Position paper

Beyond coal

Scaling up clean energy to fight global poverty

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Executive summary

Eradicating global poverty is within reach, but under threat from a changing climate. Left unchecked, climate change will put at risk our ability to lift people out of extreme poverty permanently by 2030, the first target of the Sustainable Development Goals (SDGs).

Coal is the world's number one source of CO_2 emissions. Most historic emissions came from the coal industry in the developed world in the last century, with China joining the biggest emitters at the beginning of this one. It is widely accepted that a rapid and just response to climate change will require the urgent replacement of coal with low-carbon energy sources in rich economies. Now the coal industry claims that expanding coal use is critical to fighting extreme poverty and improving energy access for billions of people in developing countries.

In fact, the opposite is true. The global commitment to eradicate extreme poverty and energy poverty by 2030 does not require such an expansion and it is incompatible with stabilising the earth's climate. The evidence is clear: a lasting solution to poverty requires the world's wealthiest economies to renounce coal, and we can and must end extreme poverty without the precipitous expansion of new coal power in developing ones.

A pro-development, no-coal strategy

This position paper has four key messages, developed in the paper and summarised along with policy recommendations in the **Conclusions** and **Recommendations**:

Key messages

1. More coal will not end energy poverty

Some electricity-poor households sit physically close to the grid, but sector mismanagement and connection costs thwart access. These households are left unconnected while power plants – coal or otherwise – sit idle. New coal will not solve this. Even more electricity-poor households live far from the grid: 84% are in rural areas. If scaled up appropriately, distributed renewable solutions will be the cheapest and quickest way of reaching over two thirds of those without electricity. Clean and safe cooking is mostly achieved through access to cleaner fuels and stoves, not by more coal power.

2. Coal is given too much credit for the reduction of extreme poverty

Many countries look to China as a model when addressing their own extreme poverty: China dramatically reduced its own extreme poverty, and powered its rapid industrialisation primarily with coal. Yet two thirds of China's reduction of extreme poverty were due to agricultural and macroeconomic policy changes *before* its coal-fired expansion in the 1990s. Industrialisation, while important to China's overall economic success, accounts for less than a quarter of the decline in extreme poverty between 1981 and 2004. Runaway coal consumption began only in the 2000s, at five times the rate of the 1990s.

3. Better energy options exist to lift people out of income poverty

Energy is needed not only for universal access, but also to lift people's incomes by powering growth and employment. Low-carbon, renewable options are competitive with coal. In the US, the price of electricity from photovoltaics has fallen by over 80%, and wind power by over 60%, since 2009. There are also options to effectively manage the intermittency of some renewables. Coal is not one of them. Renewables are also a more promising source of employment: the sector employed 9.4 million people in 2015, compared to the 7 million employed by the coal industry according to the World Coal Association's own 2012 estimate.

Key messages

4. More coal will entrench poverty

Coal's environmental and climate impacts present a clear threat to people living in poverty. Air pollution from coal causes some 670,000 premature deaths a year in China and 100,000 in India. A one gigawatt plant in Indonesia could cause 26,000 premature deaths over its lifespan. Building just a third of the planned coal-fired power plants, mostly in developing Asia, would take the world past 2°C of warming, pushing hundreds of millions into extreme poverty before the middle of the century. To quote the World Bank President Jim Kim: 'if the entire region implements the coal-based plans right now, I think we are finished … That would spell disaster for our planet.'

It is difficult to account for all the factors – political interests, the advantages of incumbent technology – that will determine how many planned coal-fired power plants get built. However, a new fleet of coal-fired power plants is not needed to combat extreme poverty or energy poverty. To achieve the ambitions of the Paris Climate Agreement, SDG1 on eradicating global poverty by 2030 and SDG7 on universal access to affordable, reliable, sustainable and modern energy by 2030, an urgent shift to renewable and efficient energy systems is required.

The following actions must be prioritised:

- *G20 governments must stop all forms of subsidy for fossil fuels.*
- *All forms of public support for coal capacity expansion should be phased out, including those channelled through Development Finance Institutions.*
- *All support for energy through bilateral and multilateral channels must prioritise the delivery of SDG7 on ensuring access to affordable, reliable, sustainable and modern energy.*
- *Development institutions must apply monitoring and reporting frameworks that track the poverty reduction and development impact of their energy support.*
- *Developing and emerging economies should develop plans for a sustainable and socially just energy shift, in line with implementing the SDGs and their Nationally Determined Contributions under the Paris Agreement, identifying support needed from development partners.*
- *Public and private finance must be more transparent about exposure to carbon risk.*

The author organisations of this position paper – The Catholic Agency For Overseas Development, the Council on Energy, Environment and Water, Christian Aid, the Institute for Development Studies, the Institute for Essential Service Reform, Misereor, the Overseas Development Institute, Oxfam, Practical Action, Renewable and Appropriate Energy Laboratory at the University of California, Berkeley, Tierra Digna and the Vasudha Foundation – have reached these conclusions after decades of experience supporting poverty eradication and development efforts and witnessing the threat that a changing climate poses to the wellbeing of poor and vulnerable groups.

1. More coal will not end energy poverty

Access to modern energy is closely linked to human development and improvements in people's wellbeing, yet more than one in three people lack clean and safe energy for household cooking and nearly one in six people lack basic access to electricity (World Bank and IEA, 2015). 'Energy-poor' people have access to some energy services – burning wood or charcoal on open flames or simple stoves, and burning candles and kerosene lanterns for light – but relying on these unsafe, poor quality and expensive fuels makes them 'energy-poor'.

Delivering affordable, safe and reliable modern energy services to poor homes can be transformative to their wellbeing. Electric lighting replaces expensive lighting fuel, reducing household costs. Electricity also powers mobile phones, fans, TVs and refrigerators that can be used to store food, medicines and vaccines (Alstone et al., 2015). Clean and safe methods of cooking using better fuels and more efficient stoves reduce indoor air pollution, a leading environmental killer (WHO, 2014). Greater access to energy services measurably improves education and health outcomes and can increase the productivity of micro- and small-enterprises and smallholder farming (World Bank, 2008).

The biggest challenge to achieving universal energy access is not generating much greater amounts of energy; it is getting it to those who have it least (Hogarth and Granoff, 2015). The aggregate effective demand of very poor people for modern electricity services is low. Most projections of demand growth in the developing world represent the growing industrial, commercial and residential consumption of individuals and enterprises already connected to the grid. Meeting that demand is important for development, but it is not the same as meeting the SDG7 goal of providing universal energy access.

There are two technical options for delivering electricity to households and communities: extending and improving grid infrastructure, and creating decentralised or distributed stand-alone systems for individual households and mini-grids for entire communities. Building new coal power plants is not critical to rapidly scaling up access in either case: coal-fired power plants are rarely built to power a system serving the energy poor, and most energy-poor families live in remote areas, far from the grid.

Many electricity-poor households do live frustratingly close to the grid. Extending the grid to them will be an important tool for energy access. Yet communities even a few kilometres from the grid face technical barriers preventing connection: cost is one issue, especially as populations are often disperse, and the low-tension distribution lines used to connect them result in high energy losses and instability in the power system.

Political barriers are even greater. Power sector mismanagement and political capture often prevent utilities from turning new electricity supply into new connections – or even into lower prices for existing poor consumers. As the Africa Progress Panel observes: 'Governance of power utilities is at the heart of Africa's energy crisis. Governments often view utilities primarily as sites of political patronage and vehicles for corruption providing affordable energy can be a distant secondary concern' (Africa Progress Panel, 2015). In many developing countries, electricity tariffs are subsidised at politically expedient rates that fail to cover the full costs of developing new infrastructure or even operating existing infrastructure (Scott and Seth, 2015). When utilities operate at a loss, it is difficult to invest additional capital in extending grids to new communities or connecting new homes.

This problem is exacerbated because these newly connected households consume relatively little electricity (Pueyo et al., 2015) – typically not enough to cover the capital costs of reaching them – and because poor households lack political influence (Alstone at al., 2015). They also often face insurmountable connection costs (Pachauri et al. 2013). For example, in Kenya, Rwanda, Tanzania, Burkina Faso and the Central African Republic, connection fees are more than the average monthly income (Alstone et al., 2015). As a result, even once a community is connected to the grid, it is common for many households to remain unconnected for decades (World Bank, 2008).

This means that for energy-poor families living close to the grid, building new power generation capacity – coal-fired or otherwise – will not help them get connected. Instead, access will require financing the upfront costs of new connections, and rationalising tariffs to reflect the true costs of supplying power.

An estimated 84% of electricity-poor households and communities live in rural areas, often further from the grid than those in urban areas (IEA, 2011). For these households, there is no need to wait for new centralised grid generation or transmission, distribution and connection: decentralised stand-alone and mini-grid

solutions are the quickest and most cost-effective way to begin delivering electricity in most cases. A large power plant will often take a decade or more from the time of the initial investment decision to the time it starts generating power. In the words of the Africa Progress Panel: 'If the aim is to deliver energy for all by 2030, then large, capital-intensive plants will not achieve the goal' (Africa Progress Panel, 2015).

Renewable technologies like wind and solar photovoltaics (PV) can be deployed much more quickly, even at scale. Their costs have declined rapidly, making them the most viable, affordable and rapidly deployable option for connecting most new households today (Granoff and Hogarth, 2015a). Even if homes will eventually be connected to a centralised grid, off-grid household systems can in most cases provide a useful and affordable energy service in the interim. Government support for off-grid enterprises and ensuring mini-grids are both enabled and eventually integrated into the grid, will accelerate access, alongside public service delivery to ensure no one is left behind.

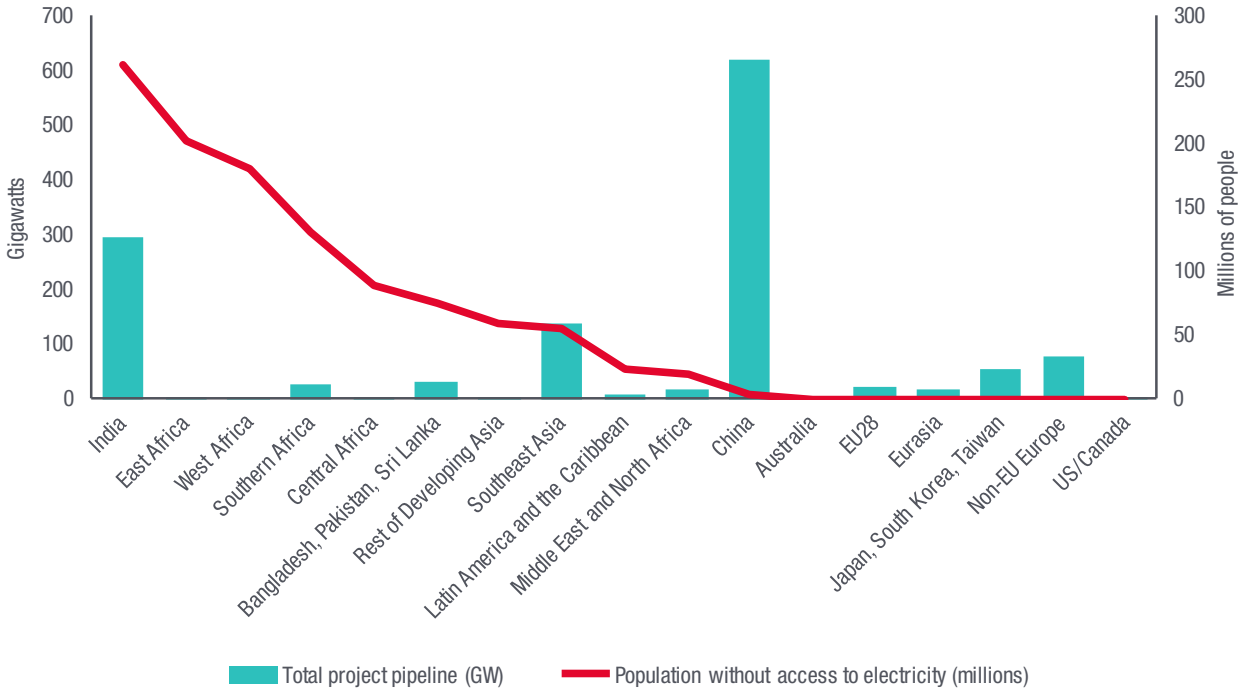
In addition, the most prevalent and harmful form of energy poverty is not lack of electricity, but lack of clean, safe and modern cooking. Indoor air pollution from unventilated cooking with fuelwood and charcoal is the fourth largest cause of mortality globally, contributing to 4.3 million deaths each year – more than unsafe water, HIV/AIDS or malaria (WHO, 2014). Increasing electricity supply – whether from coal or another source – very often has little to do with increasing access to modern cooking.

While electricity can be used for cooking, electric stoves are energy-intensive and expensive at present, so poor consumers in Africa and Asia rarely use them (World Bank, 2008). This may change as the cost of electric induction stoves falls (Putti et al. 2015). Universal access to clean, safe and modern cooking by 2030, however, will require rapidly scaling up access to cleaner fuels such as liquid petroleum gas and biogas, as well as use of advanced cookstoves.

Most coal development, on the other hand, is simply not aimed at delivering services to the energy poor. As the figure below shows, most current and planned coal power plant construction will take place in countries like China where there are very high levels of access to electricity. In sub-Saharan Africa, which has the highest number of people without access to electricity, centralised grid extension is not keeping up with population growth and there is very little coal development – or available coal reserves – outside a few Southern African nations.

Only Southeast Asia and India have both substantial coal power development plans and large populations without access to electricity. In Southeast Asia and the Pacific, most electricity-poor people are either in archipelagic states on islands distant from the grid – as in Indonesia, the Philippines and the Solomon Islands – or in mountainous countries with isolated populations, like Papua New Guinea.

Figure 1: Global projected coal pipeline vs. population without electricity access (by region)



Source: ODI analysis of data from Shearer et al., 2015 and World Bank and IEA, 2015.

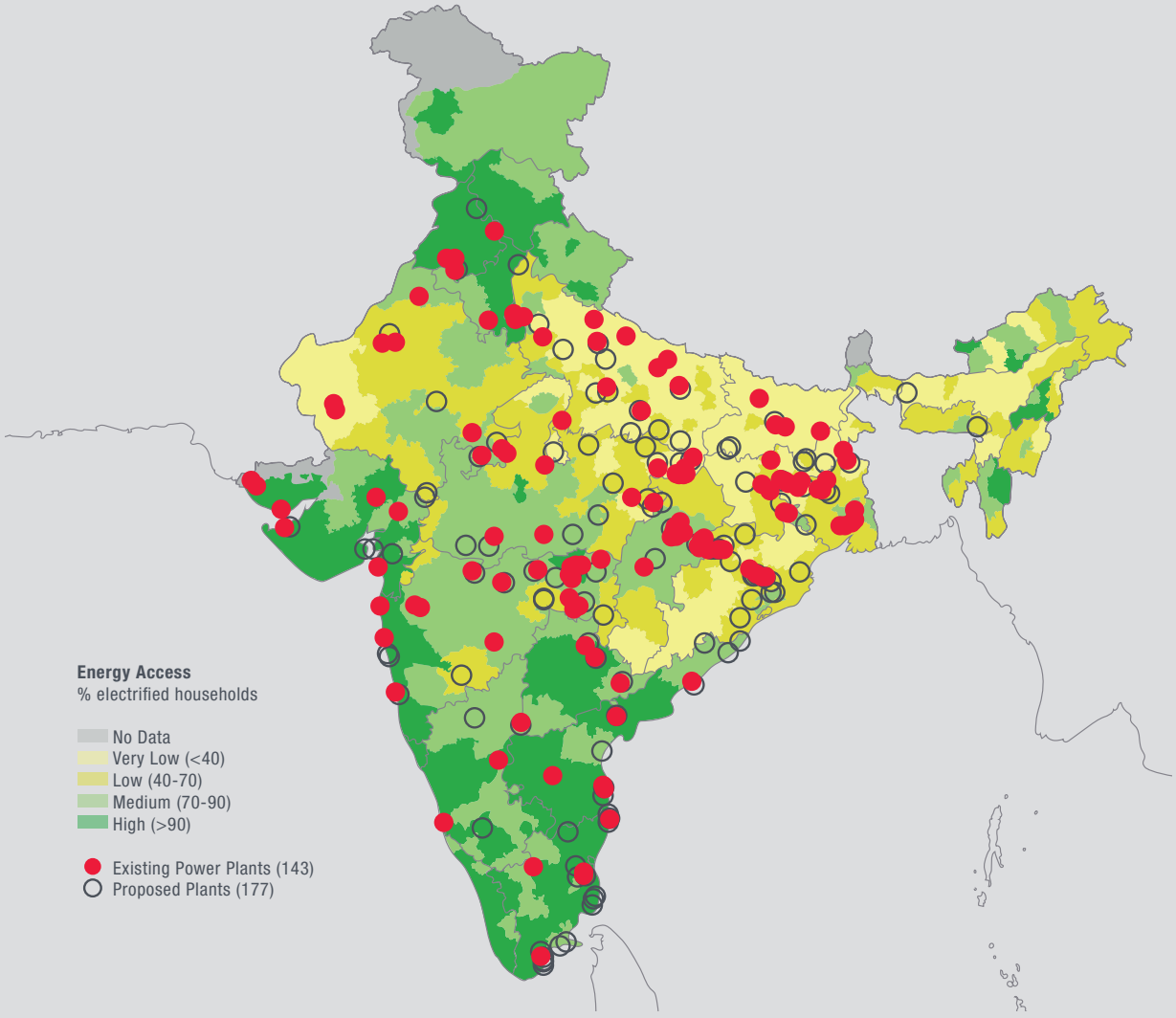
Box 1: Has India's coal served the energy poor?

To quote E.A.S. Sarma, former Secretary of India's Ministry of Power:

> *India's population of 1.24 billion comprises 247 million households, 68% of whom live in rural villages. According to the 2011 census, 45% of these rural households – 75 million – have no electricity. Of urban households, 6 million remain without electricity, or about 8% of the total. These figures have not changed appreciably since 2001, though around 95,000 MW of new largely coal-based electricity generation capacity was added during the intervening decade (Sarma, 2015).*

The map below illustrates that, to date, adding new coal-fired capacity has not led to many new connections for Indians. While coal provides 75% of the nation's electricity, many areas with the densest concentration of coal plants also have the lowest rates of electricity access (Dubey et al., 2014). In fact, the first new coal-fired power plant under consideration by the current government is in Gujarat, a region with surplus capacity (Jai, 2016).

Figure 2: Household electrification rates around major coal-fired power plants in India



Source: Dubey et al., 2014.

2. Coal is given too much credit for the reduction of extreme poverty

The 'economic miracle' of East Asia is a key area of interest to countries facing high levels of extreme poverty, and to the development sector aiming to assist them. China (and to a lesser extent Vietnam, Thailand and Indonesia) have undergone rapid industrialization in the last few decades and ushered in a new era of economic growth, while also dramatically reducing the number of people in extreme poverty. Much of this economic growth was powered by coal. Yet the relative contribution of coal consumption to extreme poverty eradication is often overstated and warrants closer scrutiny.

In China between 1981 and 2004, the number of people living on less than $1 per day declined by 500 million (Chen and Ravallion, 2007). Two thirds of this progress occurred between 1981 and 1987, ***prior*** to China's industrialisation and large-scale expansion in coal power (IEA, 1999). Between 1987 and 1999, China's growing industrialisation saw significant increases in coal-fired energy consumption. This rose from 350 to 900 terawatt hours of coal-fired electricity, at an average increase of about 46 terawatt hours per year. Most of China's success in eradicating extreme poverty had already taken place by the end of this period. Yet it was only ***after*** 1999, and a decade of industrialisation, that China began drastically ramping up coal power, adding an average of 230 terawatt hours of additional coal-fired power a year. By the end of 2013, China was consuming 4,120 terawatt hours of coal power per year (IEA, 2001-2015; IEA, 1999).

Income gains in wealthier groups correlated more closely to higher energy consumption: the industrialisation of the 1990s expanded China's middle class and even significantly helped moderately poor people, and the coal boom of the 2000s created tremendous wealth for many.

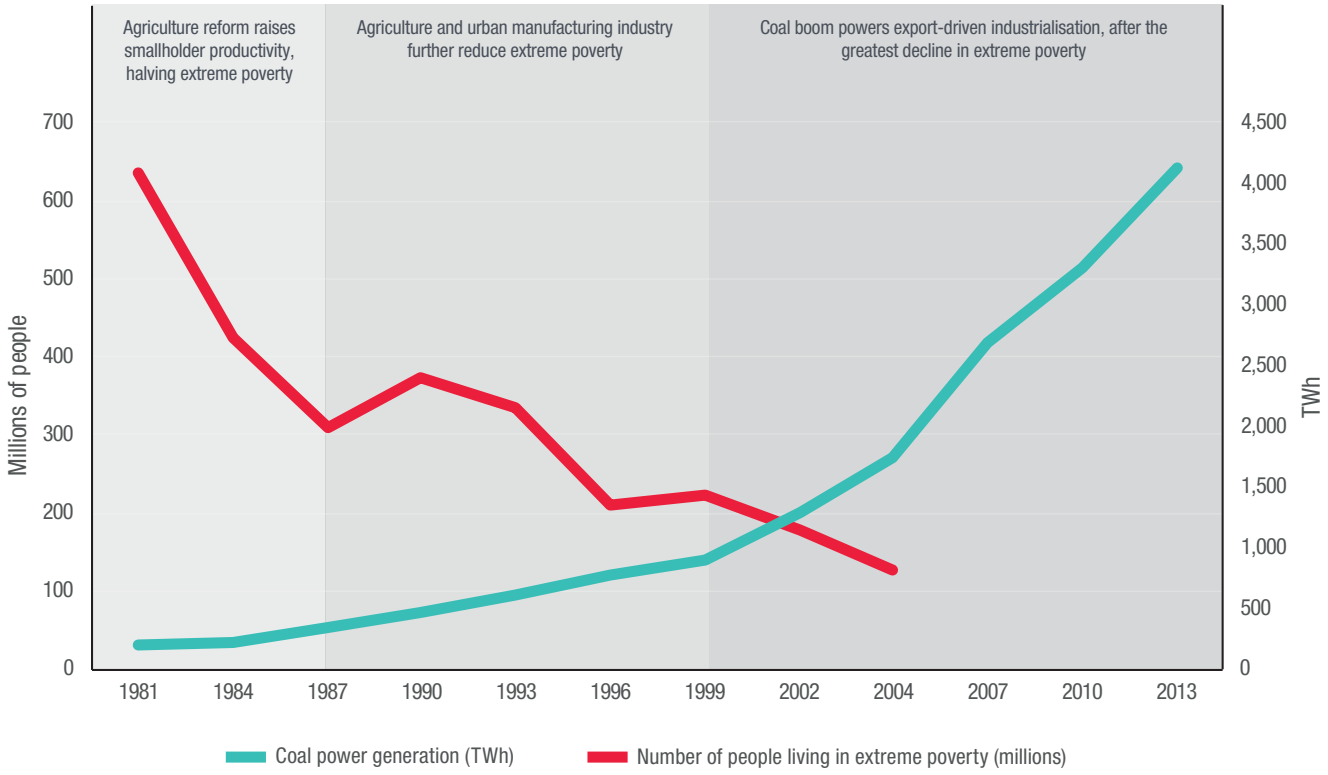
But this is different from lifting people out of extreme poverty. Industrialisation was unquestionably an important driver of China's overall economic success. Its contribution to poverty reduction was important, even if it played a smaller role in fighting extreme poverty than has often been attributed to it. In addition, while many development economists regard diversification away from agriculture as being necessary for broader prosperity gains, this does not require further expansion of coal. The energy demands of agricultural transformation, and of more socially inclusive industrial sectors like manufacturing, can now be met through lower-carbon solutions (IRENA, 2014).

Box 2: What were the real drivers of China's successful reduction of extreme poverty?

Detailed time series analyses by World Bank economist Martin Ravallion have revealed that China's success in reducing extreme poverty was primarily driven by growth in agricultural productivity, enabled by regulatory changes that dismantled collective farms and empowered smallholder farmers to benefit economically from managing their own farms (Ravallion, 2008). Between 1980 and 1985, agricultural productivity increased by an average of 7.5% per year, much of it among the poorest households. Urbanisation and the growth of export-orientated manufacturing also played a role, but can be credited with less than one quarter of the extreme poverty reduction between 1981 and 2004 (World Bank, 2016).

While few, if any, countries have succeeded in dramatically reducing poverty without industrialising, no poorer agrarian economies have succeeded in either materially reducing extreme poverty or industrialising without first improving agricultural productivity in ways that benefit the rural poor (Ravallion, 2008). Small-scale agriculture remains the primary employer in the majority of least developed countries, representing 48% of the developing world labour force (Cheong et al., 2013). In sub-Saharan Africa, it employs seven times as many people as industry (Ibid.).

Figure 3: China's extreme poverty plunged before coal power was ramped up



Source: IEA, 2001-2015; IEA, 1999; Chen and Ravallion, 2007.
Note: Figure reflects World Bank's former $1 per day (purchasing power parity) poverty line, for which historical data is available.

3. Better energy options exist to lift people out of income poverty

More power-generating capacity is urgently needed in the developing world. Capacity is needed not just in moderate amounts to ensure universal energy access, but also for a major increase in electricity supply to power productive uses for sustainable growth of markets and industry that can benefit all groups.

It is true that coal-fired power currently dominates many national energy mixes: coal provides 42% of global power supply and renewable energy only 22%. Coal's present dominance, however, is a poor indicator of the current and future economics of increasing electricity supply. Electricity plants are long-lived assets, and our current electricity mix is a hangover from the coal-heavy system installed in previous decades.

Even according to the overly conservative forecasts of the International Energy Agency (IEA) (Roberts, 2015; IEA, 2015), the generating capacity from renewable energy (wind and solar PV) over the next 25 years will be double the additional capacity from coal under business-as-usual policies. In 2015, investment in solar, wind and hydro was more than double that of gas and coal power plants (REN21, 2016). Between 2014 and 2020, the IEA expects non-hydro renewable capacity alone to exceed new fossil fuel capacity each year (Birol, 2015).

For the first time in history, renewable energy options are highly competitive with coal in nearly all markets, and becoming increasingly so. Renewable energy resources have the advantage of being more abundant and lower-cost than coal, and renewable technologies can be flexibly deployed and create more jobs. If power sectors are designed to integrate them, as discussed below, they also become increasingly reliable.

3.1. Renewable resources are abundant

The potential supply of renewable energy is many times greater than current energy consumption (IPCC, 2012). Global resource maps like the one below (Figure 4) show they are also located in both developed and developing countries (IRENA, 2016a).

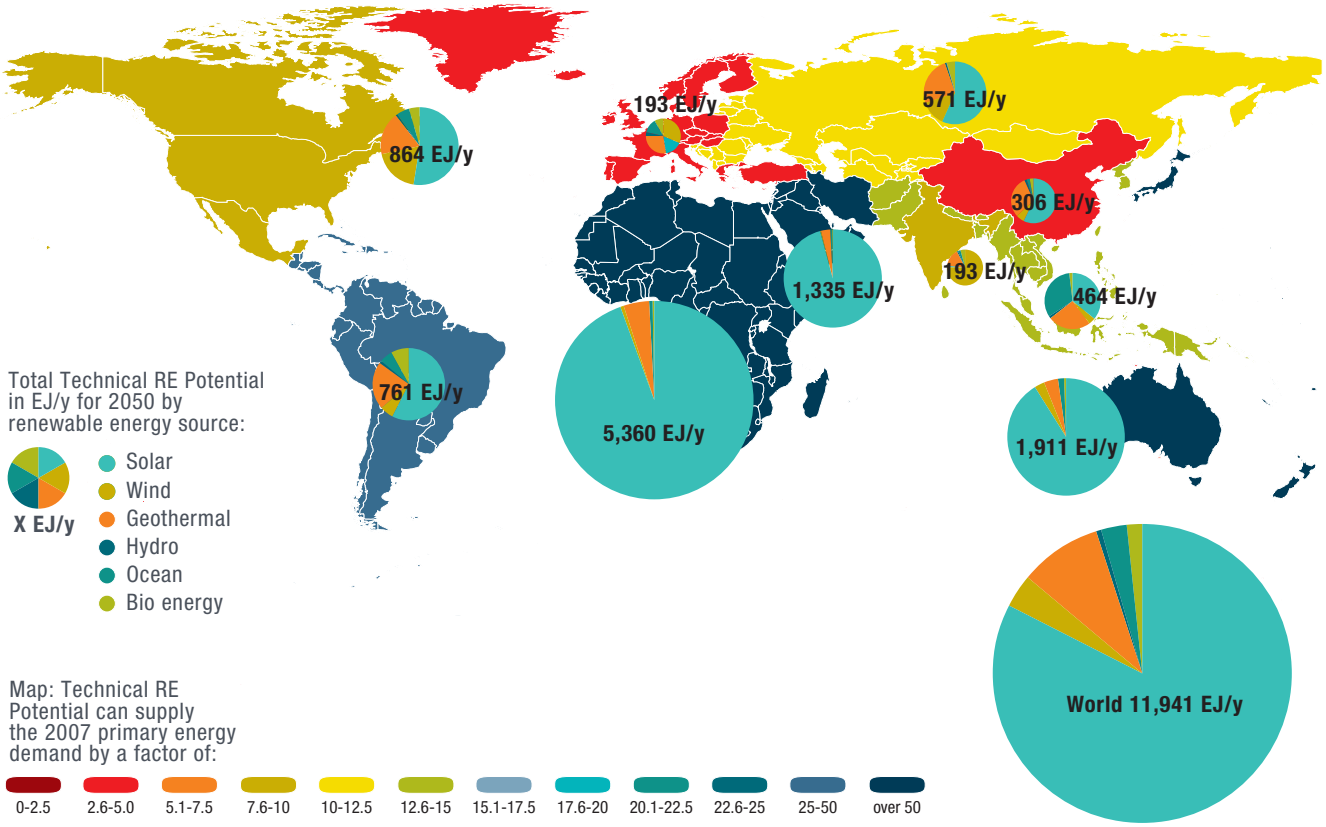
3.2. Renewable energy is a low-cost option

Renewable energy is now cost-competitive with higher-carbon alternatives, even without taking into account the latter's pollution costs. Prices of renewables have declined steadily over several decades. They have been on the cusp of competiveness for a long time, but the cost reductions in the last few years has been particularly significant. In the US for example, the cost of generating electricity from utility-scale solar PV fell by more than 80% since 2009, while the cost from wind fell by over 60% (Lazard, 2015). Globally over a similar period, the cost from wind power fell more than 18%, and the cost from solar PV more than halved (IRENA 2014b; IRENA, 2015). At the time of publication of this paper it is likely these numbers will already be outdated, as innovation continues to drive prices down (Zheng and Kammen, 2014). Unfortunately, policy-makers have often not caught up with this new market reality (Bazilian et al., 2013).

The US Energy Information Administration (EIA) calculates that unsubsidised electricity produced by onshore wind, and geothermal in the US, is cheaper on average than conventional coal technologies, and unsubsidised solar is cheaper than 'advanced' supercritical and ultra-supercritical coal technologies (EIA, 2016). In addition, renewable energy may be even more cost-competitive in developing countries, where coal is usually more expensive (especially when imported), lower quality and thus less efficient, and more polluting. Furthermore, coal plants run for closer to 60% of the time on average compared to 85% in the US (CTI and ETA, 2014; Beer, 2007; Bloomberg News, 2014; Liebreich, 2015; IEA, 2015).

South Africa, for example, is the cheapest place in Africa to generate coal-fired power, yet electricity from its new 4.7 gigawatt Medupi advanced coal plant will cost *at least double* the original estimates (Linklaters 2016). It will also cost 17% more than the electricity generated from South Africa's 2 gigawatt of new onshore wind power. In India, the minister responsible for power development recently stated: 'I think a new coal plant would give you costlier power than a solar plant' (Climate Home, 2016). The statement is supported by the extremely low bid prices for recent solar procurements in India (Kenning, 2015). Renewable energy investment in the emerging world now outpaces that in developed countries (McGrath, 2016).

Figure 4: Renewable energy potential by source and region (in Exajoule per year (EJ/y)) for 2050



Source: IRENA, 2016a.

The cost of generating electricity varies according to place, source and technology. Figure 5 shows the global range of electricity costs across different technologies in US dollars per kilowatt-hour. In installations throughout the world, electricity has been generated from large and small hydro, onshore wind, biomass, geothermal, solar PV and offshore wind at costs competitive to coal.

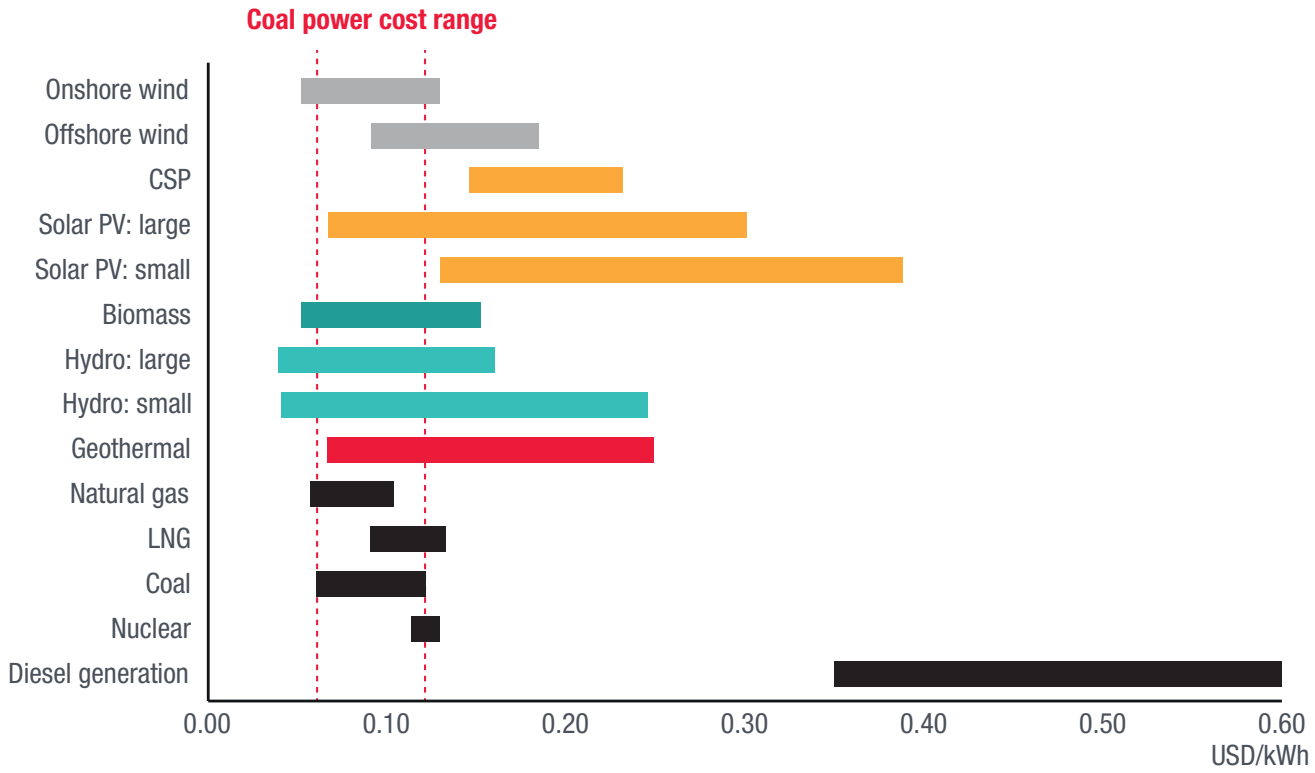
3.3. Renewable energy can be flexibly deployed

Wind and solar technologies have relatively constant returns to scale, allowing the project size to be tailored to the specific needs of different consumers (US Department of Energy, 2015; Go Solar California, 2016). In places where existing energy infrastructure is poor and energy needs vary from context to context, this flexibility means that renewable technologies can be more rapidly deployed than difficult-to-finance energy mega-projects. Smallholder agriculture, for example, is one of the most important sectors in many developing countries, and smallholders' energy needs are often served most cheaply by distributed technologies, such as off-grid or mini-grid electricity connections powered by renewable technologies, including solar PV, wind and mini-hydro, or even internal combustion engines (Hogarth and Granoff, 2015).

3.4. Renewable energy is increasingly reliable

Reliability is often the greatest concern expressed over using renewables. It is correct that currently solar and wind power are intermittent, and need to be complemented by resources that can respond to fluctuations in their supply. However, grid flexibility can easily be provided by building more responsive capacity from hydropower, pumped storage, geothermal and – in the short term – natural gas plants. Which technologies compliment intermittent renewable capacity will depend on the specific resource endowments and incumbent power system of each country, and all must be developed with strong environmental and social safeguards to mitigate any harmful impacts (Delucchi and Jacobson, 2011; van der Burg and Whitley, 2016). Coal power, on the other hand, is a particularly poor back-up for renewable energy because of the

Figure 5: Global range of electricity generation costs (levelised cost of electricity) by source, 2014-2015



Source: IRENA, 2015.

substantial inefficiencies incurred in ramping up and down supply from coal plants.

Most grids have ample room to scale up renewable energy capacity before intermittency diminishes their reliability, and the need for responsive capacity will decrease as grids become smarter, demand is better-managed, and cheaper and more efficient energy storage technologies are deployed. Interconnection and demand response already often generate significant savings (Weber and Loh, 2015; van der Burg and Whitley, 2016). A number of countries, including Guatemala, Kenya and Denmark, have used their flexible generation capacity to add significant shares of non-hydro renewables to the grid. Storage technologies will of course be critical as cheap but intermittent renewable technologies become a dominant form of generation capacity. While storage remains expensive, it is rapidly approaching competitiveness, with costs decreasing at a similar rate to renewable technologies (Eckhouse, 2016).

Renewables are also more reliable than fossil fuel options in another important respect: reliability of electricity prices. Whereas fossil fuel generation costs are variable and susceptible to price spikes, renewable technologies have no fuel costs and low operating costs. Once a renewable energy plant is built, the marginal cost of producing electricity is near zero. Reducing the cost of importing fossil fuels would be hugely beneficial for developing countries, particularly those with balance of payments deficits and weak foreign currency reserves.

Finally, as discussed above, adding more generating capacity will not itself improve many developing countries' extremely unreliable electricity systems – regardless of the energy source. India, for example, added more capacity in 2014–15 than any other year on record, yet more than a third of that capacity went unused (Dhoot, 2015). The country continued to suffer blackouts, due to transmission and financial mismanagement by distribution companies as much as to supply shortages (Ghatikar, 2015).

3.5. Renewable energy creates more jobs than coal

Countries that are heavily dependent on coal often cite concerns that an eventual phasing out of coal will result in big job losses. This is a serious issue for specific countries whose economies have depended on coal. Such a phasing out, with the accompanying impact on particular communities, must be managed sensitively and justly. Replacing coal will lead to the loss of some jobs, like coal mining. However, it will also lead to the creation of other, often higher-quality, jobs required in low-carbon energy systems. In 2015, the growing renewable energy industries – solar, bioenergy, wind, hydro and geothermal – employed a combined total of 9.4 million people globally; more

than the 7 million people the World Coal Association itself estimated were employed directly by the already mature coal industry as of 2012 (IRENA, 2016b; World Coal Association, 2012; Singer, 2015). As of 2015, three of the top four largest renewable energy labour markets were in the emerging economies of China (3,5230,000), Brazil (918,000) and India (769,000) (IRENA, 2016b). In Bangladesh, the solar home system market created 127,000 jobs along the value chain, from manufacturing to after-sales service (Ibid.). Renewables also create significantly more jobs than coal per unit of energy produced. As renewables gain a greater share of the energy mix, we can expect that overall employment in the energy sector will increase. The issue, then, is to ensure a just transition to a renewable energy future where benefits are shared as widely as possible.

In light of these trends, it is time to revisit the claims that coal capacity must significantly increase to power inclusive growth. Renewable electricity is abundant, increasingly reliable and now cost-competitive with coal. It can also be more flexibly deployed and offers greater employment potential. It improves energy security and, as discussed in the first section, can deliver energy services to the poorest. Recent evidence from as wide-ranging contexts as East Africa, Southeast Asia, and Eastern Europe all document the immediate economic benefits of pro-poor clean energy strategies for national development (Kittner, et al., 2016; Shirley and Kammen, 2016).

Given this, countries that historically used coal power to fuel industrialisation would be unlikely to make the same energy choices today. In fact, the International Renewable Energy Agency has provided a roadmap for growth in renewables to meet the demands of a growing manufacturing sector (IRENA, 2014a).

If China, for example, were industrialising today, it is reasonable to believe coal would play a smaller role in its energy mix given the country's enormous supply of domestic, secure and affordable renewable resources. China has more renewable energy capacity than any other country in the world. While it is true that China plans to add a dangerous number of additional coal plants, it has just shelved 200 coal-fired power plants from its current project pipeline, established a full moratorium on new coal mining, and existing coal capacity is being utilised at an ever lower rate (Forsythe, 2016; Davies Boren, 2015; Bloomberg News, 2015). In fact, mounting public concern about the wider social, environmental and economic burden posed by air pollution, which costs China between 9.7% and 13.2% of GDP, has reinforced the attractiveness of a low-carbon renewable energy path (NCE, 2014).

This does not mean renewable energy is without challenges, particularly in the developing world. Renewable energy projects are sensitive to financing costs, and their ability to deliver power effectively is dependent on how the grid is managed (NCE, 2015). Power sector financing and operation have historically been centred on fossil fuels, which increases the cost of renewables and the challenges to integration (Ibid.). While renewable energy investment is growing at a remarkable rate, addressing these barriers would further accelerate investment.

4. More coal will entrench poverty

Coal production and use can undermine poor households' efforts to escape poverty.

The immediate human health impacts of coal in the developing world are staggering, particularly for poor people who are the least equipped to deal with the economic burdens of illness, a premature death in the household, or degraded water and land resources. Coal-fired power is estimated to cause premature deaths in developing Asia at the following annual rates:

- China: between 260,000 and 670,000 deaths (Duggan, 2013; Smith, 2014)
- India: 100,000 premature deaths (Goenka and Guttikunda, 2013)
- Indonesia: 7,100 premature deaths (28,000 projected with planned capacity) (Greenpeace, 2015)
- Vietnam: 4,300 deaths (35,000 projected with planned capacity) (Greenpeace, 2015b)

In Indonesia, it was estimated that a single one gigawatt plant would cause approximately 650 deaths per year –26,000 premature deaths over the plant's life cycle (Greenpeace, 2015a). These estimates exclude other health burdens that typically affect much greater numbers of people: heart attacks, asthma, and hospital and emergency room visits (Ibid.).

Coal use also has other significant environmental and human health impacts that can undermine progress against poverty. The coal industry withdraws, consumes and pollutes substantial quantities of freshwater, often competing for limited water resources with other sectors, such as smallholder agriculture, that are crucial for poverty reduction. Roughly 44% of existing and planned coal plants are located in areas with high to extremely high water stress. A quarter are located in 'red-listed' areas, where surface and groundwater resources are at risk of drying up because water is being withdrawn faster than it can be replenished.

This is most severe in China and India. Roughly half of all coal plants in China and a quarter of those in India are located in red-listed areas. Prolonged droughts in India have forced numerous coal plant suspensions since 2010, leading to rolling blackouts, and causing experts to question the viability of coal-fired generation in some states. Coal plants' direct competition with poor farmers for scarce water resources has already led to political tensions and social unrest (Caldecott, 2015).

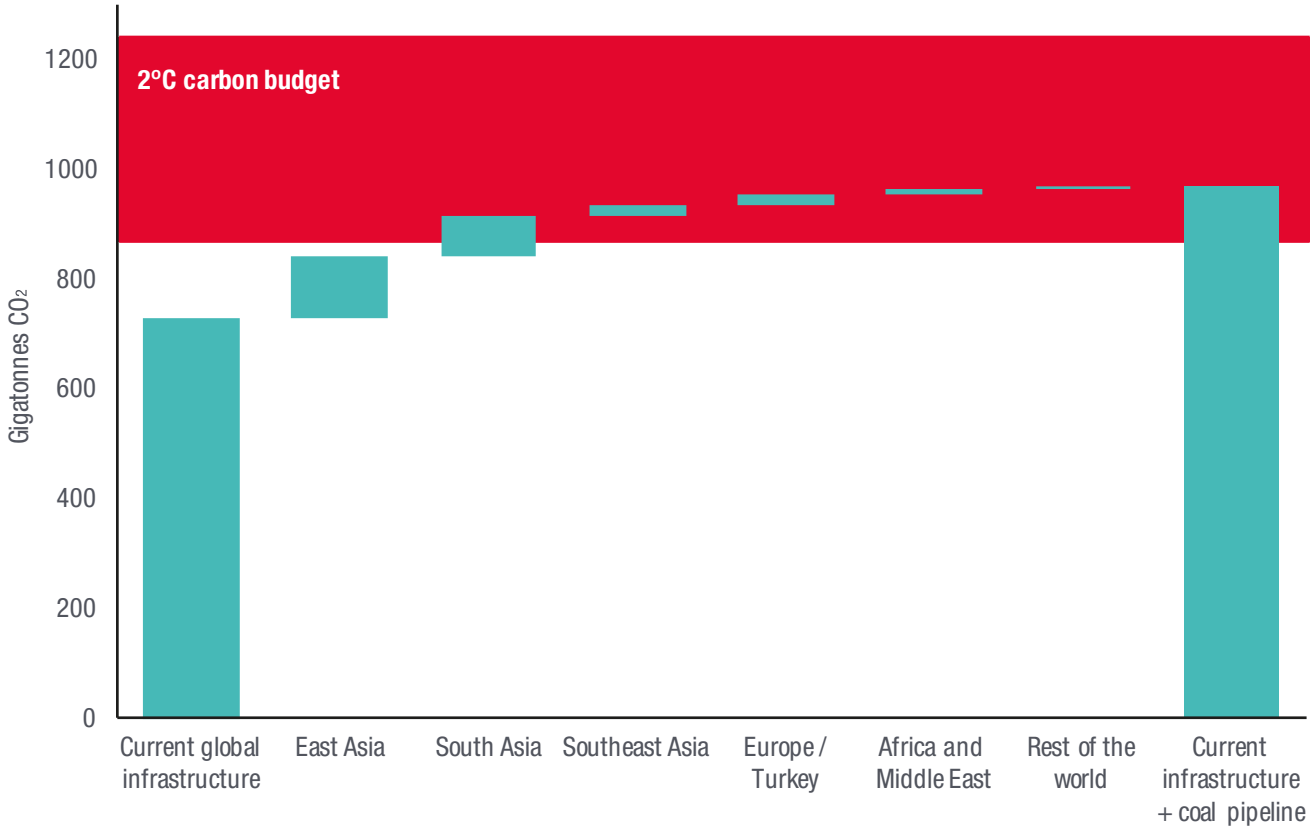
Coal mining also frequently displaces communities. In India alone, mining uprooted 2.55 million people between 1950 and 1990 as coalmines proliferated or shifted from underground to open-pit mines and grew significantly in size (Downing, 2002). Displacement continues today. A planned open-pit coal mine in northwest Bangladesh threatens to directly displace between 50,000 and 130,000 people and may force over 220,000 people to migrate as the mine contaminates water resources and irrigable land (Kalafut, 2008). Mining-induced displacement is not limited to developing countries, but governance regimes in developing countries can be less effective at protecting and compensating displaced and impacted populations (Terminski, 2013; Balch, 2013). This is particularly the case because coal mining generally occurs far from urban centres where central governments have limited capacity to regulate the industry (ABColombia, 2012).

These social and environmental impacts also have substantial economic costs. These are difficult to calculate, but in the US, one study estimated such impacts cost the US economy half a trillion dollars per year (Schwartz, 2016). Sickness and deaths from air pollution cost China an estimated 13% of its GDP (NCE, 2014).

Beyond these immediate impacts, burning coal is also a major driver of the greatest long-term threat to eradicating poverty: climate change. Current 'carbon budgets' estimate the amount of greenhouse gases that can be emitted into the atmosphere consistent with limiting the globe to a 2°C mean temperature change. If the world exceeds this, the results will be disastrous for the global fight against poverty (Granoff et al., 2015; Hallegate et al., 2016).

Even at 2°C, the World Bank estimates that climate change could result in more than 100 million additional people living in extreme poverty by if measures to protect poor families from its impacts are not taken (Hallegate et al., 2016). By 2050, climate change impacts could draw an estimated 720 million people into extreme poverty (Granoff et al., 2015). This is about the same number lifted out of extreme poverty in the last two decades and would thus cancel out much of the progress made in poverty eradication to date. If left unchecked, the World Bank estimates that climate change by 2050 could severely

Figure 6: Lifetime emissions of existing global infrastructure and proposed coal pipeline (in Gigatonnes CO2) by region



Source: Granoff and Hogarth, 2015b.

impact up to 1.5 billion people (GFDRR, 2016). Africa and South Asia are the most vulnerable (Hallegate et al., 2016).

Climate change threatens to undermine the productivity of global marine and terrestrial food production systems, the main source of income for roughly 2.7 billion people in sub-Saharan Africa, South Asia, Southeast Asia and China (Granoff et al., 2015). Climate models predict global crop yield losses of 5% by 2030 and 30% by 2080 due to climate change, even if farmers adapt by changing crops or increasing irrigation (Havlik et al., 2015). Across rain-fed farms in Africa, the failure rate of the primary growing season is predicted to increase from one in five years today to one in three years in a 1.5°C to 2°C warming scenario (Jones and Thornton, 2009). Climate-related shocks – floods, droughts, storms, heatwaves and pests – are expected to increase in severity and frequency as a result of climate change, drawing vulnerable families into extreme poverty (IPCC, 2013; CAFOD, 2014; Munro, 2014).

Coal consumption is capable of pushing climate change to levels that are catastrophic. If one third of the planned coal-fired power plant construction goes ahead (Edenhofer, 2015), the new emissions, combined with the lifetime emissions of existing infrastructure, would be sufficient to exceed a 2°C carbon budget (Granoff and Hogarth, 2015b). Most of the existing infrastructure is in the world's richest countries plus China, and most is planned in developing Asia, with 67% of new plants to be constructed in India and China alone. As World Bank President Jim Kim stated in a recent speech: 'if the entire region implements the coal-based plans right now, I think we are finished … That would spell disaster for our planet' (Goldenberg, 2016).

The developed world must move fastest to decarbonise, in order to keep the world below the 2°C rise in average global temperature. Social justice as well as international agreements demand it. Along with China, the developed world is the major emitter of greenhouse gases from the power sector, including coal. But keeping average global temperatures below 2°C requires a wholesale re-evaluation of the planned expansion of coal globally as well. To keep below 2°C, an estimated 88% of known coal reserves need to be treated as unburnable (Granoff and Hogarth, 2015b). Even technology classed as the most efficient 'clean coal' technology emits far more pollution than either oil or gas, and considerably more than renewable energy (Granoff and Pickard, 2015; NREL, 2014). Carbon capture and storage (CCS) is an unproven remedy (Pickard and Granoff, 2015). Even if CCS were already technologically and commercially proven, and widely available, an estimated 82% of known coal reserves would still have to remain in the ground to prevent dangerous global warming (McGlade and Ekins, 2015).

Poor people can ill afford the health, environmental and social burden of polluting technologies. Poor economies can ill afford the economic burden to their development.

Conclusions

Continuing expansion of coal power is incompatible with implementation of the Paris Agreement to limit global warming to 'well below 2 degrees' (UNFCC, 2015), and is not needed to achieve the SDGs, including SDG7 on universal access to energy. The world's wealthiest countries must take the lead by retiring coal-fired power plants for both environmental and social justice reasons. These plants harm their citizens' health and, by contributing to climate change, prevent the world's poorest people lifting themselves out of poverty. Of the G7 countries, the US and the UK are making progress on retiring coal power, while others, including Japan, are notable laggards, expanding coal capacity instead of retiring it (Littlecott, 2015).

However, action by developed countries to cut coal capacity is not enough to stay well below 2°C, especially since much of the expansion in coal power is in the developing world. Equally, expanding coal power is not necessary for the eradication of extreme poverty or energy poverty. While all forms of public support for fossil fuels should be phased out, stopping government support for additional coal capacity – from mining to power generation – is most urgent.

1. More coal will not end energy poverty

There are two kinds of energy poverty: lack of access to electricity and lack of access to clean and safe cooking solutions. Many people without electricity live frustratingly close to the electricity grid, and connecting them represents the cheapest route to access. The biggest barriers to this are lack of political will, power sector mismanagement and political capture, and the cost of connecting new households. These problems will not be solved by building new power plants alone – coal-fired or otherwise. However, the vast majority of those without electricity access – 84% – live in rural areas that cost more to reach with centralised electricity grids. The quickest and cheapest way to provide electricity to at least two thirds of these people is through decentralised renewable solutions (stand-alone home systems or mini-grids). Finally, providing rapid access to clean and safe cooking energy will have little to do with electricity in the near term: it requires accelerated access to cleaner fuels and more efficient cookstoves.

2. Coal takes too much credit for the reduction of extreme poverty

Over the second half of the last century, coal powered the economic development and industrialisation of several emerging economies – most notably China and other East Asian countries. Many countries with high levels of extreme poverty look to emulate the economic transformation of China. In reducing extreme poverty, however, coal power's historical role needs more careful consideration. Most of China's success in reducing extreme poverty preceded its runaway coal expansion of the 2000s. Close analysis shows that, in fact, two thirds of the decline in extreme poverty in East Asia was driven by improvements to agricultural productivity and macroeconomic policies before 1987. Industrialisation played a critical role in increasing the income of the middle class and even moderately poor people, especially in cities, but it can be credited with less than one quarter of the celebrated decline in extreme poverty in China between 1981 and 2004. Energy consumption gradually and materially rose during the two decades of the last century when China successfully lifted many out of poverty, but the country's very rapid acceleration of coal consumption only began in the first decade of this century. This requires us to reconsider the role that coal use – and especially the runaway consumption of the last decade – played in China's successfully lifting its population out of extreme poverty.

3. Better energy options now exist to power poverty eradication

Power generation is desperately needed in the developing world, not just for energy access, but also for growth of industry, commerce, and to supply a growing middle class. The vast majority of these energy needs can now be met without coal. For the first time in history, there are renewable energy options that are highly competitive with coal in nearly all markets. Between 2009 and 2015 alone, the average cost of solar PV and wind installations declined by over 80% and 60%, respectively. This is why, although many grids are still dominated by legacy coal capacity, new build of renewable energy capacity has outpaced that of other sources since 2014. In 2015, the burgeoning renewable energy industry employed a combined total of 9.4 million people across the supply chain from manufacturing to power generation. This is more than the 7 million people the World Coal Association estimated as being directly employed by the mature coal industry across its supply chain as of 2012. Some low-carbon energy sources like solar and wind are intermittent and still need to be complemented by smarter grids, storage and balancing generation, but coal is a poor technical complement to such systems and far more polluting than other, more flexible options. Lower-carbon energy sources – led by renewables – can power agricultural productivity, manufacturing, small- and medium-sized businesses and other sources of sustainable growth that leave no one behind. Governments need to prioritise renewable energy investments and develop power sectors that support and integrate them. Coal is a 19th century technology and today's challenges are best met with 21st century technologies.

4. More coal will entrench poverty

More coal slows the fight against poverty. Coal consumption is associated with a health crisis in the developing world – burning fossil fuels is the major cause of air pollution globally – and the effects of this crisis are borne disproportionately by poor people. The air pollution from a single coal plant can cause thousands of premature deaths and increase the incidence of heart and lung disease. Even technology classed as 'clean coal' emits far more pollution than natural gas and considerably more than renewable energy. Coal extraction also consumes valuable water resources and has been associated with negative environmental and social impacts that can entrench or worsen poverty. Recent droughts in India, for example, have put the needs of coal power plants at odds with the needs of poor farmers for scarce water resources in some states. Coal expansion as currently planned is enough to push climate change to catastrophic levels. A changing climate already disproportionately hits the poorest people with least resources to enable them to adapt.

Recommendations

The following actions must be prioritised in order to shift to a sustainable and just energy future:

1. G20 governments must stop all forms of subsidy for fossil fuels

The G20 must fulfil its commitment to phase out public support to fossil fuels no later than 2025. The G7 should lead this effort by immediately halting exploration subsidies, phasing out other subsidies by 2020, and championing the transparent reporting of support for oil, gas and coal by all countries. Equity demands that the G7, followed by the G20, take the lead on promptly phasing out subsidies to coal and other fossil fuels. These measures should be complimented by adequate pollution abatement requirements on power plants, to remove the implicit subsidy that governments provide by allowing the cost of pollution to be born by the public instead of polluters.

2. All forms of governments support for coal capacity expansion should be phased out, including those channelled through Development Finance Institutions

All government assistance for energy in developing countries should support a shift or leapfrog to renewable and efficient energy systems, providing financial, technical and policy training, and other support for both centralised and distributed technologies. Public institutions should strengthen accountability, transparency and public participation in energy investment decision-making.

3. All support for energy through bilateral and multilateral channels must prioritise the delivery of SDG7 ensuring access to affordable, reliable, sustainable and modern energy

In line with this, greater support must go to clean energy investment, energy access and in particular to the decentralised electricity access and clean cooking solutions needed to give poor and vulnerable groups access to energy services.

4. Development institutions must apply monitoring and reporting frameworks that track the poverty reduction and development impact of their energy support

Tracking frameworks should measure the actual, not inferred, delivery of electricity connections and clean cooking solutions to poor groups. They should also track the quality of these energy services, in terms of their reliability, affordability and safety, building on the leadership of the World Bank's Global Tracking Framework developed under the UN Sustainable Energy for All initiative.

5. Developing and emerging economies should develop plans for a sustainable and socially just energy shift, in line with implementing the SDGs and their Nationally Determined Contributions under the Paris Agreement, identifying support needed from development partners

Countries currently reliant on coal should commit to a timeline for phasing out additional coal investment and plan how to support coal-dependent communities to transition into sustainable employment. Developing and emerging economies should, with the help of multi- and bilateral development partners, also develop plans for achieving SDG7 on universal access to modern energy, including investment targets for scaling-up on- and off-grid electricity connections and access to modern cooking services. Power sector reform should capitalize on the opportunity presented by renewable energy technologies and be designed to integrate them.

6. Public and private finance must be more transparent about exposure to carbon risk

All public institutions should ensure they apply best practices in disclosing their own exposure to carbon risk. Governments in countries with developed financial systems must also put in place financial regulation to ensure the fair disclosure of carbon risk by the private sector.

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