Background Analytical Study 3

Forests and Energy [1]

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[1] In response to paragraph 23 of resolution 12/1, the UN Forum on Forests Secretariat commissioned four background analytical studies on the contribution of forests to the achievement of the Sustainable Development Goals under review by the high level political forum on sustainable development in 2018, in consultation with the Bureau of the thirteenth session of the Forum. The studies include: (a) forest ecosystem services; (b) forests and water; (c) forests and energy; and (d) the sustainable consumption and production of forest products.

[2] The views and opinions expressed herein are those of the authors and do not necessarily reflect those of the United Nations Secretariat. The designations and terminology employed may not conform to United Nations practice and do not imply the expression of any opinion whatsoever on the part of the Organization

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Executive Summary

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 Sustainable Development Goal 7 (SDG7) 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: to prepare a background assessment, and; to identify challenges and priorities for enhancing the contributions of forests to accelerate the progress towards the achievement of SDG 7.

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.

Currently there is no clear pathway to meeting SDG target #1, which is, by 2030, to ensure the universal access to affordable, reliable and modern energy services. The challenges and priorities identified in this report focus on forest and technology finance, forest and supply chain information systems, sustainable forest management, institutional co-ordination with local realities and, carbon and energy pricing.

By 2030, SDG7 target #2 is to substantially increase the share of renewable energy in the global energy mix. The challenge and priorities are consistent with those to meet Target #1. 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.

By 2030, SDG7 target #3 is to double the global rate of improvement in energy efficiency. As indicated in the report, measuring energy efficiency is a complex 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.

Forest, 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 and for wood to play an expanded role in meeting those SDG7 targets we have to change the way we manage forest and other wood lands, especially if we need to demonstrate that forest management play a positive role in the climate change discussion. The report ends with a number of recommendations for each of the challenges and priorities discussed.

List of Figures and Tables

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 consumption in 2014. In Asia–Pacific, the share was 63.1%.
- In Africa, 76.6% of energy for heat applications came from renewable energy, the highest share among all regions in 2014, showing the widespread use of traditional biomass
- Uptake of traditional biomass consumption generally tracks population growth, especially in poorer countries. (Global Tracking 2017)

The report is organized as follows:

- Part A describes forest and energy and their interaction with other key SDG goals, specifically SDG 1, 2, and 5. It also presents an extensive summary of the forest status and trends to achieve SDG 7.
- Part B present a brief summary of the benefits and challenges of wood-based energy.
- Part C discusses the linkage of SDG7 to poverty eradication and sustainable development.
- Part D describes the prospects for the sustainable use of wood-based energy.
- Part E summarizes the key policy instruments.
- Part F are the conclusions and recommendation for action.

Part A: Forests and Energy in the Context of SDG7

Forest are central to SDG15. This goal is to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. If we are to see the forest as also contributing to SDG7, which is to ensure access to affordable, reliable, sustainable and modern energy for all, it is critical that both goals are examined simultaneously in any new project development around traditional and modern biomass use.

Forests, as an important source of bioenergy, are essential to contributing to the achievement of SDG7 targets which are: 1. universal access to affordable, reliable and modern energy services (SDG7.1), 2. increased substantially the share of renewable energy in the global energy mix (SDG7.2), and 3. double the global rate of improvement in energy efficiency (SDG7.3). (See https://sustainabledevelopment.un.org/sdg7) for more details. The next three sections describe the current status and challenges with respect to meeting the SDG 7 targets.

Target #1: By 2030, ensure universal access to affordable, reliable and modern energy services

Figure 1 illustrates that roughly half the share of renewable energy is from traditional energy sources such as fuelwood. One of the significant challenges for universal access is to make sure the ‘modern’ renewables are indeed accessible to the poor. The concern is that modern renewables may not be universally accessible due to the capital investment required. One exception is that the global cook stove movement has been challenged with addressing this challenge for some time now. However, often their solutions is to increase the reliance on fossil fuels, such as LPG, due to concern about forest environments and human health.

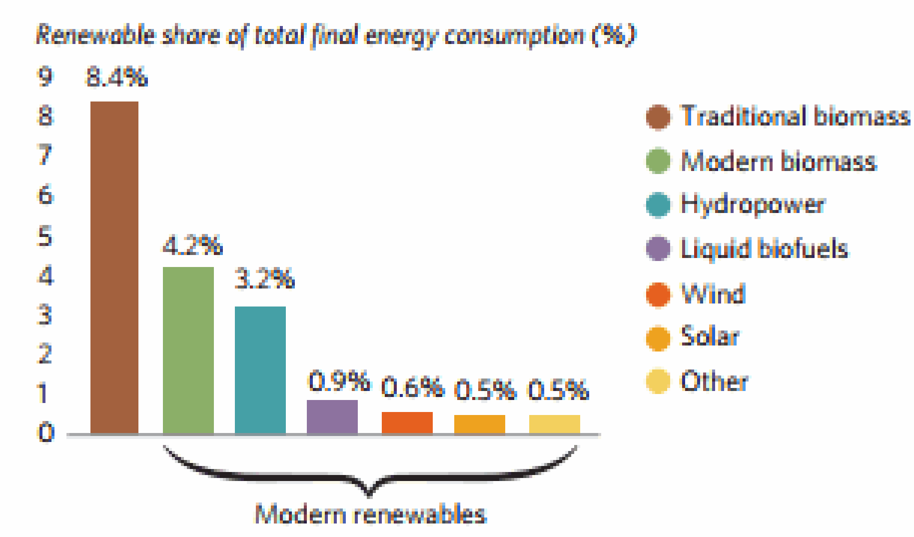


Figure 1. Technology differences in renewable energy share, 2014

Source: IBRD/WB 2017

Figure 2 indicates that globally, the regions with the greatest reliance on traditional wood biomass are still Africa and Asia. The Asia-Pacific region has the highest final energy consumption and this region has the third highest share of renewable energy. Africa has nearly 60% share renewable energy in its portfolio of energy sources.

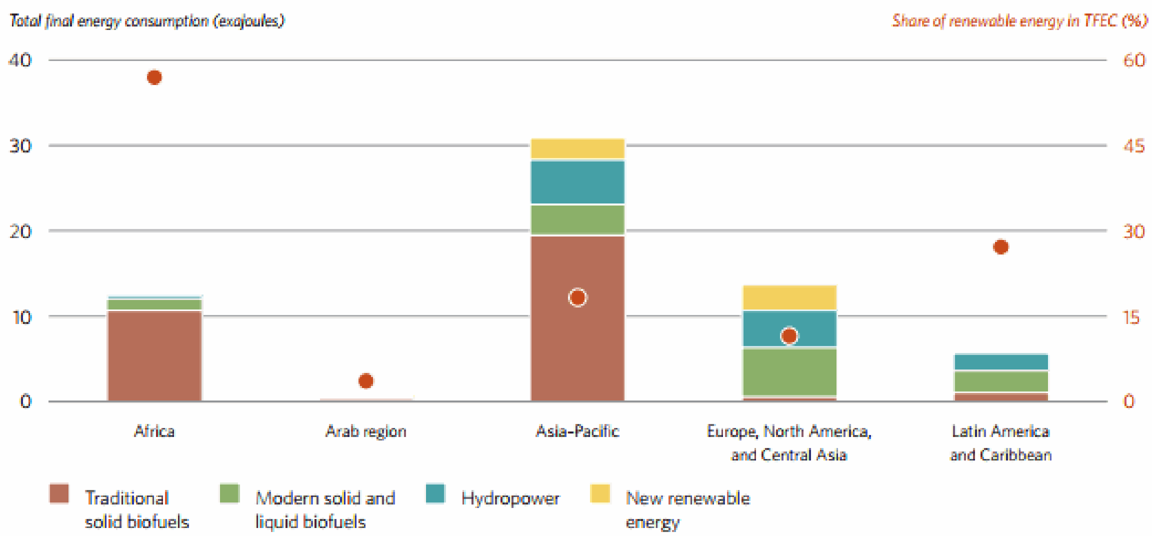


Figure 2. Traditional biomass in 2014 was still the main source of renewable energy in Africa and Asia-Pacific

Source: IBRD/WB 2017

Figure 3 illustrates the continued dependency on traditional biomass, much of it from forests and other wooded land, for Africa. The major countries with average or above average shift to 'modern' renewable energy are Mozambique, Zambia, Malawi, Ghana and Namibia. Even in the country with the highest level of modern renewable energy, Namibia, the traditional sources of bioenergy exceed the modern renewable energy.

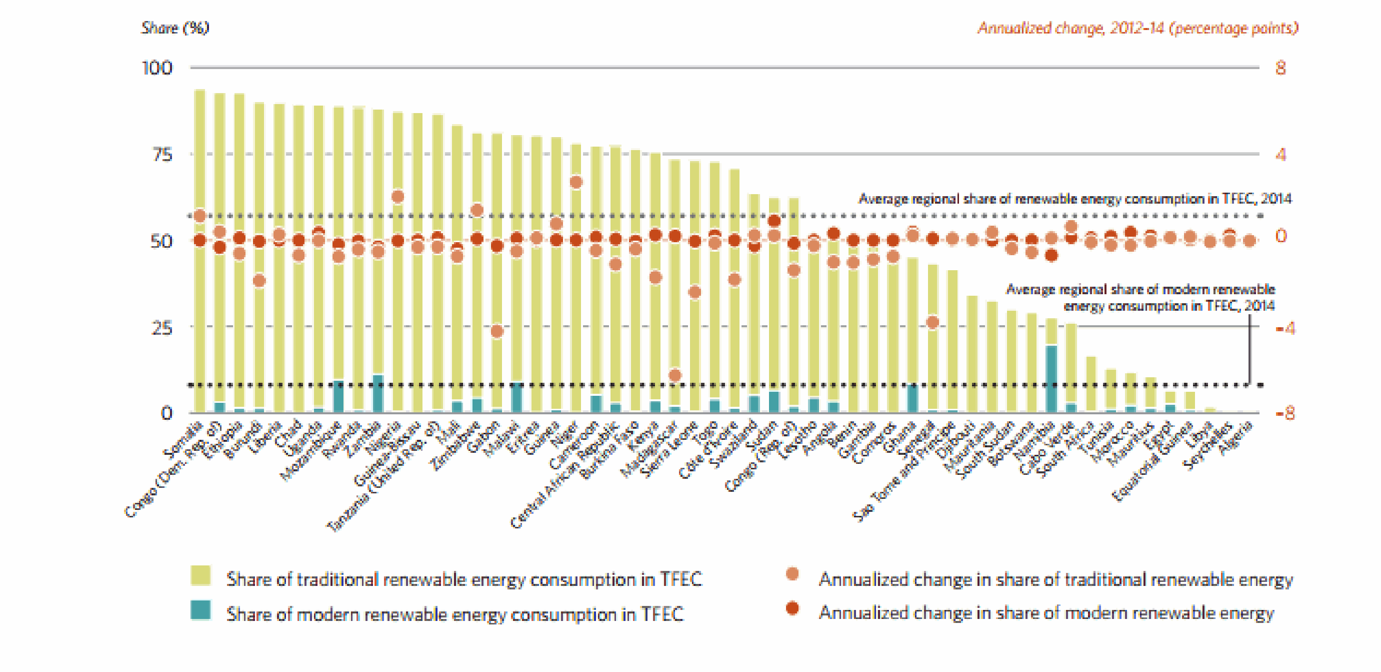


Figure 3. Africa's high share of renewable energy reflected high yet falling reliance on traditional biomass in many countries from 2012-2014

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.

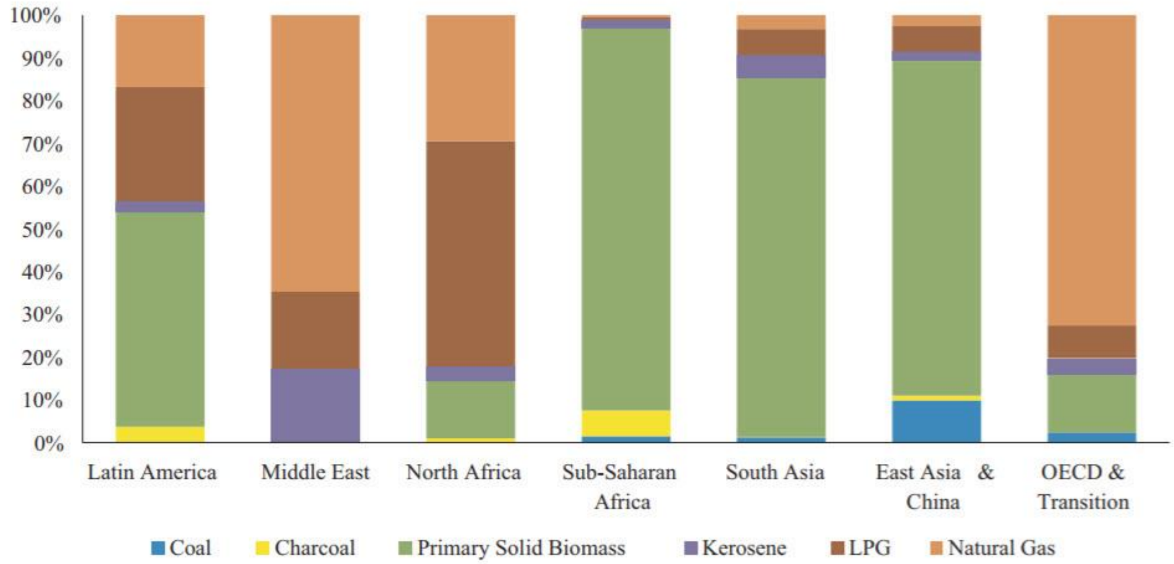


Figure 4. Structure of residential fuels use across regions in 2006: Based on IEA analysis in 2008.

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.

Target #2: By 2030, increase substantially the share of renewable energy in the global energy mix

The target is to increase share of renewable energy and forest play a major role in increasing the supply for increasing the share. Figure 5 and 6 illustrates that the share is currently approximately 18% and the trajectory is that it will continue to slowly growing; however water, solar and wind accounted for most of the increase.

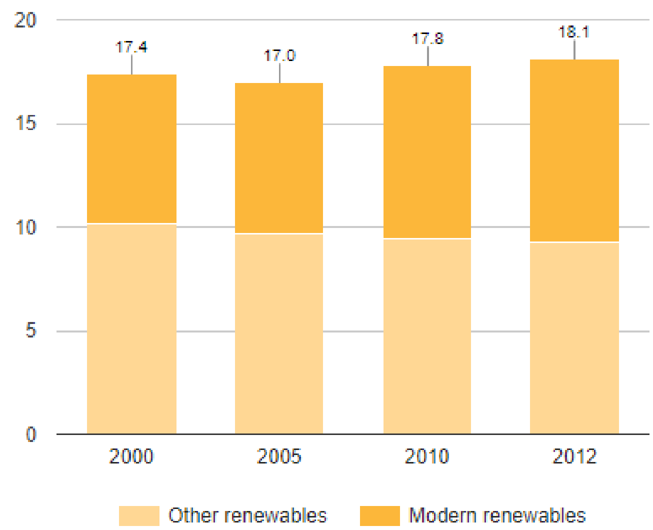


Figure 5. Global renewable energy share in total final energy consumption 2000, 2005, 2010 and 2012 (in%)

Source: IBRD/WB 2017

Figure 6 indicates that although new renewables like solar and wind are increasing fast they are operating from a low base. As demonstrated earlier, the dominant source of renewables remains traditional biomass, which is mostly from forests and other wood land.

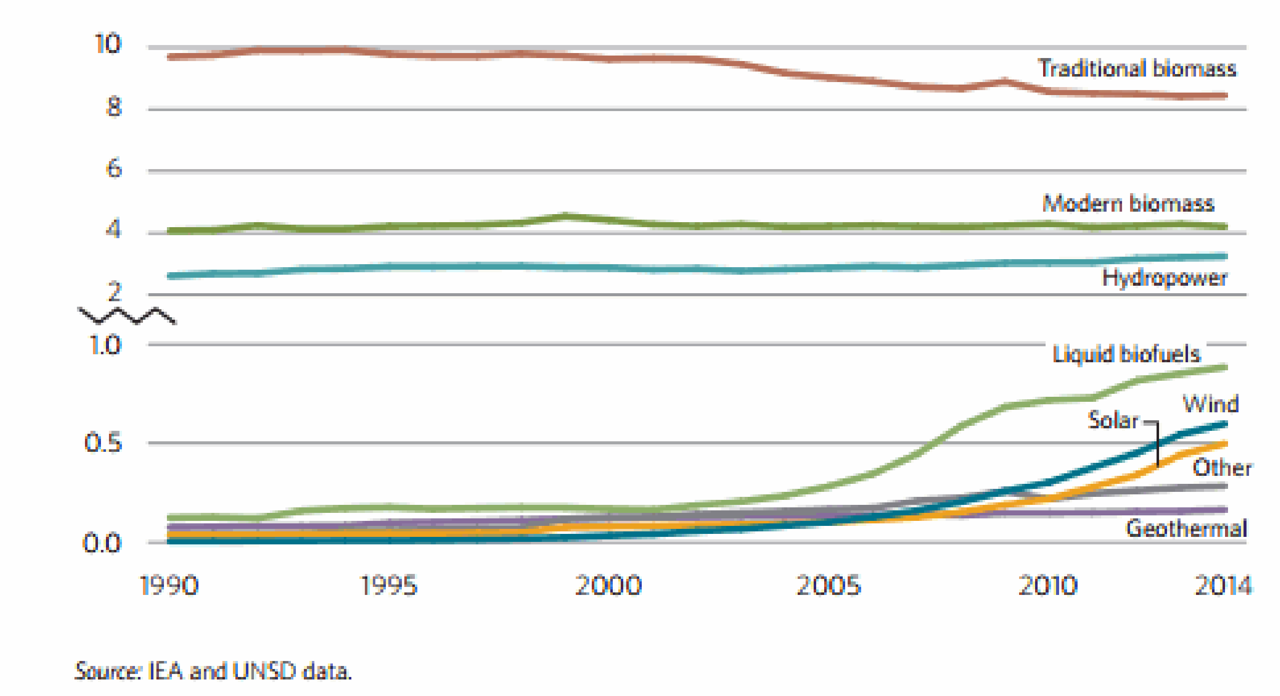


Figure 6. Modern renewable like solar and wind are increasing fast but from a low base

Source: IBRD/WB 2017

Figure 7 indicates that there are significant regional differences between the renewable energy share. Africa is particularly dependent on renewable and, as indicated, the high proportion is from traditional biomass. One generalization is that regions with the lowest GDP are the most dependent on the forest as a source of renewable energy; however this will change as regions like Europe have recently declared much higher renewable energy targets and forest biomass will be a very important source of raw material to meet these new targets.

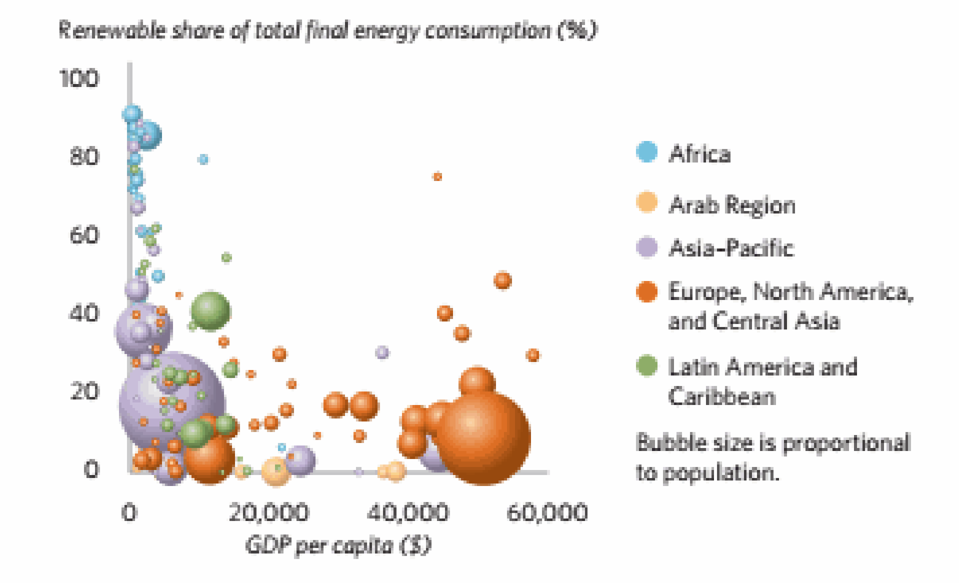


Figure 7. Regional differences in renewable energy share, 2014.

Source: IBRD/WB 2017

Finally, Figure 8, from another independent information source, support the general thesis that renewable energy is approximately 18% globally and that a startling 14% of that is from bioenergy.

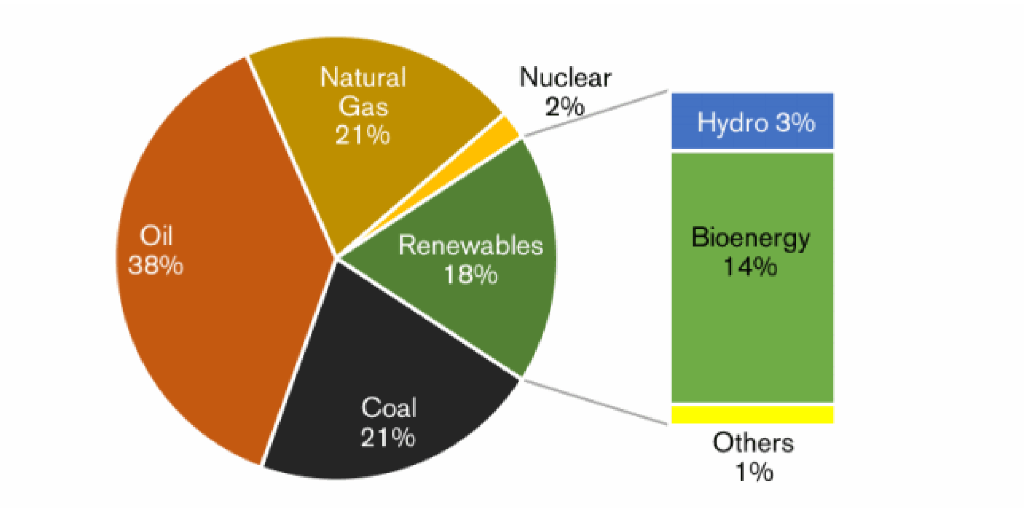


Figure 8. Global final energy consumption in 2013.

Source: World Energy Council 2016 based on data from World Bioenergy Association 2016.

To meet the 2030 target to increase the share of renewable energy does means that more bioenergy has to be produced particularly in developing countries which are already heavily dependent on bioenergy. This means that the existing forests will have to be managed sustainably, that more forest area will be needed and that new technologies will have to be introduced. In addition, it is also clear 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 being from renewable sources. This has already generated considerable debate in Europe and North America since some view bioenergy as either not renewable or not emissions friendly.

Target #3: By 2030, double the global rate of improvement in energy efficiency

Globally, there does not appear to be any statistical basis for being able to measure the rate of improvement in energy efficiency. Thus to describe how we can double the rate of improvement will be very difficult. Nonetheless, we can highlight from some reports how efficiencies in cooking, for example, have had some impact, how energy intensity is an alternative measure of improvement and how forest based biomass needs to be a central part of the discussion on meeting this target.

Cooking cleanly has been one of the greatest challenges for Africa and Asia. Figure 9 illustrates that for Sub-Saharan Africa 33% still have no access to clean fuels and technologies and for Asia it is 60%. Improving energy efficiency is a complex topic since efficiency is not always a straightforward exercise. One example of this is the widespread discussion on efficient biomass cook stoves to both alleviate the pressure on the forest but also to improve the livelihoods of the poor. The challenge in measuring efficiency comes when the traditional biomass stove was for cooking, but the modern cook stove can produce a surface for cooking, heating for the home and hot water with the same amount of fuelwood. How does one measure efficiency in this instance? A great deal of work has been underway in countries such as India to study how to decrease the pressure on forests to produce the clean cooking energy but more research need to be done to fine convincing measurement of energy efficiency.

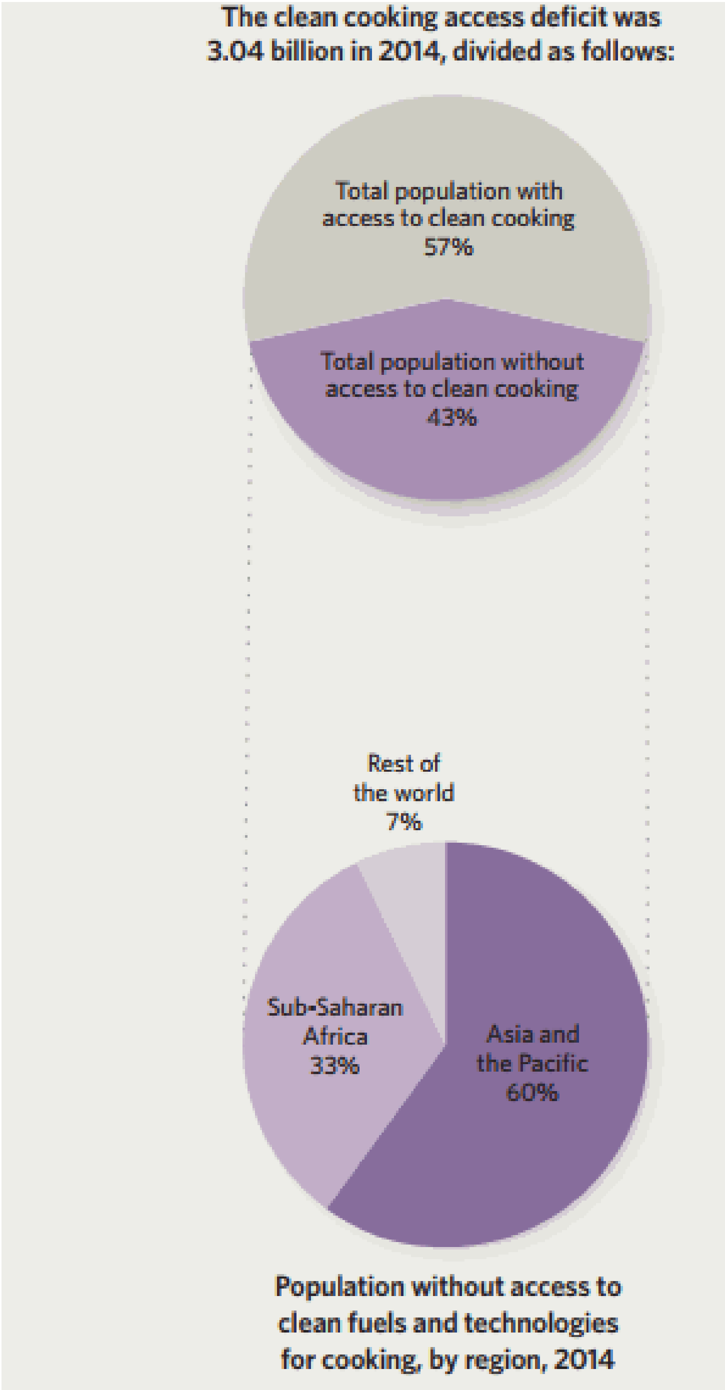


Figure 9. Population without access to clean fuels and technologies for cooking by region, 2014.

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.

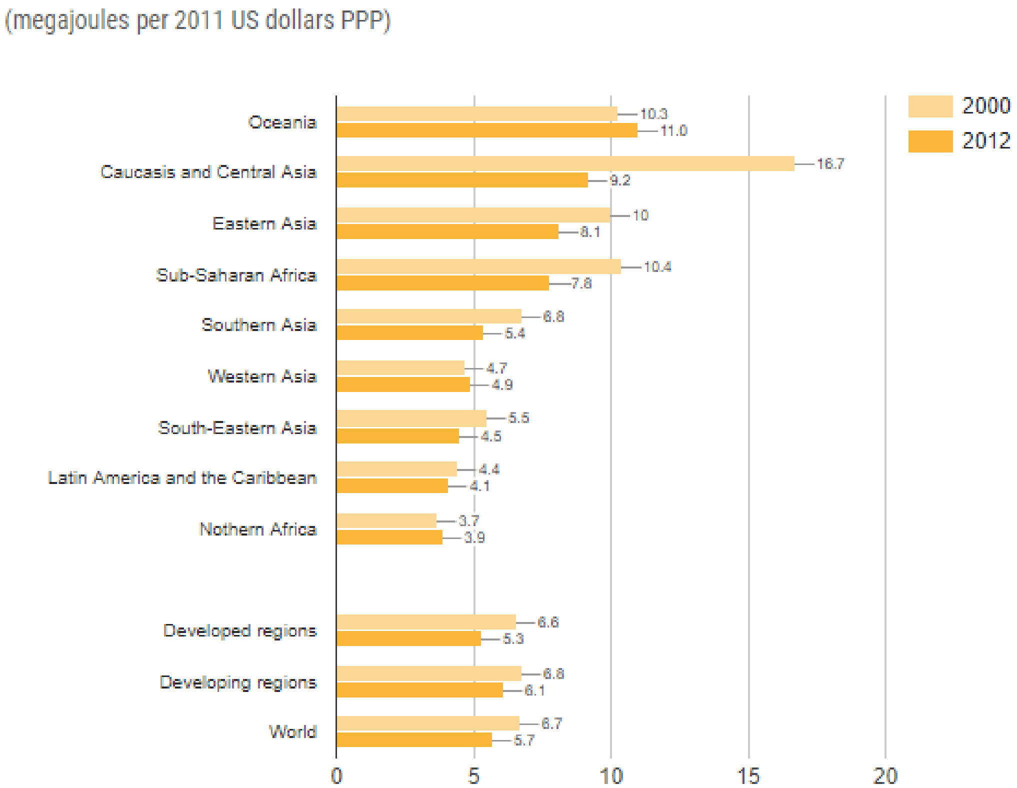


Figure 10. Energy intensity measured in terms of primary energy and gross domestic product, 2000 and 2012

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.

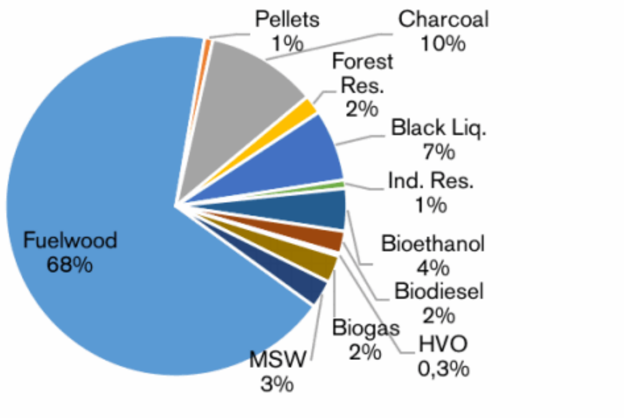


Figure 11. Primary energy supply of biomass resources globally, 2013

Source: World Energy Council 2016 based on data from World Bioenergy Association 2016

Forests still provide a dominant source of renewable energy, especially in Africa and Asia. To meet the energy efficiency target will require bolder financing and policies will be needed to embrace new technologies on a much more ambitious scale (SDG 2017).

Background - SDG 1,2,5 and 15 from UNFF12

There are many linkages of SDG goals to SDG 7. Figure 12 is an attempt to describe the complex interactions (Nerini 2018). The upper circle describe the linkages of the SD goals and targets, the lower left circle describe the synergies in decisions between goals and targets of all SDGs, and the lower right circle indicates the trade-offs decision on clean and affordable energy with other SDGs.

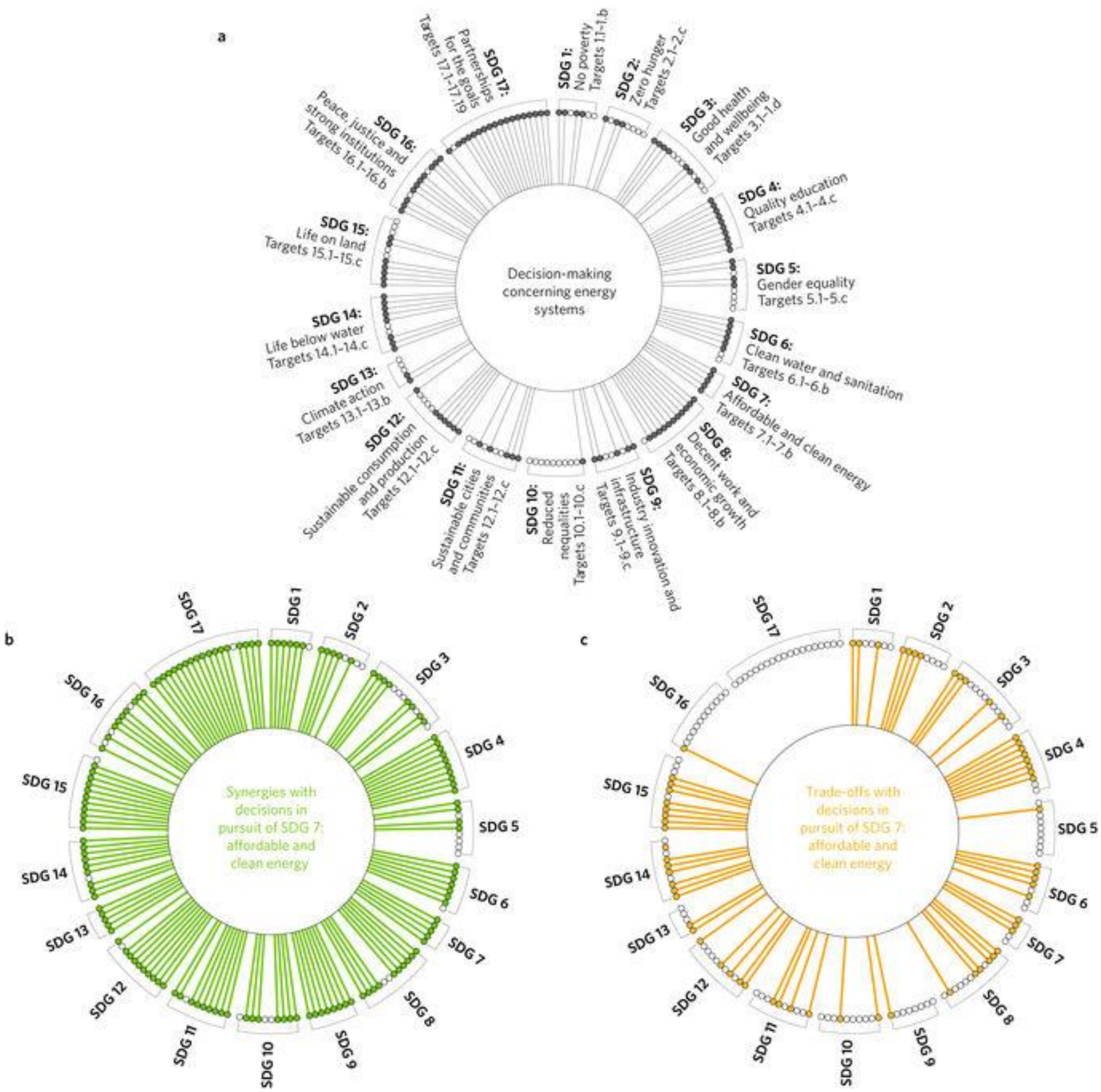


Figure 12. SDG linkages to SDG 7

Source: Nerini et al 2018.

More specifically, Figure 12 summarizes the interlinkages between energy systems and the SDGs and targets. a–c, Specific targets recognized in the 2030 Agenda for Sustainable Development are grouped together under each associated SDG. Targets are ordered clockwise; for example, Target 1.1 in each diagram is represented by the leftmost circle in the group associated with SDG1. a, Targets highlighted black (and indicated with black lines) call for action in relation to energy systems. b, For targets highlighted green (and indicated with green lines), we identified published evidence of synergies with decisions in pursuit of SDG7. c, For targets highlighted orange (and indicated with orange lines), we identified published evidence of trade-offs with decisions in pursuit of SDG7. In b and c, the absence of highlighting indicates the absence of identified evidence. This does not necessarily indicate the absence of a synergy or trade-off between the relevant target and SDG7. Full results of the assessment for each target can be found in Supplementary Table 1 of the Nerini report. (Nerini et al 2018)

From all these SDGs, the author was asked to report on just four of them in terms of synergies and trade-offs. The three are SDG 1, 2, 5, 15 which are summarized below.

- SDG 1- End poverty in all its forms everywhere
- SDG 2 - End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- SDG 5 - Achieve gender equality and empower all women and girls
- SDG 15 – Protect, restore and promote sustainable use of terrestrial ecosystems

For SDG goals 1, 2, 5 and 15 the State of the World's Forests 2016 report describes the strategic framework and FAOs key role in helping countries develop national plans, policies and programmes to achieve the Sustainable Development Goals (SDGs). In addition, the UN Strategic Plan for Forests 2017-2030 provides an additional framework for contributions to the achievement of SDGs 1, 2, 5 and 15. The 2030 Agenda recognizes that we can no longer look at food, livelihoods and the management of natural resources separately. It calls for a coherent and integrated approach to sustainability across all agricultural sectors and food systems.

FAO suggests that integrated land-use planning provides an essential strategic framework for balancing land uses (energy is just one important land use) which are essential to simultaneously meet all the targets of SDG 1, 2, 5 and 15. Importantly, such planning processes must be participatory – because it is farmers and other rural people who must ultimately put the plans into practice, and will do so only if they meet their needs and interests. An integrated landscape-scale approach to agriculture, forests and other land uses can bring valuable synergies.

The State of the World's Forest 2016 report did note that SDG5 and SDG7 does have some significant connections. In particular, women may have access to wood-fuel and non-wood forest products, but generally not to timber. The gender-based differentiation of ownership and use rights in forests can have major implications for forest management. (FAO 2016)

Current status and trends on contributions of forests to the achievement of SDG7

The Sustainable Development Knowledge Platform and the International Energy Agency have provided complementary assessments and an analysis of the current status and trends on contribution of forests to the achievement of SDG 7. Below are the highlights from their reports:

Status:

- More than 3 billion people, the majority of them in Asia and sub-Saharan Africa, are still cooking without clean fuels and more efficient technologies. This means up to 3 billion people rely on wood, charcoal or animal waste for cooking and heating.
- Energy is the dominant contributor to climate change, accounting for around 60 per cent of total global greenhouse gas emissions. We know that in many countries, particularly in sub-Saharan Africa and Asia, there is potentially a 'carbon debt' due to the unsustainable management of forests and other wood lands.
- Between 1990 and 2010, the number of people with access to electricity has increased by 1.7 billion, and as the global population continues to rise so will the demand for cheap energy. A global economy reliant on fossil fuels, and the increase of greenhouse gas emissions is creating drastic changes to our climate system. This is impacting every continent. Forests can be a source of material to produce electricity, particularly in poorer countries as illustrated in more developed countries such as Sweden.
- A low carbon future will require a comprehensive portfolio of technologies and policy measures. The IEA estimates that bioenergy will need to produce 17% of final energy demand by 2060, up from 4.5% in 2015.
- Bioenergy (both from forest and agricultural residues) is particularly important in sectors (e.g. transport – aviation and shipping) for which other decarbonisation options are not available.
- The growth of bioenergy will need to rely on a mix of technologies (e.g. biomethane from waste and residues, production of heat for district heating networks, efficient use of forest and agricultural residues for electricity generation and a number of options for producing transport fuels.

Source: https://sustainabledevelopment.un.org/sdg7 and IEA 2017

In summary, we need to halt deforestation, increase forest area and vastly improve the management of forest resources if we wish to increase our renewable energy targets, reduce emissions from the increase used of biomass and have forest available for all the other goods and services that they provide.

Trends:

- By 2030, ensure universal access to affordable, reliable and modern energy services

- By 2030, increase substantially the share of renewable energy in the global energy mix. Given the very recent approval of an increasing role for bioenergy in Europe, it is reasonable to assume we could see a significant increase in forest biomass as feedstock into the energy mix.

- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology. Many developed forested countries are keen to transfer their experience to developing countries in these areas. For example, discussion are underway between Canada and India to train engineers and scientist in these areas through Global Links programs.

- By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support. The adoption of these initiatives in developing countries could have a significant impact on the forest resources.
- Enabling bioenergy to play a key role in decarbonisation will require a fivefold increase in the supply of biomass feedstock for modern bioenergy uses compared to today. Waste and residues can meet 2/3 of this requirement but forest residues from forest operations can make a very important contribution.

  Source: https://sustainabledevelopment.un.org/sdg7 and IEA 2017

The trends is to see a significant increase in the use of forest biomass resources to assist in meeting the key SDG 7 targets. This again will require significant financing, knowledge transfer and policy/institutional changes. The increase in forest use presents a challenge: How do we develop the market and regulatory mechanisms that will help ensure the poor can participate in this new economy (SDG 1), that will help achieve more access to food security (SDG 2), ensure gender equality (SDG 5) and protect, restore and promote the sustainable use of the forest (SDG 15)? It will mean that policy actors and leaders will have to ensure the economic and policy instruments are designed to address these challenges. The key instruments will include tenure allocation, market mechanisms, financing and loans, use of appropriate subsidies and the introduction of newer technologies.

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 it could be a major contributor to the share of renewable energy and that it is possible to greatly increase the energy efficiency of the use of wood in energy production. This means that forest can contribute greatly to meeting the SDG 7 goals.

Universal access could be designed into forest policies to ensure that women, the poor and the marginalized could all benefit from the greater use of renewable energy, particularly those that are forest based. Renewable energy is a source of energy that has been widely adopted for millennia and improved access to wood-based energy has been clearly linked to improved human welfare in developing countries, especially for women and the poor. The use of more renewable energy, including bioenergy, can be an effective tool in adapting to climate change.

Biomass can also assist in contributing to an increased share of renewable energy in the energy portfolio. Forest and woody biomass will likely remain the most effective replacement of fossil fuels, especially in many low-income countries. Forest are renewable and expandable, so they represent the greatest opportunity to expand the use of renewable energy that is sustainable and at the lowest costs. Many studies on marginal abatement costs curves for technologies and forest illustrate the benefits of biomass use.

Energy efficiency, despite all the complexities of measurement discussed earlier, can be very cost effective in many instances, especially if appropriate clean technology is used such as ‘improved cook stoves’. For example, the use of modern technology in usage of bioenergy can reduce the use of wood, in the case of charcoal, by as much as 75%.

Challenges of wood-based energy

Despite the benefits of forest to meet these SDG 7 targets challenged remain in terms of universal access, increasing the share of renewable energy and energy efficiency. Addressing these challenges will be critical if we wish to see the forest an important contributor to the problem of climate change.

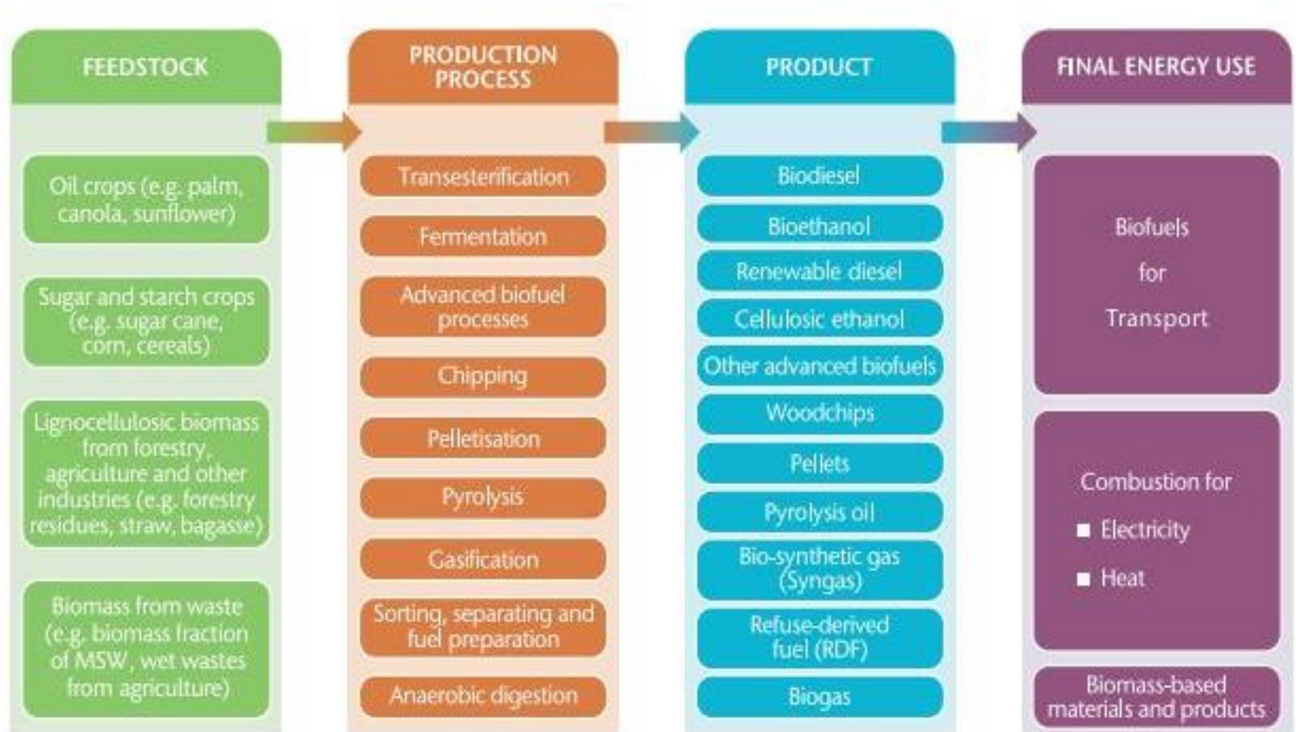
Universal access to many commonly pooled resources, such as forest, can be very difficult. Often the ethic of sustainability can be missing leading to degradation or deforestation drive by the basic human need to survive. To guarantee universal access is fairly distributed education on improved land 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 tools and practices are often missing. Effective tools could improve energy efficiency and reduce emissions at the same time. This would benefit forest resources.

Description - wood-based energy pathways, including fuelwood and charcoal

Figure 13 describes the complex configurations of the bioenergy pathways. It is important to see how these pathways are relevant, or not, to poorer countries where there remains a heavy reliance on traditional biomass energy for cooking and heat. The general idea is to figure out how to increase the shift from traditional use of biomass to modern use of biomass, in particular forest biomass. For example, if we use forest feedstock and the pelletisation production process, we can product pellet for remote and rural area for electricity and heat. This would be consider the modern use of biomass and it can create an alternative to traditional fuelwood use.



Note: while a considerable number of combinations are available to convert each feedstock type, certain applications require specific bioenergy pathways. Certain products and production processes are feedstock specific and Figure 2 does not imply that all feedstocks are suitable for meeting all energy end-use requirements in an efficient and cost-effective manner.

Sources: adapted from IEA (2012), *Technology Roadmap: Bioenergy for Heat and Power*, and FAO (2014a), *Bioenergy and Food Security Rapid Appraisal (BEFS RA) User Manual Introduction*. Additional references are available within these source documents.

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.

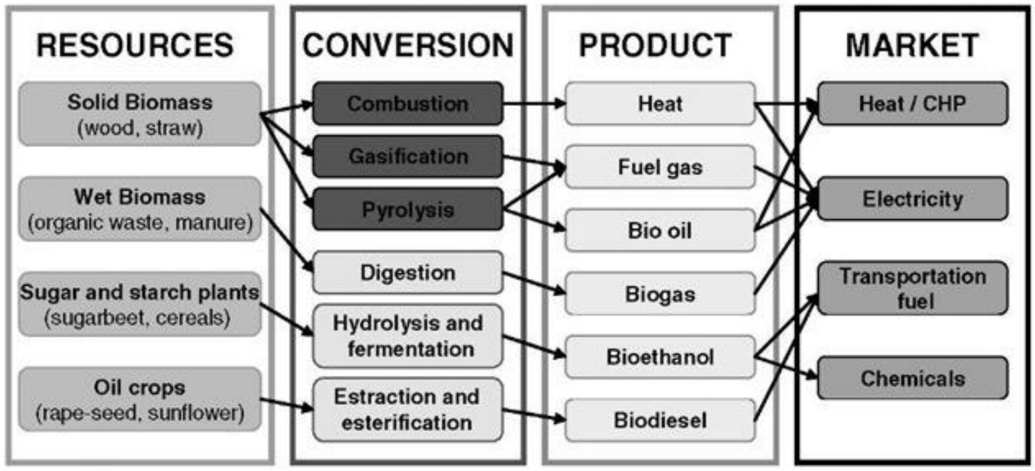
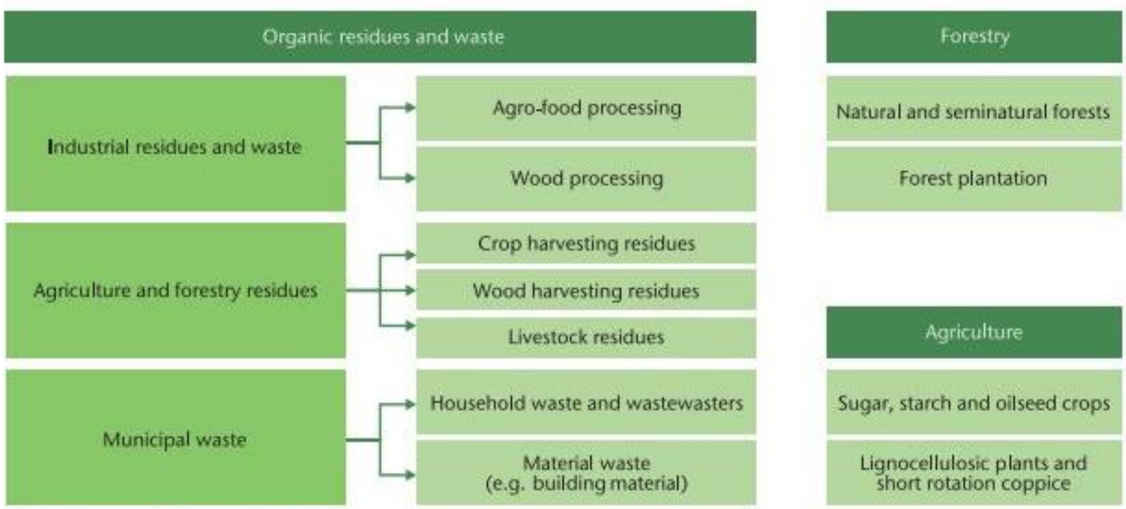


Figure 14. Potential industrial and non-industrial biopathways: from biomass to final energy use.

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.



Source: adapted from FAO (2004), *Unified Bioenergy Terminology – UBET*, www.fao.org/docrep/007/j4504e/j4504e00.htm.

Figure 15. Biomass types according to origin

Source: IEA/FAO 2017a.

Assessment factors - reliability, efficiency, affordability, sustainability

Bioenergy represents a major type of renewable energy. As such, it is key to supporting the UN Sustainable Development Goals (SDGs) in the context of energy security, poverty eradication and livelihoods, and climate change. As summarized by the IPCC 5th Assessment Report, integrated assessment modelling indicates a high risk of failing to meet long-term climate targets without bioenergy. Global assessments by REN 21, IEA and IRENA find that **bioenergy accounts for three-quarters of all renewable energy use today** and half of the most cost-effective options for doubling renewable energy use by 2030. If we agree this analysis is reasonable, then we would have to conclude that forest resources play a pivotal role in meeting renewable energy targets, particularly in developing countries.

Reliability and Efficiency

Table 1 summarizes the poor people's outlook on the factors that are deemed important to poor people: reliability, efficiency (somewhat akin to quality and adequacy), affordability and sustainability (adequacy is one dimension of sustainability) and how these factors relate to four essential needs of their energy supply. Forests do, or can, play a very important role in delivering an energy supply and what this table summarizes is the key attributes of the wood fuel that would be the most important whether in a traditional or modern usage of biomass energy. Thus, for poor people, to address critical policy issues such as poverty eradication and livelihoods will require addressing the key attributes of each use of energy supply that are essential to poor people.

Table 1. Enterprise energy access matrix.

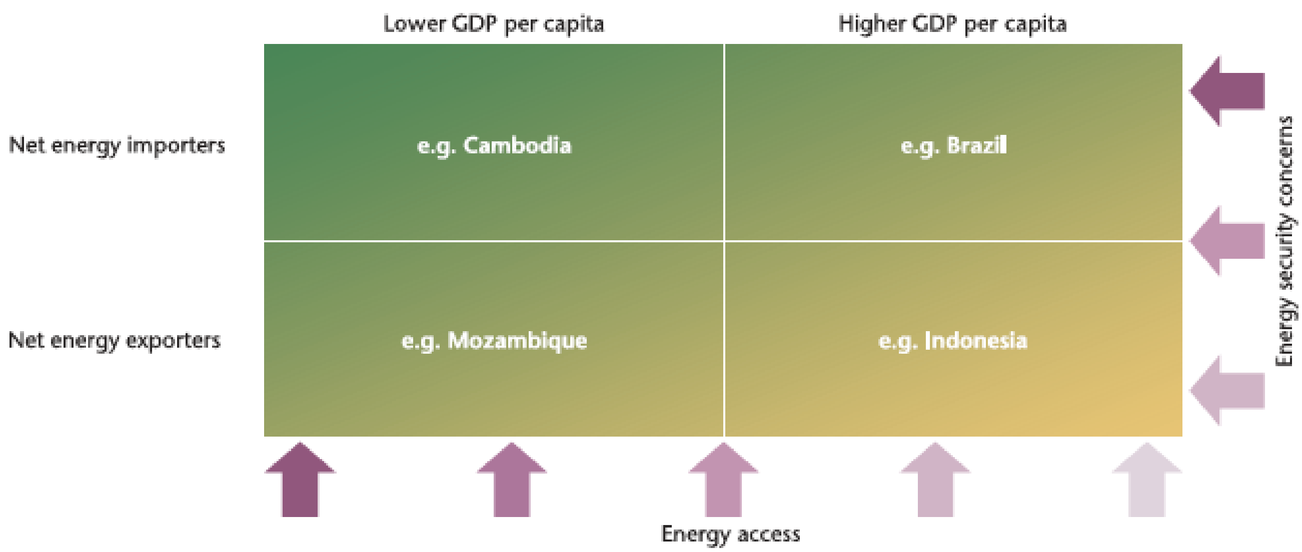
	Energy supply			
	Electricity	**Fuels**	**Mechanical power**	**Appliance**
Reliability	Availability (hours per day) Predictability (timetabled or intermittent)	Availability (days per year)	Availability (days per year)	Downtime (%), linked to ease of maintenance and availability of spare parts
Quality	Voltage and frequency fluctuation (+/- 10%)	Moisture content (%)	Controllability	Convenience, health and safety, and cleanliness of operation
Affordability	Proportion of operating costs (%), including capital cost payback if financed	Proportion of operating costs (%) Time to gather as proportion of working day (%)	Proportion of operating costs (%) Time spent (if human powered) as proportion of working day (%)	Proportion of operating costs (%) including capital cost payback if financed
Adequacy	Peak power availability (kW)	Energy density/ calorific value (MJ/kg)	Peak power availability (kW)	Capacity compared with available resource and market (% capacity)

Source: Poor People's Energy Outlook 2012 & 2016 reports

Affordability

Figure 16 illustrates the expected likelihood that energy access and energy security concerns respectively will influence bioenergy strategy. The net energy importers could rely on more forest based biofuels to decrease their dependencies on fossil fuels. The net energy exporters also see the development of biofuels as an opportunity for forest and agricultural development. The strategy is largely plantation management of forests and agricultural tree crops or energy crops,

So affordability is key to see a role for bioenergy in the future. If a country has little energy security concerns and have higher GDP per capita they are likely to be net energy exporters. If a country has poor access to energy and lower GDP per capita then they will likely find that energy is much less affordable since they have to import.



Sources: based on data from IEA (2016d), *World Energy Balances*, and adapted from IEA (2011b), *Policies for Deploying Renewables*.

Note: the arrows are shaded to illustrate the expected likelihood that energy access and energy security concerns respectively will influence bioenergy strategies. A darker arrow suggests a greater likelihood that a bioenergy strategy will be influenced by energy access and/or security concerns. IEA analysis that explored the correlation between energy balances and increases in the share of biofuels in the transport sector in the timeframe 1990-2009, suggests that net oil importers have statistically significant higher increases in biofuels' share of the overall fuel mix (IEA, 2011a). The case of Indonesia, which attained a greater share for biofuels at a moderate gross domestic product (GDP), and which is also an exporting country, points to the importance of other drivers for investing in biofuel development, such as catalysing economic growth and alleviating poverty in rural areas (IEA, 2015b).

Figure 16. Typology of country clusters by strategic bioenergy policy drivers

Source: IEA/FAO 2017b

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.

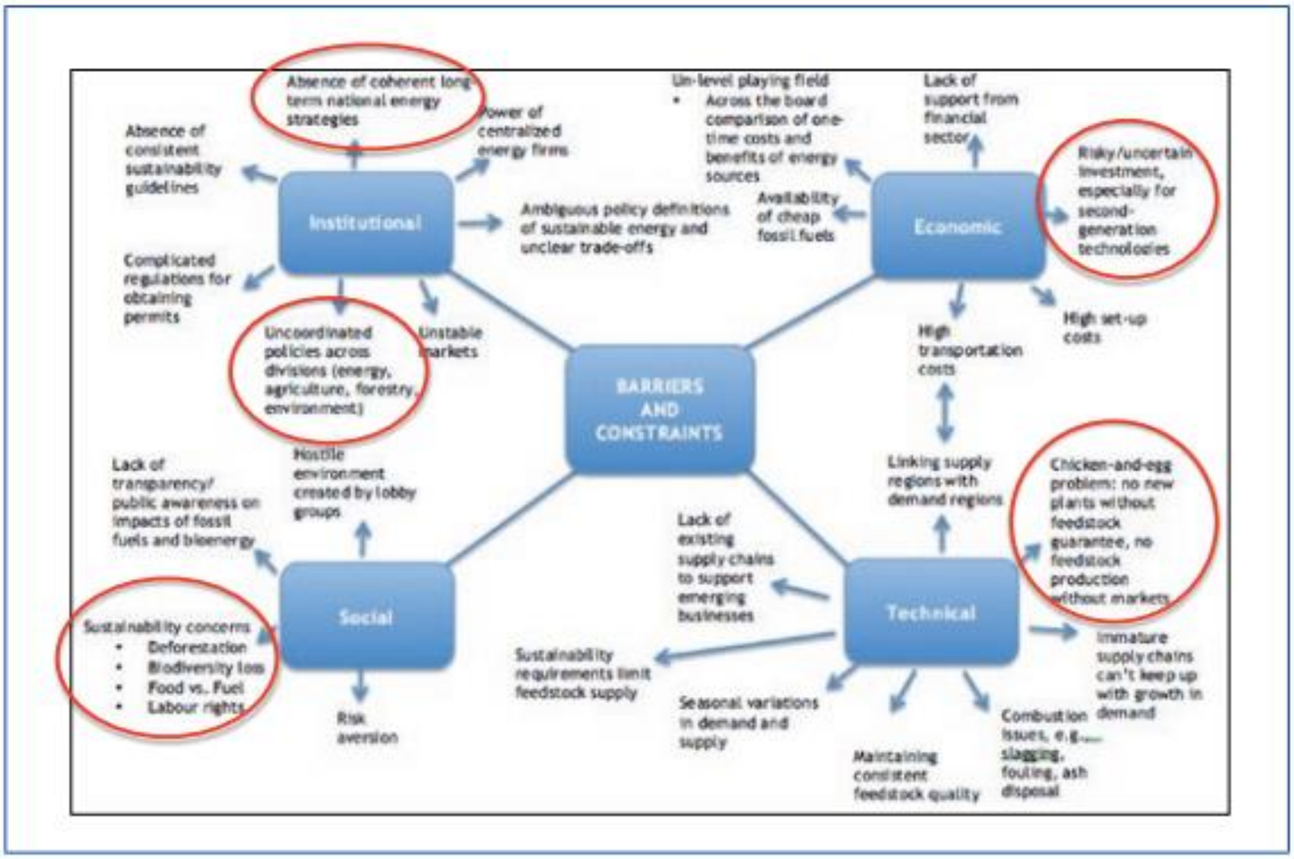


Figure 17. Barriers and constraints to bioenergy supply chain mobilisation

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

Forest continue to provide important source of food, especially in poorer income countries. They also act as a critical 'buffer' in times of food shortages driven by drought or other natural disturbance events. An estimated 767 million people lived below the extreme poverty line in 2013, down from 1.7 billion people in 1999. This represents a reduction in the global rate of extreme poverty from 28 per cent in 1999 to 11 per cent in 2013. The proportion of undernourished people worldwide declined from 15 per cent in 2000-2002 to about 11 per cent in 2014-2016. Globally, about 793 million people were undernourished in 2014-2016, down from 930 million in 2000-2002.

The challenge is to develop improved access to and availability to food as biofuels can negatively impact food security through competing uses of agricultural land and/or increase in food prices causing possible long-term, consequences for health, productivity, and well-being. To address the challenge there are many opportunities to evaluate impact of perennial agriculture and crop diversity on food security, food instability and price shocks.

From a forest point of view one priority would be to adopt large-scale diverse (i.e. move away from monoculture) production methods for biofuel feedstock. This would allow for a greater accommodation of the need for improved food security.

Health

Forest related health includes household air pollution from cooking with unclean fuels and inefficient technologies. In 2012 household air pollution led to an estimated 4.3 million deaths; another 3 million deaths were attributed to ambient air pollution from traffic, industrial sources, waste burning and residential fuel combustion. While biomass is technically renewable, its traditional uses are responsible for serious health effects and, sometimes, deforestation.
As previously discuss the evidence suggests we have failed to tackle the need to shift from the traditional use of biomass to the modern use of biomass. This means forests used for woodfuel are still highly correlated with negative health outcomes.

The challenge is to facilitate a move away from solid fuels for the 2.6 billion people globally still dependent upon them for cooking which results in significant impacts on climate (emission, black carbon), environment (deforestation), and human health (pollution). To address the challenge there are opportunities to reduce household air pollution (current attributable annual mortality of ~1·6 million), and local and regional air pollution from power generation (attributable annual mortality about 0·8 million).

From a forest point of view, the priority could be to take preventive measures to reduce the potential adverse effects of building renewable energy infrastructure. Project could be developed in a manner that address such things as hydropower (dams) impacts on human rights, noise impacts from wind turbine, access to cleaner cooking technologies and facilities for lower income peoples, etc.

To illustrate some particular health impacts Figure 18 summarizes the linkage of woodfuel consumption, the burden of household air pollution (HAP) exposure and the fraction of use of non-renewable biomass (fNRB) utilization.

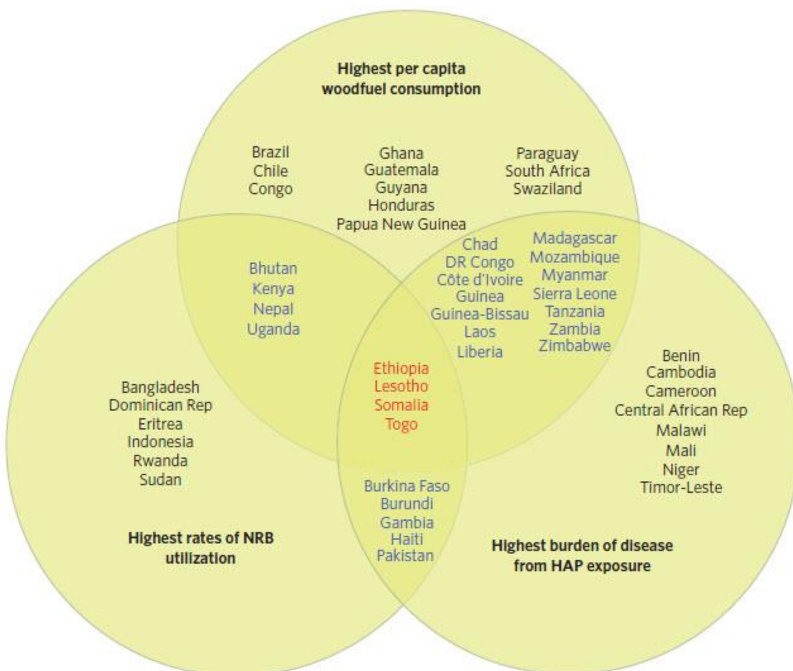


Figure 18. Countries with highest per capita woodfuel demand, highest expected fNRB and highest burden of disease from HAP exposure.

Source: Bailis et al. 2015

Sustainability of forest resources

Forest are a major source of renewable energy and the sustainability of the forest resources is constantly being questioned. The largest component of renewable energy usage is traditional use of biomass by households in the developing world, but much uncertainty surrounds attempts to measure it, and even more the question of how much its use is considered sustainable. From 2010 to 2015, the annual net loss of forest area globally was less than half that of the 1990s. The proportion of land area covered by forest decreased from 31.6 per cent in 1990 to 30.8 per cent in 2010 and 30.6 per cent in 2015.

A critical challenge is to manage sustainably bioenergy production (e.g. charcoal and fuelwood in Africa, biofuels in the north and the south regions. There is still an opportunity to promote a switch to clean energy technologies for positive impacts on forest resources from either less fuelwood demand, reduce degradation of the forest and better systems for producing charcoal and biochar.

From a forest point of view, the priority could be to promote use of sustainable forest goods through standards (e.g. FSC, SFI, SBP), promote afforestation/reforestation programs, and develop/strengthen organizations that focus on bilateral and multilateral measures e.g. FLEGT to combat illegality problem.

One example of how to improve the sustainability of forest resource with one energy product is illustrated by the FAO report on charcoal products (FAO 2017). For example, new technology in wood kilns can reduce the wood used to produce 1kg of charcoal from 12kg to 3kg (FAO 2017). This needs to be combined with the adoption of cleaner stoves which could further reduce the need of wood energy for cooking. Since charcoal represent nearly 17% of woodfuel usage and generates employment for some 40 million people it is an important economic sector to manage, particularly since it is expected to increase in its use of the forest. The FAO (2017) report had the following recommendation to 'green' the charcoal value chain:

1. Introduce measure to reduce greenhouse gas emission, targeting the entire supply chain
2. Increase the financial viability of the green charcoal supply chain by land reform, fair pricing and policy reform to push sustainability
3. Develop national policy frameworks to incentivized the sector
4. Provide more research outputs and develop information systems to manage.
5. Create many demonstration projects.

Climate change

Forest are a very important contributor to climate change mitigation given that they act as a natural storage facility for carbon and they sequester large amounts of carbon in the process of photosynthesis. The forest can also be significant sources of emissions, especially when natural disturbance factors such as fire, insect and diseases change the ability of the forest to play its critical storage and sequestration role.

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 associated with the lost of forest due to fire, insect and disease.

Table 2. CO2 emissions (only) from wood energy compared with total emissions, 2010, by region

	Emissions by activity ($Mt\ CO_2$)			Emissions by wood-energy type ($Mt\ CO_2$)			Wood-energy emissions as share of total emissions (%)
	Fossil-fuel consumption	Land-use change	Total	Fuelwood	Charcoal	Total	
Africa	1 171	1 256	2 427	590	226	817	34
Asia and Oceania	16 529	630	17 159	952	66	1 018	8
Europe	6 009	-720	5 289	195	4	199	4
North America	5 933	-116	5 817	50	7	57	1
Latin America and Caribbean	1 691	1 365	3 056	297	74	371	12
World	31 332	2 415	33 747	2 084	378	2 462	7

Note: Emissions from charcoal include those from its use and production (roughly one-third and two-thirds of the total, respectively). Geographically and between studies, there is considerable variation in emissions from the charcoal value chain and its contribution to total emissions at the global and country levels.

Source: FAO 2016a

The challenge is how can we finance the growing of more forest and healthy forest and at the same time finance the introduction of modern technologies to reduce the negative emissions impacts from energy production? The opportunity exists to have forest play a major positive role since we have extensive knowledge on how to grow trees and forests, how to manage those resources and how to reduce losses to natural disturbance. We also have well developed technologies that can greatly reduce emission from the use of those forest as a source of renewable energy.

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.

Biodiversity

Biodiversity loss in forest areas continues at an alarming rate. Illicit poaching and trafficking of wildlife continues to thwart conservation efforts, with nearly 7,000 species of animals and plants reported in illegal trade involving 120 countries.

There have been global assessment of biodiversity loss associated with different forms of renewable energy. Table 3 illustrates the linkages of various sources of renewable energy to biodiversity loss. Of particularly interest to this report is the biomass energy and biofuels sources of energy. Clearly the authors feel they have strong evidence of biodiversity loss in terms of habitat, pollution, species and climate changes. Interestingly, there is no conclusive or contextual evidence linking biodiversity loss to 'over-exploitation'. This may mean the authors acknowledge the complexity of measuring and assessing over-exploitation. Another features of this table is the acknowledgment that for many other sources of renewable energy there is frequently a lack of evidence of the relationship between the renewable energy option and the impacts on biodiversity loss.

Table 3. Millennium Assessment drivers of biodiversity loss for different renewable energy pathways.

	Habitat loss/change	Pollution	Invasive-Alien Species	Over-exploitation	Climate change
Wind (Section 2.2)	✓	?*	X	X	X
Solar (Section 3.2)	✓	?	X	X	?
Hydro (Section 4.2)	✓	✓*	?	?	?
Biomass energy (Section 5.2.1)	✓	✓	✓	?	✓
Biofuels (Section 5.2.2)	✓	✓	?	?	✓
Ocean energy (Section 6.2)	✓	?*	X	X	X
Geothermal (Section 7.2)	✓	✓*	X	X	X

✓ – Strong evidence for the existence of a causal link.

X – Lack or minimal evidence for the existence of a causal link.

? – Theoretically possible causal link, but inconclusive or contextual evidence.

* – Includes non-chemical pollution such as sound, heat and light pollution.

Source: Forest Trends 2017

The challenge is to manage renewable energy infrastructure development so as to reduce negative impacts on biodiversity and the provision of ecosystem services. Experts have suggested the following actions by renewable energy source:

- Solar – reduce use of herbicides and dust suppressants.
- Wind – monitor impact on avian and aquatic species.
- Hydropower – reduce impact on aquatic species, aquatic habitats, habitat loss, fragmenting habitats (e.g. through island creation).
- Bioenergy – monitor changes in land use resulting in habitat and biodiversity loss from expansion of biomass feedstock for energy production.
- Tidal – minimize disturbance on coastal ecosystems and species habitat at (or near) the seabed.

There is an opportunity to develop biodiversity offsets and compensation mechanisms. Currently there is a claim that over $4.8 billion toward ecological rehabilitation and protection in 2016.

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, access is lacking to clean cooking fuels and technologies for more than 2 billion people, most of them in Asia and sub-Saharan Africa. They are also exposed to high levels of household air pollution. This has lead to some 4 million premature deaths, primarily among women and children, which are caused each year by inhaling carbon monoxide and particulate matter from traditional biomass cookstoves. Biomass stoves that burn efficiently enough to be considered “clean” are not yet widely available in low- and middle-income countries.

Recent trends show some improvements. The access to clean fuels and technologies for cooking climbed to 57 per cent in 2014, up from 50 per cent in 2000. Around 2.3 billion people will continue to rely on the traditional use of biomass for cooking in 2030. The challenge is to promote access to clean cooking technologies and to electricity (1 in 5 people globally).

The opportunity is to improve resilience in the face of weather extremes (adaptation), emissions reduction (mitigation), and job creation through electricity from renewable sources. This energy can help to locally pump water, power clinics, light homes, cook food etc.

The priority is to develop “pro-poor” bioenergy to revitalize economies affected by declining market demand for traditional forest products by utilizing surplus fiber for modern renewable energy and creation of new job opportunities. This approach will also improve health outcomes.

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.

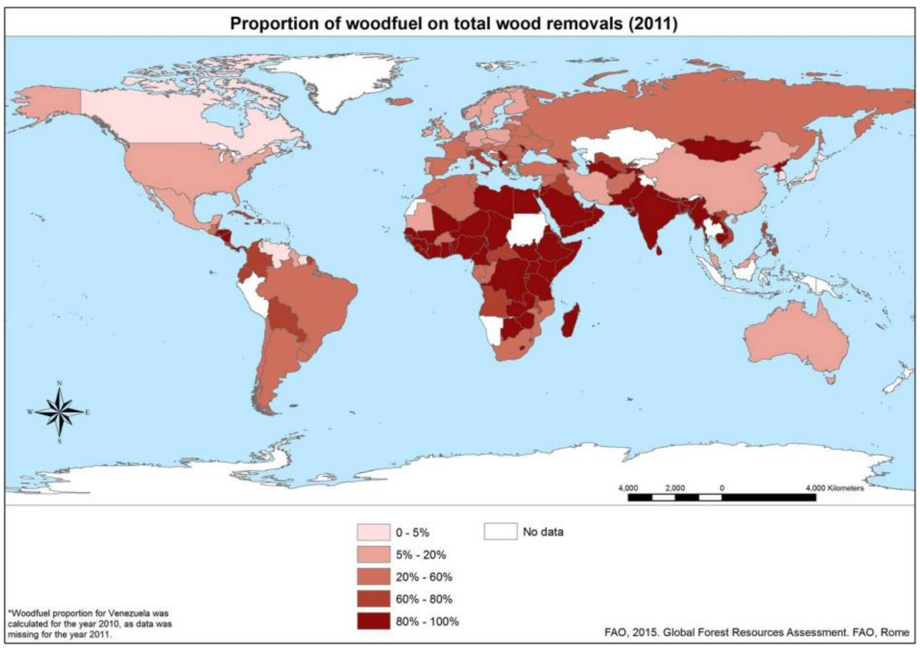


Figure 19. Proportion of woodfuel on total wood removal (2011)

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.

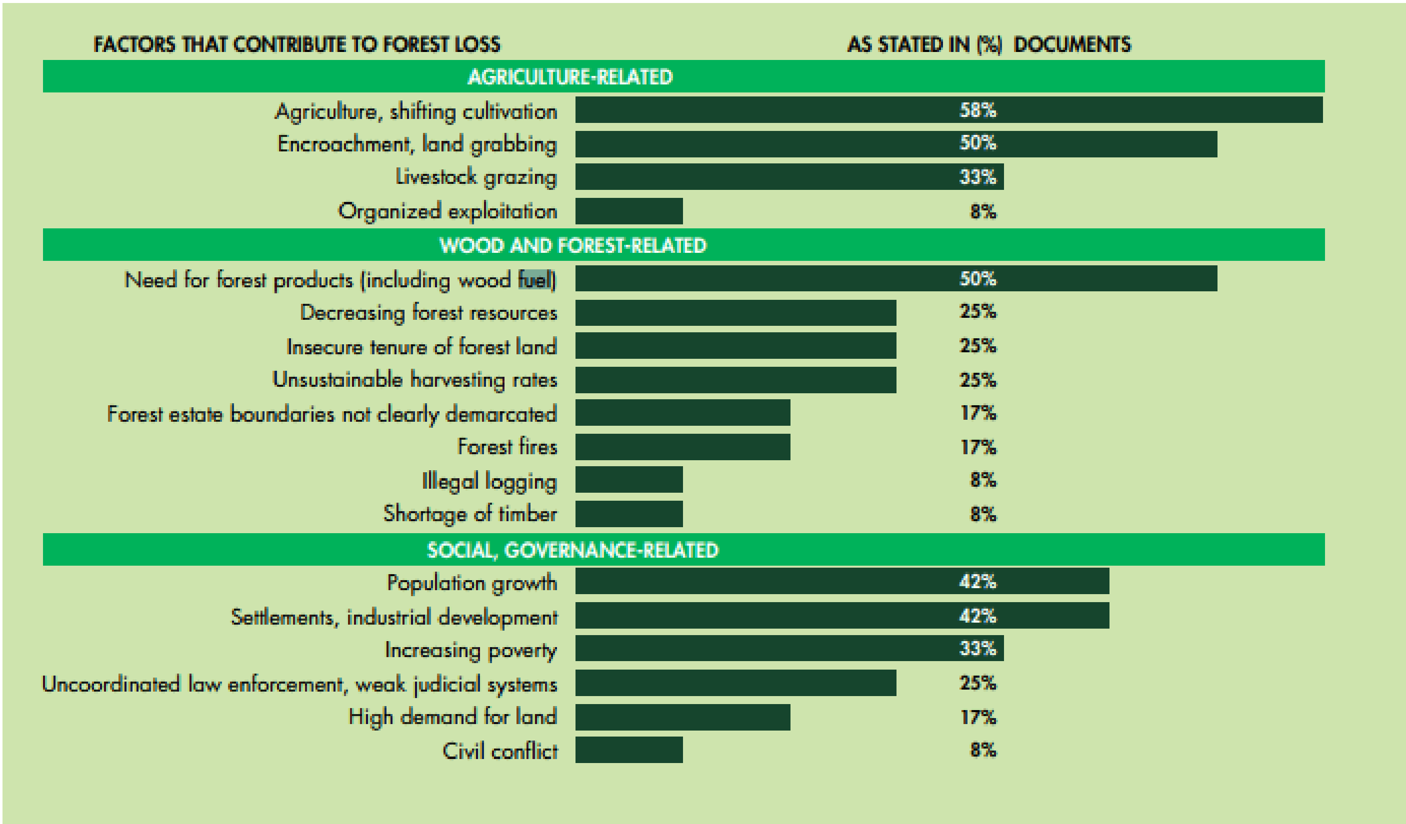


Figure 20. Factors contributing to forest loss in seven countries

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.

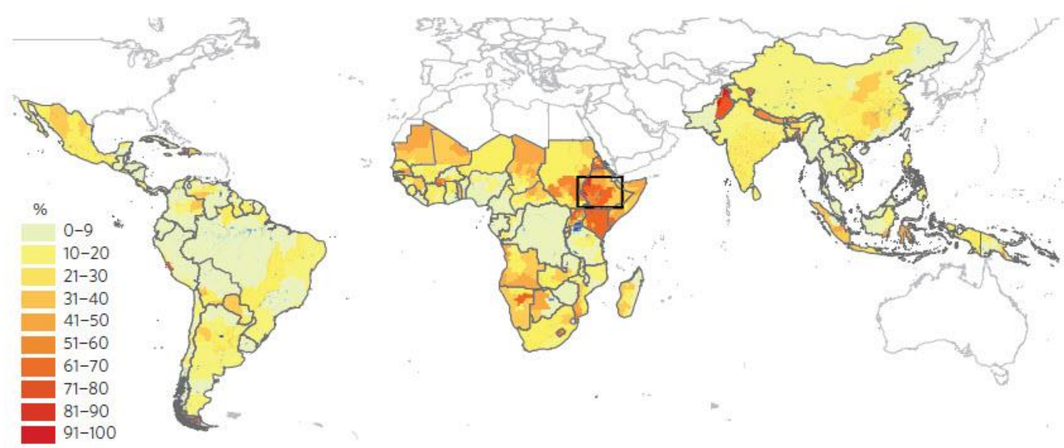


Figure 21. The percentage of fNRB from direct woodfuel harvesting

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.

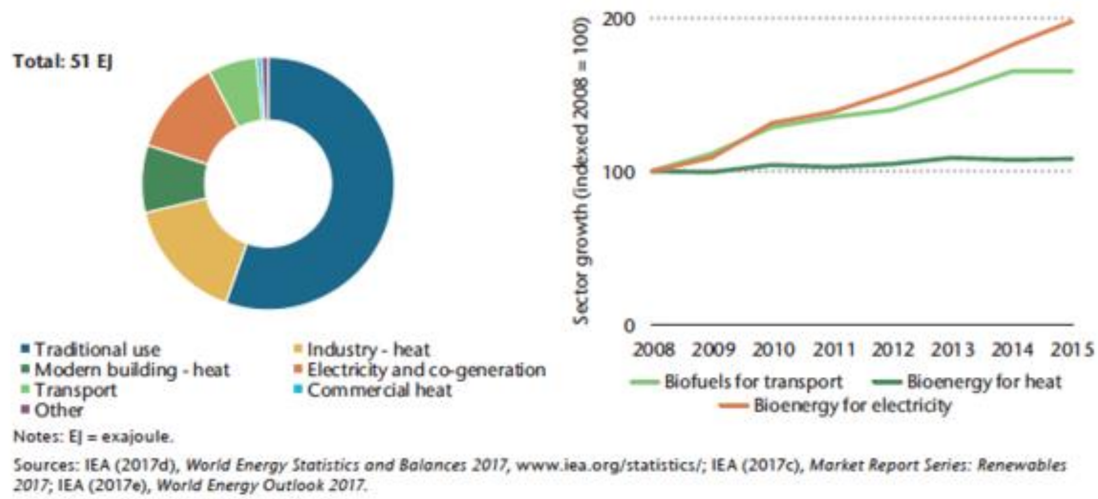


Figure 22. Consumption of biomass and waste resources by end use in 2015 (left) and modern bioenergy growth by sector, 2008-2015 (right)

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 to promote and accelerate the mainstreaming of more renewables.

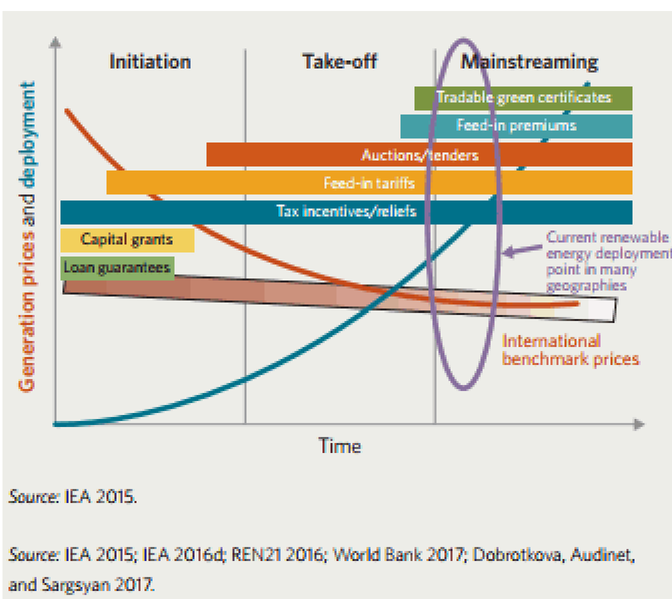


Figure 23. Renewables have become mainstream in many geographies

Source: IEA 2015.

Implications on forests: competing needs for energy and other wood uses

The competition of forest use for traditional forest products continues with energy and food. Households in poorer countries have favored any land use that provide more security either through subsistence or through cash income.

The trend in land use in some countries is changing in terms of the products produced (such as more forest based bioenergy). Land tenure reform is also changing the products and services provided by the land. Finally, there is a growing recognition of the ecosystems services that land provides in the marketplace. For example, the emergence of an ecosystems services markets (such as carbon) is emerging as a policy tool that could provide more economic incentives for the sustainable use of land.

Figure 24 describes the 20 largest energy consuming countries and their share of renewable energy in 2014. It indicates that high impact countries already consume a great deal of renewable energy, but a significant part is still in the traditional uses of biomass. The income level is an important indicator of the degree to which a country is using modern or more traditional uses of biomass.

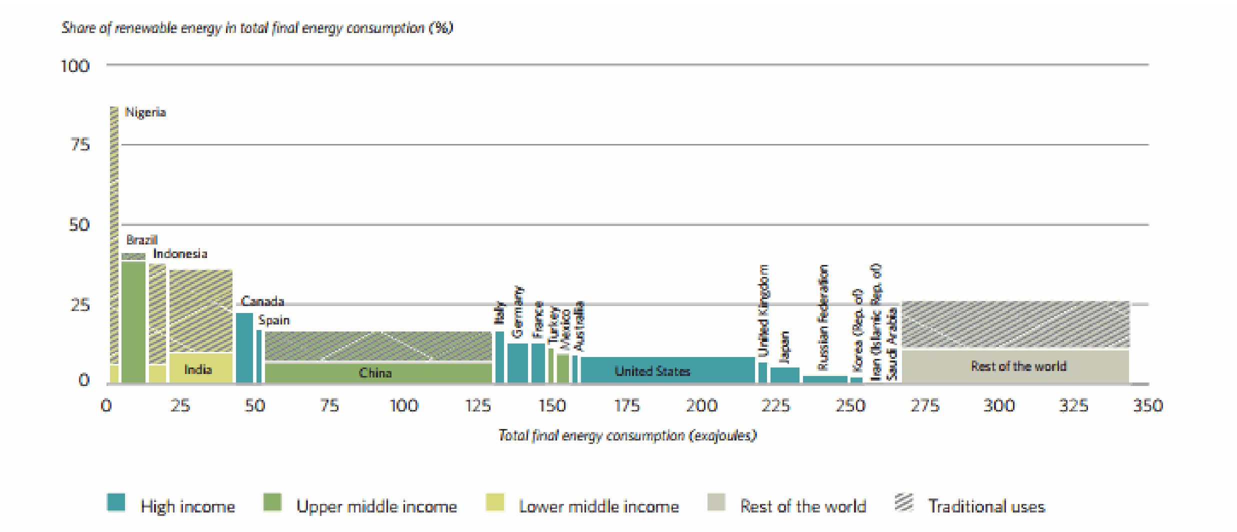


Figure 24. High-impact countries share of renewable energy consumption, 2014.

Source: IBRD/WB 2017

The challenge remains that we have to find a balance between the multiple uses of forests for products such as for agriculture, firewood production, charcoal. However, technology does offer an opportunity to revitalize or transform an industrial infrastructure affected by declining or shifting market demand for forest and energy products

The priority is to promote the global sustainable forest resource use through mechanisms (e.g. agroforestry) while stimulating more use of renewable and sustainable bioenergy that can improve employment prospects and assist in the broader goals of socio-economic development .

Implications on climate change

As discussed earlier, forests are a very important contributor to climate change mitigation. In a significant number of poorer countries the continued use of traditional biomass from forest for cooking and heat remains a significant challenge to the sustainability of forest resources. The overall trend is that efforts to accelerate poverty eradication may accelerate climate change since the human populations are continuing to grow and there is little evidence that the increase in income to alleviate poverty is going back to the sustainable management of forest resources or to investment in the wide scale adoption of modern cleaner technologies and processes. The lack of finance for sustainable management and improved technologies is a recurrent theme throughout this report.

The challenge is to find the right set of investment vehicles and incentives that will ensure significantly more investment in forest and technologies. There is an opportunity to greatly expand the uptake of clean and renewable energy technologies which will create a positive climate impact.

The priority should be to adopt approaches that will help meet the Paris Agreement (COP 21) aim of keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels through careful planning of investment, incentives, technologies and infrastructure that will allow both the rapid development and spread of advanced technologies and the sustainable management of forest resources. This different approach to management will require a careful examination of the social discount rates applied to associated projects since the standard private discount rates are not appropriate to addressing climate change challenges.

Part E: Policy Instruments

This section summarizes the key policy instruments that could be used to further support the sustainable production of wood-based energy at the international and national levels.

International

There has been a great deal of useful policy suggestions in the United Nations Forest Instrument (UNFI) and the UN Strategic Plan for Forests 201-2030 (UNSPF)[3].

They attempt to integrate a full range of socioeconomic and environmental benefits and services from forest that may not be exclusively indicated in the SDGs.

[3] The UNFI (http://www.un.org/esa/forests/documents/un-forest-instrument/index.html) provides a framework for national actions and international cooperation to sustainably manage forests, recognizing the importance of FES. It contains 25 national policies and measures and 19 international measures.

The UNSPF (http://www.un.org/esa/forests/documents/un-strategic-plan-for-forests-2030/index.html) provides a global framework for sustainably managing all types of forests and trees outside forests, halting and reversing deforestation and forest degradation, and increasing the forest area. It encompasses and engages all partners and stakeholders at all levels, and highlights their respective roles and responsibilities in the implementation of the plan.

In addition to these policy suggestions contained in these initatives, I suggest the international policy arena focus in five broad areas: forest finance, technology and information systems, forest management and institutional reform.

- **Forest financing** – Promote the design of national forest financing strategies to mobilize resources for sustainable forest management (UNFF 2018). Currently most governments have poor financial mechanism to support forest restoration, replanting and management based on the neo-classical view of investment.
- **Forest financing** – Use the Global Forest Financing Facilitation Network to serve as a clearing house on financing opportunities. A network has been created to allow the different investors to participate in the management and restoration of the world's forest.
- **Technology** - Support the development of more new technologies for producing heat and power, especially at the microscale (UNFF 2018, IEA 2017a) and accelerate the uptake of efficient bioenergy for the least developed countries.
- **Forest information systems 1.** - Improve the government approved global statistical databases to improve the assessment of the forest through organizations such as FAO. There have been some achievements, but deforestation and degradation statistics, for example, remain troublesome and controversial. FAO in cooperation with companies such as Google Earth and Bing are rapidly developing helpful tools such as FAO supported tools such as National Forest Monitoring Systems.
- **Forest information systems 2.** – Improve or develop the tools for greenhouse gas management that account for the forest, the forest dynamics and the products and services that it produces. To integrate the climate change discussion with sustainable forest management is critical to policy development. Global forest companies such as Stora Enso are not undertaking GHG reporting.
- **Forest management** - Promote the increase in plantation or planted forests, both for industrial and non-industrial uses, in both developing and developed countries, given the forecasted increase in demand for more bioenergy and wood products (IIASA 2016). The UN Strategic plan for forests recommends increasing the world forest area by 3% by 2030 (UNFF 2018)
- **Institutional reform** - Continue the international cooperation both governmental and non-governmental, and industrial organizations. With respect to SDG 7 the efforts being made by Sustainable Biomass Program (SBP) to create certification systems that could link sustainable biomass to wood product certification is noteworthy. Other international roundtables, such as the Roundtable on Biomaterials, are also noteworthy since they fill a gap in the regulatory frameworks for many countries.

National

Not all policy action should or can occur at the international level. National policy development is an important supplement and support the international efforts to sustainably manage forest while meeting the goals of SDG 7. Below are a samples of forest policy tools in the area of forest finance, forest information systems and institutional reform.

- **Forest finance 1** - Encourage more cooperation on agroforestry projects that accelerate forest restoration with new models for afforestation are required (Baker et al 2017).
- **Forest finance 2** - Conduct more research and experimentation with putting a price on nature so that payment for ecosystem services schemes can be improved (Wanggi et al 2018). Such schemes need to focus on carbon, biodiversity and water management integrated with forest management.
- **Forest information systems** - Expand the traceability systems for consumers (Baker 2017) to meet requirements of policy tools such as Lacey Amendment Act, EU Timber Regulation, Controlled wood, etc.) while paying very careful attention to privacy issues linked to transparency.
- **Institutional reform** – Provide guidance on further forest land tenure reform to create sufficient security for low income people, particularly for those traditionally disadvantaged such as indigenous groups. Provide a mechanism for coherence between local peoples and global organizations that allow for new policy entrepreneurs and knowledge brokers to have a voice in development a dynamic exchange on issues related to local realities and global policy aspirations.

Part F: Conclusions and Recommendations

This final section contains the key conclusions and recommendation on the challenges and priorities for enhancing the contribution of forests to meeting the targets of SDG 7 -affordable and clean energy.

Conclusions

The relationship of forests to SDG7 is complex as this report indicates. Wood based energy does indeed have multiple benefits but there are significant challenges to demonstrating sustainability of the forest resources that need to be utilized. There are also important implications of efforts to eradicate poverty and ensure the future generations will not be disadvantaged by the actions taken today. There are a number of opportunities for improving the health and sustainability of the forest while addressing issues of poverty, hunger and gender equality. These conclusions are not meant to be exhaustive but they are an important starting point for discussion.

Currently there is no clear pathway to meeting SDG7 target #1, which is to ensure the universal access to affordable, reliable and modern energy services. The challenges and priorities identified in the report focus on finance, forest and supply chain information systems, sustainable forest management, institutional co-ordination with local realities and, carbon and energy pricing.

- **Forest and technology finance** – Meeting any of the targets of universal access, increasing share of renewables and energy efficiency will require significant increase in finance and investment, especially if the goal is to link SDG 7 to the sustainability of forest resources. The pathways to adequate financing remain elusive and will likely require public/private/NGO partnerships to be sustainable. The traditional neo-classical view of the problem is no longer suitable to developing solutions and neither is the neo-classical government approach of simply allocating monies to the problem without a rigorous system of checks and balances. A great deal more effort to understand the local realities and how financing schemes could be developed is required.

  Sustainable forest management - Forests remain under significant human pressure and forest degradation and deforestation remain grave concerns, especially with human population growth in poorer countries. There is already a long history of poor management in much of the world's forest and yet we have the knowledge to do it much better to meet sustainability targets.

  Managing forest lands with a combination of industrial and non-industrial actors is still a significant policy challenge and policy tools such as tenure reform and contracts remain elusive in some countries. Sustainable forest management has to be the basis of expanding the use of forest to produce more renewable energy. Yet these forest are still frequently universally accessible to households in poorer countries.

- **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 lands, especially if we need to demonstrate that forest management play a positive role in the climate change discussion.

Recommendations

There are a number of ways that forest can greatly increase its contributions to the SDG 7 goal of providing access to reliable, efficient, affordable, sustainable modern energy for all. This report has outlined a number of challenges in reaching the goal but there are opportunities and priorities that have been identified.

- **Forest finance**

It is recommended that new financial pathways need to be created to work with existing institutions. Already we have GEF, GCF, Forest Carbon Partnership Facility, BioCarbon Fund and Forest Investment Program to name a few, but this require even more partnerships with private sector and NGO financing to increase in effectiveness. The argument is that we have to move from the neo-classical view of the challenges in order to find the new opportunities. The priority should be twofold: 1. Make substantial investment in appropriate technologies that increase the share of energy that is renewable and improves the energy efficiency of wood. For example, we have investment in up to 100 million improved cook stoves that could be enhanced or improved. 2. Technologies that will make the investments made transparent and accountable in real-time. For example, real time data collection systems, as highlighted earlier in this report, are now developed to work at multiple spatial scales to monitor the forest, the forest use and the GHG benefits of new forms of forest management.

Both uses of technologies will help the financing partners see clearly the evidence that the monies spent are helping achieve a broader range of goals at the local level that include: poverty eradication, climate change benefits, healthier sustainable forests and more use of renewable energy from biomass.

- **Sustainable forest management**

It is recommended that SFM is the foundation of forest management if we want to encourage more or different use of forest resources for renewable energy. There are great challenges, particularly for smallholders and those without an identified legal right to participate in the delivery of SFM. To deliver on SFM will require a landscape approach and coherence between the policies of global institutions and local realities. New ideas from disciplines such neo-institutional economics present alternative frameworks for new opportunities to effect change. For example, smallholder agroforestry in Nicaragua, with the NGO Taking Root, illustrates new sustainable approaches that could be broadly applicable to farmers with secure property rights.

- **Institutional co-ordination with local people**

It is widely recognized that the older approached of top-down implementation of forest policies had not been effective. From a forest point of view, it is now recommended that a landscape approach to forest management be undertaken allowing for policy coherence and more engagement with local people. This is necessary if we want to expand the use of the forest as a source of energy that is both modern and sustainable. Many key global institutions such as the World Bank are now supporting this integrated landscape approach and the incentive mechanisms are developed by the Biocarbon Fund Initiative for Sustainable Forest Landscapes and the Forest Carbon Partnership Facility.

- **Forest and supply chain information systems**

It is recommended that, to be successful in expanding the use of forest to produce more energy, we will need to embrace the technologies now widely available to greatly improve forest inventory and forest information systems. The challenge of managing risk and uncertainty in biological systems remain, but effective systems will greatly assist in mitigating risk and uncertainty. The costs of employing the technology is now much more affordable and it can also encourage a new era of citizen science. This will assist in the proper measurement and monitoring of forest resources for a host of policy and economic benefits. We need further test of the platforms, models and tools already in use in some countries to determine their application particularly in developing countries. It is now possible to take the various tools and 'plug and play' depending on the local needs and preferences. For example, Canada has now developed a Fibre Cascade Model for the boreal forest, FAO has developed National Forest Monitoring Systems for the developing countries and the European Forest Institute and the International Institute of Applied Systems Analysis have developed tools such as European Forest Information Scenario Model.

- **Carbon/energy pricing**

It is recommended that the international community engage actively in the development of standards/protocols and pricing mechanisms for both carbon and energy. Price and regulatory signals needs to be harmonized and consistent for use by international institutions wanting to promote the use of forest in meeting SDG #7. Is also recommended that engagement on the role of different forms of renewable energy (e.g. solar, wind, biofuels) be carefully monitored as complementary to wood energy since the marginal costs of delivering energy from these renewable sources are also dropping dramatically and therefore offer additional complementary opportunity to meet the targets of SDG#7.

It is recommended that a thorough review of the methods be undertaken to determine a more science based approach to assessing the role of cookstoves to SDG #7. For small holders in particular it will be necessary to refine, improve or correct the methods used for the estimation of emissions, carbon offsets and efficiency of both traditional and modern uses of wood energy..

Finally, it is recommended that carbon pricing mechanisms need to be developed either through taxation policy or market exchange mechanisms that are consistent with global approaches. The creation of a clearer price signal will be essential to forest and technology financing to help reach all three targets set out in SDG #7.

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