The Just Energy Transition

[Works-in-Progress]

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1. Introduction

As a result of tremendous economic growth in a number of developing countries, their greenhouse gas (GHG) emissions have increased sharply. Hence, climate change mitigation is now no longer a problem that can be exclusively addressed by emissions reductions in industrialized countries. This is best illustrated when looking at some examples. China has surpassed the US as the world's largest emitter, and the country's per-capita greenhouse gas emissions are similar to the EU average. Despite its still rather low per-capita emissions, India is currently striving to imitate China's performance in terms of economic growth and poverty reduction, and Sub-Saharan Africa is poised to follow suit. While this is good news in terms of overall development goals and poverty eradication, it goes hand in hand with increasing demand for energy use, which to a large part is fed by coal. If the global coal renaissance witnessed during the last decades and mainly driven by poor, but fast growing countries (Steckel, Edenhofer, and Jakob 2015) continues, carbon-intensive infrastructures will emerge that will lock-in emissions to an extent that will likely put the 2°C target out of reach. Coal-fired power plants currently under construction or planned would, if realized, consume one third of the carbon budget still available for stabilizing emissions at 2°C. The 1.5°C target, which many consider to be necessary to mitigate the most dangerous impacts of climate change (which would harm developing countries over-proportionally), would become largely out of reach.

This paper examines how emission reductions can be undertaken in developing countries in a way that does not imperil important development goals, such as poverty reduction, but rather creates synergies. It hence argues for a just distribution of the benefits resulting from climate change mitigation. That is, a just energy transition is a transition path that reconciles the material needs of the poorest people on the planet with the need to safeguard the stability of the Earth's climate. We propose a framework for how a just energy transition can be characterized and propose ways forward to its implementation based on the idea that simultaneously addressing the overuse of natural resources and the under-provision of public goods can create important synergies between these two aspects that are commonly addressed independently.

In this context we embed the question of a just energy transition into a broader discussion what constitutes a just society, a question that has been central to political philosophy throughout the ages. Different scholars have given very different perspectives, ranging from maximization of aggregate utility (Bentham, Mill), individual liberty (Nozick), or virtue (Kant) to the well-being of the least well off member of society (Rawls) and the creation of capabilities to allow for human beings to achieve their individual goals in life (Sen, Nussbaum). In his book "The Idea of Justice", Amartya Sen (2009) discusses different ways how people think about justice and acknowledges that it seems unlikely that there will be unanimous agreement of how a perfectly just society would look like. However, Sen also emphasizes that unanimous agreement is not necessary. Rather, to advance justice, it is sufficient to remove the gravest injustices. That is, even though people may disagree on the details, they may for instance agree that wide-spread hunger, lack of access to education, health care and basic services, or violation of basic human rights are unacceptable outcomes.

Based on these considerations we propose a framework how a just energy transition can be characterized and propose ways forward to its implementation based on the idea that simultaneously addressing the overuse of natural resources and the under-provision of public goods can create important synergies between these two aspects that are commonly addressed independently.

The potential of this approach is illustrated for the case of four countries that have emerged as key players for climate change mitigation, and where a just energy transition is crucial for emission reductions that promote human development: China, India, the Philippines, and South Africa. Finally, we analyze the role of the international community, and in particular climate finance and the Green Climate Fund, to support just energy transitions. This perspective departs from the traditional project-based approach to climate finance, and highlights the potential of ensuring maximum ownership of policies for recipients to address their specific development objectives.

2. Climate Change Mitigation in the Context of Global Justice

Even though industrialized countries are responsible for the lion's share of historical greenhouse gas emissions and display per-capita emissions considerably above the world average, ambitious climate targets can only be achieved if significant emission reductions also take place in developing and emerging economies. These developing countries are still striving to raise hundreds of millions of their citizens out of poverty. As a consequence, measures that put them on a low-carbon development trajectory and avoid the build-up of carbon-intensive energy infrastructure feature prominently in the climate policy debate. Failing to do so would likely result in a lock-in of carbon-intensive infrastructure and hence high emissions for the next decades, which would render decarbonization more difficult and put ambitious temperature stabilization goals, such as the 2°C target, out of reach.

Yet, recent developments point in the opposite direction. Developing countries are currently on a pathway to replicate the development, energy use patterns, and emissions of today's industrialized countries. Global energy use and emissions are increasing steadily, to a large degree driven by a global coal renaissance, in particular in poor, fast growing countries[1]. Despite the negative effects of coal use

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1 It has recently been suggested that emissions have remained stable in the last years. Yet, in the past, estimates of coal consumption have frequently been corrected upwards. Given that the capacity of fossil fueled power plants capacity has significantly increased in the last few years, it seems premature to conclude that emissions have stalled and will not increase in the near future.

for the climate and local air pollution, these countries increasingly rely on coal as an inexpensive and readily available source to meet increasing energy demand. Currently, more than 1,400 GW of new coal capacities are planned or under construction, in particular in developing Asia (Shearer et al. 2016) . If only one-third of these coal power stations that are planned are actually built, they can be expected to emit more than 100 GtCO2 over their entire lifetime (Shearer et al. 2016)

Given that existing infrastructure already locks in more than 700 $GtCO_2$ (Davis and Socolow 2014, Raupach et al. 2014), new coal would seriously imperil the 2°C target (for which a carbon budget[2] of about 800 $GtCO_2$ until the century must not be exceeded)[3].

The growing demand for affordable energy is readily understandable if one takes into account the important role of energy for economic development. Through the course of industrialization, countries tend to go through a stage of energy-intensive manufacturing. Leap-frogging this stage and developing a service based economy does not seem an option for the large majority of countries whose economies are currently based on agriculture, particularly as building out manufacturing sectors seems to induce spillovers on societal and economic development (Radebach, Steckel, and Ward 2016). Furthermore, energy access is an important cornerstone of human needs, e.g. for cooking, heating, and lighting and an enabler for essential developmental services like education and modern health care. Energy poverty is a serious issue in poor countries. Globally, more than 1.2 bln people lack access to electricity, and more than 2 bln don't have access to clean cooking fuels but rely on traditional biomass, which is linked to respiratory diseases. Empirical evidence shows a strong correlation between energy use and the human development index, at least up to a certain threshold, as shown in Figure 1. That is, for countries with final energy use below 42 GJ per year, the HDI is very likely to lie below the 'high' UN classification of 0.74 or more, whereas countries with at least 100 of energy use per year are likely to have a 'very high' HDI of 0.89 or more.

For this reason, it comes as no big surprise that developing countries are ramping up their energy production. This also explains why developing countries often have been reluctant to implement climate change measures out of concern that they might endanger other developmental objectives. Some of these concerns could be alleviated if, in line with the UNFCCC principle of common but differentiated responsibilities, industrialized countries would cover the incremental costs of transforming energy systems in developing countries. In fact, the question of how to achieve equitable

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2 I.e. the cumulative amount of emission over the 21st century.

3 The likelihood of achieving a given temperature target hinges on the cumulative emissions emitted to the atmosphere. The IPCC based on Meinshausen et al. (2009) for a high likelihood of achieving the 2°C goal reports a cumulative amount of 1000 Gt CO_2 – eq for the period from 2010 to 2050. Of this amount, approximately 200 Gt CO_2 have already been used in the last years.

‘burden sharing’, i.e. a fair sharing of mitigation costs, has long been at the center of the debate on climate justice. However, even if such an equitable burden sharing could be achieved, problems related to the possibility of delaying structural economic change and hence long-term economic growth still need to be addressed. The parallel to economies dependent on the export of resources that often showed disappointing development outcomes despite large financial inflows (the so-called “natural resource curse”, see van der Ploeg (2011) for a detailed review), readily comes to mind here.

For this reason, it has repeatedly been argued that climate policies in developing countries need to be embedded in a nationally appropriate context that takes into account country-specific development objectives as well as the prevailing political environment and barriers to implementation. Hence, it has been suggested that policy makers should focus on feasible mitigation strategies that have important synergies with national development objectives. For instance, expanding public transport and sustainable cities might contribute to a much larger development agenda that goes beyond climate change mitigation. The same is true for decentralized provision of modern clean energy, which has the potential to not only reduce emissions, but also provide energy access, and for fuel switch in the power sector primarily aiming to reduce local air pollution (Jakob et al. 2014).

The following section discusses how energy and climate policy can be conceptualized in a multi-objective framework based on the notion of sustainable development. This framework will serve as the foundation for the discussion on how to characterize and implement a Just Energy Transition.

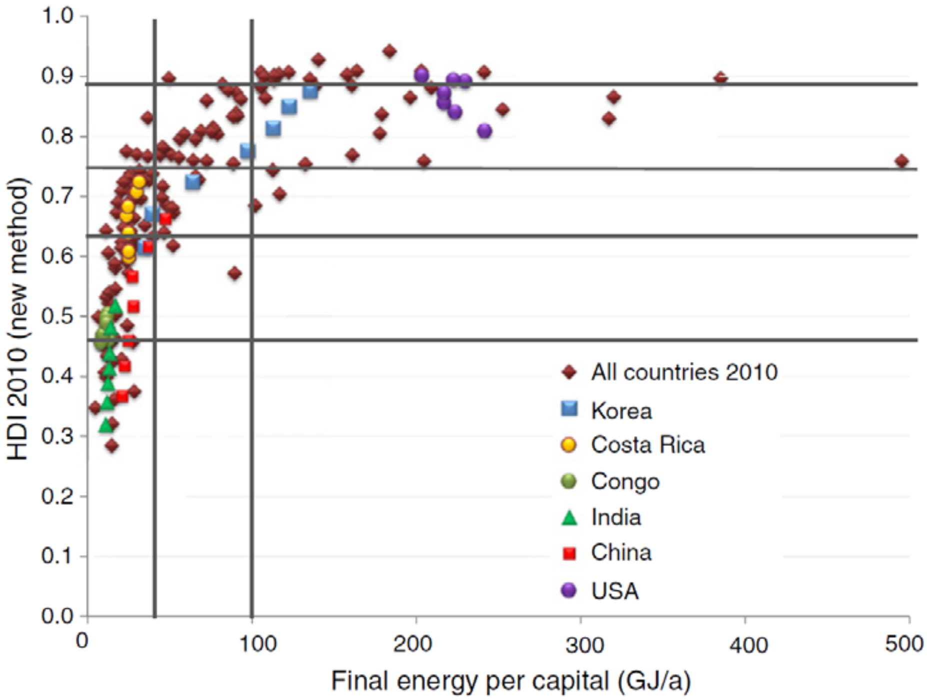

Figure 1: Correlation of (final) energy use and HDI in 2010 for 144 countries, together with the development over the period 1980–2005 for selected countries in time steps of five years. Horizontal lines indicate the separation between "very low", "low", "medium", "high" and "very high" development categories. Vertical lines indicate per capita final energy levels of 42 GJ (1 toe) per year and 100 GJ per year. Source: Steckel et al. (2013)

3. Implications of Climate Change Mitigation for Sustainable Development

In order to outline strategies to transform the global energy system in line with the requirements of justice and sustainability, it is not sufficient to exclusively focus on avoiding the most severe impacts of global warming. This is true independently of the precise definition of justice or sustainability adopted[4]. Unmitigated climate change would likely reverse most of what efforts to reduce global poverty have achieved in past decades. However, some mitigation pathways could also entail considerable risks for human development, e.g. regarding a high penetration of nuclear power or high mitigation costs (Jakob and Steckel Under review). For this reason, care must be taken that preventing the impacts of 'dangerous climate change' does not come at the price of 'dangerous emission reductions'. In order to devise a coherent picture of key risks in areas relevant to social justice and sustainable development, a range of scenarios for different climate targets as well as assumptions on the availability and social acceptance of mitigation technologies needs to be assessed.

4 The next section provides a framework to accomodate and operationalize a large range of definitions.

With regard to the impacts of climate change, scientific evidence has sharpened the understanding of the effects on inter alia sea-level rise, agricultural productivity, biodiversity, and the probability of extreme events as well as possibilities for and limits of adaptation measures. There is broad consensus in the literature that, even if global warming can be limited to (well below) 2°C, large, irreversible impacts could occur. Beyond that temperature increase, the risks of crossing tipping points increase starkly, and a recent report has warned that global warming of 4°C or more could lead to large-scale disruptions of economic and social systems and displacement of people (World Bank 2012) .

A just energy transition hence needs to contrast pronounced risks of unmitigated climate change with potential mitigation risks. Of particular importance in this respect is the use of biomass. From a climate perspective, biomass could constitute an important part of the portfolio of mitigation options. If used in combination with carbon capture and sequestration (CCS), biomass could – as plants absorb CO_2 from the atmosphere, which is then not released after their combustion – remove already emitted greenhouse gases from the atmosphere, i.e. generate 'negative emissions'. However, using large fractions of globally available arable land could potentially drive up food prices and hence seriously undermine food security. In addition, extensive use of biomass could also deplete groundwater reserves and as a result exacerbate already prevailing water scarcities. Stringent climate targets could also entail additional risks related to the use of nuclear energy (including accidents, proliferation, and storage, as well as financial risks due to costs that frequently exceed projected ones) and CCS (in particular poisoning of groundwater and future leakage of captured gasses). Of course, each of these technological risks can be reduced by limiting or foregoing the use of the respective technology. However, this will increase mitigation costs (Luderer et al. 2011), which can also be regarded as major risk if higher costs are related to lower incomes for the poor, job losses, and distributional conflicts.

It becomes obvious that policy makers (and societies) are confronted with serious trade-offs in some cases. Some of the risks mentioned can be reduced by appropriate policies, such as increasing agricultural productivity, or improving irrigation systems. However, some trade-offs will persist in spite of targeted measures, and policy makers will need to find a way to navigate between and find the most appropriate balance between different risks of climate impacts and climate change mitigation.

On the other hand, transition to low-carbon energy sources can also entail considerable co-benefits. Most important in this regards are perhaps the public health benefits of phasing out the use of fossil fuels, in particular coal. For instance, one recent study (West et al. 2013) found that a global energy transition consistent with a stringent climate target could by 2030 avoid the loss of up to 32 mio disability adjusted life years annually. China's recently implemented Action Plan for Air Pollution Prevention and Control is a good illustration of the incentives to move towards clean fuels for reasons not directly related to climate change mitigation. In addition, energy security is often emphasized as an important target of public policy. Data from the EMF27 model study indicate that energy use patterns consistent with the 2°C climate target would reduce oil imports by almost 15%, and hence significantly decrease importers' vulnerability to the macro-economic effects of sudden of price hikes (IIASA 2015). Indeed, case study evidence suggests that in India as well as Vietnam energy security played a central role in the discussion of future energy policies (Zimmer, Jakob, and Steckel 2015; Dubash 2013) .

The synergies and trade-offs between the areas mentioned above are qualitatively displayed in Figure 2, mostly based on scenarios from the EMF27 model comparison that were also used as a basis for the IPCC's Fifth Assessment Report. Even though this figure should at best be regarded as a rough indication, it confirms the intuitions and highlights some key trade-offs[5].

Sustainable energy policies will hence need to be designed in a way that minimizes trade-offs and maximizes synergies between individual development objectives. In order to operationalize this, policy makers need to spell out the *goals* that matter for social justice and sustainability as well as the *means* to achieve them. These issues will be analyzed in the following two sections.

5 Without doubt, Figure 2 only exemplarily discusses a few selected indicators of sustainable development. Others, such as gender equality or social stability are much less amenable to rigorous quantification, and their links with climate change impacts as well as mitigation are less straightforward to assess. Future research will be required to shed more light on these issues.

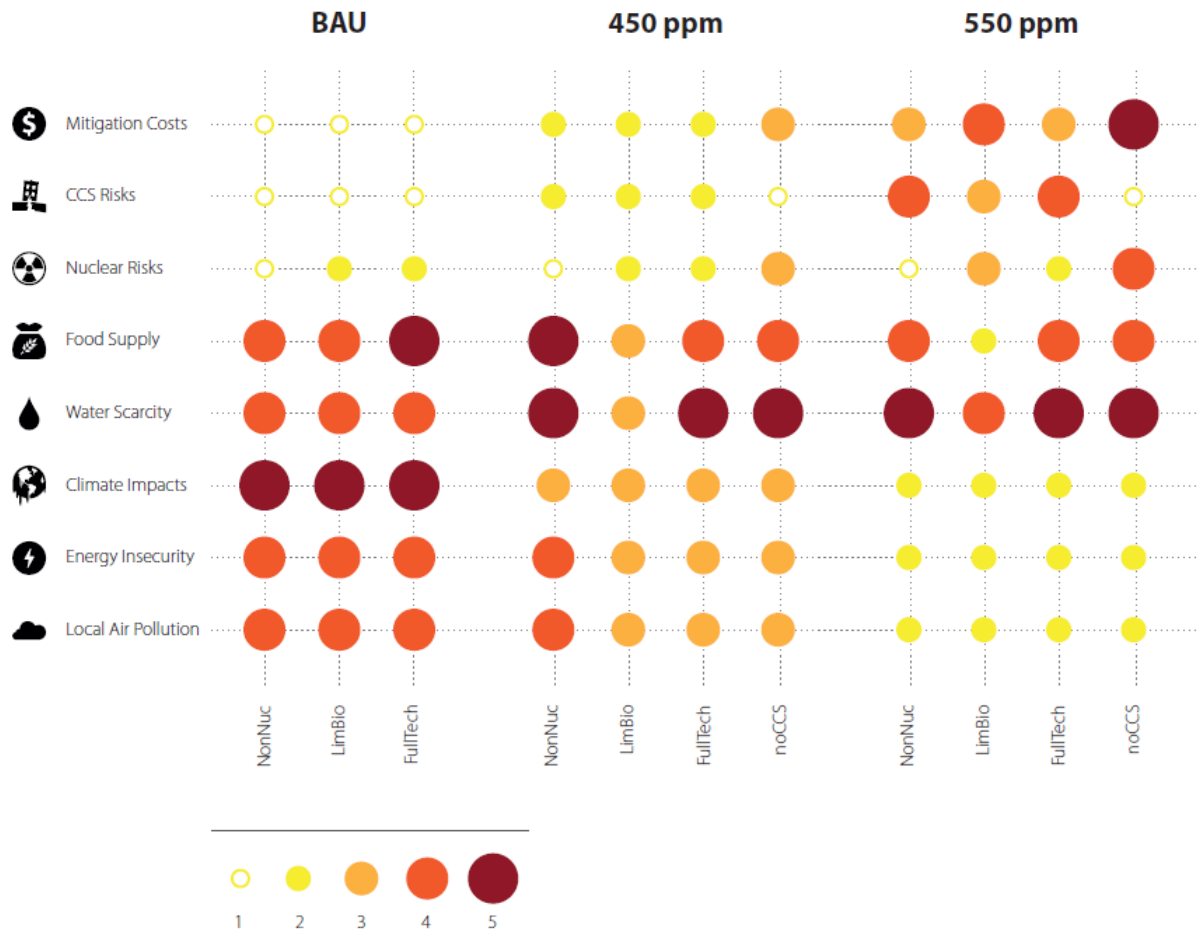

Figure 2: Trade-offs between different sustainable development objectives. Higher levels of risk correspond to points that are further away from the center. Based on Jakob and Steckel (Under review)

4. Ensuring a Just Energy Transition

In a very general sense, whether a society can be deemed to be *just* depends on the way it distributes what is judged to be valuable. Following the publication of Picketty's "Capital in the 21st century", inequalities in incomes and wealth within as well as between countries have received considerable attention, highlighting the massive concentration of economic assets in the hand of a few. However, restricting the analysis to income and wealth does not give the full picture of global injustices. In particular, we will argue below that inequalities in economic rents related to energy use as well as the consequences of different ways how energy is produced and used play an important role for inequality of opportunities to escape from multi-dimensional poverty and deprivation. Finding a just balance between the trade-offs between underlying objectives that constitute a just society requires a conception of what the relevant objectives are, and how they can be compared and evaluated against each other.

Climate impacts are without a doubt an expression of massive global injustice, as they are mostly caused by the rich but most gravely affect the poor. However, a mitigation strategy that, say, achieves the 2°C goal but makes the poorest people on Earth even poorer as a consequence of (perhaps unanticipated) side-effects of mitigation policies is obviously unjust, too.

For the case of transforming the energy system, the above conception of justice can be put into practice by defining a series of critical thresholds that are not to be violated. These thresholds would need to defined with regard to maintaining the integrity of Earth's 'life-support systems', such as the depletion of natural resources and the overuse of natural sinks for pollutants, as well as social indicators, such as health, life expectancy, and access to the material foundations required to achieve well-being in the sense of enhancing human capabilities to enjoy the individual conception of a 'good life'.

Practical implementation of this approach would need a definition of what aspects matter for social justice as well as what can be considered as a critical threshold. For the case of climate change, such a threshold would be a temperature target not to be exceeded (such as, say, 2°C), whereas for social goals, minimum requirements for e.g. access to basic infrastructure services would serve as thresholds (Jakob and Edenhofer 2014). This also means that these thresholds, once decided, cannot be traded off against each other, i.e. violating the climate target would then be considered as unjust, even if it leads to improvements in other domains (such as the satisfaction of short term material needs). Transformation pathways for the global energy system that violate at least one of these thresholds would then be excluded from the set of feasible alternatives, and only pathways consistent with all thresholds would remain for consideration.

The above reasoning is well aligned with the Sustainable Development Goal (SDG) agenda, which aims to "strive for a world that is just, equitable and inclusive, and committed to work together to promote sustained and inclusive economic growth, social development and environmental protection". At the core, the SDGs can thus be regarded as an extension of traditional development targets, such as the Millennium Development Goals, with environmental considerations. As a consequence, the SDGs include inter alia poverty eradication (goal 1), ending hunger (goal 2), universal access to health and education (goals 3 and 4) as well as access to clean and modern energy (goal 7), sustainable consumption and production (goal 12), climate change mitigation (goal 13), and conservation of oceans, terrestrial ecosystems, and biodiversity (goals 14 and 15).

Even though the desirability of these goals is almost universally acknowledged, it has been questioned whether they are realistically achievable or just constitute wishful thinking. Most importantly, the SDGs have been criticized for lacking a clear vision for how they can be put into practice. This paper argues that – if supported by the right policies – transforming the global energy system in the direction of sustainable generation and use of energy would not only have important implications for the achievement of the SDGs that are related to environmental issues. Rather, it could also have more broad-based implications for the achievements of social goals by redirecting economic rents created by natural wealth to social purposes. If aligned policies clearly aim at removing the most severe societal imbalances they would stand a good chance of being accepted by a broad majority of the population. Nevertheless, it needs to be considered that there might be groups in the society that have sufficient political power to block a just transformation out of legitimate reasons of self-interest. For example, labor unions might stand against an energy transition as they fear that particular industries will need to be given up (an example is the coal industry in Germany and Poland). Those interest groups will probably need to be compensated in order to make a just transformation feasible.

In the next section, we illustrate how a just energy transition can be operationalized by regarding the natural and social wealth of a society from the perspective of 'commons' and joint management of the portfolio of commons aimed at correcting overuse of natural wealth and under-investment in social wealth.

5. Justice and the Global Commons

In order to achieve a just energy transition, it is crucial to not only prevent the depletion of fossil fuel reserves as the overuse of the atmosphere as a disposal space for GHG emissions, but also correct the under-provision of public goods, such as public infrastructure necessary to provide access to basic services. A useful perspective to combine these two aspects into a coherent framework to regard both of them as 'commons'. This approach acknowledges that natural resources frequently display common pool characteristics, i.e. they tend to be over-used if no appropriate management schemes are in place to establish common property regimes. At the same time, infrastructures for the delivery of basic services are commons from a normative perspective; that is, every person *should have* access to e.g. water, sanitation, electricity, healthcare, and basic education.

Economic policy should then be regarded as a process of managing the portfolio of commons that constitutes a society's (natural as well as social) wealth, as displayed in Figure 3. This management of the commons is intrinsically related with the management of economic rents. It can be argued that rents accruing to natural resource owners (that is, revenues net of extraction costs) should be appropriated by the state for two reasons: first, it constitutes an economically efficient source of public revenue. Unlike taxation of e.g. wage income, taxing resource rents is associated to relatively low economic distortions and can in some cases even improve aggregate economic performance. Second, natural resources should belong to every member of a given society, such that taxing resource rents can be justified from a normative perspective. Resource rents are already appropriated to a certain extent in a variety of ways, including state ownership, royalty payments, or taxes on 'super-profits' of extractive industries. Even though not much reliable data on amount of resource rents that is already appropriated exists, the available evidence suggests that the respective figure rarely exceeds 50%, such that there seems to be considerable potential to raise additional revenues. Fossil fuel resources are of primary importance in this regard, as for the majority of countries they figure among the largest source of natural wealth (at least as long land is excluded from the analysis). According to the World Bank, in the year 2013, the global value of fossil fuel rents amounted to US$ 2.8 trn (i.e. 3.8% of global GDP), and it has been estimated that globally the market value of fossil-fuel reserves amounts to about US$27 trn. Even though a move towards low-carbon energy sources, i.e. away from fossil fuel use, will lower these rents in the long term, they could serve as a source of revenues during the transition phase. In the long-term, they could be replaced by revenues from pricing greenhouse gas emissions.

For the case of common pool resources, such as the atmosphere, putting a price on their use would not just create public revenue, but also provide incentives to avoid their over-use. Straightforward ways to implement this are emission taxes, tradable permit schemes (in which allowances are auctioned), as well as hybrid schemes, such as emission trading with a price corridor. Indeed, carbon pricing has gained prominence in recent years, even without a global climate agreement. To date, about 40 countries and over 20 sub-national jurisdictions (cities and states) use some form of carbon pricing, accounting for about 6 $GtCO_2e$ (World Bank and Ecofys 2015). However, at the same time, the use of fossil fuels is heavily subsidied in many countries, which is not only a massive drain on government budgets, but also harmful for the environment. In the year 2011, fossil fuel consumption was subsidized with about US$ 550 bln, if one only takes into account the financial side. If instead the full social costs are factored in, these subsidies amounted to as much as US$4.9 trn (i.e. globally, every ton of CO_2 emitted was subsidized by more than 150 US$), with the largest part accruing to emissions from coal combustion (Coady et al. 2015). Getting the prices right would not just reduce global emissions by about 20%, but also provide public budgets with financial means that are more than an order of magnitude above official development assistance (even if industrialized countries were to honor their pledge to devote 0.7% of their GDP to foreign aid).

Appropriating resource rents, putting a price on carbon, or removing fossil fuel subsidies would provide the financial means needed to invest in public goods in areas where they are under-provided. This is particularly true for developing countries, which often face difficulties to raise tax revenues as a result of insufficient administrative capacities and a large informal sector that is not easily amenable to taxation. The forms of raising revenues mentioned above, however, could be put into practice quite easily and are less likely to be evaded.

Recent evidence suggests that redirecting fossil fuel subsidies (of assumed US$ 550 bln per year) on a purely domestic basis could contribute to significant improvements in human well-being. If these funds were invested in basic infrastructure, universal access to clean water could be provided in about 70 countries, improved sanitation in about 60 countries, and access to electricity in about 50 countries (out of roughly 80 countries that do not yet have universal access) by the year 2030 (Jakob u. a. 2015) .

Earmarking revenues from resource rent taxation, carbon pricing, or fossil fuel subsidy reform for infrastructure expansion would very likely benefit the poor. One common concern is that energy price increases might put a disproportional burden on the poorest segments of society, as they spend the largest share of their disposable incomes on energy (however, it should be noted that for the case of fossil fuel subsidies, the poorest 20% of society on average only receive about 8%, whereas 40% accrue to the richest 20% (Arze del Granado, Coady, and Gillingham 2012). Yet, eventual price increases would very likely be overcompensated by the benefits of gaining access to e.g. water or electricity. In any case, a careful evaluation of distributional outcomes of such policies will be required, and, if necessary, appropriate compensation schemes will need to be developed. If such a shift in the fiscal system, i.e. in the way natural resource use is taxed and how the proceeds are used, is regarded as just and beneficial to the poor, it can also be assumed that policy makers are more likely to be able to gain public support and build coalitions in favor of the required reforms.

In the next section, we illustrate the potential of this approach for the case of four selected countries that can be considered as key players in international climate policy.

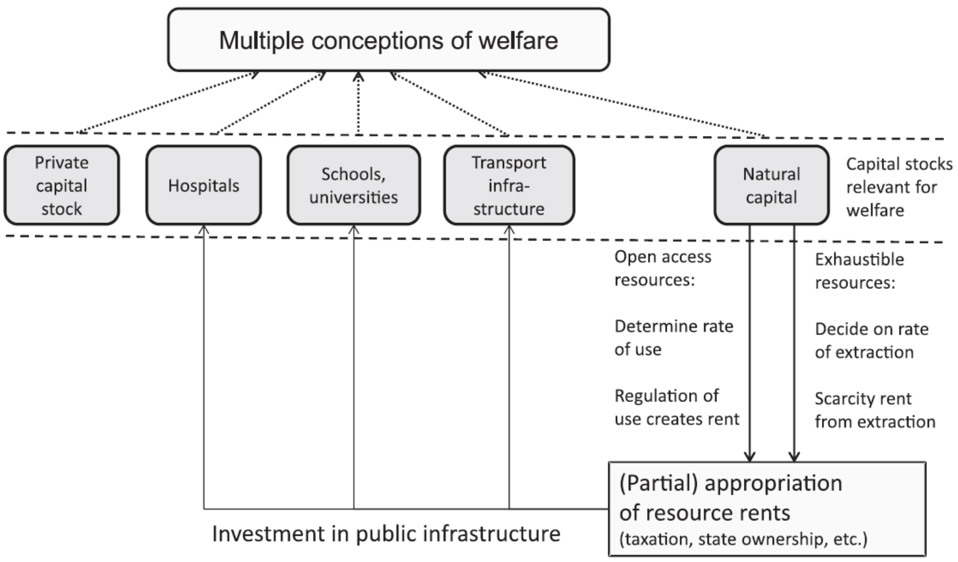

Figure 3: Stylized representation of generation, appropriation, and use of rents accruing from sustainable management of natural capital. Source: Jakob and Edenhofer (2014)

6. Just Energy Transitions in China, India, the Philippines and South Africa

The preceding section has presented three different schemes to sustainably manage natural resources in a common property regime, namely resource rent taxation, carbon pricing, and fossil fuel subsidy reform. The resulting public revenues could be employed to correct the under-provision of public goods, such as health, education, and infrastructure for basic services. Table 1 shows some selected indicators for China, India, the Philippines and South Africa and highlights that additional public investments in all areas under consideration might be necessary. For instance, in India more than 60% of the population lack access to sanitation facilities, and more than 33% in South Africa. Even in China, the country performing best on all indicators for which data are available, about 23.5% of the population do not have access to sanitation. In India, the Philippines, and South Africa, less than 40% of the labor force has secondary education, and for India and South Africa, only 9.8% and 16.5% of the labor force have benefited from tertiary education, respectively. In addition, both countries display high infant mortality rates of 37.9 and 33.6 per 1’000 live births, respectively. Finally, in all four countries life expectancy falls considerably short of the average of industrialized countries. At less than 57 years, it is especially low in South Africa. Furthermore, behind these numbers are serious inequalities at the national level, with infrastructure access being considerably lower in rural than in urban areas, and gender inequalities in educational and health outcomes. Correcting these shortcomings should be regarded as a prime objective of any strategy aiming to improve human development and well-being.

	China	India	Philippines	South Africa
Infrastructure access				
Access to electricity (%)	99.7	78.7	87.5	85.4
Improved sanitation facilities (%)	76.5	39.6	73.9	66.4
Improved water source (%)	95.5	94.1	91.8	93.2
Education				
Labor force with primary (%)	n/a	14.4	31.1	41.2
Labor force with secondary (%)	n/a	35.5	39.2	31.0
Labor force with tertiary (%)	n/a	9.8	28.0	16.5
Health				
Life expectancy at birth (years)	75.4	66.5	68.7	56.7
Mortality rate, infant (per 1,000)	9.2	37.9	22.2	33.6

Table 1: Selected indicators for infrastructure access, health, and education for the most recent year for which data were available. Source: World Bank (2016)

We now compare the revenues that could be generated from these schemes with spending needs for basic infrastructure, health, and education. We take actual data on fossil fuel rents and subsidies. For potential revenues from emission pricing, we assume a carbon price of US$ 20 per tCO_2 on all energy related emissions[6]. For education and health, we use current government expenditures. Arguably, financial needs in these areas are likely higher than what is actually available in these areas. However, a rigorous assessment of these needs would require not only a definition of what constitutes adequate health and education, but also reliable estimates of country-specific costs. To our knowledge, this data is not publicly available. In any case, the reported numbers should give a good impression of the order of magnitude at stake. Finally, universal access to basic infrastructures denotes the costs of achieving universal (i.e. 100%) access to these services in the 2015-2030 time period (which is envisaged for the achievement of the SDGs).

Table 2 reports the results as a share of GDP for China, India, the Philippines, and South Africa. Ranging from 0.45% (Philippines) to 2.48% (South Africa) of GDP, fossil fuel rents play an important role in all four countries and would be sufficient – if appropriated accordingly by governments - to finance universal infrastructure access. Even though the cost calculations for universal energy access include the possibility of fossil fuel use, using low-carbon energy would also be conceivable as an alternative.

6 Non-energy emissions could of course also be included, but the data are less reliable, and pricing would in many cases less straightforward, e.g. due to issues related to monitoring, reporting, and verification

As the costs for energy access are more than one order of magnitude below potential revenues, assuming that universal energy access is achieved by low-carbon sources would not affect our main results.

For India and China, fossil fuel rents are roughly equally divided between coal and oil, whereas for South Africa the stem almost exclusively from coal. Revenues that would accrue from a carbon price of US$ 20 per tCO_2 would generate revenues comparable to those of resource rents, between 0.60% (Philippines) and 2.51% (South Africa). This would be sufficient to meet a significant share, albeit not the entirety, of the costs of healthcare and education. In addition, much higher carbon prices are conceivable if the global community decides to move towards ambitious climate targets. For instance, for an emission trajectory consistent with the 2°C target, the EMF27 models project emission prices of up to more than US$ 250 in 2030, with a median of more than US$ 70. Carbon prices in this range would provide governments with considerable fiscal space to promote human development. Fossil fuel subsidies are most pronounced for India, amounting to 1.7% of GDP. Phasing out fossil fuel subsidies in India would hence mobilize more funds than are currently spent on healthcare.

It should be noted that the revenues are not independent and hence cannot simply be added up. For instance, imposing a carbon price would lower fossil fuel rents, such that it is not feasible to simultaneously reap the fossil fuel rents and the carbon pricing revenues to the extent displayed in the table. Hence, the numbers shown can be understood as different alternatives for revenue creation. In any case, they demonstrate the potential to promote human development if economic rents associated to energy resources and sustainable development are put to good use.

	China	**India**	**Philippines**	**South Africa**
Sources of Revenue				
Total Resource Rents	**2.41**	**2.47**	**0.45**	**2.48**
Coal rents	*1.14*	*1.06*	*0.04*	*2.40*
Natural gas rents	*0.09*	*0.21*	*0.20*	*0.05*
Oil rents	*1.18*	*1.20*	*0.21*	*0.03*
Fossil Fuel Subsidies	**0.20**	**1.70**	**0.00**	**0.60**
Carbon Pricing Revenues (20\$/tCO_2)	**1.75**	**2.16**	**0.60**	**2.51**
Expenditure Needs				
Government Expenditure on Education	**3.70**	**3.87**	**2.65**	**6.00**
Government Expenditure Health	**3.11**	**1.28**	**1.39**	**4.33**
Universal infrastructure access	**0.10**	**0.38**	**0.26**	**0.19**
Water	*0.05*	*0.01*	*0.11*	*0.02*
Sanitation	*0.05*	*0.28*	*0.06*	*0.11*
Electricity	*0.00*	*0.09*	*0.09*	*0.07*

Table 2: Potential revenues from resource rents, carbon pricing, and fossil fuel subsidy reform, as well as expenditure needs for education, health, and infrastructure access as percent of GDP.

7. Implications for Climate and Development Finance

Given that poverty reduction is the dominant policy objective for developing countries, they cannot be expected to meet the additional costs of low carbon energy technologies required to reduce emissions – a principle which is enshrined in the UNFCCC principle of 'common but differentiated responsibilities'. As a consequence, the international community has agreed to mobilize US$ 100 bn annually to support climate measures in developing countries by the year 2020. By fostering the transition to a low-carbon society, these funds are intended to create synergies between emission reductions and economic development.

The GCF, which constitutes the main vehicles to mobilize public climate finance, has received pledges of more than US$ 10 bn to be disbursed in the near future. In combination with the Adaptation Fund established under the UNFCCC, as well as schemes to provide insurance against climate-related impacts, the GCF can be regarded as a cornerstone of an emerging international climate finance architecture.

Discussions on the GCF have to date almost predominantly focused on the question how to raise the required financial means and how to account for donors' contributions. By contrast, there are relatively few persuasive proposals on how to ensure that these funds are applied such that the implied policy objectives – climate change mitigation and adaptation, as well as sustainable socio-economic development – are pursued in an effective way.

For the case of climate change mitigation, the GCF board has outlined a list of priority areas, including energy generation and access, buildings and cities, land use, and transport, that are to be potential targets for climate finance. However, it is unclear how mitigation actions in these areas can effectively be incentivized. Many observers have questioned to what extent a project-by-project approach can be an effective device for large-scale climate change mitigation. Lessons from the CDM and the JI hint towards potential problems of project-based climate finance regarding additionality (i.e. determining whether a certain project would not have undertaken without the mechanism) and leakage (i.e. emission reductions in one area being at least in part compensated by increases in others). Furthermore, it seems questionable whether the CDM has contributed to objectives additional to climate change mitigation, such as technology transfer and sustainable development (Paulsson 2009).

To date, carbon pricing is often seen as an inappropriate tool by developing countries, mainly as it increases energy costs and puts pressure on poorest households. However, carbon pricing constitutes a source of public revenue that is arguably less distortionary than taxing labor or capital.

Linking fossil fuel subsidy reform and emission pricing to investments in public goods would thus greatly reduce concerns that environmental quality is paid for by the poorest segments of the population. This approach would also be well aligned with the SDG agenda, which aims at promoting human well-being without undermining the integrity of the natural environment. Recent research by the World Bank and the IMF has identified criteria that can help to establish pro-poor climate policies. Based on these insights, climate finance can make a contribution to sustainable development by covering incremental costs of climate-related policies, facilitating technology transfer, capacity building and assisting in the implementation of schemes that compensate political losers.

By providing recipient countries with the flexibility to decide which emission pricing policies are appropriate in the national context and which measures are to be funded with the revenues, the approach outlined above allows for 'ownership' by recipients, which has proven to be of prime importance in development cooperation. That is, empirical evidence strongly supports the notion that those policies that are most closely aligned with national development objectives are the most likely to be successfully implemented. This approach could be operationalized by a competitive bidding process, in which countries propose intended measures to reduce emissions as well as the financing needs and capacity requirements to the governing board of the GCF or a comparable climate finance vehicle. The board could then allocate finance based on the merits of these proposals, facilitate knowledge transfer with regards to policy instruments and best practices, and engage in monitoring and peer-review of existing policies.

Climate finance could hence not only result in substantial emission reductions, but could also alter countries' strategic calculations and promote international cooperation. For instance, adoption of emission pricing policies in emerging economies – incentivized by climate finance – could alleviate concerns related to competitiveness and carbon leakage in industrialized countries. These countries, in turn, would then have a higher willingness to either implement their own emission pricing policies, or strengthen existing pricing schemes, such that global emissions are further reduced as a strategic reaction.

8. Conclusions

Transforming the global energy system towards low-carbon alternatives would not only mitigate climate change, but also offer an opportunity to fundamentally change the way commons – natural resources and public goods – are managed. From this perspective, a just energy transitions should be concerned with the question of how the benefits of the energy transitions can be distributed in a fair way. In particular, appropriating resource rents and preventing the overuse of natural resources would yield considerable economic rents to correct the under-supply of public goods.

For the cases of China, India, the Philippines and South Africa, empirical evidence indicates that resource rent taxation, carbon pricing, and fossil fuel subsidy reform could provide considerable funds to promote human development. For all four countries, the resulting financial means would be sufficient to allow achieving universal access to water, sanitation, and electricity. Furthermore, they would also permit substantial increases in health and education spending. From this perspective, well-managed energy policy based on objectives of human development and well-being becomes social policy.

Even though some policies, such as carbon pricing, create public revenues, they result in overall economic costs. According to the principle of common but differentiated responsibilities, developing countries should not be required to bear these costs. Rather, industrialized countries have agreed to cover the full incremental costs of climate change mitigation in developing countries, and climate finance mechanism, such as the GCF, have been set up with the goal to channel the required financial resources to recipient countries. However, current climate finance mechanisms might be ill equipped to incentivize mitigation efficiently, as the experience with the CDM and JI suggest. For this reason, a different possibility lies to target climate finance to support policies in recipient countries that aim to put a price on carbon and use the revenues to promote human development. Such an approach could have the double advantage of ensuring efficient mitigation while at the same time allowing for ownership of policies by recipients and thus maximize these policies' development benefits.

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