Summary

Fossil fuels are our dominant energy source. Fossil fuels are, however, depleting and not very environmental friendly. The use of fossil fuels results in the exhaust of a number of pollutants of which carbon dioxide is thought to be one of the major greenhouse gasses. Furthermore, our dependency on oil puts pressure on the security of energy supply. Compared to fossil fuels, biomass is a renewable energy source and more environmental friendly; it is (almost) carbon dioxide neutral. Another advantage of biomass is that it boosts the diversification and hereby the security of energy supply. It also decreases the dependency on oil exporting countries. The European Union is aiming at increasing the renewable energy share from 6% in 2001 to 12% in 2010. Biomass accounts for about two-thirds of the renewable energy share and is set to play a major role in achieving the renewable energy goals.
Biomass originates from three sources; dedicated plantations (short-rotation forestry and energy crops), residues (wood from forestry thinning and felling residues) and by-products and waste (sawmill, manure, municipal solid waste). Biomass can also be subdivided into wood, non-woody energy crops, agricultural residues and by-products, and wastes.
Usually biomass has to be converted before it can be used to provide heat, electricity or to drive vehicles. This can be done by mechanical means, thermal conversion (combustion, gasification and pyrolysis) or biochemical conversion (digestion and hydrolysis). The products of these conversion processes are diverse as well; heat, fuel gas, bio oil, biogas, (bio)ethanol and biodiesel.
The end use of biomass can be divided into solid biofuels (pellets, chips, logs), liquid biofuels (ethanol, biodiesel) or gaseous biofuels (biogas) and heat and electricity. The solid, liquid and gaseous biofuels can be used to produce heat, electricity and to drive vehicles.
Although biomass is gaining interest worldwide, the point of view seams to be different in Europe and the United States. They both try to increase the use of biomass, but the United States seam to aim at the 'terror-free' benefits of biomass whereas Europe seams to aim more at the sustainable character of biomass.

In Europe and other regions of the world, the use of biomass is being promoted by legislative measures, such as the Directive of promotion of biofuels, aiming to increase the share of biofuels in total transport fuels to 5.75% in 2010.
The biomass potential in Europe for electricity is estimated to be around 130 PJ in 2001 and almost 1,800 PJ in 2020. For heat production the potential is expected to increase from a little over 2,000 PJ in 2001 to 4,500 PJ in 2020. The potential of liquid biofuels is expected to increase enormously as well.
As in almost every situation a difference between theory (potential) and practice (implemented use of biomass) occurs. Two different scenarios for which the implemented use of biomass is determined have been found in literature. The Business As Usual scenario is applicable for if we will continue the way we are doing now and the Policy Scenario describes what can be achieved if we implement the best techniques and policies currently available. The share of renewable electricity production will grow from 13.6% in 2001 to 22.5% in 2020 for the BAU scenario and 34.4% for the PS. The amount of biomass in this growing renewable share is expected to fourfold (BAU) and ninefold (PS). The share of renewable energy sources in heat production is lower although the absolute numbers are higher than in electricity production; 11.2% in 2001 increasing to 12.3% (BAU) and 21.1% (PS) in 2020. The use of biomass in heat production is expected to grow as well. The share of renewable liquid (transport) biofuels will increase from 0.41% in 2001 to 5.5% (BAU) and 12.4% (PS) in 2020. The absolute growth of biomass for liquid biofuels is enormous. Comparing the tree uses, heat is the largest user of biomass (1.93 EJ) in 2001, electricity is second (0.13 EJ) and liquid biofuels (0.04 EJ). In 2020, heat still is the largest user (2.22 – 3.27 EJ), liquid biofuels become second (0.80 – 1.67 EJ) before electricity (0.51 – 1.21 EJ).
The use of biomass in the Netherlands and surrounding countries (Germany, Belgium and France) is expected to grow as well. Germany and France will be practically generating the same amount of electricity from biomass in 2020 (80 – 180 PJ), whereas the Netherlands are expected to produce about twice the amount of electricity from biomass Belgium does; 10 – 24 PJ vs. 5 – 10 PJ. For heat production from biomass, France and Germany are close with 413 – 613 PJ for France and 319 – 588 PJ for Germany. Belgium and the Netherlands are close as well with respectively 18 – 53 PJ and 22 – 56 PJ.

There are however, also some drawbacks to the intensified use of biomass. The environmental pressure on biodiversity, soil and water resources increases. Biomass can conflict with other industries such as the food and paper industry. This might result in increased food and energy prices. The sustainable character of biomass has to be maintained to prevent environmental problems such as deforestation.

Due to differences in biomass potential and biomass uses, biotrade is taking place and will evolve in coming years. Potential biomass exporters are Latin America, Canada, Oceania, parts of Africa and Russia. On a European scale, the countries around the Baltic Sea have abundant biomass and are exporting biomass to other European countries.
Biomass import and export streams are difficult to quantify due to the lack of a good administrational system. Research shows that pellets are the most traded biofuels. The Baltic area is leading in pellet production. The most active international biomass traders are the countries around the Baltic Sea and the Netherlands.
For the Netherlands, the biomass trade has increased significantly during the past few years. Dutch biomass import equaled nearly 1.2 million tons in 2005. Unfortunately the data available on biomass trade is very different between countries; comparisons are therefore difficult to make.

Biomass usually is converted to make more efficient transport possible. Biomass has several characteristics which are undesirable for efficient transport; it usually has a high moisture content, inefficient size or shape and it has a low (energy) density. High moisture content is not only of influence on conversion efficiency but 'wet' biomass in the form of chips tend to decompose with material losses and possibly even fire as a result. To deal with its inefficient size or shape, biomass is sized (for example chipping) to make more efficient transport possible. Compacting is a way of increasing the (energy) density of biomass. An example of densification is pelleting.
In literature, a generic long distance biomass transport chain is developed to study the effects of different transport modes and distances on costs and energy use. This transport chain starts at the place of harvest from where the biomass is transported to a central gathering point. From here on it is transported via an exporting terminal, to an importing terminal and finally the end-user. Several transport modes can be used to transport the biomass. Depending on the biomass to be transported, several chains are developed; for example a logs chain and a pellets chain.
Truck transport is one of the modes applicable to transport biomass. It is mainly used on the shorter trips. Different standard truck configurations are used to transport the different types of biomass. There are however also some dedicated biomass trucks on the markets; pellet trucks. These are used to deliver pellets to households for heating purposes. Trucks are very flexible but their payload is relatively low. Regarding costs, pellets are preferred for transport.
For longer distances, rail transport is suitable. An obvious disadvantage of rail transport is the need for rails. Pellets are the cheapest to transport.
For longer and ultra long distances, ship transport is a suitable way to transport biomass. Shipping has the lowest variable costs. In literature, the costs to transport various biomass types has been investigated. In contrast to trucking and rail transport, pellets are no longer the cheapest to transport; the liquid biofuels are now (slightly) cheaper. Pellets remain the cheapest solid biomass to transport.
A new development in biomass transport is the use of pipelines. In these pipelines, biomass slurry (biomass with water as a transport medium) is transported. Transport by pipeline has several advantages; it allows segregation, no dependence on highway truck delivery and pipes can be used as a reactor. Their disadvantage is their inflexibility towards increasing volumes and different routes. Literature shows that pipelines become financially attractive compared to trucking with capacities over 0.5 million tons per year.
It appears that importing biomass from Latin America to the Netherlands is competing with European biomass. The preferred biomass form is usually pellets.
Biomass transfer equipment is standard transfer equipment as is being used in agricultural and forestry industry. It consists of both discontinuous and continuous transfer equipment for bulky biomass and standard liquid transfer equipment for the liquid biomass. Storage is often used to dry biomass. To do so, the biomass has to be sheltered against rain. Sometimes forced drying is applied which requires additional equipment in the storage facility. Silos are also used to store biomass while liquid biofuels are stored in standard liquid storage facilities.

The major energy problem in the world is that we use too much energy which is too polluting. The solution is therefore quite straightforward; use less energy that is less polluting. In my personal view, biomass is a promising environmental and renewable energy source for the future. It offers many different end products for different end uses and can be obtained from many abundant resources. The use of biomass therefore has to be stimulated by governments. The use of biomass will not grow as fast if no stimulation policy exists. I think people are only 'willing' to use new energy sources like biomass, if it is cheaper than conventional energy or if it is equally priced, it should not cost them any more effort to use it.