SUSTAINABLE ENERGY FOR ALL

Technical Report of Task Force 2

in Support of Doubling the Global Rate of Energy Efficiency Improvement and Doubling the Share of Renewable Energy in the Global Energy Mix by 2030

APRIL 2012

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The Secretary-General's High-level Group on Sustainable Energy for All commissioned this document to assess the opportunities for meeting the universal energy access objective set by the Secretary-General. It was compiled by a group of experts involved in Task Force 1 of the High-level Group. The analysis and recommendations of this document solely reflect the views of the authors and do not necessarily represent those of the Secretary-General's High-level Group on Sustainable Energy for All, its members, United Nations, its Member States, or other organizations contributing to the work.

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Foreword

The UN Secretary General established the Sustainable Energy for All Initiative in order to guide and support efforts to achieve universal access to modern energy, rapidly increase energy efficiency, and expand the use of renewable energies. The High-level Group, which leads the Initiative, formed Task Forces involving prominent energy leaders and experts from business, government, academia and civil society worldwide. The goal of the Task Forces is to inform the implementation of the Initiative by identifying challenges and opportunities for achieving its objectives.

This report contains the findings of the Task Force Two dedicated to energy efficiency and renewable energy objectives. It convincingly shows that doubling the rate of energy efficiency improvements and doubling the share of energy from renewable sources by 2030 is challenging but feasible if sufficient actions are implemented. Strong and well-informed government policies as well as extensive private investment should focus on "high impact areas" identified by Task Force Two. We would like to thank the authors and the members of Task Force Two for their dedicated work and wish the readers to incorporate the findings and the recommendations of the report into their policy, commercial, research, educational or other work, thus making a contribution toward a sustainable energy future.

Chad Holliday and Kandeh Yumkella

Co-Chairs of the High-level Group on Sustainable Energy for All

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Executive Summary

To meet global aspirations for a sustainable future, energy systems worldwide must be transformed. Under the leadership of Secretary-General Ban Ki-moon, the United Nations is launching a new initiative called Sustainable Energy for All. By 2030, the three-fold aim of this initiative is to:

- Ensure universal access to modern energy services;
- Double the global rate of improvement in energy efficiency; and
- Double the share of renewable energy in the global energy mix.

This report addresses the second and third objectives; universal access is addressed by a separate task force report. All of the objectives are very ambitious; together they would fundamentally change the global energy landscape. Doubling the renewable energy contribution and doubling the rate of efficiency improvement, for example, would reduce global energy demand by 30% and greenhouse gas emissions by roughly 60% compared to a business-as-usual scenario. It would constitute a clean energy transformation akin to the industrial revolution. As with past technologies revolutions, the transition to cleaner energy – i.e., more efficient energy use with a higher proportion of renewables – would benefit human well-being in multiple ways, ranging from better public health to improved energy security, new jobs, reduced energy poverty, and revitalised economies.

Achieving the objectives of Sustainable Energy for All is a significant challenge. It would mean consuming 30% less energy to produce the same output of goods and services as today. The changes required are not just technological, they are also structural and behavioural. Doubling the share of renewable energy will mean deploying 500 MW of renewable electricity-generating capacity per day for the next 20 years—twice as much as the 250 MW per day that were deployed in 2009.

An energy shift of this magnitude will require reorienting and increasing energy investments, from the present figure of approximately $1.3 trillion a year to $1.8-2.4 trillion a year by 2030. Over the long term, however, these investments are expected to generate substantial returns.

Hurdles to bring about the transformational change implied by the three objectives are formidable, but there is nothing impossible about achieving all three. The challenge will be to facilitate rapid deployment of already available commercially available technologies and associated infrastructure.

All stakeholders have a role to play in bringing about a clean energy revolution and can learn from countries and companies that have successfully implemented policies and technological changes.

- The **private sector** should assume a major role by using public/private and innovative investment models to finance the deployment of clean energy technologies. In addition, private-sector entities have a role to play in developing and sharing best practices, contributing technical expertise, and providing implementation capacity for clean energy technologies.
- The **public sector** should lead by fostering innovation;i.e., supporting the adoption of new technologies; instituting smart policies that level the playing field for renewable energy and energy efficiency and de-risk investments in these areas; leveraging private investments with loan guarantees and other financial incentives and mechanisms; supporting international cooperation and knowledge dissemination; and using procurement policies to spur demand for clean energy technologies.
- **Civil society** is a critical agent of change for advancing clean energy technologies. Civil society organisations (CSOs) can form partnerships and networks to facilitate open and transparent flows of information; engage with policymakers and the private sector to advocate for and help oversee the implementation of clean energy policies and technologies, while also highlighting areas of inequity; and accelerate the rate and uptake of innovation through research.

Sustainable Energy for All is unique in that it will bring all of these stakeholders to the table to work toward a sustainable energy future. Success will be driven by the innovative partnerships and alliances that follow.

There is room and a need for energy efficiency and renewable energy improvements in developing and developed countries alike. High-impact opportunities exist in all economic sectors:

- Almost half of renewable energy deployment will need to happen in the **electricity** sector. This will require smart policies in every nation to level the playing field between electricity from renewable energy and from other sources. Widespread adoption of renewable technologies in the electricity sector will also require investments to modernise transmission and distribution grids (so that they become "super grids" and "smart grids," respectively). Other opportunities in this sector can be realised by implementing efficiency improvements in fossil fuel power plants.

- In **transportation,** improvements to vehicle efficiency can contribute about one-third of the sector's overall potential for energy savings, while avoided demand through better transport planning and behaviour changes can contribute the other two-thirds. Tripling vehicle fuel economy is technically feasible and will allow the 2.5 billion cars projected to be on the road in 2030 to use no more energy than the approximately 850 million cars in use today. Other clean energy opportunities in the transport sector involve switching to electric vehicles and increasing the use of biofuels.

- In **buildings,** the main opportunities are improving building envelopes in both new and existing buildings, improving the efficiency of appliances and lighting, and increasing access to clean cooking fuels and technologies. Public buildingsrepresent an especially high-impact opportunity for increasing efficiency of buildings. Building codes and appliance standards are proven tools for achieving large efficiency gains in the building sector. This sector can also take advantage of renewable energy sources, in particular solar energy, for heating needs.

- **Industry** holds large opportunities for both renewable energy and energy efficiency. About half of the savings achievable in the industrial sector are associated with improved thermal processes that can also take advantage of renewable solar energy. It has been estimated that five energy-intensive industrial subsectors can reduce their energy consumption by between 10% and 40% of current levels. Working with industry groups in these sectors to realise these potential savings represents a high-return-on-investment opportunity. In addition to solar energy for thermal processes, increasing renewables in industry could be done through using more biomass as a feedstock for synthetic organic materials, and greater electrification.

In sum, achieving the ambitious objectives of Sustainable Energy for All is technically feasible and economically viable. But it will require a concerted and sustained effort in all energy sectors and from all stakeholders. Fortunately, many countries have instituted successful policies to increase the use of clean energy technologies. These have to be supported, expanded, and replicated elsewhere. Sustainable Energy for All can contribute in several ways:

- Catalysing action through participants' personal networks;

- Prominently recognising the highest-impact commitments;

- Providing, through an international knowledge network, technical assistance to help proactive governments reach their policy objectives;

- Utilising this knowledge network to support local governments at all scales in their efforts to implement transformational energy programmes;

- Developing milestones and an action agenda to map activities between now and 2030;

- Bolstering key national and global institutions to support implementation; and

- Working with diverse funding agencies to make the Sustainable Energy for All agenda a central part of global energy and climate funding (e.g., through the Green Climate Fund).

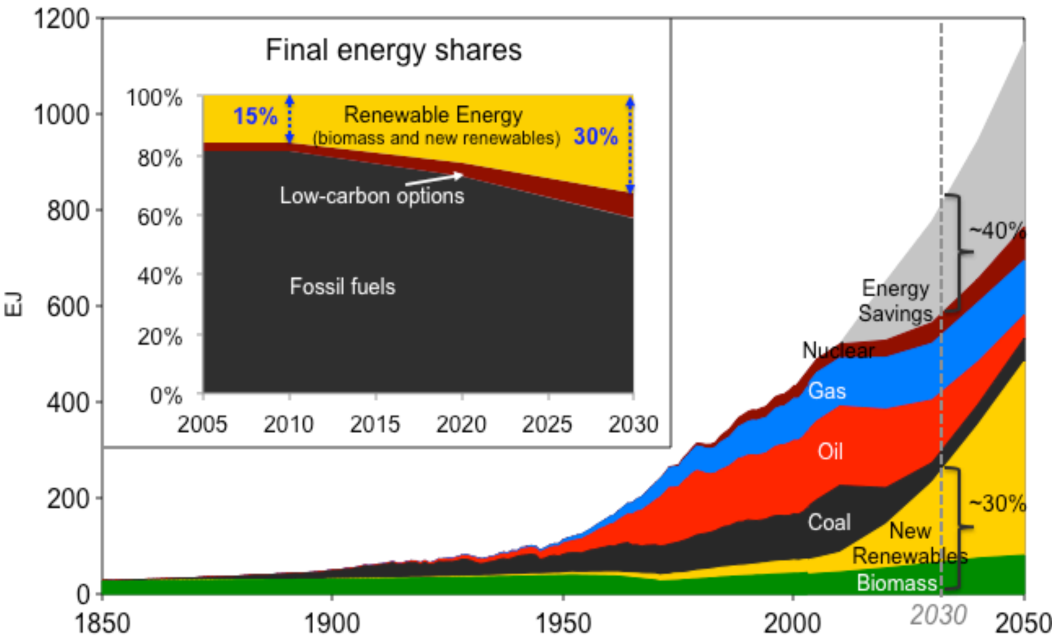
1 The Vision

1.1 Understanding the challenge

Doubling the share of renewable energy and the rate of energy efficiency improvement globally would fundamentally change the energy landscape throughout the world. It would reduce energy demand by roughly 30% and greenhouse gas emissions by roughly 60% compared to a business-as-usual trajectory and would contribute to stabilising climate change at a temperature increase of 2°C or less. In this transformed energy system, more reliance on local renewable energy sources increases the diversity of supply, which in turn provides benefits in terms of reducing price volatility and mitigating the security challenges posed by dependence on imported fossil fuels. In economic terms, a worldwide shift to energy systems that emphasise renewables and energy efficiency has the potential to energise the world economy through a wave of innovation, job creation, and diversification—both in terms of the energy supply mix and in terms of the range of actors engaged in the energy industry.

A clean energy revolution would be akin, in the scale and scope of its impacts, to the industrial revolution, when musclepower was replaced by machines. It would also bear similarities to the "age of diversification" that unfolded over the last 100 years as the introduction of various technologies—such as the light bulb, internal combustion engine, aircraft and most recently, the internet—drove rapid growth in energy demand. Figure 1 provides an overview of these historic transformations; it also illustrates an energy future that meets the Sustainable Energy for All objectives, based on the forthcoming *Global Energy Assessment*ledby the International Institute for Applied Systems Analysis.[1] While the last two historic energy transformations took place over several decades, achieving the Sustainable Energy for All objectives will require profound change over an accelerated timeline of 18 years.

Figure 1. Historical energy transformations and an energy future that meets the Sustainable Energy for All objectives



Note: The grey area represents energy demand that could be avoided through energy efficiency improvements. New renewables includes solar, wind, hydro and geothermal power. In this scenario, traditional biomass is replaced by modern biomass. The historical data are shown in primary energy, while the inset figure shows final energy demand.[2] Source: Riahi et al. 2012.[3]

[1]*Global Energy Assessment – Toward a Sustainable Future*, 2012, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria & Cambridge UP, Cambridge, UK and New York, NY, USA. ISBN: 9781107005198.

[2]Energy can be measured at the level of primary fuel consumption (e.g., how much energy is contained in the coal used to supply a power plant) or at the point of end use to provide a given level of service (how much energy is used in a house or a vehicle). The objectives of Sustainable Energy for All are defined in terms of final energy consumption to avoid ambiguity, but historical trends are shown in terms of primary energy consumption due to data availability.

1.2 Achieving the objectives

While the Sustainable Energy for All objectives are global, they can only be achieved through efforts of individual countries. How countries work towards these objectives will be determined by their capacities (natural and other resources), geography, level of economic development and ambitions. Countries can learn from the success of earlymovers in these areas. Brazil grew its renewable (primary) energy supply by over 50% between 2000 and 2009, and in 2009 almost 50% of its primary energy supply was from renewable sources.[4] The European Union, which produced 12% of final energy from renewable energy sources in 2009, has targeted a 20% contribution by 2020; according to its recently published energy roadmap, the EU is currently on track to overshoot this objective.[5] China has more than doubled its low-carbon (renewable and nuclear) energy in the last five years and plans to reach a 15% low-carbon contribution by 2020.[6]

Over the last several decades (1970-2009), global energy intensity has declined at a rate of 1.2% per year,[7] Sustainable Energy for All calls for doubling this rate of decline to 2.4% per year, which would produce a 40% reduction in global energy intensity by 2030. Measuring progress towards this objective can be done with different metrics for different stakeholders. While energy intensity of value added (generally GDP for countries and profit for companies) is a useful aggregate metric, industry-specific benchmarks could be developed of energy intensity of physical output, such as energy used per ton of steel or barrel of oil. For countries which suffer from insufficient energy access, it will be important to use indicators related to energy use for energy services delivered (such as meals cooked or hours lit).

The three core objectives of Sustainable Energy for All are built around a complementary vision of universal access to renewable, efficient, secure, and low-cost energy with benefits at the household, village, community, national and global scales. Achieving the Sustainable Energy for All efficiency objective would mean that the same goods and services we consume today could be produced using only 70% as much energy as we currently do. This can happen through a combination of changes that are technological (e.g., increasing the fuel efficiency of vehicles), structural (e.g., telecommuting to cut down on travel), and behavioural (e.g., living closer to work to reduce the length of commutes). Progress is needed in all of these areas to achieve the overall efficiency objective. Bringing about each of these types of change requires sector-specific and cross-sector efforts.

The grey area in Figure 1 illustrates the central role of efficiency in enabling both large-scale demand reductions and a large-scale increase in the renewable energy contribution. 'Negawatts' – or avoided energy demand – are a critical lever in achieving the energy objectives. Doubling the share of renewable energy is possible using commerciallyavailable technologies. Assuming the rate of energy efficiency improvement is doubled, meeting the Sustainable Energy for All objective for renewable energy means installing 500 MW of renewable electricity-generating capacity per day for the next 20 years; this would be double the 2009 rate of renewable capacity additions of 250 MW per day.[8]

Energy access and efficiency also go hand-in-hand. Access to modern forms of energy and appliances leads to a four- to five-fold increase in energy efficiency. The use of modern cooking fuels, for example, usually reduces the loss of energy in the form of waste heat while also dramatically reducing indoor air pollution, along with emissions of methane, carbon dioxide and other greenhouse gases.[9]With access to

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[3]Riahi, K., F. Dentener, D. Gilen, A. Grubler, J. Jewell, Z. Klimont, V. Krey, D. McCollum, S. Pachauri, S. Rao, B. van Ruijven, D. van Vuuren and C. Wilson, 2012: *Global Energy Assessment – Toward a Sustainable Future*, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

[4]OLADE and UNIDO, 2011, August. *Observatory of renewable energy in Latin America and the Caribbean: Brazil final report.* Available at: http://www.renenergyobservatory.org/fileadmin/outputs/Brasil%20Producto%201%20y%202%20(Eng).pdf.

[5]European Commission, 2011.*Energy roadmap 2050 and impact assessment.*

[6]REN 21, 2011.*Renewables 2011 Global status report.*Paris: REN21 Secretariat.

[7]Riahi et al. 2012 (footnote 3).

[8] REN 21, 2011 (footnote 6).

[9]Bailis, R., Ezzati, M. and Kammen, D. M., 2005 "Mortality and greenhouse gas impacts of biomass and petroleum energy futures in Africa", **308**, *Science*, 98 – 103.

Smith, K., K. Balakrishnan, C. Butler, Z. Chafe, I. Fairlie, P. Kinney, T. Kjellstrom, D. L. Mauzerall, T. McKone, A. McMichael, M. Schneider and P. Wilkinson, 2012: Chapter 4 - Energy and Health. In *Global Energy Assessment - toward a Sustainable Future*, International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

electricity people can switch from expensive, polluting and insecure small-scale diesel generators—which are used in many poor areas to provide electricity for lighting, entertainment and other needs—to reliable, cleaner and cheaper energy sources.[10] (Strategies for expanding energy access are discussed in a separate task force report.)

Sustainable Energy for All will require increasing and reorienting annual energy investments. Specifically, global annual energy investments would need to increase by about one-third from the present level of $1.3 trillion per year to $1.8 trillion per year (Table 1).[11] Over the long term this added investment would reduce global energy expenditures because it would lead to lower annual fuel costs.

Table 1. Annual investments in billions of dollars (USD2005) to achieve Sustainable Energy for All

Annual Energy Investments in…	Present (2010)			2010-2030
	Innovation RD&D	Markets Formation	Present investment	Annual Investment required to meet SE4All goals
Efficiency	>>8	~5	300	260-370
Renewables	>12	~20	200	260-410
Access	<1	<1	~9	30-40
All energy infrastructure	*>50*	*<150*	*1250*	*1770-2420*

Source: Grubler et al., 2012.[12]

1.3 An action approach

Actions taken under Sustainable Energy for All will focus on achieving the initiative's three core objectives. Figure 2 shows the framework used to organise our discussion of these actions for this report. Broad opportunities for advancing the core objectives are discussed in terms of agents of change (Section 2 of this report) and energy sectors (Section 3 of this report). The discussion in Sections 2 and 3 is then used to identify specific high-impact opportunities and enabling mechanisms; these are the subject of the Annex of this report.

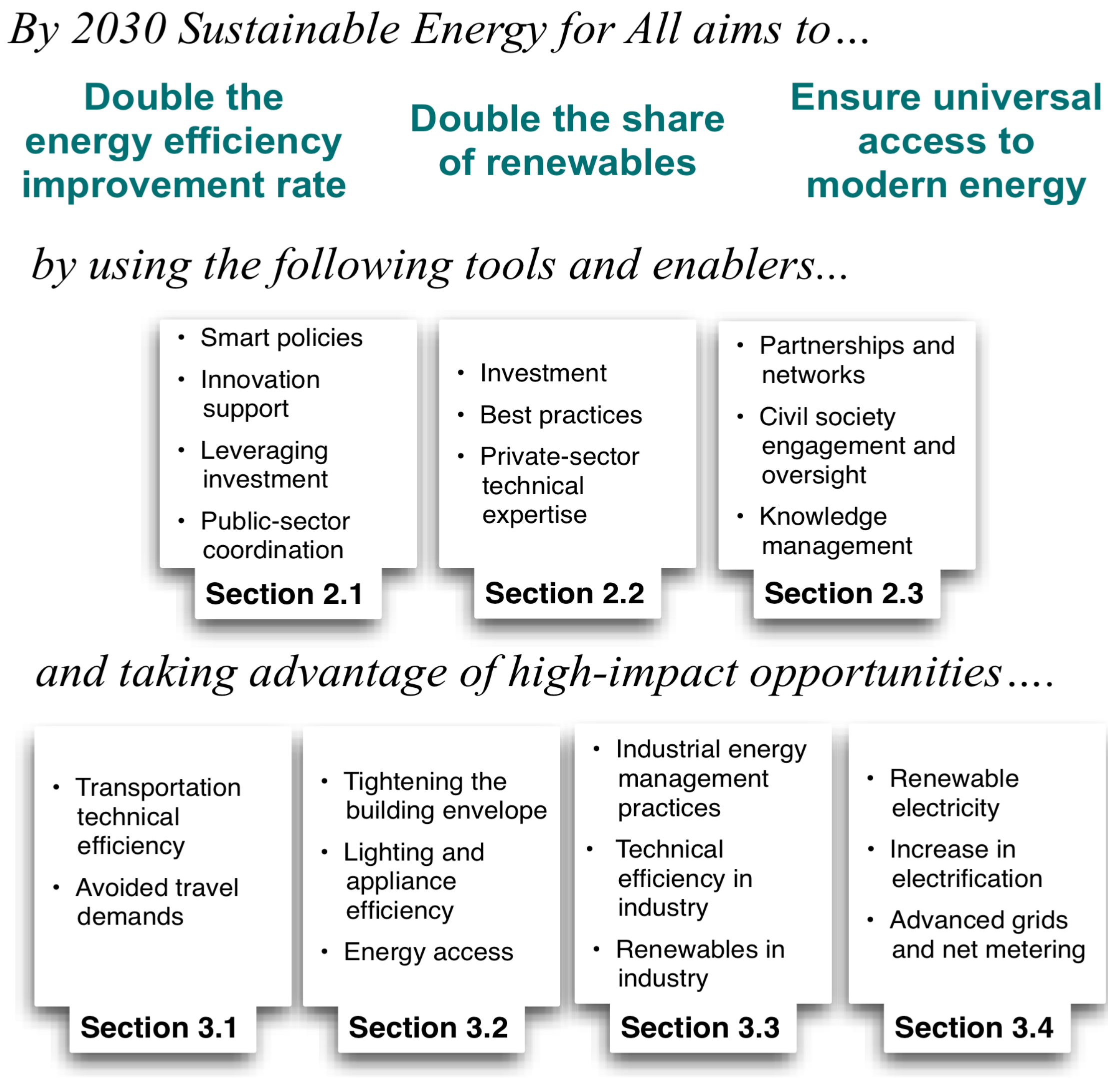
Pachauri, S., A. Brew-Hammond, D. F. Barnes, D. H. Bouille, S. Gitonga, V. Modi, G. Prasad, A. Rath and H. Zerrifi, 2012: Chapter 19 - Energy Access for Development. In *Global Energy Assessment - toward a Sustainable Future*, International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

[10]Casillas, C. and Kammen, D. M., 2010, "The energy-poverty-climate nexus," *Science*, **330**, 1182 – 1182.

[11]Grubler, A., F. Aguayo, K. Gallagher, M. Hekkert, K. Jiang, L. Mytelka, L. Neij, G. Nemet and C. Wilson, 2012: Chapter 24: Policies for the Energy Technology Innovation System (ETIS). In *Global Energy Assessment - Toward a Sustainable Future*, International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

[12]Grubler*et al.* 2012. (footnote11).

Figure 2. An action approach to the three objectives



2 An inclusive action agenda

A clean energy revolution is possible with the right combination of smart policies and dedicated investment. It will require an unprecedented level of systems-level planning and strategy, and the integration of information technologies into energy systems. The Secretary-General's vision can only be realised if action is undertaken inclusively, involving all groups of stakeholders, and comprehensively, reaching all sectors of society.

Mobilising the commitments needed to scale up efficiency and renewable energy technologies will require robust action by a range of stakeholders, including:

- The public sector—policy makers and multilateral organisations
- The private sector—investors, suppliers of renewable energy and high-efficiency technologies, industry and service providers, and end-users (consumers and companies)
- Civil society—partnerships and collaborations, foundations, non-profits, and knowledge and training organisations

2.1 Public sector

The public sector is crucial in "setting the scene" for scaling up clean energy technologies. While the most effective policy portfolio will vary by jurisdiction and context, public-sector support for clean energy is needed to:

- Institute smart policies to level the playing field for renewable energy and energy efficiency.
- Foster innovation by supporting new technologies and entrepreneurship.
- Leverage private investments with loan guarantees and other financial incentives and mechanisms.
- Support coordination and knowledge dissemination.
- Use public procurement to create market "pull" for energy efficiency and renewable energy technologies.

Smart policies

Welldesigned and implemented policies are a powerful and cost-effective mechanism to drive growth in energy efficiency and renewables. While policies need to be appropriately tailored to specific local situations, the basic reforms that governments need to undertake to scale up efficiency and renewables are well known and have been successfully implemented in many countries and municipalities. All levels of governance play an important role. While national governments are critical for levelling the playing field for clean energy technologies, local governments are important for integrated land-use planning which can lead to "smart cities" (using less energy per capita by avoiding transportation demand).

A diverse portfolio of policies has been used to drive the worldwide deployment of wind and solar technologies over the past decade. This portfolio includes feed-in tariffs, auctions, targeted incentive programmes, and carbon pricing. Other policies are needed to correct market distortions, such as removing subsidies for fossil fuel use and energy use, or lowering barriers to trade in clean energy products or services. There is great potential to improve energy efficiency on a global scale through fuel economy standards, appliance standards, building codes, and utility regulatory reforms. Standards should be wellconsidered, transparent, consistently applied, and developed with stakeholder consultation. Policies such as "feebates" (fees on inefficient electronics and vehicles, coupled with rebates on efficient models) and green labelling can encourage consumers to make energy-efficient choices. Energy management norms and mandatory audits are examples of policies that can be used to promote efficiency improvements in the industrial sector.

It is essential that policy instruments create certainty for investors. Programmes and policies that price pollution externalities can reset the investment landscape, but only if investors have confidence that these policies and programmes will be effectively implemented and sustained. Revenues from pricing policies can also be used to reduce distortionary taxes (e.g., taxes on income or investment) and/or to support public policy goals such as accelerating innovation through clean energy technology RD&D. Where pollution pricing reforms are not feasible or prove insufficient, progress can be made by levelling the playing field for clean energy technologies through production-based incentives. Multilateral organisations can help create a "race to the top" by showcasing countries and companies that have implemented effective policies for renewable energy and energy efficiency. International organisations can also provide technical assistance and support the free flow of information and expertise.

Supporting innovation

While many clean energy technologies are already available, scaling them up requires innovation to reduce costs, improve performance, and accelerate diffusion. Government policies play a crucial role in this process. Public investment in research, development and demonstration (RD&D) directly supports technology innovation. Public-private partnerships can be formed or reinforced to pursue critical areas of research. In addition, governments and multilateral organisations can offer incentives such as tax cuts or technology prizes to encourage private-sector investments in innovation. Finally, policy makers can improve conditions for entrepreneurship by protecting and enforcing intellectual property rights.

Leveraging investment

A combination of targeted public funds and supportive policies is vital to leverage private investment in innovative clean energy technologies. Of the three broad phases of investment in clean energy technology deployment, the initial design-and-construction phase is generally the riskiest because it is capital intensive and carries the highest possibility of default. This phase typically involves private equity and occasionally the banking sector. Once construction is in a later stage or has been completed, the banking sector steps in to finance the scale-up of projects. When projects produce sustainable positive cash flows, long-term investors like pension funds and insurance companies are more likely to assume financial responsibility.

The public sector can play a critical role in leveraging private resources during earlier stages of investment, when risk is high. Loan guarantees are a particularly effective option because they provide a financial backstop in case of default. With banks shying away from the second stage of investment, public money and resources can play a significant role in reducing project risk. Government support can also take the form of educating local lenders (both banks and institutional lenders), establishing facilities to warehouse debt at pre-arranged margins, or providing refinancing guarantees for projects. Fees would be paid for this kind of support, resulting in a reduced return on equity, but the process would reduce the risks of failure for the project and actually encourage lenders to participate. This type of government support could give significant comfort to initial investors and help bridge the period during which a project risk profile is not yet safe enough to attract mainstream pension fund investment. Achieving a clean energy revolution can only be achieved if long-term institutional investors increase their asset deployment.

Coordination and knowledge dissemination

The public sector also plays a vital coordination and knowledge dissemination role. The Sustainable Energy for All Action Agenda needs to be integrated into bilateral and multilateral development cooperation endeavours. As energy systems become more complex and dependent on the coordination of energy efficiency measures, newly deployed renewable energy capacity, and the judicious use of fossil-fuel resources, planning and coordination efforts become central to achieving the objectives at the least cost. Transparency in planning and coordination among all efforts—whether at the household,[13] city,[14] national or regional level—is vital to developing and disseminating best practices, to highlighting areas of need for the research community, and to creating business opportunities for the commercial and industrial sectors. 'Heat maps' showing areas of critical need for energy access and efficiency improvement or renewable energy investment are one component of the enabling and convening role the public sector can play in supporting a clean energy transformation.

Public procurement

Public procurement is potentially a powerful policy tool. Some public institutions, such as the military, use large volumes of energy. Harnessing the buying power of these sectors is a way to provide significant

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[13] For tools for local energy and climate smart planning see, e.g., coolclimate.berkeley.edu

[14] For initiatives that work with and between cities, see e.g., http://live.c40cities.org/cities/

support for clean energy technologies. Government entities can, for example, directly buy renewablygenerated electricity or renewable transportation fuels (such as biogas to run municipal buses). They can also preferentially select energy-efficient equipment and appliances for use in public buildings (see further discussion in the buildings section). Updating national and multilateral procurement policies (such as the OECD guidelines for "green" procurement) is a crucial step to leverage the buying power of the private sector to fully support an energy revolution.

2.2 Private sector

Stakeholders from the private sector will need to:

- Invest in clean energy technologies, including through public/private and innovative investment models.
- Develop and share best practices for increasing energy efficiency and the use of renewable energy technologies.
- Contribute technical expertise and implementation capacity for the deployment of clean energy.

Investment

While policymakers can help leverage private investment, proactive private-sector leadership is essential, as a source of both investment in clean energy projects and information to identify financing bottlenecks and innovative solutions. At each stage of the financing process, investors have the opportunity to work in partnership with each other, with governments and with multilateral development banks (MDBs) to accelerate investment in and financing of cleanenergy projects. International banks can work with local ones to identify promising projects; this type of bank-to-bank partnership allows international investors to leverage local capital and expertise. Investors can also help develop innovative financing tools such as on-bill financing, Property Assessed Clean Energy (PACE) programme financing, energy service agreements, and bonds. In addition, the private sector can help develop public/private investment models that leverage private-sector capital through the targeted use of limited public funds.

Multilateral development banks play a crucial role in supporting pre-commercial innovation and deployment. Over the past decade, the World Bank has supported many programmes that finance energy efficiency improvements, either through existing financial intermediaries or by establishing new ones. Similar to bank-to-bank partnerships, this type of dual financial–technical assistance can be an effective way to leverage local capacity and capital.[15] In most cases, such interventions can be successful in mobilising local commercial capital for energy efficiency programmes. Where influence on local banks is limited, other mechanisms can be used to provide financing for clean energy projects until local investors are able and willing to pick up the business line. Weak local institutions or projects and programmes that are insufficiently adapted to local circumstances are the main barriers to success when it comes to private-sector cleanenergy investments.

Investment comes not only from equity and capital-focused companies but also from energy companies and utilities. Encouraging these companies to finance investments on their own balance sheets is an important priority and will continue to be so.

Best practices

A second equally important role for the private sector is to focus on best practices—from corporate social responsibility to green chemistry and clean manufacturing, to establishing industry targets and standards for super-efficient appliances. Typically private firms can reduce their own energy consumption and increase their use of renewable energy. Industry and service providers can also develop industry-wide international clean energy standards. This can be done by working through industry groups or by lobbying policymakers to establish standards and policies for renewable energy and energy efficiency. In addition, businesses can develop clean energy improvements at the firm level and demand best practices in their supply chains. Finally, the private sector can provide direct support for innovation and for the diffusion of clean energy technologies by investing in RD&D and by deploying and scaling up new

[15] There has been a wide range of mechanisms under this category, including credit lines, revolving funds, special purpose funds (including equity, mezzanine), partial credit guarantees and loss reserves, special purpose vehicles, all of which have used climate funds such as GEF and CTF to leverage IBRD funds.

technologies. The low level of private investment in energy-sector RD&D, especially compared to other sectors, is a barrier that needs to be overcome.

Technical expertise

The private sector holds much of the technical expertise and implementation capacity that will be needed to increase energy efficiency and expand renewable energy. As a sector of the world economy, the cleanenergy industry will need to grow to meet the objectives of Sustainable Energy for All. This requires developing innovative business models to take advantage of on-grid and off-grid renewable opportunities as well as personal and business efficiency improvements. To scaleup clean energy successes, the industry will need to document and communicate the economic benefits of renewable energy and energy efficiency in terms of jobcreation, economic growth and improved balanceoftrade. Cleanenergy businesses will also need to work with policymakers to ensure that the market and regulatory environment supports private-sector investment and rapid technology diffusion.

2.3 Civil society

Civil society is a critical agent of change for advancing clean energy technologies. It will be especially important that civil society participants in Sustainable Energy for All undertake the following actions:

- Form partnerships and networks to facilitate open and transparent flows of information.
- Engage with policymakers and the private sector to advocate for and provide oversight of clean energy policies and technologies, while also highlighting areas of inequity.
- Accelerate the rate and uptake of innovation through knowledge management.

Partnerships and networks

Investment in renewable energy technologies already accounts for about 30% of all energy investments. Ensuring that the vast know-how and field experience generated by these investments gets translated to different national and policy contexts is crucial. Effective international forums and institutions are already available to help drive progress. The Clean Energy Ministerial is advancing renewable energy and efficiency through political dialogue and technical cooperation among the economies that account for 90% of recent renewable energy investments. Complementary regional and public-private forums such as APEC, REN21, the Energy and Climate Partnership for the Americas and the Global Green Growth Forum likewise provide important opportunities to drive progress on renewables and efficiency. Bilateral RD&D partnerships are also emerging, such as the US-China Clean Energy Research Center. These initiatives encourage policy progress through voluntary collaborative technical work, peer-to-peer exchange, and political dialogue. The International Energy Agency, the International Partnership for Energy Efficiency Cooperation (IPEEC) and the International Renewable Energy Agency (IRENA) provide foundational technical resources, such as technology roadmaps and inventories of policies and measures. Such collaborative technical work, peer-to-peer learning, and technical assistance can help policymakers, particularly in developing countries.

Engagement and oversight

Foundations and non-profits have a particular role in shaping and informing public opinion, providing seed money for projects and research, and engaging with policymakers and communities to support clean energy objectives. As independent organisations, foundations and non-profits can act as a voice for civil society and can also provide tools for ensuring financial and policy transparency and oversight. By engaging communities to support renewable energy and energy efficiency projects, they can also help foster a dialogue between civil society and policymakers.

Knowledge management

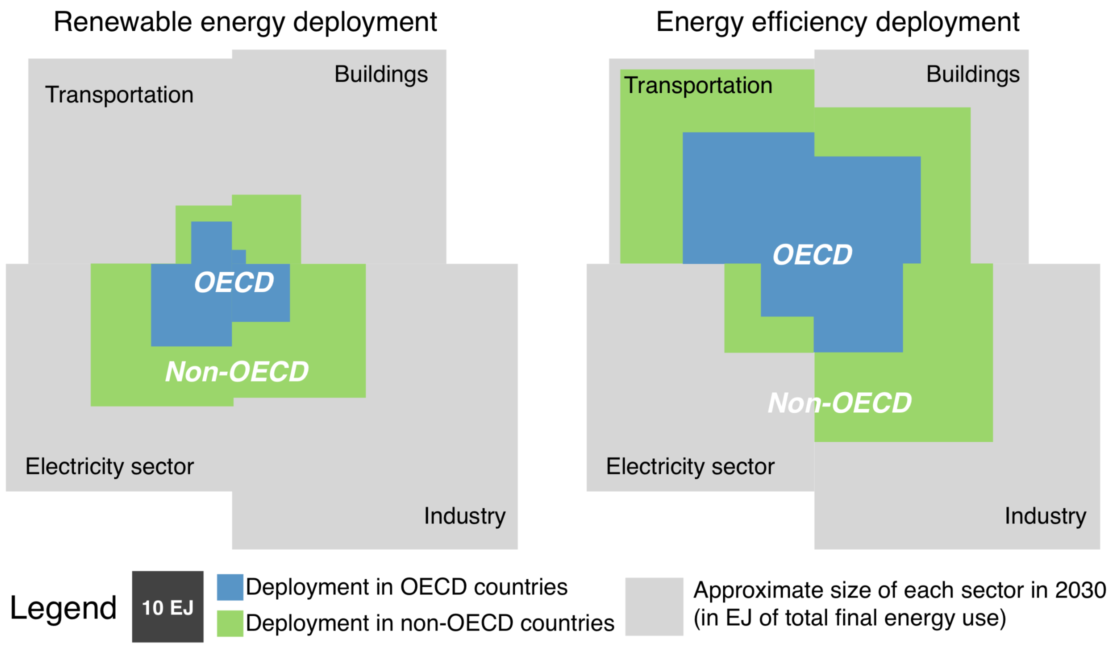
Knowledge organisations have a specific and important role to play in accelerating the rate and uptake of innovation. Academic institutions and thinktanks are critical for creating, cataloguing and distributing information as well as for bringing scientists and policy makers together, training future leaders, and empowering communities. In addition, they can offer transformational courses and degree programmes that directly link innovation in energy and development, or they can create competitions to incentivise breakthroughs. Collaborations between academic institutions and industry or between different academic institutions can help ensure that knowledge is relevant and constantly progressing. Such institutions can undertake basic research to support the development of more advanced cleanenergy technologies, as well as mission-oriented research that engages a wide variety of stakeholders to help disseminate and scale up proven technologies. Efforts to inventory current international investment in technical assistance and to identify best practices with regard to renewable energy and energy efficiency policies can help policy makers and industry target the most effective tools for achieving the objectives of Sustainable Energy for All.

3 A comprehensive action agenda

Achieving the efficiency and renewables objectives of Sustainable Energy for All, while challenging, is possible if all sectors and countries take part. Doubling the rate of energy efficiency improvement means that by 2030 the world would use some 180-200 exajoules (EJ) of primary energy—more than one-third less energy per year than in a business-as-usual case. This demand reduction can be accomplished partly through technical energy efficiency improvements, but also through structural changes—in other words, shifting the way people use energy. Examples would include replacing business travel with tele-commuting or planning cities to be pedestrian and bike-friendly. Doubling the renewable energy share will require development of on-grid and off-grid renewables. On-grid renewable energy will require grid development and expansion—which may face economic challenges and public opposition—to accommodate a large increase in renewable and intermittent capacity. Substituting electricity for liquid and solid fuels in all sectors can help increase the renewable contribution to the overall energy mix. Realising these gains can be achieved by a wider uptake of best practices.

Meeting the Sustainable Energy for All objectives also requires participation from both OECD and non-OECD nations, as Figure 2 shows. Some regions in particular will experience large increases in energy use: China, India, the Middle East, Russia and Brazil together represent three-quarters of the estimated demand growth in non-OECD countries (IEA 2011a).[16]Rapid expansion of the infrastructure needed to support this demand growth represents a significant opportunity to meet clean energy objectives, both on the supply side (by using more renewable energy) and on the demand side (by using more energy-efficient technologies). Despite slower growth in their energy use, there is also considerable potential for efficiency and renewable gains in the large energy-consuming economies of the OECD countries. This is particularly true in sectors where asset lifetimes are shorter, such as household appliances, or where a considerable amount of equipment is nearing the end of its lifetime (currently the case in the power sector in many OECD countries).

Figure 3. Energy efficiency and renewable energy deployment to meet the Sustainable Energy for All objectives by 2030



Source: Riahi et al. 2012. The regional and sectoral potentials are broadly similar to the IEA 2011.
Note: All deployment is derived from one of the six *Global Energy Assessment* scenarios that are consistent with the clean energy objectives. Renewable energy deployment by 2030 is in relation to 2005. Renewable deployment in the residential sector excludes non-traditional biomass. Energy efficiency deployment is in comparison to a business-as-usual base case and can be interpreted as “avoided energy demand” from an increase in conservation and technological efficiencies.Efficiency gains in the electricity sector only apply to fossil-generated electricity.

[16]IEA, 2011.*World Energy Outlook.*Paris: OECD/IEA.

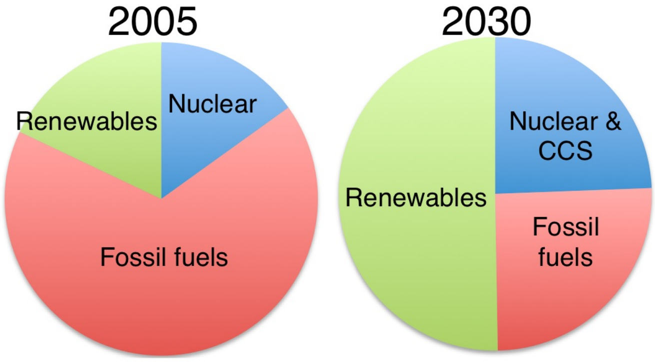
Achieving these potentials requires action across all end-use sectors and industries. We structure our discussion around electricity and three end-use sectors. Each section highlights the main opportunities that exist in these areas, as well as the proposed policy changes or actions that relate to them.

3.1 Electricity

The electricity sector needs to play a central role in meeting the renewable energy objective of Sustainable Energy for All:

- Almost half of renewable energy deployment will need to happen in the electricity sector.
- Additionally, energy systems will need to become more electrified.
- Grids will need to expand and be strengthened, including through the introduction of smart grid technology and netmetering.

Figure 4. Expanding renewables in electricity is critical to meeting the Sustainable Energy for All objectives



One fifth of the world's electricity generation today comes from renewable sources – a share that has grown by five percentage points from 15% in the year 2000. Of this, more than 80% comes from hydroelectricity, 7% from biomass and waste, 7% from wind, and smaller shares from geothermal and solar.[17] The costs of some renewable technologies – including solar photovoltaics and wind turbines – are falling, and supply chains for these technologies are reaching considerable scale, meaning that there is considerable potential for future growth.

On the national level, in both developing and developed countries, supporting the growth of renewable energy in the electricity sector requires smart policies designed to price pollution externalities and level the playing field. Sustainable Energy for All can support some of the information and technology transfer needed to make this happen. One possible high-impact opportunity would be to support a sustainable energy investment readiness index. Work on a global tool to rank countries in terms of the effectiveness of their cleanenergy policies has already started. This tool could help companies identify countries that have policies supportive of renewable energy and help countries identify the strengths and weaknesses of their renewable energy policies. Countries can use the Clean Energy Solutions Center to get free policy consulting and expert advice on the most cost-effective renewables deployment and efficiency improvement strategies for their situation.

In the developing world, Sustainable Energy for All can support the development of grid-connected renewables projects through grid expansion or smart micro-grids and solar lighting. The aim would be to create flexible access so that different users can use electricity when they want it, in the amounts they need and at a price they can afford, with pay-as-you-go architecture. The approach used to reach this objective should allow for intelligent energy management of larger mini-grids and the incorporation of captive power sources such as telecom towers. Realising the Sustainable Energy for All objective of universal access to modern energy services will also require phasing out traditional biomass and replacing it with other sources (for more discussion, see the Buildings section).

Smart grids make it possible to enhance the share of electricity generation supplied by intermittent resources (such as solar and wind) because they continually coordinate supply and demand information while at the same time reducing the need for energy storage capacity. For this reason smart grids represent an important opportunity not only for the developing world but also for the developed world. Combining advanced technical components with intelligent management practices and market signals that favourrenewable energy is a systems integration and management challenge. 'Super' grids that transport electricity from remote sources (such as solar power from deserts or from offshore generators, represent another important technology for expanding the contribution from clean energy resources.

Efficiency improvements at fossil-fuelled power plants and biomass co-firing offer further opportunities to advance the Sustainable Energy for All objectives (although it is also worth noting that considerable

[17] IEA, 2011. *World Energy Outlook.* Paris: OECD/IEA.

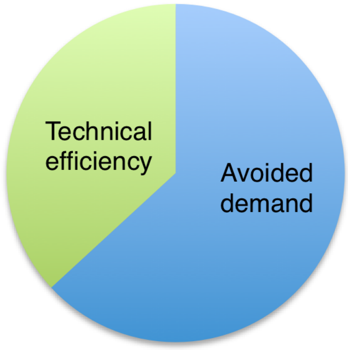
savings from efficiency improvements are likely to be achieved even in the business-as-usual case, as shown in Figure 3). New coal technologies capable of operating at supercritical or ultra-supercritical steam conditions could considerably increase the generation efficiency of coal plants, for example, from around 39% for a new subcritical plant to over 45% for a new ultra-supercritical plant. Another is to substitute coal-fired generation with gas-based generation using combined-cycle gas turbines (CCGTs), which are more thermally efficient. Most of these gains, however, will likely occur without further policy intervention (that is, for purely economic reasons), so not much action is needed.

3.2 Transport

Transport currently accounts for a little over a quarter of global final energy consumption. Energy demand in this sector, worldwide, is also growing rapidly: under existing policy frameworks, the size of the passenger light-duty vehicle fleet is projected to double over the next 25 years.[18] A recent analysis estimates that some 70-80 EJper year of efficiency savings are achievable in this sector by 2030.[19] These savings can be realised by:

- Reducing demand for transportation demand – by substituting virtual mobility for physical mobility and by promoting development and land-use patterns that enable people to live closer to where they work.
- Improving fuel efficiency and shifting to more efficient modes of transportation, such as trains and buses.

Figure 5. Potential Savings from Efficiency Gains in Transport 70-80 EJ



"Avoided demand," which can be achieved in a number of different ways, accounts for two-thirds of the energy savings potential in the transport sector (Figure 5). Integrated land-use planning and zoning cities so people live closer to work can decrease the need for travel. The rapid growth rates in urban populations, particularly in developing countries, offer a unique opportunity for smart land-use zoning to be more efficient in terms of mobility needs. Another vital component of transportation sustainability centres on providing high-quality mobility services for the rich and poor without the need for an ever-expanding fleet of personal vehicles.[20] E-governance and tele-commuting hold great promise, but require coordination and integration of efforts between industry, the public and civil society organisations, academia, and policy makers.

Technical efficiency accounts for approximately one-third of this estimated global energy-savings potential (Figure 5). Technical efficiency gains can come from increasing the fuel efficiency of conventional internal-combustion-engine vehicles or from switching to electric vehicles. Fuel efficiency standards are an excellent way to drive improvements. The global vehicle fleet is set to increase from approximately 850 million cars today to over 2.5 billion cars by 2050. Ninety percent of this growth will take place in developing countries. By tripling the fuel efficiency of the global vehicle fleet, the 2.5 billion cars projected to be on the road in the future could collectively use no more fuel than the global fleet does today. Technically, tripling average fuel efficiency would be possible even with current vehicle technologies. Rapid diffusion of vehicle efficiency standards could be achieved with international coordination, committed national partners, and regional efforts to harmonise fuel efficiency standards with fuel quality standards.

Sustainable Energy for All can play a crucial role in increasing the fuel efficiency of cars by encouraging and supporting commitments from governments and industry groups. Sustainable Energy for All may also be able to provide technical support to countries interested in setting fuel efficiency standards by brokering relationships between policy makers in these countries and multilateral institutions, vehicle manufacturers, and policy makers in developed countries that have already adopted standards (such as

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[18]IEA, 2011.*World energy outlook.*Paris: OECD/IEA.

[19]Riahi*et al.* 2012. (footnote3).

[20]Sager, J., Apte, J. S., Lemoine, D. M. and Kammen, D. M., 2011 "Reduce growth rate of light-duty vehicle travel to meet 2050 global climate goals," *Environ. Res. Lett.* **6**.

Kahn Ribeiro, S., M. J. Figueroa, F. Creutzig, C. Dubeux, J. Hupe and S. Kobayashi, 2012: Chapter 9 - Energy End-Use: Transport. In *Global Energy Assessment - toward a Sustainable Future*, International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

the U.S. and EU). A useful clearinghouse for this type of collaboration might be the Clean Energy Solutions Center. Similarly, Sustainable Energy for All could support efforts to harmonise vehicle efficiency standards at the global, regional or sub-regional level.

Electric vehicles offer a high-impact opportunity for achieving fuel efficiency and renewable energy targets in the transport sector. Today, less than 0.1% of the world's road transport fleet is powered by electricity. Sustainable Energy for All can support a larger contribution by brokering private-public partnerships to accelerate the diffusion of electric vehicles worldwide.

Since liquid fuels currently provide 95% of the energy consumed for transportation, expanding the use of biofuels represents the main near-term opportunity, next to electrifying the vehicle fleet, for increasing the use of renewables in the transport sector. A three- to six-fold increase in the use of biofuels (from 100 billion litres per year at present to around 300–600 billion litres per year in 2030) would raise the share of biofuels to 5%–10% of transport energy demand. Reducing the life-cycle carbon impacts of some biofuels feedstock will require effective policies and market instruments to discourage unsustainable forms of bioenergy.[21] Proven instruments, technologies and policies exist that make it possible to greatly expand the production of biofuels without impacting food security; however, challenges remain with respect to improving the greenhousegas balance of these fuels.

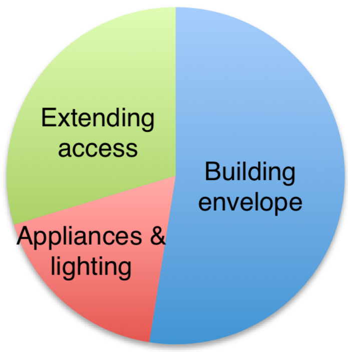
3.3 Buildings

The buildings sector accounts for about 40% of total energy demand. Enormous potential exists for improving energy efficiency in this sector, and opportunities for renewable energy exist as well.

There are three main ways to increase efficiency in the buildings sector (Figure 6):

- Tighten the building envelope.
- Improve the efficiency of appliances and lighting.
- Extend access to modern sources of energy for cooking.

Figure 6 Potential Savings from Efficiency Gains in Buildings 40-50 EJ



These three building efficiency measures could deliver global energy savings of 40–50 EJ/year by 2030, according to the recent *Global Energy Assessment*.[22] The relative contribution from each of these categories of opportunity is displayed in the pie chart. Moreover, at least half of this overall potential could be achieved by implementing policies that have already been successfully implemented in at least one country.[23]

Tighter building envelopes can be achieved through advanced building design or through retrofitting. Passive houses that require no outside source of energy to heat have been built and demonstrated. Investing in a tight building envelope during construction typically has low or no cost impacts but saves money on heating and fuel costs over the long term. Combining a tight building with advanced heating and air conditioning systems can yield significant gains in this sector. Because buildings can last for 40 years and often more, the construction of inefficient models locks in wasteful energy use for decades. Especially in developing countries, where the building stock is still growing rapidly, this sector offers the largest, most cost-effective and lasting opportunities for efficiency gains (usually with considerable co-benefits in terms of occupant comfort and workplace productivity). In industrialised countries with large existing building stocks, retrofitting older buildings offers large

[21] Hertel, T., Golub, A., Jones, A. D., O'Hare, M., Plevin, R. J., and Kammen, D. M. 2010 "Effects of maize ethanol on global land use and greenhouse gas emissions: Estimating market mediated responses", *BioScience*, **60 (3)**, 223 – 231.

[22] Ürge-Vorsatz, D., N. Eyre, P. Graham, D. Harvey, E. Hertwich, Y. JIANG, C. Kornevall, M. Majumdar, J. E. McMahon, S. Mirasgedis, S. Murakami and A. Novikova, 2012: Chapter 10 - Energy End-Use: Buildings. In *Global Energy Assessment - toward a Sustainable Future*, International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK and New York, NY, USA.

The calculation for energy saved from extending access to cooking is a rough estimate based on the replacing all traditional biomass with liquefied petroleum gas, which is four to five times more efficient.

[23] IEA, 2011. *25 Energy efficiency policy recommendations.* Paris: OECD/IEA.

IEA, 2012. *Progress Implementing the IEA 25 Energy Efficiency Policy Recommendations, 2011 Evaluation*. Paris: OECD/IEA.

potential energy savings and an opportunity to reduce building energy consumption, in some cases by as much as 90%.[24]

The key to unlocking this immense energy efficiency potential worldwide is to link energy conservation with real savings at the meter. Aligning interests in the market with public policy goals will drive the investment of private capital necessary to achieve large-scale impacts. Private investors and insurance providers need data to correlate energy savings and risk. Utilities need to value energy efficiency and demand response as a capacity resource. Service providers need to be able to profit from delivering energy savings. And, most importantly, homeowners and businesses can benefit from energy savings without incurring upfront costs or personal risk.

While aggressive building codes offer across-the-board energy savings, the Sustainable Energy for All efficiency and renewables task force has identified public buildings as a high-impact opportunity. Since public buildings are usually built or procured in a centralised manner, they avoid the principal-agent problem, where the party making the efficiency investment (such as the home builder or landlord) is not in a position to recoup the added up-front cost because another party (such as the home buyer or tenant) captures the subsequent energy savings. In the public sector, targets and guidelines for procurements or investments by a single stakeholder—in this case the government—can yield large energy efficiency gains.

Increasing lighting and appliance efficiency also has the potential to generate large energy savings, and there are proven examples of large returns to consumers from limited government investment. It has been estimated that the appliance standards implemented in the United States in 1978 cost $200-$250 million but resulted in more than $250 billion in consumer savings.[25] Efficient lighting also offers a large cost-effective source of energy savings—savings that in developing countries can make it possible to expand access without having to build new generation capacities.

Combined with lighting, appliances can deliver 5% of the Sustainable Energy for All efficiency objective. Significant momentum for realising further efficiency gains already exists in this realm. For example, the Clean Energy Ministerial's Super-efficient Equipment and Appliances Deployment (SEAD) programme, which has initial funding of $20 million over a five-year period, is working to facilitate the easy adoption of cost-effective appliance efficiency policies and programmes. Incandescent lamps will soon be phased out in almost all OECD countries and in Argentina, Brazil, South Africa and China. The UNEP/GEF en.lighten Global Partnership assists countries in developing and implementing phase-out strategies and supports country activities to ensure that new lamps meet global minimum efficiency standards. By promoting these existing initiatives, Sustainable Energy for All can gather more partners and commitments and help accelerate some of the tremendous shifts that are already underway.

Increasing the share of renewable energy in buildings does not offer the same potential as efficiency, since "traditional" renewable fuels (such as wood and dung) have to be phased out at the same time that "modern" renewables (such as wind and solar power) are phased in. Most of the biomass used in the buildings sector worldwide is traditional, which causes indoor air pollution and creates a number of health problems. With increased urbanisation and development, the use of traditional biomass fuels will likely be phased out, possibly reducing the role of renewables as a share of final energy consumption in the buildings sector. Furthermore, a distinction should be made between renewable energy opportunities in rural regions versus those in cities.

Replacing fossil fuels with modern renewables and increasing the share of electricity and heat generated from renewable sources are the main options for increasing renewable energy penetration in this sector. Technology options such as solar water and space heating, heatpumps, cold and heat storage can play an increasing role. To take advantage of these opportunities, Sustainable Energy for All can support distributed solar energy and solar hot water.

3.4 Industry

Industry accounts for around one quarter of final energy consumption globally,[26] and industrial production is expected to expand substantially in the coming decades. This sector offers large potential

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[24]Ürge-Vorsatz *et al.* 2012 (footnote22).

[25]Meyers SP, McMahon J, Atkinson B., 2008. Realized and Projected Impacts of U.S. Energy Efficiency Standards for Residential and Commercial Appliances, Lawrence Berkeley National Laboratory: LBNL-63017. Retrieved from: http://escholarship.org/uc/item/8p26w1jq

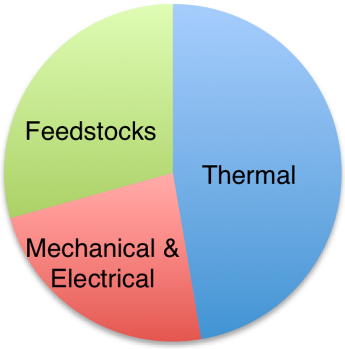
[26]IEA, 2011.*World energy outlook.*Paris: OECD/IEA.

for progress on both energy efficiency and renewable energy. It is clear that modest rates of improvement in energy efficiency will not be sufficient to stabilise or reduce the sector's energy demand in absolute terms. What's needed is the adoption of more ambitious energy efficiency policies and measures. Many efficiency improvements can be achieved cost-effectively or even at a profit once the value of the savings is taken into account.

The industrial sector consists of a diverse set of businesses and is discussed in detail in the report of Task Force 3, which focuses on business commitments. In spite of its great diversity, three types of energy use are common throughout this sector:

- Thermal energy use related to heating processes.
- Mechanical and electrical energy use related to powering electric devices and lighting.
- Replacing some fossil fuel feedstocks with biomass ones – e.g., in the production of plastics in the petrochemical industry.

Figure 7 Potential Savings from Energy Efficiency Gains in Industry 60-70 EJ



All told, the industry sector is estimated to offer about 60–70 EJ of annual energy savings by 2030.[27] While efficiency gains are achievable in all types of industrial energy uses, almost half of the estimated potential for savings involves thermal processes (Figure 7).

Some areas in particular offer large and easilyachievable energy savings that could be realised using already identified, low-cost policies that could save over 25 EJ per year on a global basis.[28] Experience shows that effective industrial sector efficiency policies and programmes depend on strong action to overcome informational, institutional, policy, regulatory, price, and other market-related barriers to improving performance. Achieving the Sustainable Energy for All efficiency objective will require identifying, distilling and—where appropriate—transferring key features of the most successful energy efficiency policies and programmes. Use of high-efficiency industrial equipment can also generate large energy savings at low cost. Opportunities for cost-effective efficiency improvements can also be found in small and medium-sized enterprises (SMEs), although the characteristics of these opportunities and the barriers to realising them are significantly different than in the case of large industry.

The industrial sector is broad and diverse, but the International Energy Agency (IEA) has estimated that five of the most energy-intensive industrial subsectors (iron and steel, cement, chemicals and petrochemicals, pulp and paper, and non-ferrous metals) could reduce their energy consumption somewhere between 10% and 40% on a worldwide basis.[29]

There are five main ways that the Sustainable Energy for All initiative can help realise the substantial energy efficiency potential that exists in this sector:

- By working with industry groups in these sectors to set aggressive energy efficiency targets.
- By securing high-level commitments to energy efficiency programmes at companies and then publicising successful efforts.
- By working with countries to establish ambitious but achievable national efficiency targets.
- By using experience gained in working with individual countries and companies to develop training programmes and information sharing.
- By supporting initiatives that are aligned, even if already underway, such as the Global Gas Flaring Reduction Initiative.

The industrial sector also offers interesting opportunities for deploying renewable energy technologies that have so far not received a lot of attention. On a global basis, around 9% of the energy currently used by industry is from renewables, typically to produce on-site electricity, provide process heat, or as a source of carbon and hydrogen for chemical reactions. Opportunities to expandthe use of renewables in this sector include greater electrification, taking advantage of solar energy to run thermal processes, and using biomass as a feedstock for synthetic organic materials.

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[27]Riahi*et al.* 2012. (footnote3).

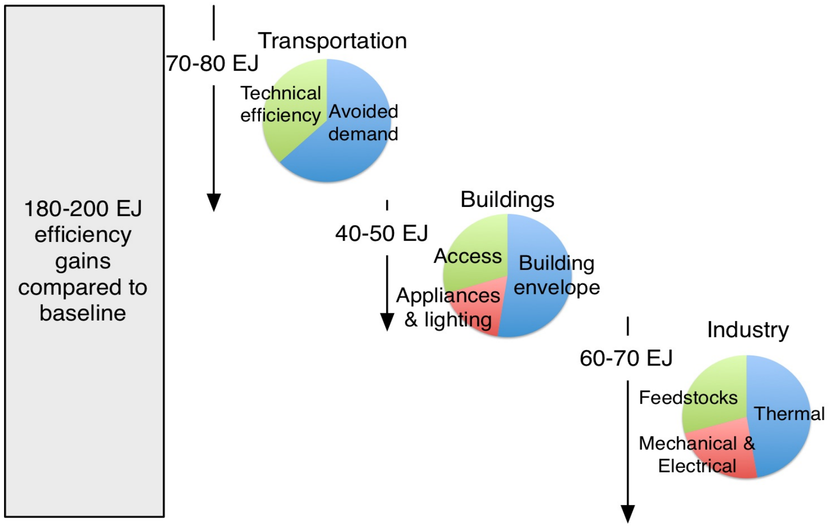
[28] IEA, 2011. *25 Energy efficiency policy recommendations*. Paris: OECD/IEA.

[29]IEA, 2009*. Energy Technology Transitions for Industry*. Paris: OECD/IEA.

4 Next steps

The objectives of Sustainable Energy for All cannot be achieved without a concerted and sustained global effort. Indeed, the renewable energy and efficiency objectives require nothing short of an energy revolution. Fortunately, a lot of positive action is already taking place in many countries. These countries provide a growing base of experience on how to design smart policies that can catalyse growth in energy efficiency and renewable energy. Energy efficiency improvements are central to these efforts and will be needed in all sectors (Figure 8).

Figure 8.Energy efficiency in all sectors is central to Sustainable Energy for All



Note: Electricity is not included to avoid double counting.

Sustainable Energy for All is an action-driven initiative that must reach all stakeholder groups. Policy makers must level the playing field for clean energy technologies, leverage private investment, and support innovation. The private sector needs to find ways to invest in clean energytechnologies, develop internal best practices for efficiency and renewable energy, and contribute implementation capacity for deploying clean energy technologies. Finally, civil society organisations can engage policy makers and the private sector in support of clean energy policies, form partnerships and networks to facilitate transparent flows of information, and invest time and creativity in devising innovative solutions.

The most important part of this process is not the design of specific policies or the development of specific technology innovations—these are processes that we anticipate will continue to unfold organically.Rather, the most important factor is the implementation of commitments to change the energy economy through specific public-sector decisions, private-sector investments, and the catalysing role of civil society with consumer organisations as educators and watchdogs. To ensure that the period from 2012 to 2030 and beyond is characterised by concrete and honoured sustainable energy commitments, a range of actions is needed:

- Proactively catalysing actions through the personal networks of principal actors in Sustainable Energy for All.
- Developing criteria to judge impact and prominently recognise the highest-impact commitments.
- Providing technical assistance, on request and through a growing international network, to help proactive governments reach policy objectives.
- Utilising this knowledge network to support municipalities at all scales in their efforts to develop and implement programmes on energy access, energy security, and clean energy transformation.
- Developing milestones and an action agenda to map activities between now and 2030.
- Bolstering key national and global institutions to support implementation.
- Working with national, multinational, and private-sector funding agencies to make the Sustainable Energy for All agenda a central part of global energy and climate funding (such as through the Green Climate Fund).

Annex: High-impact opportunities

The following is an initial list of potential high-impact opportunities that may be pursued as part of Sustainable Energy for All drawn from the analysis in the preceding report and discussion with task force members.[30]The list is not meant to be exhaustive, and exclusion of a technology or other opportunity from the list does not imply that it will not be pursued later in the initiative.

Table 2 Examples of high-impact opportunities

Area	Example of potential opportunity	
Industrial and agricultural processes	Energy smartfood, Light industrial equipment efficiency Industrial heat use	Corporate energy efficiency Industrial process efficiency Waste to energy Gas flaring
Buildings and appliances	Commercial building efficiency Public building efficiency Residential building efficiency Cool roofs	Advanced lighting Appliance efficiency Solar hot water Solar rooftops
Grid infrastructure and supply efficiency	Coal-powered efficiency Clean energy mini/micro grids	Grid expansion
Large scale renewable energy power	Biomass co-firing Grid-connected renewables Desert solar	On/off-shore wind Utility decarbonisation Corporate renewable energy procurement
Transportation	Fuel efficiency standards Electric vehicles	Biofuels-first generation Biofuels-second generation
Clean cooking appliances and fuels	Clean cook-stoves and fuels including LPG	
Distributed electricity solutions	Solar rural lighting/charging	
Capacity building and knowledge sharing	Consumer education Clean energy investment index Information sharing and capacity building for clean energy policy making (e.g., Clean Energy Solutions Center)	Global resource map Institutional capacity building National sustainable energy plans Skills development
Finance and risk management	Finance–asset allocation Carbon credits Consumer credit	Debt for projects Equity for projects Finance flows to developing world
Cross-cutting	Clean cities	Island renewables

[30] These were also developed in close-collaboration with Bloomberg New Energy Finance.

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