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Research paper

Factors behind the development of forest chips use and pricing in Finland

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ABSTRACT

In this study, factors were analysed that had an effect on the development of forest chips use and mill gate price from 2007 to 2016 in Finland. During this period the average price of forest chips has increased by 66% from 12.66 € MWh^{-1} to 20.69 € MWh^{-1}. The competitiveness of forest chips use was the result of different incentives, price and taxation of competing fuels such as peat and fossil fuels, and the price of emission allowances. The sliding premium tariff bound to the price of emission allowances and excise tax of peat fuel had a straightforward effect on the price formulation of forest chips. During the reference period, both incentives and taxation levels were updated several times to implement the national objective set by the EU on increasing the utilisation of renewable sources. The future demand of forest chips is dependent on the price development of emission allowances and electricity. Their current low price has become a significant threat to CHP-plant investment activity. Policy regulation is needed to enable bioenergy CHP investments, which will also secure energy infrastructure and energy security in the future in Finland.

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1. Introduction

The use of forest chips has almost tripled since 2007 in Finland and reached the level of 8.0 hm^3 by 2015. However, the use of forest chips has declined by 8% from the peak year in 2013, when it was 8.7 hm^3. A majority has been combusted in heat and power plants, with 7.35 hm^3 in 2015. The rest has been in small-scale use, such as space heating at farms and biofuel production like bio-oil, based on fast pyrolysis technology. The target is to further increase the use of forest chips in heat and power production to the level of 13.5 hm^3, i.e. 27 TWh, by 2020 [1]. Additionally, bio-based transportation fuel production may need large amounts of forest chips to reach the targeted 7 TWh of biofuels by 2020 and again another 5.7 TWh by 2030 [1]. The demand for forest chips will be 12 TWh, if the target of 2020 will be fulfilled solely by forest chips. The wood fuel use and potential supply is dependent on round wood use in the forest industry, due to by-products in mills and forest residues of fellings. Only small-sized energy wood offers potential resources beyond the forest industry round wood supply and it has been become the main source of forest chips.

The price development of forest chips is dependent on demand and supply factors, which are site specific, depending on the regional situation. The demand and supply situation, i.e. the regional balance of forest biomass, is a substantial factor for forest biomass fuels. In addition, national policy regulation such as incentives, fuel taxation, and EU policy as the price of emission allowances and sustainability criteria for biomass fuels have a more temporal effect on price developments. The competing fuels dictate the range for the price of forest chips, since fuel prices are typically interlinked. Typically, fossil fuels as oil and coal prices are determined on global commodity markets, which then define the price formulation for local domestic fuels as peat and woody biomass. The concept of profitability for forest chips is a result of alternative fossil fuel prices and local and EU-level regulation.

Supply–demand equilibrium curves are one way to depict the price and quantity changes, according to the market situation. In the free market, there is an equilibrium where supply and demand curves intersect. However, subsidy systems will move the curves from the base state (S_0, D_0) to the subsidized state (S_1, D_1) (Fig. 1). For forest chips, there are subsidy systems at both the supply and demand side, a harvesting subsidy for small-sized energy wood, and a sliding premium tariff for wood-based electricity. Both will increase energy wood supply and use, but the price effects are opposed to each other. Production subsidy will decrease the market

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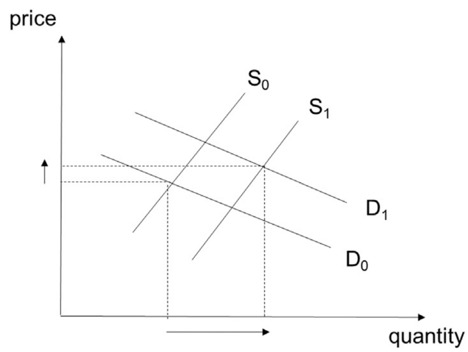

Fig. 1. Supply and demand equilibrium curves.

price, whereas the sliding premium tariff will increase the market price of forest chips. The total effect is dependent on the elasticities of demand and supply [2]. In Fig. 1, it is assumed that demand is more elastic than supply and therefore the price increases. There will be a regional variation between supply and demand elasticities and the effect could also be the opposite. The situation varies according to the raw material markets, and in areas abundant in small-sized energy wood eligible for the harvesting subsidy and lower energy wood demand, the market price could decrease because of the lower elasticity of demand. Without the harvesting subsidy, the energy wood market price would be higher. Later in this study, the supply and demand side factors and price formulation for forest chips will be analysed more deeply.

2. Material and methods

2.1. Forest fuel price factors

This study analysed factors that had an effect on the development of forest chips use and mill gate price from 2007 to 2016 in Finland. There was continuous statistical information available from the year 2007 until the present [3]. Both supply and demand factors were evaluated (Fig. 2). Competitiveness of the use of forest chips was a result of different incentives granted by the Energy Authority [4], the price and taxation of competing fuels such as peat and fossil fuels [3], and the price of emission allowances [5]. During this period, both incentives and taxation levels were updated several times to implement the national objective set by the EU on increasing the utilisation of renewable energy sources.

The availability of alternative forest biomass sources and their cost competitiveness were factors that had an effect on supply possibilities. Cost competitiveness was a result of supply logistics system development and supply incentives. Alternative forest biomass resources varied regionally, where availability according to transport distance and supply cost was a very site-dependent factor. The mill gate price statistics were based on averaged national values taken together and mixed all forest chips raw material sources (logging residues, stumps, small-sized energy wood). Data was updated quarterly and is based on sample amounts gathered from sellers and buyers. There were separate values for forest industry by-products (sawdust, bark, and wood residue chips). There were no mill gate price statistics on the regional or forest chips raw material level, but there were other price statistics based on standing sales (stumpage) and delivery sales (at the forest roadside) level regionally (forest centres), which presents the price variation from the supply side [6]. The mill gate price tells the selling price and standing/delivery sales the raw-material costs.

2.2. Forest fuel demand

Forest fuel demand will be defined according to the energy plants' existing capacity (energy and biofuels) suitable for forest chips. Energy plants are either CHP or heating plants, since there is no pure condensing power unit using forest chips in operation in Finland at the moment. Therefore, the heat demand is the main factor for the use of forest chips and clear seasonal variation exists, but there is also annual variation due to temperature differences.

Forest fuel combustion capacity has increased every year and has doubled since the 1990s, comprising 9784 MW at the moment (Fig. 3). The current situation was based on District Heating statistics from Finnish Energy [7], the power plant register from the Energy Authority [8], and heat entrepreneurship statistics from the Work Efficiency Institute [9]. There were 234 large-scale and 541 small-scale (<1 MW) plants, with 775 units in total. Heat entrepreneurship is a typical solution for small-scale heating plants. Naturally, the capacity was heavily concentrated on a few units, since some 10% of units constitute 90% of the capacity (Table 1). They belong within the EU Emission Trade System (EU ETS), where

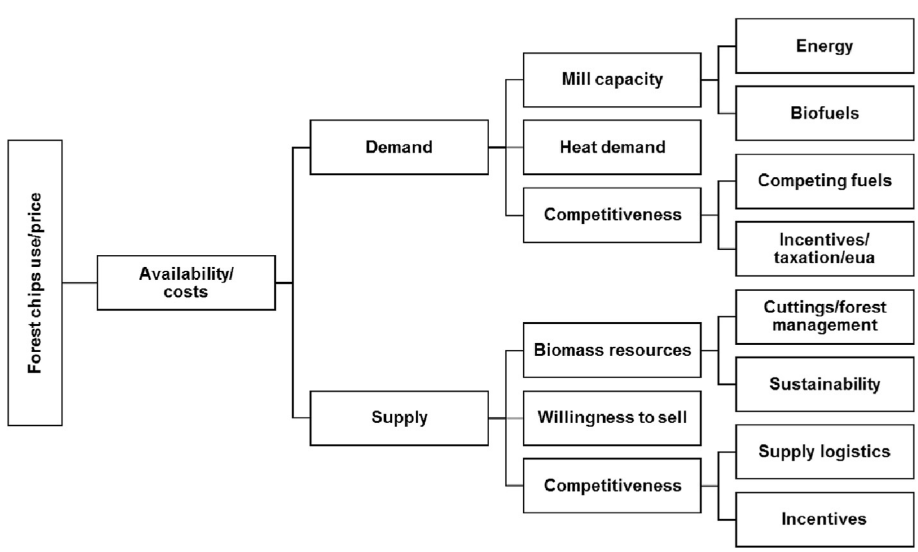

Fig. 2. Forest fuel price factors.

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