The Forests Dialogue
Scoping Dialogue on Sustainable Woody Biomass for Energy
June 20-22, 2016 | Montpellier, France

BACKGROUND PAPER

Prepared by James Griffiths[1]

INTRODUCTION - International Development, Climate, Forests and Renewable Energy priorities:

Context

As global demand for energy grows and efforts to use more renewable energy accelerate, the opportunity and need for scaled-up deployment of renewable woody biomass for primary energy production seems self-evident and is strongly promoted by some stakeholder groups. Recent international agreements and commitments appear to further strengthen the case for sustainable woody biomass energy, namely:

- Transformation of the sustainable development agenda by 2030 with specific goals for access to sustainable energy, climate change mitigation and sustainably managed forests under the Sustainable Development Goals (SDG) agreed to in September 2015,
- Global commitments for low carbon development and Greenhouse Gas (GHG) emissions neutrality by 2050 embedded in the Paris Agreement of the UN Framework Convention on Climate Change (UNFCCC), negotiated in December 2015.

Pressing national and regional energy security considerations, based on ready access to locally available or internationally traded renewable woody biomass resources, also enhances deployment prospects. Yet a variety of stakeholders including researchers, civil society groups, industry, media commentators, government policy makers and regulators, point out this is not without risks associated with sustainable production and consumption factors (Creutzig[2]).

Given this international context and the current momentum of woody biomass deployment in key geographies and sectors (e.g. Europe for large scale power generation; in parts of Africa as the primary source of household energy), we can anticipate intensifying discussions on the:

- Expanding role of renewable energy, including woody biomass as well as the land use and forest sectors as a whole, as UNFCCC climate change commitments are made and operationalized under the Paris Agreement - on a 5 yearly cycle starting in 2020 with progressively deepening GHG emission reduction targets,
- Scaling up international development assistance initiatives and funding to achieve SDG outcomes that are woody biomass energy related,
- Formulation of regional and national level public policy energy frameworks and incentives to

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[2] Felix Creutzig et al, *Bioenergy and climate change mitigation: an assessment*, Global Change Biology Bioenergy (2015)

manage and mitigate supply risks associated with expanding woody biomass deployment - happening already in Europe and US,

- The evolving international agenda on forests, such as a focus on scaling up public policies and finance to deliver forest restoration (e.g. the 2011 Bonn Challenge); eliminating deforestation drives from major agricultural commodities like palm oil, soya, beef and pulp/paper (e.g. the Tropical Forest Alliance 2020 public private partnership established in 2012 at the Rio+20 Summit) and action commitments across stakeholder groups to support sustainable forest management (e.g. New York Declaration on Forests at the 2014 UN Climate Summit),
- Launching of research programs and advocacy campaigns to inform and influence woody biomass public policy development, energy sector investments, supply chain business practices and societal attitudes.

Within this context, The Forests Dialogue (TFD), supported by the Program on Forests (PROFOR), the World Business Council for Sustainable Development (WBCSD) and the Sustainable Biomass Partnership (SBP), convened stakeholders for an inaugural scoping dialogue on the topic of *sustainable woody biomass for energy*, June 20-22nd, in Montpellier, France.

<u>Objectives of the background paper and its development:</u>

This TFD background paper was designed to inform the scoping dialogue, with specifically the following objectives:

1. Provide dialogue participants with a brief baseline overview and understanding of concepts and contexts – Part 1
2. Stimulate discussion during the scoping dialogue on challenges and opportunities associated with increased use – Part ll.
3. Present a short listing of information resources as optional pre-reading for dialogue participants and a listing of key acronyms used in the background paper – Parts lll & lV

This background paper was developed with guidance from an Advisory Group involving some 15 stakeholders established by TFD in March 2016 to develop the scoping dialogue. Most of the materials reviewed for the paper were proposed by the Advisory Group which include representatives from civil society, business, research and development organizations, whom also reviewed initial versions.

The background paper was sent in draft format by TFD to all participants on June 14th and it remained as a draft throughout the scoping dialogue. It was presented and extensively discussed at the beginning of the dialogue (morning of June 21st) and participants were invited to provide any further comments by close of business June 24th. This final version reflects some of the key comments made during the dialogue as well as submissions from 8 participants provided post the event.

PART 1 – Context & Concepts:

Concepts – Global Energy and the role of Renewable Energy:

Renewable energy comes from resources that are not significantly depleted by their use including solar, wind, biomass, water and geothermal. According to the Renewable Energy Policy Network for the 21st Century[3] (REN21), renewables are gradually replacing conventional fossil fuels across four distinctive areas – electricity generation, heat and power, transport fuels and rural off-grid energy services.

Based on REN21's 2016 global report[4], renewables contributed annually 19.2 % of global energy consumption and 23.7 % of electricity generation. This energy consumption is divided as 8.9 % coming from traditional biomass, 4.2 % as heat energy (modern biomass, geothermal and solar heat), 3.9 % hydro and 2.2 % electricity from wind, solar, geothermal and biomass.

Worldwide investments in renewable technologies are growing – in 2015 amounting to more than US$ 286 billion with countries like China and the US heavily investing in wind, hydro, solar and biofuels.

Unlike fossil fuels, renewable energy resources exist over wide geographical areas. According to REN21, rapid deployment, in combination with energy efficiency initiatives, results in significant energy security, climate mitigation and economic development benefits and in many countries there is strong public opinion support for promoting renewable sources, especially solar power and wind power.

At least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply and national and regional renewable energy markets are projected to continue to grow strongly in the coming decade and beyond.

Concepts – Woody biomass and the current and future role of Bioenergy:

The International Energy Agency[5] (IEA) defines *biomass* as any organic matter derived from plants or animals on a renewable basis, including wood and agricultural crops, herbaceous and wood energy crops and organic waste.

Bioenergy is energy derived from the direct consumption of biomass as unprocessed or semi-processed *solid or woody biomass* or further processed into *liquids or gas biofuels* – illustrated here:

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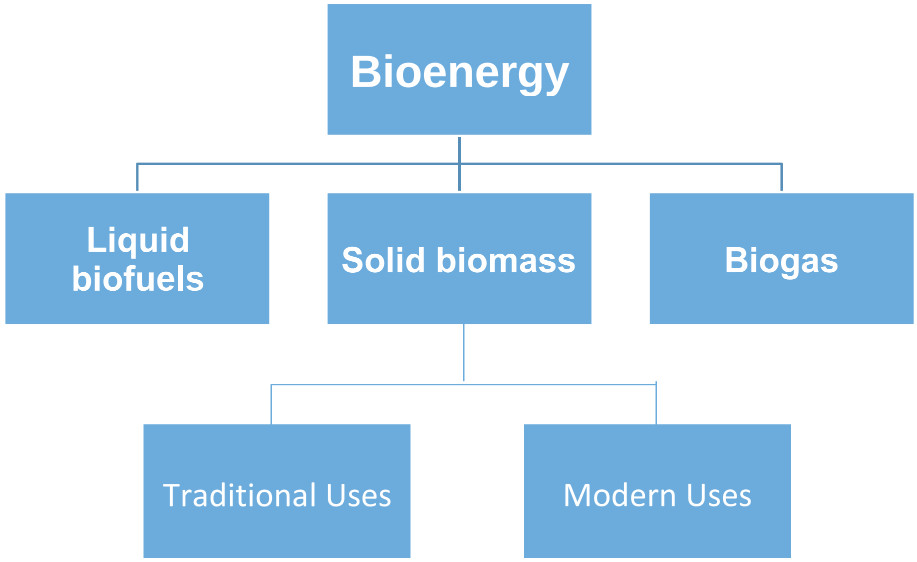
[3] REN21 is a global multi-stakeholder policy network that provides international leadership supporting a rapid transition to renewable energy. Established in 2004 the network is hosted by the UN Environment Program (UNEP).

[4] REN21, Renewables 2016 Global Status Report, web publication http://www.ren21.net/

[5] IEA is an autonomous organization hosted by OECD which works to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA has four main areas of focus: energy security, economic development, environmental awareness and engagement worldwide www.iea.org



(The World Bank 2015)

Note that the primary "scope" of this TFD scoping dialogue is on solid woody biomass for energy developments sourced from forest-based systems, involving stakeholders focused on deployment issues across traditional and modern uses and reflecting the interests of the three sponsoring organizations. Although sharing the same forest origin and sustainable production considerations, it does not encompass forest-derived industrial fuels such as lignin or black liquor. These and other future "bio-economy" fuel developments can certainly be expected to place an increased demand on woody biomass overtime and could be included if any further TFD initiatives eventuate from the Montpellier dialogue.

IEA notes that bioenergy, including woody biomass, is the single largest renewable energy source available today providing some 50 Exajoules[6] (EJ), about 10 % of the world's annual primary energy supply, more than all other renewable sources combined. In the case of solid woody biomass this reflects its use across two contexts – *traditional* or household mainly in Developing countries and *industrial* or modern in Developed countries. Note that some stakeholders feel this historical distinction is an artificial construct, becoming blurred and less relevant as overall renewable woody biomass energy use expands.

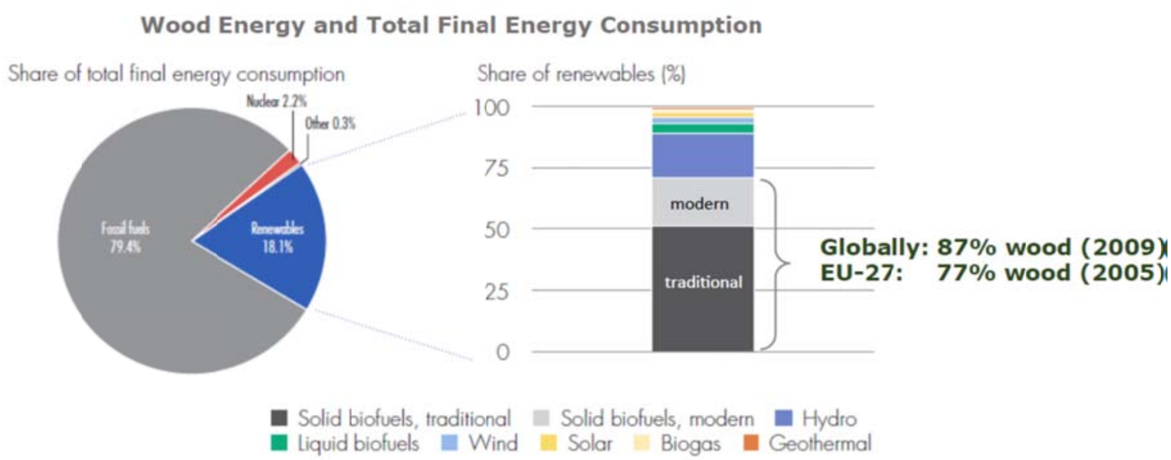
Woody biomass - also referred to as *wood energy* – is primarily derived from production or "working" forests, intensively managed planted forests, agroforestry systems as well as trees outside forests (TOF[7]). Woody biomass provides primary energy in a variety of overlapping fuel formats across both use contexts, including:

[6] EJ are used to describe very large scale energy units. 1 EJ is equal to 10^{18} Joules (J). 1 J is the amount of energy required to light a 1 watt LED light for 1 second. Another large energy unit often used is Petajoule (PJ) which is equivalent to 10^{15} J.

[7] The world has billions of trees not included in the Food & Agriculture Organization's (FAO) definitions for forests and woodlands upon with its global Forest Resources Assessments are made (see note 10). TOF exist in industrialized and developing countries - on farms in rural areas as well as urban situations. TOF providing a wide range of functions and services (e.g. shade and wind shelter, soil protection, livestock fodder) including as a primary source of fuelwood in many developing countries.

- Fire or fuel wood e.g. household cooking and heating.
- Charcoal e.g. household cooking and heating and commercial scale use in urban areas and some industrial processes, such as steel production in Brazil.
- Forest slash, thinnings, roundwood, wood chips, bark and wood processing residues such as sawdust e.g. industrial scale use as the primary energy source in pulp, paper, sawn timber and panel production, but also other sectors including food processing, cement production, chemicals industry.
- Wood pellets e.g. large-scale power generation, district and domestic heating, combined heat and power applications.

Woody biomass energy's current share of total energy consumption is illustrated below:



(The World Bank 2015)

IEA's Technology Road Map Bioenergy for Heat and Power[8] envisages world total primary bioenergy supply increasing to 160 EJ by 2050 to meet expanding global energy demand. This model predicts growth across all sectors utilizing woody biomass, with 100 EJ of this from the large scale generation of heat and power and 60 EJ for transport.

The World Bank attributes this significant growth to a number of core demand drivers operating across many geographic and end use contexts:

- Household use – population growth and urbanization in many developing countries, often with low purchasing power, as well as expanding "discretionary" use in developed countries for outdoor cooking and internal heating,
- Commercial use – readily and locally available alternative to other energy sources, like bottled gas or kerosene, across a variety of applications including catering, food processing and dry cleaning operations, mainly in developing countries,
- Industrial use – renewable energy source and substitute for fossil fuel for low-carbon industrial production across a wide range of sectors, in developed and developing countries,
- Utility use – increasing the renewable energy mix for large scale power and heat generation in developed countries in line with climate commitments and energy security considerations; and as a primary fuel in off-grid or mini-grid energy development, especially in rural areas of developing countries, in line with sustainable development and climate related outcomes.

[8] IEA, *Technology Roadmap: Bioenergy for Heat and Power*, IEA website (2012)

Within the UNFCCC, the role of forests as carbon sinks, stores or sources has been a long term focus under the themes of Land Use, Land Use Change & Forestry (LULUCF) and Reducing Emissions from Deforestation and Forest Degradation (REDD+). The Intergovernmental Panel on Climate Change's (IPCC) 4th Assessment report released in 2007 stated a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or *energy* from the forests, will generate the largest sustained climate mitigation benefit.

This finding has been reconfirmed in subsequent IPCC assessments, which have also acknowledged significant pressures on terrestrial and freshwater ecosystems in the face of growing global food and bioenergy demand. Some environmental advocacy groups, like the Natural Resource Defence Council[9] (NRDC), have strong reservations with the actual on-the-ground implications of such intergovernmental recommendations.

Global forest statistics compiled by the Food & Agriculture Organization of the UN[10] (FAO), further confirm the current global significance of woody biomass as a primary source of energy – with wood fuel production accounting for 57 % (1.8 billion m3) of the annual global harvest, compared to industrial round wood production at 43 % (1.6 billion m3).

To conclude this section, Daioglou[11] summarizes many of the practical opportunities and political policy challenges associated with scaled up biomass for energy use within the context of climate change mitigation:

- Practical advantages include – multiple input sources (e.g. crops, residues, waste streams); provides both heat and power on an ongoing basis (i.e. solar and wind provide electricity only on an intermittent basis); can provide multiple services (i.e. heat/power, transport fuels, feedstock non-energy uses such as biochemical); easily integrated into existing energy infrastructure.
- Political disadvantages span – considerable disagreement on the primary potential of biomass amongst researchers and key climate and energy institutions; the effectiveness of biomass reducing GHG emissions, including direct and indirect production and conversion impacts, when directly substituted for fossil fuels; overall emissions reduction potential is dependent on changes in the overall energy system which, in turn is dependent on a range of connected technical, social, behavioral, political and economic factors.

Context – Household and Commercial use in Developing Countries

Using wood as fuel for heating and cooking is one of humankind's oldest, traditional practices. An estimated one-half of the world's population, primarily in non-OECD[12] countries, depend on woody biomass in the form of fuelwood and charcoal to meet their daily energy needs. Population growth,

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[9] NRDC *Wood Pellet Issue Brief*, web publication (2015)

[10] FAO is the UN system's main technical organization on forests and forestry. Regular collection and analysis of comprehensive statistical forest data from Member States is a primary and important task, including global Forest Resources Assessments.

[11] Vassilis Daioglou, *"The role of biomass in climate change mitigation: Assessing the long-term dynamics of bioenergy and biochemical in the land and energy systems"*, PhD thesis, Utrecht University (2016)

[12] The Organization for Economic Co-operation and Development (OECD) is a grouping of the wealthiest, industrialized Developed Countries with the mission of developing policies that improve the economic and social well-being of people around the world. Currently with 34 member countries, its scope includes energy

economic development and the unconnected nature of energy supply grids in many developing countries means that demand for fuelwood and charcoal will continue to expand.

Traditional use of woody biomass for heating and cooking in the form of fuel wood and charcoal is vast and varied and generally tends to have low energy conversion efficiency. In addition to household use, productive businesses – ranging from bakeries, restaurants, breweries, and brick factories, and iron and aluminium forges – depend on fuelwood or charcoal for their daily operations.

Globally, traditional biomass is often associated with hazardous indoor air pollution and health effects. In many contexts, there is a gender component as well, with women and children spending a disproportionate amount of their time collecting fuel wood and higher exposure rates when cooking. This sector employs significant amounts of labour in supply chains that service urban areas, often on an informal basis.

A 2015 study on the carbon footprint of traditional use estimated that as much as one third of wood fuel harvesting was unsustainable, with large geographic variations. Affecting some 275 million people living in depletion "hotspots" concentrated in Southeast Asia and East Africa, the report suggests these geographies become priority areas for REDD+ interventions and note that the successful deployment of and utilization of energy efficient stoves would deliver major emissions reductions alongside many social and economic co-benefits (Bailis[13]).

In some parts of the developing world, traditional woody biomass use has peaked or is in decline, while other regions, such as Sub-Saharan Africa (SSA), are projected to experience significant growth in biomass use over the next 15 years and could account for as much as 75 % of total residential energy by 2030. In some localities, woody biomass extraction is not driving deforestation, while in others it is perceived as a primary source of forest loss, although location-specific evidence for this is weak. Some developing countries certainly do acknowledge fuelwood as a deforestation driver, despite this weak correlation, and renewable biomass energy is a feature in some REDD+ readiness plans (RPP) and REDD+ strategies.

Extrapolating to the whole of SSA, the World Bank[14] estimates indicate that the charcoal industry was worth more than US$8 billion in 2007, with more than seven million people dependent on the sector for their livelihoods. In line with consumption predictions of the IEA, the economic value of the charcoal industry in SSA may exceed US$12 billion by 2030, employing almost 12 million people.

Modernizing the woody biomass energy sector has the potential of significantly increasing the revenue base of most SSA countries, unlocking resources urgently needed for targeted investments in sustainable natural resources management and other key areas for sustainable economic development and "green" growth. For example, in Kenya, government revenue losses from clandestine charcoal production and trade are estimated at around US$65 million (2007), while in Tanzania, this amount is estimated to be around US$100 million (2009). Indirect value-added, such as employment for government officials or taxes charged on production inputs, such as the use of mobile telephones or tools, are not even considered.

The World Bank notes that more than half of the SDG have wood energy relevance and a growing body of research based evidence suggests substantial co-benefits associated with modernization in

[13] Robert Ballis et al, *The carbon footprint of tradional woodfuels*, Nature Climate Change on-line publication (2015)

[14] World Bank, *Wood-based Biomass Energy Development for Sub-Sahara Africa*, AFREA (2011)

production, processing, distribution and consumption throughout the value chain. These include efficiency advances in stoves, kilns and processing systems which can be achieved through interventions in forest governance, taxation, regulation and technology (Owen[15]). Some examples provided by the World Bank[16] include:

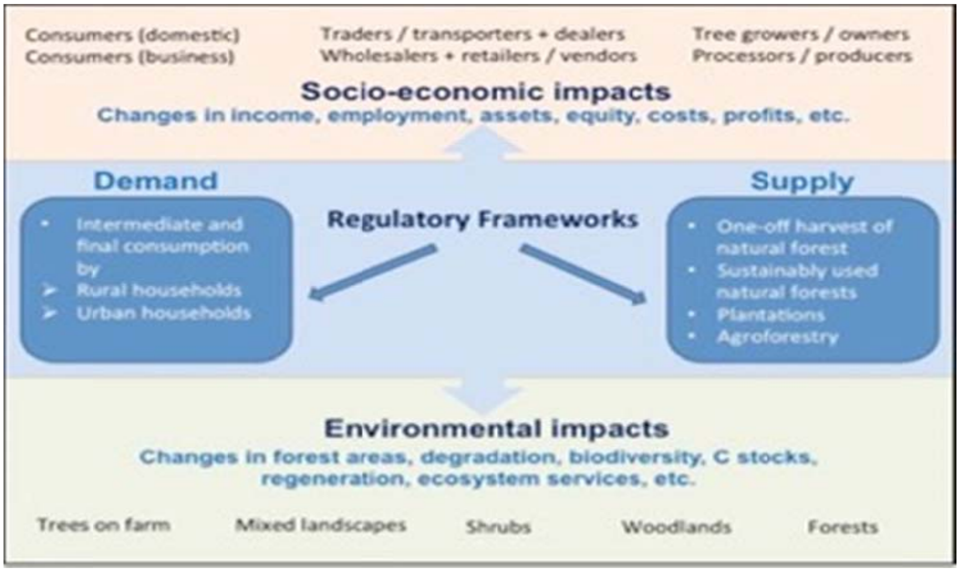
- SDG Goals 1 (end poverty), 3 (health) and 5 (gender) – enhance access to clean cooking and heating technology and appliances to reduce health impacts, improved agroforestry practices to reduce collection burdens
- SDG Goal 7 (energy) – wood energy as off-grid/mini-grid solution, increasing use of renewable energy in commercial and industrial processes.
- SDG 8 (economic growth & employment) – modernization of the wood energy sector, which is often informal, as a higher priority economic growth sector expanding the tax revenue base and generating new opportunities for business and employment.
- SDG 13 (climate change) and 15 (forests) – modernized wood energy sector as drivers of locally controlled tree management systems, vibrant wood energy markets make forests competitive to other land-uses and incentivize re and afforestation investments, wood energy as a low carbon development option; promote the sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.

To conclude with this context, the Center for International Forestry Research[17] (CIFOR) has undertaken a recent systematic review of local development, energy and forestry regulatory frameworks in SSA.

The review looked at wood energy supply and demand and forest management impacts and the many environmental, social and health consequences associated with SSA wood fuel value chains. It concluded that the literature is relatively weak and currently too geographically limited for informed policy formulation.

A more solid, coherent and broad body of knowledge is urgently needed to shape, inform and catalyse at scale modernization and deployment in the SSA region, as illustrated in the following value chain and regulatory framework map:

[15] Matthew Owen et al*, Can there be energy policy in Sub-Saharan Africa without biomass?* Energy for Sustainable Development (2012)
[16] Paula Caballero, *The potential role of wood energy in the post-2015 development agenda,* The World Bank presentation at The World Forestry Congress, High-Level Event on Wood Energy (8 September 2015)
[17] Paolo Omar Cerutti et al, *The socio-economic and environmental impacts of wood energy value chains in Sub-Saharan Africa: a systematic map protocol*, CIFOR Environmental Evidence (2015)



(CIFOR 2016)

Context – Industrial and Modern uses

Woody biomass for energy is often seen as a developing country traditional use issue, but in reality this is far from the case.

Forest and forestry industry statistics from FAO and the United Nations Economic Commission for Europe[18] (UNECE), which covers Europe, North America and the Russian Federation (CIS), confirm its significance throughout these countries with wood as the single most important source of renewable energy, contributing 46 % of total renewable energy. Despite the recent faster pace of solar and wind energy development, wood energy consumption still grew by 4.8 % p.a. in the UNECE region over the period 2011-2013.

Industrial scale use of woody biomass to generate energy is a long, well-established and integrated part of the production of pulp and paper, sawn timber and panels and associated wood mobilization supply chains across the UNECE region, and the forest based industry at 43.9 % is the largest consumer of wood energy.

Other significant and expanding wood energy use includes residential heating (35.8 %), particularly significant in some countries like Italy, and industrial scale combined heat and power applications (17.3 %). In Europe, large scale district home heating networks, with woody biomass as the primary energy source, are also in place (e.g. Germany, Denmark) and will further develop, with forest-rich countries like Sweden leading on the utilization of woody biomass energy.

Within the UNECE region, public policy developments relating to large scale utilization of woody biomass for direct power generation have gained prominence, driven by a mix of climate change and energy security considerations.

In response to the European Union's Renewable Energy Directive (RED) target of 20% renewable energy consumption by 2020, most European Member States are incentivizing increased use of wood for energy. Further, some Member States are currently incentivizing power and heat utility

[18] FAO UNECE, *Forest Products Annual Market Review 2014-2015, Chapter 9 Wood Energy* (FPAMR 2015)

companies to switch from coal to woody biomass as a primary energy source, primarily in the UK, Denmark, the Netherlands and Belgium.

The US Environmental Protection Agency (EPA) is developing rules on carbon accounting which will be important in determining future national utilization of biomass in power generation including woody biomass. While the EPA Framework is still under review, draft guidance is provided on how to assess carbon values across production and consumption cycles[19]. Similarly, the European Commission is currently developing a new policy to address the sustainability of all bioenergy, including wood energy, to address sustainability factors – including verifiable emissions savings – associated with different biomass feedstocks[20]. Significant public policy developments and business investments to support woody biomass mobilization for use in power generation are also evident in Japan and South Korea.

One outcome of these public policy developments has been rapidly expanded investments in the production and regional and international trade of wood pellets, although wood pellets is a small part of the overall forest products industry, which remains very much dominated by traditional paper and wood-based products. As with many rapidly expanding business sectors, this has included new plant openings but also some closures and consolidations of business units in the North American and Baltic wood pellet sectors.

The truly dynamic development of the industrial wood pellet sector over the past decade has transcended the business-as-usual supply limitations of "local" wood-baskets areas, enabling rapid expansion of regional and international wood pellet supply chains to service markets with expanding wood energy demand, primarily in Europe, but also key demand markets like Japan.

According to Hawkins Wright[21], Europe will continue to dominate the industrial wood pellet trade with total projected demand in 2015 at 11.3 million tonnes (compared to the world total of 13.7 million tonnes), rising to a peak European demand of 22.15 million tonnes in 2019 (compared to world total 27.3 million tonnes). Thereafter, demand growth is expected to plateau reflecting completion of major coal-to-wood pellet power plant conversion projects in the UK, Denmark, Netherland and Belgium.

To give this context, 11.3 million tonnes of pellets is "equivalent" to 25 million m3 of wood raw material which, in turn, is part of a global annual harvest of 3.4 billion m3 of Roundwood.

Current global wood pellets trade flows are illustrated in the following map:

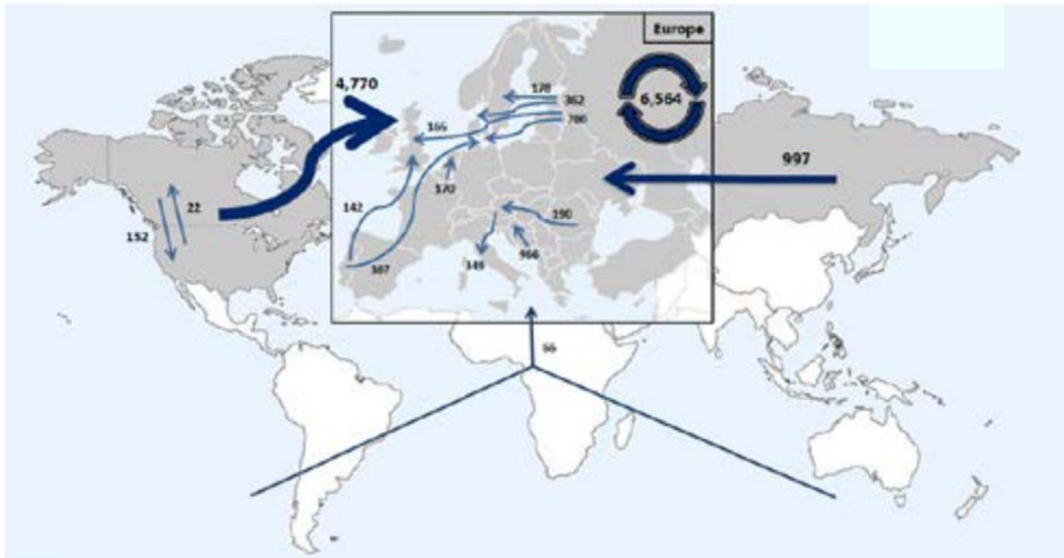
[19] FAO UNECE FPAMR (2015) notes that under these draft EPA rules carbon neutrality of all biomass sources is not assumed automatically.

[20] European Commission renewable energy package roadmap (2016)

[21] Hawkins Wright, *The Outlook for Wood Pellets*, on-line publication. Trends largely support by Q 2 2015 industrial pellet market research by Pöyry

FIGURE 9.2.1

Global main trade flows of wood pellets, 2013 (thousand tonnes)



Note: The map highlights major trade flows.

(FPAMR 2014-2015, FAO UNECE)

This current scale of European market development and the speed of supply chain expansion, especially in the forest-rich US southeast states which has emerged as a major woody biomass supply and pellet manufacturing region, has heightened public policy, supply chain and civil society stakeholder interest, focus and actions. A range of specific sustainability challenges has been raised by NGOs associated with the "policy-driven" growth of wood use for energy, including the:

- Carbon benefits associated with increased use of woody biomass,
- Impacts on forests in Europe and in the US southeast of industrial wood energy use and pellet supply chains[22],
- Merits of direct conversion of logs given high value use options,
- Level of public subsidy associated with large scale biomass for energy development relative to other renewable energy options which are considered to be less carbon intensive e.g. solar, hydro, wind.

In public statements many NGOs have also indicated a strong preference for Forest Stewardship Council (FSC) certification as an independent verification option.

Industry groups have responded to many of these claims: citing sustainable forest management sources and statistics; decline in traditional markets and forest owner interest in new supply opportunities; the important role of biomass as part of an energy mix that cannot be solely dependent on intermittent wind and solar power sources; and the lack of FSC uptake in important resource centers.

[22] The Dogwood Alliance is actively campaigning on overall impacts but has particular concerns about the use of logs for direct conversion into wood pellets – see website https://www.dogwoodalliance.org/wetland-investigation-3-16/. Also on Europe forest impacts see http://www.fern.org/flames

As part of this dynamic, the Sustainable Biomass Partnership[23] (SBP) has been established by European utility companies to specifically provide an assurance framework for forest management to woody energy utilization supply chains to certify performance against EU Member State sustainability regulations. SBP's certification scheme, which is purpose built for wood pellets and chips used in industrial large-scale energy production, leverages existing forest management and chain-of-custody certification provided by the FSC, the Programme for the Endorsement of Forest Certification (PEFC) and the Sustainable Forestry Initiative (SFI). Currently, the Danish and UK regulators have recognized that SBP certification satisfies their verification requirements[24].

Stakeholder differences and conflicting views are certainly evident within the European Commission process, noted earlier, this is now underway to develop its sustainability bioenergy policy 2020-2030 to support Europe's GHG emissions reduction target of 40 % relative to 1990, with a target of 27 % of the EU's energy to come from renewable resources, up from the 20 % RED target for 2020. This regulatory process is intended to include the development of a sustainable biomass policy to maximize resource-efficient use, deliver robust and verifiable GHG savings, ensure fair competition between biomass use sectors, encompass sustainable land use and forest management and address indirect land-use change (ILUC) or leakage effects[25].

To conclude this context section, the development of the Dutch renewable energy sector provides an additional and current national level illustration of how these sustainability concerns play out via the design of public policy energy and subsidy programs, NGO advocacy initiatives and corporate actions.

The 2013 Dutch National Energy Accord (SDE+) set out a subsidy scheme for co-firing solid biomass up to 25 PJ/year under conditions that extensive and prescriptive sustainability criteria would apply. In the absence of European Union level sustainability standards for forest management (forests remains as area of Member State competency) or woody biomass energy (although EU sustainability standards do exist for liquid biofuels) this national level process included extensive consultations between Dutch environment groups and utility companies.

The Dutch process has generated a very detailed set of sustainability requirements for biomass feedstock for co-firing and large scale heat production for any utilities accessing the SDE+ program. These requirements cover 7 feedstock categories with around 50 principles across criteria for sustainable forest management, GHG balance, carbon debt, ILUC, soil quality, compliance with legislation and chain-of-custody. To date, no Dutch utility company has moved ahead with any co-firing projects, while some supply chain actors are unsure if access to the Dutch wood pellet for energy market is feasible given these complexities[26].
It is very likely that as other countries develop policy frameworks these same tensions around sustainability will manifest themselves, with the potential to generate considerable inertia in the deployment of sustainable woody biomass as a significant renewable energy solution - be it for large scale utilization or use within small to medium decentralized grid or heating systems.

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[23] See SBP website http://www.sustainablebiomasspartnership.org/
[24] There are quite a few examples of industry-based biomass verification or certification schemes – see for instance AEBIOMs ENplus http://www.enplus-pellets.eu/about-enplus/ and this scheme in Massachusetts https://www.nrdc.org/sites/default/files/massachusettsbiomass.pdf. By enlarge, NGOs remain skeptical of the credibility of business developed sustainability frameworks.
[25] European Commission on-line public consultation documentation
[26] Dutch Biomass Certification Foundation workshop, Rotterdam, May 25th 2016

PART ll – Challenges and Opportunities for a sustainable woody biomass future

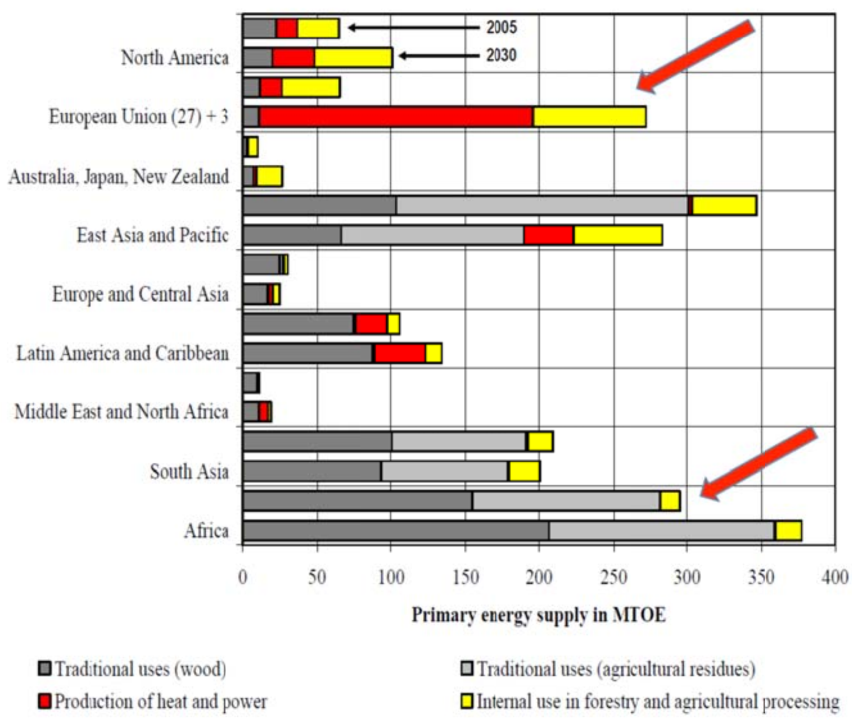
Renewable Woody Biomass Energy Facts

Two woody biomass for energy *facts* are self-evident, which poses a number of sustainability challenges:

1. *Current use* is *significant* across both traditional and industrial contexts in developing and developed countries to meet *existing* energy demand, including home heating, commercial and industrial use through to large-scale heat and power production.
2. *Future use* as a key renewable energy resource will *increase* in many geographies to meet *growing* energy demand with deployment influenced by a combination of sustainable development, climate change, low-carbon growth, renewable energy and energy security considerations – as illustrated by these World Bank projections:

Total Primary Energy Supply from primary solid biomass by region and type in 2005 and 2030

- 2.8 billion people will depend on traditional fuels in 2030
- How much wood is that? Impact on forests/trees?

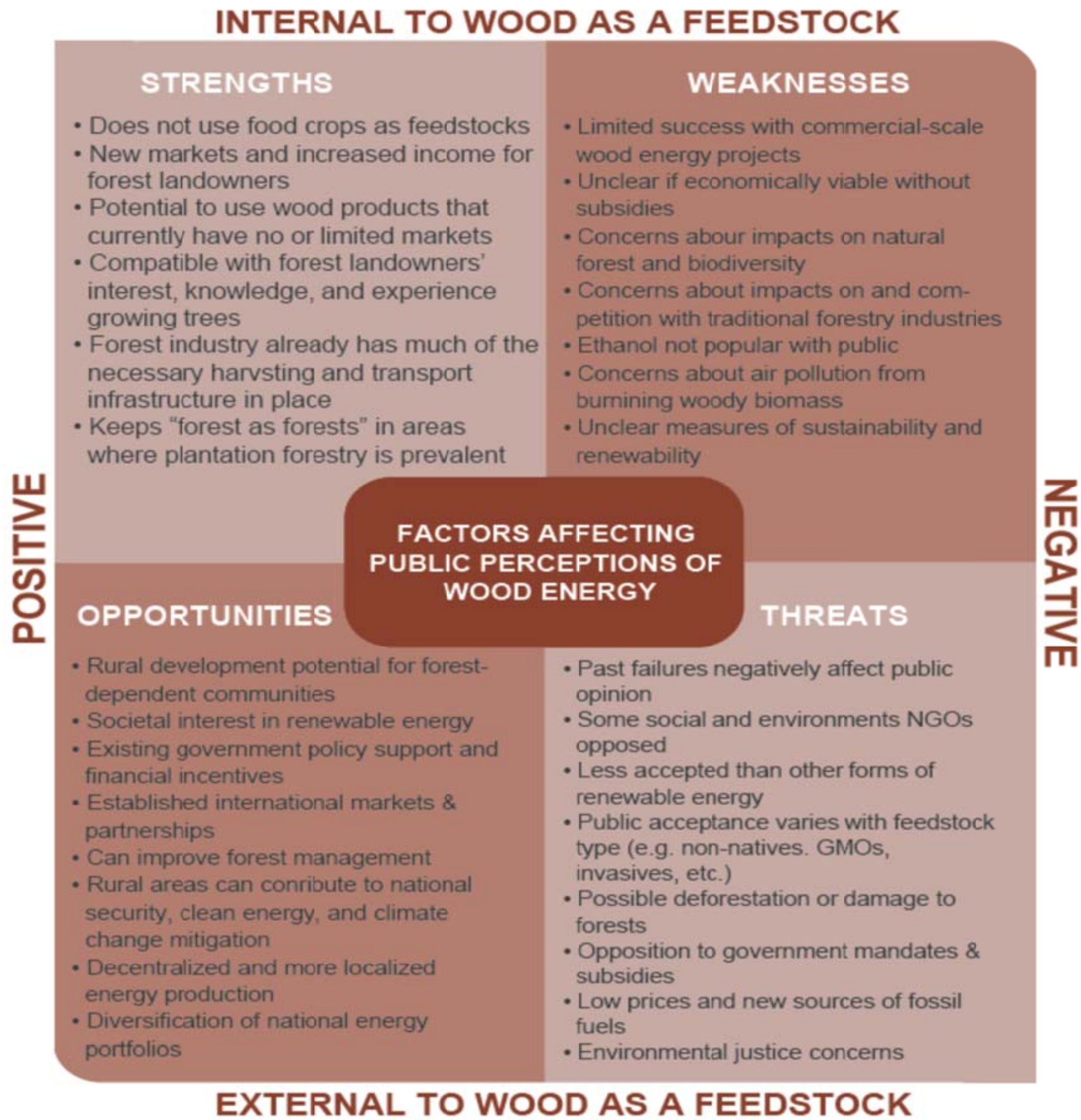


(The World Bank 2015)

Public Perception and Public Policies – diverse perspectives on what is sustainable

Public perceptions and public policies interact over time and this holds true for wood energy policy frameworks and market development. This makes public opinion research one useful way of identifying and categorizing conflict issues, or fracture lines, associated with woody biomass for energy use.

Research in the US and Europe by Hitchner[27] provides the following illustrative summary of external and internal sustainability factors affecting public perceptions relating to wood energy, both positive and negative.



Factors on the right side of this matrix are representative of key *fracture lines* in the sustainable woody biomass for energy debate.

These public perceptions both *impact on* and are *impacted by* public policy frameworks in a circular pattern, either *preventing and delaying* wood energy deployment or *enabling and accelerating* developments.

[27] Sarah Hitchner et al, *Public opinion and wood energy*, condensed summary published as *Public Perceptions of Bioenergy*, Southeastern Partnership for Integrated Biomass Supply Systems (2015)

A number of researchers have stressed the importance of developing more widely acceptable sustainability criteria and indicators (environmental, social and economic), not only for biomass for energy, but for the long-term development of a broader bio-based global economy (Fritsche et al[28]).

Woody biomass for energy fracture lines

The literature surveyed for the dialogue indicates that deployment of woody biomass at the levels envisaged by IEA and REN21 to meet expanding global energy demand will be impacted and influenced by many sustainability challenges, symptomatic of the existence of a number of fracture lines between different stakeholder groups.

These fracture lines are significant and warrant focused dialogue, discussion and, if possible, resolution. Drawing from this literature these fracture lines have been clustered below under five categories, each concluding with a series of questions that might provide a discussion focus for dialogue participants:

1. Forests and Land Use.
2. GHG Neutrality and Carbon Balance.
3. Resource Efficiency.
4. Regulatory Frameworks.
5. Technology.

1. <u>Forests and Land Use Impacts</u>

The potential for direct and indirect forest and land use change, primarily driven by the scale and speed of expanding woody biomass energy development, appears to be the paramount concern of many stakeholders.

El-Lakany[29] indicates that central to all forest based supply strategies are embedded concepts of multi-functional landscapes, integrated landscape design and resilience in the face of climate changes yet to come, and points to the need for fundamental research to better quantify socio-ecological costs, advantages and tradeoffs of bioenergy development.

WWF's Living Forest Model[30] has a vision that by 2050 100% of the world's energy will come from sustainable renewable resources. Within this, depending on how bioenergy including woody biomass is deployed, it could either be a significant *threat* (e.g. forest conversion, increased emissions, food production displacement) or *solution* (e.g. biodiversity is conserved and zero net deforestation achieved; well-managed bioenergy production supporting energy security, rural development, emissions reduction and provides incentives for good forest stewardship).

Some civil society groups in Europe and the US are advocating that the scale and pace of European woody biomass for energy supply chains are significantly impacting forest management practices in

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[28] Uwe Fritsche & Leire Iriarte, *"Sustainability Criteria and Indicators for the Bio-Based Economy in Europe: Stage of Discussion and Way Forward"*, Energies 2014
[29] Hosny El-Lakany, *The forestry, agriculture, bioenergy nexus*, UBC branchlines (Winter 2015)
[30] WWF International, *Living Forests Report – Forests and Energy (Chapter 2)*, web publication (2011)

the US southeast, accelerating harvest levels, encouraging whole tree conversions and undermining biodiversity conservation[31].

Research reports by Galik[32] and Forest2Market[33] counter these assertions - indicating that US southeast forest inventories are not decreasing or carbon storage capacity diminishing as a result of the significant growth in wood pellet production and trade to Europe. These reports contend the development of woody biomass markets in fact helps provide additional incentives to forest owners, who in this region are mainly private landowners with small holdings, to maintain forests and improve management practices. These points were reconfirmed very recently by US Forest Service (USFS) Chief Tom Tidwell in his speech at a European Commission hosted bioenergy stakeholder conference[34].

Key questions:

- Can the capacity of woody biomass for energy production systems in key supply areas service expanding demand on a sustainable basis without compromising ecosystem service delivery, contributing to forest conversion and loss of biodiversity?

- What is the appropriate role of intensively managed planted forests, agroforestry and TOF systems to meet expanding demand without contributing to further forest conversion and associated emissions?

- Can these more managed land use options be adapted to contribute to landscape restoration (e.g. the rehabilitation and recovery of degraded land) and sustainable livelihoods?

- What are the natural capital opportunity costs of production intensification and increased harvesting compared to keeping forests in-tact and ensuring ecosystem service generation?

2. GHG neutrality and Carbon balance

A key tension point in the current debate on sustainability of woody biomass is the claimed climate benefits of biomass production and consumption relative to fossil fuels and other renewables. This becomes particularly significant and polarizing in the context of public funded large scale subsidy programs for woody biomass energy use aimed to reduce carbon emissions.

In addition to the direct land use change emissions impacts commonly considered under Life Cycle Assessments (LCA), emissions associated with processing, manufacturing and transportation and when the woody biomass is consumed are also within scope. Whilst some view wood energy carbon emissions as essentially neutral if sourced from a sustainably manged forests[35], the relatively small emissions of methane and nitrous oxide created in the burning process are not reabsorbed into the standing and growing forests. So while woody biomass from sustainable sources are considered by some stakeholders as carbon neutral, broad based GHG neutrality claims cannot be made.

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[31] Patterson Clark and Joby Warrick, *Cutting trees to fight climate change?* Energy & Environment (2015)
[32] Christopher Galik and Robert Abt, *Sustainability guidelines and forest market response: an assessment of European Union pellet demand in the southeastern United States*, Global Change Biology Bioenergy (2015)
[33] Forest2Market, *Wood Supply Market Trends in the US South 1995-2015*, Forest2Market Inc. report (2015)
[34] USFS, *prepared remarks for European Commission Stakeholder conference – A sustainable bioenergy policy for the period after 2020*, Brussels, May 12th 2016
[35] WBCSD NCASI, *Recommendations on Biomass Carbon Neutrality*, WBCSD website (2015)

There is a body of research that carbon neutrality of biomass cannot be assumed[36] and, when it is claimed, usually reflects an incomplete understanding of IPCC guidelines on full GHG accounting[37]. Some stakeholders strongly share this perspectives – they see biomass energy as a "high" carbon renewable energy option compared too solar and wind and, when it comes to wood energy, that "high" (e.g. from forest harvested at levels which deplete carbon stocks) and "low" (e.g. forest product processing residues) carbon sources exist.

LCA is a one widely accepted tool for assessing the impact of products or services resulting from short term industrial processes, including GHG emissions and is primarily used to identify input and output "hot spots" and reduction potential. It assists decision making by comparing and benchmarking the product or service in questions with alternatives or by exploring different product or service use scenarios.

IEA's Bioenergy Task Group 43[38] indicate that the LCA assessment of biomass supply chains is not straightforward when applied to long term forest production systems which are based on many natural factors like sunlight, water and nutrients. To better assess environment aspects including emissions, the Task Group recommends inclusion of a number of additional non-standard impact categories like land use and land use change, water use, carbon stocks, soils and biodiversity. With regard to GHG emissions, it points out the need to distinguish between carbon emissions resulting from biomass consumption which can be considered neutral if the forest, including its carbon stock, is sustainably managed and the carbon which is emitted when fossil fuel is combusted.

Gaudreault[39] points to the need for using LCA, complemented by site and region specific studies, as an additional tool in forest biomass harvesting assessments. These can help prevent shifting environmental problems, such as land use impacts that contribute to biodiversity loss, across the supply chain as a result of very localized land management decisions.

Miner[40] offers several research-based insights to better understand forest bioenergy and "carbon debts" in the context of US bioenergy policy, including (1) if wood producing land remains in forests, long-lived wood products and bioenergy reduce fossil fuel use and long term carbon emission impacts (2) increased demand for wood can trigger investments that increase forest area and forest

[36] As illustrations see video clip featuring William Moomaw, Tufts University and IPCC author https://eubioenergy.com/2015/11/20/bioenergy-is-not-carbon-neutral-says-ipcc-author-william-moomaw/ posted on EU Bioenergy website hosted by Birdlife Europe, European Environmental Bureau and Transport & Environment (2015); February 22nd 2016 letter from 65 US climate and forest scientists to the US Congress expressing concern at the climate implications of the proposed "forest biomass carbon neutrality" amendment to the Energy Policy Modernization Act; other sources include Joint Research Centre (2013), Matthews et al. (2014), Manomet Center for Conservation Sciences (2010), Opinion of the EEA Scientific Committee on Greenhouse Gas Accounting in Relation to Bioenergy; http://www.sciencedirect.com/science/article/pii/S0301421512001681

[37] See IPCC accounting guideline Q2-10 relate to biomass for energy http://www.ipcc-nggip.iges.or.jp/faq/faq.html

[38] IEA Bioenergy Task 43, *Assessing the environmental performance of biomass supply chains*, Report 2015:TR01 (2015)

[39] Caroline Gaudreault et al, *Addressing Biodiversity Impacts of Land Use in Life Cycle Assessment of Forest Biomass Harvesting,* Wiley On-Line Library (2016)

[40] Reid Miner et al, *Forest Carbon Accounting Considerations in US Bioenergy Policy*, Journal of Forestry (2014)

productivity and reduce impacts associated with increased harvesting (3) the carbon debt concept emphasises short term emissions, although it is long term cumulative emissions that are correlated with peak global temperature, and these cumulative emissions are reduced by substituting forest bioenergy for fossils fuels.

IEA's Bioenergy Task Group[41] has also considered the timing aspects of forest-based bioenergy emissions, noting the importance of understanding the full climate effects of bioenergy from existing forests (e.g. climate forcing factors). Rather than focusing on more immediate aspects, such as the timing of differences between emissions and sequestration, the Task Group advises that it is more relevant to focus on assessing the contribution that bioenergy from existing forests may make to the establishment of renewable energy systems that will provide GHG-friendly energy supply into the future.

Key questions:

- Is there scope for convergence between stakeholder groups that have taken very different positions on the carbon neutrality of woody biomass for energy?

- Can a more harmonized approach around forest carbon accounting methodology support more aligned stakeholder viewpoints on GHG impacts and benefits as well as better informing public policy frameworks and investments in sustainable woody biomass for energy developments?

- Can different perspectives on the time horizons for accounting for woody biomass for energy emissions be narrowed or reconciled? Is LCA a useful or adaptable tool in assessing GHG balance of woody biomass energy? In particular, can the accounting scope for woody biomass emissions across both production and consumption cycles be agreed? What could be effective measures to tackle emissions from wood energy use and identify and differentiate between "low" and "high" sources?

3. Resource efficiency and cascading use[42]

A civil society coalition of 10 organizations coordinated by BirdLife Europe submitted, as one of its key policy recommendations on the European Union's post 2020 climate and energy policy, that to ensure the efficient and optimal use of biomass resources, the cascading use "principle" should apply so biomass is used to make materials and products first and then recover the energy content[43]. Similar recommendations have been made by civil society groups – including WWF[44] – during the current public consultation process for EU level sustainable biomass standards.

A coalition of six European trade associations coordinated by the European Biomass Association[45]

[41] IEA Bioenergy, *On the Timing of Greenhouse Gas Mitigation Benefits of Forest-Based Bioenergy*, IEA ExCo (2013)
[42] There is no official or commonly agreed upon definition for cascading use. One researcher has proposed "Cascading use of biomass takes place when biomass is processed into a bio-based final product and this final product is utilized at least once more either for material use or energy" – see Carus, M. (2014): Cascading concepts and proposal for a new definition. Presentation at the second workshop "Cascading use of biomass – from theory to practice", Brussels, 01.04.2014.
[43] NGO coalition recommendations, *Pitfalls and Potentials: The role of bioenergy in the EU climate and energy policy post 2020,* Birdlife Europe website (2014)
[44] WWF, *A sustainable bioenergy policy for the period after 2020*, EU on-line public submission (2016)
[45] AEBIOM et al, *Joint statement on cascade use of wood*, AEBIOM website (2013)

(AEBIOM) has a counter position outlined in a joint statement on the cascade use of wood, making the case that it was not feasible to legislate for higher use and that sustainable wood mobilization to meet expanding demand was a more feasible and impactful approach.

IEA Bioenergy Task Group 40[46] has recently released a working paper on the cascading of woody biomass. Its findings note there is considerable uncertainty about what cascading actually entails, implementation would be complex (e.g. allocating different material type between alternative use assortments) and it was unclear how it could support the policy goal of expanding renewable energy and the role of woody biomass within this. It advises that policy makers should avoid artificial constraints to mobilizing biomass resources given only 65 % of Europe's annual growth increment is currently harvested. Further, a focus on resource mobilizing is a more productive way of meeting EU aspirations for development of a bio-based economy.

A supply chain actor perspective suggests that the market realities of low value international trade commodities like wood pellets relative to higher value products like wooden building materials, paper and packaging, ensures that the primary feedstocks for wood pellet will predominately remain lower value pulp logs, forest slash, cuttings and waste and wood residues from sawmilling. Some industry groups, such as pulp, paper or panel companies, have stated that public incentives for wood energy use distorts markets and the ability of the forest products industry to compete with the energy sector for available fiber[47].

For yet other stakeholder groups, logs deemed to be of low economic value may be considered of high conservation and ecological value when from natural forest systems. These groups have generally called for an alignment of existing public policies with cascading use objectives, modelled on waste management and the waste hierarchy approach.

Key questions:

- Is scaled-up use of woody biomass for energy the optimal use of valuable natural resources in situations when alternative longer life and reuse options are available e.g. wood based products; pulp, paper and paper-based packaging?

- Why is woody energy considered the lowest value option under the cascading principle given the priorities now placed on sustainable development, low carbon emissions and energy security including increasing renewable energy use?

4. Regulatory frameworks and governance capacity building, including the role of independent verification

Thiffault[48] warns of the challenges of developing transboundary governance mechanisms like the European Union's RED without a deeper understanding of sustainable forest management

[46] IEA Bioenergy TASK 40, *Cascading of woody biomass: definitions, policies and effects on international trade*, Working Paper (2016)

[47] See the American Forest & Paper Association (AFPA) http://www.afandpa.org/media/news/2015/11/18/new-research-shows-uk-wood-pellet-subsidies-distort-the-us-market-for-wood-fiber

[48] Evelyne Thiffault et al, *Sustainability of forest bioenergy feedstock supply chains: Local, national and international policy perspectives*, Biofuels, Bioprod. Bioref. (2015)

frameworks and practices in key supply regions. The lack of a uniform definition for sustainable forest management and significant national differences in land definitions, delineation and reporting make the implementation of supra-national sustainability schemes complex, requiring an open and multi-stakeholder approaches to reduce or eliminate pitfalls.

Lamers[49] also reviews and notes the challenges and opportunities associated with developing stainability standards at a national level for forest biomass when there is a strong regional and international trade dimension, due to the complexities associated with different national approaches and forest circumstances.

The role of existing voluntary forest certification systems to verify woody biomass energy products has also been the subject of a number of reviews. Sikkema[50] found that some (e.g. legality, sustainable harvest rates, no deforestation) but not all (e.g. GHG harvest emissions, forest carbon stocks) existing EU requirements could be verified by FSC and PEFC forest management certification, while existing risk based approaches under FSC and PEFC provided lower levels of assurance.

The report made a number of suggestions to strengthen the verification role of existing voluntary forest certification schemes including mass balance requirements, tracing and tracking, mutual recognition between systems and efforts to expand certification uptake in some regions (US southeast) through group certification. Note that the need for carbon accounting outlined is this report, has been acted on by PEFC which is developing an Emission Data Transfer Standard. Note also that during the current transition period for the Dutch SDE+ sustainability requirements, both FSC and PEFC endorsed standards are recognized as verifiers for sustainable forest management and sustainable management of residues.

Stupak[51] surveyed stakeholders on views and experience for systems needed to govern the sustainability of bioenergy. The survey revealed significant support along the supply chain for legislation which uses market-based certification systems to demonstrate compliance. The development of meta-standards to bridge divergent views emerged as a promising approach and the need to adapt some standards for specific bioenergy needs was noted e.g. to deal with issues like Indirect Land Use Change (ILUC). More research was recommended to better understand differences between existing schemes including costs, inclusiveness, quality of substantive and procedural rules and subsequent on-the-ground effectiveness.

In its submission to the European Commission on post 2020 sustainable bioenergy policy, the SBP recommended an efficient and pragmatic approach to the sustainability verification of woody biomass used in large scale heat and electricity production in Europe. This should include development of a high-level clear and simple set of criteria integrating EU and Member State requirements, which certification schemes and assurance frameworks, such as SBP, can then incorporate within standards[52].

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[49] Patrick Lamers at al, *Challenges and opportunities of sustainability standards for forest biomass designated for International trade*, Chapter in Mobilization of forest bioenergy in the boreal and temperate biomes (2016)
[50] Richard Sikkema et al, *Legal Harvesting, Sustainable Sourcing and Cascaded Use for Bioenergy: Their Coverage through Existing Certification Frameworks for Sustainable Forest Management*, Forests (2014)
[51] Inge Stupak et al, *A global survey of stakeholder views and experiences for systems needed to effectively and efficiently govern sustainability of bioenergy*, WIREs Energy Environ (2016)
[52] SBP submission to European Commission post 2020 public consultation (2016)

Some stakeholders have strong views that sustainable forest management frameworks, including 3rd party verification, is not sufficient to ensure the sustainability of woody biomass energy and that additional policy tools and "safeguards" therefore are essential.

Wood energy public policy needs in developing countries – including governance capacity – is also an important theme with many stakeholder groups. The CIFOR[53] review, mentioned earlier, calls for a more solid, coherent and broad body of knowledge to shape, inform and catalyse at scale modernization and deployment in the SSA region. Bailis[54], in identifying potential areas of wood fuel-driven degradation or deforestation in South Asia and East Africa, is seeking to inform the ongoing development of REDD-based approaches to climate mitigation and recommend improving interventions and research around charcoal as a key renewable energy option.

Owen[55] calls for an urgent need to recast with national policy makers the current and future role of biomass energy in Sub-Sahara Africa to generate employment, support urban-rural revenue flow, strengthen energy security and drive green economic development. The World Bank[56] also recognizes the significant current role and a much more promising future for woody biomass based energy development within many developing countries.

Some Overseas Development Agencies (ODA) already have sustainable biomass energy as a high priority theme. As an illustration, the German international development agency, GIZ, has developed a number of policy guide and resource kits[57] for stakeholders in government institutions, NGO's and donors involved in biomass energy sector development based on many years of practical experience across many African countries.

Key questions:

- How will public policies currently emerging in Europe and the US constrain or enable sustainable woody biomass energy developments internationally? How will growing interest in tradable woody biomass products from Japan and Korea impact the debate? Will these Developed Country processes seek to include or exclude Developing Country supply opportunities?

- Should the Precautionary Principle be more central in public policy considerations when designing subsidy and regulatory frameworks that will generate substantial increased use of woody biomass?

- In addressing the scale of demand for woody biomass, are qualitative requirements need to ensure sustainability? In public policy design, how should supply or demand "caps" be best deployed? Are caps flexibility enough to respond to market dynamics and business investment cycles?

- Shouldn't public subsidy program be better balanced to incentivize deployment of a broader mix

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[53] See earlier
[54] See earlier
[55] See earlier
[56] Elizabeth Cushion et al, *Bioenergy Development: Issues and Impacts for Poverty and Natural Resource Management*, The World Bank Agriculture and Rural Development (2013)
[57] For instance, see *"Towards sustainable modern wood energy development"*, GIZ/GBEP (2014); "*Biomass Energy Sector Planning Guide*", GIZ/EUEI PDF (2014); *"Wood Energy: Renewable, profitable and modern"*, GIZ/BMZ (2014)

of renewable options (e.g. solar, tidal, hydro) and energy efficiency outcomes, rather than mainly prioritize woody biomass developments?

- Can independent forest certification frameworks provide, on a cost effective basis, sufficient assurance on forest management practices in key source areas (e.g. forest carbon stocks, no conversion or controversial stocks) and chain of custody control, and support GHG accounting through the value chain? Can other measurement, reporting and verification (MRV) options also provide the necessary level of assurance, such as the MRV systems being developed for REDD+?

- Given current use and future potential, should woody biomass energy be a higher priority for national and international development assistance finance and strategies in particular to build local wood energy governance, management and project implementation capacity in Developing Countries?

5. <u>Technology</u>

WBCSD's Low Carbon Technology Partnerships initiative (LCTPi)[58] prepared for the UNFCCC Paris conference included key proposals to "scale-up" deployment of forest-based climate solutions with significant bioenergy and technological dimensions. These included expanding sustainable forest management; increasing the production of forest products, including bioenergy, as the basis for the bio-economy with 50 % of all materials made from forest-based renewable resources by 2050, as well as an increased share of forest-based biomass residues in the energy mix; and the deployment of resource use and energy efficiency breakthrough technologies throughout operations and supply chains[59].

Owen[60] articulates the need in many developing countries for the modernization of traditional biomass for energy production, processing, distribution and consumption processes, capitalizing on the significant and currently available technological advances in stoves, kilns, processing systems and means of salvaging waste energy sources for productive use. Bailis calculates that the successful deployment of 100 million improved stoves in wood fuel dependent countries could reduce current emissions by 11-17 %, generating avoided GHG emissions worth over US $ 1 billion a year[61].

Key questions:

- How to adapt intensive forest and tree management practices to manage carbon sequestration and stocks while meeting expanding demand from established timber, pulp & paper markets as well as additional wood energy to achieve the carbon and other societal benefits associated with fossil fuel substitution?

- What is the role of technologies in scaling up the deployment of sustainable woody biomass

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[58] WBCSD*, Low Carbon Technology Partnerships initiative: Forests and Forest Products as carbon Sinks,* WBCSD website (2015); Fibria, *Future Forest Industry – Results of an on-line survey*, on-line publication (2016)

[59] As indicated earlier, forest biomass biofuels are outside the scope of this particular dialogue. Note that WBCSD's LCTPi includes a range of initiatives and targets associated with expanding production of biomass source biofuels. As the diversity of these fuels increases over time, certain desirable attributes of wood biomass for biofuel production will be sought. LCTPi anticipates this will lead to the selected certain tree species and deployment of intensively managed tree fuel crops.

[60] Owen - see earlier

[61] Bailis - see earlier. GHG value illustration calculated using a price of US$ 11 per tonne of carbon dioxide

energy throughout the supply chain covering production, conversion and consumption phases?

- Is the future development of bio-based technologies, contributing to a global bio-economy, a more useful framework within which consider challenges and opportunities associated with the sustainable production and consumption of renewable woody biomass energy solutions?

Creating a framework for future dialogue:

In discussing the fracture lines outlined above, participants might also want to also reflect on the following points relating to future multi-stakeholder initiatives that could emerge from the Montpellier scoping dialogue:

1. *Will* dialogue on these (and other) fracture lines contribute to a more *compelling vision* for a sustainable woody biomass for energy future - across multiple geographic and end-use contexts - that is *collectively shared* across stakeholder groups?

2. *Can* stakeholders agree on any *guiding principles or standards* to "safeguard" the deployment of sustainable wood energy supply outcomes that are environmentally sustainable, economically viable and socially equitable in response to growing energy demand and the need to reduce GHG emissions?

3. *How* can sufficient *consensus* be built between stakeholder groups to *collectively support* the design of current and future public policy frameworks to accelerate deployment of woody biomass energy solutions that help achieve sustainable, low-carbon and bio-economy based development?

4. *What* initial steps can be taken to start *building* a sustainable woody biomass for energy *consensus* within the SDG's 2015-2030 process now under way and ahead of the 2020-2050 timeframe of the UNFCCC Paris Agreement?

PART lll – Some suggested pre-reading resources:

In preparation for the dialogue, participants are invited to review some of these on-line resources on sustainable woody biomass for energy.

Overviews – development, energy and sectors:

- FAO UNECE Forest Products Annual Market Review 2014-2015 – chapter 9 on wood energy
- World Bank Bioenergy Development – Issues and impacts for poverty and natural resource management
- REN21 Renewables 2016 Global Status Report

Research articles:

- Robert Bailis et al, The carbon footprint of traditional woodfuels, Nature Climate Change (2015)
- Felix Creutzig et al, Bioenergy and climate change mitigation: an assessment, Global Change Biology Bioenergy (2015)
- IEA Bioenergy, On the Timing of Greenhouse Gas Mitigation Benefits of Forest-Based Bioenergy, IEA ExCo (2013)
- Richard Sikkema et al, Legal harvesting, Sustainable Sourcing and Cascaded Use of Wood for Bioenergy: Their coverage through Existing Certification Frameworks for Sustainable Forest Management, Forests (2014)
- Inge Stupak et al, A global survey of stakeholder views and experiences for systems needed to effectively and efficiently govern sustainability of bioenergy, John Wiley & Sons (2015)
- Sarah Hitchner et al, Public Perceptions of Bioenergy, IBSS (2015)

Civil Society Groups:

- WWF International – Living Forest Report: Chapter 2 Forests and Energy
- Pitfalls and Potentials: The role of bioenergy in the EU climate and energy policy posts 2020

Industry Associations:

- USIPA wood pellet information and resources
- AEBIOM European Bioenergy Outlook – 2015 statistical report

PART lV – List of woody biomass and stakeholder acronyms used in the background paper

AEBIOM	European Biomass Association
AFPA	American Forest & Paper Association
CIFOR	Center for International Forestry Research
EJ	Exajoules
EPA	US Environmental Protection Agency
EU	European Union
FAO	Food and Agriculture Organization of the UN
FSC	Forest Stewardship Council
GHG	Greenhouse Gas
IEA	International Energy Agency
ILUC	In Direct Land Use Change
IPCC	Intergovernmental Panel on Climate Change
J	Joule
LCA	Life Cycle Assessment
LCTPi	Low Carbon Technology Partnership initiative
LULUCF	Land Use, Land Use Change & Forestry
NGO	Non-governmental Organizations
NRDC	Natural Resource Defence Council
ODA	Overseas Development Agencies
OECD	Organization for Economic Co-operation and Development
PEFC	Programme for the Endorsement of Forest Certification
PJ	Petajoules
PROFOR	Program for Forests hosted by The World Bank
RED	European Union Renewable Energy Directive
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REN21	Renewable Energy Policy Network for the 21^{st} Century
SBP	Sustainable Biomass Partnership
SDE+	Dutch National Energy Accord
SDG	Sustainable Development Goals
SFI	Sustainable Forestry Initiative
SSA	Sub-Saharan Africa
TFD	The Forests Dialogue
TOF	Trees Outside Forests
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USFS	United States Forest Service
WBCSD	World Business Council for Sustainable Development
WWF	WWF International