

Growing the Renewable Energy Potential in Developing Countries

Layth Hazim Majid^{a*}, Hamid Hazim Majid^b, Hussein Fawzi Hussein^c

^{a,b}*Pache Protopopescu 43, Bucharest 021406, Romania*

^c*Calea Rahovei 293, Bucharest 050898, Romania*

^a*Email: laith_aldolaemy@yahoo.com*

^b*Email: laithhazim02@gmail.com*

^c*Email: husseinalaubi@live.co.uk*

Abstract

The world is facing major challenges in providing energy services to the future needs of the developed world and in particular the growing needs of the developing countries. The challenge is enhanced by the need to provide these energy services with due to climate change effects and specifically the emission reduction targets of the Kyoto Protocol and subsequently to the even stricter targets expected to be agreed for the years ahead (post Kyoto targets). Recent research shows that a sustainable development focus can facilitate a path that both ensures economic development and meets concerns about the environment, but this will require major shifts compared with present policies and finance decisions. The aim of this article is to present new developments and trends in energy technologies which may become main contributors to the energy scene in 15 to 20 years.

Keywords: renewable energy sources; fossil fuels; Kyoto agreement; sustainability issues; clean energy; carbon footprint; environmental sustainability engineering.

1. Energy Technologies for Post KYOTO Targets in the Medium Term

Energy production and consumption worldwide is the main source of greenhouse gas emissions and it is therefore mandatory to examine how future emissions can be limited in the energy sector. At the same time it is fully accepted that energy plays a key role in development and economic growth so it must be made clear that the issue is not to reduce energy services but to provide these in ways that do not affect the earth's climate.

* Corresponding author.

New energy technologies are cleaner and more efficient to sustainable development. In industrialized countries new and stricter emissions targets can be expected after the Kyoto Protocol's first commitment period, which will require the research, development, and deployment of new energy technologies. In developing countries the focus will generally be on providing access to reliable and affordable energy services for expanding populations and industries, ensuring economic growth that leads to improved living standards [1].

It is very important, however, that this development is based on cleaner and more efficient energy technologies as well. If we fail at this there will be unwelcome environmental impacts, not only on the global environment but also at the local and national levels.

The Plan of Implementation adopted at the World Summit on Sustainable Development in Johannesburg in September 2002 also highlights the need for improved access to reliable and affordable energy services for sustainable development, sufficient to facilitate the achievement of the Millennium Development Goals [2].

The plan specifies the most important areas of intervention as: access to energy, sustainable use of renewable energy, the development of national policies and regulatory frameworks for clean energy, and enhanced international co-operation in the energy area. With a UN system focus on the so-called WEHAB priority issues (Water-Energy-Health-Agriculture-Biodiversity), the WSSD also for the first time put energy issues high on the intergovernmental agenda.

By linking energy with other areas on the development agenda, WSSD helped people who are not energy specialists. Figure 1 clearly shows the links between energy and other development goals.

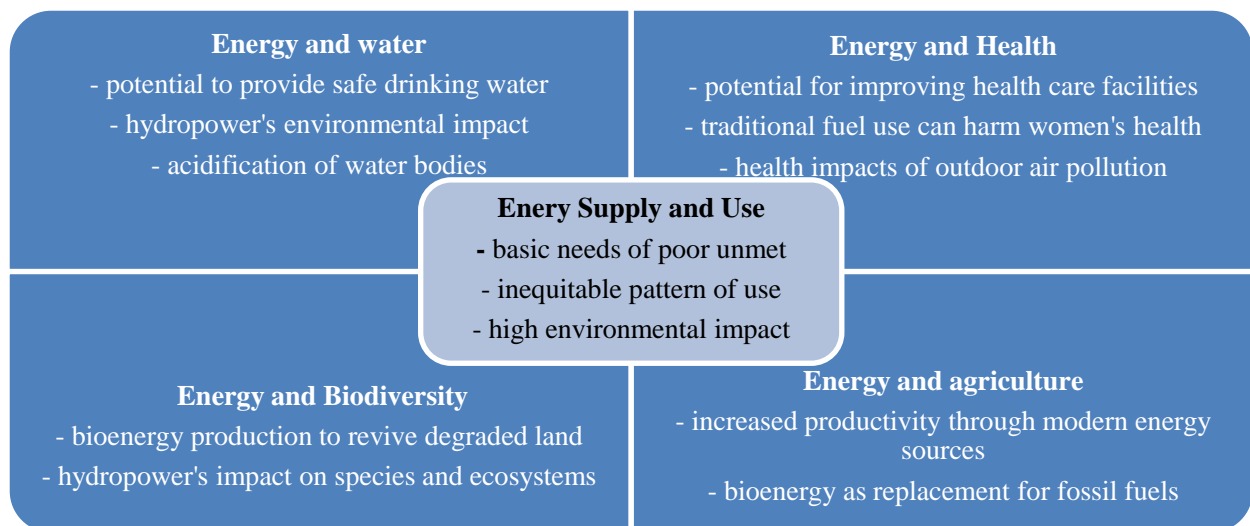


Figure 1: WEHAB working group paper.

The global energy scene is presently characterized by significant changes in the structures of energy markets: institutional and market reforms are taking place in almost all regions. While the general driving force is a desire to increase overall cost-effectiveness and improve the delivery of energy services, there are clear regional differences.

The industrialized countries are concentrating on environmental concerns, while developing countries are more concerned with energy for development and access to energy for the poor.

Access to energy services is an important instrument for economic growth and essential for providing the basic living conditions for all human beings. No country has substantially reduced poverty without increasing its use of energy, replacing human and animal labor with more convenient and efficient sources of energy and technology. The stable and efficient provision of energy services is necessary an input to improve productivity at all levels in both rural and urban production. Energy is needed for most income generating activities and to gain access to markets [3].

These energy needs can be met in different ways, however. In the climate context it is important that developing countries do not blindly follow the high emission development paths of the industrialized countries but rather focus broadly on making their energy development more sustainable. It is a false argument to state that countries need to pollute in order to become wealthy, and only then can afford to attend to the consequences of a polluted environment.

The scale of this challenge is huge. In Africa, Asia, and Latin America 1.6 billion people lack access to electricity and cannot light their homes adequately. Almost as many people use fuel wood for cooking, forgoing productive activities during the time they must gather wood and then suffering the health effects of exposure to noxious fumes.

Only 15 percent of large cities in developing countries have acceptable air quality, largely due to the way energy is used in homes and industries and for transport [4].

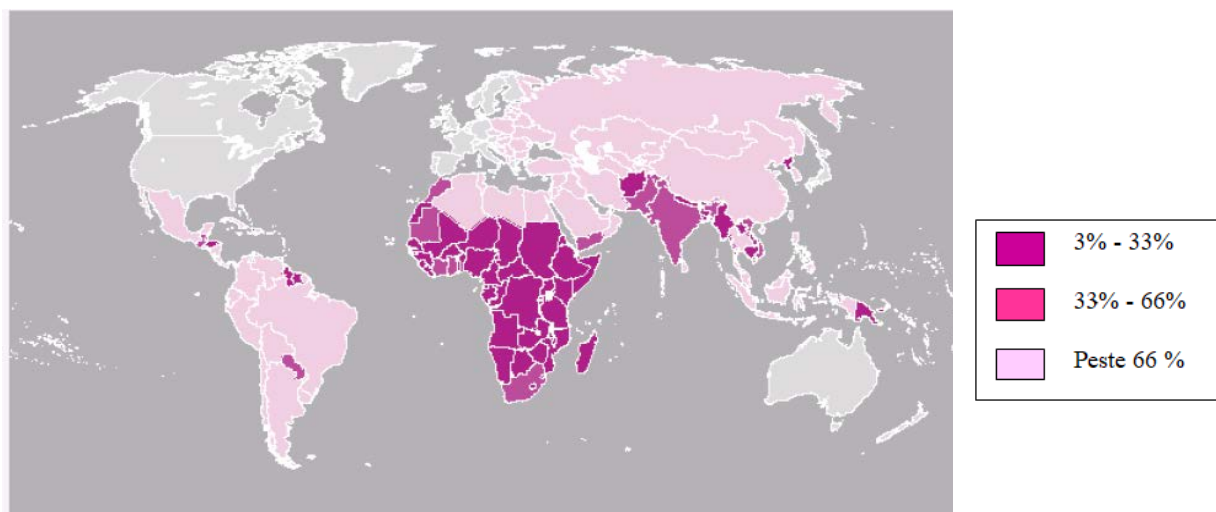


Figure 2: World Bank Group staff estimates

Significant investments are required to ensure access to new energy resources and to deliver energy services, especially to consumers in developing countries. This is a challenge to the international finance community and to industrialized countries in particular.

2. Potential of Renewable Energy Technologies

All these trends relate to technological developments in the short or long term. The conventional fossil-fuel-based energy systems still dominating energy investment, the introduction of new and emerging energy technologies need to be assessed over a longer time scale. Such time scales are consistent with IPCC emission scenarios, which common sense tells us will not occur overnight.

Renewable energy technologies hold great potential to satisfy basic needs and to support poverty alleviation and sustainable development. There is a range of commercially available, field-proven renewable energy technologies, including solar, wind, geothermal, biomass and hydropower, but they are not yet widely enough used in tackling the shortfall in access to energy services.

In its Global Energy Outlook, the International Energy Agency (IEA) states that production of primary energy from renewable sources is expected to grow rapidly, but that the impact of renewable on the global energy mix will remain relatively small in the next two decades.

From 2020 onwards this situation is expected to change significantly, driven especially by environmental concerns, but this shift will require governments and industry to act together and to invest heavily in technology and infrastructure [5].

The modularity and decentralized nature of renewable energy technologies make them particularly well suited for rural energy development and an environmentally sound alternative to grid extension.

To speed the introduction and adoption of renewable energy systems, the key issues are expanding access to the technologies and reducing their costs. This can be done through supportive policy measures, market incentives and promotion activities. As the G8 - Renewable Energy Task Force has recognized, expanding markets in industrial countries will be essential for bringing costs down. Costs cannot be reduced through activities in developing countries alone.

Moreover, developing and industrial countries together will need to work to expand the manufacturing, assembly and service capabilities in developing countries to begin to make inroads in meeting the challenge of increasing access to energy services.

Worth special note are modernized biomass technologies that provide fuels and electricity to meet rural energy needs; these are particularly promising and an area ripe for transfer to developing countries.

This will require unique approaches to address technology, financing and capacity development efforts that support biomass generation where the natural resource base is sufficient.

Enhanced regional and international co-operation will be important in identifying the appropriate entry points for supporting the expansion of renewable energy. UNEP's contribution in this regard is described.

3. Advances Fossil Fuel Technologies

For several decades, fossil fuels will continue to be the primary energy supply option worldwide when considered as a proportion of the global supply mix. The challenge is how to use them more efficiently and how to reduce their negative environmental effects.

Fossil fuel resources are still abundant on a global scale. Even taking into account short-term price fluctuations, the trend towards relative price stability is expected to continue for the next 20–30 years.

There are significant regional differences, however, and the uneven geopolitical distribution of resources and demand means that any projections are subject to a high degree of political uncertainty. Security of energy supply has become an increasing concern, first in the USA and now in the European Union.

The transition to cleaner and more advanced fossil fuel technologies is recognized as essential to support sustainable development. This is particularly important in developing countries, where the rising demand for energy services and growing populations will drive the largest demand for new installed capacity for electricity and increased supply of clean fuels. Efforts should be focused on efficiency improvements in power plants, wider access to existing technologies, and research and development for advanced energy systems and fuels.

In order for developing countries to move to cleaner, more advanced fossil fuel energy systems, collaboration and cooperation at the international and regional levels are necessary. Given that the most rapid advances in these technologies have occurred in industrial countries, technology and information exchange is important for speeding up the transition to improved energy systems in developing countries.

This will need to be done so that developing countries can maintain service and potentially manufacture and assemble the equipment, enhancing their own energy self-sufficiency and security.

Regulatory and financing mechanisms will serve as the foundation to encourage the adoption of clean fossil technologies. Government will need to establish guidelines and norms for regulations that will make this happen in a clean and sustainable manner.

A potential major incentive for stimulating technology transfer is the Kyoto Protocol mechanisms, including the Clean Development Mechanism. Through the developing countries can use technology leapfrogging to actively advance their sustainable development objectives while reducing greenhouse gas emissions [6].

4. UNEP Energy Promotion for Sustainable Development

UNEP's Energy Programmed addresses the environmental consequences of energy production and use, such as global climate change and local air pollution. We assist decision makers in government and the private sector to

make better, more informed energy choices, which fully integrate environmental and social costs.

Since UNEP is not an implementing organization, its role as facilitator is core, but at the same time, the driving principle is that its recommendations have to be practical and based on pilot programs that have developed and tested the approaches in specific case applications at the national level.

UNEP has been working closely with the Risø National Laboratory for almost 13 years through the NEP Collaborating Centre on Energy and Environment, which is located at here at the Laboratory.

This collaboration, which also includes the Danish Ministry of Foreign Affairs, plays a key role in implementing the energy and climate programmes in UNEP and has since its inception grown from staff of 4 to now 25 international economists and scientists who are recognised as an international Centre of Excellence on energy and climate issues.

Most of UNEP's energy activities link to mitigation – the reduction of greenhouse gas emissions –but these are generally accompanied by broader objectives related to energy and sustainable development.

This includes climate change mitigation, but not as the sole objective since many of our partners in developing countries have more immediate development objectives.

The following sections describe the main programmes in a summary way; more details and activity timelines are available on the relevant websites. Activities generally focus on promoting and overcoming barriers to more widespread application of renewable energy and energy efficiency.

5. Data Information

The Solar and Wind Energy Resource Assessment (SWERA) project is providing solar and wind resource data and geographic information assessment tools to public and private sector executives who are involved in energy market development. Its high quality information on solar and wind energy resources help brings renewable energy projects to developing countries in two ways.

First, by showing the overall potential for renewable energy in a country, good resource data can help renewable energy become part of the national energy development plan in areas where it makes good technical and economic sense. Second, reliable site-specific information is required for analysing the merits of individual projects. UNEP's SWERA effort is compiling such data in 13 developing countries. Eventually this helps bring about investments in solar and wind energy projects.

With a US \$6.7 million investment from the Global Environment Facility (GEF), SWERA is developing new information tools for energy planners and project developers, including regional and national maps of solar and wind energy resources. SWERA is also developing a geographical information system (GIS) interface that will allow easy access to data and thus help the screening and pre-investment evaluation of wind and solar energy-based renewable energy projects [7].

6. Renewable Energy Technologies and Finance

As discussed above renewable energy technologies are receiving more policy attendance, their commercialisations still too slow, especially from an environmental perspective. In response, UNEP has increased its efforts to “green the finance sector”, particularly focusing on promoting investment opportunities in the renewable energy and energy efficiency sectors.

For these sectors, the conservative attitude of financial institutions combined with their difficulty in assessing the risks involved often lead to decisions against extending loans or providing other form of financial support for otherwise sound projects.

In the end, projects that might really be good investments and yield a global environmental benefit, such as reducing greenhouse gas emissions, fail to go forward.

Not being a financial institution UNEP is able to deal with the finance sector in non-competitive ways. It has tried to use this neutrality in testing new approaches to supporting the sustainable energy finance sector, particularly in the application of soft financing ‘catalysts’ that develop the market without distorting it.

UNEP’s Energy Group currently oversees various activities in the sustainable energy finance area, including enterprise development (seed finance) programmes, energy efficiency finance activities with the World Bank, concessional loan programmes for solar PV, and advisory support to financiers considering clean energy investments.

UNEP maintains close links with the finance sector, and each of these efforts are implemented with the involvement of one or several finance partners, both public and private. Involving the UNEP Finance Initiative in UNEP energy projects makes for easy links to finance partners already committed to environmental lending. Helping finance partners take forward clean energy investments has also induced some of them to broaden their environmental focus.

The REED programme - Rural Energy Enterprise Development - seeks to develop new sustainable energy enterprises that use clean, efficient, and renewable energy technologies to meet the energy needs of under-served populations, thereby reducing the environmental and health consequences of existing energy use patterns.

The REED approach offers rural energy entrepreneurs a combination of enterprise development services and start-up financing. This integrated financial and technical support allows entrepreneurs to plan and structure their companies in a manner that prepares them for growth and makes eventual investments by mainstream financial partners less risky.

7. Conclusions: Looking to 2030 – Energy Technology

To what extent can increase the energy technology development and deployment enhance energy security? How can it contribute to meeting economic goals and generate significant cuts in CO₂ emissions?

More meaningful progress in technology is expected to play an important, if not crucial, role in achieving a sustainable energy economy in the long term, probably even in the medium term. In the short term, we have to live with the disappointing reality: the energy economy is not on a sustainable pathway. The most obvious underlying fact is that greenhouse gas emissions will inevitably grow before they can be reduced. And they have to be reduced dramatically.

The Reference Case Scenario in the most recent IEA World Energy Outlook (WEO) paints a bleak picture for the future if governments maintain their current policies. Oil will remain the largest individual fuel source (increasing by 60% from 75 mb/d in 2000 to 120 mb/d in 2030). This raises energy security issues. Gas will overtake coal as the second largest fuel source in 2020 [8].

For many countries, this would shift dependence on imported oil to dependence on gas. Oil, gas and coal are expected to cover close to 90% of energy demand in 2030. As the dominance of fossil fuels grows, so will CO₂ emissions from energy use in all regions of the world, averaging a 70% increase by 2030. But let me emphasise that the WEO findings are merely projections, based on current policies and behaviour patterns [9].

The life-time of energy equipment and infrastructure is rather long. Capital stock turnover in the energy economy is slow. Therefore, in the short term -- which I define here as the time-span to 2030 focused in the (WEO) -- we have to look to a broader energy market, one not confined to fossil fuels.

This is even more long term, beyond 2030, to the end of the century. Regional shares in world primary energy demand and CO₂ emissions reflect the growing importance of non-OECD countries. Energy is indispensable for economic development, for social welfare and political stability. Making energy accessible to all is a challenge in its own right. It is an underlying necessity for more balanced world economic development, and even for worldwide peace.

If greenhouse gas emissions are to be reduced significantly, low-carbon technologies need to be developed and used in both OECD and non-OECD countries. But each region, each country has its own aspirations, its own approaches to energy security, economic growth and environmental protection; the pursuit of a sustainable energy future must respect those aspirations and approaches. But supplying low-carbon energy is not the only option. Energy efficiency offers huge potential.

Technical progress could lead to substantial improvement in energy security by reducing demand for carbon-bearing fuel, much of which is imported oil, and increasingly gas. Large amounts of greenhouse gas emissions could be eliminated through efficiency gains. Reducing the energy bills of countries, industry and the private consumer liberates funding to enhance economic development.

References

- [1] M. Blarke, „Information on COMEED XL,” [Interactiv]. Available: <http://www.energianalyse.dk>.
- [2] Minister Dr. Mariyam Shakeela calls for collective international commitment, dedication and steadfast

- efforts to achieve a green global economy,” [Interactiv]. Available: <http://www.environment.gov.mv/v1/news/minister-dr-mariyam-shakeela-calls-for-collective-international-commitment-dedication-and-steadfast-efforts-to-achieve-a-green-global-economy/>.
- [3] E. Hughes, „Utility coal-biomass cofiring test,” 2011. [Interactiv]. Available: <http://www.netl.doe.gov/publications/proceedings/98>.
- [4] G. Gallagher, Biomass for electricity generation, The Chemical Engineer, 2012.
- [5] K. Kaygusuz, „Energy for sustainable development: A case of developing countries. Renewable and Sustainable Energy Reviews, 16,” 2012. [Interactiv]. Available: <http://dx.doi.org/10.1016/j.rser.2011.11.013>. [Accesat 28 4 2018].
- [6] S. A. T. Abassi, Renewable energy sources: Their impact on global warming and pollution, Delhi: PHI Learning, 2010.
- [7] C. Hoyer-Klick, „Systems Analysis and Technology Assessment,” 2018. [Interactiv]. Available: http://www.dlr.de/tt/en/desktopdefault.aspx/tabid-2885/4422_read-6548/. [Accesat 17 05 2018].
- [8] „World Energy Outlook - the gold standard of energy analysis,” 2018. [Interactiv]. Available: <https://www.iea.org/weo/>. [Accesat 17 05 2018].
- [9] A. Ajanovic, „Biofuels versus food production: Does biofuels production increase food prices?,” 2011. [Interactiv]. Available: <https://doi.org/10.1016/j.energy.2010.05.019>.