Faculty of science and Forestry

Department of

WOOD MATERIALS SCIENCE

BIOENERGY MARKETS AND POLICIES LEARNING PORFOLIO

By

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1. Background of Basic concepts in Bioenergy

Bioenergy is energy generated from solid, liquid and gaseous products derived from biomass, typically wood, agricultural crops, and organic waste from municipal and industrial sources. While bioenergy in the form of wood, dung and peat has been a key energy source for humanity for centuries, this document refers only to modern commercial/industrial deployments for transport, industry, electricity, etc.

Biomass-based materials and products for non-energy use (such as food and feed ingredients, pharmaceuticals, chemicals, materials and minerals) can be generated through bio-refinery process alongside bioenergy-based products for power, heat and biofuels. Bioenergy-and biofuel-based bio-refineries are becoming more common and in these, heat, power and biofuels are the main products, with both agricultural and process residues used to produce additional bio-based products.

Bioenergy plays an important role in today's energy system, representing 11% of global final energy consumption in 2015. Traditional biomass for cooking and heating, still dominates the use of bioenergy (65%). The use of biomass in industry is the next most important use (18%), with bioenergy for electricity, transport and space heating less significant. Bioenergy can only play a role in helping meet the temperature rise limit agreed by the international community if its applications are aligned with these aims. CO2 emissions are generated when biomass is combusted and, if not done with care to replace the combusted stock, bioenergy assets/projects can generate net GHG emissions. Likewise, high emissions can be generated where land with pre-existing high carbon stocks is converted for feedstock cultivation, and/ or where feedstock's are transported long distances from cultivation sites to bioenergy facilities.

To achieve 2°C global warming target, IEA estimates that investment in bioenergy needs to rise from current levels of around USD25 billion per year to USD60 billion per year by 2030, and to around USD200 billion per year between 2050 and 2060. The total investment in bioenergy required under 2DS is expected to reach USD 6.1trillion, with USD1.6trillion in bioelectricity and USD4.5 trillion in transport biofuels production. The B2DS will require a further investment of USD1.7trillion in bioenergy. The USD93trillion global bond market has a huge potential to provide capital for bioenergy investment. Green bond has proven to be a useful tool to mobilize debt capital market for climate change solutions. The green bond

market has been growing rapidly over the last three years with the global issuance totaling USD155bn in 2017.

The Climate Bond Standard needs to ensure that the bioenergy assets and projects included in Certified Climate Bonds deliver on GHG mitigation potential and climate resilience benefits, in line with best available scientific knowledge and compatible with the goals of the Paris Agreement. At the same time, the Bioenergy Criteria need to be pragmatic and readily usable by stakeholders in the market, to maximize engagement and use.

Today, transportation fuels based on biomass (i.e., biofuels) are identified as first and second-generation biofuels. First generation biofuels are produced from sugar, starch, vegetable oil, or animal fats using conventional pyrolysis technologies. The basic feedstocks are often seeds and grains such as wheat, corn, and rapeseed. The most popular first generation biofuels are bioethanol, biodiesel, and starch-derived biogas, but also straight vegetable oils, bio-methanol, and bio-ethers may be included in this category. The key advantages of first generation biofuels are due to the high sugar or oil content of the raw materials and their easy conversion into biofuel, while the disadvantage is the competition with food and feed industries for the use of biomass and agricultural land. Since climate change mitigation and energy security are the two most important driving forces for biorefinery development are GHG and energy balances.

2. The role of policy on bioenergy markets

The Biomass Futures project assesses the role of bioenergy in meeting Europe's renewable energy targets as provided in the Renewable Energy Directive (RED). This was done by conducting sectoral market analyses, estimating the availability of biomass for energy and by modeling demand and supply of bioenergy within the EU27 energy system. The results of the Biomass Futures project are significant given the important contribution foreseen for bioenergy in delivery of Europe's renewable energy targets. According to Member States' National Renewable Energy Action Plans (NREAPs), biomass will make up 19 % of total renewable electricity in the year 2020, 78 % of total renewable heating/cooling in 2020 and 89 % of total renewable energy in transport. Altogether, bioenergy is expected to make up over 50 % of total renewable energy use. The high-level horizontal strategies have enshrined the green economy concept, the main ones being the Europe 2020s flagship initiatives "an industrial policy for the globalization era' and 'Resource efficient Europe'. ′the Commission

will work to promote the competitiveness of Europe's primary, manufacturing and service industries and help them seize the opportunities of globalization and of the green economy". Demand for biomass will increase strongly over the coming years. Results from the Biomass Futures project indicate EU27 biomass potential in the range 375 to 429 MtOE, depending on the sustainability criteria applied. This is approximately 250% of the amount of resource required to realize total bioenergy demand for 2020, as set out in NREAPs However, in the demand analysis performed by the project with the RESolve model it is predicted that only a part (37%) of domestic biomass supply could actually be exploited by 2020 due to primarily lack of clearly focused policies and support measures at local/ national level that can promote efficient resource mobilization.

The start of the Biomass Futures in mid-2009 coincided with the time that the European Commission published the NREAP templates and requested Member States to complete these by June 2010.

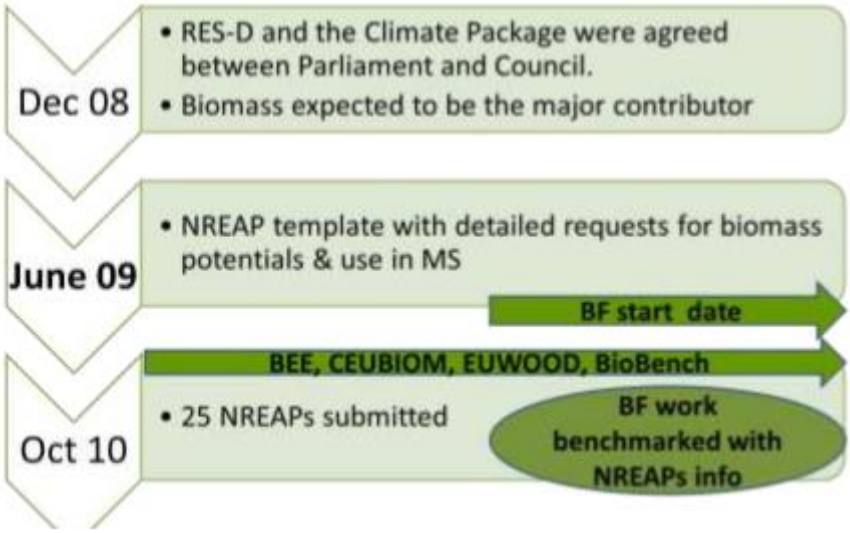

Figure: State of play at the outset of the Biomass Futures project.

Participants to the Biomass Futures project consulted with stakeholders at the proposal stage, and reported that individuals reported a number of fundamental areas that lacked information and consistency of approach. These included issues such as:

• Harmonized assumptions on biomass feedstock's availability and sustainability.

• Information on sustainable biomass feedstock potentials at MS level to meet 2020 and 2030 targets.

• Outlooks on the optimal use of biomass feedstock potential by market segments.

• Clear data on the role of biomass in energy and transport sectors, with focus on MS 2020 targets.

• Transparent, clear briefings for use by stakeholders.

The key objective of the Resource efficient Europe flagship initiative is ´to support the shift towards a resource efficient and low-carbon economy that is efficient in the way it uses all resources. The main goal is to decouple our economic growth from resource and energy use, reduce CO2 emissions, enhance competitiveness and promote greater energy security´. In this context, policies related to resource efficiency need to be seen as efforts for shifting towards a resource-efficient and low-carbon economy within the global context of green economy transition EC.

The European Commissions have some approach to covers all bioeconomy sector 'the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy', including both traditional and emerging sectors, i.e. 'agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries'. The Renewable Energy Directive (RED) also includes a set of provisions to facilitate the development of renewable energy, such as a legal requirement for the MS to prepare National Renewable Energy Action Plans (NREAPs) with detailed roadmaps to reach the RES targets and measures taken to reach these targets and develop energy infrastructure. Bioenergy is expected to provide almost 60% of the renewable energy in 2020. Bioenergy is expected to have an important role within the long-term goal to become a competitive low carbon economy according.

'The Atlas of EU Biomass Potentials' provides quantitative and spatially explicit estimates of potential biomass supply available across the EU Member States. The potentials analyzed include resources potentially available from the agricultural, forestry and waste sectors including residues arising from the former two categories as well as dedicated crops or wood-based biomass. The analysis sets out the estimated potential in both 2020 and 2030. Estimates have been calculated based on the two scenarios: reference and sustainability.

3. Economic Instruments in energy policy

Economic instruments are fiscal and other economic incentives and disincentives to incorporate environmental costs and benefits into the budgets of households and enterprises.

The objective is to encourage environmentally sound and efficient production and consumption through full-cost pricing. Economic instruments include effluent taxes or charges on pollutants and waste, deposit-refund systems and tradable pollution permits.

Economic Instruments can be designed in a variety of ways, and for a variety of applications, including the following:

- Increasing prices of goods and services that damage health and environment, as well as increasing financial returns in the case of more sustainable approaches that foster more environmentally- friendly production and consumption patterns.
- Reduction of compliance costs by providing flexibility to polluters or users of natural resources to choose the most cost-efficient and environmentally-effective measures.
- Incentives for investments in innovation and improved environmental technology so that both environmental and financial benefits are generated.
- Allocation of property rights and responsibilities of firms, groups or individuals in a manner so that they have both the incentive and the power to act in a more environmentally- responsible manner.
- The raising of revenues to achieve environment and health objectives via tax policies.

Carbon taxation policies

A carbon tax is a tax levied on the carbon content of fuels. It is a form of carbon pricing. Carbon is present in every hydrocarbon fuel (coal, petroleum, and natural gas) and converted to carbon dioxide (CO2) and other products when combusted. In contrast, non-combustion energy sources—wind, solar, geothermal, hydropower, and nuclear—do not convert hydrocarbons to CO2. CO2 is a heat-trapping "greenhouse" gas [2] which represents a negative externality on the climate system (see scientific opinion on global warming. The objective of a carbon tax is to reduce the harmful and unfavorable levels of carbon dioxide emissions, thereby decelerating climate change and its negative effects on the environment and human health. Carbon taxes offer a potentially cost-effective means of reducing greenhouse gas emissions.

Finland was the first country in the world to adopt a carbon tax in 1990 and since then has used a variety of different types of economic instruments to control GHG emissions and to protect the environment. This brief report summarizes the main national economic instruments used in Finland that aim to control GHG emissions (i.e. economic climate policy

instruments) and what we know of their (potential) impacts on emissions, fiscal balances and innovations. Electricity certificates and the EU emissions trading scheme, which are market-based systems, are described insofar as they interact with other economic instruments. Although carbon tax is only an economic policy at national level, the international coordination system in carbon tax cannot be missing. And governments have conducted a series of international cooperation in programs of responding to climate change, and several cooperation frameworks have been signed such as the "United Nations Framework Convention on Climate Change", the "Kyoto Protocol" and the "Bali Roadmap". Environmental protection is one of Europe's key values. The EU has set clear policy objectives in the areas of energy and climate change and has committed to achieve ambitious targets with respect to energy savings, reductions of greenhouse gas emissions (GHG) and deployment of renewable energy sources by 2020. However, aggregated projections of EU-27 for 2020 show that, even if the additional measures currently planned by Member States are adopted and fully implemented, greenhouse gas emissions will increase between 2010 and 2020, reaching a level approximately 2 % higher than in 2005, and only 6 % below their 1990 level. This is a significantly higher level than the unilateral commitment of a 20 % reduction, compared to 1990 levels, decided by the European Council in December 2008. The EU has increasingly favored economic or market-based instruments ("MBI") – such as indirect taxation, targeted subsidies or tradable emission rights for such policy purposes.

The market is shaped by the demand and supply of commodity. The demand and supply curve set the market price. Generally, low supply and high demand increase price. In contrast, the greater the supply and the lower the demand, the price tends to fall. The equilibrium price is the price at which the producer can sell all the units he wants to produce and the buyer can buy all the units he wants.

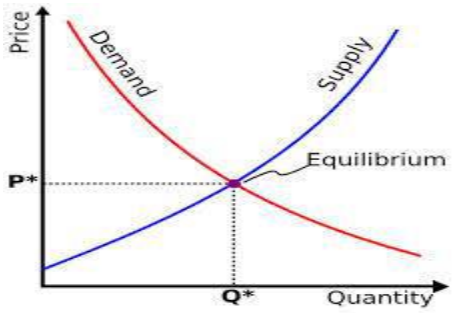

Figure: Supply and demand curve

4. Adoption dynamics in bioenergy markets

Biomass is the renewable energy sources. As renewable energy sources (RES), forest biomass and other biomass provided about 10% (54 EJ equivalent with 1,300 MTOE) of global total primary energy demand (TPED) in 2011. Europe's future wood demand for energy is expected to increase by 10 million to 200 million m3 in the period 20102030. This will be supplied by both domestic sources (forests, industrial residues post-consumer wood waste), but also from sources outside Europe. The EU-28 predicts a near future (2020) gap between solid biomass supply and demand for renewable energy: 21.4 million tonnes of oil equivalents (MTOE). This is estimated via preliminary renewable energy action plans (NREAP's) per country. The EU-28 expects wood pellet import will merely complete this gap of 21.4 MTOE, with more than 50 million tonnes of pellets. This implies a feedstock need of 125 million m3 of wood from forests and other sources outside the EU-28.

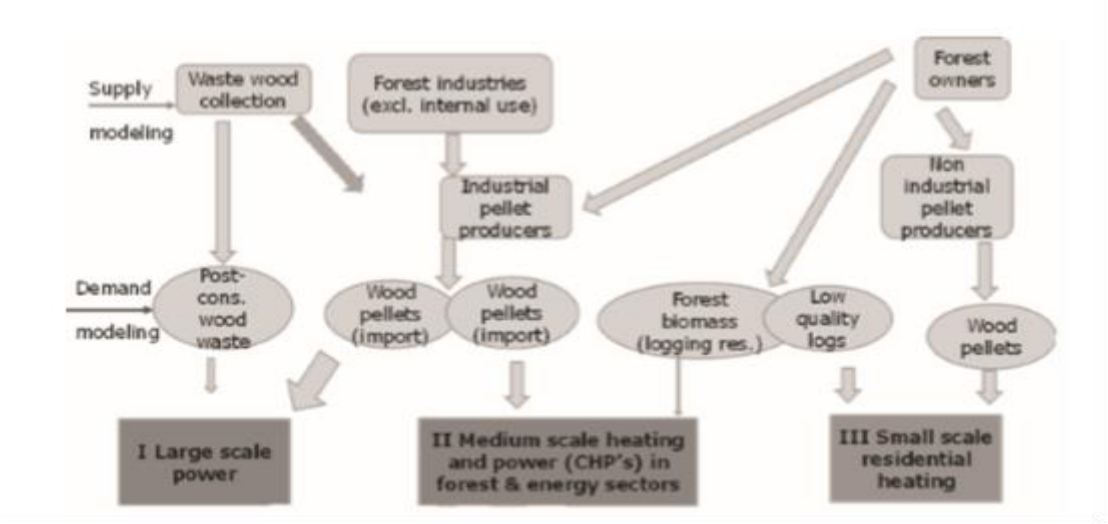

Figure: Division on EU bioenergy sector in three major market.

Wood pellets are homogeneous densified wood fuels of a standardized size of typically 6–12 mm in diameter and 25–50 mm in length. They are produced from wood residues under high pressure, with or without the use of organic binders, and have a relatively high average energy content of about 18 MJ/kg. Pellets can be burned at low pollutant emission levels in fully automated small-scale heating systems that require only a modest level of maintenance. Apart from GHG mitigation, the use of pellets for heating purposes can improve fuel supply security by reducing dependence on oil imports, and stimulate local and regional job creation and economic development. Finally, the development of a strong domestic market also enhances the opportunities for technology export.

After Sweden, Finland has the second-highest share of renewable energy in Europe. The use of renewable energy sources in the production of electricity and district heat has progressed rapidly in Finland. In five years, the use of renewable energy sources in the production of district heat has doubled to 36 per cent. According to our estimates, this share will rise to 55 per cent in a well-functioning market. In 2015, the share of renewables in electricity generation was 45 per cent. Within it, the largest share was hydro power followed by wood and wind power. The volume of wind power will still double from the current levels during this decade. Almost 80 per cent of electricity generation was emission-free, which will rise to 90 per cent by 2030 as the share of renewable production and nuclear power increases. We reached the national, binding EU-targets for renewables set for 2020 already in 2014. According to the latest estimate, the use of renewable energy sources will surpass fossil fuels this year. Wood has been the most significant energy source in Finland for some time. Currently, at the annual level, wood is used more than oil, which still produces the highest share of greenhouse gas emissions in Finland out of all fuels. Emissions from oil are even greater than the emissions from all other fossil fuels combined. Traffic faces the biggest challenges in using renewable energy and cutting greenhouse gas emissions. Oil still accounts for almost 90 per cent of fuels used in road transport. In order to replace oil in transport, we need actions to promote both liquid biofuels and electric traffic.

In Sweden, around 50% of the 1.6 million detached houses have electric or oil-based heating systems, i.e. electric boilers, electric resistance heaters, or oil boilers. These systems could be replaced by pellet heating systems, but also by biomass-based district heating, heat pumps or logwood boiler systems, among others. System analysis of small-sized heating systems has revealed that pellet boilers, on a life cycle basis, emit significantly less GHGs than electricity or oil-based heating systems.

5. Biomass Markets: model behavior

Day by day increase the biomass demand and limited availability in the EU is expected to be made up by imports from countries in eastern Eurasia, Africa and the Americas, that have been the source of wood for energy in Europe. Russia have an almost a quarter of the global forest area, one of the fifth of the global forest growing stock and close physical proximity to the EU is the biggest potential source for bioenergy. The Russian Energy Agency (REA) has estimated that Russian forest resources could be used for sustainability producing 1,2 billion tons of pellet, 315 million tons of ethanol and large quantities of syngas annually produced. The level and location of energy crop demand is available from the set of operating plants

and supply from the set of farmer agents. However, supply and demand must be matched, to allow calculation of the transportation costs, to know how much supply a plant has been allocated, or to identify farms that have unused supply. To match supply and demand, farmer agents were selected at random; each choosing to supply the nearest plant with demand, to minimize transportation costs. This selection process continued until all demand was met or all supply was allocated. If the market is in over-supply, then farmers who have unallocated biomass hold this for potential allocation at a future time. Alternatively, when the market is in under-supply, power plants with unfulfilled demand operate at less than maximum capacity. This reduces their profitability, which is reviewed by the agent's learning mechanisms.

The European Union (EU) and other nations worldwide are discussing to amend the course of their long-term energy strategies in a way that they will abate significant current and future problems such as the global warming effect, the regional concentration and limits of fossil energy resources and the rapidly increasing global demand for energy. The EU has enacted two binding directives which set quantity targets for renewable energies and fuels in the current and future energy supply up to 2010 (Renewable electricity in 2010: EU 22%; Biofuels in 2010: 5.75%; Total renewable energy consumption in 2010: 12%). Until 2020 these targets are to be enlarged considerably. Given that nearly 66% of renewable energy production in the EU in 2004 was based on biomass (hereafter referred to as bioenergy), the demand for biomass will increase rapidly during this time horizon. The EU lunch agricultural sector model CAPRI (Common Agricultural Policy Regional Impact Analysis). An advantage of the CAPRI model, which was especially developed to analyses CAP (Common Agricultural Policy) and European trade policies, is the well-developed representation of agricultural supply behavior in Europe under consideration of current CAP measures and global trade agreements for agricultural products. The model consists of two interlinked modules: 1. a globally closed spatial multi-commodity model for primary and secondary agricultural products based on the Armington assumption (market module) and 2. NUTS II (Nomenclature of Territorial Units for Statistics, level 2) aggregate non-linear programming models for EU27, Norway and Western Balkans which capture in detail farming decisions (regional supply module).

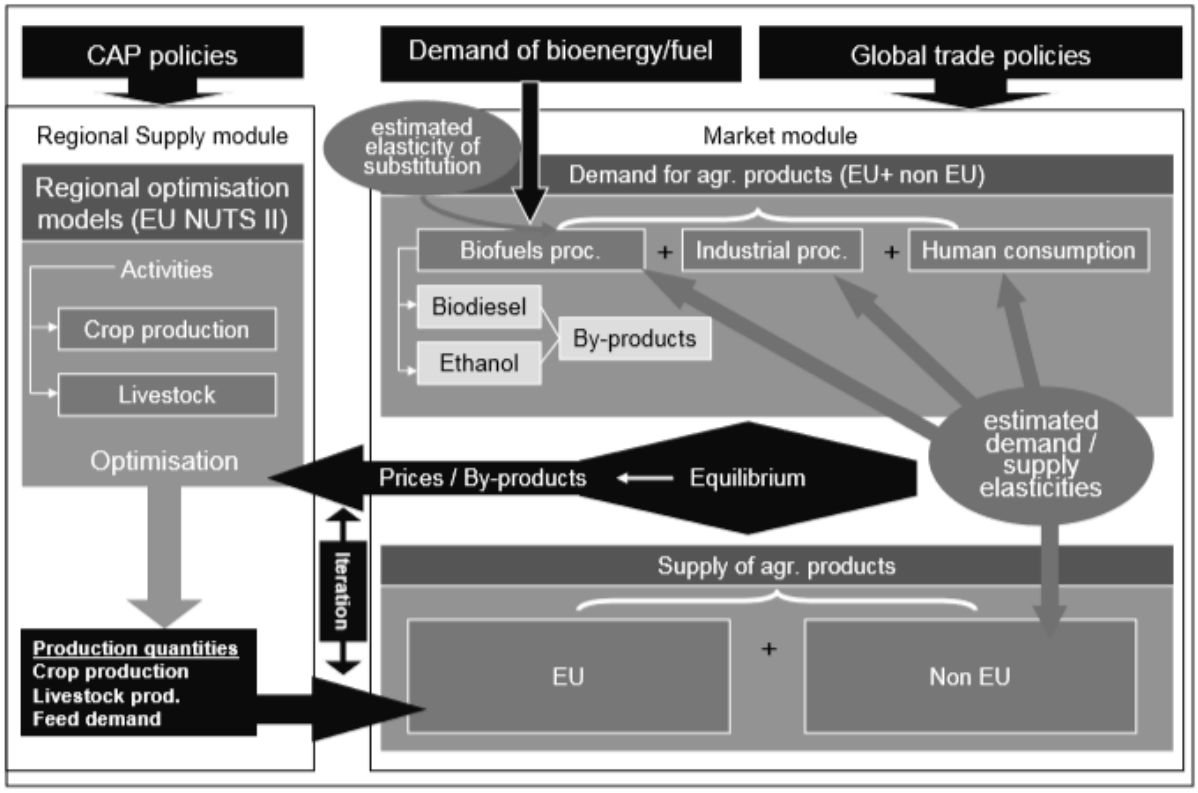

Figure: Implementation of biofuels in CAPRI

6. Concepts and approaches to bioenergy governance

Governance is the sum of the many way's actors and institutions, public and private, manage common affairs. According to the Business Dictionary, governance is the establishment of policies and its execution, monitoring and assessment. This is done by a governing body or an organization. Governance is especially important regarding the issue of biodiversity and ecosystem services protection. The negative effects of bioenergy and biofuel production on biodiversity and ecosystem services can be avoided or reduced and positive effects enhanced by attention to three guiding principles: (1) identification and conservation of priority biodiversity areas; (2) identification of effects of biofuel feedstock production on biodiversity and ecosystem services that are context specific; and (3) implementation of location-specific management of biofuel feedstock production systems to maintain biodiversity and ecosystem services110. Governance policies are needed that are especially designed to avoid the implications of unsustainable exploitation of natural forests for biofuels, which frequently lead to "exporting" deforestation to other regions in the same country or to other countries as well as encouraging illegal logging and trade in wood and non-wood forest products111. Participatory governance that engages the public and key stakeholders in an open and

informed dialogue is required for a broad public support of bioenergy Bioenergy supply chains pass several layers of governance, including both emerging governance mechanisms that specifically address bioenergy and existing regulations, such as environmental codes affecting forestry and agriculture. The sustainability requirements associated with the EU Renewable Energy Directive (EU-RED) is an example of how norms and sustainability priorities in one region can be expressed to influence activities in other regions, when actors in these other regions aim to produce for the EU market.

EU-RED have some general sustainability aspects for bioenergy governance:

o Social sustainability

o Biodiversity

o GHG emissions

o Carbon stock

o Air, water and soil

o Ecosystem services

o Land-use

Governance is deceptive and not as easy as it sounds and even though all rules are for all intents and purposes, good for the majority, there will always be a negative reaction which is what we call conflicts. For bioenergy governance, there are a lot of conflicts that arises such as prioritization of energy from food. Production of energy crops such as jatropha, willow and poplars can compete with existing resources especially land. Carbon neutrality is still an issue and of course the capacity of the people to pay for new and more expensive energy compared to the cheaper coal or oil alternative. The absence of good governance can represent a considerable business risk to actors operating in the European bioenergy sector. Sustainability schemes can help reduce risks by increasing the trust and legitimacy in companies and bioenergy supply chains.

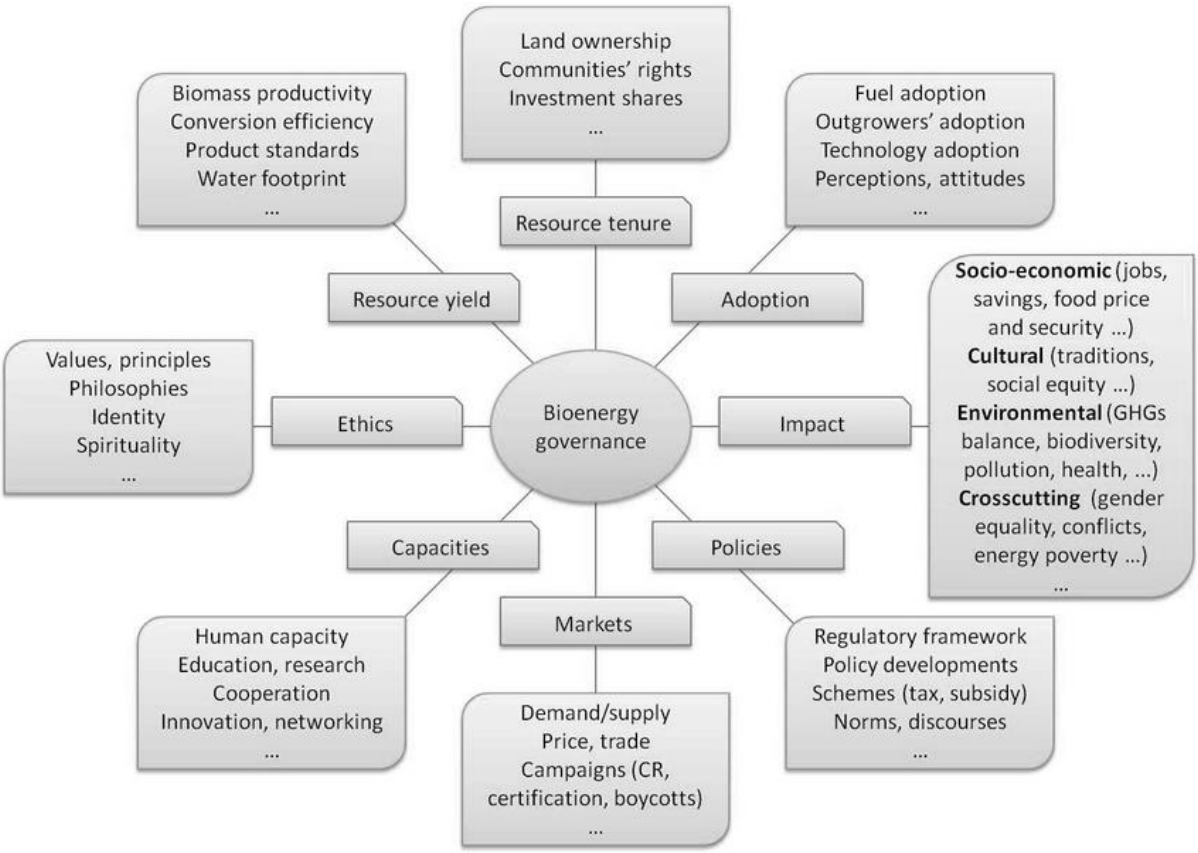

Figure: Bioenergy governance framework

7. International bioenergy markets

The price for primary biomass is determined by three factors: (i) the supply side factor (technically achieve-able biomass supply volume with associated cost), (ii) the demand side factor (energy demand, land demand associated with food and feed production/energy crop production/and other usages, the price of competing usage (i.e., fossil fuel price, food price)), and (iii) the policy factor (i.e., tax incentives, blending mandate) All three factors are dynamically interlinked and require economic models for detailed assessment. To avoid an overly complex procedure, actual market prices of primary biomass in 2010 were used in this analysis as a proxy for the prices in 2030. For the residue and waste, price estimates from the literature were used and global averages were assumed in regions for where there were no reliable statistics. Biomass has potential areas of application in all sectors. In 2010, biomass use reached 56 EJ. Of this total, 62% is used in residential and commercial buildings sector. Industry (15%), transport (9%) and the power and district heating (8%) sector are the other large bioenergy users. Bioenergy demand in these four sectors account for more than 90% of its total consumption worldwide. There is also a relatively new market for biomass: its use as

a feedstock to produce chemicals and polymers. Today around 600 petajoules (PJ) of biomass is used as raw material for this purpose, in Brazil, South East Asia, the US and Europe.

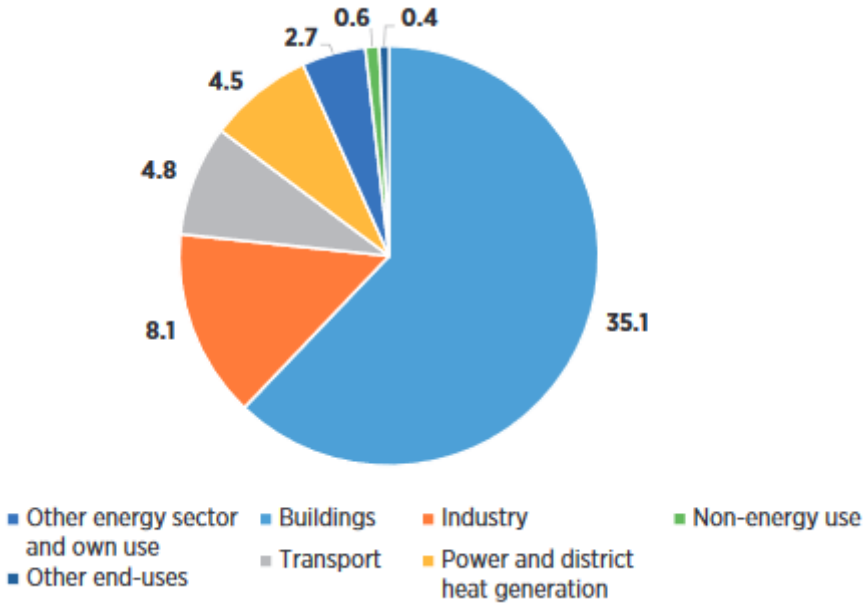

Figure: Breakdown of current bioenergy use by sector, 2010

Finland is one of the most interesting countries in EU in terms of bioenergy and pellet production. Biomass is widely used for industrial purposes (e.g. in the paper and pulp industry) and is also used for power generation within these sectors. The share of 28.5 % (2005) RES in final energy consumption makes Finland one of the leading uptakes concerning RES market uptake in the EU (average 8.5 %). The development of the pellet marked started in Finland in 1998. The biggest share of renewable energy (37.5%) in Finland is used in the industry. Even today, a large share of the produced pellets is exported and in this respect. Finland is competing with Norway, Canada, Estonia-Latvia and even Denmark and the Netherlands (both are also pellet importers at the same time) but not yet with Russia. The Finnish pellet market started as export market and today about 75 % of the pellet production is exported.

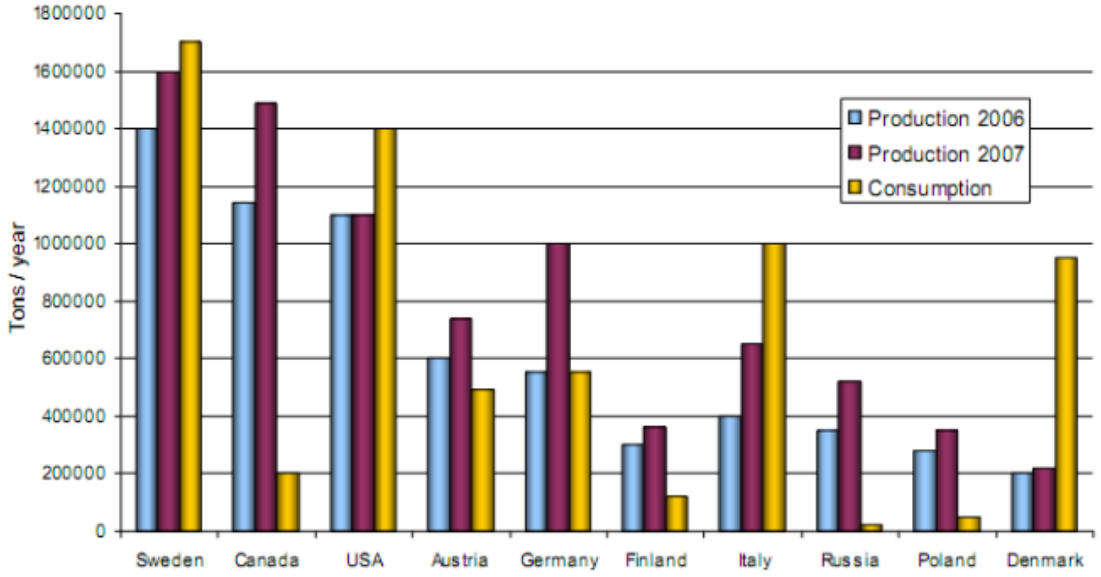

Figure: The pellet production and consumption of the leading pellet countries in 2006-2007 [Pellet time Report 2008].

8. Policies for European Commission

Bioenergy is an alternative and renewable energy source and by promoting bioenergy production and use municipalities can gain energy autonomy and ensure local energy supply, reduce greenhouse gas (GHG) emissions, save money and create jobs. On the other hand, over the past year's bioenergy came under criticism since it can have adverse effects on biodiversity and environment and cannot necessarily be regarded as CO2 neutral. Hence, when bioenergy is promoted, some basic principles for its sustainable production and consumption should be considered.

In 1998, EU adopted a first Forestry Strategy to create an EU-wide frame work for forestry. In 2013, a new version of the EU Forestry Strategy was issued. It encourages Member States to exploit forest resources in a way that minimizes that impact on the environmental and climate, and prioritizes the forest outputs that have higher value-added, create more jobs and contribute to a better carbon balance. EU also take several policies such as climate policy, energy policy, and trade policy.

Climate policy

EU adopted climate change prevention as a strategic priority. For the first commitment period of the Kyoto Protocol (2008-2012)., the 15 countries that were EU member before 2004 committed to reduce their collective emission to 8% below the 1990 levels. According to EC

strategies, 1% out of 8% of the EU15 target was supposed to be reached through forest activities. Climate policy is closely connected to energy policy, where the role of biomass is paramount.

Energy policy

Directive 2009/28/EC (EU-RED) requires that at least 20% of that EU's total energy consumption is generated from renewable energy by 2020; in this perspective, it confirms forest biomass as the most important renewable energy sources in Europe in the 20-20-20 strategy; wood and wood waste represent 47% of gross consumption of renewable energy by 67% of bioenergy use.

Box 2. Main EU policies affecting the production and use of energy wood

Some of the most important EU policies affecting the energy wood context are listed and described here, also the policies' effects on the production and use of forest wood as an energy source are explained.

Policy	Description	Effects
Common Agricultural Policy and Rural Development Policy	They aim at the competitiveness of the primary sector and at promoting rural development, amongst other things by offering financing opportunities to farmers and forest owners.	Forestry measures and related activities aimed at producing forest energy wood can be directly financed. These policies determine the availability, types and costs of forest woody biomass to the energy sector.
Directive 2002/91/EC on energy performance of buildings	It promotes energy performance of new and existing buildings, for example by fostering the efficient use of installations like boilers and air-conditioners, and of renewable energies.	It stimulates demand for energy wood, since this is among the energy sources most broadly used for efficient heating technologies like the cogeneration of heat and electricity and district heating.
EU Emission Trading Scheme (Directive 2003/87/EC)	The core of EU climate change policy – it applies a market system to cost-effectively reduce greenhouse gas emissions. It applies a 'cap and trade' system: it imposes a limit to industries ' total emissions, and it allows trading the assigned 'emission allowances' which can be used to emit or can be sold on the market.	By putting a price on greenhouse gas emissions, it fosters the substitution of fossil fuels with less carbon-intensive energy sources, therefore strengthening the economic competitiveness of woody biomass and other renewable energy sources.
Renewable Energies Directive (Directive 2009/28/EC) and Biofuels Directive (Directive 2003/30/EC)	By establishing individual legally binding targets for the share of renewable energies consumed in the various EU Member States, they promote an increased use of renewable energy sources for all energy sectors and in particular for the transport sector.	They force EU Member States to increase the use of wood and other renewable energy sources to reach the mandatory targets.

The data were collected and analysed within the project COOL (COmpeting uses Of forest Land; www.cool-project.org). Author: Francesca Ferranti.

I have learned a lot from this topic, most especially the way EU is charging taxes to companies emitting carbon dioxide and EU energy and climate policy. What I'm interested in though is how countries decide which method to use? As discussed, charging carbon taxes makes small companies pay higher while big companies pay lower taxes. Of course, this is terrible because the more CO2 you produce the less you pay due to economies of scale, which is unacceptable. But there are countries that uses the method and I wonder how EU is doing about it because in the long run, this carbon will also be affecting the whole world. And it is unfair that one country is doing its part mitigating GHGs, but other countries are not, such is the case of China and USA. Which bring us to the same dilemma of these bigger countries not caring about the world while they are two most producers of GHGs, it does not make sense too that smaller and poorer countries must cover for them. We all know that putting a cap on CO2 emissions also means halting development using unsustainable means and unrenewable resources.

9. Nordic Bioenergy Market

The bioenergy share of gross inland energy consumption varies in the Nordic countries from 4.2 per cent in Norway to 12.2 per cent in Denmark, 19 per cent in Sweden (2006) and up to 20 per cent in Finland (2004 numbers). Especially in Denmark, Sweden and Finland did the share of bioenergy increase significantly over the past 25 years.

The Nordic countries show a generally strong complementarity in bioenergy technology strongholds.

• Denmark holds a leading position in the demonstration and commercial operation of biomass combustion, biogas technologies, grate firing of municipal solid waste and large-scale centralized biogas plants using animal manure. Denmark also holds a leading position in the prospects of using enzymes in second generation ethanol production.

• Finland holds a leading position in the commercialization and use of biomass combustion from farm level to the world's biggest power plants. Whereas Denmark has experience in grate firing, Finland is specialized in fluidized bed combustion technology that allows for low-grade fuel like bark and sludge.

• Sweden is leading in the use of biomass in district heating and has a fast maturing market for pellet production with over 80 factories and a strong market for pellet boilers, pellet burners and stoves. Also, Sweden has a relatively long experience in the production of energy

crops such as Salix and is leading among Nordic countries in the development and implementation of a functioning biofuel market, including production of cars and ethanol and setting up an efficient distribution network.

Different targets for renewable energy and bioenergy exist in the Nordic Countries. Not all have a specific target for bioenergy, although the sector in all countries is set to play an important role.

• Targets in Denmark include an increase in the share of renewable energy to 30 per cent by 2020, where the Biomass Agreement for electricity production plays a significant part.

• In Finland, the national targets for renewable energy follow the targets set by the European Commission in An Energy Policy for Europe. This aims at increasing the share of renewables from final energy consumption from 28.5 per cent in 2005 to 38 per cent in 2020. As bioenergy represents 85 per cent of the renewable energy in Finland, this target is primarily linked to the increase in the application of bioenergy in the energy system.

• In Norway, a proposed target for bioenergy has been set to increase the use of bioenergy by 14 TWh by 2020, which is close to a doubling from current use (16 TWh/year). As part of this includes the target by 2012 to generate 4 TWh of heat from bioenergy. A general ambitious target is 30 TWh more renewable energy and energy savings compared to 2001.

• Sweden has an ambitious strategy to break Sweden's dependency on oil by 2020 using energy efficiency and increased use of renewable energy.

It is very interesting topics for me because the Nordic countries are pioneer for using biomass as source of their energy and I want to know how these countries do it. I have already learning all the strategies and incentives that the government provides to encourage use of renewable energy, it is very clear that governance and policy has a main role. Of course, we cannot discount the fact that the people also made it possible due to their cooperation as well as the available technology.

10. Translating EU bioenergy policy: Bioenergy regions

As a part of the EU transition towards renewable energy systems and a low-carbon economy each member state can choose their own approaches within the common EU 2020 target framework and the 2030energy strategy. EU 2020 low-carbon policy documents highlight security of supply, sustainability of the energy sector and internal (energy) market

development as key targets. Additionally, EU environmental policy is one of the main drivers for the development of a common EU renewable energy policy. The EU's Roadmap to a Resource Efficient Europe (EC, 2011a) outlines how we can make Europe's economy sustainable by 2050. It proposes ways to increase resource productivity and decouple economic growth from resource use and associated environmental impacts. The Roadmap analyses key resources from a life-cycle and value-chain perspective and illustrates how policies interrelate and build on each other. It sets out a vision for the structural and technological change needed up to 2050, with milestones to be reached by 2020.

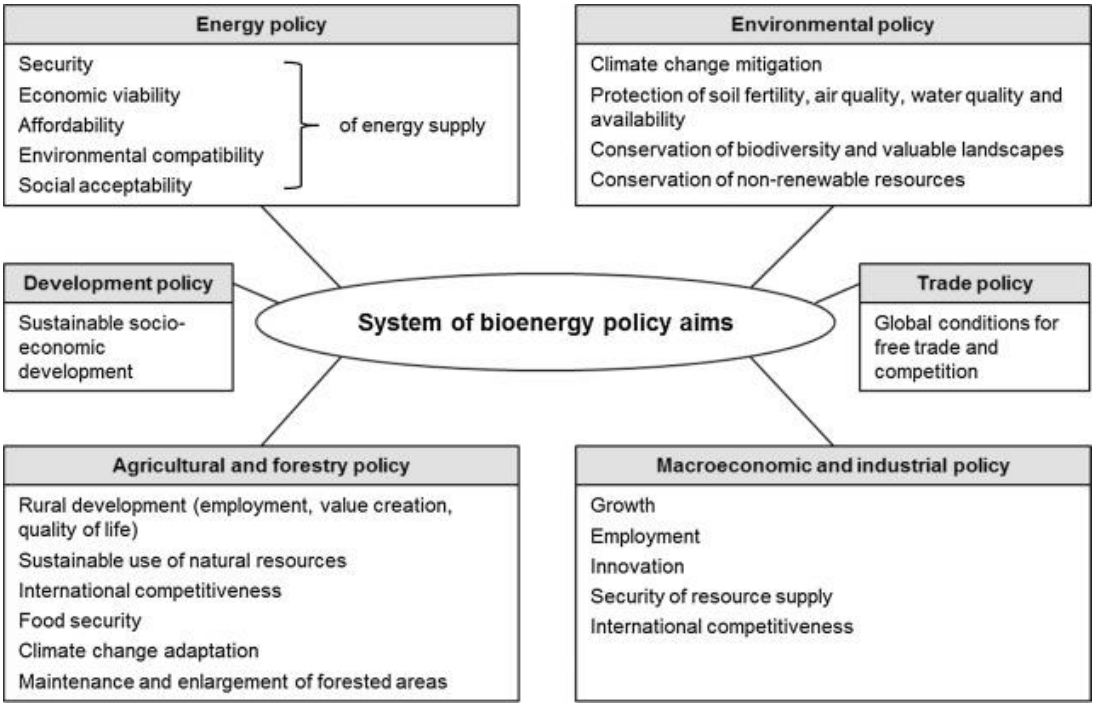

Figure: Major policy fields and aims impacted by bioenergy use.

Accurate translation of polices is very important on this matter, because there can be differences in translating the policy and this can shift the objectives or rationality of a policy. These can happen and sometimes it is not monitored very well. A better policy can therefore be translated into something harmful and less beneficial to the community. This topic, I would really like to know more about the process of translating EU polices into action plans and concrete strategies and how these bioregions are conducting it. It would be a great experience to know and see for myself how it is done.

11. Recent and future trends in bioenergy

EU´s, China´s and some other actors´ targets for renewable energy have long been assumed to be met by massive use and import of bio mass. This trend has lost strength. Global demand

of woody bio mass has been assumed to be on the rise, due to increasing production of pulp, advanced biofuels, bio chemicals, and bioenergy. The evidence is only scattered, it is no strong and general trend. The number of industrial plantations (willow, poplar, eucalyptus, pine, oil palm) has continued to increase since 1960s, partly replacing natural forest or agricultural use of land. This trend exists, but many factors threaten it. Since 1990s, a growing part of plantation produce, and land use has been used in energy production, as chips/pellets, in production of bio fuels or through use of side streams. The trend exists but has not gained much more pace in recent years.

Future bioenergy investment strongly depends on:

- Price level of other forms of energy production (fossil, nuclear, solar, wind etc.)
- Price level of feedstock.
- The efficiency of the production technology
- The volume of public/state support and the political incentive structures

These factors depend in turn on other factors, such as:

- energy supply and demand

- other forms of land use (especially food production)

- the need for climate policy measures (especially cutting carbon emissions)

- political/ideological goals: energy security, food security, economic interests

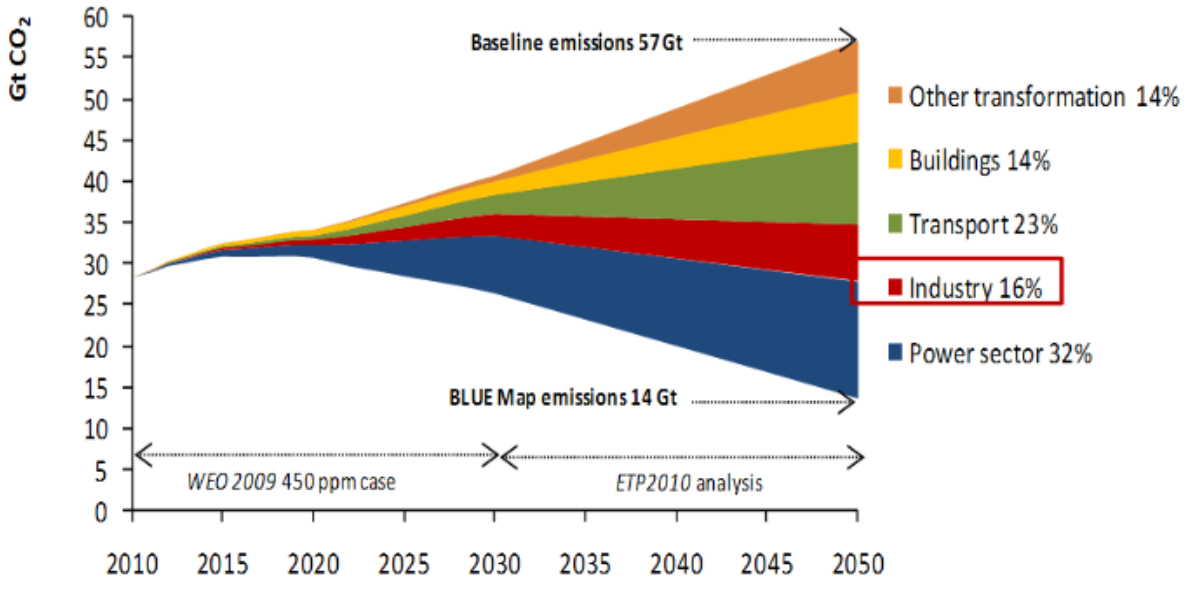

Figure: The IEA Blue Map Scenario – Towards a Low Carbon Future.