

Assignment 2

Energy Transitions
0EM140 course 'Energy, economy and society'
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Netherlands 2030 v4

Vision and Goals

This report gives insight into the changes, the energy sector in the Netherlands has to undergo by 2030. The report is based on the internet website www.pro.et-model.com where different kinds of energy scenarios can be simulated. The scenario 'Netherlands 2030' is used and in this report the influences of these changes are written down.

To simulate the scenario by 2030, different targets are set for the Netherlands. For these targets several indicators are chosen which are based on information from the European Union and the ECN in cooperation with 'Planbureau voor de Leefomgeving'. The following four targets are set for 2030:

1. The amount of CO₂ emissions have to be reduced with 24% with respect to the current situation.
2. The amount of renewables for energy and electricity production has to increase with 27%.
3. The total energy use has to decrease with 30%.
4. The total costs of energy are allowed to increase with 10%.

The emissions of CO₂ are a hot topic on the political agendas of many countries. They have to be strongly reduced in order to keep the global warming within acceptable limits. Therefore many companies are working together with the government in order to achieve this. The (International Energy Agency, 2015) indicates that by 2030 the total emissions of CO₂ can be reduced to 76% of the current emissions (page 137). This is however a very optimistic goal whereby the global temperature will only increase by 2 °C. if implemented globally.

By the same agency the goal to increase renewable energy sources for energy and electricity production is defined (page 150). The target here for the complete European Union is to achieve at least 27% of renewables and energy efficiency targets by 2030. They strongly advise to reduce the usage of coal power plants and increase the implementation of bioenergy and other renewables. Therefore the amount of biofuel in the transport also has to increase. Not only the (International Energy Agency, 2015) sets the target for renewables at 27% by 2030, there are many other climate institutes that are spreading the same information (Energieonderzoek Centrum Nederland (ECN), 2014).

The amount of CO₂ emissions strongly depends on the amount of energy that is used. Of course solar panels and wind turbines do not emit CO₂ while generating electricity but these devices have to be produced as well. These kinds of renewable energy sources are just a fraction of the total energy usage in the Netherlands. So in order to decrease CO₂ -emissions, devices can be made more efficient which reduces the energy usage. For example devices can be made 'smarter' whereby they shut down when they are not in use or can detect people in order to power up. The European Union has therefore set a target for the energy use in 2030 (Energieonderzoek Centrum Nederland (ECN), 2014). The yearly amount of energy usage by 2030 has to be 30% lower than the yearly amount of energy that is currently used.

In order to increase renewable energy sources in the Netherlands it is necessary for both consumers and companies to make these sources attractive. The government has the possibility to enforce the uses of renewable energy sources, by making use of penalties for those who don't use renewable energy sources. However, they will then receive a lot of criticism. In some cases it is better to subsidize such kind of renewability's in order to make them more attractive, because healthy companies will always take a look at what saves (or generates) more money over time. Therefore we think that it is allowed that the cost of energy can increase with 10% by 2030.

Tweaking the Model

Energy demand

In order to achieve these goals several drastic energy improvements have to be done. It is very important that the government support these decisions. The most important decisions with the highest overall results for these goals are written in this report. The complete analysis can be found on the website with the credentials given at the end of this report.

The population in the Netherlands will increase in the upcoming 15 years with 0.4 million (Access, 2011), this would normally result in a higher energy usage, although devices will become more efficient and people will become more aware of the global threats. They will become more efficient with appliances (10%), light (40%), heating (60%), and washing (60%). The residences built before 1992 will slowly disappear (-0.2 million) and the new buildings build after 2020 have to become net/nearly Zero Energy Building (nZEB) (Gvozdenovic, Maassen, & Zeiler, 2015). Geothermal heat pumps will become more attractive both for cooling (+20%) and heating (+7.3%), this has also to do with the fact that in 2050 we think households will no longer use gas for cooking (-50.5%) and heating (-29%). District heating will take over individual oil and coal-fired heaters, and will increase the use of geothermal (+25 %), biogas GHP(+2.5%), and gas CHP (+2.5%). This ensures that the efficiency for the total grid increases with renewable sources integrated. Of course solar PV panels and solar thermal collectors will increase because of higher efficiency and lower payback times (Stanford (Glenn Martin), 2015).

Due to better economic times the number of companies will increase (+0,1%/year) and electricity usage will increase (+0.5%/year). Companies will also make more use of cooling systems (+0.5%), but smart systems (e.g. Toon and Nest (Eneco, 2015)) will decrease heating usage (-1.0 %). They will see the advantages of renewable sources as heat pumps with TS (+25.3%), solar thermal panels (+1.0%), and the advantage of district heating (+0.8%). The gas-fired heat pump will disappear (-10%) by 2030. Because of high costs fluorescent tubes (-61.9%) will be displaced by high-performance fluorescent tubes (+13.5%) and LED (+48.4%). By 2030 the recently uprising 'switchable windows' as renewable source, will be more and more implemented in buildings (+34.3%) (Karlsson, Khandelwal, Loonen, Hensen, Debije, & Schenning, 2015). Switchable windows are windows that can generate electricity from light.

The expectancy is that it becomes more profitable and simple to travel with public transport, whereby trains will be used more (+1.5%) than cars (-0.2%). Other transportation systems such as trucks (+1.5%) and inland navigation (+2.0%) will increase due to more demand of consumers (Fraunhofer, Analysis of a European Reference Target System for 2030, 2013). From 2035 forward all sold cars have to be electric (ECN, 2015). This, together with subsidies, will stimulate a decrease of diesel cars (-32.1%), Gasoline cars (-33.1%), diesel trucks (-35%), and diesel trains (-0.7%), while newer technologies will significantly increase like electric trucks (+20%), trains (+0.7%), LPG driven vehicles(+5.5%), compressed gas cars (+9.8%), and compressed gas trucks(+15.0%). For trucks it is more difficult to become completely electric because of high peak powers and long distance drives.

Industry uses a lot of energy, mostly consumed by heating processes. Therefore it is necessary to implement more recycling systems in the Netherlands, possibly subsidized by the government. Of course this is energy consuming as well, but it is a lot more efficient. However because of high demands of consumers, the aluminum supply will still grow (+0.5%) and the steel and polymers

supply will be stable over the coming 15 years. By replacing older machines with new more efficient ones, electricity and heat demand will decrease with 1.6% and 1.3% each year. (Trautmann, et al., 2013) Industry will make more use of combined heat & power as well (8.8%) therefore gas (-4.9%) and oil-fired furnaces /heat (-5.2%) will disappear.

We foresee more intense agriculture in the future; therefore electricity usage will go up in this sector. The electricity demand will grow with 0.3%. The energy use will shift mainly from gas-fires (-22.3%) and oil-fired (-12.2%) towards biomass-fired heating (+4.2%), heat pumps (+14.6%) and geothermal heating (+14.5%) (vox, Teitel, & Pardossie, 2010). This is because most equipment within the agricultural sector is out dated, and more renewable and high efficient equipment is more profitable.

Supply and Cost Analysis

In order to receive a complete analysis it is important that not only energy demands and efficiency improvements are taken into consideration, also the costs and supply are adapted to the new situation. This means that among others fuel costs, investments and maintenance costs of renewable energy sources and penalties of CO₂ have to be adapted to 2030.

In (Cemeco, 2015), (Nasdaq, 2015) and (InvestMine, 2015) several data of fuel prices for the previous years are given, which use of these data an idea can be formed of what the price will be in 2030. This is done for Uranium (+30%), Natural gas (0%), Coal (-29%) and Oil (+80%). The fact that the coal price will decrease more by 2030, while it already is very cheap, indicates that coal usage will increase when the government will not strictly regulate the usage of coal.

The investment costs for combustion plants will increase by 1 to 2 percent cause after treatment systems will be needed in order to reduce emissions. Operation and maintenance costs will increase cause of CO₂ penalties, however for biomass and waste incinerator plants the costs will decrease cause of subsidies. The complete costs for wind turbines will decrease by a few percent due to higher capacities for the turbines. The price for solar panels and geothermal power plant will decrease as well due to higher efficiencies which means that a payback period is shorter and people will invest more in these sources. The penalty of CO₂ emissions will increase drastically by 280% to 30 €/ton whereby companies are only free to allocate 50% of CO₂ which is now still at 85%.

It is very difficult to foresee exactly what amounts of renewable energy sources in the Netherlands will be in 2030. However from the data we found we think wind turbine parks will double in the coming 15 years for both onshore and offshore. This results in more percentage of renewables, lower CO₂ emissions, and lower amount of energy imports. The Netherlands will not make use of nuclear plants anymore and all old coal plants will be shut down as is already part of the agenda in the parliament nowadays (AD.nl nieuws, 2015). This counteracts with the wind turbine parks as it will increase energy imports again and therefore also will increase the total costs. Therefore this is probably such a high political issue.

By 2020 a minimum of 10% of all fuels in transport has to be alternative fuels, like biofuel. We think this trend will go on and in 2030 a minimum of 20% is bio fuel in all transport tracks. When more biofuels are added the CO₂ emissions will decrease while costs and renewables will increase.

Outcome and Reflection

First each sector will be discussed by the following criteria: What is the most important factor that influences the energy need, how to achieve that and which actors are affected by that. The order of the program will be followed: Households, Buildings, Transportation Industry, and Agriculture. After this discussion the overall outcome combined with a reflection on the set goals will be discussed.

Households are at this instance accountable for 15 percent of the overall energy demand in the Netherlands. As mentioned in the preceding section the energy intensity can be lowered by a fair amount: From almost 400 PJ to 220 PJ is possible with a yearly increase in costs of 1 billion. The biggest influence here is the heating demand. This is lowered by 2% per year. On first glance this may be ambitious but the introduction of among others reel smart thermostats will help to achieve this goal. Besides the homeowners should become more aware of the impact they causes on the environment when they set the thermostat a degree warmer. The government together with the utility suppliers are the main actors that can enforce the use of smart thermostats, but the homeowners will eventually also benefit from this development as their energy bill will become lower.

For Building the energy demand can be lowered by 150 PJ while saving 1.5 billion euros a year on the costs. Increasing the isolation value of the buildings greatly reduces the energy demand, Furthermore the use of thermal storage/ heat pumps help to reduce the use of gas. By the 2020 all new buildings should be nZEB. This regulation will have a positive contribution to the decrease of energy usage. However, if it will be enough to reduce the energy to our goals is questionable. The positive aspect of changing the buildings to more energy efficient buildings is the decrease in overall costs. The most important stakeholder here is the government, that demands the owners to comply with the nZEB regulation by 2020.

The transportation sector is difficult to adapt, in the near future electric trucks are not realistic. However electric cars are more promising. With the rise of car sharing initiatives we predict that the total amount of cars will not increase anymore. Those two factors combined with more bio based fuels help to lower the overall energy demand of the sector. To get a 50% share of electric cars is not straightforward. The car manufactures should therefore invest more in electric cars and the government should support the use of electric cars and invest in the infrastructure to charge the cars. The investment cost of the infrastructure is not incorporated in the analysis. In total 100 PJ of energy could be saved. The expected yearly decrease of cost by 8 billion is cancelled out by the infrastructure investment costs.

The difficulty with changing the industry is twofold: The industry uses a lot of oil as raw material for making goods. The other problem is that the energy insensitive industries use fuel to generate heat. This cannot (easily) be replaced by electricity or bio fuel. A solution can be in the form of more intense recycling of namely metals. In the chemical industry CHP can help to increase the efficiency and with that lowering the CO₂ emission. Shifting from Best practice to Best technology in all the different industries is very effective.

Upwards to 26 percent of energy could be saved according to (Fraunhofer, Analysis of European Reference, Target system for 2030, 2013). By our measures the energy demand is decreased with 157 GJ.

Changing the industry will not be easy. There are a lot of big companies that will probably use their influence on the government if the implementation of the best technology needs large investments.

The Agriculture it is not changed drastically, because the agriculture uses only a small amount of the total energy, and typically farmers are financial not able to do large investments in energy saving measures. Therefore the focus is on making processes more efficient, in that way the environment and the farmer will benefit from it. The main actor will be the farmers themselves. Supported by the government they can make the production more efficient and less polluting.

Overall goals.

With help of the energy transition model it turns out that it is possible to use 30% less energy, to decrease the CO₂ emissions by 24%, and to produce 17.5% of the total energy demand using sustainable energy sources, without increasing the energy costs with more than 10%.

One goal was that 27% of all energy should be produced by renewables. One of the biggest problems with renewables besides availability is that most of them are only for electricity generation. For example in the optimized model the total amount of electricity used is equal to around 350PJ. This is just a small fraction of the total 1740 PJ of energy used in the Netherlands. Especially in energy industries this causes problems. In the steel industry there is for example no sustainable technology available to replace the huge furnaces used to melt iron ore.

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