199 Page E. 1999. International justice and climate change. *Political Studies* 47(1): 61-66.
- 1200
- 1201 Page E. 2012. Give it up for climate change: A defense of the beneficiary pays principle.
- 1202 *International Theory* 4(2): 300-330.
- 1203
- 1204 Parfit D. 1984. *Reasons and Persons*. Oxford: Clarendon Press.
- 1205
- 1206 Pascual U, Muradian R, Rodríguez LC and Duraiappah A. 2010. Exploring the links
- 1207 between equity and efficiency in payments for environmental services: A conceptual
- 1208 approach. *Ecological Economics* 69: 1237-1244.
- 1209
- 1210 Paturot D, Mellbye K and Brys B. 2013. Average Personal Income Tax Rate and Tax Wedge
- 1211 Progression in OECD Countries. OECD Taxation Working Paper 15.
- 1212
- 1213 Pelletier N. 2010. Environmental sustainability as the first principle of distributive justice:
- 1214 Towards an ecological communitarian normative foundation for ecological economics.
- 1215 *Ecological Economics* 69: 1887-1894.
- 1216
- 1217 Pigou AC. 1932. *The Economics of Welfare*. 4th edition. London: Macmillan.
- 1218
- 1219 Piketty T and E Saez. 2003. Income Inequality in the United States 1913-1998. *Quarterly*
- 1220 *Journal of Economics* CXVIII (1): 1-39.
- 1221
- 1222 Proctor RJ. 2014. Fixed-Cost Recovery, Renewables Adoption and Rate Fairness. *The*
- 1223 *Electricity Journal* 27(5): 42-53.
- 1224
- 1225 Raymond LS. 2003. *Private rights in public resources: equity and property allocation in*
- 1226 *market-based environmental policy*. Washington, DC: Resources for the Future.
- 1227
- 1228 Rhodes EL. 2003. *Environmental Justice in America*. Indiana University Press: Bloomington,
- 1229 IN.
- 1230

- 1231 Ringius L, Torvanger A and Underdal A. 2002. Burden Sharing and Fairness Principles in
1232 International Climate Policy. *International Environmental Agreements* 2(1): 1-22.
1233
- 1234 Robertson HG. 1995. If Your Grandfather Could Pollute, So Can You: Environmental
1235 “Grandfather Clauses” and Their Role in Environmental Inequality. *Catholic University Law*
1236 *Review* 45(1): 131-179.
1237
- 1238 Rode A. 2014. Rent-seeking over tradable emissions permits: Theory and evidence. AEA
1239 Conference Proceedings 2015 and working paper, Department of Economics, University of
1240 Chicago.
1241
- 1242 Samuelson PA. 1937. A Note on Measurement of Utility. *The Review of Economic Studies*
1243 4 (2): 155-161.
1244
- 1245 Schlosberg D. 2007. *Defining Environmental Justice: Theories, Movements, and Nature.*
1246 London: OUP.
1247
- 1248 Schwartz P. 2010. The polluter-pays principle. Chapter 12 in *Research Handbook on*
1249 *International Environmental Law*, Eds Fitzmaurice M, Ong CM and Markouris P.
1250 Cheltenham: Edward Elgar.
1251
- 1252 Shue H. 2010. Subsistence Emissions and Luxury Emissions. In *Climate Ethics: Essential*
1253 *Readings*, Gardiner SM, Caney S, Jamieson D, Shue H (eds): 200-214.
1254
- 1255 Singer P. 2010. One Atmosphere. In *Climate Ethics: Essential Readings*, Gardiner SM,
1256 Caney S, Jamieson D, Shue H (eds): 181-199.
1257
- 1258 Smith S. 1992. The distributional consequences of taxes on energy and the carbon content of
1259 fuels. *European Economy, Special Edition no. 1*: 241-267.
1260
- 1261 Stern N. 2007. *The Economics of Climate Change: The Stern Review.* Cambridge University
1262 Press: Cambridge.
1263

- 1264 Stern N. 2014. Ethics, equity and the economics of climate change paper 1: Science and
1265 philosophy. *Economics and Philosophy* **30**(3): 397-444.
1266
- 1267 Stern N. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University
1268 Press: Cambridge.
1269
- 1270 Stern N. 2014. Ethics, equity and the economics of climate change paper 1: Science and
1271 philosophy. *Economics and Philosophy* **30**(3): 397-444.
1272
- 1273 UNEP. 2015. *Global Trends in Renewable Energy Investment*. Frankfurt: Frankfurt School-
1274 UNEP Centre and Bloomberg New Energy Finance. Available at [http://fs-unep-](http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2015)
1275 [centre.org/publications/global-trends-renewable-energy-investment-2015](http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2015). [Retrieved 3
1276 October 2015.]
1277
- 1278 United Nations Framework Convention on Climate Change (UNFCCC). 1992.
1279 <http://unfccc.int/resource/docs/convkp/conveng.pdf> [Retrieved 14 February 2014].
1280
- 1281 United States Census Bureau. 2011. Share of Aggregate Income Received by Each Fifth and
1282 Top 5 Percent of Households. Available at: [www.census.gov/hhes/www/income/data/](http://www.census.gov/hhes/www/income/data/historical/household/index.html)
1283 [historical/household/index.html](http://www.census.gov/hhes/www/income/data/historical/household/index.html).
1284
- 1285 Weitzman ML. 2007. A review of the Stern Review on the Economics of Climate Change.
1286 *Journal of Economic Literature* **45**(3): 703-724.
1287
- 1288 Woerdman SC, Clò and Arcuri A. 2008. European emissions trading and the polluter-pays
1289 principle: assessing grandfathering over allocation. In Faure M and Peeters M (Eds). 2008.
1290 *Climate Change and European Union Emissions Trading: Lessons for Theory and Practice*.
1291 Cheltenham, UK: Edward Elgar.
1292
- 1293 Wood G and Dow, S. 2011. What lessons have been learned in reforming the Renewables
1294 Obligation? An analysis of internal and external failures in UK renewable energy policy.
1295 *Energy Policy*, **39**(5), 2228-2244.
1296
- 1297 Young HP. 1990. Progressive taxation and equal sacrifice. *American Economic Review*

1298 80(1): 253-266.

1299

1300