Faculty of Science and Forestry
MDP in European Forestry

Course diary
bioenergy policy and markets

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Lecture 1: Background – Basic concepts in Bioenergy

Description

There are different reasons and pre-conditions why the modern bioenergy development started. 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 common groups of bioenergy – wood energy, agroenergy and energy from municipal by products. All biomasses can have a solid, liquid or gas physical state, which is a big advantage for example during the transportation. In the course, we are focussing on solid wood biomass, which consists fuel wood (wood in the rough, forest chips, wood pallets and pulp / wood powder) and charcoal. This wood based biomass like branches is normally a by-product of forestry for furniture for instance.

Example

In Germany bioenergy first experienced a remarkable boom in the beginning of the second century. In 2000 Germany had about 1000 biogas plants. In 2016 there were more than 9.000 plants. The reason for this development were political supports based on a law of supporting renewable energy of the year 2000. The lion share of bioenergy in Germany comes from fuel crops and is used to produce electricity. In 2016, about 9 % of the gross power consumption is produced in bioenergy plants. [1]

Own thoughts

I am very interested in comparing different renewable energy sources like bioenergy, solar energy and wind energy in consideration of the ecological footprint. I am excited about forming myself an opinion about bioenergy in general, about environmental concerns, the relevance as an energy source for Scandinavian in particular for Finland and political possibilities to support it.

[1] https://www.cleanenergywire.org/factsheets/bioenergy-germany-facts-and-figures-development-support-and-investment; http://www.dw.com/de/co2-bilanz-2016-deutschland-macht-einen-schritt-zurück/a-37023555

Lecture 2: The role of policy on bioenergy markets I

Description

When talking about policy the question arises what is policy and for what it is needed. Based on the slights policy is a "deliberate system of principles to guide decisions and achieve rational outcomes". So, policy sets targets like reducing unfair situations or internalizing negative externalities by using tools / instruments to achieve the goals. For instance, policy aiming that biomass become an explicit share like 8% in the energy mix, so biomass become an objective.

Policy is mostly an intervention in free market and therefore question, in which direction the policy should intervene, is often discussed. For example, there are a lot of reasons for and against bioenergy. Reasons to support bioenergy production in 1970 were less air pollution by carbon, availability of wood, existing technology, local economy, energy sovereignty, diversity of energy sources (maybe lower costs as a result) and less environmental hazards. Opponents of bioenergy also have good arguments like costs, investment costs, deforestation, food security or less GDP growth, due to public subsidies.

One of the reasons of policy as I mentioned before were the existence of externalities. Often, they occur by consuming public goods like the environment. Public goods have the characteristics that they are non-rival (consumption of A does not reduce the available quantity for B) and non-excludable. The externalities like air pollution are not directly reflected in the market price and affects a party (negative or positive) who did not choose to incur that cost or benefit. 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.

Examples

In forestry, there are many externalities. It is for example not exactly sure, which effects forestry has on biodiversity. But it is certain, that extraction of living or dead biomass causes a disturbance for the forest ecosystem services like providing food for animals. However, there are also positive effects on biodiversity because forestry reduces the darkening of European forests, so smaller different species also becomes sunlight and can survive. Other externalities are the emission of C02 and the danger of soil losses due to deforesting, even if the trees are replant.[2]

[2] http://www.efi.int/files/attachments/publications/efi_wsctu_4_net.pdf

Own thoughts

I think it is very important to know all externalities and trade-offs with other ecosystem services of biomass extraction for bioenergy. After identification, the risks need to be measured, the extern costs quantified and in the last step internalized. Only by doing so, bioenergy can become a powerful puzzle piece in achieving sustainable development goals.

In my opinion, it is the task of the policy to declare regulations, so that foresters operate within the boundaries of sustainability.

Lecture 3: The role of policy on bioenergy markets II

Description

Three parts of the EU policy are related to Bioenergy: Environmental Policy, Agricultural Policy and Energy Policy. Instruments of the policies are implemented and structured in different layers, for instance on EU, national or communal level.

EU Energy Policy aims to create alternative technologies and fuels to reduce dependency while at the same time securing energy supply, reducing pollution and Co2 emission (environmental protection) and structuring / deregulate the electricity markets (promote competition). Differently the EU Common Agricultural Policy (CAP) has the objectives of an increasing productivity, fair standard of living for the agriculture population, guarantee of secure supply of food and reasonable prices for consumers. Furtermore, the environmental policy has its own goals, in some cases conflicting ones. The environmental policy is in contrast to the other policies mostly focussing on national level.

Examples

Four main EU policies affecting the production and use of energy wood in Europe. The first is the support of the primary sector (agricultural) and rural development which amongst other things offering financing opportunities to farmers and forest owners, so producing forest energy wood becomes cheaper. The second policy is the guideline on energy performance for buildings. Because of the promotion amongst others of renewable energies, it stimulates the demand for energy wood for heating. Thirdly the EU Emission Trading Scheme affects bioenergy due to the price on greenhouse gas emission, which supports alternatives to fossil fuels with less carbon emissions. The fourth are the Renewable Energies Directive and Biofuels Directive. Various EU Member States determined individual legally binding targets for the share of renewable energies, so the countries try to increase the consumption of renewable energies like wood energy.

Besides the international level, there are also national policies effecting bioenergy. The regulations can be separated in policies on harvesting practices (branches, leaves, machinery), forest and environmental policy (sustainability) and general recommendations (damage on soil, insect damages).

Own thoughts

While studying all the political instruments, departments, targets, trade-offs, stages and so on, I recognised ones more, how complicated policy is. My dream is less but strictly supports and restrictions instead of hundreds of different, non-transparent tools. I think, an auction of Co2-ceritificates like the EU Emission Trading Scheme is the right way. But it need less and more expensive certificates and should also apply for airlines and so on. This would have an effect on bioenergy and also the money would be available to support this kind of technologies.

Lecture 4: Economic Instruments in energy policy

Description

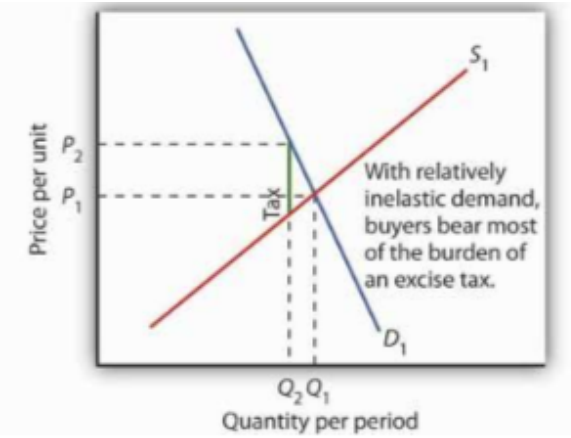
The policies use different instruments to achieve their targets. The most common instruments to promote bioenergy development are capital subsidies (for example subsidies of district heating systems like in Austria), tax incentives (for instance less taxes on income like in Sweden), Energy Tax Policies (mostly Co2 taxes like in Finland) or Guaranteed Markets (like fix percentage of renewables like in Germany). Further efforts are Eco-labelling, education, or marketing campaigns.

In the next step, we thought about the effects different instruments have on the energy market, which consists of a supply and demand curve. How the price and quantity change and who gets how many costs or benefits is depending on the instruments and elasticity of the curves.

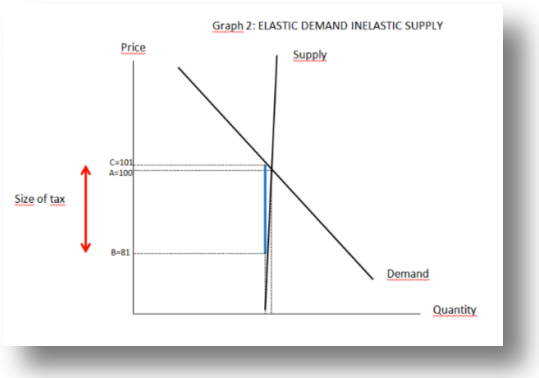
Examples

An often-discussed tool is the taxation on fossil fuels with high emission intensity. The following figure is representative for many energy markets like the one of oil.

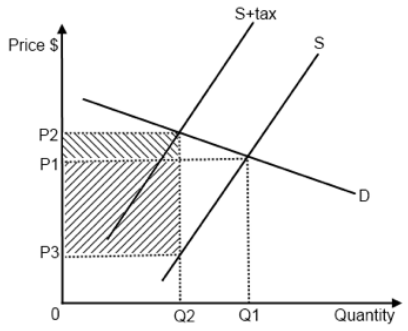
The demand of oil is very inelastic, which means the demand is nearly constant when the prices are changing. If policy decides to tax oil (the green vertical line) the quantity decreases a little bit (Q1 → Q2), while the price rises are dramatically increasing (P1 → P2). In the case most of the taxation is paid by the consumer (P1-P2) and only a little by the producer (P1 – S1).



A completely different situation consists in the coal market, where you can find an elastic demand and an inelastic supply. Due to many substitutes, only little rises of the price are reducing the demand a lot. In this case coal producer pay the main part of a tax. Additionally, very interesting is the determination that you need a high tax of 20 to get a higher price of +1.



The following figure illustrate in a good way how the supply curve is shifted by the tax.



[3]

[3] http://ibguides.com/economics/notes/indirect-taxes

Due to the tax producer will raise up the price from P1 to P2, which reduce the demand quantity and form the new equilibrium P2Q2. Due to elastic demand curve in the figure, the tax burden is mostly passed to the producers (P1-P3).

But it is also possible to introduce taxes for the consumer. In this case the demand curve will shift down.

Own thoughts

I never thought before that a relatively high taxation can affect the price so little. That was a really new thing for me, although I am used to the d-s-graphs and elasticities. Besides think about taxation and restrictions for fossil fuels, 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.

Lecture 5: Adoption dynamics in bioenergy markets I

Description & example

Because of reasons like desire of independence after the oil-crisis and environmental concerns many countries were looking for alternative energy sources. One of these alternatives were energy crops as a source of biomass for energy purposes, which for instance was supported by Sweden policies. The properties of these plantations (for example willow plantations) are that they get planted on agriculture land, grow fast, need constant action / management and are cut every 2 – 4 years and harvest + replant every 20 years. After harvesting the chips can used in the wood fuel market in Sweden or stored for higher demands e.g. in winter times.

Sweden began its researches in 1970s and 1980 and establishes a supporting program in 1990s. The incentives can be divided in two main tools. Firstly, direct monetary subsidy for farmers who would change their business to willow production. And secondly, simultaneous increasing taxes on carbon and sulphur.

The Sweden example also illustrate the effects of changings in the policy framework. Because Sweden joined the EU in 1995 they have to change their incentive program, because the EU-CAP do not allow subsidies above 50 % of the establishment costs. So, Sweden decrease their subsidies on willow and try to compensate it by increasing for carbon – without the desired success being achieved. The commercial plantations areas didn’t increase as before.

This shows the adoption patterns of farmer to innovations and risks. Subsidies have special thresholds or rather trigger points, which determine if they have an effect on the market or not.

The target of the policy instruments in the case of Sweden was to adopt the new technology of energy crops and make it profitable. If the market increases normally no supports are needed anymore. Because of plant breeding, technology and organizational development future costs can be reduced. The effect of reduced costs per unit if the total amount increase is called economies of scale. By double the production quantity economic studies found out that the average costs per unit decrease by 20 %. In the case of willow plantation, the expected cost reduction potential during the next 15 years is about 32 % - the highest percentage compare to alternative crops.

There are very different business cases of willow plantations: selling heat, dry & sell chips, produce & sell pellets and feed pigs. Furthermore. you can take care of sludge or waste water. The example of waste water can be a win-win-situation for the farmer and a wastewater treatment plant. Because of the cross-industry collaboration the plant can save 85-90 % of the wastewater costs and the farmer need to buy less fertilizer and create also a higher yield.

Own thoughts

I think the example of Sweden shows a lot of things:

- Combination of demand and subsidies are successful. The main idea of subsidies or feed-in tariffs like in the energy transformation in Germany is to reduce the risk of the potential producer / consumer. After some time, when the technology is settled, it is possible to reduce or cancel the supports.
- Different to plan policy tools to achieve the goal because of psychological patterns. You need for example steep curve of adaption to make the transformation as soon as possible.
- Policies on the different stages (local, national, EU) need to be coordinate

Furthermore, I am interested in Energy Crops, because I've never heard about them before. For instance, the positive externalities like carbon sink, reduced nitrogen leaching and Heavy metal removal as well as combined uses like waste water treatment, re-circulation of sewage sludge and hunting are impressive, when compared with other forms of agriculture.[4]

[4] http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/35/018/35018132.pdf, pp.89;

Lecture 6: Biomass Markets: model behaviour

Description

The lecture dealt with a business exercise of dynamics of the wood biomass market and effects of political regulations on the market. On the market are 3 different main participants: forest owners, different dealers / carriers and bioenergy plants. The forest owner tries to sell his wood to the highest price by taking into consideration that the price need to be higher than the production costs. A Dealer buys and sells the wood in order to bring it to the plant. And 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.

In the first rounds, there were no market regulations. The consequences at the end of the game was, that a few dealers and one plant had zero profit or a even loss, while at the same time high profits become centralised to only a few players. To get more fair distributions of the earning and inhibit bankruptcy, the policy makers determine some regulations. The tool of a profit restriction of 20 % had the result, that the prices were fallen, but the unequal profit distribution was not stopped – the forest owner became rich. Other restrictions were a maximal amount of biomass, which was possible to trade and limited prices for the forest owners.

Own thoughts

It is interesting to feel the dynamic of markets – a lot of people got in the competition mood of maximizing profits without thinking about social issues. This is also how real liberal economic market works – it creates unfair situations. The task of a social policy is to take countermeasures. The business game illustrated in a good way, that it is very difficult to choose the right instrument and achieve the desired result. All the tools which were used by the policy makers were restrictions and regulation frameworks. It would be very nice to see effects of profit taxes, trading taxes or different types of subsidies. However, this would increase the complexity much more.

Lecture 7: Adoption dynamics in bioenergy markets II

Description

There are psychological tools, like dynamics of adoption, which help us to understand why, when and how policy instruments are achieving their goal. An adaption curve of new technologies can be divided in four parts – early adapter, early majority, late majority and laggards. At the beginning of the adaption normally the market size is small (=difficult to sell, poor organization around harvest), the processes not efficient and machineries not matured. Moreover, there are plantation risks (like wrong variety, weeds and dry soil), prejudices (ugly, food vs. bioenergy, big restore capacities needed…) which brakes on the development.

Therefore, it is much more expensive for pioneers to adopt new technologies (economics of large scale). Moreover, there are a lot of factors which are influencing an adoption process. In the example of farming farm size, forest land, owner age 50-65 and mechanization have positive influences, while pasture, young or very old owner and animal husbandry have negative impacts.

One policy instrument to reduce the risks and equalize the additional costs of early adapters (pioneers) are subsidies. One opportunity to define the amount of subsidy is to calculate the cost-disadvantage for early adapters by estimate the costs reductions in future. Other examples, how farmers could reduce their risk (and policy can help) of energy crop cultivation are increased knowledge, cultivation technology, contract design (contracts, what happen if the crop die) and portfolio thinking.

Politics who want to reach a goal (xx % of the energy mix by wood plantation) need to understand all interactions and influencing factors of the adaption. The adaption of a farmer, so that he changes to wood plantations, is for instance depending on local attitudes, yield / efficient perspectives, profitability and market forces (like Demand, Opportunity costs & Alternatives). The yield / effectiveness is also depending on several factors like climate, diseases, management and R+D innovations. Policy has the chance to influence the whole system by subsidies for R+D, subsidies for the producer so that the profitability rise or taxes for alternative technologies, for instance.

Examples / Own thoughts

It could be that Germany calculated the subsidies for pellet heating systems in the described way. The policy maker calculated that the investment costs of the heating system will decrease in the next 5 years by 3000 € and therefore determine an incentive of 3.000 €. Another example are the feed-in tariffs for electricity of renewable resources. Because the renewable technologies like wind turbines and PVs were not competitive on the electricity market in the past, all pioneers who decided to produce their own green power got a fixed price for the electricity.

But the lecture has shown how complex and nearly impossible it is to consider all variables.

Lecture 8: International biomass trade (pellet example)

Description

The production and demand of pellets increase in Europe. The compressed wood fuels have many advantages like easy transportability, good storage suitability and high energy intensity (ratio compare to oil is 3:1). Pellets are solid but have properties like liquids. In Finland &

Sweden pellet heating systems are mostly (about 80 %) used in medium and large plants for of companies. In contrast in Central Europe the systems are mainly (ca. 60 %) used in domestic and small plants in private houses. To high energy demands, less availability of pellets and higher costs are the reasons.

Most of the pellet used in Europe is produced in Europe. But there are also trade flows from Canada and USA due to cheaper prices (for instance cause of a beetle infestation in Canada). In Europe, almost 40 % of the pellets are produced in Sweden and Germany. However, it is striking that the production is centralized in four areas – Sweden, Finland, Baltic and Central Europe (Bavaria, Austria, and neighbouring areas of France, Switzerland and Italy). If any of these markets would collapse, it would have huge effects on the pellet world market. The markets in the EU countries have very different characteristics – from Import- or Export-Countries to Countries which consume mostly their own production.

The pellets are the mostly made of by-products of forestry and the furniture industry. But the demand of pellets (bioenergy) is independent from the demand of forest products. Therefore. the available supply quantity of pellets is complicated to plan.

The reasons for the growing demand of pellets are different national policy incentives like subsidies for pellet heating systems, feed-in tariffs for renewable energy, or co2 taxes.

But there are also many strong barriers for the pellet market development. One barrier is the difficult guarantee of raw material supply, because supply of sawdust is not endless, productions are centralised in a few regions etc.. Moreover, due to limitations and infrastructure problems in some locations logistic can also be a barrier. Other Countries like Germany have also many sustainability concerns about bioenergy of wood fuels. The discussion about the conflict of food vs. wood is for instance one reason. Other barriers are the fuel quality, lacking financial policy support and unfair competition fossil fuels.

Examples / Own thoughts

The German policy has for instance started a market incentive program for renewable energies in the heating market since 1993. The program has subsequently been further developed by increasing the incentives. The supporting based on two pillars. The first pillar is monetary subsidies, which are depending on size, technology and efficiency. The second pillar is low-interest loans and repayment bonus by national-owned bank. Both supports are following the target, that potential clients are able to handle the high initial investment-costs of a heating system and new ones get interested. The initial investment costs are between 10.000 and

15.000 Euro for a family house. It has to be said, that the program applies in particular to modernize existing buildings. For new buildings, the subsidies are only in special, innovative cases available.[5]

It can be assumed, that the German policy has chosen this instrument, because they know, that the demand function of the pellet heating system was elastic. Due to a lower price of the technology the demand has increased. Currently there are enough by-products (sawdust and wood chips) to produce the demanded pellets and simultaneously ensure sustainability. However, the capacity is endless and not usable for the big mass-market. If the capacity is achieved, the policy need to cancel the incentive program.

Lecture 9: Governance

Description

Before the lecture I was never clear what Governance exactly is. Due to the given definition "Governance can be defined as any effort to coordinate human action towards goals, and can be understood in a broader sense than government as it can encompass coordination mechanisms that rest outside the authority of states" (IUFRO, 2010). So, Governance includes legally binding rules as well as customary social arrangements and has international, national and local dimensions. On the international level for instance international rules like about climate change (UNFCC), international norms and discourse like food vs fuel, markets (global supply and demand, targeting campaigns (ENGOs)) and direct accesses like partnerships have influences on bioenergy governance. The main issues of bioenergy governance are carbon balance, bioenergy crops (deforestation, biodiversity, communities' rights, impact on food availability & price), market forces (Biofuel as global commodities, outgrowths), technology issues (conversion, efficiency...), across disciplines and policies [e.g. involving Ministerial departments of: Environment, Energy, Livestock, Lands, Agriculture, Trade, Transport...].

Important in this context is the social acceptance. If there is no acceptance the risk of conflicts is much higher. Moreover, the social acceptance is the precondition for political legitimacy of the bioenergy industry and determine the existence of policy supports for bioenergy.

However, the perceptions of bioenergy are from very positive (local economy, reliance) to very critical (sustainability, higher energy prices, food security).

[5] https://www.unendlich-viel-energie.de/media-library/charts-and-data/wood-pellet-heating-system ; https://www.heizsparer.de/heizung/heizungssysteme/pelletheizung/pelletheizung-foerderung

The result of these different attitudes and opinions are conflicts, if one group try to influence the activities of another in a negative way. Forest industry has been under increased scrutiny regarding its operating practices in recent years, for instance Asia Pulp and Paper (APP) in China and Indonesia. Cases like this are discussed in the public and media due to campaigns by ENGOs
such as Greenpeace and WWF, who call for more sustainable practices. These campaigns can have significant influences on corporate, social and political decisions. Their instruments are research, campaigns and advocacy – so it includes monitoring and reviewing of political legislation, lobbying, Owning and managing environmental resources, mouthpiece of voiceless…

Like in the forestry industry there is a development to globalisation in the ENGOs movement. They open offices around the world and conduct their campaigns in a new way. The internet plays an important role for the ENGOs for building connections between different groups
Clear evidence of this trend is in the important role that internet plays for the ENGOs for building connections between different the groups, spread information and thereby increase their potential impact and funds.

Examples
In Webau (Germany) is a conflict, which deals with a planned biogas plant for fermentation of organic substances, in particular slaughterhouse wastes of a meat factory. A chemical company wants to build the biogas plant to produce their own energy for their energy intensive business segment. The firm has introduced their first construction plans in 2013. However, until now an ENGO and a citizens' initiative have taken legal actions against the intentions and inhibited the beginning of the building process. Although the federal administrative office approved the building in 2015. This case a good example of the strength of citizen resistance. With the help of Facebook campaigns and stands in the city centre to inform the people about possible impacts of the biogas plant, they create a movement. Because of the long process, cooperation partners like a slaughter company became disappointed and cancelled the cooperation contracts. A great success for the initiative and the ENGO.[6]

Own thoughts
One of the reasons that international climate debate has increased are NGOS. Events, protests and critical reports create reflective thoughts / opinions of civic society, political and

[6] https://www.mz-web.de/burgenlandkreis/umweltschutz-protest-gegen-geplante-biogasanlage-24426358; https://www.mz-web.de/burgenlandkreis/umstrittene-biogasanlage-fleischwerk-toennies-verliert-die-geduld-24682334

business actors. The consequence is for instance a demand of sustainable energy like bioenergy. But of course, the campaigns can be questioned. For example, ENGOs had food vs. energy campaigns in the context of bioenergy. Campaigns change mind in society or rather of the voters. As consequence, it guides governance processes.

Lecture 10: Bioenergy Regions

Description

The design and implementation of EU bioenergy policy can be illustrated in translation loops. EU/Brussel establishes rules and standards (mandatory governance e.g. fixed targets of renew. energy per country) and soft incentives (voluntary governance e.g. recommends, ideas). The next step is the national translation (empty governance space), where the countries establish measures to achieve the goals. In the following, regional translation is the step before production. This is the most important part, because it determines if the goals can be reached. On this local / regional – level, there is often a lack of identification with the objectives and local problems like bureaucracy complicate the implementation. At the end of the circle comes feedback form the production to Brussel.

Example / Own thoughts

The example contains "Bioenergy Regions in Germany" as translation loops.

On the EU-level there are regulations like the EC Biomass Action Plan (2005) and the Renewable Energy Directive (2009) (EU members with own targets and approaches) following the aim of a sustainable development, low-carbon energy supply, security of supply and rural development. Germanys translated the regulations in measures like "national biomass action-plan (2009)" with the campaign "energy for tomorrow – chance for rural areas", EEG (renewable energy directive) and German Government Energy Concept. Germanys target in this case is to increase bioenergy within sustainable limits, climate protection, security of supply, economic development (particularly rural) and network creation. One of the local translation are the "Bioenergy Regions", where selected regions get supporting to integrate bioenergy. Due to the problems of translation loops, the aims of these regions are not the same as the ones of the EU anymore. The targets are to create networks of regional actors (entrepreneurs, consumers...), local energy transition to benefit rural development & climate and the creation of added value in the regions. It shows that sustainability is only a side focus and economic growth & connections become the main target. When it comes to the production / realization the translation processes are also completely different due to different legal forms of the operator, different approaches, socio-economic environment… An example of the regional translation was for example a stopped building of a biogas plant because the neighbour put threatened species in a stream to stop the green development. So, personnel

conflicts, traditions and cultures could destroy EU plans. This is when policy & markets meet reality.

Lecture 10 / 11: Bioenergy Policies for EU & Nordic regions

Description

Policy makers have the decision between various policy tools to reduce externalities / environmental problem, to achieve the binding and universal agreement on climate, with the aim of keeping global warming below 2°C. The main tools are Command and control (t/year), Subsidies (EUR/investment), Tax (EUR/t) and Emissions Trading (EUR/t). The problems of command and control is, that it is less flexible and does not take into account different mitigation costs compliance options. The other three instruments are market based policies. There are a lot of advantages like higher flexibility for firms to reduce GHG emissions, achieve objectives at lower overall costs, incentive for investors to invest in green technologies, incentive to use greener technologies and freedom to private market.

The Policy and status of EU bioenergy is the following. In the third EU climate and energy package, EU determines in 2010 20 % reduction of GHG, 20 % share of renewable energy, 20 % improvement in energy efficiency to achieve the goals security of energy supply, secure climate and competitions. These targets need to be attained by 2020 compare to 1990. Moreover in 2007, EU member states set their national targets for 5.75 % share of biofuels in Europe within 2010.

However, the question if bioenergy is sustainable is also discussed in European policy. The European commission proposed three fundamental concerns to increase sustainability and multi-functionality of forests: Better managing of carbon stocks, increasing ecosystem services of forests, ensuring a sensible use of forest biomass. Three actions to deal with these challenges are increasing use of wood as a substitute of fossil fuels, increasing the GHG-efficiency in the production of wood-based products and increasing the size and rate of carbon stocks and storage in the forests.

Example / Own thoughts

One famous tool is a tax on carbon. So, any producer of carbon has to pay a fix amount of money per tonnes of carbon, which it emits. In Germany for example many economist and sciences call for a carbon tax in addition to the existing EU ETS, to create a bigger incentive to switch to renewable energies. One point of criticism is that there are no health-related thresholds for example for central areas. On the market, a tax increases the price of carbon intensive technologies, so that they become a disadvantage against greener technologies.

The alternative is a trading system, which obliges polluter to buy a Co2-permits / certificates if they want to pollute carbon. The most common trading system is cap- and trade. It sets a maximum level of pollution, a cap, and distributes emissions permits among firms that produce emissions. Firms which need less permits can sell them on the co2-market.

The most famous one is the European Union Emissions Trading System (EU ETS). It started in 2015 and contains the biggest companies in Europe, which emit about 45 % of the co2-emissions. It sets a cap on emissions which is reducing every year. About 60 % of the permits are distributed for free, the others are auctioned. How and to whom the free certificates are distributed is often discussed, because in the past coal producer got advantages over gas producer. Moreover, the reduction factor of the cap (-1,7) is too low to achieve the EU-climate-goals, because there are too much and therefore to cheap permits on the market.[7]

Let's have a look on the Finnish policy regarding to bioenergy. The ratio of wood-based energy has been increasing and accounted for approximately 35% of total energy consumption in 2013. Although Finland export wood and use it for energy production, the forest resources increased over the last half a century. In 2016 the policy makers introduce their new climate and energy plans for 2030. The aims of the plan are an increasing role of forests in both energy production and climate change mitigation, increasing use of bio liquids (like biodiesel) in transportation, abandoning coal by 2030 for energy and achieving a carbon-neutral energy system by 2050.

The main policy incentives to strengthen bioenergy are a carbon tax (since 1990) and investment subsidies for CHP plants (since 1990). The implementation of the plans need increasing harvesting which would critically depend on biodiversity and conservation measures.

Lecture 12: Recent and future trends in (bio)energy

Description

The lecture based mostly on open discussion. Firstly, we discussed about trends in global energy market, based on the papers of the *International Energy Agency*. The resulted most important trends are heavy REN growth and decreasing costs (in particular in solar PV and wind energy), the increasing relevance of natural gas and that policy instruments switch from feed-in tariffs to auctions. As a result, bioenergy had only a slight decrease in the last decade

[7] https://en.wikipedia.org/wiki/European_Union_Emission_Trading_Scheme; https://ec.europa.eu/clima/policies/ets_en

and this trend will probably not end. But the importance in some sectors will increase. For example, the use of bio liquids as a gasoline substitute increase in many countries like Brazil. Moreover, in the heating and cooking segment bioenergy is currently the most important renewable energy source due to lack of renewable alternatives.

There are a lot of reasons and factors which have to take into account while explaining these trends. One important economic aspect is the price alternative energy sources like oil. In the times when the prices were high, it was an incentive for REN. When the price decreases the growth of REN decrease as well. In my opinion, the highest relevant have policy. For instance, a political incentive program in America was the reason for the great growth of gas. And of course, there are driver of new technologies. In these days China with its super-high population and resources determines energy development.

Examples

The International Energy Agency (IEA) wrote in their World Energy Outlook-2017, that there are four main trends which will influence the world energy system. First, 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 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 of China. Between 2017 and 2022, it is expected that the global renewable electricity capacity will expand by 43%. Secondly, the growing electrification of energy. Which means in particular the transformation to electricity based technologies in heating and transportation. Moreover, the shift to a more services-oriented economy and a cleaner energy mix in China. The last years told us: “when china changes everything changes”. And the surprisingly las trend will be the resilience of shale gas and tight oil in the United States. USA will probably export more energy and gas becomes the second largest fuel in global mix after oil. [8]

In the case of policy, it is striking that governments move away from feed-in tariffs to competitive auction with long-term purchase agreements. 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 increases 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 Energy Directive.[9]

[8] http://www.iea.org/weo2017/

[9] https://www.iea.org/publications/renewables2017/

Own thoughts

The whole future development of the energy market is far from clear be influenced by many factors and surprising events. Of course, this applies also bioenergy. There are many examples of change-making factors. Maybe in ten years scientists develop a new super-technology which creates biomass with the help of fast growing organisms or there is a wonderful new sort of energy crops due to genetically genetic engineering. A change of Chinas policy to high subsidies of bioenergy could also influence the development dramatically. 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 further on. The growth will not be so great due to the land-use conflict as long as the world population increase and exhaustible resources like oil are affordable.