TOWARD ENERGY AS A SUSTAINBLE DEVELOPMENT GOAL

A contribution of **ICSU** (International Council for Science), **IIASA**, the International Institute for Applied Systems Analysis, and **TERI**, the Energy and Resources Institute.

Authors: Nebojsa Nakicenovic –the International Institute for Applied Systems Analysis and Technical University of Vienna; **Mathis Rogner** – the International Institute for Applied Systems Analysis; **Leena Srivastava** - The Energy and Resources Institute.

Key Messages: Sustainable Development Goals for Energy

1) Universal access to modern energy services by 2030.
2) Doubling the rate of energy intensity improvements by 2030.
3) Doubling the contribution of carbon-free energy sources by 2030.
4) Stabilizing climate change at 2 °C by 2100.
5) Increasing energy security and eliminating air pollution.

The Context

Energy was neither explicitly one of the Millennium development Goals (2000) nor in the Johannesburg Plan of Action (2002). There may have been many reasons for why energy was unfortunately excluded and subsequently termed as an "underlying" MDG or a "missing" MDG. These ranged from discussions on whether energy was a means or a goal; energy's linkages to geo-political issues; or the entangled role of energy in climate change vis-à-vis its central crucial role in ensuring development.

The world has been undergoing severe and rapid changes involving significant challenges. These changes include globalization, urbanization, technological innovation and fundamental shifts in economic and political power, global environmental impacts, climate change and potentially explosive social conflicts. It is where such changes have been net negative that the role of energy has come into focus. These negative changes encompass the concerns related to water security, food shortages and climate change as well as on the slower than expected performance of the MDGs. Energy is inextricably linked to the solutions to these challenges – its adequate

availability and sustainable use can provide a positive outcome for development and human well-being (e.g., water, food, health, and other developmental challenges) or it could exacerbate the adverse changes that the world has been experiencing (e.g. climate change, air pollution, competitiveness, equity). The paradox of energy use is that it can at the same time alleviate or aggravate a challenge – energy is important for delivering health services but also causes health problems; it is necessary for delivering water and improving its quality but is also an important consumer and polluter of water. In most cases, if one was to drill down, energy aggravates the inequities in the world through the costs and benefits of its use.

The global economic output has increased some hundredfold since the beginning of the industrial revolution translating into some $12,000 per year (measured in purchasing power parity) average income for the seven billion people on the planet, a level high enough to provide adequate quality of life for everyone. However, three billion are excluded having to rely on solid fuels for cooking and some 1.5 billion are without access to electricity. Lack of access means that development is inhibited leading to some 1.3 billion people living in abject poverty. Global inequality from an energy entry point mirrors that of the global income disparity. Roughly 60% of global final energy is used by the richest 20%, with only 5% going to the poorest 20%. Also, half of the global population living in the cities accounts for some 60-80% of total energy needs and as urbanization progresses, we can expect doubling of energy needs of the cities unless the global energy system is transformed toward more sustainable practices.

At the same time, the hundredfold increase of global economic output required almost a fiftyfold increase in energy needs and about a twentyfold increase in carbon dioxide emissions leading to dangerous anthropogenic climate change that impact poor drastically more than the affluent. The relationship to greenhouse gas emissions is similar: with the richest 20% accounting for roughly 60% of global emissions. As mentioned, the 1.5 billion people with no access to electricity hardly contribute to global emissions, with the top 20% accounting for the consumption of almost 80% of global electricity production. Those still relying on solid fuels for cooking suffer the effects of indoor pollution and account for 4 million deaths per year, mostly children and women, representing a major cause of premature mortality four times the global deaths due to malaria.

Energy deserves to be recognized as a Sustainable Development Goal in itself due to its strong and universally accepted links with sustainable development in all its dimensions – economic, social and environmental.

Sustainable Energy for All and the SD agenda

The Secretary General of the United Nations founded the Sustainable Energy for All (SE4all) initiative with three sub-goals to be achieved by 2030:

(1) Ensuring universal access to modern energy services,
(2) Doubling the global rate of improvement in energy efficiency and
(3) Doubling the share of renewable energy in the global energy mix.

The UN General Assembly declared the year 2012 as the International Year of SE4All (A/RES/65/151) and in its 67th session, the United Nations General Assembly unanimously declared the decade 2014–2024 as the Decade of Sustainable Energy for All, underscoring the importance of energy issues for sustainable development and for the elaboration of the post-2015 development agenda. Analysis from the Global Energy Assessment provided a scientific foundation for this initiative. The board of SE4All is co-led, in an unprecedented manner, by the UN Secretary General and the World Bank President.

As recognised in the SE4ALL Framework for Action "Achieving each of the three objectives would realise multiple, substantial benefits to countries, companies and society. Energy is the world's largest industry, and the transition to sustainable energy systems provides perhaps one of the largest global economic opportunities of the 21st century – particularly important at a time of financial hardship in many nations. Developed countries face the combined challenge and opportunity of transforming existing infrastructure; developing countries have the opportunity to adopt cleaner, more efficient technology from the start; leapfrogging technologies and infrastructure that developed countries had to establish."

Energy access is increasingly seen as a vital catalyst to wider social and economic development, enabling education, health and sustainable agriculture, and creating jobs. Energy for productive uses is particularly important to enable local business innovation and create a more vibrant economy for communities and countries, while providing societal benefits as well. Universal access to electricity and cleaner cooking fuels and stoves can be achieved by 2030, but requires innovative institutions, enabling mechanisms and targeted policies. GEA estimates that universal access will require annual global investments of at least US$60 billion through 2030.

Energy efficiency improvements are an immediate and effective option: efficiency improvements are proving to be the most cost-effective option for transforming energy systems. Energy efficiency means cutting out waste and getting more done with the same amount of energy – a step made even more critical by the fact that three billion more consumers will enter the middle class by 2030, according to the OECD. Improving energy efficiency through new investments and retrofits requires focused and aggressive policies that support rapid innovation through more stringent regulations of energy efficiency, fiscal incentives for new technologies, and pricing GHG emissions. Cost and rebound effects mean that the acquisition of energy-efficient devices alone will produce the desired results. For these gains to be realized, carefully targeted and regularly updated policies are needed. Energy efficiency improvements are possible in all sectors.

The rapid decarbonization of the energy system for climate protection is essential and requires low carbon energy from renewables, bioenergy, nuclear power and carbon capture and storage (CCS) coupled fossil-fuels, particularly natural gas. Fossil resources and renewable potentials are abundant and widely available, yet geographically unevenly distributed. The share of renewable energy in global primary energy could increase from the current 17% to between 30% and 75% by 2050; in some regions it could exceed 90%. Increasing the share of energy from renewable sources can reduce greenhouse gas emissions and local pollution, insulate countries from fuel price volatility, and improve their balance of payments.

The Case for an SDG on Energy

At the core of the post-2015 sustainable development agenda are people. And, as human beings, we all share similar needs and aspirations for a better life, good health, peace, etc. In order to fulfill these needs as well as meet future aspirations, we require basic access to food, water and energy while remaining within the natural planetary boundaries. It is important that we adopt and maintain a long-term perspective by taking into account the changes and development patterns over time.

Energy access is but one aspect of transforming the world's energy systems, which is central to achieving our future objectives without putting the planet under even more pressure. Analysis by over 500 scientists in the in 2012 published Global Energy Assessment (GEA), the first integrated energy assessment that analyzes energy challenges, opportunities and strategies for developing, industrialized and emerging economies, calls for a grand transformation of energy systems worldwide is required if future energy systems are to be affordable, safe,

secure and environmentally sound. By assessing a broad range of resources, technologies, and policy options which support such transformations, GEA identified forty-one alternative integrated scenarios or 'pathways' which simultaneously meet all of the goals (i.e., increasing energy security and stabilizing future mean global climate change at 2°C) and at the same time increase global prosperity and well-being. This transformation towards sustainable future energy systems requires:

- Immediate action and the avoidance of 'lock-in' to energy demand and supply patterns counterproductive to sustainability goals;
- Radical improvements in energy efficiency, especially in end-use, focusing on both new developments and retrofits;
- Decarbonization through the rapid escalation of investments through greater shares of renewable energy and smart grids enabling more effective utilization of renewable technologies; and
- Universal access to modern forms of energy and cleaner cooking through micro-financing and subsidies.

GEA identifies the major technological and economic challenges for deployment of new low carbon technologies to be:

- Reducing costs through learning, scale-up and improved institutional arrangements;
- Creating a flexible investment environment that provides the basis for scale-up and diffusion;
- Integrating renewable energies and other zero-carbon technologies into the energy system; and
- Enhancing research and development with particular emphasis on early deployment to support new technologies.

Policies to enable rapid transformations of energy systems must contain incentives for large-scale deployment of energy efficiency, renewable energy, and advanced energy system technologies. GEA analysis indicates that global investments in energy systems will need to increase from present annual levels of about $1.3 trillion to $1.7–2.2 trillion (about 2% of current world GDP). Reallocating energy subsidies, particularly those related to fossil fuels and nuclear energy, can help support the initial deployment of new energy systems. They are estimated at some $500 or more billion per year. Additionally, publicly funded research needs to be reoriented toward energy efficiency, renewable energy, and advanced energy systems, as current efforts in these areas are inadequate.

While it is essential that the post-2015 development agenda regarding energy is universally relevant, there will be large regional differences in opportunities and perceived priorities. In many low-income countries, the focus will understandably be to ensure universal access to modern energy services, whereas for many developed countries, the emphasis will be placed rather on working towards decoupling our energy use and greenhouse gas emissions. This isn't to say that low-income countries should neglect low-carbon technologies. In fact, all countries need to recognize the risks and costs associated in technological lock-in, which is a recurring factor, especially in energy supply systems. This is particularly important in the rapidly developing parts of the world that are now making crucial decisions and capital investments in energy systems and other infrastructures.

There are important synergies between these two goals. Modern energy services are more efficient than traditional biomass uses; the acceleration of energy access would contribute to a more rapid increase in energy efficiency (by four- or five-fold), while increased energy efficiency effectively allows for existing and new infrastructures to reach more people by freeing up capital resources for energy access investments. By promoting renewable energy through smart centralized and decentralized grids, we not only reduce GHG emissions and local pollution, but allow for more self-sufficient communities while offering insulation for communities from fuel-price volatility. The necessary fundamental transformation of the global energy system has the potential to

be a source of sustainable and equitable wealth creation for the earth's growing population, while remaining within the planetary boundaries by reducing the strain on its resources and climate.

To echo the UN Sustainable Development Solutions Network: the world has changed profoundly since 2000, when the Millennium Development Goals were adopted. Thus, the post-2015 development process should build upon the shared experiences and lessons learnt from the Millennium Development Goals and the Kyoto Protocol. The post-2015 agenda should effectively integrate these initiatives under one united pennant. In this sense, on the one hand it is important that the post-2015 agenda include a limited number of simple, concrete, and above all, communicable goals and targets. On the other hand, the post-2015 goals need to be universally relevant while taking into account the long term sustainable development dimensions applicable to all societies that were lacking within the MDGs. This results in an increase in complexity and a broadening and integration of new issues into the future agenda. While we approach the post-2015 agenda from an energy perspective, these need to actively take into account issues regarding biodiversity, population dynamics, human conflict, food security, health, education and governance, to name a few.

From an energy perspective, we are already on a positive pathway. Under the SE4All umbrella, initiatives such as the US Government Initiative to Power Africa, The European Investment Bank, the Economic and Social Commission for Western Asia, and other Rio+20 initiatives such as Kazakhstan's Green Bridge have laid important institutional and cooperative foundations for effective international governance of the global commons. Defining a unified set of SDGs is challenging, especially due to potential conflict between individual goals, for example the case for sustainable energy provision versus climate-change prevention. This argues for integrated goals that can capture potential synergies and multiple co-benefits. Embedding and expanding the sub-goals of the SE4ALL within the SDGs and recognising explicitly the relationship of energy with all aspects of sustainable development as defined by the multiplicity of geographical contexts in which applicable, will be critical to both meet the SE4ALL goals in themselves as also to meet every other SDG that may be defined. The experience from the MDGs mandates an explicit inclusion of energy within the SDG process for greater overall success.

Thus, the SDGs should be built around cross-disciplinary themes such as food, water and energy security, rather than the separate columns of the economy, environment and social development. In any case, the choice of primary SDGs is intricately linked to the choice of measures of progress and human well-being, that is, metrics must be based global "inclusive wealth," including the state of environment and natural resources, and not just economic indicators such as GDP and HDI, which focus on the short term.

Encouragingly, combinations of resources, technologies, and polices that can simultaneously meet global sustainability goals also generate substantial economic, environmental, and social development benefits. Synergistic strategies that focus on local and national benefits are more likely to be implemented than measures that are global and long-term in nature. Such an approach emphasizes the local benefits of improved end-use efficiency and increased use of renewable energy, and also helps manage energy-related global challenges. These benefits make the required energy transformations attractive from multiple policy perspectives and at multiple levels of governance.

Policies to control emissions of greenhouse gases and stabilize climate change to 2°C by 2100, or to increase access to cleaner cooking fuels could, in turn, bring significant improvements in pollution related health impacts. For example as the GEA pathways indicate, a saving of 20 million disability adjusted life years (DALYs) from outdoor air pollution and more than 24 million DALYs from household air pollution. In addition, universal access to electricity and cleaner cooking fuels opens up opportunities for education, for income generating activities, and significantly improved well-being.

The international scientific community has long recognized the pivotal role of energy for the future research and scientific programs. In its goal to strengthen international science for the benefit of society, ICSU has placed energy as a strategic priority for the future agenda. Future Earth is a common platform for international research collaboration and has also placed energy as an integral part of its research teams.

The science and engineering perspective is clear: addressing many of the social ills of the 21st century demands an energy system transformation. The transition to sustainability will not happen on its own, however. Strong leadership is needed to ensure that decisions made today have the most desirable outcomes tomorrow. Science and engineering companies have a crucial role to play in enabling the needed transformational change.