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Introduction

Forests, which is a critical source of bioenergy, play an essential role in creating options for affordable and clean energy, particularly in developing countries. The World Energy Council defines bioenergy to include traditional biomass (example forestry and agricultural residues), modern biomass and biofuels. It represents the transformation of organic matter into a source of energy, whether it is collected from natural surroundings or specifically grown for the purpose. In developed countries, bioenergy is promoted as an alternative or more sustainable source for hydrocarbons, especially for transportation fuels, like bioethanol and biodiesel, the use of wood in combined heat and power generation and residential heating. In least developed countries traditional biomass is often the dominant domestic fuel, especially in more rural areas without access to electricity or other energy sources. There are multiple challenges and opportunities for bioenergy as a potential driver of sustainable development, given enough economic and technological support.

The world's forests are still our largest bioenergy source; it has been this way for thousands of years. Forests, as a source of energy, is affordable for many of the world's poorest people and it can be reliable as along as the forests are restored with proper management techniques. The sustainability of forest, as a source of energy, is predicated on the notion of successful regeneration forest to match what we harvest, and on the recognition that forests must also produce a wide range of additional goods and services which must also be sustained. Rapidly emerging new technologies, which can introduce an array of efficiency gains, also heavily influence the sustainability discussion since they could dramatically change the demand for wood; for example, improved cook stoves could reduce demand for wood while the greater use of biofuels using wood could increase the demand for fuels.

The Sustainable Development Goal 7 seeks to address four themes in the goal statement: "Ensure access to affordable, reliable, sustainable and modern energy for all". This background report was prepared to facilitate informed discussions at the upcoming UNFF13 on these four themes with two main purposes:

1. to prepare a background assessment, and;
2. to identify challenges and priorities for enhancing the contributions of forests to accelerate the progress towards the achievement of SDG 7.

The key targets for SDG 7 are to ensure universal access, increase substantially the share of renewable energy and to double the rate of improvement in energy efficiency. All of these targets should be met by 2030. In many countries the forest play a pivotal and critical role in people meeting their basic energy needs and so it is critical to evaluate the current interplay of forest and energy in order to assess progress and identify the challenges and priorities.

The 2016 progress report of Goal 7 has been reported (https://sustainabledevelopment.un.org/sdg7) indicating that universal access has improved, that the share of renewable energy has shown limited progress since 2010, especially for solid biofuels (wood-fuel), and finally, that energy efficiency rate of improvement is still too low in order to meet the targets.

Other relevant reports also highlight the following in progress towards Goal 7. They are

Even though the global access rate to electricity is improving, the lack of fast progress in access to clean fuels and technologies for cooking ("clean cooking") is holding back both the efficiency of the global energy system and improvements in the sustainability of biomass uses.).
Traditional biomass continued to overshadow other sources of renewable energy in Africa and Asia–Pacific. In Africa, traditional renewable energy represented over 85% of renewable energy

Figure 3. Africa's high share of renewable energy reflected high yet falling reliance on traditional biomass in many countries from 2012-2014

Source: IBRD/WB 2017

Figure 4, although dated, supports the general thesis of Figures 1-3, but shows the contrasts by region of renewable energy in comparison to non-renewable energy. (The author could not identify a more updated global summary of the share of renewable and non-renewable energy by region for this study.) Clearly for many parts of Africa and Asia the primary residential fuel is still from solid biomass, which is often forest related.

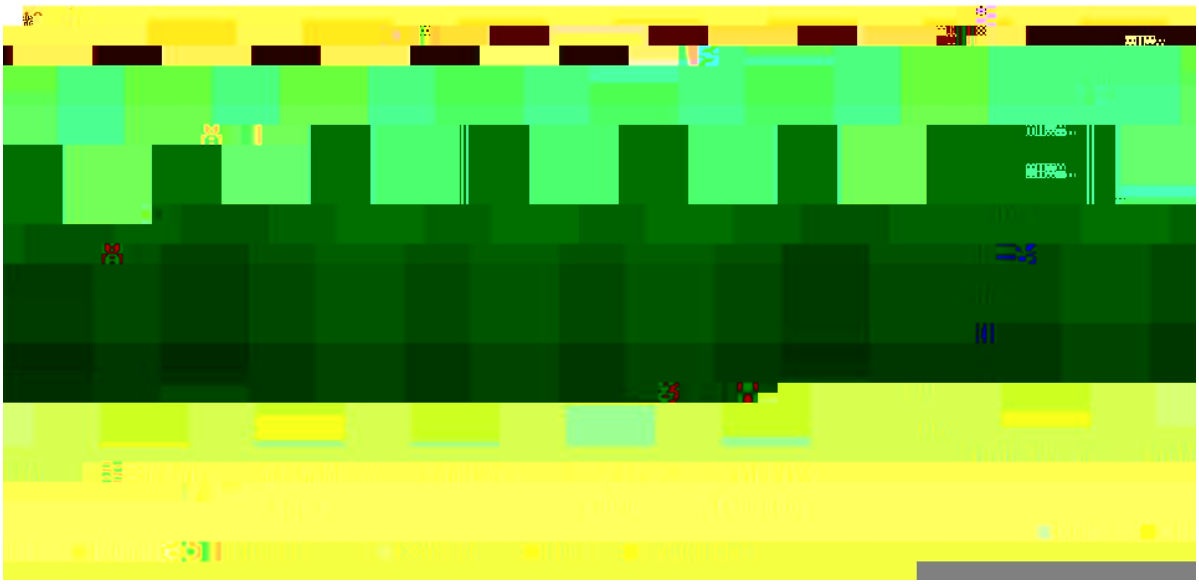

Figure 4. Structure of residential fuels use across regions in 2006: Based on IEA analysis in 2008.

Source: Pachauri & Brew-Hammond 2012

Clearly, there are significant differences between regions and we see two major challenges from reviewing Figures 1 to 4. First, the share of modern renewable energy is still very low in most global regions and where it is a larger share, it is still dominated by the traditional forms of renewable energy. This could mean that there is a distinct lake of investment in modern forms of renewable and/or the technology has simply not been transferred from regions where the technology has been developed. It could also mean there is cultural resistance to the adoption many forms of modern renewable energy. Second, the dominance of non-renewable forms of energy is still very significant in many of the more prosperous global regions and that increasing the share of renewables will still be a formidable challenge in those regions.

that the modern renewables are still a very small share and perhaps the biggest challenge is to find ways to increase the use of bioenergy in the developed world which is far behind Africa in the share of energy

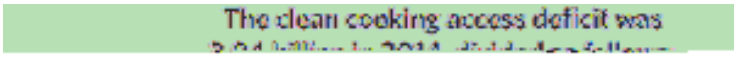

Figure 9. Population without access to clean fuels and technologies for cooking by region, 2014.

Source: IBRD/WB 2017

Figure 10, energy intensity, describes how much energy is used to produce one unit of economic output. Between 2000 and 2012 the global energy intensity improved by 1.3% (6.7 megajoules down to 5.7 megajoules). Industry was the largest contributor to the reductions, which likely means non-industrial energy intensity has not improved a great deal. The clean cook stove story illustrate the challenge of

measuring efficiency at a more refined geographic scale. It is also important to bear in mind, that at these sub-regional scales a driver of energy usage is the forest resources.

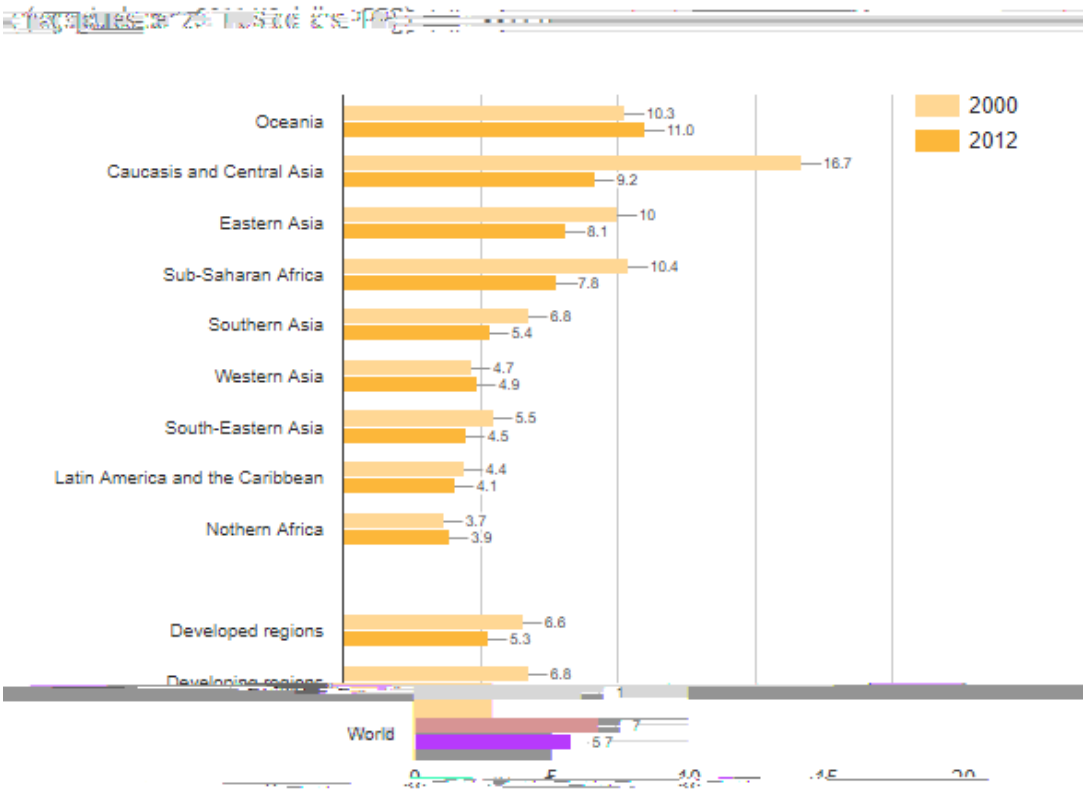

Figure 10. Energy intensity measured in terms of primary energy and gross domestic product, 2000 and 2012

Source: Statista 2018

(https://www.statista.com/statistics/585938/population-with-primary-reliance-on-clean-fuels-and-technology-for-cooking-by-region/)

Finally, Figure 11 indicates how forest based fuelwood, which is often used very inefficiently, remains the dominant form of biomass resources globally. One example, in many countries, of inefficiency is the dominance of open fire pits in confined spaces. The challenge to double the improvement in efficiency will have to focus on how to measure efficiency of biomass use statistically, how to introduce more technologies and how to focus on the regions with the greatest needs if renewables are to replace traditional non-renewable fuels.

Part B: Benefits and Challenges

Wood based energy has a number of benefits and challenges and they have been organized by the three key targets SDG #7 and summarized below. This section also describes the types of wood based energy and the linkages to the key factors used to evaluate energy: affordability, efficiency, reliability and sustainability.

Benefits of wood-based energy

There is great potential that wood based energy can be much more universally access, that itte

need to survive. To guarantee universal access is fairly distributed education on improved land use practices is still widely needed and the distribution of benefits from forest resources can be very unequal given the structure of property rights or property right disputes.

To increase the share of renewable energy in the energy mix will require the great sharing of appropriate cleaner technology to poorer countries in Africa and Asia . The inability of policy makers to address the cultural dimension of technology can also prevent the uptake.
The human population increases, particularly in poorer countries, means the proportion of renewable energy is not increasing significantly.

Energy efficiency is mentioned earlier as a challenge for a few reasons mentioned earlier in this report. Some still view renewable forest based biomass energy as a problem not a solution since we have a long history in some country of not sustainable managing forest resources. In addition, efficiency, as measured by energy intensity, is too narrowly defined for local application. In addition, market and regulatory mechanism that might improve efficiency, for example, carbon markets or carbon tax, are often not yet established and public understanding and consensus is rarely in place. For example, a functioning carbon market or tax to send a fair carbon price could greatly support the efficiency in energy use by rewarding those who minimize emissions and invest in modern technology. Finally, the improved management of natural risk factors (fire, insect and disease) with

Figure 13. Potential industrial bioenergy pathways: from biomass to final energy use

Source: IEA/FAO 2017a

Figure 14 is a more simplistic description of the transformation of natural resources such as forest to produces and finally to markets. It is easy to see this figure is relevant to countries where modern renewable energy is in widespread adoption and the great challenge is to see if it is possible to have poorer countries engage in a discussion on how, or if, they should adopt this modern approach to biomass use.

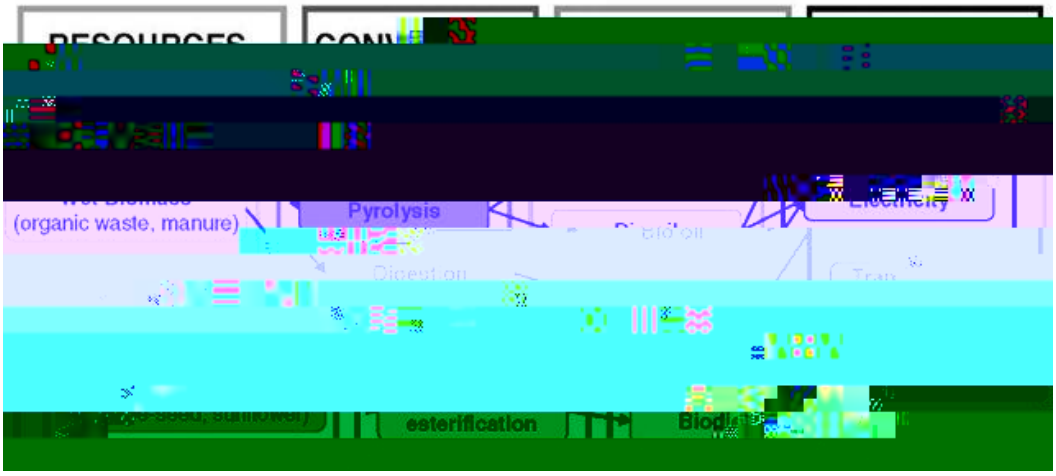

Figure 14. Potential industrial and non-industrial biopathways: from biomass to final energy use.

Source: IEA/FAO 2017a

Figure 15 illustrates how in the discussion on forest resources and biomass energy it is very difficult to ignore other forms of residues and waste that contribute to the overall energy supply picture, particularly agriculture and municipal waste. In both developed and developing countries these organic residues and waste and are intricately interwoven.

Figure 15. Biomass types according to origin

Source: IEA/FAO 2017a.

Sustainability

Forests are an important supply of bioenergy in most countries. Figure 17 is a summary of the barriers and constraints to bioenergy supply chains. The social constraints are largely to do with sustainability concerns, the technical constraints with investment in feedstocks without markets already developed, the economic constraints with risk and uncertainty in investment and finally the institutional constraints or barriers associated with long term energy strategies and uncoordinated government policies across economic sectors and with environmental sector. Figure 17 is meant to be illustrative of the complexity of linking an energy target to forest and forestry. To increase the use of forest as an renewable energy source will require addressing all of these barriers and constraints simultaneously.

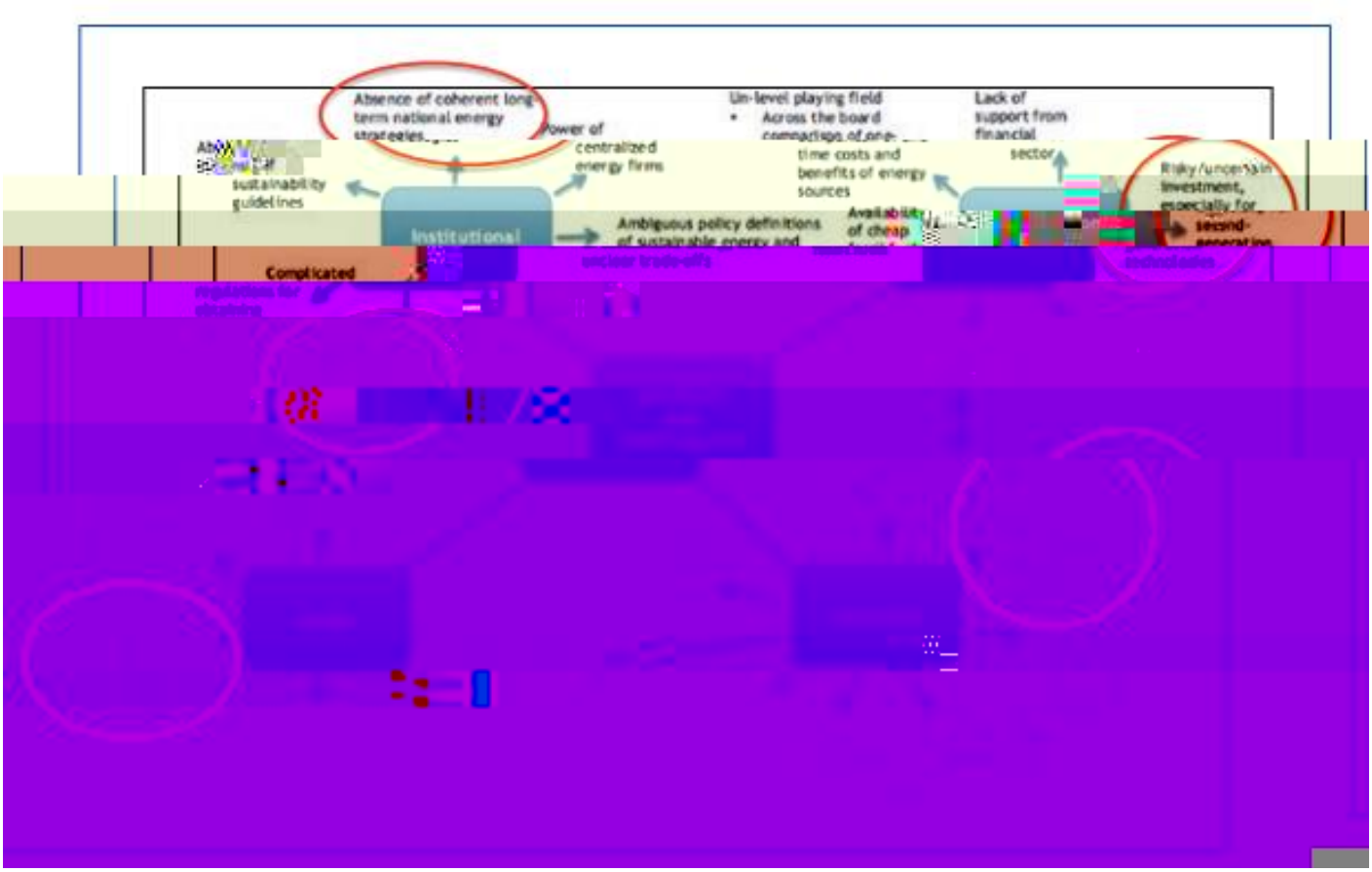

Figure 17. Barriers and constraints to bioenergy supply chain mobilisation

Source: Smith in IEA 2016

Part C: Impact on Poverty Eradication and Sustainable Development

This section summarizes the status, trends, challenges, opportunities and priorities for assessing the linkage of SDG 7 to food security, human health, sustainability of forest resources, climate change, biodiversity and livelihood of the poor.

Food security

We know that the climate is continuing to change and it has been reported that planetary warming continued in 2016, setting a record of about 1.1 degrees Celsius above the pre-industrial period. This changing climate could accelerate the impact of these natural disturbance factors just mentioned and we would then have even higher levels of emissions. Recent records still indicate that the climate change continues unabated indicating we must make every more serious efforts to address the challenges.

An example of how forests plays such an important role in changing climate can be seen by examining the statistics and estimate on global emissions by source. Table 2 illustrates the important of wood energy on total emission, particularly in developing countries. The emission from wood energy (2,462 Mt CO2E) is roughly equivalent with emission from land-use change (2,415 Mt CO2E); Taken together this represents more than 15% of emissions from all fossil fuels and this does not include the emissions

The priority is to invest in forest management, increase in forest area and in global clean energy infrastructure which provides technology to Least Developed Countries (LDCs) for sustainable development.

The priority could be to use advanced technologies such as advanced GIS, LIDAR, camera tracking and remote sensing to understand spatial constraints and suitable locations for renewable energy infrastructure without compromising critical biodiversity could avoid potential clashes between renewable energy expansion and market-based biodiversity conservation instruments

Livelihood of the poor

Currently, a

Part D: Prospects for sustainable use of wood-based energy

Demand for and availability of wood resources

Developing regions, due to their continuing reliance on traditional uses of biomass, show particularly high renewable energy shares, most notably in Sub-Saharan Africa at 70%, and South-East Asia and South and South-West Asia at around 30%. But there are signs that as incomes rise, economies modernize, and households and small enterprises switch to modern fuels there could be a reduction in the reliance on traditional biomass as an energy source.

Figure 19 indicates that dependencies on forest for woodfuel as a proportion of wood removal is very high in Africa and parts of Asia. This implies that finding ways to manage for woodfuel is critical for the sustainable use of forest resources.

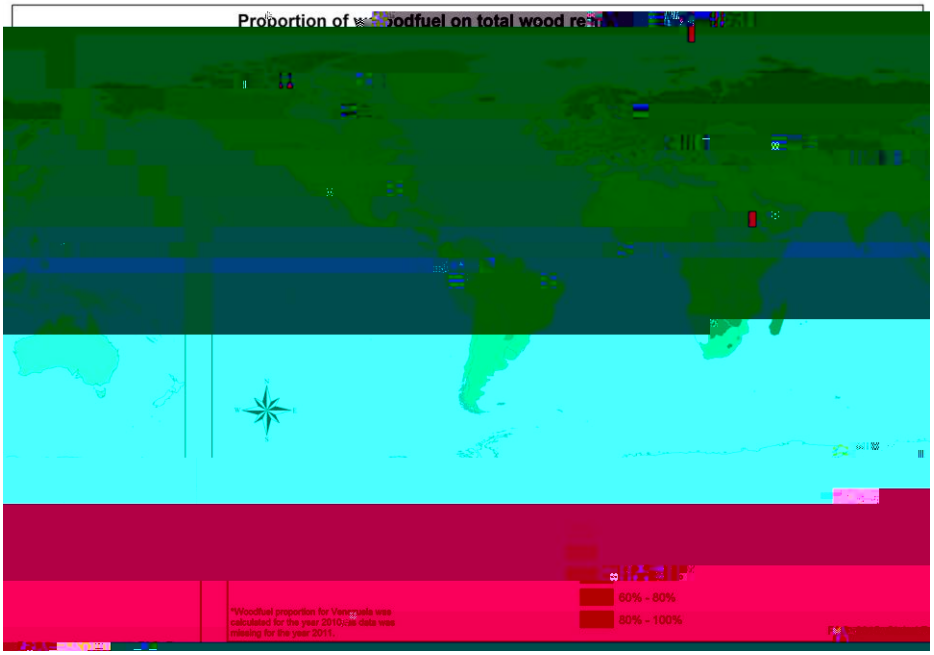

Figure 19. Proportion of woodfuel on total wood removal (2011)

Source: Global Forest Resource Assessment, FAO, Rome 2015

A worrying development is that traditional uses of biomass still continue to grow in absolute terms, and at an accelerating rate, up from 1.0% 2010–12 to 1.4% in 2012–14. Still, this rate was below total final energy consumption (TFEC) growth, so biomass share has continued falling. Moving away from traditional uses of biomass for cooking and heating is crucial for improving the sustainability of renewable energy consumption, particularly in Nigeria, Indonesia, India, and China.

Figure 20 indicates that the nearly 50% forest losses in 7 countries (Cambodia, Ghana and Kenya, Lao, Mali, Zambia) is linked to forest use, which includes being uses as a fuel source. All countries exhibit a decrease in forest area and an increase in agricultural areas in the period 2000-2010. This appears to

occur at the same time as other pressures such as human population growth and shifting cultivation are occurring.

Figure 20. Factors contributing to forest loss in seven countries

Source: FAO 2016

Another challenge is the increase in indirect land use change (ILUC) from bioenergy production resulting in displacement of food crops for biofuels and/or high crop prices incentivizing crop production elsewhere. Important opportunities include the promotion of agroforestry, the increased utilization of bioenergy from forests impacted by insects, disease and fire, the

A priority is to move from 'food vs fuel' debate to discuss of how 'food & fuel' can be co-produced with an increased usage of science and technology to generate healthier and sustainable outcomes.

Role of forest biomass in meeting growing demand for renewable energy

More than 40 per cent of the world's people still rely on polluting and unhealthy fuels for cooking. Much of that fuel is from biomass. In industrial processes the use of renewable energy is growing only modestly, but modern renewables (e.g. pellets and biofuels) comprise a large and expanding share. In 2014, solid biomass used for traditional ways of cooking and heating in developing countries accounted for 8.4% of global total final energy consumption (TFEC), or 30.4 EJ, while modern forms of renewable energy accounted for 9.9% of global TFEC, or 35.6 EJ. Among modern forms of renewable energy, the largest was solid biomass for modern uses was at 15.2 EJ in 2014, followed by hydropower (11.7 EJ), liquid biofuels (3.2 EJ), wind (2.2 EJ), and solar (1.8 EJ). This supports earlier statistics.

It was estimated in 2010 that half of the renewable energy mix was using modern technology and half was the traditional use of biomass and together they make up about 18% of renewable energy. The goal of one international agency is to replace the traditional use of biomass and increase the share of renewable energy to 36% of the global energy mix by 2030. However, the problem of sustainability of the forest resources is a direct challenge to this goal. Figure 21 indicates the countries where unsustainable use of forest is occurring with the most intensity. The fraction of non-renewable biomass (fNRB) could be an indicator of sustainability practice but on closer examination there are problems with the methodologies used for the estimations since they fail to account for forest growth dynamics appropriately.

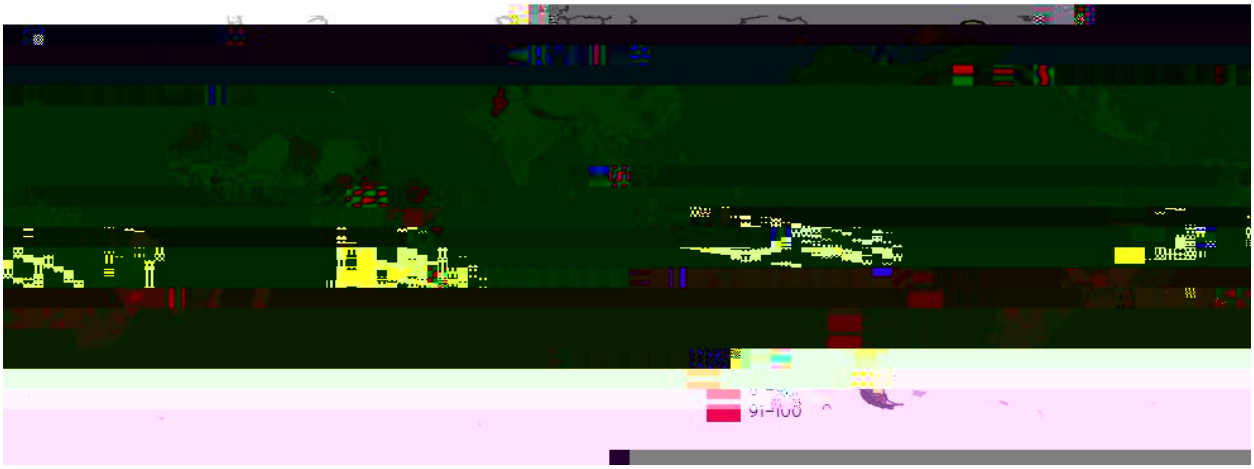

Figure 21. The percentage of fNRB from direct woodfuel harvesting

Source: Bailis et al., 2015; FAO 2017

The challenge is to ensure that the increase in biomass demand for renewable energy will not put pressure on forest resources and result in unsustainable production. The opportunity is to increase the

usage of biomass by power stations (e.g. co-firing) but ensure that it can be met through sustainable methods (e.g. use of surplus from traditional forest products etc.) .

The priority is to expand bioenergy usage in countries such as India from excess biomass waste but mix energy use with other bioproducts created through bio-chemical and/or thermo-chemical conversion processes.

Technology and energy efficiency

Technological improvements range from high-performing forced draft gasifiers (with internal fans to improve combustion of biomass fuels), to processed biomass fuels (pellets) that burn more efficiently and completely than wood, to gas stoves that produce negligible particulate emissions. Some of these stove models can be charged offgrid using solar or other energy sources, further increasing the chances of adoption.

Biomass using modern technology differs from traditional biomass in two key characteristics; firstly that the source of organic matter should be sustainable and secondly, that the technology used to obtain the energy, should limit or mitigate emissions of flue gases and account for ash residue management. Also, the efficiency of conversion is higher leading to less use of fuel. Modern biomass is largely used in some regions, notably in northern Europe and parts of North America. In Finland, about 60% of bioenergy is produced in forest industry using black liquor, bark, sawdust, and other industrial wood residues. In Sweden, about 40% of bioenergy use is in the forest industry, using residues such as bark, chips, black liquor and tall oil.

From 2005 to 2014, the proportion of the global population with access to clean fuels and technologies for cooking, such as gas and electricity, increased from 54 per cent to 58 per cent. Advancements have been slow in some regions, such as sub-Saharan Africa, where access remains very low. Limited progress since 2010 falls substantially short of global population growth and is almost exclusively confined to urban areas. As a result, the absolute number of people relying on polluting fuels and technologies for cooking has actually increased, reaching an estimated 3 billion people. Nonetheless, the share of traditional uses of biomass is in long-term structural decline, as developing countries modernize their economies and replace solid biomass products with fossil fuels. During 2012–14, both traditional and modern uses of solid biomass fell as a share of TFEC, meaning that their absolute growth rate was slower than that of global TFEC. This decline was more than offset by increases in other forms of renewable energy.

The focus of clean energy technology is on innovation and deployment of energy supply technologies rather than on energy efficiency. This create an opportunity to invest in efficient end-use technologies rather than energy-supply technologies for emission reductions and higher social returns. Figure 22 illustrates this emphasis on energy supply technologies.

Figure 22. Consumption of biomass and waste resources by end use in 2015 (left) and modern bioenergy growth by sector, 2008-2015 (right)

Source: IEA and FAO 2017.

The priority could be to promote cleaner cooking technologies (traditional fire to more efficient stoves) as well as invest in renewable energy infrastructure, such as microgrids, in LDC's for sustainable growth. Figure 23 describes the policies and market options t[illegible]

- Institutional co-ordination with local people - Forests remaining a critical tool for poverty alleviation and its management must be fairly distributed to ensure gender equality. Yet there is often incoherence between local realities and global policies initiatives. New efforts need to be undertaken with both knowledge brokers and policy entrepreneurs to ensure the dynamic linkages between global institutions and local realities.

- Forest and supply chain information systems - Forest and supply chain information as related to carbon and energy products remains a challenge but there is technology available to integrate both human and natural disturbances in forest landscape to keep track of changes over time. This is particular important to improve the probability of the inclusion of small scale farmers in decision making. It is also critical to have credible information systems since forest are biological systems subject to constant change and we need the tools to manage the associated higher levels of risk and uncertainty

- Carbon/energy pricing - Managing forest to help with SDG #7 will require the development of energy protocols/standards for government and market regulators, industry and households. It will also require the development of clearer market price signals for carbon and energy. Carbon needs to be priced in order to expand the options for managing forests and to justify the shift to modern renewable energy systems.

The SDG7 target #2 is to substantially increase the share of renewable energy in the global energy mix. To meet this target will also require new forest and technology finance tools, new approaches to measure and monitor sustainable forest management with local people and new pricing systems to send the right market signals to decision makers. It will also require an expansion of planted forest in many regions and the judicious use of technologies to manage water, insect and disease, tree breeding and other management inputs.

SDG7 target #3 is to double the global rate of improvement in energy efficiency. As indicated in the report, measuring energy efficiency is not a straightforward exercise, especially with respect to the non-industrial uses of energy from woody biomass. Doubling of the rate will required a widespread adoption of new technologies for both industry and households. It will also require a careful assessment of population growth since you can double the rate of efficiency but still have more pressure on the forests. You also have to consider cultural norms and values, since some may be highly resistant to the adoption of new technologies, in cooking for example.

Forests, and wood products, do play a pivotal role in meeting any of the targets in SDG7 but history suggests we have not been the best steward of forests in previous times and for wood to play an expanded role in meeting those targets we have to change the way we manage forest and other wood

References

Bailis, R., Drigo, R., Ghilardi, A., & Masera, O. (2015). The carbon footprint of traditional woodfuels. Nature Climate Change, 5(3), 266–272.

Baxter, J., Morzaria, R., & Hirsch, R. (2013). A case-control study of support/opposition to wind turbines: Perceptions of health risk, economic benefits, and community conflict. doi://doi.org/10.1016/j.enpol.2013.06.050

Bennett, G., & Gallant, M. (2017). State of biodiversity mitigation 2017: Markets and compensation for global infrastructure development. Washington, DC: Forest Trends Ecosystem Marketplace.

Buchholz, T., Gunn, J. S., & Saah, D. S. (2017). Greenhouse gas emissions of local wood pellet heat from northeastern US forests. *Energy*, *141(Supplement C),* 483-491. doi://doi.org/10.1016/j.energy.2017.09.062

Cameron, C., Pachauri, S., Rao, N. D., McCollum, D., Rogelj, J., & Riahi, K. (2016). Policy trade-offs between climate mitigation and clean cook-stove access in South Asia. Nature Energy, 1, 15010.

International Energy Agency. (2016). ExCo77 Mobilising sustainable bioenergy supply chains: Opportunities for agriculture – summary and conclusions; Rome: *IEA Bioenergy*.

Jeffery, R. D., Krogh, C. M. E., & Horner, B. (2014). Industrial wind turbines and adverse health effects. *Canadian Journal of Rural Medicine: The Official Journal of the Society of Rural Physicians of Canada 19*(1), 21.

Ravindranath, N. H., Sudha, P., & Rao, S. (2001). Forestry for sustainable biomass production and carbon sequestration in India. *Mitigation and Adaptation Strategies for Global Change, 6*(3), 233-256. doi:1013331220083

Renewable Energy Policy Network for the 21st Century, *Renewables 2017 Global Status Report,* REN21 *Secretariat* (Paris, 2017).

Rosegrant, M. W. (2008). Bi Q