COPENHAGEN CONSENSUS CENTER

ENERGY

PERSPECTIVE PAPER

Benefits and Costs of the Energy Targets for the Post-2015 Development Agenda

Adele C. Morris

Benefits and Costs of the Energy Targets for the Post-2015 Development Agenda

Post-2015 Consensus

Adele C. Morris
Brookings Institution

Working Paper as of 23 September, 2014

Introduction

This paper considers the Assessment Paper by Isabel Galiana and Amy Sopinka on the post-2015 challenges related to energy. The authors analyze the benefit-cost ratios of six potential energy goals with an eye towards helping set policy priorities efficiently. This paper reviews the targets and gives another perspective on how to set priorities among them. I also propose a seventh target, which is to phase out implicit subsidies to fossil fuels by gradually imposing taxes that reflect their external costs.

Part 1 of the energy Assessment Paper provides a useful discussion of the range of energy challenges in poor countries. It convincingly explains how access to modern energy resources is critical to economic development, both because safe, reliable energy directly improves the welfare of poor households and because it is a necessary condition for achieving other important development goals, such as clean water and sanitation, health care, and transportation. Part 1 also reviews important recent trends in the energy sector and what those trends mean for the prospects for modern energy delivery in developing countries.

Few doubt the merits of expanding modern energy access in principle. Thus, the operative questions are: what energy sources to emphasize; where the net benefits of expansion are highest; and what policies would most efficiently induce the highest-value energy development. A related question is how best to analyze the net benefits of different energy options, particularly when important tradeoffs across different approaches arise. For example, the Assessment Paper mentions the World Energy Council's three core dimensions of "energy sustainability": energy security, social/economic equity, and environmental sustainability. What if, say, the cheapest and most reliable electricity technology is more polluting than other options? How should policymakers strike the tradeoffs across competing goals?

Many disagreements about the direction of energy policy surround the extent to which such tradeoffs exist, and where they do, how to account appropriately for hard-to-monetize factors, such as damages from greenhouse gas emissions and human health impacts of local air pollution. Further, as the Assessment Paper points out, regional differences in both the costs and benefits of investments in modern energy abound, and some tradeoffs involve two different environmental endpoints, such as arise in some biofuel and hydropower contexts (local ecological outcomes vs. potential greenhouse gas effects). These complexities and others make targets such as "double the share of renewable energy in the global energy mix" intrinsically ill-suited to benefit cost analysis.

The Six Targets

In their draft assessment, the authors consider six potential energy-related targets for the post-2015 agenda, to be achieved by 2030:

1. Increase access to modern forms of energy to 100% of the population, i.e. a "zero target" of unserved households.
2. Double the rate of energy efficiency improvement globally.
3. Double the share of renewable energy in the global energy mix.
4. Phase out fossil fuel subsidies.
5. Provide access to modern cooking fuels to 30% of the populations currently using traditional fuels.
6. Double investment in R&D for energy technologies.

The first three targets correspond to three of the energy targets that came out of the 13th session of the Open Working Group (OWG), the United Nations body charged with proposing the post-2015 sustainable development goals (SDGs).[1] The fourth goal, to phase out fossil fuel subsidies, reflects the G-20 Leaders' Declaration.[2] The fifth goal is a subset of the first goal, confining the expansion of modern energy to cooking fuels and reducing the ambition to providing access to only half of those who currently do not have it. It reflects an option that came out of the 12th session of the OWG. The sixth goal is the authors' proposal.

The targets pose several challenges to benefit-cost analysis. One challenge common to all of these targets, with the exception of the phase out of fossil fuel subsidies, is they are simply target levels of a desirable outcome, not specific policies. In some cases, the authors are clear about the policies and programs they assume, and in other cases they are not. In this perspectives paper, I will describe what might be reasonably efficient strategies, and explain some pitfalls associated with cost-ineffective approaches.

Another analytical challenge is the lack of a clear baseline against which "doubling" would be measured. For clarity, I will assume this means an increase by 2030 in the desired outcome by 100 percent relative to business as usual projections for the same year. For example, the targeted level of energy R&D expenditures in 2030 in SDG 6 would be double the projected spending in the absence of policies undertaken to achieve the goal.

The arbitrary quantitative level of the targets is inconsistent with a benefit-cost analysis that accounts for the structure of the marginal benefit and marginal cost curves. For example, as the Assessment Paper points out, if one sorts households by how costly it is to provide them with access to modern energy, serving the last decile could be far more expensive than serving the next-most-costly decile – with approximately constant marginal benefits. In principle, the benefits should justify the costs at whatever level of service expansion policymakers target.

---

[1] The full Outcome Document of the OWG on SDGs is available here: http://sustainabledevelopment.un.org/focussdgs.html

[2] G-20 Leaders Declaration, St. Petersburg, Russia, September 2013, p. 23. https://www.g20.org/sites/default/files/g20_resources/library/Saint_Petersburg_Declaration_ENG.pdf.

Finally, aggregate welfare or GDP increases may mask important underlying distributional outcomes. For example, phasing out fossil fuel subsidies would probably increase GDP by improving the efficiency of the fiscal system and rationalizing investment incentives, but the policy may make many households worse off. Thus a policy with a high benefit-cost ratio may be problematic if it is not carefully designed.

Despite these challenges, the authors endeavor to assess the potential for improving net social benefits from each of these targets. I review the targets below, grouping targets 1 and 5 together as they involve related endpoints.

Targets 1 and 5. Increase Access to Modern Energy: Cooking and the "Zero Target"

The term "modern energy" is a loose term for a basket of basic energy services that includes electricity and clean, convenient cooking technology. It may also include mechanical power for agricultural and other household production activities. "Modern cooking" refers primarily to biogas systems, liquefied petroleum gas (LPG) stoves, and advanced biomass cookstoves that burn cleaner and more efficiently than traditional three-stone fires.[3] Traditional solid fuels include wood, coal, and animal waste.

Modern cooking

The Assessment Paper authors find that the target with the highest benefit cost ratio is SDG 5, expanding access to modern cooking. They cite evidence of improved indoor air quality, reduced mortality, and morbidity, and time savings. The data are solid and convincing.

Although the success of past efforts has been uneven, I share the authors' conclusion that with careful implementation Target 5 is likely to provide strong net benefits. According to Ostojic et al (2011), over 100 different new types of stoves are available in developing countries, and they vary substantially in their sophistication, durability, and reliability.[4] They observe that many past cook stove programs promoted products were not well designed, manufactured, or installed. In a test of more than a dozen different stove designs MacCarty et al (2012) find that "one stove is more efficient, another heats quicker, others are safer, and each of these stoves pollutes more or less than others." Fortunately, newer, better-built stoves are coming to market and organizations involved in promoting them are learning how best to tailor technologies for local conditions. Thus, the outlook for the next generation of cook stove programs appears promising, and the Assessment Paper's conclusion that increased access to modern cooking is likely to provide high benefit cost ratios appears sound.

---

[3] The International Energy Agency's definition of modern energy for statistical purposes appears here: http://www.worldenergyoutlook.org/resources/energydevelopment/definingandmodellingenergyaccess/

[4] Ostojic et al (2011), p. 85.

Given the strong evidence of net benefits, I would recommend policymakers consider a 2030 target of providing access to modern cooking fuels to more than 50% of the populations currently using traditional fuels. How much more than 50% would be feasible is unclear, but to the extent they scale back from the "zero target" for electricity, it may be appropriate to push harder on the modern cooking goal.

Electricity

The authors convincingly describe the benefits of access to electricity, and it is impossible not to be sympathetic to the goal of delivering this enabling power to the entirety of humanity. However, I share the authors' conclusion that the costs are likely to be non-linear with the level of ambition, and I concur that all sorts of political, social, institutional, and infrastructure challenges are likely to emerge as efforts expand. Such challenges are particularly likely as the share of those not served by electricity becomes more predominantly rural. However laudable the target, I would suggest a less lofty but more realistic approach, perhaps in a similar formulation as the modern cooking target.

Target 2. Double the Rate of Energy Efficiency Improvement Globally

One should not conflate the energy intensity of the macroeconomy (BTU/GDP) with the energy use of a household or firm or the energy efficiency of a particular product. The U.S. Department of Energy makes the point:

> "At the level of the aggregate economy (or even at the level of an end-use sector) energy efficiency is not a meaningful concept because of the heterogeneous nature of the output. The production of a huge number of goods, the mixing of the transport of freight and people, and the variety of housing and climates makes an aggregate energy intensity number based on Gross Domestic Product (GDP), a number that disguises rather than illuminates. A simple intensity measure can be calculated (as Energy/GDP), but this number has little information content without the underlying sector detail."[5]

The energy intensity of a macroeconomy is a function of its sectoral composition, among other things. If, as an economy develops, the service economy gradually increases relative to industrial output, this alone can reduce the energy intensity of the economy. In that case, the reduction in energy intensity is an artifact of development, not a cause of it. Thus I would argue that the target itself does not make much sense, and that it must be substantially revised to allow for meaningful measurement and benefit cost analysis.

An alternative version of SDG 2 would target energy efficiency improvements in a particular sector. Energy efficiency (EE) connotes the amount of energy used to produce a unit of output of a specific product or service. But even there, such a target may not make sense without specifying the policy that would pursue it. Certainly, all else equal, using less energy is beneficial, and no energy is cleaner than the energy that is never produced. But

[5] http://www1.eere.energy.gov/analysis/eii_efficiency_intensity.html .

one must be clear about what is given up to produce the energy savings. Many energy efficiency investments produce net benefits, but some costs of energy saving investments, including performance, reliability, uncertainty, overhead, and the time value of money are not straightforward to monetize.

The authors cite the "EE gap" as motivation for government policies to increase EE. The EE gap is the unexploited economic potential of energy saving investments, including all costs and benefits. It is not synonymous with the entire set of "barriers" to energy efficient product deployment because some of those barriers are real costs that directly decrease the net benefits of the investments. Numerous engineering economic studies such as those cited in the Assessment Paper show large potential gains from EE investments, thus implying the existence, not just of low hanging fruit, but fruit on the ground.

The peer-reviewed economic literature on the EE gap reviews these studies and asks whether it really is the case that investors are consistently overlooking cost effective energy-related investments. Allcott and Greenstone (2012) find that much of the extensive literature assessing investment inefficiencies related to energy efficiency "does not meet modern standards for credibility." They find that energy efficiency engineering analyses or observational studies "can suffer from a set of well-known biases," and that it is difficult to substantiate the case for a significant and pervasive EE gap. They conclude that while investment inefficiencies do appear in various settings, the actual magnitude of the EE gap is small relative to the assessments from engineering analyses. The likelihood that there is substantial heterogeneity in investment inefficiencies across the population suggests that targeted policies would generate larger welfare gains than general subsidies or mandates.

Gillingham and Palmer (2014) also review the EE gap literature and come to similar conclusions. Although real market failures exist (imperfect information, principal-agent issues, credit constraints, learning-by-using, and regulatory failures), the EE gap is overstated. Further, policies to address it need to be tailored to the specific market failure at hand.

Another theme of the EE gap research questions whether energy efficiency standards for household goods really do make consumers (and society) better off, particularly when consumers bear the full energy cost of ownership. Gillingham and Palmer (2014) cite studies that show that broad energy efficiency standards are not consistently welfare improving, and some evidence suggests they can produce large welfare losses. Gayer and Viscusi (2013) illustrate how U.S. federal agencies, in justifying their energy efficiency standards, rely heavily on engineering analyses that confine consumer effects of the rule to energy savings, ignoring other consumer preferences. For instance, agencies justify fuel economy standards for vehicles using fuel costs and the energy efficiency of the vehicle, omitting other features consumers also care about, such as comfort, cargo capacity, safety, maintenance costs, and power. Thus, some regulations rely on an assumption that government choices on behalf of consumers are better for consumers and firms than choices they would make for themselves in the absence of regulations. The authors conclude that "in the absence of these claimed private benefits of the regulation, the costs to society dwarf the estimated benefits."

Thus, in my view SDG 2, which sets a global "energy efficiency" target, is too ill-formulated to be useful. It conflates energy efficiency and energy intensity, and evidence suggests policies to implement it may in fact reduce consumer welfare.

Target 3. Double the Share of Renewable Energy in the Global Mix.

This target is intended primarily to reduce greenhouse gas emissions. However, as formulated, one could infer that this target means replacing much of existing non-renewable energy with renewables, or it could mean greatly expanding renewable energy and leaving existing non-renewables on a business-as-usual trajectory, or anything in between. It is also unclear whether renewables are to be doubled in each energy sector, or collectively, or what. If the goal of the target is to ensure that much of the energy that would be deployed anyway is renewable rather than fossil fuel, then the benefits of the target are only the environmental benefits of that difference. In that case, the question arises whether the environmental benefits outweigh any extra costs associated with deploying renewable energy instead of a less expensive non-renewable alternative. This cost difference could be much lower for electricity than transportation fuels, particularly in rural areas.

If the primary purpose of the renewable target is to reduce carbon emissions and other air pollutants, the renewable goal should be compared with other strategies that could lower emissions. By that measure, the renewable target falls short.

The peer-reviewed economic literature provides strong evidence that carbon abatement policies vary widely in their costs, and that policies designed specifically to promote renewables are less cost effective than policies to price carbon. For example, Palmer et al (2011) examine three illustrative abatement policies in the United States: a cap-and-trade program for emissions, a renewable portfolio standard for electricity production, and tax credits for renewable electricity producers. They use an electricity market model to evaluate the economic and technology outcomes, climate benefits, and cost-effectiveness of the policies, individually and in combination. They find that the CO2 emissions reductions from cap-and-trade can be significantly greater than those from the other policies, even for similar levels of renewable electricity production, since of the three policies, cap-and-trade is the only one that distinguishes electricity generated by coal and natural gas. Such fuel switching from high carbon fossil energy to lower carbon fossil energy can be relatively low cost, and a renewable target does nothing to encourage this.

Policies to price carbon, either through a cap-and-trade program or a carbon tax, are widely known to be more cost effective than renewable energy standards. Thus while the target may offer positive net benefits if implemented wisely, it fails to create consistent incentives across all greenhouse gases sources and thus would be far less cost effective than a target of pricing carbon.

Subsidies for fossil fuels may decline with an increase in renewable penetration, but I concur with the authors that the net fiscal result is not obvious. First, much of the increase in renewables with be for new generation, not displacing existing fossil generation. Second, much of the point of fossil fuel subsidies (at least in developing countries) is to lower the cost of basic services for the poor. If renewable power is just as expensive or more expensive than fossil power, then the case for energy subsidies won't fall. It might actually go up. The subsidies will be spent on renewable power instead of fossil power, so the environmental distortion will be smaller, but the fiscal implications could be at least as high.

Target 4. Phase Out Pre-Tax Consumption-Distorting Fossil Fuel Subsidies

The draft Assessment Paper discusses many of the negative consequences of fossil fuel subsidies, including higher greenhouse gas emissions, trade distortions, and exacerbated fiscal deficits. "Energy subsidies" involve a wide range of policies with widely varying economic impacts. For example, consumption-distorting subsidies (such as direct retail price controls) are importantly different from, for example, tax expenditures for which energy companies are eligible along with other manufacturers (such as accelerated depreciation). The former can worsen pollution and traffic congestion, artificially promote capital-intensive industries, and accelerate natural resource depletion, in many cases while disproportionately benefitting higher income households. The later may do little economic harm other than to lower government revenues. Such tax expenditures are mainly transfers to energy shareholders. Thus the benefits of eliminating them are largely fiscal, i.e. reducing the deadweight loss associated with raising the revenue to pay for them.

The G-20 declaration calls for phasing out fossil fuel subsidies that "encourage wasteful consumption." In more economic terms, this would mean reducing fossil fuel subsidies that distort consumption by inducing retail prices that are lower than they would be if the prices reflected the full cost of production and distribution. According to IMF(2013), energy subsidies are pervasive and impose substantial fiscal and economic costs in most regions. The IMF estimates that on a "pre-tax" basis (meaning subsidies provided by direct spending and price controls), subsidies for petroleum products, electricity, natural gas, and coal were about US$492 billion in 2011 (0.7 percent of global GDP or 2 percent of total government revenues). The subsidies in oil exporting countries account for about two-thirds of the total.

The benefits of reducing these subsidies depend on how they were implemented and what would happen to the resources that would have been spent on the subsidies. To the extent that countries substitute income support for energy subsidies, the net fiscal and welfare impact (not counting environmental benefits) may be small. In some cases there may be no net fiscal benefits, but poor households could be made better off with lump sum transfers rather than equivalent good-specific subsidies. To the extent that the revenue goes to pro-growth education, infrastructure, and health spending or a less burdensome fiscal system, a double dividend of both environmental benefits and net economic benefits may accrue. The net result of the spending shift could be more progressivity, particularly if fossil fuel subsidies are replaced with income support and other programs targeted to the poor.

By concentrating on fossil fuel subsidies in developed countries, the Assessment Paper understates the critical role of distorted energy markets in impeding access to electricity in lower income countries. As discussed in IMF (2013), the effects of energy subsidies go past their impact on fiscal balances and public debt: "Subsidies can discourage investment in the energy sector, crowd out other public spending that would enhance growth, create incentives for smuggling, and over the long term diminish the competitiveness of the private sector."[6] Below-market prices and the low (or negative) profits they produce, both for state-owned enterprises and private companies, predictably limit investment in new infrastructure, maintenance, and service quality. If firms can't recover their existing costs, why should they dig a deeper hole by expanding service? If a key objective of the energy SDGs is to extend access to electricity, then aligning incentives and ensuring adequate cost recovery in the sector is critical.

For example, Pakistani state-owned power companies have accumulated losses and debt that government subsidies have not fully covered, despite those subsidies imposing a fiscal loss of 4 percent of GDP.[7] Power companies are unable to buy sufficient fuel, prompting deliberate rolling blackouts – up to 12 hours per day in urban areas and 20 hours per day in rural areas (NEPRA, 2012). The Asian Development Bank deems deterioration in the power sector "the main physical constraint on growth and a major cause of financial and economic instability" in Pakistan; the bank estimates that prolonged power shortages cut Pakistan's GDP growth by 2 percent points annually, which implies forgone economic activity of over $4.6 billion each year.[8]

While some countries, such as India under the new administration of Nahendra Modi, are well poised for important reforms, others are lagging. A post-2015 goal of phasing out fossil fuel subsidies could help crystalize the political will and technical assistance to tackle the challenge. IMF (2013) lays out useful guidelines to successful reform.

Target 6. Double Energy R&D

To be sure, stabilizing concentrations of greenhouse gases in the atmosphere and making modern energy available globally will require a generations-long effort to develop and deploy new technologies. Much this research must be devoted to developing technologies that are as cheap, reliable, and scalable as possible so that transitioning from traditional fossil fuels will be as painless as possible. Given the exigency of the problem, a goal of expanding energy R&D seems reasonable. The question is what policies should drive that expansion.

The Assessment Paper appears to frame the target as expanded public sector-funded research and development. Certainly, basic research is important in this context and is generally underfunded by the private market. However, a large share of global R&D is

[6] IMF(2013), p. 15.
[7] ADP(2013), IEA (2013), Chapter 2.
[8] ADB (2013), p. 207.

private sector driven. What policies will create demand for clean energy technologies, once they are developed, such that private actors have an incentive to expand their R&D? If there is no carbon price in major economies (or some other policy driver for clean energy), simply spending more government funds on clean energy R&D is pushing on a string. The design of an amped-up federal research program is important. It should allocate resources objectively, not politically, and avoid bidding up the price of research inputs, for example by being mindful of the supply of energy-relevant PhD's. Also, in a world of fixed budgets, one must ask whether incremental federal spending on energy research provides higher net welfare gains that medical research or anything else. It is entirely possible that other research fields are even more under-funded relative to the social optimum than energy. So to me it's not clear whether doubling energy R&D is necessarily the best goal. Rather, I would suggest a modest increase in federal research funding, plus a market signal that investment in cleaner, more efficient technologies would be profitable. Hence my recommendation for Target 7…

Target 7. Phase Out Implicit Fossil Fuel Subsidies by Imposing Energy Taxes that Reflect External Costs

Failing to tax the negative externalities from energy consumption, such as air pollution and greenhouse gas emissions, is a form of subsidy, arguably even larger than the pre-tax subsidies discussed above. The external costs of related to energy consumption can include: damages from climatic disruption; outdoor air pollution, such as sulphur dioxide and particulate matter; and congestion and traffic accidents from vehicle use. IMF(2014) discusses in great detail the myriad potential benefits from corrective energy taxes and offers extensive examples and recommendations on how to price energy efficiently.

For example, IMF (2014) reports that energy tax reforms can reduce worldwide deaths from outdoor, fossil fuel-related air pollution by 63% and reduce CO2 emissions by 23%.[9] A fiscal system that "gets energy prices right" will bolster other energy-related SDGs, such as promoting renewable energy, correcting inefficient subsidies, promoting R&D, and inducing energy efficiency. Further, in developing countries corrective taxes can be progressive and provide revenue to help expand modern energy to the poorest households.

Several analytical challenges arise in estimating the global benefits and costs of internalizing the external costs of energy. First, the optimal corrective tax will vary significantly by region and sector depending on local air quality, traffic conditions, and existing energy mixes and policies, as IMF (2014) documents. Second, significant uncertainty underlies the "correct" monetization of the social cost of a ton of CO2 emissions (SCC), and the extent to which global benefits should motivate local policies is controversial.[10] Third, the outcomes of unilateral policies will be different than for policies that are coordinated internationally owing to the potential for emitting activities to shift towards relatively less regulated areas. Finally, the economic outcomes of pricing pollution depend importantly on what happens to the revenue raised. If corrective tax revenues are

[9] IMF (2014), p. 7
[10] Gayer and Viscusi (2014) discuss this issue in the U.S. context.

used to reduce other distortionary taxes rather than spent or distributed to households, the economic burden could be substantially lower.[11]

Few economic studies of carbon taxes or other pollution pricing policies calculate benefit cost ratios. Generally they report emissions and economic outcomes, in most cases sidestepping a valuation of the environmental benefits. One study that benchmarks the potential benefit cost ratio of climate policy appears in the technical documentation of the recent proposed rule from the U.S. Environmental Protection Agency (EPA).[12] The agency is proposing to limit CO2 emissions from existing U.S. power plants to a level 30 percent below 2005 levels by 2030. The policy does not price carbon at the federal level, as this proposed SDG would recommend, but it allows states to choose cost effective options to achieve the emissions targets EPA sets for them; states can comply individually or cooperate in groups to comply collectively. Stavins (2014) breaks down the costs and benefits of the rule, as estimated by EPA, along two axes: climate benefits and human health benefits (from ancillary air quality improvements); and U.S. benefits and global climate benefits:

Benefits and Costs of EPA's Proposed Clean Power Plan Rule in 2030

From Stavins (2014)

(Mid-Point Estimates, Billions of U.S. Dollars)

	Climate Change Impacts		Health Impacts (Co-Benefits) of Correlated Pollutants plus …	
	Domestic	Global	Domestic	Global
Benefits				
Climate Change	$ 3	$ 31	$3	$31
Health Co-Benefits			$45	$45
Total Benefits	$ 3	$ 31	$48	$76
Total Compliance Costs	$ 9	$ 9	$ 9	$ 9
Net Benefits (Benefits – Costs)	- $ 6	$ 22	$ 39	$ 67
Benefit-Cost Ratio	0.3	3.4	5.3	8.4

The table illustrates the importance of the scope of benefits in determining net benefits, which range from -$6 billion to $67 billion. Taking the broadest measure of benefits --

[11] Morris and Mathur (2014) review the literature on carbon tax design in the context of other fiscal reforms.

[12] EPA's analysis appears here: http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf.

global climate benefits plus all domestic human health benefits -- EPA estimates benefits and costs with a ratio of about 8.4. Of course, one may quibble with the measure of SCC that EPA uses or the monetization of human health benefits or any of the other aspects of the modeling and computations. However, considering that this analysis reflects a policy that is likely far less cost effective than an economy-wide carbon tax in which the revenue is used wisely, it suggests that a well-designed carbon tax (at least in the United States) could provide benefit cost ratios in excess of most if not all of the other SDGs reviewed in the Assessment Paper.

References

Allcott, Hunt, and Michael Greenstone. 2012. "Is There an Energy Efficiency Gap?" Journal of Economic Perspectives, 26(1): 3-28.

Asian Development Bank (ADB) (2013), Asian Development Outlook, ADB, Manila.

Gayer, Ted, and W. Kip Viscusi. 2012. "Overriding Consumer Preferences with Energy Regulations" Journal of Regulatory Economics. June 2013, Volume 43, Issue 3, pp 248-264. Working paper available here: http://mercatus.org/sites/default/files/Overriding-Consumer-Preferences-with-Energy-Regulations-Final.pdf.

Gayer, Ted, and W. Kip Viscusi. 2014. "Determining the Proper Scope of Climate Change Benefits," Brookings Institution, June 3, 2014. http://www.brookings.edu/~/media/research/files/papers/2014/06/04%20determining%20proper%20scope%20climate%20change%20benefits%20gayer/04_determining_proper_scope_climate_change_benefits.pdf.

Gillingham, Kenneth and Karen Palmer, "Bridging the Energy Efficiency Gap: Insights for Policy from Economic Theory and Empirical Analysis," Rev Environ Econ Policy (2014) First published online: January 7, 2014. Working paper available here: http://www.rff.org/RFF/documents/RFF-DP-13-02.pdf.

International Energy Agency (IEA) (2011). World Energy Outlook 2011: Energy for All. OECD/IEA, Paris. http://www.iea.org/media/weowebsite/energydevelopment/weo2011_energy_for_all.pdf

International Energy Agency (IEA) (2013). World Energy Outlook 2013: Energy for All. OECD/IEA, Paris. http://www.worldenergyoutlook.org/media/weowebsite/energydevelopment/WEO2013_EnergyForAll.pdf

International Monetary Fund (IMF) (2013). Energy Subsidy Reform: Lessons and Implications. Washington, D.C.: IMF.

International Monetary Fund (IMF) (2014). Getting Energy Prices Right: From Principle to Practice. Washington, D.C.: IMF.

MacCarty, N., Still, D., and Ogle, D. (2010). Fuel use and emissions performance of fifty cooking stoves in the laboratory and related benchmarks. Energy for Sustainable Development 14. 161-171.

Morris, Adele C. and Aparna Mathur (2014), "A Carbon Tax in Broader U.S. Fiscal Reform: Design and Distributional Issues," Center for Climate and Energy Solutions, May 2014. http://www.c2es.org/publications/carbon-tax-broader-us-fiscal-reform-design-distributional-issues

NEPRA (Pakistan National Electric Power Regulatory Authority) (2012), State of Industry Report 2012, NEPRA, Islamabad.

Ostojic, Dejan; Jammi, Ramachandra; Barnes, Douglas; Sanghvi, Arun; Mathur, Subodh; Zhang, Yabei; Durix, Laurent. 2011. One goal, two paths: achieving universal access to modern energy in East Asia and the Pacific. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/2011/01/15156077/one-goal-two-paths-achieving-universal-access-modern-energy-east-asia-pacific

Palmer, Karen, Anthony Paul, and Matt Woerman, "Federal policies for renewable electricity: Impacts and interactions," Energy Policy, Volume 39, Issue 7, July 2011, Pages 3975–3991.

Stavins, Robert (2014), "What are the Benefits and Costs of EPA's Proposed CO2 Regulation?" An Economic View of the Environment, Harvard University, Kennedy School, Belfer Center for Science and International Affairs, June 19, 2014. http://www.robertstavinsblog.org/2014/06/19/what-are-the-benefits-and-costs-of-epas-proposed-co2-regulation/.

This paper was written by Adele C. Morris, Fellow and Policy Director for the Climate and Energy Economics Project at Brookings Institution. The project brings together more than 50 top economists, NGOs, international agencies and businesses to identify the goals with the greatest benefit-to-cost ratio for the next set of UN development goals.

For more information visit post2015consensus.com

COPENHAGEN CONSENSUS CENTER

Copenhagen Consensus Center is a think tank that investigates and publishes the best policies and investment opportunities based on how much social good (measured in dollars, but also incorporating e.g. welfare, health and environmental protection) for every dollar spent. The Copenhagen Consensus was conceived to address a fundamental, but overlooked topic in international development: In a world with limited budgets and attention spans, we need to find effective ways to do the most good for the most people. The Copenhagen Consensus works with 100+ of the world's top economists including 7 Nobel Laureates to prioritize solutions to the world's biggest problems, on the basis of data and cost-benefit analysis.

POST-2015 CONSENSUS