Position paper

"A Global Assessment on Sustainable Energy for All"

Submitted to UNCSD2012 by Stockholm Environment Institute (SEI) and Brazilian Foundation for Sustainable Development (FBDS) on behalf of the assessment partnership.

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Supporting the political preparations for Rio2012, the UNDESA secretariat's analytical preparations, and the high level group appointed to the official UN year of Sustainable Energy for All, leading research institutes have joined forces to produce a global assessment on sustainable energy for all. The assessment is supported by the Governments of Sweden and Brazil. The assessment builds on and integrates existing efforts in among partners such as the Global Energy Assessment (IIASA, PBL and SEI), Planetary Boundaries (SEI and PBL), Low carbon development (ACPC), energy access and clean energy (TERI), Electricity Governance (WRI), Brazilian Biofuels Programs from the water, energy and land nexus perspective" (COPPE), Guidelines for a Green Economy in Brazil (FBDS) and Integrated Sustainability Scenarios (PBL).

The assessment can be followed at www.sei-international.org/Rio20. The final report will be published in March 2012. Contact: Måns Nilsson, Research Director, SEI, mans.nilsson@sei.se .

The global energy predicament

Energy is fundamental to human and economic development. Without reliable energy services, development is not possible. However, the debate about energy for all must go beyond current debates about basic access for poverty alleviation. Since the industrial revolution, people have relied on affordable energy to meet economic development aspirations. It is time to consider what energy services need to be available to enable all countries to reach an economic development equivalent to at least today's middle income segment.

Our planet is currently inhabited by 7 billion people, yet some three billion people still lack access to basic energy services. With the global population projected to reach ~9 billion people by 2050, an additional two billion people will require energy services by 2050. At the same time, energy is one key driver behind some of the troubling global environmental trends we are now experiencing. The combined pressures on the Earth system have now reached a point where we increasingly risk crossing a number of thresholds that could cause serious disruption and harm on societies across the world. We have entered a new era – the Anthropocene – where humans are now a dominant driving force of change at the planetary scale; we may be approaching, or in some instances have actually reached, an upper limit in terms of human pressures on the planet (Stockholm Memorandum, 2011). This means that meeting energy demands of a growing world economy and population must occur in a world that on aggregate bends the curves of current global environmental change.

Thus, human development will not be possible without an energy transition that responds to the demands of development and poverty alleviation as well as the constraints imposed by climate change. This energy transition needs to unfold in a new geopolitical and global economic context, with structural and geographical shifts in both economic and political power. On top of that, the global financial crisis brings into play additional challenges in terms of availability of resources but also can open new opportunities if used to implement anti-cyclic measures.

The need for a new sustainable energy based development strategy

Humanity thus faces a triple global energy challenge; (1) the urgent need for affordable energy services for all – both covering basic needs and income-generating productive activities, (2) the need for a rapid phase-out of fossil fuels (the cheap energy sources that have been key to historical wealth creation) to stabilize the global climate system, and (3) the necessity to meet this need within the "safe operating space" of Earth systems boundaries such as biodiversity, land use and freshwater use. All these are impacted by the energy choices we make.

Resolving this triple challenge will require an unprecedented energy transition over the coming 3-4 decades, backed up by strong political endorsement and financial resources. In order to assess the scope of such a global energy transition, our partnership is carrying out a scenario based global energy assessment on sustainable energy for all as a contribution to the Rio + 20 Earth Summit (summary in Annex below). Our assessment urges nations in the world to recognize:

a) *the fundamental importance of increasing energy demand in poor and emerging economies*, from basic needs to energy services for income generation, as a precondition for attaining sustainable development. Energy is not only a fundamental building block for human development but the key to unleashing economic development. Securing energy for development is therefore a primary concern – and point of shared interest – across developing, emerging and developed countries.

b) *that energy is a driver in the "Anthropoce" but also that a global energy transition within planetary boundaries is within reach*, despite massive growth in energy demand, to meet basic energy needs and growing energy demands from economic development. The transition will require substantial investments but will generate co-benefits such as employment opportunities, enhanced security from diversification of supply, and better resource efficiency.

c) *the urgent need to accelerate the energy transition*. Key transformation pathways have been set in motion but must be accelerated at national and regional levels. Carbon pricing is necessary but not sufficient for driving the transition. Beyond this, governance responses need to be explored across levels to induce transitions through scaling up a diversity of supply and demand options.

The overarching recommendation for the world's nations to consider is the adoption of a set of strategic principles, translated into practical action in order to enable a global energy transition in time to avoid large scale crises for nations of the world:

1. Accelerate the implementation of national and international energy policies that drive efficiency enhancements and provide incentives for innovation and support scale-up of renewable energy sources (e.g., white and green certificates, feed-in tariffs, technology standards, and removal of subsidies for fossil energy sources).

2. Develop a transparent global investment fund for renewable energy systems for poor and emerging economies and couple this with technology sharing and learning platforms for sustainable energy. Investments and accelerated adoption of renewable energy technologies by developed countries can bring down the costs thereby reducing the size of the fund needed.

3. Develop policy assessment frameworks for economic development policies and strategies that enable the management of Earth systems risks and vulnerabilities in relation to renewable and non-renewable energy expansion worldwide, and its linkages to other sectors such as water and agriculture. The planetary boundaries framework can be a basis for an integrated and systemic assessment framework for the world's energy systems, with due regard to issues of equity and justice.

4. Adopt sustainable energy supply and demand measures as a "currency" for measuring progress in development endeavors (e.g., for reaching the Millennium Development Goals) and for policy action on meeting global environmental goals. This means that sustainable energy provision or demand improvements are accounted for and credited within the global negotiating frameworks including UNFCCC and CBD.

ANNEX: A global assessment of a sustainable energy for all (Summary)

Our assessment complements the range of energy pathways previously examined in the recently launched Global Energy Assessment (GEA, 2011). Our assessment develops two key scenarios; (1) basic levels of energy access are met within a carbon constrained world (based on GEA pathways), and (2) an energy pathway is developed, which is consistent with much greater levels of development in the developing world and higher levels of convergence to the levels of well-being currently enjoyed in OECD nations, whilst still keeping within the planetary boundaries.

Energy for all: from basic access to pathways in a new development model

Worldwide, approximately 2,7 billion people today rely on traditional biomass for cooking and heating and about 1.3 billion have no access to electricity (IEA, 2011). Up to a billion more have access only to unreliable electricity networks (AGECC, 2010). Access of the poor to energy is a central concern for governments around the world. Providing clean and affordable energy reliably for poor households is an important prerequisite in the fight against poverty and to improve wellbeing, and widely regarded as a key to make advancements on the Millennium Development Goals (Ekholm, Krey et al. 2010).

However, there is an increasing consensus in the developing world that "energy for all" must go beyond basic access and should be understood as energy system development through electricity and modern fuels for productive and industrial uses everywhere in the world, compatible with income generation and economic development, in for instance agriculture, industrial processes, and fuel for transport. Our assessment therefore looks at the implications of a new global development model in energy terms, which in income terms shows a more rapid convergence over time in GDP per capita than is usually considered, and examines what energy end uses are required at these levels of GDP, taking into account potentials for efficiency improvements.

In the "new model" scenario, annual GDP per capita growth trajectories will average 0.5-1% for EU and US, 4-5% for emerging economic powers such as China, and 7-8% for the less developed countries (preliminary estimates). This means that by 2050, all countries in the world will have a GDP per capita which is at least at the level of current middle-income countries (ca 20,000 USD per capita). Extrapolating the trends would imply converging income levels globally before 2100. The converging GDP trajectories is a development that has normative connotations, but it is also one that is already underway in several places. For example, while the EU has experienced growth rates of about 0-2% annually over the last decade, many countries in Latin America, Asia and Africa have registered growth rates of about 10% annually.

Achieving the three sets of objectives that we included in our operationalization of sustainable energy for all requires transformations in several energy subsystems, including, for instance: reorganization and modal shifts of urban and regional transport and infrastructure, enhancing energy efficiency in buildings and industry; expanding wind, solar and agro-bioenergy production, enabling consumption reductions and lifestyle change, expanding off grid solar energy, and new cooking and heating technologies and developing smart transmission networks and distribution grids. Such transformations and systems changes will unfold with specific patterns in each of the world regions, depending on demographic and income trajectories, natural resource constraints, and technical feasibility. They are examined in in-depth case studies from a socio-technical systems and innovation perspective.

Planetary boundaries: sustainable energy within a safe operating space

The growing scientific insights that we may have entered a new geological epoch, the Anthropocene, where humanity constitutes a global geological force through the aggregate human pressures on the Earth system, triggered the scientific development of a new framework for global sustainability – "the planetary boundaries concept" - building on recent advancements in Earth system science (Rockström et al., 2009). The planetary boundaries framework identifies Earth system processes that require active stewardship in order to avoid unwanted non-linear changes in the biophysical systems on Earth that in turn are likely to generate deleterious or even catastrophic outcomes for regions of nations or the world at large. Nine planetary boundaries have been identified, of which 7 have received proposed quantifications for safe boundary levels of key control variables (Table 1).

PLANETARY BOUNDARIES

Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1–1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N_2 removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	Quantity of P flowing into the oceans (millions of tonnes per year)	11	8.5–9.5	-1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km^3 per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to cropland	15	11.7	Low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis		To be determined	
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof		To be determined	

Boundaries for processes in red have been crossed. Data sources: ref. 10 and supplementary information

Table 1. Planetary boundaries (source: Rockström et al, 2009)

Energy systems are dependent, and impact upon, essentially all of the planetary boundaries. Energy systems based on fossil energy sources impact on the planetary boundaries for climate change, ozone depletion, aerosol loading, and chemical pollution. Hydropower affects the boundaries on freshwater use, rate of biodiversity loss, and land use change. Nuclear power affects the boundaries on chemical pollution risks and biodiversity. Renewable energy systems based on biomass systems impact the boundaries on land use change, freshwater use, interference with the nitrogen and phosphorus cycles, the rate of biodiversity loss, aerosol loading and climate change.

Energy access to service basic human needs will have a limited impact on our ability to stay within the planetary boundaries. According to the IEA (2011) basic universal electricity access would add around 1.3 per cent of total GHG emissions in 2030. However, more ambitious targets associated with productive uses of energy provide more of a challenge. On the climate change boundary, as an example, our assessment looks at the global energy pathways up to 2050 compatible with a 2 degrees target, based on the most recent review of the global climate science (eg Rummukainen, Johansson et al. 2011 and GEA, 2011). The 2 degree target requires global emissions reductions of 50-60% from 2000 to 2050 (and close to 100% by 2100). At the same time, to enable the provision of energy for development requires a convergence in per capita emissions around the world. Preliminary estimates point to emissions reductions in the EU and US in the range of 75-90% compared with 2000 levels by 2050**.** Countries in Sub-Saharan Africa and many parts of Asia can instead increase emissions for a few decades more, but will ultimately have to bend the curves on emissions well before 2050.

Assessment Partners: Stockholm Environment Institute (SEI), Brazilian Foundation for Sustainable Development (FBDS), African Climate Policy Centre (ACPC), Energy and Resources Institute (TERI), Federal University of Rio de Janeiro (COPPE), International Institute for Applied Systems Analysis, (IIASA), Netherlands Environmental Assessment Agency (PBL), World Resources Institute (WRI).

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