Comparing the Energy Efficiency in Belgium and Finland

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ABSTRACT

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ABSTRACT

The purpose of this thesis is to compare Belgium and Finland on energy efficiency. Before comparing these two countries I will talk about the European view on energy efficiency. The European view is the basic view for countries from the European Union (EU). The goals for the EU are described in their different energy projects. They have a project for 2020, this project contains three big objectives for energy. These objectives must be met by all the countries from the EU. Each country can choose how they want to participate and they can set their own goals.

Next I will explain the view and goals from Belgium. I will also explain which tolerances they have set to meet their own goals. These tolerances can be split up in different values. The most important one being the E-value. This value is the one needed to make energy certificates. These energy certificates help the people to build, buy and rent more responsibly. After the tolerances I will talk about the way Belgium gets its energy. This can be from a non-renewable source or from a renewable source.

The view of Finland is explained in the following part. I will explain the same tolerances but from Finland's point of view. Finland has a slightly different view on most tolerances but the energy certificate is almost identical. After the tolerances I will talk about the way Finland looks at energy production. Finland thinks differently than Belgium about renewable energy sources, they put more effort into getting more renewable energy.

The comparison and the conclusion is that Finland is better than Belgium in almost every energy efficient aspect looked at in the thesis. Belgium is a lot behind on the renewable energy aspect but with the building of nearly zero emission buildings (nZEB) Belgium is not so far behind.

Keywords Energy efficiency, E-value, renewable energy.

Pages 20 pages

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1 INTRODUCTION

We are living in a world where global warming is a fact and our fossil fuels are running low. This global warming effect is due to the many greenhouse gasses we keep producing. The biggest one is CO_2 gas. If you look at the graphic of the world CO_2 emissions below you can see it keeps going up. If we want to reduce the effect of global warming this needs to be reduced. This is a really big challenge for the world and every country needs to work hard on this.

The reduction of energy usage is not the only solution. We need to keep looking for alternative sources to get our energy and if we still need to use non-renewable energy we must make it as efficiently as possible.

The way each country looks at energy efficiency is different. I will compare the way Belgium and Finland take on these challenges to make their country more energy efficient. Even though Belgium and Finland both are part of the EU they still look differently at the goals set by the EU.

(Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, 2013)

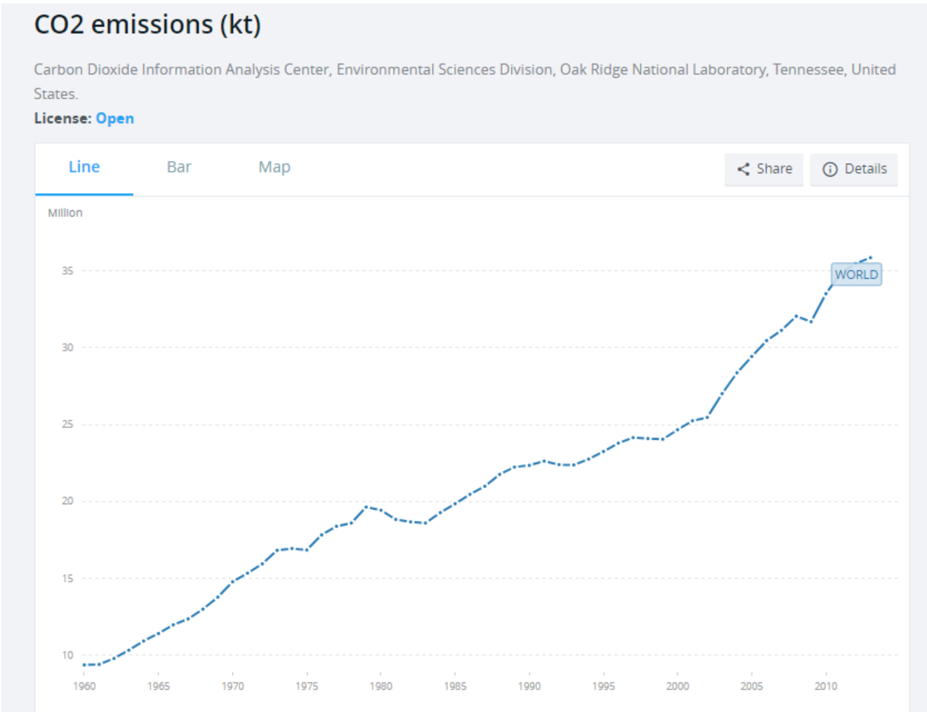

Figure 1. Graphic of CO_2 emissions in the world

2 EUROPE

2.1 General

The European Union's energy policies are driven by three main objectives:

We want secure energy supplies to ensure reliable provision of energy whenever and wherever it is needed.

We want to ensure that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses and industries.

We want our energy consumption to be sustainable, through the lowering of greenhouse gas emissions, pollution and fossil fuel dependence.

These objectives are important for Europe because now Europe is importing half of its energy from outside of Europe to a cost of €350 billion a year. This money can be better invested in our own alternative energy sources. The price is not the only argument. We have to think about the environment. Now we are still using a lot of fossil fuels to make energy for us. This contributes to a higher level of CO_2 which is a greenhouse gas and contributes to the global warming process.

The goals of the European Union vary from each other. First of all the EU wants to make an energy union. In Paris the EU agreed that it will reduce its emissions by at least 40%. This is a big challenge and at the same time a big opportunity to create jobs and new technologies. The effect must be seen in each household by cheaper and more accessible energy.

Another goal is to make a big energy market. This will be a benefit to every country in the EU. If a country has too much energy they can transport it to a country that is struggling at that time. The cities in Europe will become producers of domestic energy. This is possible thanks to new techniques for alternative energy. In the city people can build a house with solar panel roof tiles.

(European Union, 2017)

2.2 **Energy Strategy**

To pursue these goals within a coherent long-term strategy, the EU has formulated targets for 2020, 2030, and 2050.

2.2.1 2020 Energy Strategy

By 2020, the EU aims to reduce its greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption and achieve energy savings of 20% or more. All EU countries must also achieve a 10% share of renewable energy in their transportation sector.

To meet these difficult targets the EU has five topics to focus on:

The EU wants to make Europe more energy efficient by investing in efficient buildings, products and transport.
This includes measures such as energy labelling schemes, renovation of public buildings and eco-design requirements for energy intensive products.

They want to construct a pan-European energy market by building the necessary transmission lines, pipelines, LNG (Liquid Natural Gas) terminals and other infrastructure.

The EU wants to protect the rights of the consumers. They want to allow consumers to easily switch energy suppliers and check their energy consumption.

The implementation of the Strategic Energy Technology Plan which is the EU's strategy to accelerate the development and deployment of low carbon technologies such as solar power, smart grids and carbon capture and storage.
The EU is working on good relations with external suppliers of energy and energy transit countries. Through the Energy Community, the EU also works to integrate neighbouring countries into its internal energy market.

(European Union, 2017)

(European Union, 2017)

(European Union, 2017)

2.2.2 2030 Energy Strategy

In the Paris agreement (Climate summit organised by United Nations Organisation – UNO) of 2015 195 countries from all over the world agreed to limit the global warming by maximum 2 degrees. To meet this goal each country has to come up with a plan to reduce its emissions. The different strategies are transparent for every country.

The EU has set a goal for itself. The EU will reduce its emissions by 40% in comparing to 1990. The renewable energy share must be at least 27% in the European Union. The energy efficiency must be at least 27% by 2020 and will be reviewed to 30% in 2030. In Europe there must be The target level of cross- bother infrastructures in the European energy market is set at 15% by 2030.

(European Union, 2017)

2.2.3 2050 Energy Strategy

In 2050 the EU wants a reduction of all the greenhouse gas emissions by 80%-95% in comparison with 1990. To reach this difficult goal the EU has to continue working hard on its energy solutions.

2.3 **Buildings**

Buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU. While new buildings generally need fewer than three to five litres of heating oil per square meter per year, older buildings consume about 25 litres on average. Some buildings even require up to 60 litres.

Currently, about 35% of the EU's buildings are over 50 years old. By improving the energy efficiency of buildings, we could reduce total EU energy consumption by 5-6% and lower CO_2 emissions by about 5%.

To succeed in these topics the EU has set two directives: one is the Energy Performance of Buildings Directive and the second one is the Energy Efficiency Directive. Both directives have influence on the construction of buildings and houses in the countries of the EU. Each country can choose how they want to implement these directives in their own building laws.

The first directive is the Energy Performance of Buildings Directive. This directive talks about different subjects in the building.

An energy performance certificate must be included in all advertisements for the sale or rental of buildings.

The European union member states must establish inspection schemes for heating and air conditioning systems or put in place measures with equivalent effect.
All new buildings must be nearly zero energy buildings by 31 December 2020.
EU countries must set minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements.
EU countries have to draw up lists of national financial measures to improve the energy efficiency of buildings.

The second directive is the Energy Efficiency Directive. This directive sums up the guidelines for the energy efficiencies in the European countries.
The first two guidelines are for the government. They must make energy efficient renovations to at least 3% of buildings owned and occupied by the government and they should only purchase buildings which are highly energy efficient.
For other houses the government must draw-up a long-term national building renovation strategy which can be included in their National Energy Efficiency Action Plans.

(European Union, 2017)

2.4 **BUILD UP Skills**

The BUILD UP Skills is a European project to improve the knowledge of the people in the building sector. The aim of this project is to improve the quality of the buildings in Europe. The workers over the whole of Europe should have the same knowledge about building. This is important because in 2020 all new buildings should be nZEB buildings. This type of buildings require a lot of specific knowledge.

The project is split up in two big parts. The first part is the initiative to make big projects where they implement the current knowledge and make lessons and guidelines for all of the workers. These guidelines should become a base for future projects. There are 22 projects like this in the EU.
The second part is the use of these lessons and guidelines to teach every employee and worker on the construction site.
To share the knowledge and set up projects the EU hold exchange meetings.

The BUILD UP Skills initiative helps to train craftsmen, on-site construction workers and system installers in the building sector. Its aim is to increase the number of qualified workers across Europe who are able to undertake energy efficient building renovations and help to construct nearly zero energy buildings.

BUILD UP Portal
The BUILD UP Portal brings European experts together to discuss energy reduction in buildings. The aim is to share information and best practices.

(Intelligent Energy Europe (IEE) programme, 2017)

(Intelligent Energy Europe (IEE) programme, 2017)

3 BELGIUM

3.1 General

In Belgium we divided the implementation of the demands from Europe over different governments as energy is a local competence. Each government of Belgium has to decide what values they are going to use and what they are going to focus on. EPBD = Energy Performance of Building Directive. The EPBD in Belgium was first implemented in the region of Flanders in 2006. In the rest of Belgium it came two years later.
The general idea behind the EPBD is the Trias Energetica.

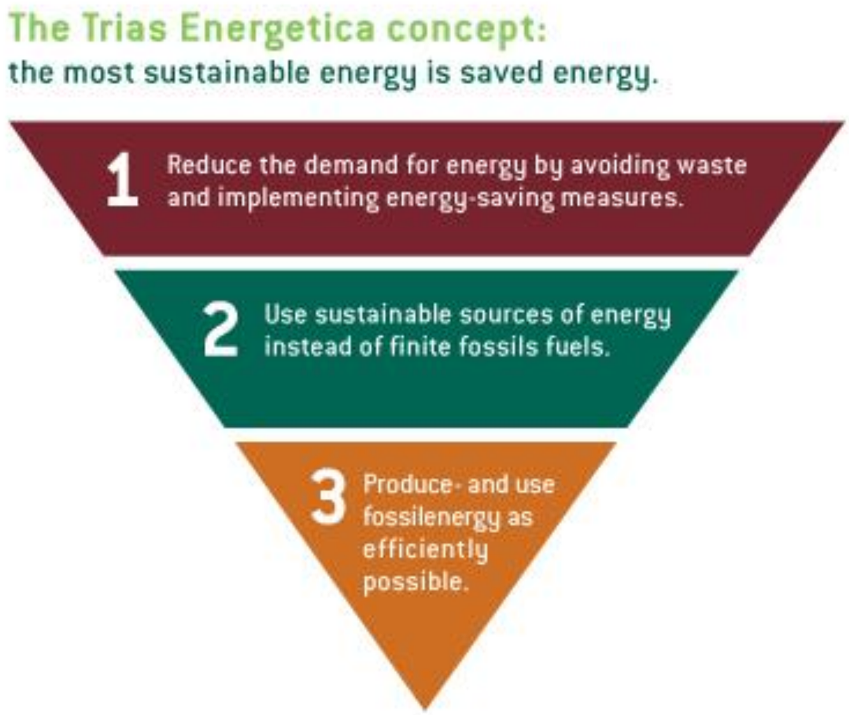

Figure 2. Trias Energetica

The Trias Energetica is a triangle graph to determine which investment is more important and interesting to make.

The best possible effort you can make is to reduce the energy needed by saving energy and building more energy efficient buildings. You can do so by insulating better and more. You can never insulate too much as long as you take care of the airproofing and the ventilation of the building.

(Eurima, 2011)

3.2 **Tolerances in Belgium**

In Flanders you need a building permit or a notification for all buildings and you have to respect several tolerances for the energy efficiency. These tolerances depend on the different elements. The final use of the building is important, for example there are different tolerances for sport buildings and shops. The type of work is also different, with a completely new building you need better results on energy efficiency than with the renovation of buildings. The last factor that influences the tolerances is the year in which you need the building permit. Because each year the tolerances are getting better and stricter.
After 2021 we will try to build all buildings according to the nZEB principal.

3.2.1 E-value

The E-value is a score that points out how much energy a building consumes. The lower the E-value, the less energy it consumes. The E-value is mandatory for every newly built house after 2006. Since 2015 it is also mandatory for renovations.
The E-value has had different values over time. It has changed every two years. It started in 2006-2009 with an E-value from E100, now in 2017 the E-value for new buildings must be lower than E50. This trend will continue until 2021 when every new building must be E30 which is an nZEB building. When you carry out a big renovation after 2015 you need to have at least an E-value of E90. The calculation of the E-value is done by a certified person. With a special program designed by the government.
And as you know

(Vlaanderen, 2017)

3.2.2 U-value

The U-value is used to measure the heat transfer through building structures. This value is expressed in W/m^2K. In Belgium the U-values are regulated. The lower the U-value, the better the structure is insulated.
The maximum U-values in Belgium for buildings after 2016 cannot be higher than 1, 5 W/m^2K for transparent surfaces. For roofs, walls with or without ground contact and floors in contact with the exterior, the

maximum U- value is 0, 24 W/m²K. The maximum U-value is 2 W/m²K in doors and garage gates. The maximum U-value for walls in between apartments is regulated to 1 W/m²K. If you renovate your exterior walls the U-value cannot be higher than 0, 24 W/m²K.

(Vlaanderen, 2017)

3.2.3 K-Value

In Belgium there exists a special value to determine the heat losses from the complete house. This value is called the K-value. The K-value is the average heat losses over the whole exterior surface of the house. This value is regulated to K40 in 2017.

(Vlaanderen, 2017)

3.2.4 EPB-controller

In Belgium a new profession is growing. The energy controller. It's his job to calculate the E-value of a house with the help of the plans and his notes. He always goes to visit the building he is calculating. When the controller is there he checks everything there is to check. He goes around and controls the heating system. He checks all the rooms on fouls. The control is done with the help of the government's own EPB-program.
The result of his research is noted in the energy certificate.

3.2.5 EPB-program

In Belgium we use a special program to calculate the E-value of a building. This program is called EPB. The program is used by EPB controllers. In the program you have to put in a lot of information about the building. You have to input the structures of the exterior walls, the roof and all the windows. In the program there is also a space to put the technical information about the heating and ventilation. If you have some alternative energy sources in the building you can also add them to the file. Once you inputted all this information you get a result. The result tells you how well the building preforms on energy efficiencies.

3.3 **Energy**

More of Belgium's energy comes from petroleum products and nuclear power and less from coal and other solid fuels than in other EU countries on average. Belgium also imports all its gas and thanks to its strategic position in the heart of North Western Europe it is a significant gas transit country: a number of gas pipelines interconnect within its borders. The

Belgium port of Zeebrugge is the site of a liquid natural gas (LNG) terminal from which supplies of LNG are transported to neighbouring countries.

(European Union, 2017)

3.3.1 Classic Energy

Most of the energy of Belgium comes from a non-renewable source. We depend for the biggest part of our energy on the imported fossil fuels. In 2015 75, 6% of the energy came from fossil fuels and 8, 7% came from nuclear energy. In Belgium we have 7 nuclear reactors that supply us with energy. Recently the Belgium government signed a new contract to keep the nuclear reactors open longer, despite of all the commotion about the little fractures in the reactor. Due to these fractures four reactors are currently under revision. The use of nuclear energy used to be more than 28% in 2014.

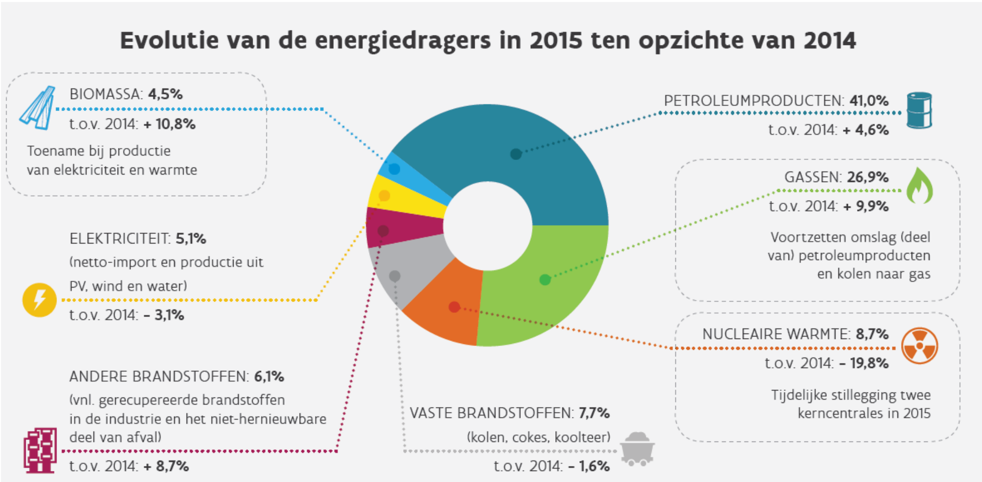

Figure 3. Graphic of energy consumption by energy source in Belgium

(Vlaanderen, 2017)

3.3.2 Alternative Energy

In 2014 the share of renewable energy was around 8%. We set the goal for our 2020 project to 13% of renewable energy. This is less than the goal from the entire EU. They want to have 20% renewable energy in total in the EU.

Wind Energy

To search for a sustainable alternative energy solution you have to look at everything that is available in your surroundings. In Belgium we have a lot of wind in the North Sea so we will build a big wind turbine park on the

Thornton bank, this is a sandbank close to the coast. The project is called C-Power and is an offshore wind farm.
The total capacity of the wind farm is 325, 20 MW, the 54 wind turbines generates about 1.050.000.000 kWh per year, enough to provide 300.000 families with renewable energy. The projects on its own represents already 7% of the Belgium's renewable energy target by 2020.
This will result in a reduction of C02 emissions equivalent to 415.000 tons per year.

(C-Power, 2017)

Wave Energy
In Ostend in Belgium the LAMWEC project is currently developing a new kind of renewable energy. They are using waves to power a generator to make energy. The goal is to develop and test a 200kW Laminaria wave energy converter. After the testing faze the project might be used on a big scale in the North Sea.
The system uses the horizontally traveling of the water as result of the tide to power the generator. The system is tied to the bottom of the sea and consists of two parts. The top part can move with the waves and this movement powers the generator inside. The bottom part of the system remains steady. To resist storms the system can be lowered to the bottom of the sea so it doesn't move so much and will not take damage from the big storm waves.

(Laminaria, 2017)

4 FINLAND

4.1 General

The Finnish view on land use and energy

Land use and building planning create the preconditions for a high-quality and vital built environment. Well-planned land use and building solutions promote well-being, vitality and sustainable development.
Land use and building are regulated by legislation and steered by the authorities. The objective of such steering is to create a healthy, safe and pleasant living environment which is socially functional and meets the needs of different population groups. Also to ensure the high quality and energy efficiency of construction to make the urban structure more cohesive and compact, while promoting sustainable development. And guarantee that everyone has the opportunity to participate in land use and building planning.

The key commitments of the European Union climate and energy policy are to reduce greenhouse gas emissions by 20%, to increase the share of renewable energy sources to 20% of final energy consumption and as a normative commitment, to improve energy performance by 20% by 2020.

In order to meet these commitments Finland must achieve a notable increase in the use of renewable energy sources and a significant improvement in both energy saving and energy consumption.
The renewable energy target set for Finland is 38%; in 2005, the share of renewable energy was 28.5%. This target requires that the use of renewables must be increased by 38 TWh.
In 2008 the strategic objective set by the Finnish Government in the national climate and energy strategy entailed halting and reversing the growth in final energy consumption so that in 2020, final energy consumption will be approximately 310 TWh. In 2011 final consumption was 386 TWh.

Buildings account for about 40% of Finland's total energy consumption. It is therefore interesting to make buildings more energy efficient. This is done in Finland by the energy certificate you need to build, sell or rent a house.

(Ministry of the Environment, 2013)

(Ministry of the Environment Finland, 2017)

4.2 Tolerances

In Finland when you want to apply for a building permit you also need to have an energy performance certificate. This certificate was first implicated for houses built after 2008. After 2009 all the existing buildings needed the certificate when sold or rented.
The certificate is valid for 10 years and must be made by an authorised person. The energy performance certificate contains a label which indicates how energy efficient your building or house is. This is done on a scale from A to G, A being the most efficient and G being poor efficient. The label that the building will get at the end is based on the calculated value of the energy consumption per m^2 per year.

In 2018 every new built house must be built according to the nZEB principal. And in 2020 every public or governmental building must be built in nZEB.

4.2.1 U-value

In Finland the maximum U-value is regulated by the Finnish building code. The part about the energy performance is called D3 and was changed several times. These changes were necessary to satisfy the tolerances of the EU.
The maximum U-value now for an external wall in Finland is 0, 17 W/m²K. For a roof or floor against the outdoor air the max U-value is 0, 09 W/m²K. For the floor against a crawl space the U-value is 0, 17 W/m²K. For windows the max U-value is 1 W/m²K.

(Illikainen, 2015)

4.2.2 Surface area of windows

The surface area of the windows is limited in Finland. The percentage of window surfaces can't be higher than 15% of the floor area or more than 50% of the external wall area.

(Illikainen, 2015)

4.2.3 E-value

The E-value in Finland represents the overall energy consumption. It is mandatory for all new constructions. The E-value is needed for building permits and energy performance certificates.
In small residential buildings, the calculated energy consumption includes space and water heating, all electricity consumption and cooling energy. In large residential buildings, household electricity is not included in the energy consumption. The energy consumption of non-residential buildings includes heating, cooling energy, Heating, ventilation and air conditioning (HVAC)-electricity and built-in lighting.
To check the E-value of the construction a qualified person needs to do the calculations. This person has a permit and must go to the working area to check all the available data.

(Green Building Council Finland, 2016)

4.3 **Energy**

Finland is a Nordic country and has a harsh and cold climate. To live a comfortable life the Fins are obliged to use a lot of energy to heat their houses and their buildings. They can make their house as energy efficient as possible but they still need a lot of energy to heat up from -20°C. That is why the Fins are investing so much in renewable energy. The goal is to make 38% of all energy renewable in 2020. This goal is higher than the one from EU.

Finland is already doing well as you can see on the graph from OECD (Organisation for Economic Co-operation and Development). The renewable energy keeps getting higher. In 2015 the proportion of renewable energy was already 35% of all energy.

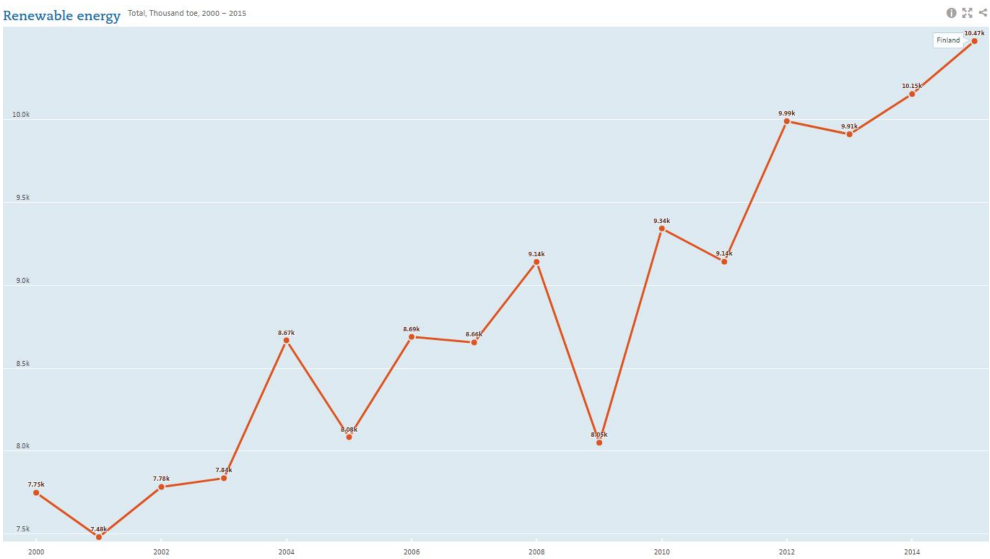

Figure 4. Graphic of renewable energy in Finland

(OECD, 2015)

(Statistics Finland, 2016)

4.3.1 Classic Energy

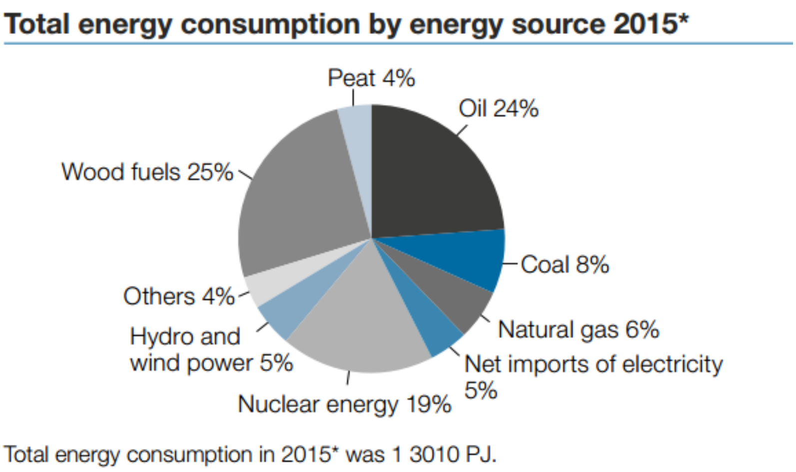

Figure 5. Graphic of energy consumption by energy source in Finland

Most of the energy from Finland still comes from non-renewable sources. The fossil fuels are most prominent to use for the energy demands of the Fins. These fossil fuels are not found in Finland so it imports all of the fossil fuels. Most imported fossil fuels come from Russia.
The nuclear power takes also care of a big part of the energy usage. There are four nuclear reactors in Finland in two power plants. Finland is building a fifth reactor which will open in 2025. When this reactor is ready, nuclear energy will take care of 60% of all electricity produced in Finland.
In Finland 4% of the energy comes from the burning of peat. This is considered the most harmful energy source in Finland.

(Statistics Finland, 2016)

4.3.2 Alternative Energy

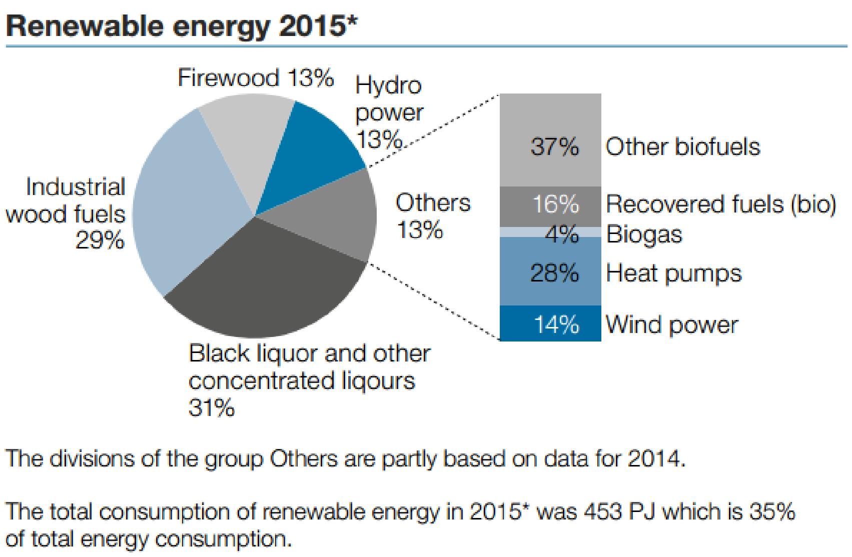

Figure 6. Graphic of renewable energy by energy source in Finland

In Finland there is a lot of forest and this means a lot of wood. The burning of wood is a big energy source for heating. Not only is the firewood used for energy. The waste of wood from multiple companies is used to burn in biomass centrals.
Finland is the home land of a big forestry and paper group called UPM, this company produces paper and pulp. When the company makes pulp there is a waste product called black liquor. This black liquor can be distilled and made into biodiesel but most of the black liquor gets burned for energy.
There are also a lot of hydro power plants which take care of 13% of the renewable energy.

(Statistics Finland, 2016)

5 COMPARISON

5.1 General

Both countries are part of the EU so they must follow the guidelines from the EU. For the 2020 goal of the greenhouse gas emissions of -20% from Europe, Finland set the goal only on -16% and Belgium even set the goal on -15%.
For the goal of 20% renewable energy of the total Finland set the goal a lot higher than Belgium. Finland will try to have 38% renewable energy by 2020, while Belgium will only try to go for 13%.

(European Union, 2013)

(European Union, 2016)

5.2 Tolerances

There are a lot different tolerances in Finland and Belgium in constructions. There are even values only used in Belgium or Finland. This is the case for the K-value in Belgium. In Finland they only have the U-value. In Finland there is a maximum value for the surface area of windows. In Belgium there is no maximum value.

5.2.1 E-value

The term E-value is only used in Finland and Belgium and not in any other country.
According to the EU legislation all the European countries must use an energy certificate if a house is being built, rented or sold. The value calculated there is measured in kWh/m²year. This value is called the E-value and is only known in Finland and Belgium.
The E-value is in both the countries calculated by a qualified person with a special permit. This person must go in both countries to the construction site. He checks all the fouls and data in the building and gives an energy certificate.
The energy certificate is in both countries the same because it's a European law.

The view on the nZEB in both countries is really different.
In Finland in 2018 every new house must be nZEB and in 2020 every new governmental building must be nZEB.
In Belgium in 2019 every new governmental building must nZEB and in 2021 every new house must be nZEB.

5.2.2 U-value

The U-values are different in the way that Finland always has a lower value which means it is more strict.
For windows in Belgium the U-value is 1, 5 W/m²K and in Finland 1 W/m²K. For an external wall the U-value in Belgium is 0, 24 W/m²K in Finland it is 0, 17 W/m²K. For the roof the U-value in Belgium is 0, 24 W/m²K and in Finland it is 0, 09 W/m²K. The U-value for a floor with underneath air and not ground the U-value in Belgium is 0, 24 W/m²K while in Finland the value is 0, 17 W/ m²K.
There is a really big difference in their U-values. Finland is way more strict than Belgium in the U-values.

	Finland	Belgium
U-value wall	0,17 W/m²K	0,24 W/m²K
U-value roof	0,09 W/m²K	0,24 W/m²K
U-value window	1,00 W/m²K	1,50 W/m²K

5.2.3 Programs

In Belgium there is a special program from the government to calculate the E-value, the K-value, all the U-values and renewable energy in buildings. In Finland this kind of program doesn’t exists. The people in Finland who calculate the E-value use different programs to calculate the U-value and E-value. They can use for example the site from laskentapalvelut and another tool they can use is the Autodesk program Revit.

5.3 **nZEB**

To make an nZEB in Belgium the focus is more on the on-site renewable energy sources. If you want an nZEB in Belgium you have to have at least one on-site renewable energy source such as solar panels or a heat pump. In Finland the focus is more on the U-values of the building. All the walls and roofs of nZEB buildings in Finland must be really good insulated.

5.3.1 Belgium case study "MASSEMEN"

Figure 7. Massemen nZEB Photo 1

Figure 8. Massemen nZEB Photo 2

Figure 9. Massemen nZEB Photo 3

This modern one-family house was built with a timber frame. The nZEB is mainly insulated with cellulose insulation. The space heating of the building is done by a gas condensation heater. For domestic warm water solar panels were used. There are also photovoltaic solar panels for electricity. There is a ventilation system with heat recovery. The complete house was built with bio, natural, ecological and healthy products.

E-value: E28
U-value roof and celling: 0, 17 W/m²K
U-value exterior walls: 0, 21 W/m²K
U-value floors: 0, 17 W/m²K
U-value windows: 0, 98 W/m²K
U-value glass: 0, 6 W/m²K
U-value doors and gates: 0, 98 W/m²K
K-value: K29
Energy demand: 36, 5 kWh/m²
Building year: 2014
Renewable energy sources: photovoltaic and heat solar panels

(Vlaamse confederatie bouw, 2017)

5.3.2 Finland case study “BLOK”

Figure 10. BLOK nZEB

The one-family nZEB house was designed in a competition. The winners of the competition were Tiina Antinoja and Olli Metso from Muuan Studio. The house was built in southern Finland. The most important factor for the design of the house was to minimize the energy demand for heating, cooling and electricity use. The main heating source is a ground source heat pump but there are also solar heat panels. In addition to the pump,

the building is equipped with a fire place capable to store some heat in its massive structures. The space heating is distributed with floor heating.
The structures were designed for high thermal resistance in the Finnish climate.

The efficiency of the heat recovery unit in the ventilation system is designed for 80% and the set point temperature for heat exchange surface freezing is −10°C, corresponding a yearly heat recovery efficiency rate of 76% for the ventilation system.
The calculated delivered energy is 8200 kWh yearly corresponding 53 kWh/-living-m². Roughly 60% of the energy is used for heating and ventilation. The cooling system was integrated in the ventilation system to cool the supplied air.

Air tightness: 0, 4 m³/m²h with 50 Pa
G-value glass: 0, 49
U-value Exterior wall: 0, 09 W/m²K
U-value Roof: 0, 06 W/m²K
U-value Base floor: 0, 09 W/m²K
U-value Window: 0, 75 W/m²K
U-value Door: 0,6-0,75 W/m²K
Energy demand: 53 kWh/m²
Building year: 2014
Renewable energy sources: photovoltaic and heat solar panels.

(Miimu Airaksinen, 2014)

5.4 **Energy**

In Belgium there is less usage of renewable energy. Even the goal Belgium has set for 2020 is not that high, only 15% while in Finland they are aiming for 38%. The energy in Belgium comes for the most part from fossil fuels while in Finland more of the energy comes from wood products.

5.4.1 Classic Energy

In both countries there is a lot of usage of fossil fuels. But in Belgium there is a lot more usage of oil than in Finland. Belgium uses 41% while Finland only uses 24%. Both countries have nuclear power plants but Finland uses 19% nuclear energy while Belgium only uses 8,7% nuclear energy.

5.4.2 Alternative Energy

In Finland already 35% of the energy is from a renewable source. In Belgium 8% of the energy is from a renewable source.
In Finland there is a big part of the energy supply that comes from wood and wood products, while in Belgium we only use 4, 5% biomass energy in Finland they use 25% biomass.
In Belgium the little part of the renewable energy we have comes from wind energy and solar energy.
In Finland the renewable energy comes from different sources the biggest one being wood and wood products. There is also a big part of the renewable energy that comes from hydro power plants. A third source for renewable energy in geothermal energy.

	Finland	Belgium
Renewable energy	35%	8%
Nuclear energy	19%	8,7%
Fossil fuels	24%	41%

6 CONCLUSION

My conclusion is that Belgium can learn a lot from Finland. In almost everything that is related to energy Finland does better.
Finland is especially good in renewable energy. Belgium has a lot of catching up to do if they want to become a more environmental friendly country.
In the construction part Belgium is not that much behind, in 2021 all constructions in both countries will be nZEB. And Belgium has a really good and accurate program to calculate the E-value, which could be beneficial for Finland as well.

7 REFERENCES

Bibliography

Intelligent Energy Europe (IEE) programme. (2017). *About BUILD UP Skills*. Retrieved from www.buildup.eu: http://www.buildup.eu/en/skills/about-build-skills

Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory. (2013). *CO2 emissions (kt).* Retrieved from data.worldbank.org: http://data.worldbank.org/indicator/EN.ATM.CO2E.KT

C-Power. (2017). *C-Power*. Retrieved from www.c-power.be: http://www.c-power.be/

Eurima. (2011). *Trias Energetica*. Retrieved from www.eurima.org: http://www.eurima.org/energy-efficiency-in-buildings/trias-energetica

European Union. (2013). *Europe 2020 in Finland*. Retrieved from ec.europa.eu: http://ec.europa.eu/europe2020/europe-2020-in-your-country/finland/progress-towards-2020-targets/index_en.htm

European Union. (2016). *Europe 2020 in Belgium*. Retrieved from ec.europa.eu: http://ec.europa.eu/europe2020/europe-2020-in-your-country/belgium/progress-towards-2020-targets/index_en.htm

European Union. (2017). *2020 Energy Strategy*. Retrieved from ec.europa.eu: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2020-energy-strategy

European Union. (2017). *Buildings*. Retrieved from ec.europa.eu: https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

European Union. (2017). *Energy Strategy and Energy Union*. Retrieved from ec.europa.eu/energy: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union

European Union. (2017). *Energy Strategy and Energy Union*. Retrieved from ec.europa.eu: https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union

European Union. (2017). *Energy union and climate*. Retrieved from ec.europa.eu: https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

European Union. (2017). *Focus on Belgium: the Energy Union tour*. Retrieved from ec.europa.eu: https://ec.europa.eu/energy/en/news/focus-belgium-energy-union-tour

European Union. (2017). *Paris Agreement*. Retrieved from ec.europa.eu: https://ec.europa.eu/clima/policies/international/negotiations/paris_en

Green Building Council Finland. (2016). *E-Value – calculated consumption based on building characteristics*. Retrieved from figbc.fi: http://figbc.fi/en/building-performance-indicators/calculation-guide/e-value-guide/

Illikainen, K. (2015). *Sustainable Buildings for the High North. Energy performance, technologies and challenges of new buildings in Russia and Scandinavia*. Retrieved from www.oamk.fi: http://www.oamk.fi/epooki/2015/sustainable-buildings-high-north-energy-performance-technologies-and-challenges-new-buildings-russia-and-scandinavia/?ccm_paging_p_b1802=2#cite-text-0-6

Intelligent Energy Europe (IEE) programme. (2017). *Skills*. Retrieved from www.buildupskills.eu: http://www.buildupskills.eu/

Laminaria. (2017). *LAMWEC*. Retrieved from www.laminaria.be: http://www.laminaria.be/

Miimu Airaksinen, J. S. (2014). *A net Zero Energy.* Retrieved from www.rehva.eu: http://www.rehva.eu/fileadmin/REHVA_Journal/REHVA_Journal_2014/RJ_issue_3/P.51/51-52_Airaksinen_RJ1403_WEB.pdf

Ministry of the Environment. (2013). *Ministry Of The Environment Decree On Improving The Energy Performance Of Buildings Undergoing Renovation Or Alteration.*

Ministry of the Environment Finland. (2017). *Land use and Building*. Retrieved from www.ym.fi: http://www.ym.fi/en-US/Land_use_and_building

OECD. (2015). *Renewable energy*. Retrieved from data.oecd.org: https://data.oecd.org/energy/renewable-energy.htm

Statistics Finland. (2016). *Energy in Finland.* Retrieved from www.stat.fi: http://www.stat.fi/tup/julkaisut/tiedostot/julkaisuluettelo/yene_efp_201600_2016_15894_net.pdf

Vlaamse confederatie bouw. (2017). *ben-projecten*. Retrieved from www.vcb.be: http://www.vcb.be/ben-projecten-aanbod-detail?id=44

Vlaanderen. (2017). *Energieverbruik Vlaanderen 2015.* Retrieved from www.energiesparen.be: http://www.energiesparen.be/sites/default/files/atoms/files/infografiek_energiebalans.pdf

Vlaanderen. (2017). *EPB-eisen.* Retrieved from www.vlaanderen.be: http://www2.vlaanderen.be/economie/energiesparen/epb/doc/epbeisentabel2017v03.pdf

Vlaanderen. (2017). *E-peil*. Retrieved from www.vlaanderen.be: https://www.vlaanderen.be/nl/bouwen-wonen-en-energie/bouwen-en-verbouwen/e-peil

Vlaanderen. (2017). *Maximaal toelaatbare U-Waarden.* Retrieved from www.vlaanderen.be: http://www2.vlaanderen.be/economie/energiesparen/epb/doc/epbuwaarden2016.pdf