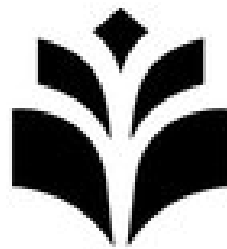


Learning Diary Bioenergy Markets and Policies

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1. Background

There are several definitions of biomass, varying from the point of view. From the ecological perspective, biomass can be defined as **“the amount of living matter in a given habitat, expressed either as the weight of organisms per unit area or as the volume of organisms per unit volume of habitat.”** From the economic perspective, which is rather focused in creating value e.g. in form of energy, biomass can be defined **“as organic matter, especially plant matter, that can be converted to fuel and is therefore regarded as a potential energy source.”**

Biomass in form of dead and organic matter can be used to create bio energy which can briefly defined as **“renewable energy produced by living organisms.”** In the past, bio energy has mainly been used on small scale e.g. on household level, since fossil fuels e.g. crude oil has been utilized on large scale, as it was rather cheap, containing high energetic potential while occupying relatively small space for transportation and storing.

The crisis began in October 1973 when the members of the Organization of Arab Petroleum Exporting Countries proclaimed an oil embargo. The embargo was targeted at nations perceived as supporting Israel during the Yom Kippur War. The initial nations targeted were Canada, Japan, the Netherlands, the United Kingdom and the United States. By the end of the embargo in March 1974, the price of oil had risen from US\$3 per barrel to nearly \$12 globally, whereas US prices were significantly higher. The embargo caused an oil crisis with many short- and long-term effects on global politics and the global economy. It was later called the "first oil shock", followed by the 1979 oil crisis, termed the "second oil shock."

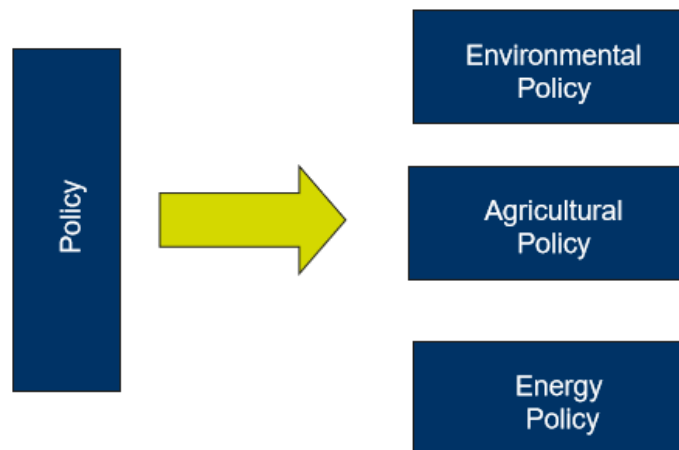
As a result, as the Western World became more aware of the need to seek self-sufficiency to decrease dependency on oil imports. Hence, focus on raw material for energy production changed from external fossil fuels to domestic renewable resources, such as wood, crops but also municipality waste. From that time on, lots of efforts have been invested to develop certain processes to transform renewable raw materials into commercial products. Also, companies involved in the bio economy sector are strongly aiming to find opportunities for multifunctional usage of by-products deriving from bio energy production to maximize efficiency.

2. Role of policy

A policy is a tool to guide decisions. It is implemented to manage and regulate resources which would not be a feasible solution otherwise. In terms of bioenergy markets, policy plays a key role in establishing the ideal energy mix, wherein aside from using oil or coal, biomass will be used to have alternative sources of energy and at the same time complying with the current international agreements. Additionally, externalities – a consequence, either positive or negative that affects third parties when an economic activity was done. They can be considered as main reason for implementation of certain policies. After all, it is the obligation of the

state/government to make sure that benefits are distributed equally and that costs are reduced or avoided. Currently, bioenergy policy can be divided into 3 major policy groups:

EU's **energy policies** aim to ensure that European citizens can access secure, affordable and sustainable



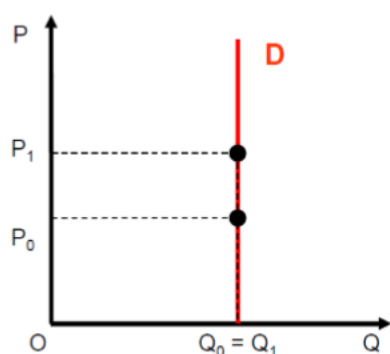
energy supplies. The EU is working on several areas to promote this development. For instance, as part of its long-term energy strategy, the EU has set targets for 2020 and 2030. These cover emissions reduction, improved energy efficiency, and an increased share of renewables in the EU's energy mix.

Established in 1962, the EU's common **agricultural policy** (CAP) is a partnership between agriculture and society, and between Europe and its farmers. It aims at supporting farmers at improving agricultural productivity to enable a stable supply of affordable food. It also aims at tackling climate change by promoting a sustainable management of natural resources while maintaining rural areas of the EU.

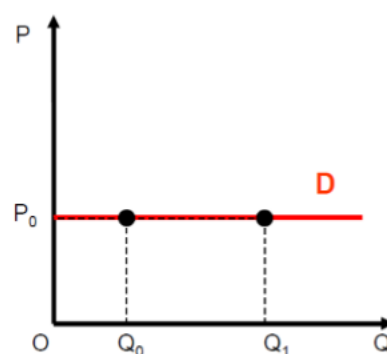
EU citizens benefit from some of the highest environmental standards in the world. The EU and national governments have set clear objectives to guide European **environmental policy** until 2020. As a vision beyond that, by 2050, with the support of dedicated research programs, legislation and funding, EU environmental policy aims at protecting, conserving and enhancing the EU's natural capital. Also, turning the EU into a resource-efficient, green, and competitive low-carbon economy is considered as the main objective with the interior motive of safeguarding EU citizens from environment-related pressures and risks to health and wellbeing.

3. Economic instruments in energy policy

Markets are shaped by demand and supply of a commodity, wherefore political interference affecting the amount supplied of a certain product or service therefore also affecting quantity demanded are considered as main economic instruments in energy policy. Generally, the shape of a demand curve reflects the elasticity of a certain product. Price elasticity of demand is a measure to show the responsiveness, of the quantity demanded of a good or service to a change in its price. We can divide between inelastic good (oil, energy, food) and elastic goods, for which the market is highly competitive:



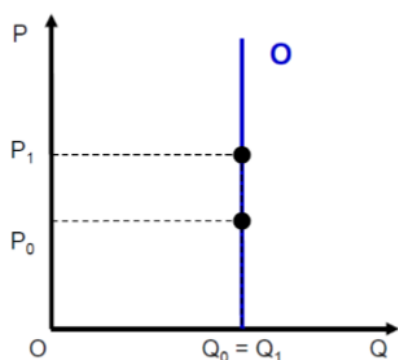
Inelastic



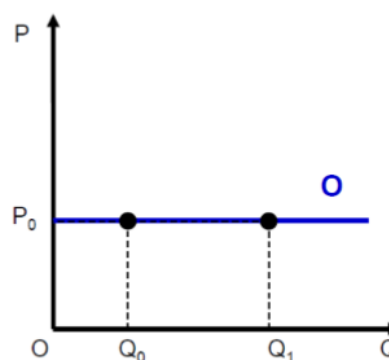
Elastic

One can see, that quantity demanded for inelastic goods stays the same also if prices vary a lot. In case of elastic goods instead, quantity demanded tends to vary a lot, even though the price might be stable which can be explained by market competition.

Shape of supply curve also differ in terms of inelastic and elastic goods:



Inelastic

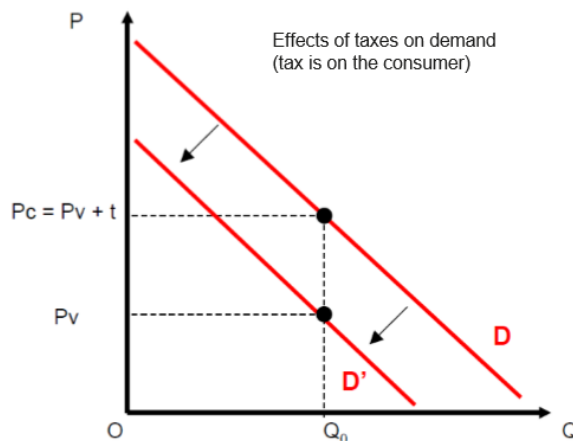
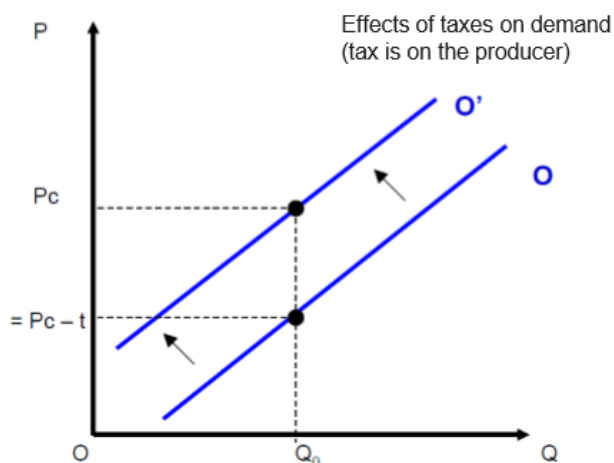


Elastic

Regarding inelastic goods, quantity supplied does not undergo any changes due to varying prices, whereas in terms of elastic goods, quantity supplied can vary strongly even if prices are stable.

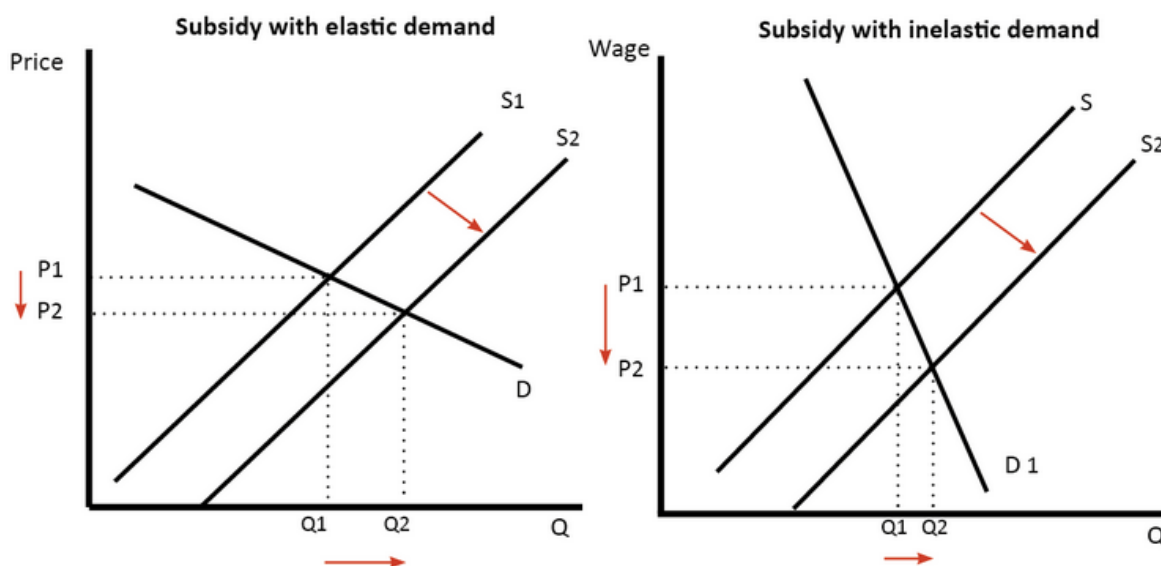
Taxation is a common policy measure to raise required revenues to meet expenditures. Apart from raising revenue, taxes are considered as instruments of control and regulation with the aim of influencing the pattern of consumption, production and distribution. Taxes thus affect an economy in various ways, although the effects of taxes may not necessarily be good. There are some bad effects of taxes too.

Taxation can be aligned to affect producers and consumers:



Thus, having a decreasing impact on quantity supplied or quantity demanded.

Subsidies instead mean, that the government pays parts of the cost. The effect is to shift the supply curve to the right, leading to lower price and higher quantity demanded. Effects of subsidies strongly differ on whether demand for a certain commodity is elastic or inelastic:



If demand is elastic, then a subsidy causes a bigger percentage rise in demand. There is only a small fall in price. In this case, producers benefit from the subsidy because their producer surplus increases more than consumer surplus. If demand is price inelastic, then a subsidy causes a substantial fall in price, however, there is only a small increase in demand.

Sweden for instance is a positive example of how economic instruments can promote bio energy transition. In 1990, high taxation on CO₂ and Sulphur has been implemented and exponentially increased within the following years. This measure lead to an increasing use of bio energy especially in district heating plants and small-scale heating.

In Finland on the other hand, there has been a bunch of political measures to trigger bio energy transition and to reduce usage of fossil fuels:

- Tax relief for all fuels used for electricity generation (tax incentive), Feed-in tariff for wood fuel based small-scale CHP (operational subsidy), Investment subsidy for biomass Energy taxation for fossil fuels used for heat generation → financial instruments
- Obligation to distribute biofuels to the transport market → regulations

4. Adoption dynamics

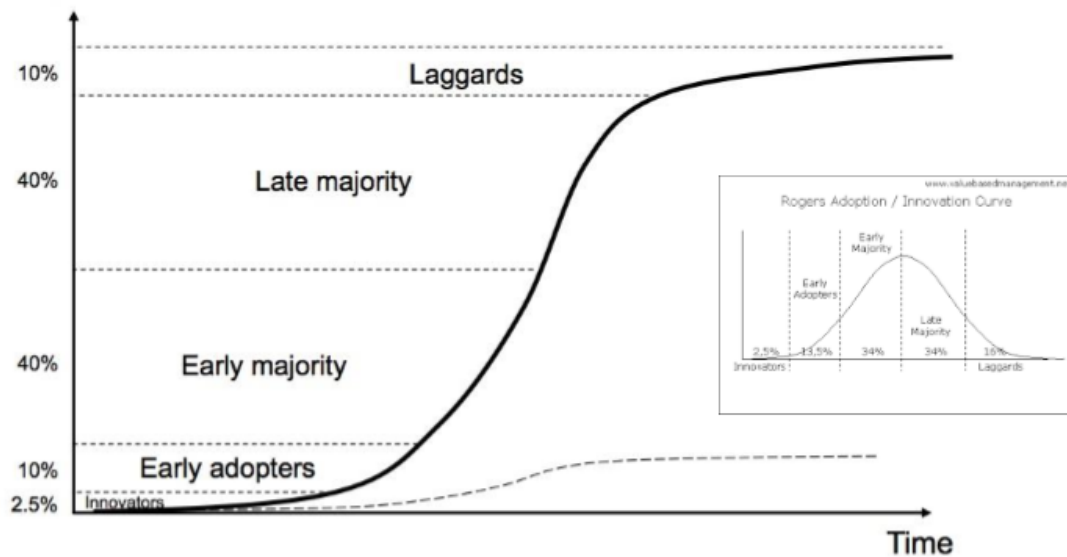
As the demand for raw material bio energy production has increased, so did the versatility of sources for raw material provision. In Sweden for instance, *Salix* came to the fore, as they are rather easy to manage, while providing a competitive product on certain types of soils. Nowadays, Willow (*Salix*) has been cultivated as an agricultural crop for bioenergy purposes in Sweden for the last twenty years and is regarded as an important crop to produce wood fuel for the Swedish energy sector. During the last two decades, more than 14 000 ha of short rotation willow plantations have been established in Sweden, i.e. about 0.5% of the total cultivatable land in Sweden, making Sweden the leader in commercial plantations of short rotation willow in Europe.

Certain policy measures, such as subsidizing of farmers for crop transition and specifically willow production have triggered spread of plantations for energetic purposes in Sweden.

Once willow plantations have become a serious alternative for farmers does not necessarily induce an immediate cultivation due to specific circumstances:

<i>positive influence</i>	<i>negative influence</i>
Farm Size Forest land Lease to others Owner age 50-65 Institutional owner Irrigation Mechanization	Pasture Tenancy Owner very young or very old Animal husbandry

Generally, there are certain adoption patterns of bio energy crop cultivation:



Adoption of willow plantations led to increase of yield over time, as knowledge and experience increased. Also, new business models and opportunities derived with plantation management, such as agroforestry, opportunities to increase biodiversity within plantation as well as fertilization with industrial and municipality wastewater.

5. Biomass market behavior

On bio energy market for wood chips deriving from plantation forestry, there are basically three key players:

1. **Plantation owner**
 - ➔ Determines the price (must exceed production costs)
2. **Dealer**
 - ➔ buys and sells the wood to bring it to the plant
3. **Bio energy plant**
 - ➔ Buys wood to produce energy (price can not be higher than energy profit)

In the framework of a lecture, the class made an exercise to imitate market behavior. Therefore, the group has been divided into three major sectors, the plantation producers, the dealers and the bioenergy plants.

The forest owner tries to sell his wood to the highest conditions, also taking into consideration that the price needs to be higher than the production costs. A Dealer buys and sells the wood to bring it to the plant. At the end of the supply chain the bioenergy plant buys wood to produce bioenergy. This price cannot be higher than the profit the plant gets with selling energy.

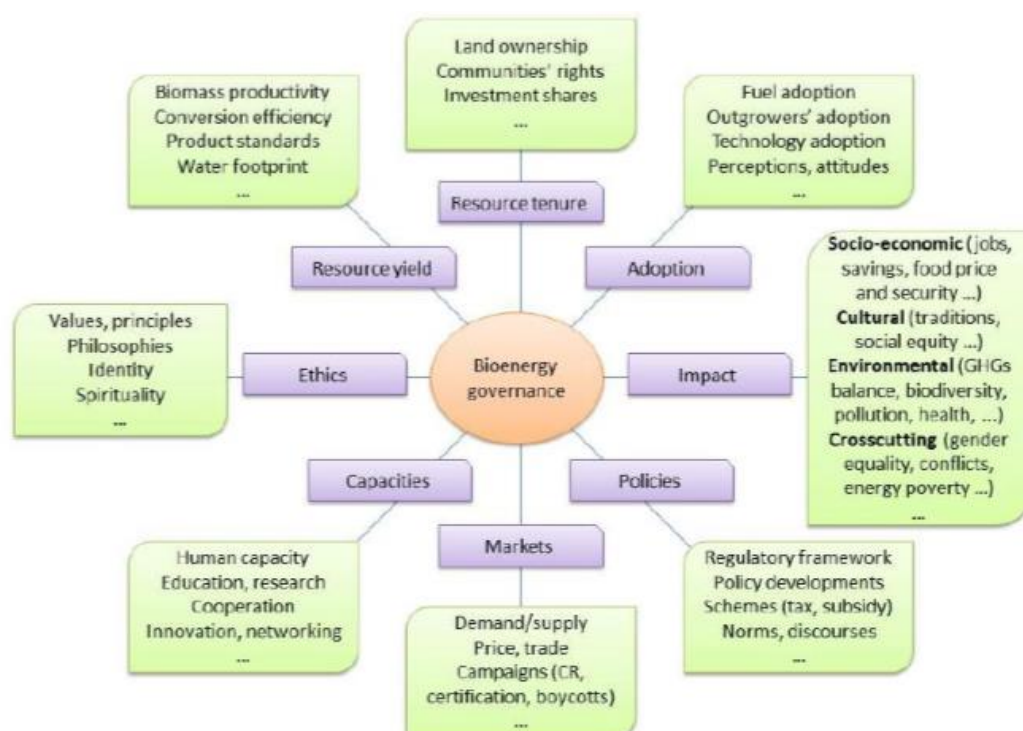
Going through different market scenarios including different starting situations, students learned to bear in mind, that certain conditions such as free market competition, policy influence in form financial instruments as well as certain regulations can induce strong impacts on overall market behavior.

6. Governance

Governance comprises all the processes of governing - whether undertaken by the government of a state, by a market or by a network - over a social system (family, tribe, formal or informal organization, a territory or across territories) and whether through the laws, norms, power or language of an organized society. It relates to "the processes of interaction and decision-making among the actors involved in a collective problem that lead to the creation, reinforcement, or reproduction of social norms and institutions". In lay terms, it could be described as the political processes that exist in and between formal institutions.

The concept of **forest governance** does not have an official definition and the utilization of the term ranges from direct reference to governments, to more broad concepts of norms, processes, instruments, people, and organizations that shape interactions with forests. This includes arrangements found in cultural traditions, laws, markets, and bureaucracies, which can influence how forests are managed, protected, and used. Elements of "good forest governance" are considered to include transparency, lack of corruption, accountability of officials, stakeholder participation and political stability.

In terms of bio energy governance, there is a versatile number of stakeholders, developments and social aspects, that must be taken into consideration:



Concerning management of forests there is high conflict potential, as there is usually a versatile number of stakeholders involved, pursuing their own interests. Conflicts often occur, occur when there are disagreements and disputes regarding access and management of natural resources.

Forest conflicts can be divided by its' intensity:

- **Restrained conflict** (anxiety feeling, critiques and debates, lobbying and persuasion)
- **Open conflict** (protests and campaigns, access restrictions, court)
- **Violent conflict** (intimidation and physical exchange)

Regarding forest conflicts in Europe, it is interesting to mention that the main conflict types are restrained conflicts, followed by open conflicts, whereas violent conflicts are rather seldom but existent. Main subject of conflict types are discrepancies concerning urban forestry.

Ethical analysis tool is a research and conflict management tool to understand complex conflicts and map differing principles, interests, and values of stakeholders. I can help external parties to get a better understanding concerning the reasons for certain conflicts and provides certain steps to facilitate solution finding:

1. Identification of problem
2. Identification of stakeholders
3. Identification of their interests, values and principle
4. Explore the stakeholders' differences 'perception
5. Identification of bridges (common interests, values and principles)
6. Make stakeholders aware of the ethical assessments and give a possibility to comment

7. International bio energy trade

While there are different types of bio energetic products on the markets today, mainly based on wood, focus of the lecture lied on wood pellets, as its' market is growing nowadays. This development can partly be explained by the rather low energy ratio between oil and pellets (1:3), which makes transportation economical. Another advantage of wood pellet is the fact, that they are mainly produced using by-products of the forest industry, thus providing an outstanding opportunity of increasing efficient usage of wood while also providing a serious alternative for fossil fuels. However, as raw material for pellet production are mainly by-products, supply strongly depends on demand for timber products. In Europe, main production areas are Central Europe, Scandinavia, Finland and the Baltics whose pellet markets have been analyzed within the lecture.

Regarding the European and global wood chip market, it can be said, that Sweden, Germany and Denmark are the main importers, whereas Russia and the Baltics are the most important exporting countries. Waste wood serves as an important source for wood chip production, which is why there is a specific market for it. As main importers for wood chips, Germany, Sweden and Italy must be mentioned, whereas the Baltics are the main exporters but also overseas countries like Canada and Liberia. In the following part, most important participants on pellet market are considered particularly:

Sweden: 94 pellet plants/producer ☐ producing 1.4 Mio tons of pellets (domestic consumption higher than production; imports esp. from interior Canada, long distances) In Sweden and Finland many plants are not using full capacities. First plant in Sweden was built in 1982. Nowaday the country takes a leading position in production and consumption of wood pellets. Additionally, in the future new pellet plants with high capacities are planned which will rise total pellet production capacity over 2.5 Mio. tons. Counties of Jönköping in South and Västerbottens in North with highest annual capacities. Generally, Majority of plants located on the East coast and in the South of Sweden. Also, large number of small-scale producers (producing few hundred to several thousand tons per year) must be mentioned, even though they are only representing a small share of total production.

Finland: 24 plants/producers producing around 750.000 tons (domestic consumption lower) ☐ large exports (to Sweden, Denmark, Netherlands). First plant built in 1998, whereas nowadays, new plants are planned, and production capacity may go up to 1.16 Mio tons in future. Highest capacity plants are located in Western Finland, followed by South and East.

In Sweden and Finland, main use of wood pellets at large scale heating plants, overall increasing trend in pellet consumption

In **Central Europe** on the contrary, the main use lies at small scale e.g. households. In general, highest production capacities are available in Central Europe.

The largest operation pellet plants Europe are in Norway, Germany, Russia, where different predominant feedstocks are used for production.

Generally, consumption in Western Europe higher than production (except Spain, Portugal, Germany), whereas in Eastern Europe production exceeds consumption.

The biggest pellet producers in Europe are Germany (20%), Sweden (19%) and Italy (9%), while the Baltic States are the main producers. Also, Canada and the US occupy an important share on the pellet market as they are exporting large amounts to Europe.

Generally, political interventions are considered as an effective bundle of measures to promote energy systems change, as they can either impede or simplify transitions toward more sustainable energy systems. Therefore, different policy initiatives have been implemented over time in pellet market participants to promote bio energy transition:

Sweden

Year	Policy initiative
1991	Carbon tax and energy tax focus on heat
1997-2005	Investment subsidies
2001	Carbon tax increased
2003	Green electricity certificate system
2004	Tax on electricity for household and services

Finland

Year	Policy initiative
1990	Carbon tax introduced
1990	Investment subsidies for CHP plants
1998	Energy tax increased

Denmark

Year	Policy initiative
1991	Energy tax and carbon tax reformed
1993	Biomass agreement and compensation scheme for renewable electricity
1994-1998	Energy tax increased on heating and power
1995-2000	Subsidy scheme for small wood pellet boilers
1996	Feed in tariffs introduced
2008	Increasing the existing CO2 tax
2001	NOx tax introduced

Germany

Year	Policy initiative
1991	Feed in tariffs for renewable energy
1999	Investment subsidies for automatic pellet heating system
1999	Taxes on fossil fuel increased and tax on non renewable electricity introduced
2009	Renewable heat law introduced

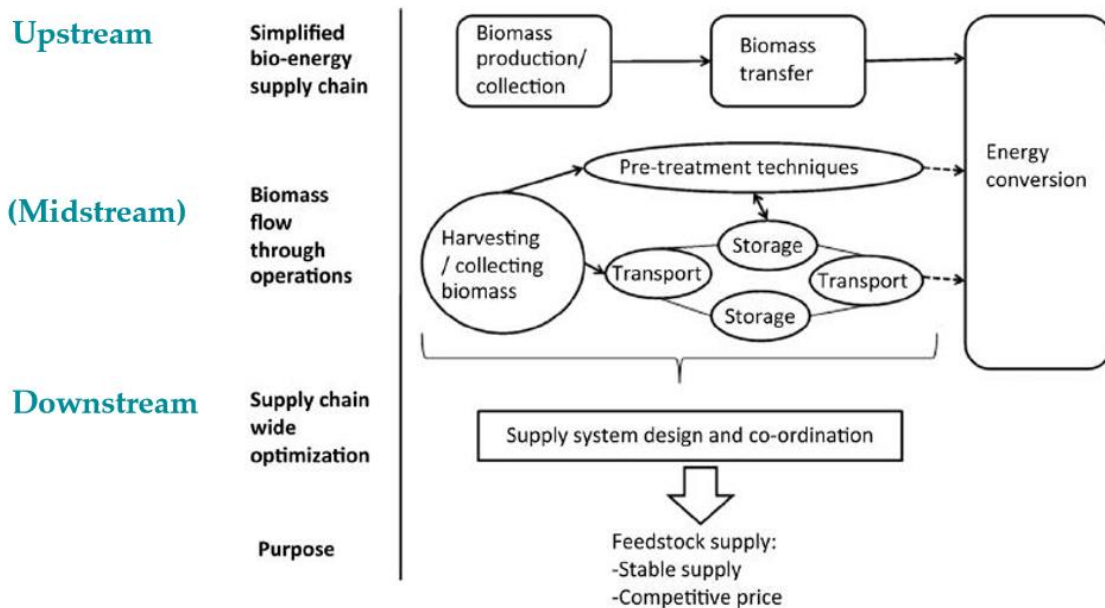
AS main barriers of wood pellet market raw material supply, logistics and lacking financial policy support, as it occurred in Sweden after joining the European Union in 1995.

8. Bio energy market supply

Main sources of bio energy raw material are plantations and residues deriving from forestry and agricultural sector.

Supply chains of bio energy resources can differ strongly due to certain characteristics affecting profitability transportation e.g.

In the framework of an exercise during the lecture, students were asked to introduce supply chain of a certain bio energetic resource to the class including upstream, midstream and downstream, while also emphasizing potential difficulties when applying the product on the market.



The group I was involved in was discussing pellet supply chain in Sweden and as main difficulties of wood pellets in Sweden, variation in size and quality due to large number of small-scale enterprises producing pellets has been detected. Another, limiting factor of pellet supply can occur due to the fact, that raw material for production is a by-product mainly in form of sawdust and therefore strongly depended on the timber market. This can lead to potential trade-offs, for instance when demand for timber in a certain time is rather low, whereas demand for pellet for energy production is high. This situation may lead to unsaturation of the market as demand is higher than supply.

9. International policies affecting EU bio energy market

Political interference by applying certain financial instruments are usually implemented when economic externalities e.g. caused by environmental pollution lead to market failures. Market failures for instance, can occur in form of an inefficient allocation of economic resources or an improper allocation of property rights.

Generally, there are different types of policy tools to comply with such externalities and in many cases a combination of different tools is implemented to reach political goals.

- **Command and control** → e.g. determination of amount of carbon allowed to be emitted per year
- **Subsidies** → e.g. a bio energy related company receives EU funding for investing in more efficient technology, therefore aiming to encourage a particular economic action
- **Tax** → e.g. payment per ton of carbon emitted, carbon tax determines level of emission
- **Emission trading** → a market-based approach to controlling pollution by providing economic incentives for achieving reductions in the emissions of pollutants

We can divide between economic policy tools and market-based tools. While economic tools tend to be less flexible as they do not associate costs certain production processes cause, market-based environmental policies are more flexible, encouraging a progressing development in carbon emission reduction.

Following table shows different types of policies for promoting bio energy:

Policies		Instruments	Examples
Explicit	Fiscal policies	Taxes (Incentive or penalty) or Subsidy	Investment tax credit, excise tax credit for renewable energy, Carbon tax, emission taxes, Subsidies for flex fuel vehicles, Price supports and deficiency payments, Tariffs or subsidies on imports/exports
	Market mechanism	Enforcement of property rights and trading	Cap and trade, Clean Development Mechanism
	Regulatory policies & Voluntary agreement	Direct control	Fuel standards, Mandatory blending, Emission control standards, Efficiency standards, Quotas
	Policy process	Educational and informational Programs, Improving governance	Labeling, Certification programs
		Compensation Schemes	Payment for environmental services
Implicit	Regulatory policies & Voluntary agreement	Agriculture and Trade policies, Vehicle policies	CAP
Best solutions	R& D policies		
	Mix Policies		

On EU level, there are different political initiatives to reduce GHG emissions, therefore reaching certain predetermined goals.

EU ETS (Emission Trading System)

- sets limitations on emissions and requires producers to keep a permit for each ton emitted (market-based approach)
- in case of lacking permits:
 1. reduction of emissions
 2. or purchasing emission from other entities
- creation of a market of tradable allowances for emissions
- enables political control of emission levels

Baseline and Credit

- sets limits on absolute emissions or per unit of output
- firms that emit below can sell credits to firms that emit more

Cap and Trade

- sets a maximum level of pollution and distributes permissions among firms

In terms of climate change mitigation, UN Framework Convention on Climate Change has to be mentioned. 197-member countries have confirmed membership so far and different conventions concerning climate change have been implemented so far:

Kyoto Protocol

It has entered into force in 2005 and sets emission targets for developed countries while providing support in mitigation and adaptation of climate change. Also, participants are free to apply flexible mechanisms for meeting the targets. A regularly report and verification based on emission monitoring is required. Later, commitments also affected developing countries, in which certain emission-reduction projects were started.

In the framework of conferences of the UNFCCC progresses and deficiencies in reaching envisaged goals are discussed and within the Paris Climate Conference in 2015 a specific countable goal in climate change mitigation has been defined. Purpose was to achieve a binding universal agreement aiming to keep global warming below 2 °C. However, there are still discrepancies prevalent concerning the inclusion of all countries, underdeveloped, developing and developed countries.

China is by far the largest producer of CO₂ emissions, followed by the USA who did not ratify regulations determined in the Kyoto Protocol.

On EU level, certain targets have been formulated to mitigate climate change by promoting bio energy. For instance, the **20-20-20 target**, which aims at **reducing GHG emissions by 20%** until 2020, increasing the **share of renewable energy of 20%** and improving **energy efficiency by 20%**. According to recent investigations prescribed targets are probably to be reached by 2020.

Also, EU member states agreed in aiming at a share of biofuels of 5.75% in Europe within 2010.

Additionally, to the 20-20-20 target EU member states also defined long-term targets like 2030s target and 2050s target which contain constant improvements concerning reduction of GHG emission, increment of carbon stocks and promoting bio energy production.

10. Future trends

There is no doubt that energy transition towards renewable energies is proceeding and while energy use is still growing together with world population, energy-related carbon emission is scarcely increasing. Especially natural gas and solar and wind energy were increasing rapidly in the past, while the amount energy obtained from nuclear power, coal and oil is decreasing. However, it is quite likely that low price level of oil is slowing down energy transition at least until early 2020s.

Increasing usage of bio energy tends to be rather slow due to several reason:

- Stagnating production costs, while wind and solar power becomes cheaper
- Uncertainty concerning policies
- Low prices for fossil fuels
- Fear of land use conflicts and sustainability issues are limiting investments

→ **Future development rather unclear**

→ **Important challenge is to apply certain foresight methods to become a better idea of how bio energy sector may develop in the future**

Personal assessment

The course “Bioenergy Markets and Policies” enables the students to develop a better understanding concerning the current situation on the European energy markets. Also, it introduces different policy measures which have been applied in certain EU member states to promote bio energy transition. Therefore, students get confronted with the complexity of approaches to trigger certain targets, while also recognizing, that external factors can strongly influence developments. Yom Kippur war of 1973 is a good example therefore, since without that undesirable occurrence energy transition would probably not that advanced as it is nowadays. In addition, students were introduced to empirical approaches on how to increase raw material supply for bio energy in form of plantation forestry. Invited as a guest lecturer, Hakan Rosenqvist transmitted his practical knowledge concerning profitability of plantation forestry by showing authentic number to the students, which I appreciated a lot.

In my opinion, bio energy sector has high potential in certain regions on global scale and especially in the case of Sweden and whole Scandinavia it has been proved that it can provide a serious alternative to fossil-based fuels and least take an important part renewable energy transition.