IEA Bioenergy

Finland – 2018 update

Bioenergy policies and status of implementation

Country Reports

IEA Bioenergy: 09 2018

This report was prepared from the 2018 OECD/IEA World Energy Balances, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members. Reference is also made to Eurostat. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report[1] for all country reports.

Edited by: Luc Pelkmans, Technical Coordinator IEA Bioenergy

Contributors: Lauri Kujanpää, Antti Arasto, VTT; Tapio Ranta, LUT

NATIONAL POLICY FRAMEWORK IN FINLAND

Finland has committed itself to a target of 38% share of renewable energy in gross final energy consumption in 2020, with a split in sectors as displayed in the table below.

Table 1: *Finland´s 2020 renewable energy targets*

Sector	Share in gross final consumption per sector
Overall target	38 %
Heating and cooling	47 %
Electricity	33 %
Transport	20 %

Source: National Renewable Energy Action Plan of Austria (2010)[2]

Feed-in premiums for electricity from wind, biogas and forest residues (chips or hog fuel from tops, branches, thinning wood and stumps) are an important instrument to reach the above mentioned targets. In order to avoid distortion of wood availability for industrial use, the feed-in premium is restricted to 60% if wood chips are made from larger stemwood (breast diameter > 16 cm). Investment support enhance new RES technology innovations. A special support is granted for investments with high risks and high cost (>EUR 5 million) e.g. investments to advanced biofuels plants. In addition, a CO_2 tax for fossil fuels in heating has been a long-term incentive to promote RES-heating. The amendment of the biofuel distribution obligation (Act on Promoting Use of Biofuels in Transport) of 2011 increases the share of biofuels corresponding to the obligation (15% in 2018, advanced biofuels from non-food raw material being double counted). Finland joined the Methane to Market Partnership (afterwards Global

[1] Available at https://www.ieabioenergy.com/iea-publications/country-reports/2018-country-reports/

[2] https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans

Methane Initiative) in July 2008, seeking to expand its emissions reduction measures and to increase its cooperation with the private sector in areas such as the conversion of methane emissions into energy.

According to preliminary data by Statistics Finland, the share of renewable energy in the gross final energy consumption was over 40 % in 2017. The Finnish Government has employed funding of research and development projects, energy taxation, tax relief, production subsidies for electricity and forest chips and investment subsidies as financial measures to implement the energy policy. Generally, the Finnish financial incentives to utilize biomass in energy production are at a quite moderate level compared to some other EU countries that apply considerably stronger financial measures. In addition, the support system of bioenergy has been almost constant for several years. CO_2 tax for fossil fuels in heat production has increased in 2018 to EUR 62/ton CO_2, on a par with taxation of liquid fuels for transport. The CO_2 tax is halved for CHP-plants. Feed-in-premium for forest chips is EUR 18/MWh in 2018, depending on emission allowance costs and excise tax of peat fuel. When the emission allowance cost is over EUR 22.95/MWh with the current excise tax EUR 1.9 EUR for fuel peat the feed-in tariff will be set to zero.

A detailed description of all fiscal and non-fiscal supports for bioenergy development is available at.: http://www.iea.org/policiesandmeasures/renewableenergy/?country=Finland

TOTAL PRIMARY ENERGY SUPPLY (TPES) AND THE CONTRIBUTION OF BIOENERGY

The total primary energy supply of Finland in 2016 amounted to 1,424 pet joule (PJ). Fossil energy represents less than half of the Finnish TPES. Oil products account for one quarter (364 PJ), coal products account for less than 10% (133 PJ) and natural gas for 6% (86 PJ) and. Peat and peat products hold a share of 4% (56 PJ) and non-renewable waste 0.8% (11 PJ). The statistic also features 17.8% or 253 PJ of nuclear energy in nuclear power stations (which represent one third of national electricity production). Renewable energy sources have a share of 31.2% or 444 PJ – 26.4% bioenergy and 4.8% other renewable energy sources. 68 PJ of electricity is imported, which represents 23% of electricity consumption in Finland and 4.8% of Finnish TPES.

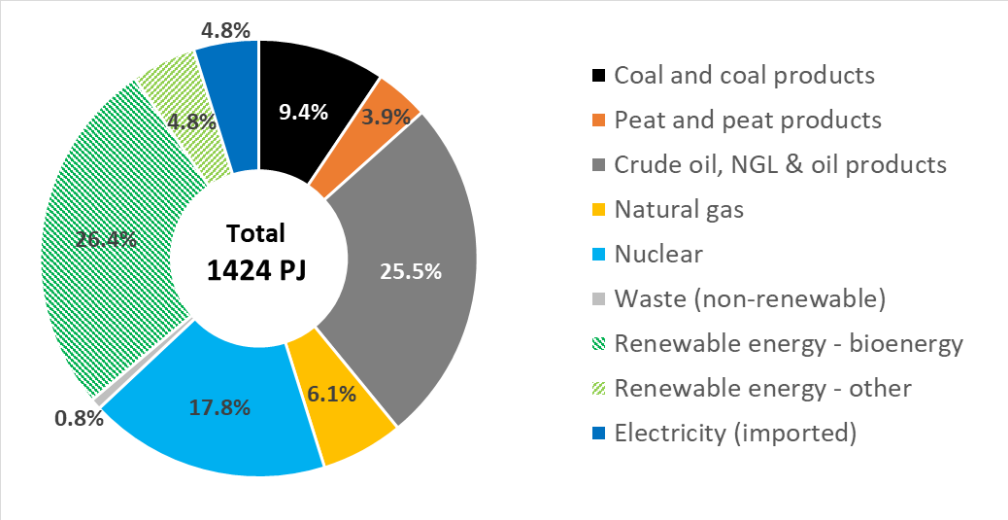

Figure 1: Total primary energy supply[3] in Finland in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Compared to 5 year earlier (2011) the share of coal has gone down from 11.2% to 9.4%, the share of peat from 5.8% to 3.9% and the share of natural gas from 9.5% to 6.1%. In the same period the share

[3] TPES underestimates the actual role of pure electricity sources like PV, wind or hydro energy, and overestimates the role of resources producing electricity with a high share of unused waste heat (like nuclear).

of renewable energy increased from 26.0% to 31.2%, with increases both in bioenergy and other renewable energy. The share of oil products, and nuclear energy remained relatively stable.

The total primary energy supply of renewable energy sources in 2016 is mostly (85%) covered by bioenergy, with 376 PJ. Hydropower amounts for 57 PJ and wind energy for 11 PJ. The role of solar energy is not significant.

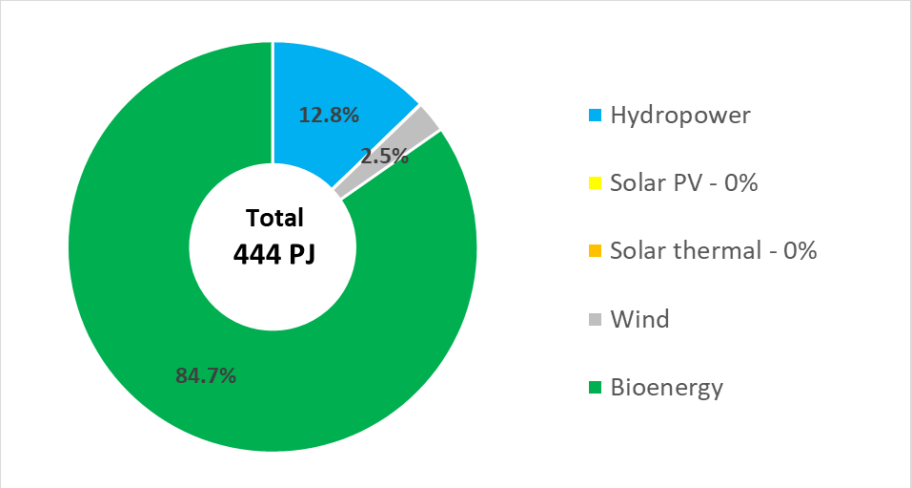

Figure 2: Total primary energy supply of Renewable Energy Sources in Finland in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Bioenergy in Finland is almost exclusively from solid biomass (349 PJ), mostly in forest based industries (chips, bark, sawdust) and pulp and paper industries (black liquor), where it is used for the production of electricity and process heat. Around 54 PJ solid biomass is used in the residential sector. The next item is renewable MSW (12.9 PJ), followed by liquid biofuels (9.8 PJ) and biogas (4.6 PJ).

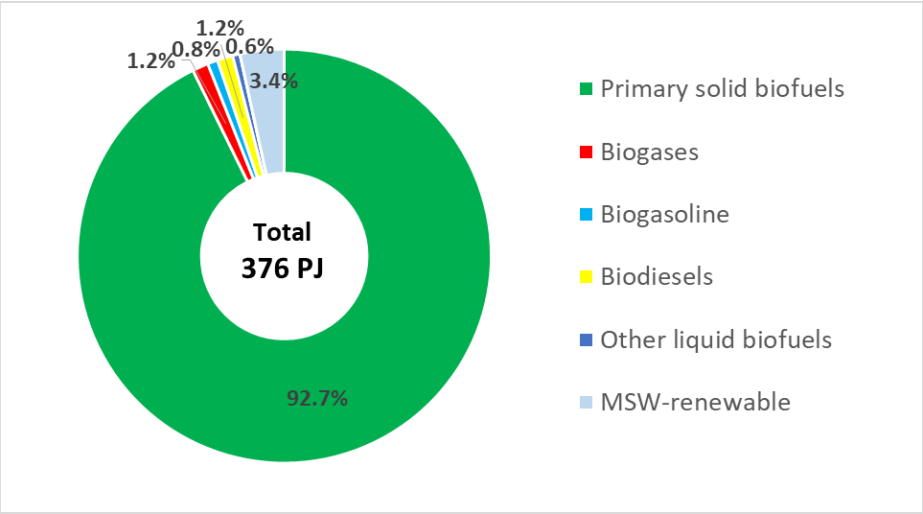

Figure 3: Total primary energy supply from bioenergy in Finland in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Bioenergy consumption in Finland increased steadily from 1990 to 2014, when its share in Finnish TPES went from a share of 16% to 26%, and more or less stabilized in 2014-2016. In 1990 bioenergy merely came from solid (forest) biomass and accounted for 191 PJ. From 2010 the use of solid biomass stabilized between 320 and 350 PJ. Liquid biofuels were introduced between 2005 and 2010 up to a level of 11 PJ; from 2013 to 2014 there was a step increase of liquid biofuels to 24 PJ. In 2016 consumption of liquid biofuels dropped temporarily to 10 PJ, due to the flexibility mechanism set in the biofuel quota act that allows fuel suppliers to blend less than required in case of oversupply in the previous year. First figures indicate that liquid biofuel supply increased again to 18 PJ in 2017. There is also a steady increase of the use of renewable MSW for energy and biogas.

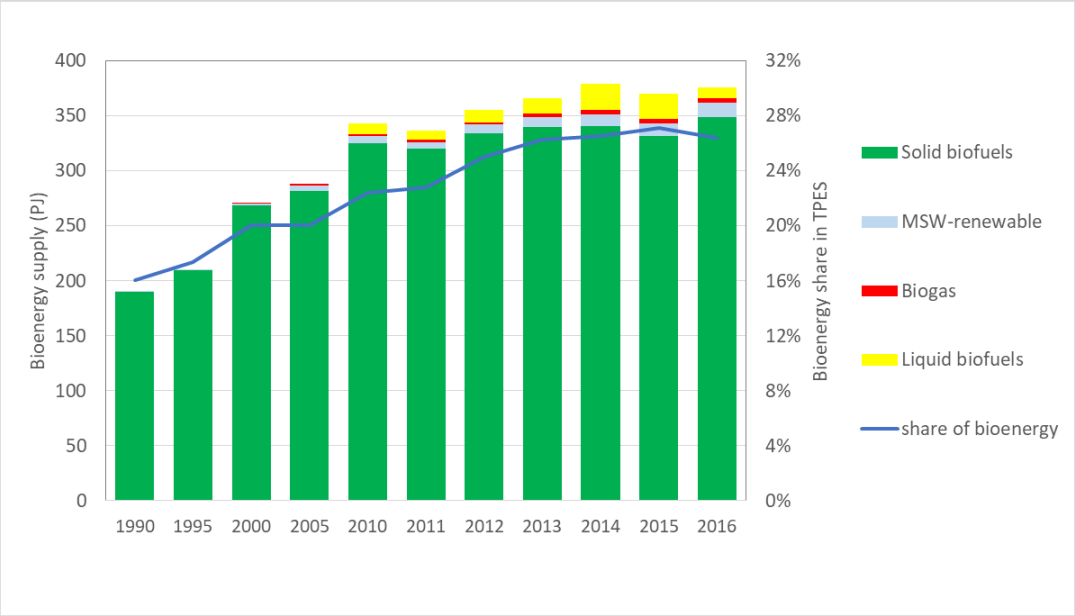

Figure 4: Development of total primary energy supply from bioenergy in Finland 1990 – 2016 (Source: World Energy Balances © OECD/IEA 2018)

Table 2 expresses the 2016 TPES figures per capita, considering Finland's population of 5.5 million people. Compared to the other 22 member countries of IEA Bioenergy (expressed per capita), Finland ranks highest for solid biofuels, in the top 5 renewable MSW, and in the top 10 for biogas and liquid biofuels.

***Table 2**: Total primary energy supply per capita in 2016*

	GJ/capita
Total energy	259.0
Bioenergy	68.4
Solid biofuels	63.4
Renewable MSW	2.4
Biogas	0.9
Liquid biofuels	1.8 (4.1 in 2015)

Source: World Energy Balances © OECD/IEA 2018

Role of bioenergy in different sectors

Finland has a relatively high share of renewable electricity, half of it related to hydropower, and a third through electricity from biomass.

The share of biofuels for transport amounted more than 10% in 2015, which is much higher than European average, but dropped to 4% in 2016 (these values are without multiple counting as foreseen in the Renewable Energy Directive). It is expected that this will recover in 2017.

Overall, the direct share of biomass for heating in the different sectors is around 40%. Heat output generated and sold by CHP plants and heat plants represents around 32% of fuel/heat provided, of which on average 41% is produced from biomass.

Table 3: *Role of bioenergy and renewable energy in electricity production, transport energy consumption and fuel/heat consumption in 2016*

Sector	Share of bioenergy	Share of renewable energy	Overall production/ consumption
Electricity production	16.8%	44.2% *(23% hydro)*	68.8 TWh (248 PJ)
Transport energy (final consumption)*	4.1% (12.0% in 2015)	4.7%	181 PJ
Overall fuel and heat consumption[4] *	Direct biomass: 41.1% Biobased heat: 13.2%	54.5%	527 PJ

Source: World Energy Balances © OECD/IEA 2018

According to Eurostat[5], the following renewable energy shares in gross final energy consumption were reached in Finland in 2016:

- Overall share: 38.7%
- In heating and cooling: 53.7%
- In electricity: 32.9%
- In transport: 8.4% (22.0% in 2015)

Most sectors have reached or are very close to reaching the renewable energy targets for 2020 (see Table 1). Mind that some of these figures can differ from the IEA derived data because of different accounting rules. This is particularly the case for transport biofuels, e.g. where cellulose or residue based biofuels are double-counted towards the target.

[4] This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.

[5] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_335a&lang=en

Biomass fuels import and export

Similarly to raw wood, a part of imported and exported forest products, food, and fodder streams ends up as energy. Determining to what extent a country's bioenergy production is based on these products is troublesome, and they were thus excluded from this study. The study covers all remaining biomass streams, which can be categorized as follows:

- Biomass fuels (products traded for energy production, such as fuel ethanol, wood pellets, and firewood)
- Raw materials that are traded for the manufacture of biomass fuels (e.g. sawdust and pulpwood used in pellet production or pre-processed biomass that is used in the production of transport biofuels)
- Raw wood (wood matter used in the manufacture of forest products)

First, cross-border biomass streams were considered in view of foreign-trade statistics. The information was obtained from the Trade Map and UN Comtrade databases, which can be accessed freely over the Internet (Trade Map, UN Comtrade Database). The product groups selected in the investigation and their Combined Nomenclature (CN) codes are presented in Table 4.

Table 4: *The CN codes of the products included in the investigation.*

Product	CN code(s)
Round wood	44032031, 44032039,44032011, 44032019, 44032091, 44032099, 44039951, 44039959, 44034100 … 44039910 and 44039995
Chips	44012100, 44012200
Sawdust from wood	44013010
Wood waste and scrap[a]	44013090 (44013080 since 2009)
Fuel wood (firewood)	44011000
Wood pellets	44013020 (since 2009)
Tall oil	38030010, 38030090, 38070090
Peat	27030000
Ethanol	22071000, 22072000
MTBE, ETBE	29091900 (since 2008; 29091910)
Palm Oil	15111010

[a] *Including solid wood processing industry by-products and residues (and wood pellets until 2008)*

Information on the volumes of import and export streams from the Foreign Trade Statistics and the wood streams determined for the forest industry provided a starting point for evaluating the energy balance of international biomass fuels trade. The export and import balances of biomass fuels determined for 2004–2016 are presented in Figure 5. In Finland, the direct import and export of biomass fuels, being mainly composed of wood pellets and tall oil, have a minor importance compared to the total consumption of biomass fuels. The development of direct import of biomass fuels in Finland is presented in Figure 6. Especially, the import of palm oil for biodiesel manufacturing increased a decade ago, but past years its imports have decreased slightly. The largest biomass fuels streams are composed of raw wood. The indirect import volumes of wood fuels has been quite stable past years.

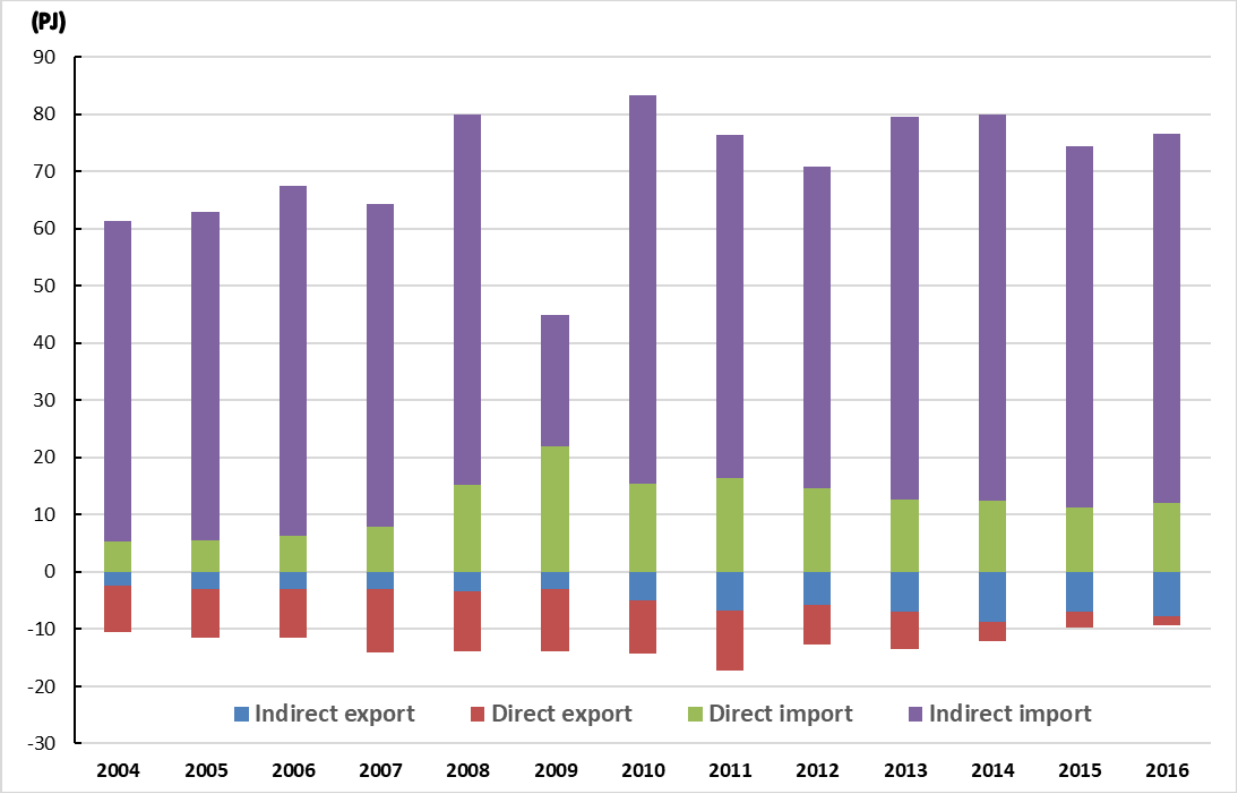

Figure 5: Import and export balance of biomass fuels in Finland in 2004–2016.

The total calorific values were calculated based on the state of the streams across the border. The positive figures illustrate import and negative figures export.

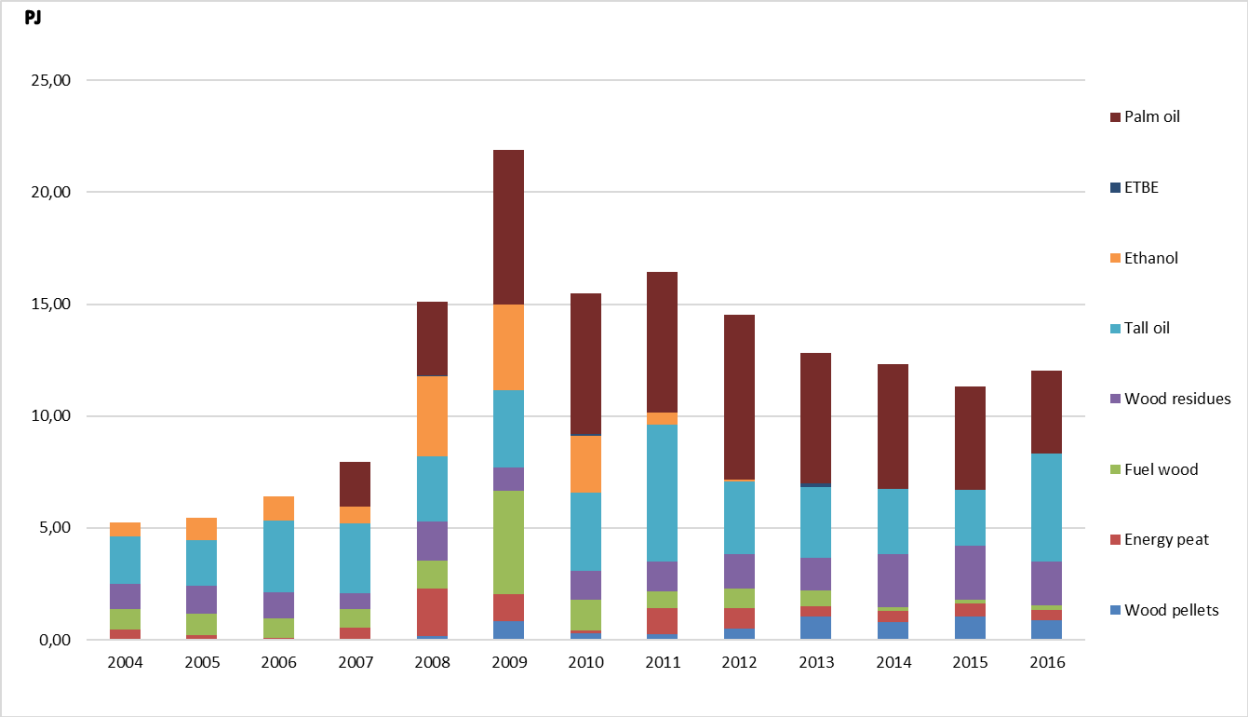

Figure 6: Direct import of biomass fuels in Finland in 2004–2016.

The total calorific values were calculated based on the state of the streams across the border.

The origin of imported palm oil to Finland is currently classified, but earlier most of the palm oil was imported from Indonesia by ships. Already now as well as in the future, use of palm oil in biodiesel production should decrease and it will be replaced by other vegetable oils. Tall oil is currently imported mainly from other Northern European countries. Import volumes of tall oil have increased after biodiesel production from domestic crude tall oil started in 2014 in Lappeenranta. Solid wood fuels and raw wood are imported mainly by trucks and trains mostly from Russia and Baltic States. In the future, import of raw wood, solid by-products and energy wood should increase when new large-scale users located on coastal areas are fully operational and commercialise, e.g. Helsinki and Naantali. According to Finnish national energy strategy, future self-sufficiency in energy production will be improved and dependency on some imported fuels and raw materials should be decreased, e.g. palm oil and wood pellets.

RESEARCH FOCUS RELATED TO BIOENERGY

The objective of the Finnish Bioeconomy Strategy (published in 2014) is to generate new economic growth and new jobs from an increase in the bioeconomy business and from high added value products and services while securing the operating conditions for the nature's ecosystems. The leading idea of the strategy is that competitive and sustainable bioeconomy solutions for global problems will be created in Finland, and that new business will be generated both in the Finnish and international market, boosting the welfare of the whole of Finland. Bioeconomy refers to an economy that relies on renewable natural resources to produce food, energy, products and services. The Bioeconomy Strategy aims to reduce Finland's dependence on fossil natural resources, prevent biodiversity loss and create new economic growth and jobs in line with the principles of sustainable development. The objective of the strategy is to increase Finland's bioeconomy output up to EUR 100 billion by 2025 and to create 100,000 new jobs. The Bioeconomy Strategy promotes bioenergy by encouraging higher exploitation of sustainably available forest biomass by forest industries and by advancing innovations in cleantech and circular economy.

The Government's strategy to promote cleantech business in Finland has four focus areas for spurring renewal and growth in the Finnish business and industry: bioeconomy, cleantech, digitalization and the health sector. Cleantech refers to products, services and processes that promote the sustainable use of natural resources while reducing emissions. The goal of the government's cleantech strategy is to accelerate growth in Finnish cleantech business and to renew the traditional industry through innovations in clean technology. The vision is that in 2025 Finland will be a one of the global leaders in bio- and circular economy and in the cleantech business. Achieving the vision requires maintaining cooperation between administrations. (Alakangas 2016)

RECENT MAJOR BIOENERGY DEVELOPMENTS

Usually every Finnish government issues an energy and climate strategy. The aim in the newest 2016 National Energy and Climate Strategy until 2030 is to eventually reach the targets adopted by the EU for 2030 and enable achieving 80 to 95% greenhouse gas emission reductions by 2050. The share of renewable energy in the final consumption will be increased in a sustainable way in the 2020s to over 50%, the use of imported oil for domestic purposes will be halved and the energy self-sufficiency increased to over 55%. Simultaneously, Finland will largely phase out the use of coal for energy, which represented a share of 9% of the TPES in 2016. 23% of Finland's TPES came from oil in 2016. The government has decided that the use of coal in energy production will be banned by law in 2029. In addition, an incentive package of EUR 90 million is being prepared for urban district heating companies who are committed to abandoning the coal already in 2025.

The intended biomass for the production of heat and electricity are forest residues and side streams

from forest industries. The competitiveness of these fuels is ensured by taxing the use of fossil fuels (including peat). Production of electricity from forest biomass will be subsidised by current feed-in tariffs until emission allowance costs favour their competitiveness over fossil fuel alternatives.

The greatest non-ETS sector emission reductions will be reached in the transport sector, where the share of transport biofuels will be increased to 30%. Also, an obligation to blend light fuel oil used in machinery and heating with 10% bioliquids will be introduced. In addition to the increase in the production and use of domestic biofuels for transport, electrification of the fleet is pursued. The strategy sets a minimum aim of 250,000 electric vehicles on the roads. Moreover, 50,000 gas-powered vehicles should be introduced to the fleet, while biogas production is promoted by subsidies and by streamlining regulations. These numbers suggest fast transformation of the Finnish road transport fleet.

Reaching the goals requires investing billions in production as well as efforts from both companies and the state. The Finnish Government aims to start pilot, demonstration and reference institutions and projects for new energy technology as cost-effectively as possible.

Technology neutral tendering processes will be organised in 2018−2020. Aid will be granted to cost-effective new electricity production from renewable energy. Support will be strongly directed towards the energy solutions of the future, and that is why the amount of electricity produced is not the only basis in distributing funds – the choice is based on a comprehensive view. In addition to the development of technology, export possibilities as well as employment effects of the projects in various areas in Finland will be taken into account. (Alakangas 2016)

In case of Finland, forest industry has been an important driver to establish CHP units, which utilize side streams of forestry and low quality wood with no competing uses to produce heat and power required in pulp and paper production as well as providing heat to communities locating in vicinity. Combined with adequate technology, a CHP plant can also be designed to include for instance fast pyrolysis bio-oil production (e.g. Fortum CHP plant in Joensuu, Finland).

Kaidi Finland, a subsidiary of the Chinese Sunshine Kaidi New Energy Group is currently studying prospects to build a biorefinery in Northern Finland using energy wood and residues. The new Renewable Energy Directive (REDII) set new requirements to the allowed raw materials for sustainable biofuels, where risk-based approach was approved. This provides the possibility to look at the already-existing national regulations for forest management, which was an important decision for possible biorefinery investors as Kaidi. UPM is among the companies who have researched the use of pine oil for feedstock of bio-based diesel and commercialised their own proprietary biofuel technologies in recent years. UPM biorefinery locating next to the UPM Kaukas pulp and paper mill has produced renewable wood-based diesel and naphtha since 2015. UPM is also studying biofuels development opportunities by starting an environmental impact assessment (EIA) for a possible biorefinery in Kotka, in south-eastern Finland. The Kotka Biorefinery would produce approximately 500,000 tonnes of advanced biofuels for transportation, made from several renewable and sustainable feedstocks. There are also prospects to make liquid biofuels (ethanol) from sawdust and/or lignin; for example, Finnish St1 biofuels Oy is currently running a plant that produces 10 million litres ethanol per year from residue sawdust in Kajaani and the next 50-million litre investments are planned in Pietarsaari.

LINKS TO SOURCES OF INFORMATION

http://www.biofuelstp.eu/country/progress-reports/Article_22_Finland_en.pdf

Alakangas, E. 2016. National policy landscape, Finland, Biomass Policies project. www.biomasspolicies.eu (see Finland)

The Ministry of Economic Affairs and Employment (MEAE). 2016 National Energy and Climate strategy until 2030. http://urn.fi/URN:ISBN:978-952-327-190-6

Trade Map. List of importers and exporters for the selected product.. International Trade Centre. [Accessed 9 September 2018]. Available at: https://trademap.org/tradestat/Country_SelProductCountry_TS.aspx

UN Comtrade Database. United Nations. [Accessed 9 September 2018]. Available at: https://comtrade.un.org/data/