Bioenergy markets and policies: Learning Diary

Yoko Lu

1. BACKGROUND

Short description

Bioenergy market and development started in 1973, with countries that were fighting over resources and had wars, with countries allying with each other. Oil market started in 1922, with its averagely yearly price for an oil barrel started low back in 1946, but the price rose to a very high extent in 1980 because demand was very high from western countries. The price dropped again after mid-1990's and price rose much higher again in 2008. Since then, the price was lower but still much higher compared to other periods. Oil was the major commodity until around 1972 when new sources were being used, including wood fuel, natural gas, coal, and peat. For production and supply, wood energy, agroenergy, and municipal by-products are commodities that are used to develop products into both solid and liquid forms, which are then put into market as final products such as heat and electricity.

For plantation, crops are first planted then harvested. Harvested crops are then chipped into smaller pieces so they are easier to be converted and put into use. Uses can be multifunctional, such that the society's residues rich in nutrients can be used to fertilize trees or rely on biomass energy.

Examples or cases

Within the lecture, wastewater treatment in Enköping is mentioned. The treatment process uses willow, which causes several environmental issues such as endangering species, economic issues (i.e. labour, investments, energy production), and nutrient availability and physical problems (i.e. groundwater, surface water) and carbon sequestration. These are impacts from short rotation cultivation of the willow.

Another example is wood fuel. It is sourced from sources of logging residues, trees and tree sets, chips, and pulpwood. District heating is one another case. It can be a cooperative measure between each of the local forest owners.

In Joensuu, other than the current heat and power industry, as well as electricity and district heat, bio-oil will be also produced as new development stage, and this was the expectation in autumn of 2013.

My own thoughts

It is nice to touch the bioenergy market from the historical context. Oil market in 1922, which in my opinion, it seems rather late, or is it me who misinterpreted the lecture slide (wasn't there whale oil back in the 1800's?). Anyhow, it was interesting to see that they are different kind of energy and markets that I am not aware of – I am not from forestry background after all, since this is all new to me. Examples and cases mentioned in the lecture has nice mention to Joensuu too, since we are in Joensuu studying forestry, and it would be nice to compare Joensuu to the rest of Finland and world.

2. THE ROLE OF POLICY

Short description

A policy is where procedure or protocol are implemented by the Board or senior governance body to make sure that decisions are made with appropriateness wherein reasonable outcomes are achieved. When it comes to implementing bioenergy production, it is both necessary and unnecessary to support bioenergy production and these reasons can be: Reason to support – to make sure that the resources are sustainably used and pass onto next generation, or encourage alternative use instead of a destructive source; Reasons *not* to support – bioenergy may not be sustainable if overused and it may not support all the population; it may produce too much end products like GHGs, and since bioenergy is one small portion of the whole energy sector.

Externalities is one key aspect that has impact on forestry, aside from normal good (a.k.a. commodity) and public good. Externalities are not direct form of price in the market and it affects on all regardless of benefits and losses from its effects. Such cases be climatic changes in local areas, general climatic conditions like CO2 pool sink (where does the price go for the CO2?), soil conservation (soil loss and its risks, and water quality, and many others. In terms of forestry, residues are produced from the factories and raw materials, then CO2 is emitted from factory/production stage, then it becomes biomass, and finally, products are put into market. Within such cycle, new biomass crops and conventional biomass are developed, as well as fuel/power/heat and new products are derived from the stage where resides are converted, producing recycle.

Examples or cases

Within bioenergy sector, policy can be divided into environmental, agricultural, and energy sectors. For energy, half of the energy in EU is exported from outside the EU in 2005. It is estimated that it will increase 20% in export from outside the EU by 2030.

Climate and energy:

United Nations Framework Convention on Climate Change (UNFCCC), which is International Environmental Treaty at Rio 1992, is aimed to make sure that the atmospheric GHG

concentrations do not harm the climate system, and the goal is to not go beyond 2 degC that is higher than the industrial global average temperature. 2015 Paris Agreement is another convention that follows this concept, among other conventions. However, UNFCCC has some drawbacks such as no mandatory limits set for each country regarding GHG emissions, no enforcement requirements, and not legally bending. Its key points are responsibilities that are common but differentiated and polluter pays principle.

In context of Europe, European Climate Change Programme (ECCP) is one initiate that is involved across energy, transport, and industrial divisions. It includes various mechanisms such monitoring and reporting of GHG emissions, promoting co-generation of heat and electricity, renewable energy use, and biofuel use for transportation, as well as energy efficiency (i.e. new buildings).

My own thoughts

In general, I think it was nice to touch basis on all three policies, not just forestry or bioenergy/biomarket, in different approaches: environmental, agricultural, and energy, at both international level and national level. However, I think it would be nice to compare different countries and it would be interesting to see the issues that Finland might have and how Finland is doing compared to other European countries or globally, and areas that can be improved.

3. ECONOMIC INSTRUMENTS

Short Description

Demand and supply are the key instruments that make up one part of the policy. Demand refers to the number of consumers wanting to buy products, and consumers may include sectors, actors, consumers, and society. Supply is the product that consumers want to buy, such as biomass and energy products. Demand and supply are dependent on each other. As demand goes down, supply goes up. For demand curve, elasticity shapes the demand curve, which places quality on the x-axis and price on the y-sis. As price goes up, quantity goes down. As lecture notes: “Price elasticity of demand is a measure to show the responsiveness, of the quantity demand of a good or service to a change in its price” (p.5). If it is inelastic (price is fixed), then it generally refers to oil, energy, and food. If it is elastic, in which quantity is fixed, then the market is highly competitive. For supply curve, inelastic can be Velazquez paint (as it is highly valuable?) and elastic being highly competitive market.

Examples or cases

In Sweden, energy policy is implemented in the form of energy tax. For biomass, taxes virtually does not exist for both district heating and industry, yet taxes are high for coal, heavy fuel oil, and gas oil, in which district heating tax is higher than industry for these three products. Having tax on biomass, it is shown that the bioenergy in small-scale heating and district heating is rising when there is taxation put ono CO2 and sulphur.

Meanwhile, in Sweden, energy policy consists of implementations such as capital grants, local initiatives which are based in environmental concern, and forest-owning farmers who are interested in the issue themselves.

My own thoughts

Indeed, without putting taxes to manage the use of bioenergy and biomarket and the resources, then it is prone to overuse the resources – resources will be depleted in no time as well as harming the environment without being sustainable.

4. ADOPTION DYNAMICS IN BIOENERGY MARKETS

Short Description

For plantation, management such as cut-back and harvesting. Willow (*Salix*) is one crop that is cultivated for bioenergy in Sweden for the last two decades. This crop is also recognized as an crucial crop for wood fuel production in Sweden as in energy industry. Energy crop is only a small portion part of the whole energy mix. Natural science and social science can be combined to gain multiple perspectives as well as thinking both scientifically and social scientifically. To reach the goal, yield (efficiency, management, clonal material) and total area (adoption studies, policy incentives, profitability) planted need to be considered. Policy tools such as subsidies and taxation are important to be implemented to ensure that the resources are sustainably managed. Policies incentives are subsidies, taxes, promotion, and public research. The plan and goal for Europe is to target energy share from renewable sources in consumption of energy by 2020. Now, it comes to the concept of adoption dynamics. At the beginning, there is early adopters, then early majority emerges. After the early majority adopts market, then there are those who adopt late, then laggards who came in much later. Temporal and spatial adoption dynamics show that as the market grows, then there are crops established in the same area. For adoption, profiling is important as well. Influence on *Salix* activity from farming has both positive and negative influences: negative being such as farm size, forest land, and lease to others, while negative being pasture, tenancy, and age of owner. Thereby, to reach the goal, adoption is required, in addition to yield and total area planted. These can be improved such as new varieties, experience of farmers, and better overall methods. However, there is also uncertainty, in which risks need to be considered.

Examples or cases

Agroforestry (“simultaneous cultivation of plantations and annual crops on the same area” is one example from the lecture), impact on groundwater (NO3-N and PO4-P leaching), impact on soil (C storage in soil organic matter, soil organic matter stability, Cd concentrations, sludge applications, soil remediation), biodiversity, and soil salinization management. all have impacts and results from the market adoption. Enköping is the wastewater treatment facility that has

multifunctional uses. 50% N reduction in outflow from the facility is needed; to solve this, load of the water flow through needs to be reduced, such as transporting septic-sludge to rural storage ponds and separating wastewater from sewage sludge. New business models are needed to track assumptions and economic value for the externalities such as carbon sink, reduced N leaching, and heavy metal removal. The view also varies between the policy maker and the farmer. Planning can be proceeded at landscape level.

My own thoughts

Adoption is indeed important. If the old technology needs to be changed to something new, then alternative is necessary to make the new society important. As innovation emerges, then the customer dynamic changes as well. As early customers are attracted to the new product, then they will attract others as well, further improving the market and increase profitability.

5. BIOMASS MARKETS: MARKET BEHAVIOUR

Short description

Market for biomass starts from forest owner, then wood biomass, and finally, bioenergy market. The forest owner has the decision to set the selling price, but it cannot be sold lower than the costs. Dealer then buys the wood biomass so they bring it to the plant. Wood is bought to get bioenergy but the wood cannot be bought higher than the profit with energy. Biomarket market is structured as follows (as lecture says): (1) Initial round: open rules; (2) Set up: 3 biomass plants, time regulation (5 min); (3) subsidies; (4) no skipping; (5) more amounts; (6) local monopoly (demand); (7) local monopoly (supply); and, finally, (8) timber market. Initial amounts are variable, information flow is not equal, then restrictions are not symmetrical. At the beginning, as initial amounts being variable, there are more options but less risk; however, at final stages, where the restrictions are not symmetrical, then there are less options but more risks. Factors involve individual factors of the agent (skills and experience), individual factors of the agent role (costs and location), and controllable factors (amounts and rules).

A policy is an enforcement that sets decisions and make sure that rational outcomes are achieved. A policy is nevertheless implemented as a procedure or protocol. All those mentioned above can be incorporated into a policy.

Examples or cases

For consumer, there can be two lines representing effects of taxes on demand. When the quantity is set, but when the quantity is not fixed, then the effects of taxes can be affected as well. So does the effect of taxation on producer. When energy policy is implemented, the size of tax differs, depending on where the point of supply and demand intersects. When the graph/relationship becomes inelastic, the size of tax changes. There are many variations of these graphs, and it affects the behaviour of the buyers and sellers. When subsidies are applied,

it applies the same, but it may be enlarged than when only taxes are included into the price-quantity graph.

My own thoughts

This lecture was particularly difficult for me to understand as I had never understood the mechanisms of environmental economics. Although the initial relationship between price and quantity is easy to understand, however, when inelasticity and elasticity come in, it becomes more difficult to analyze the graph. Also, the diagram for the biomass market is not easy to understand as well, as there are many options where each path runs.

6. GOVERNANCE

Short Description

Governance is defined as, as noted in the lecture: "(i) the activity or process of governing; (ii) those people charged with the duty of governing; and (iii) the manner, method, and system by which a particular society is governed". Governance occurs at all levels: international, national, and local. Legally binding rules and customary social arrangements are included. Governance is very important to address "short term operational management to long term policy development and planning…"[1]. In terms of domestic policy processes, direct access, international rules, international norms and discourse, and markets are integrated.

Although bioenergy governance is necessary, ther are also issues within the framework. Carbon balance, such as how much GHGs is needed to be saved over fossil fuels, affect bioenergy crops, which result in land (LUC (land use capacity), ILUC (indirect land use capacity)), deforestation, biodiversity, and community rights, as well as food availability and price are highly affected. When it comes to market forces, issues rely in biofuel as global commodities. Other issues include technology, cross-cutting, and across disciplines.

Although there are issues, there are also positive perspectives. Local economy and environment will have positive effect, reducing reliance on oil imports. Critical perceptions, in turn, shows that biofuel is costlier than gasoline. Thereby, low air quality and sustainability are concerns to the nearby forests due to increasing energy biomass use. Economic benefits are also uncertain, from the point view fof the local ethanol plant.

[1] Food and Agriculture Organization of the United Nations (FAO). 2013. Improving governance of forest tenure: A practical guide. Retrieved on 11 February 2018, from http://www.fao.org/docrep/018/i3249e/i3249e.pdf.

Examples or cases

According to the lecture, young citizens who are of 15 years old from Finland, Slovakia, Taiwan, and Turkey have very small percentages of whom having knowledge on bioenergy. Most of these young citizens are generally very critical on environment, which tends to be positive, as 60% of the students consider bioenergy as non-environmentally friendly and over half of the population think that harvesting trees for bioenergy is negative.

My own thoughts

In general science, the world is going the right direction, educating its citizens regarding bioenergy. It is very positive that even such young people tend to see the concept on bioenergy from both ways. Although the term 'bioenergy' sound environmentally friendly and can be used as an alternative for fossil fuel, etc., the young people see the difference. I believe that it is well educated in developed countries, and the current situations should be more focused on developing countries which are still highly populated and still use the traditional fossil fuel and oil/gas.

7. INTERNATIONAL BIOENERGY MARKETS

Short description

Wood chips are mostly developed from wood that is recovered or waste or virgin wood, which are harvesting residues. In terms of international market within the Baltic area, Sweden, Denmark, and Germany are the main importers while Russia and other Baltic countries are main exporters. Other key players are China (exporter more prominently than importer) and Japan (importer).

Pellets is another product and it is used as woody raw material. It is used for industry in other wood processing, such as plywood, particle board, planting, and furniture industry. Pellet or briquette production is one of the product that is stemmed from this industry, which is then used for heat and power (utilities and industry) and heat in residential sector.

Consumption and production patterns have been changing during the past 5 years due to lacking comprehensive statistics and accounts.

Examples or cases

In Finland and Sweden, heating plants are mostly large scale, at 70%, while small scale is only 5%. In contrast, central Europe is mostly small scale with 35% while large scale is only 15% of the whole market.

In the lecture, SWOT analysis is used on the pellet markets in northern Europe. For strengths, Finland has sufficient domestic production to increase amount of pellet uses as well as

producing raw materials domestically. In comparison, Sweden has developed pellet market, many small scale producers, well-developed delivery networks, high standard so that most of the pellets are produced, and taxation is favourable. For weaknesses, Finland does not have good quality raw materials, no standard for pellet, number of fines confined in bulk deliveries, and no taxation. Sweden does not have raw materials, a high amount of small producers not follow any standards, and quality of imported pellets and amount of fines. For opportunities, while Finland is developing pellet handling and transportation, localizing pellet market, increasing domestic pellet consumption, and introducing new materials; whereas Sweden also introduces new materials and improve facilities at harbour for handling imported pellets. Finally, for threats, Finland is at danger of sawmill production effect being increased due to raw material availability, pellet price being risen, and raw material supply being uncertain for delaying in-progress plants. For Sweden, meanwhile, there is high competition between other industries for raw materials, raw material price increasing, and pellet importation being decreased.

My own thoughts

It is important to analyze and compare other countries' markets, especially neighbouring competiting nations to observe how own country is doing. In this way, own country can look forward to improve its industry as well as perhaps, developing friendship and partnership with those countries. Indeed, taxation and standards are necessities for improvising the current market and helps market grow.

8. BIOENERGY REGIONS

Short description

Governance is mentioned again in terms of renewable energy. Sustainable development / climate change is widely debated globally. Energy transition such as developing other ways instead of oil, coal, and gas so that a more sustainable growth or low-carbon economy is well-discussed. Energy resource trade does not happen locally, but more transnationally and globally. Renewable policies should be defined in EU as well, comparable to the international standards such as RE, sustainability criteria, and NREAPs. There are indeed various approaches and conflicts across all governing levels.

For the EU renewable energy policy, policy mobility & mutation refers to the "process that transport and translates particular policy programs and ideas developed in one spatial context to other places in geographically variable ways; [for policy's spatial design, this is a] " a purposeful activity which aims to make a policy a coherent but mutable whole and thus transportable and implementable in various contexts; [and finally,] EU policy design as a local process [questions:] 'what [exists] kind of spatial context [and] how is the renewable energy policy designed to be transportable to various parts of Europe?" (lecture slides).

Translation loops of bioenergy policy and materialization can be complex. There are four types of governance methods: coercive governance (rules and standards), voluntary governance (soft incentives), empty governance space (policy with no concrete measures; 'filling in' required by various loops); and finally, translation & mutation (domestication based on problems arising at national and local level).

Examples or cases

For regional translation and rationalities, there are good potentials for innovative network for entrepreneurs and availability of sustainable supply. In this case gas provider at local level offers cheaper economic method, and this lasts for 20 years of fossil fuels. Another case would be resistance to renewables at outcome that is more efficient and sustainable and this is the good example for wind energy in Bavaria, which applies NYMBYism. Third example is learning negative side effects for local bioenergy development, which can result in threatened species right next to the biogas plant. Last example is the planning of a biomass-based combined heat and power (CHP) in Bavaria, including appropriate policy, savable investment, information supporting the office in bioenergy, and large local forest resources. However, there is conflict locally, that the locals complain of dirt, noise, smell, poison, as well as money going to exterior investor.

My own thoughts

It is very nice to learn from perspectives of different regions in terms of bioenergy market. Although it is not difficult to learn how policy affects the market in general, but it becomes more difficult if it goes beyond the policy level, as such that energy can be related transnationally – since each country has different policies and such, it is difficult to track the process of product.

9. POLICIES AND MODELING OF ENERGY SYSTEMS FOR REACHING EUROPEAN BIOENERGY TARGETS

Short description

Supply chain begins in harvesting, then production site via biomass transport, and finally, distribution via bio-product transport. The question lies on the location where the plant should be built. Mixed integer linear programming (MILP) refers to the model that minimizes the total cost of the supply chain:

(Total Cost) = (Supply chain cost) + (supply chain emissions) * (CO_2 cost)

Supply chain cost can include various factors such as feedstock/collection cost, production plant, and bioenergy transport. Supply chain emission include the ones from fossil CO_2 via biomass and biofuel transportation and additional transport for fossil fuel.

Examples or cases

BeWhere is a tool that is a connection of nodes between biomass supply, bioenergy production, and energy demand, which can be derived into heat demand, from bioenergy production. For bioenergy production, chain costs include biomass (harvesting, forwarding, chipping, and storage), biomass transport (truck, train), production (investment, operation and maintenance, interest rate), bioenergy transport (truck, train), and distribution (fuel station). Biomass supply refers to biomass supply, transport network, candidate sites, and energy demand. The BeWhere tool has parameters (yield, emission factor), constraints (i.e. biomass supply, production plant), and other costs (fossil fuel, price). Model results will inform the results such as user number of plant, optimal location, biofuel/heat/electricity sold, and parameter sensitivity.

My own thoughts

BeWhere is seems to be a complex tool that has interactions between various factors. It sounds like coding somewhat, and coding is particularly difficult to use to analyze on problem or topic. In particular, there are only three factors that need to be interpreted and interact with each other to come up with various connections, which in turn, makes it resulting in different results. It would have been interesting to test out in person within class as an exercise.

10. BIOENERGY POLICIES FOR EU & NORDIC REGIONS

Short description

To solve environmental problems efficiently, policy tools such as command & control, subsidies, tax, and emissions trading are necessary. For command & control tool, regulatory programs are traditional and less flexible and require polluters to take actions to lower emissions. It is noted that the policy designed for the polluters to reduce emissions need to ensure that the emissions do not go beyond the thresholds that harms health. No incentive is required for firms to innovate to apply, in which required by the standard – i.e. reductions technology. For market-based environmental policies, flexibility is greater for firms and other appropriate industries to lower GHG emissions, overall cost is lower to achieve environmental objectives, incentive is provided for inventors and investors who product and use emission friendly technologies, and freedom for private market where technology is thriving and expanding.

Carbon tax is the tax that offsets the emission level. Subsidy is to encourage the citizens to be aware of environment.

Examples or cases

European Union Emissions Trading System (EU ETS) is the first GHG multi-sector GHG trading program, which is also largest. Currently, its phase is third, which is 2013-2020. It follows the Kyoto Protocol's emission reduction targets. The key component of the EU ETS sets emission

cap and requires entity to keep a permit per tonne of CO2 emission. If the firm does not have a firm, then emissions have to be cut back or permit has to be bought from another mechanism that already cut back their emissions. A market is created for tradable allowances for emissions within EU. Cost on emissions refers to the price of permit being bought or sold. Level of cap refers to level of emissions and the number of available permits.

My own thoughts

Tools like command & control, subsidies, tax, and emissions trading are interesting to be learnt within the market, which is the target of the course, though it was quite difficult for me to understand as I have not actually taken any courses on this, so I am just a slow learner. It was interesting to learn many new and interesting tools.

It is important and the taxes should be input to lower emissions. Though the EU ETS occurs within EU, I am sure other regions also have similar policies. If they do not, then they need to follow the example of EU. I think it is important to have something equivalent at international level like the Kyoto Protocol, so in this case, the EU ETS is a great example.

11. FUTURE TRENDS

Short description

Future trends is a definite prediction that needs to be studied and analyzed to make sure that energy production or process in general is going in right direction. Energy is inevitable and it is the most required sources for the daily life. Power generation is needed, particularly solar PV and wind. Cost continues to decrease, which means that renewable power generation is being equal and it is continuously developed by many major energy companies, leading to increasing use of energy. A positive factor is that even though the energy use is growing, carbon emissions relevant to energy grows only little, which is the major step. However, lowering emissions and using fossil fuel remains the main problem, especially in the developing parts of the world.

Uncertainties remain for policies and subsidies; these may be the main issue for present trends to continue. Carbon trade is important but it is not rated as highly regarded, therefore strong incentive may be out of the picture. Economically, production cost for bioenergy has stayed generally the same, but other renewable energy products are decreasing. These are just some factors that questions the future trend and therefore, the future role of bioenergy is uncertain and various factors and not-yet-known developments affect the trend. For the future, there are two different futures: ‘maximum use’ (i.e. natural resources will be harvested and used much more in the future) and ‘balanced, efficient, and sustainable use’ (i.e. land can become arable as the land becomes drier through drought or floods).

Thereby, a positive foresight includes innovation, multidiscipline, both non-scientific and scientific perspectives, client-focused and participatory approach, autonomous and independent approaches, and international level so to expand cooperation and coordination s

well as shared knowledge. When all or some of these criteria are met, then strategic planning and decision making can prove very useful. However, independency may be lacked thereof.

Examples or cases

As mentioned previously, bioenergy development in the future can result in various directions. Within the lecture, the following were mentioned: world economy, world trade, geopolitics, climate policy, energy, land use, food security, technology, and citizens. Each discipline has effect on each other. For example, climate policy has huge impact on energy, land use, and food security, for example. Carbon tax or any other policies that includes monetary value or incentives to lower emissions can make impact on developing bioenergy. If the energy is developed with appropriate price, then land use and food security can be well maintained. There will be no scarcity so everyone will not go into hunger and there will be no rapid increase in price. For food, if the land is well-maintained, then food is accessible to everyone. Thereby, technology can be innovative, keeping the citizens (which is another factor within this framework) well satisfied.

My own thoughts

To conclude, the United Nation's 17 Sustainable Development Goals (SDGs) are the key components that address the global crises, including energy. If bioenergy is innovated with effectiveness and efficiency, then everything else can be well maintained, since energy is one key compartment that defines the livelihood, especially for those that require energy. Perhaps, SDGs should be introduced more often in the courses?