# A GLOBAL OVERVIEW OF WOOD BASED BIOENERGY: PRODUCTION, CONSUMPTION, TRENDS AND IMPACTS

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***Enviva bottomland hardwood cut in Southeast Virginia, US.***
***Photo courtesy: Dogwood Alliance***

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**GLOBAL FOREST COALITION**

## Executive Summary

Globally, world primary energy production remains overwhelmingly dominated by coal, oil and gas. According to the International Energy Agency (IEA), only around 13% of all energy used worldwide comes from energy classified as renewable. However, of that around 77% is from bioenergy and waste including liquid transportation fuels and the combustion of municipal solid waste and wood bioenergy. In total around two thirds of that bioenergy use involves traditional use of wood and other biomass for cooking and heating, as is practiced by much of the population in the global South.

Those traditional uses bear little resemblance to the escalating commercial and industrial-scale production and consumption characteristic of industrial countries like Europe and North America, and energy intensive industries such as paper production and metal smelting, worldwide.

With respect to industrial use, about 25% is by pulp mills, with wood and black liquor (a byproduct of pulp production) being burned to provide heat and electricity for facilities. Charcoal production for the steel industry is particularly significant in some regions, for example in Brazil. The push to develop liquid transportation fuels from wood continues, but so far it is not being produced on a commercial scale in spite of ongoing research and investment. The most rapidly growing new frontier for wood bioenergy is as 'renewable' electricity and heat generation in Europe and North America and, to a smaller extent, in East Asia.

However, the case of the UK's DRAX facility (case study 7) illustrates the potential scale of this new frontier, which depends almost entirely on the emerging international trade in wood pellets. This trade is currently almost entirely 'north-north', and is primarily made up of wood pellets exported from the USA and Canada to EU countries (especially the UK) but also with an emerging trade between Russia and the EU, and Russia and East Asia. Some trade also exists between European countries.

While there is concern that this expanding demand for wood bioenergy will result in trade from southern to northern countries, this has not yet materialised. While there have been numerous project proposals, they have mostly not come to fruition.[1] Nonetheless, it is important to note that there have been investments made in expanding tree plantations supposedly with a view to supplying northern demand, based on expectation and hype about the possibility of new markets, even in the absence of actual real and concrete agreements. A case in point is the Suzano e Papel investment in Maranhão, Brazil, (see Box 1) where Cerrado forest was bulldozed and communities lost their land to eucalyptus plantations across 40,000 has, partly for the purpose of producing wood pellets for a UK power station—yet neither the proposed pellet plant nor the UK power station that was intended to burn the pellets have so far been built.[2]

Significant new demands for wood are being created through renewable energy subsidies in Northern countries, and these are being carefully monitored by the forestry products industry, and also by tree biotechnology companies, which see potential markets for trees engineered to meet the specifications of that market. The 'modern' push to use wood bioenergy in the North is part of a larger overall attempt to develop alternative non-fossil fuel sources not only for energy but also for the

[1] See http://www.biofuelwatch.org.uk/2014/biomass-landgrabbing-report/
[2] http://biofuelwatch.org.uk/wp-content/uploads/eucalyptus-plantations-for-energy-online.pdf

production of materials and chemicals. These are encompassed under the term 'bioeconomy.' Should a substantial portion of the proposed bioeconomy become manifest, the threats to forests and ecosystems could be vast indeed.

Meanwhile, wood remains a traditional primary source of energy for many people and this use is being targeted as 'dirty, dangerous and destructive' even as modern bioenergy, including from wood-based biomass, is being touted as clean, green, renewable and climate-friendly. For example, the International Energy Agency states that, "*Traditional biomass use refers to the use of wood, charcoal, agricultural residues and animal dung for cooking and heating in the residential sector. It tends to have very low conversion efficiency (10% to 20%) and often unsustainable supply.*"[3] While this may be the case, pellet stoves and boilers in the global North are classed as 'modern' and in Europe ultramodern gasifiers with ~20% efficiency are being subsidised.

The push to develop this modern wood bioenergy, including coal plant conversions, is driven entirely by subsidies and targets for renewable energy, which is clearly not the case for traditional uses of biomass. Those supports are provided on the assumption that burning wood for electricity and heat is clean, green, renewable and good for the climate in spite of a very substantial literature to the contrary. Burning wood for electricity is still considered to be inherently 'carbon neutral' or 'low-carbon' and is thus granted incentives as a means to reduce emissions. Yet per unit of energy generated the amount of carbon released from biomass power stations is up to 50% higher than even coal. It is assumed new tree growth will offset those emissions, but this is far from guaranteed and the time scale over which it may occur is far too long. In fact, industrial biomass facilities cause similar levels of air pollution to coal power plants.

Certainly there are problems with traditional uses of biomass, but these must be evaluated from the perspective that they are often the only option people have available for meeting their most basic needs. In some cases it may be possible to maintain ecological balance and meet those basic local needs for fuel. However, as these case studies indicate, expanding demand for both wood and charcoal for domestic and industrial fuel use is taking its toll on forests and woodlands in many places and thus on people's future ability to meet their basic needs at the local level. Expanding demands may include providing wood and charcoal fuel to nearby urban centres, meeting demands for growing commercial and industrial applications (iron production, brick firing etc.), or even exporting wood and charcoal to other regions and countries. In addition, the usurpation of lands for plantations in order to provide wood that is mostly for export (especially for the pulp and paper industry)—and, particularly in Brazil, for bioenergy, including industrial charcoal—also undermines access for local communities.

Ultimately, the degradation of forests and woodlands and the expansion of plantations to meet additional demand for wood-based biomass undermines local people's capacity to meet basic needs, including for wood and food, as both wood and farmland become increasingly scarce. The consequences of this are often felt most strongly by women and children as they are largely tasked with acquiring firewood as well as cooking. When they are forced to travel further and further to find wood, time for other activities including schooling is diminished and they may be exposed to risks of injury or abuse during forays in search of wood. In addition the use of pesticides in tree plantations contaminates waterways and is affecting community life in many areas.

[3] http://www.iea.org/topics/renewables/subtopics/

In general deforestation and the spread of plantations leads to degraded soils and lands that cannot be used anymore, a further loss of endemic/endangered biodiversity and ecosystems, contaminated waterways, land grabs and restrictions on access to traditional forests that are closely linked to cultures and people's livelihoods.

On the consumer side, air pollution has been an important factor affecting communities living near wood-processing facilities.

Cooking over open fires also represents a serious health threat for women and children and is linked to over four million deaths per year. This has been a focus of attention and investment by public-private partnership initiatives such as the Global Alliance for Clean Cookstoves (GACC). These have directed efforts towards the development and distribution of supposedly modern and more efficient cookstoves. Yet very little has been done to properly evaluate and independently assess the effectiveness of these 'top down' programmes. Evidence is now emerging that in many cases ineffective and inefficient stoves are being promoted, with little benefit for people's health. As a public-private partnership, GACC is boosting corporate profits and corporate control over the domestic cooking sector. For example, under the auspices of GACC, USAID are soliciting grant applications for cookstove distribution in Kenya, but only from those who *"have the potential to achieve sales volume of several thousand units per month within the project period."* [4] Such corporate-controlled cookstove initiatives are attracting increasingly large funds.

Meanwhile another public-private partnerships, the UN Sustainable Energy for All (SE4Aall, which collaborates closely with GACC), proclaims its mission to provide 'energy for all' including cooking fuel, transport fuels and electrification, in regions where these are currently scarce. SE4Aall even goes so far as to call traditional biomass the *"only unsustainable form of energy"* and one that should be eradicated. Yet apart from this, the SE4all initiative does not discriminate between different kinds of energy, supporting everything from natural gas and coal, through to nuclear power and even industrial-scale biomass. Nothing is excluded and no standards are applied.[5]

Thus 'solutions' and technologies are being imposed under the guise of being 'pro-people' even though they are really aimed at opening up new commercial markets for corporate interests and developing infrastructure for extractive industries (eg building roads and extending electricity grids to enable the development of mining company operations). These 'solutions' tend to be high tech and to require outside expertise and manufacturing.

Increased reliance on wood-based biomass also opens the door to the acceptance of genetically-engineered trees—which may be engineered to grow in a wider range of habitats and/or be engineered for easier processing into fuel—resulting in irreversible negative impacts, including the escape of modified genes into natural forests. Civil society organisations are currently mobilising to prevent the commercialisation of GE trees in Brazil and the US.[6]

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[4] http://www.cleancookstoves.org/funding-opportunities/usaid-winrock-kenya-cookstoves-rfa.pdf
[5] http://www.biofuelwatch.org.uk/2012/biomass_myth_report/
[6] http://climate-connections.org/2014/08/20/groups-globally-mobilize-to-stop-commercial-release-of-genetically-engineered-eucalyptus-trees-in-brazil-and-us/

Empowering communities to develop their own solutions is clearly a far better option than imposing them from above and afar. For example, in the case of cookstoves, some stoves have been rejected out of hand because they fail to take into account simple commonly understood aspects of local cultural traditions for cooking. In other cases the operation of the stoves has been difficult, or the stoves required certain kinds of fuel that are not generally available, or the manufacture of the stoves themselves is not possible locally and people become dependent on outside sources for purchase and repair.

In the case study from Colombia (case study 4), for example, there was a clear framework of energy sovereignty within which local solutions to these problems was developed. The concept of energy sovereignty is based on local control over local resources to meet local needs. As such it is a key tool for ensuring that communities avoid being preyed upon by corporate and commercial interests who present their activities with a veneer of providing assistance and services, alleviating poverty, or addressing health concerns, when they are actually seeking access and control over markets, land and resources.

In sum, uses of wood bioenergy, must be evaluated within the context of a justice-based framework that prioritises meeting basic needs, seeks to avoid ecological damage, protects health and empowers communities to hold and maintain control and sovereignty over their energy and resources.

***Box I. Eucalyptus plantations for energy: A case study of Suzano's plantations for Wood pellet exports in the Baixo Paranaíba región, Maranhão-Brazil.***

*The expansion of eucalyptus in the Baixo Parnaíba caused an explosion of conflicts with communities who started to lose their land in the highlands, the flat, agricultural lands that Suzano was interested in. Due to a temporary fall in global paper demand and prices as a result of the financial crisis, Suzano shifted the focus of their eucalyptus production away from pulping for paper production to producing wood pellets for export. In 2009, Suzano received permission to clearcut around 40,000 hectares of Cerrado. The appropriation of land in Baixo Parnaíba has been characterised by the exploitation of the traditional communities that have occupied it for generations, and by the violation of their legitimate rights to use and access the land. Eucalyptus quickly caused negative impacts; communities complained that river headwaters close to plantations have dried up and that the volume of water flowing in nearby streams in Baixo Parnaíba has reduced significantly. The Cerrado and its biodiversity set the pace of life for people living in the area; the people and animals there have no use for the vast tracts of monoculture plantations, which provide no fruit or other kind of sustenance. In March 2013, Suzano decided to suspend the construction of a pellet plant that would process eucalyptus planted in Baixo Parnaíba. A Federal Prosecutor successfully appealed the granting of an environmental licence for a pulp mill and eucalyptus plantations awarded to Suzano by the State Government of Maranhão (which was not the competent authority to issue it in the first place). The Federal Court in Piauí revoked the company's preliminary environmental licence and on 3 May 2013, the Secretary of the Environment and Water Resources announced the cancellation of Suzano's licence for its pulp mill project.*

**Source:** **http://biofuelwatch.org.uk/wp-content/uploads/eucalyptus-plantations-for-energy-online.pdf**

***Box II. Biofuels for a sustainable future: Challenges for a 100% renewable energy system in Sweden, Swedish Society for Nature Conservation (SSNC)***

*Currently, bioenergy only constitutes a small portion of the global energy market. However, the percentage is growing rapidly. Crucial to the total impact on the environment is what crop is grown on the site before it is claimed for energy production. SNCC discusses bioenergy in several of their own policy documents, particularly those dealing with climate, forestry and agriculture.*

*Bioenergy constitutes about 20% of the total energy supply in Sweden (2010). Most of it comes from the forest sector, about 90%. In the heating sector bioenergy dominates, but this type of energy also plays an important role in electricity generation. Transpors is still mostly (over 90%) based on fossil fuel energy. Fuel from biomass represents a small, albeit rapidly growing part. Imports of biofuels represents a relatively small proportion, mainly different kinds of biofuels (ethanol and biodiesel) and their raw materials.*

*A supply mix of electricity that is based entirely on renewable sources of energy and raw materials in 2030 at approximately 115-125 TWh (i.e. about the same level as today) could include 15-25 TWh biomass power.*

*Sweden has good prospects for the domestic production of biomass from forest and farmland. Problems and possible opportunities are discussed and a list of criteria for long-term sustainability is provided in the full report iIn Swedish). Today, about 110 TWh of bioenergy is derived from the forestry sector (of which approximately 14 TWh is from forest fuels and the rest industrial waste products) and 2.3 TWh from the agricultural sector. Common to both of these is that there is a great theoretical potential to increase production but the competition for raw materials with other uses and a need for restrictions to protect the ecological and social values reduces the potential. Today, the total withdrawals for all uses is around 225 TWh from the forest (calculated as wood fuel, including stem wood and stumps) and about 80 TWh from arable land (today's production level of feed, food and energy).*

*Import of biofuels produced in the Global South is briefly reviewed. EU total import of biofuels is significant. Incentives for this include the Renewables Directive and the, in many cases, short-term profitability of plantations for energy in the South. In many cases, this production causes huge problems for both humans and the environment. In some cases, the climate impact from plantations can undermine the purpose of a transition to renewable energy. The rapidly increasing production of palm oil in Southeast Asia is highlighted as an example. Increased competition with other land uses, including food production, is an important aspect. The problem of exploitation where ownership and use rights are unclear is discussed in the section on 'Land grabbing.'*

*The future potential for biofuel production in Sweden is discussed. Assessments of the potential from a range of companies, organisations and authorities are presented and discussed. The report highlights market conditions, technical and practical problems and opportunities, and the need for ecological and social constraints on production. One conclusion of the report is that many stakeholders tend to overestimate the potential. Despite this, there are good opportunities to increase the Swedish domestic production of biofuels, giving sufficient consideration to biodiversity, others ecosystem services, climate change and social aspects.*

*The assessments of the potential for forest fuels that applies reasonable restrictions conclude a future sustainable yield of 20-35 TWh. The difference between these figures depends mainly how much stem wood (other than felling residues) is used for energy, which in turn depends on future market conditions and policy instruments. The assessments for the agricultural sector vary even more. The initiative called fornybart.nu (Renewables Now!), of which SNCC is a part, has estimated 7 TWh from this sector in 2020.*

*Policy instruments and eco-labelling are discussed in the report. Sweden's energy policy is largely dependent on EU directives being implemented in national legislation. Some of these are highlighted, including the proposals from the EU Commission that involves indirect impact on land use (ILUC effects). Eco-labelling's role as a driving force for a transition to a 100% renewable energy system is discussed in a review of the SSNC eco-label 'Good Environmental Choice.'*

Summarised from http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/rapporter/rapport_biobranslen.pdf

## Case Studies

### 1. Firewood and Charcoal Production in Paraguay - *by Miguel Lovera, Espacio Orgánico, Paraguay*

### Background

Paraguay is a country originally rich in forests. Of its 40,600,000 ha territory, some 25,000,000 ha were covered by forests, approximately 8,000,000 ha of which were subtropical moist forests and 16,000,000 ha dry subtropical and tropical formations in the Chaco Region. However, only some scattered patches of the subtropical moist forests remain (about 1,000,000 ha in total); and there are only about 14,000,000 ha of the dry forests formation in the Chaco remaining.[7]

Deforestation is still rampant throughout the country.[8] The main drivers are the expansion of the agricultural frontier, mainly to plant soybeans in the Eastern Region and to enlarge the pastures for cattle ranching in the Chaco. But the production of charcoal and the harvesting of firewood are key drivers of degradation and devastation of forests as well.

Paraguay is a great producer of hydroelectric power, generating an average of 9,000 kWh per inhabitant.[9] However, much of this is exported and the most common source of energy for domestic consumption is biomass. Firewood and charcoal provide for most household and industrial uses and this consumption contributes heavily to the deforestation and degradation of forests in the country. Additionally, domestic wood combustion—in stoves without chimneys laid on the floors of the huts of poor people—poses significant health problems for women who are exposed to smoke on a daily basis while cooking.

In recent years, charcoal also became an important export product, with quantities traded reaching and even surpassing domestic consumption levels.

Both the consumption and production of firewood and charcoal need to be addressed. Alternative energy sources such as solar and, in some cases, wind, should be accessed. A rationalisation of the distribution of and democratic access to hydropower should also be established without more ado, thus distributing the power generated by the installed hydropower plants democratically and fairly amongst the population, so they depend less on wood.

### Firewood

Firewood is the most used source of energy, mainly for cooking. More than half (52%) of domestic energy consumption is based on biomass; 70% of this biomass is charcoal (8%) or firewood (70%).[10] This situation makes Paraguay the largest per capita consumer/producer of firewood in the Mercosur region (which comprises Argentina, Brazil, Paraguay and Uruguay).[11] Up to 50,000 ha of wood is harvested

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[7] These data are derived from analysis of the latest deforestation maps by INFONA (Instituto Forestal Nacional www.infona.gov.py)

[8] See for example www.lanacion.com.py/articulo/153813--chaco-paraguayo-presenta-la-mayor-deforestacion-del-mundo-en-23-anos.html

[9] http://www.ssme.gov.py/VMME/sector%20energetico/sec_energetico.htm

[10] Secretaria del Ambiente, 2013. Hoja de Ruta para la Estrategia Nacional para un Desarrollo Bajo en Carbono. SEAM. Asunción, 2012. www.seam.gov.py

[11] Viceministerio de Minas y Energia, Balance Energetico Nacional 2011, in, Ministerio de Obras Publicas y Comunicaciones, Asuncion, 2012. www.ssme.gov.py

annually for energy purposes, most of it from native forests. In the case of the Eastern Region of Paraguay, where the subtropical moist forest is

situated, the remaining stands are mainly secondary. This means that the firewood harvest in this region takes a particularly heavy toll on forest recovery and resilience.

Nowadays, the main industrial demand for firewood is grain drying. Paraguay is the fourth largest exporter of soybeans and produces some 9,000,000 tons/year. This requires more than 500,000 tons/year of wood. A similar quantity of wheat, maize and other grains demand a comparable amount of wood every year, most of which is sourced from natural stands.[12]

**Charcoal Production**

Charcoal production in Paraguay has a dismal tradition. More is exported than retained for domestic use even though the local population, mainly households and small industries, depends on it, including for cooking.

During the 70's and in recent years, most of the exported charcoal has gone to Brazil. The majority of that was illegally exported, providing no benefit to the peasants who produced it beyond the meagre wages paid on a piecework basis. It is difficult to quantify the volume of charcoal sold in this way. However, on one spot check a visiting investigative committee found 17 truckloads of illegal charcoal waiting at the Paraguay-Brazil border, in broad daylight, for their Brazilian counterparts to arrive and collect the charcoal.[13] Assuming each truckload of charcoal weighs approximately 20 tons, 100 tons of timber would be required to make the charcoal carried by each lorry, which would in turn have required the harvesting of roughly one ha of Paraguay's subtropical forests per truck. This adds up to 17 ha of deforestation being generated by just this one event. The quantity actually crossing the border will be some five times this every day, so we can estimate that more than 20,000 ha of forest are being lost every year to produce illegal charcoal to export to Brazil.

Paraguay also exports high-quality barbecue charcoal. Last year exporters earned some US$ 35,000,000 in exports to countries including Spain, Germany, Belgium, Brazil, Israel and Chile.[14] This represents the destruction of roughly 12,000 ha more forest.

Another great charcoal consumer in Paraguay is the steel industry. At the moment, only one steel mill exists in the country, ACEPAR. According to the Workers Cooperative of ACEPAR,[15] in the period between 2000 and 2008 the mill produced 815,174 tons of pig iron. The mill consumes 1.25 tons of charcoal per ton of pig iron, which meant consuming 1,018,968 tons of charcoal during this period, with equates to an average annual consumption of 127,371 tons of charcoal. This represents some 636,855 tons of wood or 6,369 ha of forest.

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[12] Calculated on basis of conventional firewood use in drying grain for storage in silos.

[13] http://www.abc.com.py/edicion-impresa/interior/el-contrabando-del-carbon-al-brasil-florece-en-la-zona-de-canindeyu-906897.html

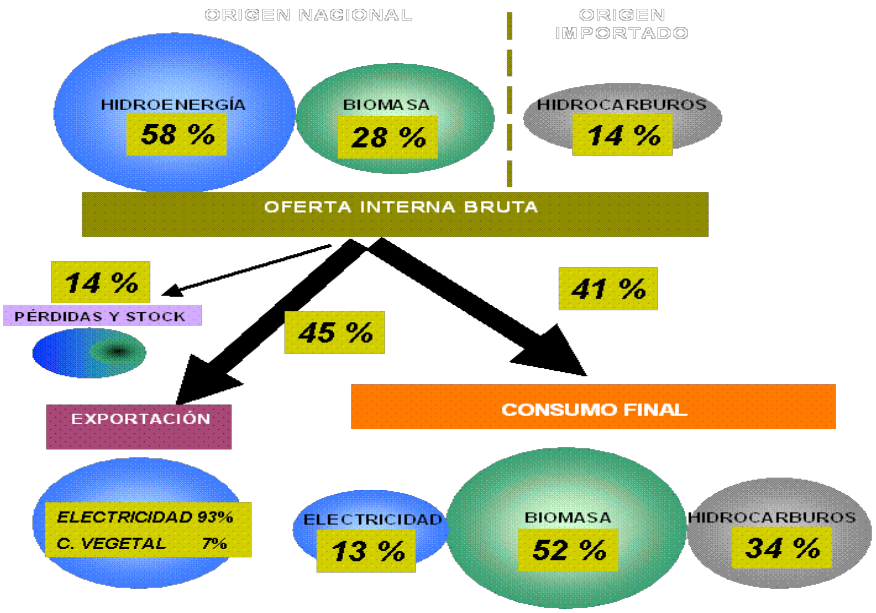
[14] REDIEX, 2010. Perfiles de Productos para la Exportación No. 9. Carbón vegetal Red de Inversiones y Exportaciones http://www.rediex.gov.py/userfiles/file/9%20-%20PPE%20Carbon%20vegetal.pdf

[15] http://www.diarioprimeraplana.com/v1/index.php/locales/itemlist/date/2014/2/19?start=10

## Conclusion

With abundant resources for hydroelectric production and some 250 sunny days per year, Paraguay should not rely so heavily on wood as a source of energy. Paraguay's energy transmission infrastructure needs to be improved, and democratically controlled and accessible hydroelectricity transmission facilities should be built. Shifting to these sustainable renewable sources of energy would clearly make a very significant difference to Paraguay's rates of deforestation and forest degradation, potentially reducing deforestation by something in the order of 50,000 ha/year.

**Structure of the Energy Matrix of Paraguay**




***Source: Vice-Ministry of Mines and Energy of Paraguay, 2007.*** *From top left to right: Hydroenergy 58%; Biomass 28%; Hydrocarbon 14%; Internal Gross Offer (from left to right): Losses and stock 14%; Export 45%; Final consumption 41%; Row below left to right: Electricity 93%; Charcoal 7%; Electricity 13%; Biomass 52%; Hydrocarbon 34%*

**2. Wood-Based Bioenergy in Uganda: The Bukaleba Forest Reserve** - *by David Kureeba, NAPE, Uganda*

Uganda is one of numerous African countries that seem to have a thirst for foreign investment in a number of sectors regardless of its impacts on the environment and people's livelihoods. This can be exemplified by the Government of Uganda's decision to lease over 347 ha of the south Busoga forest reserve in Bukaleba to Norwegian company Green Resources for commercial tree planting.[16] This project is located in eastern central Uganda along the fringes of Lake Victoria. The project borders the Madhvani sugar company's plantations, Lake Victoria water catchment areas (wetlands) and communities.

***Firewood collection in the Bukaleba forest reserve. Photo courtesy: D. Kureeba***

**Background national context**

Energy is sourced primarily from biomass (88.9%, of which fuel wood comprises 78.6%, charcoal 5.6% and agricultural residues 4.7%), with the remainder coming from petroleum products (9.7%), and electricity (1.4%). Access to electricity stands at 14% nationally and in rural areas it is just 7%. Per capita electricity consumption remains one of the lowest in the world at less than 100kWhrs per person.[17] With respect to renewables, solar use is about 1%, hydro and thermal electricity about 4%, and biogas and geothermal about 0.5%.

About 91% of Ugandans use wood-based energy for cooking, lighting and baking, and it is used as fuel in institutions such as schools, hospitals and households; most of the fuel wood used for cooking is used in highly inefficient 'three stone' cookstoves, especially in the rural areas where most of the population lives.

This is a clear threat to tree and shrub species in forests and woodlots. Uganda's renewable energy policy adds to that threat: its target is to blend biofuels and fossils fuels (with biofuels eventually expected to constitute at least 20% of the mix[18]). This

[16] http://www.ndf.fi/project/ncf-bukaleba-charcoal-project-ndf-c3-b14

[17] https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Uganda_EOI.pdf

[18] Renewable Energy Policy for Uganda 2007

has led to the promotion of plantations of crops such as oil palm, which is a biofuel feedstock crop.

In addition, according to a paper published by Renewable and Sustainable Energy Reviews[19] in 2013, there is a high level of wastage of biomass resources in Uganda. This is due to the fact that an estimated 72.7% of the population uses traditional cookstoves with efficiency estimated to be less than 10%. Inefficient cookstoves are also blamed for indoor air pollution and respiratory illness.

**The policy context with respect to wood based energy in Uganda**

There is no clear information on wood based bio-energy in Uganda. The information available at administrative centres is scanty.

Uganda developed a policy on climate change in 2013[20] and is also in the process of developing a national REDD+ strategy.[21] In addition it aims to scale up renewable energy provision in Uganda generally.[22]

Uganda's energy policies mainly focus on hydropower generation and rural electrification, but also include policies concerning the potential production of crops such as jatropha, oil palm and other crops, as potential biofuel feedstocks. According to the renewable energy policy 2007, Uganda aims to blend at least 20% of biofuels with fossil fuels. This will be disastrous for the environment, because of the land required to grow the feedstocks.

If plantations happen to be included in the definition of forests used in policies relating to REDD+ and biomass, this may have an impact on existing forests. It can be expected that most people will go for fast growing trees produced in plantations, potentially at the expense of slow growing indigenous species. Indigenous trees will most likely be replaced with exotic species.

There is also a guideline on governance of the charcoal sector. This is aimed at regulating charcoal, creating standards that lead to the use of improved technologies and increasing efficiency. It is believed that one of the challenges relating to local charcoal burning relates to the rudimentary way in which it is burned. Investment has thus been sought to introduce new kilns, which are intended to be more energy efficient. However, while this might be desirable, in practice it seems that the overall process is not involving local people at all. As a result, communities are increasingly becoming energy deficient. For instance, the charcoal kilns promoted by the government do not seem to be for producing charcoal for domestic use but for export to nearby towns and neighbouring countries. There is no evidence that local communities are benefiting.

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[19] http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.elsevier-093a9717-97ec-3e37-a43a-aee9ad3afc39

[20] http://www.ccu.go.ug/index.php/news-events/news-media-releases/90-approval-of-national-climate-change-policy-2013

[21] http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0CEsQFjAG&url=http%3A%2F%2Fmwe.go.ug%2Findex.php%3Foption%3Dcom_docman%26task%3Ddoc_download%26gid%3D659%26Itemid%3D223&ei=CWZPVNHDI_Ow7AaBi4HQCw&usg=AFQjCNEeoiEfh3rOem9QdqfMQVwl09VMjQ&sig2=XladPpGYuEXkaQM6fpzrSA&bvm=bv.77880786,d.ZGU

[22] https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Uganda_EOI.pdf

Uganda's Renewable Energy Policy which was published in 2007, is supposed to "*increase access to modern, affordable and reliable energy services as a contribution to poverty eradication"* [23] but it has not been well implemented so far. In reality the country's approach to renewable energy is heavily biased in favour of biomass technologies such as biomass gasification, co-generation, biogas generation, biomass densification, and energy-efficient cookstoves (although these have not been widely disseminated so far). However, while these policies may look good on paper, they are not pro-people.

**Left: Burning kiln for charcoal production at the Bukaleba forest; Right: Cooking with firewood. Photos courtesy: D. Kureeba**

### Current situation regarding bioenergy

Biomass is a supposedly renewable energy resource. However, its extensive exploitation in Uganda raises concerns about growing demand and its negative impacts on the environment, particularly in this era of climate change and low adaptive capacity in less developed countries, Uganda included. These concerns are more prominent on the African continent, particularly in countries like Uganda, where explosive population growth rates mean that the country's population is predicted to grow fivefold by 2050 (from 27.7 million to 130 million people).[24] If all these people continue to rely on wood as a fuel, the consequences for Uganda's remaining natural forests and small-scale farmers (whose land is being grabbed as plantations expand) are stark. The use of traditional and inefficient bioenergy technologies and appliances certainly exacerbates this problem, but Uganda needs to move away from wood-based fuel sources.

### Key environmental, social, cultural, health and gender impacts

The excessive use of wood-based energy is leading to the destruction of the environment including the fragile ecosystems and biodiversity that would otherwise support the local climate and provide other environmental functions, such as pollination, soil aeration and enhancement, and decomposition.

Extensive loss of trees also impacts the communities who depend on them. For example, the destruction of Bukaleba forest has resulted in too much runoff into the low lands, meaning that soil fertility has been lost. This affects communities, as the soils can no longer support food crop plants (annual or perennial).

Wood-based bioenergy can also lead to the destruction of sacred and medicinal trees. In Bukaleba the communities say their treasured medicinal trees such as

[23] http://www.reegle.info/policy-and-regulatory-overviews/UG
[24] http://www.worldwatch.org/node/4525

*Prunus africana* (locally known in Luganda as Entasesa or Ngwabuzito) were cut down, and other medicinal plants including lianas, epiphytic plants, strangler figs and other parasitic plants have all been lost because of the pine plantations and eucalyptus planted by Green Resources. Fruit trees were cut and these trees also formed part of local food sovereignty.[25] Their treasured tourist attraction, where the communities used to take their guests—Walumbe tree—was also destroyed. This was a spot the communities used to go to for cleansing and praying for blessings.

Indeed, with the arrival of Green Resources almost everything is gone. There is no energy sovereignty at all. Communities are only allowed to pick the dead wood from the plantation three days a week. This puts communities at risk, because in most cases the children and women responsible for this task may not be able to free up enough time to get what they need over those three days.

Furthermore, communities have to walk long distances to come to a designated area where the company directs them to pick firewood. They cannot simply pick freely from the forest without the clear consent of the company, but the company has a responsibility to ensure that they can get firewood from somewhere as part of its 'Corporate Social Responsibility'.

Overall the communities now have very limited land for agriculture because of the extensive amount of land now under pine and eucalyptus. The communities are not allowed to continue their 'taungya' system of farming in the forest.[26]

Unfortunately, the charcoal produced from Bukaleba does not benefit the local communities either. They continue to look for firewood, while the charcoal is taken to towns in Kampala, Jinja, Entebbe and even to neighbouring Sudan. There is no community-owned modern biomass conversion and Uganda's renewables policy does not provide for that.

**Conclusion**

Strategies and policies in which the communities are key players in the use and implementation of modern biomass technologies could ensure energy access and contribute much more effectively to the reduction of poverty.

However, what the Ugandan experience shows—as in the case of Green Resources—is that increasing land acquisition by foreign investors can restrict community access to energy and contradicts the Renewable Energy Policy's proposed goals. Instead the promotion of vast fields of monoculture tree plantations is the preferred solution to 'stop deforestation', at least with respect to charcoal production, and is regarded as the best method for supplying the increasing demand for woody biomass for electricity generation. Uganda needs to change course, and pursue policies that will accelerate the proliferation of more decentralised, accessible and efficient renewable technologies.

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[25] Further information on Green Resources' activities in Uganda and other African countries via http://www.foe.org.au/carbon-markets-and-failed-promise-new-green-gold-plantation-forestry-uganda

[26] Taungya is a form of shifting agriculture that was a forerunner to agroforestry. http://www.worldagroforestry.org/units/library/books/Book%2032/an%20introduction%20to%20agroforestry/html/6_taungya.htm?n=29

**3. The use of Wood Based Bio-energy by Women in Maasai Communities in Kilindi** - *by Amon Richard and Loyce Lema, Envirocare – Tanzania*

***Maasai woman with firewoods. Photo courtesy: Envirocare.***

This case study considers a Maasai community in Kilindi District-Tanga Region in Tanzania. The District has no coastline and its altitude ranges from about 300m to 1,700m above sea level. The altitudinal gradient rises from the South to the North, West and Southwest and most of the district area is covered by hills and mountains. Some of these mountains, for example the Nguu Mountains, are part of the beautiful 'Eastern Arc' of Mountains in Tanzania, which are renowned for their biodiversity and richness in endemic species.[27] The average annual rainfall is 800-1000mm.[28] Other surrounding ecosystems include Kilindi Forest Reserve which is located at 5º 34' 60" South and 37º 34' 60" East. According to Tanzania's National Human and Settlement Census 2012[29], the district has a population of 236,833 inhabitants. The availability of untapped natural resources in the district attracts immigrants from other parts of the region and from other parts of the country. This case study describes rural communities which involve Maasai and Nguu tribes, who are pastoralists and small holder farmers.

In Tanzania 88.6% of the total energy consumption is estimated to be biomass (firewood and charcoal). The remainder comes from petroleum (9.2%) and electricity from hydropower (1.8%).

Domestic households are major consumers of fuel wood, and charcoal is the largest source of household energy in urban areas.[30] In rural areas fuel wood constitutes 96.6% and 4.2% of cooking and lighting fuel respectively.[31]

Biomass energy provides the major energy source for a wide range of rural and urban activities, including commercial, institutional and industrial uses; it is estimated that this non-household demand is equivalent to approximately 15% of urban household consumption, amounting to 300,000 tonnes of charcoal in 2012. Commercial biomass energy is also a major source of rural and urban livelihoods. Charcoal and commercial fuel wood (firewood) generated approximately TZS 1.6 trillion (US$1 billion) in revenues for hundreds of thousands of rural and urban producers, transporters and wood energy sellers in 2012. In fact commercial biomass energy is the largest source of cash income in rural Tanzania.

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[27] http://www.easternarc.or.tz/nguu

[28] Kilindi District Council Report, 2012

[29] www.nbs.go.tz/censusgeneralreport-29March2013_combined_financialforprinting.pdf

[30] Scaling-up Renewable Energy Programme (SREP), Investment Plan for Tanzania, 21 April 2013, http://www.ewura.go.tz/newsite/attachments/article/95/SREP%20Tanzania%20IP%20April%2022%20Final%20Final%20Final%20Draft.pdf

[31] www.fao.org/docrep/012/i1321e/i1321e09.pdf

Initial results from the National Forestry Resources Management Monitoring and Assessment Report (NAFORMA)[32] show that rural household demand (some 47 tonnes in 2012) was roughly equal to national annual forestry yield outside protected areas. However, demand for charcoal, without supply- and demand-side interventions, is expected to double by 2030, from approximately 2.3 million tonnes of charcoal in 2012.

The Tanzanian National Energy Policy (2003)[33] states that, *"the energy balance is dominated by biomass-based fuels particularly fuel-wood (charcoal and firewood), which are the main source of energy to both urban and rural areas. Biomass-based fuel accounts for more than 90% of primary energy supply."* Its main objective is to address national energy needs. The policy includes an objective of reducing forest depletion and references climate change.[34]

The National Environmental Policy of 1997[35] defines the environmental framework for various sectors, including energy. Among its objectives are the equitable use of resources to meet the basic needs of present and future generations, without risking health and safety.

Specifically with respect to wood-based energy, there are various policies and strategies that call for sustainable wood-based energy use in both rural and urban areas. For example the National Energy Policy 2003 includes a focus on the development and utilisation of indigenous and renewable energy sources and technologies and increasing energy efficiency and conservation in all sectors. The main elements of the policy are the development of domestic energy sources, economic energy pricing, encouragement of private sector participation in the energy market, and enhancement of energy efficiency and energy reliability. The Charcoal Regulations 2006[36] also state the importance of investing in sustainable charcoal production that will enhance environmental conservation.

Tanzania's Biomass Energy Strategy identifies ways of ensuring a more sustainable supply of biomass energy; raising the efficiency with which biomass energy is produced and utilised; promoting access to alternative energy sources where appropriate and affordable; and ensuring an enabling institutional environment for implementation.[37]

**Current situation regarding bio-energy in Kilindi**

In Kilindi district, firewood is the main source of energy for rural households, and many communities including the Maasai rely solely on firewood for cooking and other household tasks. It is generally the preferred fuel for cooking different type of foods, making local beverage varieties, and heating water.

Envirocare poverty mapping report in Kilindi[38] signifies annual per person consumption of fuel wood is about 1.1m$^3$. The 180 households in the six villages

[32] http://www.mnrt.go.tz/resources/view/national-forestry-resources-monitoring-and-assessment-of-tanzania-nafo, 2013

[33] United Republic of Tanzania (2003) Tanzania, National Energy Policy, Government Publishers, Dar es Salaam.

[34] http://www.reegle.info/policy-and-regulatory-overviews/TZ

[35] http://www.tzonline.org/pdf/nationalenvironmentalpolicy.pdf

[36] www.fao.org/docrep/012/i1321e/i1321e10.pdf

[37] The Biomass Energy Strategy Tanzania 2014, http://www.euei-pdf.org/country-studies/biomass-energy-strategy-best-tanzania

[38] In Press. 2014. Envirocare Report On Mapping Poverty, Vulnerability and Resource Rights in Tanzania.

visited (Jungu, Loriparaku**,** Balang'a, Kibirashi, Mafisa and Gombero) produce and use at least five kilograms of stacked wood in a conventional manner every day. This makes a total of approximately 328.5 tones of stacked wood/firewood consumption per annum. For modern house construction, it was estimated that brick burning (50,000 bricks) requires about 20 tonnes of firewood.

**Key environmental, socio-cultural, health and gender impacts**

**Environmental**

*Deforestation:* In the case of Kilindi district, fuel wood is used as domestic fuel especially by the Maasai communities, and the community forests and woodlands including Kilindi Forest Reserve are some of the main places where these fuel woods are collected.

Also, the nomadic nature of grazing is associated with shifting cultivation, which does have an impact on forest clearing. As the result of over-utilisation of forest resources for firewood, house construction, etc., there has been a 30%+ increase in the rate of deforestation since the 1990's.

*Greenhouse gas emissions:* Due to excessive combustion of fuel wood and other biomass fuels, $CO_2$ emissions have increased. Increasing $CO_2$ in the atmosphere is leading to increasing temperatures (global warming) and humidity. Amongst visited villages, most of the community members claimed to feel changes in annual temperature and rainfall patterns.

*Loss of Biodiversity and Erosion*: Unsustainable firewood harvesting has significantly contributed to loss of biodiversity (loss of access to fresh water and endemic species) and erosion due to loss of forest cover within the Kilindi Forest Reserve.

**Socio-cultural**

The gradual destruction of the local forests in Kilindi has impacted most of the inhabitants as biodiversity significant for local food and medicines production, such as nuts, fruits, berries, tubers, leaves, honey, and mushrooms, has declined. For many forest communities in Tanzania, including the Maasai communities, their culture and identity are intricately linked with the forest ecosystem, and loss of this environment profoundly and perhaps irreversibly transforms these cultures.

**Health & Gender**

In Kilindi district, most of the Maasai community houses are locally constructed in such a way that they do not allow any ventilation. The Maasai women tend to cook inside these houses, even though they have no windows and there is insufficient air circulation. This eventually leads to several health problems mostly for the women and children, who are most exposed. A good example includes eye diseases, respiratory disorders (TB, pneumonia and even lung cancer amongst older Maasai—about 35% of the visited households in Kilindi are suffering from several respiratory disorders). Red eyes can also lead to discrimination against them, as women with red eyes are thought to be wicked people and practicing witchcraft in the communities. In addition, girls are exposed to a risk of dying from house fires or from problems caused by indoor air pollution. For instance, in 2010 more than 10 Maasai girls are reported to have died following indoor air pollution.

***Left: Maasai woman cooking outdoors; Right: Typical Maasai houses and villages***

*Burns:* The use of firewood among the Maasai women and children has led to several injuries especially burns, mostly amongst young girls. This happens when young girls are left cooking food for their brothers during the day when their mothers have to walk a long way in search of more firewood and water.

In Kilindi District the Maasai women and girls work long hours every day. This is because they have responsibilities for taking good care of their families which include walking over 20 km searching for firewood (which can take five hours), and fetching water and food. When searching for firewood, food and water, Maasai women and girls are exposed to the danger of being attacked by wild animals or being raped.

**Conclusion**

In Tanzania fuel wood is used for everything, including by industry and institutions, but it is urban centres that are using most of the charcoal while leaving rural communities in need of this primary source of energy for their livelihoods. Thus, in order for the Maasai to find fuelwood, women have to walk further distances enduring serious risks and devoting valuable time to this instead of education. Furthermore, it is women and girls who are bearing the impacts of cooking with firewood while lacking a safe source of energy; health impacts mainly consist of respiratory diseases but there are others that could also generate impacts on women's livelihoods.

The Rural Energy Act 2005 established the Rural Energy Board, Fund and Agency, which is responsible for promoting improved access to modern energy services in the rural areas of mainland Tanzania and through the Rural Energy Fund, to provide grants to institutions that are ready to promote the use of energy sustainably. According to estimates made by the Renewable Energy Agency (REA), Tanzania generates about 15 million tons per year of agricultural, livestock and forestry residues, including sugar biogas, some of which may be available for use in power generation. But rural communities like the Maasai in Kilindi, are in urgent need of such modern energy availability in order to reduce pressure from the over utilisation of wood-based energy, as well as to improve women's and girl's livelihoods.

The reports 'Scaling up Renewable Energy Programme, Investment Plan for Tanzania' and the Biomass Energy Strategy are very detailed and focus on both the demand for and supply of energy. However, while the former considers plantations as a source of wood-based energy, the latter document prioritises participatory forest management, community-based forest management, joint forestry management and 'overall sustainable wood energy production' promoting reduced reliance on wood-fuel and deforestation. Also there is a significant focus on the use of crop waste, and organising and licensing charcoal production to get efficiency up by 50%.

**4. Using Wood for Energy in Peasant Farms in Santander, Colombia** - *by Juan Pablo Soler, CENSAT Agua Viva and Fundaexpresión*

This case study concerns the introduction of energy efficient wood-burning cookstoves in the provinces of Soto (municipalities of Lebrija and Matanza) and García Rovira (municipalities of Concepción and Cerrito) in the department of Santander, Colombia. Garcia Rovira is located in a region of high-mountain, in the 'Almorzadero' Moorland ('Paramo'); the village of Santa Cruz de la Colina (municipality of Matanza) is located near farmland and community natural forest reserves that are guarded by the locals (also known as an ICCA[39]). The introduction of these cookstoves reduces respiratory disease, advances energy sovereignty and alleviates pressure on local forests.

***Cookstoves before. Photo courtesy: J.P. Soler***

**National economic context**

Colombia is a country with three major mountain ranges and vast wilderness areas. It has invested heavily in the oil and electricity sectors, but providing energy to people living in remote areas is expensive. Because the supply of energy is treated as a profit-making business by governments and companies, rather than as a social function, rural provision has so far been neglected, marginalising rural life over the centuries.

However, rural communities, primarily made up of peasants, 'barequeros', fisherfolk, indigenous and black communities, are meeting their energy needs by using wood, just as they did before the oil era. There are strong cultural and ancestral practices relating to the use of firewood for purposes including cooking food, heating spaces, sugarcane production, and brick making. But the availability of wood varies, both between regions and over time. Some communities must travel great distances to get firewood, and as more wood is extracted for various purposes so it becomes scarcer.

***Cookstove after. Photo courtesy: J.P Soler***

In this light, the United Nations World Health Organization and other organisations have gradually been demonising this cultural practice, arguing that it impacts the health of infants and adults by causing air pollution, and that collecting fuelwood from forests causes deforestation. However, this discourse, rather than addressing the situation of communities and their need for fuel, supports World Bank guidelines urging governments and businesses to increase the supply of modern energy services such as natural gas and electricity in rural areas. This approach puts oil companies' interests above the real needs of communities, and centralises control of the energy sector, including through energy privatisation.

[39] A close association is often found between a specific indigenous people or local community and a specific territory, area or body of natural resources. When such an association is combined with effective local governance and conservation of nature, we speak of 'ICCAs' which stands for Indigenous Peoples' and Community Conserved Territories and Areas. Further info through http://www.iccaconsortium.org/

We believe that the use of wood as a fuel is not itself a problem. Rather, its use may be enhanced, thereby strengthening its cultural role, by practices that make the activity more sustainable, such as the development of small-scale dendro-energy crops, the community management of forests, and the use of appropriate technologies such as efficient cookstoves that also minimise pollution.

In this sense, a number of communities have sought to improve their self-sufficiency without compromising their cultural traditions. They have been gradually implementing newer and more energy efficient methods, which lead to greater fuel economy, better air quality inside homes, and greater added value for produce and handicrafts from rural family farms. These include, for example, the production of corn and squash cakes in Santander, and the dyeing of virgin wool in the town of Cerrito, García Rovira province. These community initiatives are very different from initiatives proposed by the government, because the economic model promoted by the government is focused on national economic and industrial development rather than the peasant sector and rural life.

**National political context**

In recent years, the government has expressed its intention to improve the situation in the countryside by implementing energy programmes based on 'non-conventional' energy sources. To this end it has created the Program on the Rational Use of Energy and Other Forms of Non-conventional Energy (PROURE in Spanish). Based on an action plan and vision stretching to 2025 PROURE establishes that the national government needs to invest more than four million dollars to boost the sector, and suggests priority areas of action including the promotion of non-conventional energy sources through education, advocacy, capacity building, consumer protection, and the management and monitoring of goals.[40] However, it appears that even these non-conventional energy resources are still viewed from the perspective of integrating them into the dominant national electricity market.[41]

PROURE was developed following the introduction of Law 697 of 2001 on rational and efficient energy use, and its regulatory decree, 3683 of 2003. These also set the guidelines and functions for public and private actors, granting greater responsibility to the Ministry of Mines and Energy[42] (UPME) in terms of promoting, organising, supervising, designing, and ensuring the development of PROURE.[43]

The Colombian government has also established a series of policy documents with guidelines regarding topics of importance for the country through the National Council on Economic and Social Policy, the CONPES. CONPES no. 3700 from 2011, for instance, defines guidelines for an institutional strategy for addressing climate change.

In addition there is a Colombian Low Carbon Development Strategy (CLCDS), which is a medium and long-term development programme involving the Ministry of Environment and Sustainable Development (MADS), the Department of National Planning (DNP), and sectoral ministries of Colombia. This is aimed at promoting Colombia's economic and social development in ways that reduce greenhouse gas

[40] Ministerio de Minas y Energía República de Colombia. 2012. Programa de uso raciona y eficiente de energía y fuentes no convencionales. PROURE. Informe Final. PLAN DE ACCIÓN 2010-2015. Informe Final.
41 https://unfccc.int/files/bodies/awg/application/pdf/3_colombia-revised.pdf
[42] www.upme.gov.co
43 http://www.minminas.gov.co/documents/10180/558752/Proure_English.pdf/cca18348-a31b-4b08-905c-aeea3cc92149

emissions and enhance environmental performance without impeding efficiency and competitiveness in the global market place.

This same document refers to Reduced Emissions from Deforestation and Forest Degradation (REDD+) proposed under the UNFCCC. The Colombian government has created an Interdisciplinary Working Group on REDD+, which will coordinate sectoral actions and REDD+-related decisions.[44] It will be supported by advisory groups that will guide their technical, social, environmental, regional and economic decisions. This is part of a national REDD+ strategy that is included in the National Development Plan 2010-2014 and directed by the Ministry of Environment. Actions have been prepared through the Forest Carbon Partnership Facility (FCPF), UN REDD+, international cooperation, the National Institution for Hydrology, Meteorology and Environmental Studies (IDEAM), and some NGOs (Fund for Environmental Action and Childhood, Natural Patrimony Fund, WWF, and ONF Andina). [45]

The estimated budget for formulation and implementation of Colombia's Readiness Preparation Proposal (RPP)[46] for REDD+ is US$18.5 million from a variety of sources including the World Bank's Forest Carbon Partnership Facility (FCPF) and others.

**The importance of firewood in Colombia**

In Colombia a significant proportion of the total energy used from primary energy sources[47] comes from biomass (firewood and bagasse). According to data provided by UPME, about 31% of the total is generated in this way, with most of the remaining energy being generated from natural gas (51.3%), mineral coal (12.2%), and petroleum (2.1%).
With respect to household consumption of secondary sources,[48] wood is the second most important energy resource (at 28.1%) after electricity (30.4%). It is followed by natural gas (21.2%), liquefied petroleum gas (11.5%), charcoal (5.2%), mineral coal (1.2%), biodiesel (1.1,%) and gasoline (0.9%). This is despite the best efforts of the central government and businesses to replace firewood with natural gas in both urban and rural Colombia.

**Efficient cookstoves and their benefits**

In the province of Garcia Rovira, the communities have succeeded in stopping the government and companies exploiting the region's anthracite coal for over twenty years. Mining in this region would endanger the vital Páramo wetlands ecosystem, disrupting the water supply.

The communities have taken a different approach. On their own initiative, they have launched economic alternatives that allow them to stay in their territory and retain their peasant identity. Since the nineties they have been implementing agroecological processes on their farms and plots, as well as developing education and training in crafts based on straw and wool, and baking cakes for local markets. They decided to give added value to their products by building efficient wood-burning

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[44] Ministerio de Ambiente y Desarrollo Sostenible. 2012. Construccion colectiva de la Estrategia Nacional REDD+. Bogotá

45 Ibid

[46] Ministerio de ambiente y desarrollo sostenible. 2012. Preparación de la Estrategia Nacional de Reducción de Emisiones por Deforestación y Degradación Forestal - REDD+

[47] Those that do not require transformation (i.e. coal, gas,etc.)

[48] Those energy sources that require processes for transformation (i.e. electricity from hydropower or power plants, nuclear energy, etc.).

cookstoves. This allows them to increase the overall energy efficiency of their products, reducing their consumption of wood and pressure on local forests. At the same time it improves air quality inside their homes, and generally increases the profitability of local productive processes.

Similarly, families who are part of the Municipal Association of Rural Women of Lebrija-AMMUCALE and the Collective of Peasant and Community Reserves in Santander have introduced efficient cookstoves to save wood and increase energy efficiency while baking squash cakes and slaughtering creole chicken. This is helping to save firewood, an increasingly scarce resource in that region.

**Main environmental, cultural, and health impacts of introducing efficient cookstoves**

Energy efficient wood-burning cookstoves allow a significant saving in the amount of wood being used, which directly reduces emissions of carbon monoxide (a highly toxic pollutant) and carbon dioxide (a major greenhouse gas). This in turn leads to a reduction in respiratory and eye diseases caused by indoor smoke. A key feature of these ovens includes the installation of a furnace vent allowing the use of the heat from combustion fumes, keeping temperatures stable at around 250°C for baking cakes.

This experience is contributing to the ongoing process of defending territories and cultures that was started decades ago with a focus on food sovereignty. This is now being complemented by new energy sovereignty practices. Energy sovereignty helps communities enjoy their independence and self-sufficiency in terms of fuel for cooking, while decreasing pressure on local ecosystems and the water cycle. At the same time 'mingas' are held, bringing people together to share knowledge on the one hand, and strengthen ties between local families on the other. Thus, the substantial funds that are used for complex and uncertain schemes like REDD+ could be used for efficient cookstoves and other locally-based solutions.

The following organisations are all participating in these processes: Censat Agua Viva,[49] Fundaexpresion,[50] the Municipal Association of Rural Women of Lebrija-Ammucale, the Collective of Community and Rural Reserves in Santander, the Manufacturers Association of Agroecology-Agrovida, the Association of Women Farmers and Artisan Cerrito-Asomuarce and the Colombian Movement in Defense of Territories Affected by Dams 'Rios Vivos'.[51]

***Left: Cookstove before; Right: Cookstove after. Photo courtesy: J.P. Soler***

[49] energia@censat.org, fundaexpresion@gmail.com
[50] fundaexpresion@gmail.com
[51] https://www.youtube.com/watch?v=b1-4tyUkYFk

**5. Current and potential use of wood biomass in Russia and trade with Japan: threats and opportunities -** *by Andrey Laletin, Friends of the Siberian Forests, Russia*

Mankind has used woody biomass for energy for millions of years, and has continued to do so even in the fossil fuel era. Indeed, in countries with extensive forests there has been a steady increase in the production of bio-energy, including energy produced from woody biomass, in recent years.

Russia is one such country. The total area of forests in Russia is more than 540 million hs, and the total timber volume is around 82 billion $m^3$.[52] Fortunately in many parts of Russia (especially in Siberia and the Far East) there are not many roads, meaning that the majority of these forests are not accessible for industrial purposes.

Wood as a fuel is only relatively sustainable, primarily because many decades are needed for it to grow. One can—as proposed by Professor Reimers—consider forests as an exhaustible natural resource, because the timber can be extracted faster than it can regenerate. Forests are natural ecosystems, and can only be considered a renewable resource if their management is truly sustainable and environmentally balanced.[53] This means that current management conditions must be of such a quality that all future forest ecosystems can survive.

For Russia one of the most urgent tasks that currently needs to be addressed is the inefficient use of wood wastes and wood from the secondary forests (birch and aspen) that have grown in place of many primary coniferous forests. One can consider wood waste as the product of an incomplete processing chain—in other words, rather than seeing it as a waste, it is seen as a raw material for the production of heat and electricity. A large quantity of this material is generated in cutting areas, in the processes of felling and thinning, and it includes fragments of trunks, tree crowns, small-diameter trees, and other pieces. It also includes wood chips, cutting boards, and bark. According to the estimates of Doctor Sukhanov, at final felling in mature stands the volume of this waste material is about 30% of the total volume of the harvested wood.[54] It is therefore a significant potential biofuel feedstock.

***Siberian forest. Photo courtesy: A. Laletin***

[52] Bit Y.A., Belenky Y.I. Production of wood fuel. St. Petersburg. 2001. (In Russian).
[53] Reimers N.F.Natural resources. Dictionary. - Moscow, 1990. (In Russian)
[54] Sukhanov V.S. Speech at the International Workshop 'Bioenergy 2004. Classification and standardization - from wood to energy production', St. Petersburg.15-16 June 2004. (In Russian).

However, it is also possible that an increased use of wood waste may give a financial boost to the forestry sector, which might have the additional impact of significantly increasing logging for pulp mills and wood production in general. Furthermore, it would be very difficult to control such an increase, and ensure that it does not trigger increased forest exploitation and forest degradation, especially in ecologically sensitive zones. There is also a risk that the establishment of additional industrial wood-based bioenergy plants will trigger overexploitation of natural forest resources, as this would be a cheaper and easier way to feed that industry than waste collection—especially in a country that faces very serious governance problems.[55]

If the use of wood is to be truly sustainable it must address ecological, economic and social issues (including gender aspects) and their interlinkages. With respect to ecological aspects, logging residues and firewood may be renewable resources, but one of the conditions of their use as a biofuel must be to return wood ash to forest soils, renewing their organic content. This is very rarely done by logging companies. Wood waste plays an important role in the health of forest ecosystems.

Greater attention should also be paid to using wastes from the pulp and paper industry. It also helps to solve the problem of waste disposal.

There is also a concern that larger biomass businesses may start exploiting the forests that communities depend upon, once a profitable business sector in wood-based bioenergy is created. This is potentially very dangerous for Russian forests and local communities. That's why we support only small-scale local bioenergy projects, not industrial-scale implementation.

Russia has a huge capacity to deliver sustainable biomass for local use. The current share of fuel wood is negligible. For example, only 12 out of 534 municipal boilers in the Leningrad region (only 2.2%) use fuel wood.[56] In contrast, in Sweden 15% of the total energy produced is obtained from fuel wood (although it is not yet clear if that is sustainable from social and environmental points of view).

Another potential problem is that industrial biomass plants tend to cause significant air contamination, triggering very serious health problems in local communities living near them. It would be very difficult to avoid these risks.

Clearly there is much to investigate and clarify in terms of the sustainable and local use of biomass energy in Russia. We will track these issues and collate the necessary data as it emerges, with a view to continued reporting on the development of this sector.

Another potential problem relating to woody biomass in Russia concerns the export of timber and woody biomass. We could not find statistics on the export of woody biomass from the Asian part of Russia to South Korea and Japan. But there is useful information on the export of wood pellets. In 2012, Russia exported 850,000 tons of wood pellets. Most of these are exported to Western Europe, with more than 50% passing through St.Petersburg. In 2011, Russian's largest wood pellet producer VLK exported more than 220,000 tons of wood pellets to Europe. And it seems that

[55] BBC. Battling Siberia's devastating illegal logging trade. 2009 http://news.bbc.co.uk/2/hi/8376206.stm

[56] Resolution of the Government of Leningrad region from 24.07.2003 "On the concept of balance of energy resources for utility boilers in Leningrad region until 2020." (In Russian).

Russian wood pellets producers are now planning to expand their market into other areas and countries, including Japan.[57]

In Japan, the number of boilers in timber processing plants has increased by 35% in the last five years. This increase has contributed to the reduction of wood wastes in the plants as well as contributing to the mitigation of climate change through avoided emissions from fossil fuels.[58] But if the increased use of biomass generally in Japan creates a significant demand for timber imports from Russia, then there is a risk of environmental and social impacts in Russia, as described above.

***Box III: New biomass power plant in central Japan***

*For example, a ¥9billion (US$83million) biomass power plant will be built in central Japan's Mie prefecture, by JFE Engineering's Tsu complex, with the company having a 35.2% stake in the project. The state-owned Development Bank of Japan will have a 25% share, providing around ¥1billion in project financing, on top of a ¥7billion loan from Japanese private-sector banks Hyakugo and Sumitomo Mitsui Trust. Japanese distribution company Nippon Express also joins the project with a 14.9% stake. Trading firms Hanwa and Daichu have a 10% stake each, with counterpart Okaya having the remaining 4.9%. Construction will start in November, with commercial operations scheduled to start in July 2016. The plant will use wood chip and palm kernel shell feedstock that will be imported mainly from Malaysia and Indonesia but also probably from Russia. Electricity produced will be supplied to JFE Engineering's power subsidiary, helping meet demand for around 43,900 households. Japan renewed its feed-in-tariff (FIT) scheme in July 2012, expanding renewable sources to include biomass, wind, geothermal and small-scale hydroelectric generation facilities, in addition to solar panels. Japan's biomass consumption for power generation for the first seven months of 2014 totaled 1.2million tons, up by 9.9% compared with the same period last year.*

**Source: Argus Media - http://www.argusmedia.com/News/Article?id=930636**

[57] An Analysis of Wood Pellets Market in Russia http://www.wood-pellet-mill.com/wood-pellet-news/Russia-wood-pellet-manufacturing-market.html

[58] Bioenergy http://montrealprocess.org/Addressing_Global_Forest_Challenges/bioenergy.shtml

**6. Power Plants for co-generation of electricity from wood-based biomass in Chile** - *by Eduardo Giesen, Viento Sur, Chile*

## Description and Location

This study addresses the proliferation of electricity co-generation[59] projects from wood-based biomass in Chile. In this process, biomass is used directly for the generation of electricity, and the so-called 'residual heat', in the form of steam or hot gases, is then used for drying wood. This method is also used in the pulp and paper industry, where heat requirements are low.

The main source of biomass used as fuel is waste from the forestry and timber industry such as:
- Bark (the outer layer of roundwood)
- Mops (the side sections of the log obtained in the sawmilling process)
- Sawdust (small particles obtained from the sawing process and sizing of the timber)
- Chips (thin ribbons of wood of varying thickness)

We searched through the records of projects entered into Chile's Environmental Impact Assessment (EIA) System, as all energy projects with more than 3 MW of installed capacity must undergo an EIA. Likewise, we looked for this type of project in the registry of projects of the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change (UNFCCC).

Thus we find a representative sample of projects, as shown in the Annex table at the end of this document. [60]

From this search, and from official information, it is evident that a high concentration of biomass co-generation plants are found in the region with the largest area of forest plantations in Chile, that is the Bio-Bio, as shown in the table below:*


| Region | Tree plantations area[61] [has] | No. of biomass electricity plants |
|---|---|---|
| 5 - Valparaíso | 51,575 | 1 |
| 6 – O'Higgins | 101,591 | 1 |
| 7 – Maule | 439,084 | 1 |
| 8 – Bio-Bío | 861,248 | 13 |
| 9 - Araucanía | 434,185 | 3 |
| 14 – Los Ríos | 182,076 | 1 |
| 10 – Los Lagos | 60,531 | 1 |
| **Co-generation plants from Region 12 and Metropolitan Region were not included because in these areas monoculture tree plantations are not representative.* | | |

[59] Cogeneration is defined as the joint production of electricity and thermal energy, from the same source.
[60] The tables shown in this case study have been created by the authors based on the cited sources.
[61] Tree plantations area, from Coquimbo to Aysén regions, updated on Dec 2008, INFOR.

## National Context

### Dictatorship and state subsidies

The problematic that the forestry model has generated is well known. Implemented in Chile by the Pinochet dictatorship (1973-1989) and subsequently maintained by successive governments, forestry in Chile has been based on strong support for tree plantations, which have been subsidised by the state through the provision of Decree 701, 1974. The extension of this decree is currently under discussion in Parliament.

These policies have been instrumental in the expansion and concentration of industrial plantations of exotic trees, mainly *radiata pine* and *eucalyptus*, and extensive development of the timber processing and pulp and paper industries.

These financial incentives have effectively reduced the costs associated with obtaining wood residues for use as fuel. As a result the forestry, timber and pulp industries are highly concentrated and are the main owners of biomass co-generation plants, which allows for a further increase in profits generated from the plantations.

Wood-based biomass cogeneration in Chile is, by far, dominated by the two largest forestry companies in Chile, namely Arauco and CMPC, which generate 572 MW and 220 MW respectively. No other company generates more than 20 MW.

### 'Environmental' Incentives

On the other hand, electricity generation from biomass is considered a source of non-conventional renewable energy (NCRE) by the Chilean government, and is thus subject to policies promoting this type of energy. In fact, together with wind energy, biomass-based energy is considered the NCRE with the highest development potential. The UNFCCC considers that biomass has 'zero' net carbon emissions, so the combustion of biomass instead of fossil fuels is permitted as a means of generating carbon credits. This represents a new economic benefit for these projects, and for the forestry industry's profits.

Indeed, in the records of the UNFCCC's Clean Development Mechanism[62] we found at least a dozen CDM projects focusing on energy generation from biomass in Chile. We consider this to be highly irregular as projects associated with tree plantations relate to productive processes already receiving state subsidies, making them unsuitable for certification and the commercialisation of emission reductions under the CDM.

The electricity generated in these processes is primarily intended for use during the same logging operations, sawmills or pulp mills, or for injection into the Central Interconnected System, the main private-owned electricity transmission system in Chile.

### Social and Environmental Impacts

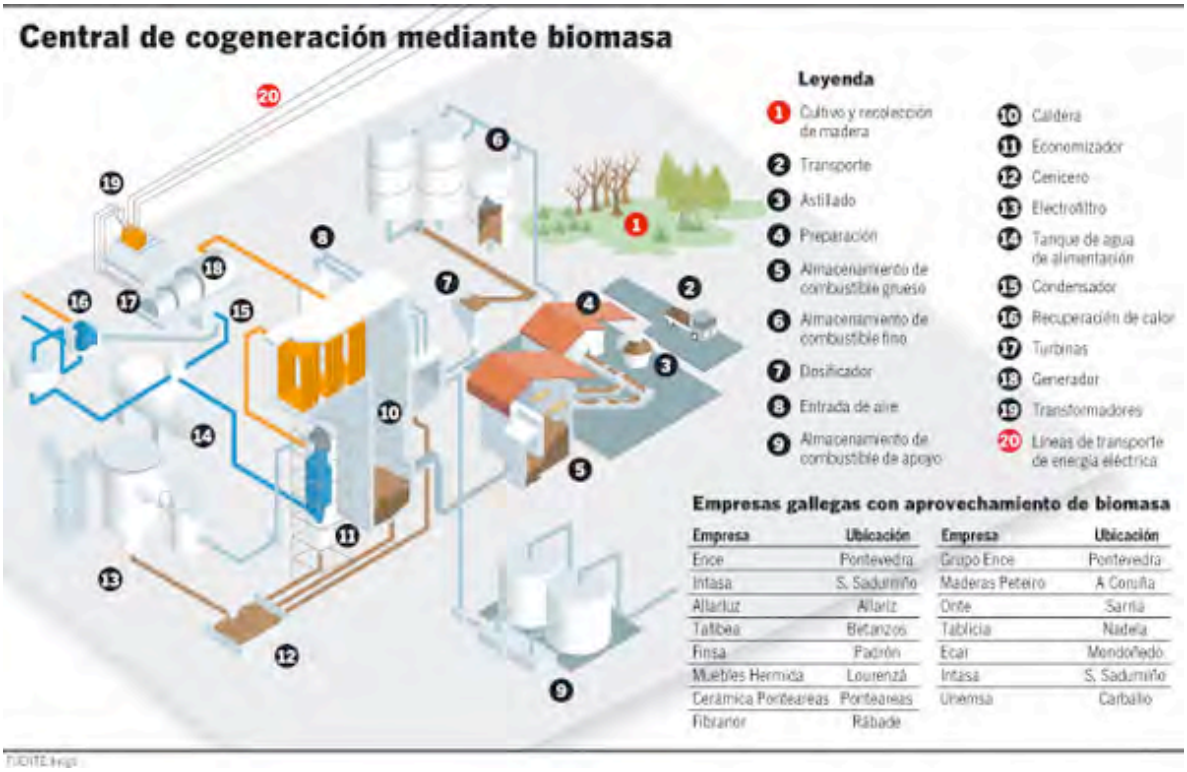
Wood-based biomass co-generation provides additional financial incentives to industries based on the use of timber produced in tree plantations. This means that its development intensifies the impacts of plantations which include erosion and destruction of soils, drought due to over-consumption of groundwater, surface water pollution, biodiversity loss, the loss of local economies and traditional ways of life, job insecurity, and destruction of the landscape and sites of cultural or ancestral

[62] CDM projects can be searched here: https://cdm.unfccc.int/Projects/projsearch.html

significance. More directly, the combustion of forest biomass involves a local loss of water and the nutrients it contains, that cannot be returned to the ground.

There is also a risk of air pollution resulting from incomplete combustion of forest biomass and the consequent emission of carbon monoxide (CO), hydrocarbons (such as methane), nitrous oxide ($N_2O$) and other materials, with effects on human health and ecosystems.

Finally, due to the previously mentioned concentration of this 'energy' activity in the hands of the timber and forestry industry, the loss of energy sovereignty is added to the loss of land, food, political and economic sovereignty suffered by communities.



**7. Drax in the UK: subsidies for burning coal and increasingly more and more wood from overseas** - *by Almuth Ernstig, Biofuelwatch, United Kingdom*

The UK's Drax coal power station, located in North Yorkshire, is burning more coal than any other plant in the country—and now more wood than any other power plant in the world. Drax—owned by a company with the same name—was opened in 1974 and, with a total capacity of nearly 4 gigawatts (4,000 megawatts), remains the EU's second biggest coal power station. So far, Drax has converted one out of six units to burning wood and is in the process of converting a second. They are committed to converting three units overall and are even considering converting a fourth.

What does this means in numbers? Running just one of Drax's six units requires 2.5 million tonnes of wood pellets – three units would thus require 7.5 million tonnes. And each tonne of pellets is made from two tonnes of freshly cut wood (called 'green wood'). The UK's annual green wood production is on average 10 million tonnes a year. Thus Drax alone wants to burn 1.5 times as much wood as is currently produced domestically. This is in addition to burning 3.7 million tonnes of coal, a figure that will also increase if their plans for a new coal power unit with Carbon Capture and Storage (CCS) are realised. Much of their coal comes from the Cerrejon mine in Colombia,[63] in an area from which small-scale Afro-Colombian farmers were brutally evicted 13 years ago.

***Wetland cut w/ visible Cypress stumps. Photo courtesy: Dogwood Alliance.***

Of all the EU countries, the UK has seen the most explosive growth in wood pellet burning—from 176,000 tonnes in 2010 to an estimated 5 million tonnes this year.[64] In other words it has increased by a factor of 28 in just four years.

The UK accounts for a quarter of all the wood pellets burned in the EU—though not a quarter of all wood-based bioenergy in the region, since other countries will be burning a larger proportion of wood in the form of woodchips and briquettes. Pellets are far less bulky and thus cheaper to ship than other forms of wood, and wood pellet trading therefore makes up the vast majority of the long-distance international trade in wood-based bioenergy. Most of that trade currently consists of pellet exports from the southern US and Canada to the EU, with the UK being the single biggest importer of North American wood pellets.

**Political context**

The reasons for the UK's pivotal role in the fast-growing international trade in wood-based bioenergy come down to government policies and subsidies.

Meeting EU renewable energy targets while curbing the expansion of onshore wind turbines (unpopular with many rural communities and especially with members of

[63] http://londonminingnetwork.org/2014/08/cerrejon-coal-the-best-mine-in-colombia/

[64] http://gain.fas.usda.gov/Recent GAIN Publications/Biofuels Annual_The Hague_EU-28_7-3-2014.pdf

parliament from the main party in the UK's coalition government) has been one of the government's key motivations

for supporting large-scale wood burning. The other motivation is their—and energy companies'—aim of keeping old, polluting coal power stations open.

Renewable energy subsidies in the UK currently favour energy from biomass. Indeed, across the EU, the lion's share of the 20% overall renewable energy target for 2020 is expected to be met from bioenergy, mainly burning wood. In the UK, the majority of renewable energy subsidies have so far gone to the electricity sector, different to other countries such as Germany that burns vast amounts of pellets for heat, or Scandinavian countries that burn loads of pellets for combined heat and power. However the UK government has recently introduced subsidies for 'renewable heat', by which they primarily mean wood boilers, and this is now creating yet another new market for pellets. Burning wood in power stations has attracted generous subsidies for years, but recently those subsidies have been more blatantly skewed against onshore wind and solar power and in favour of large-scale biomass and (less problematically) offshore wind.

Overall, energy companies' published plans would see well over 60 million tonnes of green wood being burned in UK power stations, although not all published plans will be realised. Most of this would be from imports. Even before the biomass boom started, the UK was already 80% dependent on net imports for all the wood products consumed in the country. Any large-scale wood burning for energy will, whether directly or indirectly, lead to more imports.

With respect to keeping old power stations open, a significant share of the UK's power stations are supposed to close at the end of 2015 because they do not meet EU limits for sulphur dioxide ($SO_2$) emissions, and yet more face closure soon after, when even stricter EU limits for $SO_2$ and nitrogen dioxide emissions come into force. Drax is one of the plants that would not meet the stricter directive if it continued to burn coal alone. Converting all or part of a coal power station to burning wood pellets reduces $SO_2$ emissions, even if burning wood is overall as polluting as burning coal. For Drax Plc., a 50% conversion to biomass is a way of keeping their power station running—and a very lucrative one at that. Once the third unit has been converted, their subsidies—paid via the general public's electricity bills—will jump from around €270 million to €858 million a year. They have also been awarded a €95 million public loan guarantee and a €64 million loan from the government-owned Green Investment Bank. On top of this are the public funds already obtained for their planned new coal power station unit with Carbon Capture and Storage (CCS)–so far up to €300 million from the European Commission, with hundreds of millions of pounds in additional UK subsidies a year expected.

**Impacts**

The only type of biomass which can be burned in a coal power station such as Drax is powdered wood pellets made from slow-growing trees.[65] Residues tend to have a high bark content which, just like fast-growing biomass, contains so many alkali salts that it would corrode the boilers. Slow-growing hardwood trees appear to be more suitable than wood from faster-growing conifers that are widely grown on plantations. Drax has entered into long-term supply contracts with three US and two Canadian pellet producers and they are in the process of building their first two fully-owned pellet plants in Mississippi and Louisiana. Canada holds the sad world record of

[65] Ibid

destroying its 'intact' forests the fastest.[66] The growing new demand for wood pellets can only worsen the devastation already caused by scarcely regulated industrial logging. In the southern US, the vast majority of the region's forests has long been destroyed—with many of them having been converted to monoculture pine plantations. Yet the remainders include some

of the most biodiverse subtropical ecosystems on the planet. Amongst them are the coastal swamp forests, also called bottomland hardwoods, of North and South Carolina—from which Drax's supplier Enviva sources wood for pellets. Dogwood Alliance has published evidence[67] of the clearcutting of those swamp forests, primarily for pellets (see also Box 4). They have also shown the environmental injustices inflicted on local communities by Enviva pellet plants.[68] These include excessive noise and traffic, and pollution and wood dust exposure. The latter is particularly worrying. Wood dust is a known carcinogen and exposure to it is associated with a range of other health risks too, such as skin disease, increased incidents of asthma attacks and chronic bronchitis and nasal problems.[69] Drax's own pellet mills in the southern US are still under construction but both are located near highly biodiverse native hardwood forests, including cypress forests.

Drax's is Europe's largest-scale single investment in biomass in general and in burning wood in coal power stations in particular—though by no means the only one. E.On, for example, has also converted a UK coal plant to biomass, although the company has indicated that this may close at the end of 2015. E.On is in the process of converting another one in southern France, in spite of strong local opposition. And Ontario Power Generation's converted Atikokan Generating Station[70] is North America's largest biomass plant. What the experience with Drax illustrates well is the symbiotic relationship between coal and big biomass: the world's biggest biomass scheme exists partly to secure a 'future' for coal too.

***Active Enviva bottomland hardwood cut. Photo courtesy: Dogwood Alliance.***

[66] http://news.mongabay.com/2014/0905-gfrn-morgan-ifl.html
[67] http://dia.dogwoodalliance.org/p/salsa/web/questionnaire/public/?questionnaire_KEY=1656
[68] Residents close to the plant have faced extreme an constant noise levels and bright lights. They have lived with sticky wood dust that coats cars, buildings and lungs in just a few minutes, as well as dangerous, heavy truck traffic.
[69] http://www.biofuelwatch.org.uk/wp-content/uploads/Biomass-Air-Pollution-Briefing.pdf
[70] http://www.opg.com/generating-power/thermal/stations/atikokan-station/pages/atikokan-station-biomass-conversion-project.aspx

***Box IV. Enviva's Wood Pellet Mill in Ahoskie, North Carolina Threatens Endangered Ecosystems and Wildlife***

*Conversions of large coal-burning power plants to wood (co-)firing in Europe have resulted in the explosive growth of wood pellet exports from North America. Enviva, the South's largest exporter of wood pellets, sources wood for its pellet-manufacturing mill in Ahoskie, North Carolina, from clearcut wetland forests in the Mid-Atlantic Coastal ecoregion. This mill produces approximately 400,000 tons of wood pellets per year for export to Europe as fuel for electricity. Multiple scientific studies have shown that burning trees to generate electricity releases more carbon than burning coal. While there is some regional variability in their results due to variations in climate and forest type, all have concluded that most forest biomass is not carbon neutral and, in particular, burning whole trees in power plants increases carbon emissions relative to fossil fuels for many decades.*

*Enviva's Ahoskie facility sources wood from the Southeastern Mixed Forests and the Middle Atlantic Coastal Forests ecoregions, both of which have been designated as Critical/Endangered. Pine plantations generally provide poor wildlife habitat, and the biological diversity they support pales in comparison with the diversity found in natural forests. Remaining natural and seminatural forests in this landscape are highly fragmented. Much of the forested wetlands in the broad ecoregion from which Enviva is sourcing wood have already been lost to logging. The North Carolina and Virginia Natural Heritage Programs already consider these forests highly imperiled where soil conditions, periodic flooding, and the low commercial value of the often twisted and less desirable trees have made utilisation of wood product resources less profitable.*

*Enviva's pellet mill puts additional pressure on these forests, making clearcut logging and shorter-rotation harvesting of these remaining forests economically practical. Because of the relative importance of forested wetlands as anchors for remaining biodiversity across this broad landscape, increased industrial logging in these forests will have significant negative impacts. Restoring bottomland hardwood wetlands is challenging because of the long time frame necessary for these forests to mature and because altered flood patterns can reduce the future diversity of trees and plants when a forest regenerates. Forested wetlands play a vital role in maintaining both biodiversity and ecosystem services in this region, offering habitat for waterfowl, songbirds, black bear, and a variety of reptiles and amphibians while also providing services for communities such as improved water quality, flood storage, and the buffering of water flow during drought. This forest type occurs mainly in and adjacent to wetlands, both riverine and non-riverine. Hence, these forests are important for maintaining healthy populations of all kinds of aquatic animals, including economically important species such as fish and shrimp.*

*Wetland hardwood forests are also critical to the maintenance and recovery of songbirds and raptors deemed to be declining and vulnerable to continued losses. Many priority bird species (those that are threatened due to the degradation and/or disappearance of their habitat), including the Swainson's warbler, yellow-throated warbler, Wayne's black-throated green warbler, and prothonotary warbler depend on mature bottomland forests during their annual cycle. Some bird species demonstrate a negative response to any timber harvest in bottomland habitat including Yellow-throated Vireo, while other forest interior species, such as prothonotary warblers, can tolerate thinning but only if 60-70% of the canopy is left intact. Additionally, radar analysis of bird migration in the Southeast reveals that mature forested wetlands are disproportionately important stopover habitat for migrating land birds.*

*The main forest types available for pellets in the area surrounding Enviva's Ahoskie facility are Loblolly/Shortleaf Pine, nearly all of which are pine plantations and early successional stands (young forests), although it is not clear to what degree these stands will be exploited for pellets. This could mean that the remaining, more natural forest types in the region, which consist principally of Upland Oak-Hickory (concentrated toward the western edge of the Ahoskie radius), Bottomland Oak-Gum-Cypress, and Bottomland Elm-Ash-Cottonwood, could become candidates for logging for pellets. Less than one percent of the forests in the Ahoskie facility's sourcing region are protected from logging activities that would degrade native ecosystems. Increased use of these (more natural) forest types will lead to additional fragmentation of an already highly fragmented landscape, decreasing landscape integrity, water quality and flood storage, wildlife corridors and habitats, and recreational resources. At the same time, increased use of plantation pine will incentivise future conversion of the few remaining natural and semi-natural forests to intensive uses.*

**Source:** http://www.nrdc.org/energy/forestnotfuel/files/enviva-wood-pellets-FS.pdf

***Box V. Burning Biomass From Natural Forests For Energy Production in Australia - By Peg Putt, Markets for Change***

*The forest industry in Australia began to press for the establishment of wood burning power stations to generate electricity in the late 1990s. The major feedstock was to be sourced from natural forests. The industry creates substantial volumes of low quality logs through extensive industrial forestry operations conducted substantially by clearfelling, or in some places by modified clearfelling methods. At times, for example in the state of Tasmania, up to 95% of logs removed from the forest after logging have been categorised as 'pulpwood' residues, whilst less than 5% of the volume is sawlog for sawn timber production. The pulpwood is the proposed feedstock for power generation.*

*The electricity to be generated from burning wood from natural forests is categorised as 'renewable', although it would take many hundreds of years for such forests to grow again. Flawed carbon accounting rules (LULUCF rules for the Kyoto Protocol) and forest industry propaganda create an impression that such electricity generation is carbon neutral, whereas in reality some of the most carbon dense forests on the planet would release massive tonnages of carbon into the atmosphere. The impacts on biodiversity and other high conservation values caused by the logging destruction of the natural forests is also of serious concern.*

*Environmental campaigns have successfully forestalled the development of any large-scale forest burning energy plants, using a strategy of characterising the electricity as 'dead koala power', and successfully using public opposition to gain commitments from energy retailers not to purchase power from this source. Government policy settings at national and state level have also been an arena in which hard fought restraints on inclusion of material sourced from natural forests into the Renewable Energy Target have constrained government subsidisation—a necessary component of making such ventures financially viable.*

*We are now entering a new phase. This entails a new push by the forest industry for wood-fired energy production—either in electricity generation or by utilising the wood for liquid or gaseous fuels (especially for transport fuels). The woodchip export industry based on natural forests being shipped out of Australia to Japan has suffered a significant decline, and in the state of Tasmania suffered a near total collapse. Whilst this has been blamed on the work of the conservation movement other factors are also in play. The global financial crisis constrained demand, as has the poorly performing Japanese economy, whilst the advent of new sources of supply at lower prices and a shorter distance to market have also been important factors. In particular, woodchip from plantations in Vietnam and Thailand has substantially replaced the Australian trade with Japan and China. Australia cannot compete with the lower prices.*

*Hence the domestic forest industry is looking desperately for another way to utilise the vast majority of wood generated from logging natural forests in order to sustain its very survival. Without the income generated by these low value logs the industry is uneconomic. In fact even with a market for this product the industry is chronically reliant on government subsidies. Most natural forests subject to logging are on public land managed by state-based government logging agencies. They all tend to lose money and are propped up by the public purse. The continued environmentally destructive logging of Australia's natural forests paid for by taxpayers has been a long running source of conflict, which continues today. The forest industry wield enormous political power, but public opinion has been around 90% against woodchip exports, and is also very opposed to burning such forests for power generation.*

*The newly elected Australian government (one year old) was elected on a promise to incorporate burning of biomass from natural forests into the Renewable Energy Target. A recent report to government reviewing the Renewable Energy Target supported this course. (The review was conducted by a climate change sceptic.) The threat of industrial biomass burning is now immediate domestically. Another possible threat is the export of biomass from natural forests for energy production in north Asia—export to Europe is less likely due to transport distances. Thus the domestic energy policies of Japan and South Korea are of particular concern. We are currently investigating the likely demand from these sources, and it seems that Japan is the most clear and present danger as it struggles to rework its domestic energy policy and pulp companies increasingly move into energy production. Whole logs have already been exported from Australia and trialled for electricity generation, and the bioenergy industry in Australia is keen to establish an export trade in wood pellets.*

***Note**: Currently Japan is sourcing the majority of its wood pellets from Canada, with impacts on natural forests there. The possibility that they may look south for supply if their energy policy takes on the biomass burning option in a big way is not only a potential problem for Australia—it has serious implications for the forests of south Asia.*

## Conclusions

The case studies documented in this report show that there is already extensive use of wood-based bioenergy for fuel in many countries, and that overall demand for wood is likely to increase further as industrialised countries switch from using fossil fuels to biomass, even though some poorer countries that are already highly dependent on wood-based fuels are endeavouring to make the process of extracting energy from wood more efficient. However, the dynamics differ significantly between rich industrialised countries, and poorer impoverished countries already dependent on wood.

Countries in the Global South are already excessively reliant on the use of conventional wood-based energy sources, especially charcoal, mainly for the production of heat and electricity. This is clearly evident in the cases of Paraguay, Colombia, Uganda and Tanzania, and is contributing to deforestation and forest degradation.

In Paraguay for example wood charcoal is the main source of domestic fuel, and it is also used for drying soy, and wheat, maize and other grains. Paraguay is now exporting high-quality barbecue charcoal to Spain, Germany, Belgium, Brazil, Israel and Chile, even though deforestation is still rampant in the country.

Similarly, in Tanzania and Uganda wood-based biomass is the main source of energy. In Tanzania, biomass accounts for 87% of the energy used, including for commercial, institutional and industrial uses, and domestic commercial biomass energy is the largest source of cash income in rural Tanzania. Over 90% of Ugandans use wood-based energy for cooking, lighting and baking, and it is also used in institutions such as schools, hospitals and households. Energy is sourced primarily from biomass (84% fuel wood and charcoal).

The situation in the Global North is quite different. There is a shift taking place, from fossil-based fuels to wood-based energy, and this is clearly evident in the UK, US, and Sweden. This trend is particularly marked in the UK, which has seen the most explosive growth in wood pellet burning.

Pellets are far less bulky and thus cheaper to ship than other forms of wood, and wood pellet trading therefore makes up the vast majority of long-distance international trade in wood-based bioenergy. Most of that trade currently consists of pellet exports from the southern US and Canada to the EU, with the UK being the single biggest importer of North American wood pellets. Russia also exports significant quantities of wood pellets to the EU.

The case study from the UK shows that the reasons for the UK's pivotal role in the fast-growing international trade in wood-based bioenergy comes down to government policies and subsidies. Meeting EU renewable energy targets while curbing the expansion of onshore wind turbines (unpopular with many rural communities and especially with MPs from the main party in the UK's coalition government) has been one of the government's key motivations for supporting large-scale wood burning. The other motivation is the government's and energy companies' aim of keeping old, polluting coal power stations open by supposedly 'modernising' them.

Overall, energy companies' published plans would see well over 60 million tonnes of green wood being burned in UK power stations, although not all published plans will be realised. Most of this would be from imports. Even before the biomass boom

started, the UK was already 80% dependent on net imports for all the wood products consumed in the country. Any large-scale wood burning for energy will, whether directly or indirectly, lead to more imports. Overall it is the EU in particular that is driving global demand and it is expected that "*land the size of Poland and Sweden combined will be needed to produce crops and wood for Europe's bioenergy needs by 2030.*" [71]

In addition it is also possible that the potential for international trade in large-scale wood-based biomass may have been overestimated, in view of the fact that projects to produce wood-based biomass, including for export to the EU, have been suspended in countries such as Australia, Tasmania (see Box IV) and Brazil (see Box I). In other cases, the energy produced from wood-based biomass may be primarily for domestic consumption, but the business may be operated by a foreign company that has minimal regard for impacts on local communities, as is the case with Green Resources in Uganda.

Whatever the energy scenario, it is clear that using wood as a primary fuel is highly detrimental both for the environment and for people's health. The rapid loss of primary forest is devastating for local weather patterns and biodiversity, and in regions such as the Amazon can have significant consequences for the earth's climate control processes. The spread of monoculture plantations, for the production of wood-based biomass and other purposes, such as pulp and paper production, also has highly significant consequences for biodiversity and the availability and quality of water resources. It can also involve land-grabbing and exclusion from traditional forests that are closely linked to cultures and people's livelihoods.

In the cases of Uganda and Tanzania, for example, the negative environmental impacts associated with heavy reliance on wood-based energies are compounded by social impacts, with women having to walk many miles further to find firewood, and charcoal generally being much less accessible for local people as it is trucked to urban centres and even to neighbouring countries. This can in turn create a series of subsequent effects on women's lives as not finding water or firewood can mean that they can't prepare food, which in turn can be a factor leading to discrimination and violence against them.

Health is a key issue in almost all of the case studies, with respect to either the processing or consumption of wood-based biomass. Air pollution has been an important factor affecting communities living near wood processing facilities. A further pressing problem in all the case studies in the global South was the highly detrimental impacts that using wood-based biomass indoors can have on health, especially for women and children. Even though there is a clear need to move away from the use of wood-based biomass on an industrial scale, case studies indicated a clear and immediate concern to improve the well-being of people currently reliant on inefficient woodfuel cookstoves, with considerable efforts being made in countries such as Colombia and Uganda to improve the efficiency of cookstoves.

In the case study from Colombia, for example, there was a clear framework of energy sovereignty within which local solutions to these problems was developed. The concept of energy sovereignty is based on local control over local resources to meet local needs. As such it is a key tool for ensuring that communities avoid being preyed upon by corporate and commercial interests who present their activities with a veneer of providing assistance and services, alleviating poverty, or addressing health

[71] http://www.foeeurope.org/World-land-forests-threat-bioenergy-280514

concerns, when they are actually seeking access to and control over markets, land and resources.

In sum, uses of wood bioenergy must be evaluated within the context of a justice-based framework that prioritises meeting basic needs, seeks to avoid ecological damage, protects health and empowers communities to hold and maintain control and sovereignty over their energy and resources.

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**Annex Case Study 6: Relevant wood-bioenergy projects[1]**

Projects subjected to the System for Environmental Impact Assessment (SEIA) and to the CDM of the UNFCCC are included.

| Name | Region | Vapor generated [ton/hr] | Installed power [MW] | Holder | Investment (MMU$) | CDM | SEIA |
|---|---|---|---|---|---|---|---|
| Central Térmica Biomasa Agrícola Newenkutral | 8 | 164 | 40 | Narvik Ltda. | 100,00 | | Ver |
| Central Energía Biomasa Mulchén | 8 | 80 | 20 | Energía Pura S.A. | 42,00 | | Ver |
| Planta de Cogeneración con Biomasa en Norske Skog Bio Bio | 8 | 120 | 27 | Papeles Norske Skog Bio Bio Limitada | 60,00 | | Ver |
| Reemplazo de Caldera de Petróleo por Generación de Energía Térmica por Biomasa | 5 | | 4 | ENERGÍAS INDUSTRIALES S.A. | 5,00 | | Ver |
| Embarcadero, Uso de Biomasa y Depósito de Cenizas Central Térmica Andino (e-seia) | 2 | | | Central Termoeléctrica Andina S.A. | 5,25 | | Ver |
| Planta de Cogeneración de Energía Eléctrica y Vapor con Biomasa en CFI Horcones Caldera de Biomasa CFI Horcones | 8 | 210-250 | 31 | Celulosa Arauco y Constitución S.A. | 73,00 | Horcones | Ver |
| Sistema de Cogeneración de Energía con Biomasa Vegetal Cogeneración MASISA Cabrero | 8 | 65 | 9,6 | MASISA S.A. | 17,00 | MASISA | Ver |
| Cogeneración de Energía con Biomasa Vegetal cogeneración de energía con biomasa vegetal | 8 | 35 | 4,0 - 6,0 | Allan Lomas Redón | 10,00 | | Ver |
| Modificación Proyecto Caldera A Biomasa En Planta Pacífico, Mininco | 9 | 150 | | CMPC Celulosa S.A. | 35,00 | | Ver |

[1] Sources: http://seia.sea.gob.cl/busqueda/buscarProyecto.php - https://cdm.unfccc.int/Projects/projsearch.html

| Name | Region | Vapor generated [ton/hr] | Installed power [MW] | Holder | Investment (MMU$) | CDM | SEIA |
|---|---|---|---|---|---|---|---|
| Caldera a Biomasa | RM | | 14 | Energias Industriales S.A. | 1,20 | | Ver |
| Caldera a Biomasa en Planta Pacífico, Mininco | 9 | 100 | | CMPC Celulosa S.A. | 25,00 | | Ver |
| Cogeneración de Energía de Forestal y Papelera Concepción S.A. | 8 | 20 | 10 | Francisco Bebin Campos | 12,00 | Concepción | Ver |
| Central Bioenergía Cabrero | 8 | 100 | 20 | Terra Cabrero S.A. | 50,00 | | Ver |
| Central de Cogeneración Coelemu | 8 | 11 | 7 | Energía León S.A. | 15,00 | | Ver |
| Eficiencia Energética con Incremento de Generación Eléctrica en Planta Santa Fe | 8 | 210 | 100 | CMPC CELULOSA S.A. | 120,00 | | Ver |
| Eficiencia Energética con Incremento de Generación Eléctrica en Planta Pacífico | 9 | | 14 | CMPC Celulosa S.A. | 12,00 | | Ver |
| PLANTA TÉRMICA COGENERACIÓN VIÑALES | 7 | 210 | 41 | Aserraderos Arauco S.A. | 105,00 | Viñales | Ver |
| Planta Cogeneración San Francisco de Mostazal | 6 | 45 | 15 | Energía Pacífico S.A. | 27,00 | | Ver |
| **Small CDM projects that do not enter the EIAS (<3MW) or big ones that are contained into cellulosic plants projects** | | | | | | | |
| Nueva Aldea Biomass Power Plant Phase 1 | 8 | 250 | 29,94 | Celulosa Arauco y Constitución S.A. | | | Nueva Aldea 1 |
| Nueva Aldea Biomass Power Plant Phase 2 | 8 | | 41,7 | Celulosa Arauco y Constitución S.A. | | | Nueva Aldea 2 |
| Russfin Biomass CHP Plant Project. | 12 | | 1,2 | Forestal Russfin Ltda. | | | Russfin |
| Trupan Biomass Power Plant in Chile | 8 | 170 | 30 | Celulosa Arauco y Constitución S.A. | | | Trupan |
| Valdivia biomass power plant | 14 | | 61 | Celulosa Arauco y Constitución S.A. | | | Valdivia |
| Mafrisur renewable thermal energy | 10 | | | Matadero Frigorífico del Sur S.A. | | | Mafrisur renewable thermal energy |