Bioenergy markets and policies

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1.- Background

Bioenergy is produced from biological material (biomass). There are different groups of bioenergy which are wood energy, agro-energy and municipal by-products. Wood energy can be produced for example from fuel wood (solid), black liquor (liquid) or pyrolysis gases of above fuels (gas). Furthermore, wood energy can be generated by pellets that are solid but behave like a liquid.

Biomass generates about the same amount of carbon dioxide as fossil fuels, but every time a new plant grows, carbon dioxide is removed from the atmosphere. Some experts consider bioenergy from biomass as being carbon neutral while others think that it is not due to a lot of factors which are plausible. However, this is a debate that at the moment can go forever since there is lack of common ground in some terminologies and also in being able to measure at the full extent the implications of producing energy from renewable sources versus fossil fuels.

To classify energy as bioenergy it is important that the resources are renewable which means renewable in human-relevant time spans.

As mentioned above, nowadays bioenergy is characterized by technology, efficiency and planning.

There are different reasons and pre-conditions why the modern bioenergy development started. The two main events that have changed international policies and contributed to the development of bioenergy systems were the first oil crisis in 1973 and the second oil crisis in 1979.

One important aspect were instable situations and wars in countries with large oil reserves beginning with the Arab–Israeli War in 1973, which had rising oil prices as consequence. Western countries recognised their dependence on oil and supported the

development of other, own energy sources. For example, USA promoted Fracking, France promoted Nuclear Energy and Scandinavian Countries promoted Bioenergy made of wood.

There are three main policy fields on the EU level related to and influencing the development of bioenergy systems: energy policy, agricultural policy and environmental policy. The lack of policy integration might be a barrier for bioenergy development.

2.-The roles of policy on bioenergy markets

A policy is a deliberate system of principles to guide decisions and achieve rational outcomes. A policy is a statement of intent and is implemented as a procedure or protocol. Policies are generally adopted by the Board of Directors or senior governance bodies within an organization where a procedures or protocols would be developed and adopted by senior executive officers.

The EU Policies related to Biomass are divided into Environmental Policy, Agricultural Policy and Energy Policy.

In the European Commission's approach, bioeconomy covers '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.

The Renewable Energy Directive (RED) includes a set of provisions to facilitate the development of renewable energy, such as a legal requirement. Biomass is expected to contribute to about half of the EU Renewable Energy target in 2020.

Bioenergy at EU level is expected to remain the main (RES) contributor. Within this framework, it is necessary to ensure that these expected increases in biomass use take place within a sustainable framework and biomass sustainability is thus a key issue. There are a lot of reasons for and against bioenergy like less air pollution by carbon, availability of wood, existing technology, local economy, energy sovereignty, diversity of energy sources and some negative aspects like costs, investment costs, deforestation, food security or less GDP growth, due to public subsidies.

The externalities like air pollution are not directly reflected in the market price. However, externalities like air quality have a value for human being, so the resulting difficulty is to quantify this value for instance with the help of a shadow price. It is impossible to calculate the value exactly, so the shadow costs are based on estimates.

There are several different instruments to support the production of bioenergy, such instruments are capital subsidies (Sweden/Austria on district heating systems), tax incentives, energy tax policies (CO2 taxes in Finland, Denmark, Sweden, Norway, Netherlands), obligations percentages on renewable energies in Germany, regulations (Command and control), R+D, eco-labelling, information/promotion campaigns, education and quotas or emissions trading. In Finland, there are financial instruments like a tax relief for all fuels used for electricity generation, a feed-in-tariff for wood fuel based small-scale CHP, an investment subsidy for biomass and an energy taxation for fossil fuels used for heat generation. In addition to these financial instruments, there are regulations like the obligation to distribute biofuels to the transport market.

3.-Economics instruments of Policy

Policies make use of economic instruments to influence the market, specifically the demand and supply of bioenergy, in this case. Elasticity plays a key role in the development of bioenergy markets because it shows how economic variables response to changes in the market. Elasticity will help us assess which part of the value chain is receiving the benefits or paying the costs. In this topic, we also discussed various economic instruments, such as capital subsidies, guaranteed market, regulations, quotas, research and development grants, soft actions, eco-labels and promotional campaign. But for this topic, we are focusing on taxes and subsidies. Its effects and the response of the market when these two instruments are used by policy makers.

To encourage development of bioenergy, market size should be increased and there are three tools that can make this happen: subsidies, taxes and others in the form of promotion of bioenergy and policies stimulating competition by decreasing risks or providing feed-in tariffs.

On determining taxes, who should pay for the taxes should always be taken into consideration. It is the responsibility of the state to determine such. If taxes are increased and consumers has to pay for them, consumption decreases. While, if taxes are increased on the side of the producer's production increases due to economies of scale.

On the other hand, subsidies enlarge the market, the state has to pay/dole out certain amount to reach the target size of production while maintaining equilibrium price or lowering the price so consumers will buy, and producers will produce continuously.

Taxes and subsidies are indeed the most used economic instruments by policy makers because it is effective and beneficial not only to the government but also to the producers and consumers. However, caution should be done in determining who should pay what, because perverse incentives can happen if the case is not properly studied. State can be subsidizing something that can be potentially harmful in the long run. Like in the case of the Philippines, wherein farmers are subsidized in planting coconut for biofuel production. This in turn made farmers plant more coconut and converting forest lands into coconut plantation, thereby increasing deforestation and increasing carbon emission. The said effect goes against the objective of biofuel of decreased carbon emission.

It should also be noted that research and development as well as promotion is important in increasing market size. Without the proper technology to produce the required products, the aim of the state to increase market for bioenergy will likely fail. And if the people do not know about the product and the reasons behind such decisions it will most likely fail in the market too. I think a holistic approach is needed for markets to develop.

In my opinion a combination of subsidies for renewable energies and taxes on fossil fuels is the best way. But the tolls need also to stimulate for example forest owners to take into consideration biodiversity conservation and other sustainability issues.

4.-Adoption dynamics in bioenergy markets

Over the past century, socio-technological innovations and the abundance and reasonably low cost of fossil energy sources have significantly changed the quality and way of life in many countries. At the same time, it has also led to a number of environmental problems, such as global warming, ozone layer depletion, air and water pollution, and the deposition of hazardous waste. A number of options, including sustainable use of renewable resources, replacement of non-renewable resources and dematerialization have been suggested as means of mitigating these problems. Sustainable use of forest resources can mitigate greenhouse gas as (GHG) mitigation.

Forest resources can be used to replace fossil fuels directly, as well as indirectly by materials substitution, for example in building construction, packaging, etc. One option is to replace fossil fuels with forest resources for space heating of detached houses by using wood pellet heating systems (boilers, burners, or stoves).

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. Swedish energy policy is aimed at phasing out oil and electric heating on the one hand, and at increasing energy efficiency and the use of renewable energy resources in the residential and commercial premises sectors on the other hand. 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

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 period. 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.
Their main resource is the land that they farm, which is spatially specific to account for soil and climate variability, resulting in variation in crop yields. In aggregate, the farmer agents control the supply side of the market. A single delivered market price exists for each energy crop and is adjusted over time based on market conditions. After each time-step, agents learn from their own experiences and that of their neighbors, and this influences their future decision-making.
From my point of view, this was an interesting exercise, because I get to see the market in action and how the policy affects the transactions. Also, even though the policy was good, it doesn't mean that everything will go well. Most of the time, it also has negative effects and that is why policy making can be difficult most especially if the policy makers don't have an idea about the situation of the forest owners, dealers and bioenergy plant.

6.-Bioenergy governance

The global dimension of bioenergy trade has grown parallel to new challenges. Biomass is based on the extraction of natural resources, such as wood, that are not equally distributed along the geography. When this extraction fulfils sustainability criteria, in the environmental, economic and social dimensions, their impacts are minimal and contribute to several benefits. However, the policy frameworks that regulate these operations is variable along countries and geographies, creating unequal conditions: often the production of wood is located in one place, operated by a company from a different place, to be transported and consumed in another location. The subject of governance focuses on these "coordination mechanisms that rest outside the authority of states"

Governance is all of the processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organization or territory and whether through the laws, norms, power or language of an organized society.

Governance is the way the rules, norms and actions are structured, sustained, regulated and held accountable. The degree of formality depends on the internal rules of a given organization and, externally, with its business partners. As such, governance may take many forms, driven by many different motivations and with many different results. For instance, a government may operate as a democracy where citizens vote on who should govern and the public good is the goal, while a non-profit organization may be governed by a small board of directors and pursue more specific aims.

In the bioenergy governance there are different issues that need to be covered, such as: carbon balance, market forces and technology issues.

Governance is tricky 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. In 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.

7.-International bioenergy markets

In the past decade, international bioenergy trade of both solid and liquid biofuels has shown high growth rates regarding the total trade volume of major bioenergy commodities such bioethanol (used for fuel), biodiesel and wood pellets, which have increased by a factor of 10 or more between 2000 and 2010. Total international trade volumes of liquid biofuels exceeded 200 PJ in 2010; the trade of solid biomass trade exceeded 300 PJ. This increasing demand has triggered a debate on the sustainable production of biomass. However, international bioenergy trade if done right, can have important benefits in terms of socio-economic development, and sustainable management and the rational use of natural resources. Bioenergy markets are about to change. The current increasing demand for biomass is creating opportunities for exporting regions of traditional fuels, such as Brazil (ethanol), Argentina, Malaysia and Indonesia (biodiesel and vegetable oils) and Canada, the US and Russia (wood pellets). It is clear that major supply and demand regions are geographically separated, which means that global bioenergy trade will play a major role to match supply and demand.

In Finland the wood pellet production started in 1998, when the first pellet plant was built in Vörå, Ostrobothnia. The consumption of wood pellets has a stable growth Figure. At present, approximately 25 wood pellet mills are in operation in Finland. The main wood pellet production plants are located mainly in the southern half of the country, where the greatest concentration of forest industry facilities is located.

The Finnish Pellet Energy Association has set a target number of domestic pellet consumers of nearly 80,000 (75,000 single family houses and 4,000 industrial users) and a domestic pellet consumption target of approximately 1.5 Mt/a by 2020. The consumption target of Pellet Energy Association is much higher than the government's target indicates in NREAP (0.4 Mt/a).

Concerning the pellet market in Sweden and Finland it must be pointed out that Sweden is the biggest consumer as well as producer of wood pellets in the world. Different

factors affecting the development of the pellet industry to become a leader have been identified: Good availability of raw materials, a taxation system that favors biofuels and extended district heating networks. There exists a total of about 100 pellet plants producing about 1,4 million tons of pellets in 2007.

In Finland, recently the domestic consumption has started to increase, but markets have been export-oriented from the beginning. There are 25 pellet plants with a production of 330.000 tons of pellets existing in 2007. The development has been slower than in Sweden, especially on the consumption side, but recently subsidies are also available and should foster the small-scale use of pellet stoves in Finland as well.

Small-scale pellet producers are typically producing pellets as a by-product, whereas middle and large-scale producers are mainly concentrating on pellet production. In both countries, there are still significant capacities concerning increasing the production and consumption.

The main challenge for the coming years will be the supply and development of raw materials. It is crucial to secure pellet supply and ensure price stability to build trust in this still young technology.

8.-Bioenergy regions

Bioenergy represents energy from biomass, therefore the logistics costs of transporting it on longer distances make it inefficient. Bioenergy is considered a local resource and we can translate it in Bioenergy Regions.

The need of changing the traditional energies and a transition from coal, oil, gas, etc is driven to a more sustainable growth along with more efficient ways of producing energy from biomass.

The EU has set some renewable sources policies such as RED, Sustainability criteria and National Renewable Energy Action Plans.

The general aims of these directives in the European Union is to promote a sustainable development/low carbon energy, security of supply and rural development.

Renewable Energy Directive (2009) establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020 to be achieved through the

attainment of individual national targets. All EU countries must also ensure that at least 10% of their transport fuels come from renewable sources by 2020.

A good example of Bioenergy Regions is Scandinavia and more specifically we can take a look on Norway's local bioenergy governance and targets: 67,5% renewable energy by 2020, electricity grid of 95% from hydropower, various support schemes (investments funds, chipping grants, etc), very strong electric appliance sector,ect.

There is need of local interest and involvement in order to get bioenergy development and to make it sustainable, however in the context of very negligible rural development and employment benefits, in Norway, people ask if there is really a need for developing an alternative source of energy, especially since there is no financial incentive for a change.

Another important reason to know why there is so much pressure on the internal capability of energy production is that forecasts predicted that the EU in the current pace will have 70% of its energy need by 2030 to be imported from outside Europe. Therefore, seeing the renewable energy action plans from a geo-political point of view, aside of its environmental reasons, can pose to be a very interesting part to analyze and account for future forecasts on investments and policy making.

As in all policies and strategies, conflicts arise in the context of bioenergy since there are several NGO's that condemn is as being unsustainable and unreasonable in the contexts of land-use change dilemma and population growth prognostics.

9.-Models for energy systems

Basically, carbon-energy taxes can provide benefits in two different directions: a demand effect, whereby the demand for energy is reduced as a result of the price increase caused by the tax; and a substitution effect, whereby carbon fuels are substituted by low-carbon or carbon neutral fuels that are taxed at lower rates. As reduced energy demand may reflect either a lowering of output or actual energy savings it is often more appropriate to monitor energy intensity. In other words, we would expect to see changes in energy intensity as well as carbon intensity as a result of carbon pricing.

While some analysts have suggested that a global carbon price will need to be increased to a level of 30-40 euro/ton CO2 by 2020 to stabilize atmospheric concentrations, the price at which CO2 is traded under the cap in the European ETS is presently about 15 euro/ton. Unilaterally applied carbon-energy taxes in individual EU member states have been more modest and for industries range generally from a low, to some extent symbolic level (for the most energy intensive industries) up to approximately 25 euro/ton in the case of Sweden and Finland.

Denmark is exceptional with a tax on energy consumed for heating purposes (including for industries) at an effective rate of about 80 euro/ton CO2.

In evaluating the impact of carbon-energy taxes on CO2 emissions a complicating factor is that in some cases they have replaced pre-existing energy taxes, and now come under a different name and with a modified tax base according to carbon content rather than energy content. Sweden, for instance, has had taxes on industrial energy consumption in place already since 1974, which then were modified in 1990 towards a CO2 tax base. Whereas in Germany and UK carbon-energy taxes were introduced only from the end of the 1990s, the four Nordic countries and the Netherlands, with time series of more than a decade, generally provide the firmest basis for exposit assessment. Slovenia has a longer timeline too, but as a country in transition, one associated with data and conversion difficulties. According to the estimations six countries show a reduction in fuel demand that results from the environmental tax reform (ETR).

A global polluting strategy is a good idea and it promotes internationally fair pricing, whereas the taxes collected from the tax can be invested in clean energy and technology or research on the area. On the other hand, it can be that the tax will not have the desired effect and just brings an economic disadvantage to adopting countries since the most probable thing to happen is that industrial production will shift to countries with no tax carbon or a low one.

10.-Bioenergy policies for EU

Finland’s long-term objective is to become a carbon-neutral society. Within the next 10 years, Finland wants to be a pioneer in bioeconomy, circular economy and cleantech.

In the energy system, wood fuels are already the largest energy source, and it is planned that their use will increase by 35 % by 2030. Many new biofuel and energy plants are planned. The use of biomass for energy is increasing, but the development has not been steady nor even for different bioenergy sectors. Electricity and fossil fuel prices are currently low, which has become a barrier for wider use of energy-efficient combined heat and power production with biomass in some of the Nordic countries. Sustainability of biomass is also a hot topic with direct impacts on the market.

According to the recent Communication on low emission mobility by the EU Commission, advanced 2nd and 3rd generation biofuels will play a key role in a transition from fossil fuels towards low emission transport. In this session, industry specialists will provide updates on latest developments in the biofuels market.

The European Commission has issued non-binding recommendations on sustainability criteria for biomass. These recommendations are meant to apply to energy installations of at least 1MW thermal heat or electrical power.

The 2030 climate and energy framework set three key targets for the year 2030: 40% cuts in greenhouse gas emissions (from 1990 levels), 27% share for renewable energy and 27% improvement in energy efficiency. For bioenergy to be accounted towards the EU´s 2030 renewable energy target and to be eligible for financial support, its use and production should meet this criteria: There should be an overall limit on the amount of bioenergy used to meet 2030 targets, bioenergy should not be produced from high risk sources of biomass, soil, water and biodiversity should be protected during the harvesting of agricultural and forestry residues for bioenergy, production and use of all biomass sources for energy should respect rights to land tenure, free prior and informed consent of affected communities, food security and human and labor rights, the use of biomass for energy should not cause displacement of other uses of biomass and be in line with the principles of cascading use and the waste hierarchy

The framework was adopted by EU leaders in October 2014. It builds on the 2020 climate and energy package. It is also in line with the longer-term perspective set out in the Roadmap for moving to a competitive low carbon economy in 2050, the Energy Roadmap 2050 and the Transport White Paper.

Concerning the greenhouse emissions, it wants to be achieved a cut of at least 40% of the total. The framework contains a binding target to cut emissions in EU territory by at

least 40% below 1990 levels by 2030. This will enable the EU to: take cost-effective steps towards its long-term objective of cutting emissions by 80-95% by 2050 in the context of necessary reductions by developed countries as a group and make a fair and ambitious contribution to the Paris Agreement.

To achieve the at least 40% target: EU emissions trading system (ETS) sectors would have to cut emissions by 43% (compared to 2005) – to this end, the ETS is to be reformed and strengthened and non-ETS sectors would need to cut emissions by 30% (compared to 2005) – this needs to be translated into individual binding targets for Member States.

11.-Recent a future trend in bioenergy sector References

There can be four main trends which will influence the world energy system.

First, there is the rapid deployment and falling costs of clean energy technologies. In 2016, growth in solar PV capacity was larger than for any other form of energy generation. Since 2010, costs of new solar PV have come down by 70%, wind by 25% and battery costs by 40%. Drivers of growth are solar PV and Wind, mostly because of the rapid development in China. Between 2017 and 2022, it is expected that the global renewable electricity capacity will expand by 43%.

Second, the growing electrification of energy takes place. This means in particular the transformation to electricity-based technologies in heating and transportation.

Furthermore, there is a (surprising) trend of the resilience of shale gas and tight oil in the United States. The US will probably export more energy and gas becomes the second largest fuel in the global mix after oil.

In the case of policy, it is striking that governments move away from feed-in tariffs to quota systems with green certifications or other form of auctions. Reasons are for instance high costs for the subsidies and that the renewable technologies are competitive now due to falling prices.

The share of renewables in heat consumption is forecasted to increase slowly. The most important renewable source of heating is bioenergy, followed by renewable electricity for heat. For this development, the European Union plays a central role due to the binding targets of the Renewable.

Moreover, resource conflicts, geopolitics, wars and/or catastrophes like Fukushima can have big impacts, although they cannot be forecasted. I think, bioenergy will constantly and slightly increase also in the future. The growth will not be tremendous due to the land-use conflict as long as the world population increases and exhaustible resources like oil are affordable.

The factors that might have the strongest impact on the future of bio-energy are : biofuel technology development, oil and bioenergy prices, climate change, population, political tensions, lifestyles, production costs, and use conflicts, policies concerning bioenergy sustainability, transfer challenges (generation to grid and storage) and power generation.

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