Biomass role in achieving the Climate Change & Renewables EU policy targets. Demand and Supply dynamics under the perspective of stakeholders . **IEE 08 653 SI2. 529 241**

D2.3. Outlook on Market Segments for Biomass Uptake by 2020

Calliope Panoutsou and Arturo Castillo

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BIOMASS FUTURES

Preface

This publication is part of the BIOMASS FUTURES project (Biomass role in achieving the Climate Change & Renewables EU policy targets. Demand and Supply dynamics under the perspective of stakeholders - IEE 08 653 SI2. 529 241, www.biomassfutures.eu) funded by the European Union's Intelligent Energy Programme.

1 Scope and Overall Approach

This report provides a structured outlook of the key market segments – within the EU27 heat, electricity / CHP and transport sectors – in which biomass is likely to have successful penetration by the year 2020.

The report is based on analysis of (1) current trends using available statistics and (2) technical, economic and organisational factors influencing future biomass penetration. Analysis of influencing factors included in-depth consultation of a wide range of stakeholders from industry and policy levels.

This report is based on the work performed in Task 2.4 and follows an overview of the current share of biomass in existing markets (D2.1) and identification of the technical, economic and organisational factors affecting biomass penetration (D2.2). The report is focused on:

- identification of market segments that appear to be the most promising for future penetration of biomass;
- analysis - validated through a stakeholder group - of the influence that the selected key factors have on the further penetration of biomass technologies in these segments.

The final version of this report will include be updated with the scenarios which will be based on the final scenarios defined within Task 5.5 (D5.2).

There are two fundamental requirements for market segments. Firstly, segments have to be recognisable, and secondly, segments have to be applicable and operational (Harvard Business Review 2006). Segments are characterised in several ways such as energy carrier (heat, electricity), location (rural, urban), user type (domestic, services, industrial), ownership (private, public transport). Analysis focuses on relative attractiveness and competitiveness of biomass compared to fossil fuels. The originality lies in the use of a systematic approach, where analysis is performed segment by segment, rather than looking at each sector as a whole.

The approach is demand-driven, focusing on the energy users' demand for heat, electricity and transport. Conversion processes used to transform biomass into useable energy covered in this study include: (1) heat production (stoves, heat-only boilers), (2) combined heat and power production (biomass combustion units) and (3) liquid biofuels (biodiesel and bioethanol).

2 Heat and Electricity / CHP Sectors

2.1 Potential Market Segments

Potential market segments for biomass use in the EU27 heat, electricity / CHP and transport sectors can be described at high-level as follows.

Households can use individual stoves or boilers that use biomass to supply their space heat and/or hot water needs. There are a range of technologies available, the fuel of choice is wood, and capacity is in the range 15-50kWth. Advanced technologies include wood pellet boilers with high conversion efficiency and low environmental impact. At the other end of the spectrum, traditional stoves use wood logs and have relatively low technical efficiency and environmental performance.

Household heat needs may also be supplied by district heat. A central plant room may have boilers that are fuelled with pellets, chips or, less commonly, chopped straw. Boilers may be 100kWth to 1MWth or larger. Hot water is distributed from the energy centre to individual households via flow and return pipe work. Schemes will typically supply space heat and hot water needs instantaneously and year-round.

Services include schools, hospitals, municipal offices, leisure centres as well as commercial offices, shops etc. Such buildings may also be supplied via district heat schemes. An alternative approach is for such buildings to use individual boilers to provide their heat needs. Boilers will be typically automated (or semi-automated) and fuelled with wood pellets or chips. These boilers may have capacity 100kWth to 1MWth or larger.

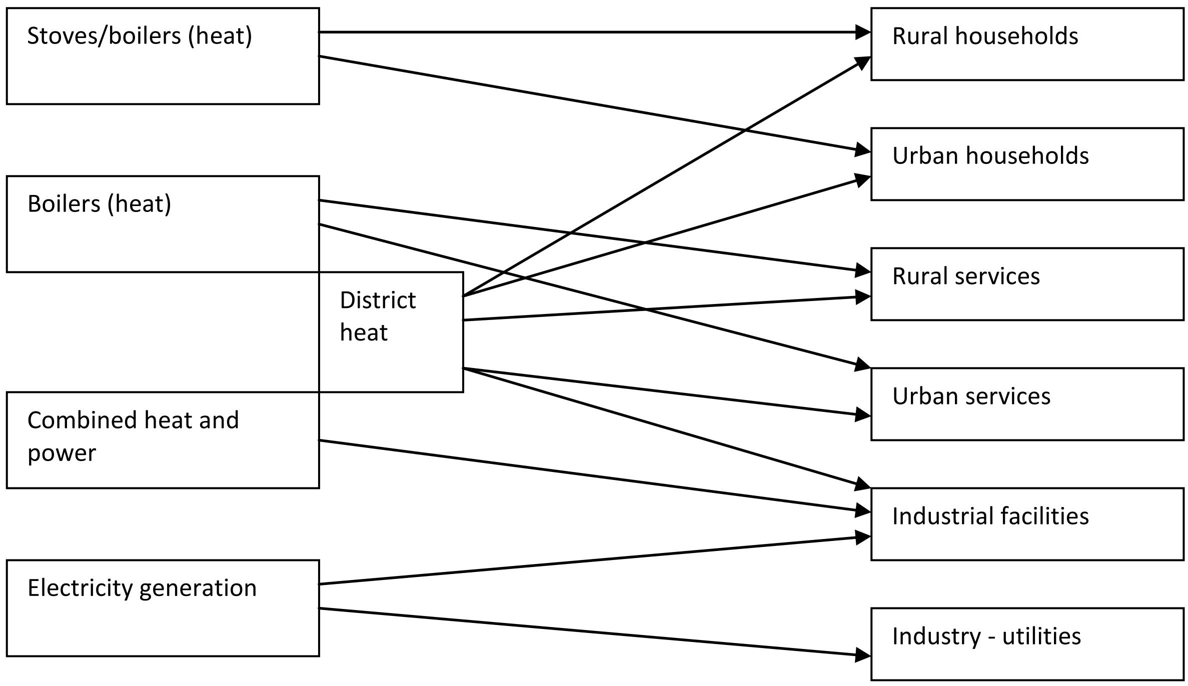
District heat schemes are an appropriate site for CHP technologies. Such technologies are medium scale i.e. 3MWe or larger. Boilers raise steam that is used to drive turbines to generate electricity. Heat is supplied to end users via district heat. Electricity is typically exported to the grid.

Industrial facilities may also be linked to district heat schemes. Larger industrial facilities, typically in the wood or agriculture processing sectors, have the opportunity to install individual boilers and / or CHP systems.

Finally, there is the possibility for electricity-only plant to be installed by industry, say at 30MWe scale or larger. Utility-scale installations are also possible, for example 100MWe plants. Also, co-firing biomass in existing coal power stations is an opportunity.

Twelve potential market segments for biomass use in the EU27 heat, electricity / CHP and transport sectors are illustrated in the following diagram.

Potential Market Segments for Biomass in the EU27 Heat, Electricity/CHP Sectors



2.2 Market Data

Europe uses about 90 Mtoe of oil and more than 170 Mtoe of natural gas for heating purposes every year for households and services (Eurostat, 2009).

According to AEBIOM (2009), in 2007 33.3 Mtoe biomass were used to produce 101.81 TWh electricity (8.75 Mtoe) and 61.5 Mtoe biomass were used for heat production. France and Sweden are the leading Member States. Domestic appliances are widespread in France while district heating is widespread in Sweden.

Conversion from existing fossil fuel heating systems to wood fuels heating systems can play a significant role in reducing the dependence of Europe on oil and gas imports. Heat consumption in the EU-27 was 45.59 Mtoe in 2007, which was a 5% decrease from 47.95 Mtoe in 2006. The major part of heat consumption occurs in Austria, France, Germany, Italy, Poland, Finland and Sweden, together accounting for 83% of the European reported heat consumption in 1980 and 60% in 2007.

Over the same period, heat consumption has declined in Hungary and Poland as older heat plants have been closed and replaced with decentralized heat in some areas. Growth has been particularly strong in Austria, Denmark, Finland, France, Iceland, Portugal and the United Kingdom.

According to AEBIOM (2009), annual sales of heating appliances reached 3.8 million units in 2007. Direct heating stoves represented the largest share of the sales with 1.3 million units. Given that heating with wood fuels is much cheaper than heating with fuel oil (AIEL, 2010); there is a significant opportunity for biomass feedstocks to capture substantial parts of the replacement market.

These data do not refer to the consumption of heat produced in industrial premises or service industries for their own use. In this section heat consumption refers to heat sold to third parties by both main activity producers and energy auto-producers. In 2007, about 39% of third party heat consumed in EU countries was used in the industrial sector, about 21% in the residential and about 11% in the commercial/public services sector.

Currently, there are around 203 million households in Europe. Only a small share of heating systems installed in Europe today are state-of-the-art. The majority of domestic heating systems are clearly obsolete and could be replaced immediately on account of their poor energetic performance.

According to AEBIOM (2009) it is estimated that approximately 8.2 million wood biomass boilers of up to 500 kW are installed in Europe, over 90% of which are boilers of up to 50 kW.

In the Baltic States and Eastern European countries, fossil fuel heating systems are still the most widespread. In some countries, e.g. Poland, the use of coal-boilers is still very common. The replacement of existing heating systems offers an opportunity to reach the RES targets.

The highest potential for wood fuel heating appliances to penetrate existing markets is likely to be in Eastern European and Baltic countries. In addition, wider market penetration should be stimulated in Mediterranean countries, where the use of wood boilers is still in early stages. Moreover, pellet stoves also offer fairly low investment costs while producing significant amounts of renewable heat and they could be acquired by households with lower incomes (AIEL, 2010).

2.3 Analysis of Influencing Factors

This section of the report provides results from thorough analysis of stakeholder inputs. The team contacted a representative range of experts throughout Europe and conducted detailed interviews with duration typically two hours. The qualitative analysis used a set of subjective assumptions to gauge the influence that each key factor has for each segment. This was largely based on the evidence gathered in the semi-structured interviews.

The qualitative analysis of the EU27 heat and electricity/ CHP markets was conducted in a systematic manner by constructing a matrix in which the key factors and market segments are listed in columns and rows respectively. Scores are assigned based on whether the factor is a driver, barrier or neutral, as follows: 3 very strong driver; 2 strong driver; 1 weak driver; 0 neutral; -1 weak barrier; -2 strong barrier; -3 very strong barrier; na not applicable.

A matrix of the qualitative analysis is presented below.

Summary percentage scores by each of the categories – technical, economic and organisational – are shown below. Percentages scores are based on the maximum attainable score, making an allowance for factors that are not applicable to any particular segment.

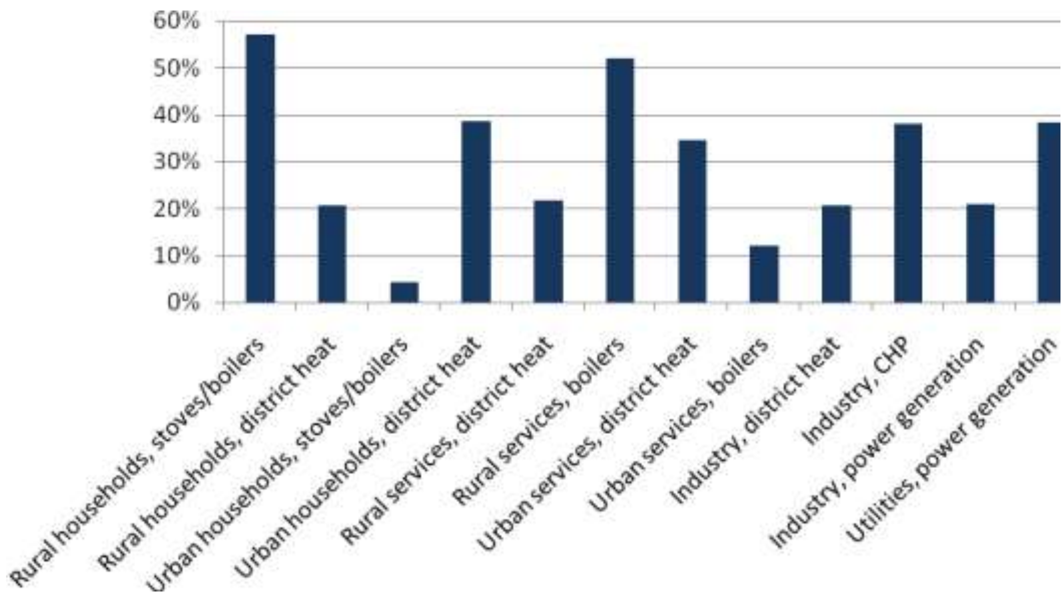
Finally, the results are described in four graphs, showing overall total percentage score and the score for each category of influencing factor, namely technical, economic and organisational.

		Rural households, stoves	Rural households, district heat	Urban households, stoves	Urban households, district heat	Rural services, district heat	Rural services, boilers	Urban services, district heat	Urban services, boilers	Industry, district heat	Industry, CHP
	Technical										
1	Proven, reliable technology	2	2	2	2	2	2	2	2	2	2
2	Technology / energy demand match	2	-1	2	-1	-2	2	-1	2	-3	3
3	Demand proximity	3	-3	2	2	-2	3	2	2	1	3
4	Fuel supply logistics	3	2	-2	2	2	3	2	-2	2	1
5	Fuel quality	2	2	2	2	2	2	2	2	0	2
6	Space requirement	-1	0	-3	0	0	0	-2	-3	0	-1
7	Conversion efficiency	1	-1	-1	-1	-1	0	-1	0	-2	-1
	SUBTOTAL	**12**	**1**	**2**	**6**	**1**	**12**	**4**	**3**	**0**	**9**
	Economic										
8	Capital cost	1	-3	1	-3	-3	2	2	-1	2	2
9	Operation and maintenance cost	1	1	-2	2	-1	-1	2	1	1	2
10	Fuel cost versus fossil fuel	2	2	2	2	0	2	0	2	0	2
11	Heat sales revenues	na	2	na	3	1	na	3	na	2	1
12	Electricity sales revenues	na	na	na	na	na	na	na	na	na	2
13	Capital grants	na	na	na	1	na	na	na	na	na	1
14	Emissions trading incentives	na	2	na	na	2	1	2	1	1	2
15	Access to capital / cost of capital	2	1	2	2	1	2	2	1	2	2
16	Eligibility for favourable loans	0	0	0	1	0	0	0	0	0	1
17	Other administrative costs	1	1	0	0	1	0	1	0	2	1
18	Other “embedded” benefits	na	na	na	na	na	na	na	na	na	2
	SUBTOTAL	**7**	**6**	**3**	**8**	**1**	**6**	**12**	**4**	**10**	**18**
	Organisational										
19	Potential for carbon displacement	2	2	2	3	3	2	3	3	1	3
20	Employment creation	3	1	2	1	3	3	2	1	2	2
21	Social acceptability	3	2	-2	2	2	3	2	-1	0	0
22	Educational policy instruments	2	-1	0	1	0	1	0	0	0	1
23	Amenity issues	2	0	-3	1	1	2	-1	-2	0	-2
24	Organisational capability	3	-2	0	2	0	2	2	1	2	3
25	Fuel infrastructure availability	3	3	0	2	2	3	2	0	2	3
26	Security of fuel supply	2	2	1	1	2	2	1	1	-1	-1
27	Fuel price stability	2	2	2	1	2	2	1	1	2	-2
28	Regulatory frameworks	0	0	-2	2	0	1	-1	-1	-1	-1
29	Administrative issues	0	0	-2	0	0	0	0	-1	-1	0
	SUBTOTAL	**22**	**9**	**-2**	**16**	**15**	**21**	**11**	**2**	**6**	**6**
	GRAND TOTAL	**41**	**16**	**3**	**30**	**17**	**39**	**27**	**9**	**16**	**33**

Influencing Factors and Market Segments – Summary Percentage Scores

	Rural households, stoves/boilers	Rural households, district heat	Urban households, stoves/boilers	Urban households, district heat	Rural services, district heat	Rural services, boilers
Technical Score %	57%	5%	10%	29%	5%	57%
Economic Score %	39%	25%	17%	33%	4%	29%
Organisational Score %	67%	27%	-6%	48%	45%	64%
Total Score %	57%	21%	4%	38%	22%	52%
	Urban services, district heat	**Urban services, boilers**	**Industry, district heat**	**Industry, CHP**	**Industry, power generation**	**Utilities, power generation**
Technical Score %	19%	14%	0%	43%	22%	39%
Economic Score %	50%	19%	42%	55%	23%	50%
Organisational Score %	33%	6%	18%	18%	18%	27%
Total Score %	35%	12%	21%	38%	21%	38%

Influencing Factors and Market Segments – Total Percentage Score



The overall scores indicate six segments which are relatively well predisposed for biomass. In descending order of attractiveness, these are:

- rural households, stoves/boilers (heat)
- rural services, boilers (heat)
- urban households, district heat
- industry, CHP
- utilities, power generation
- urban services, district heat

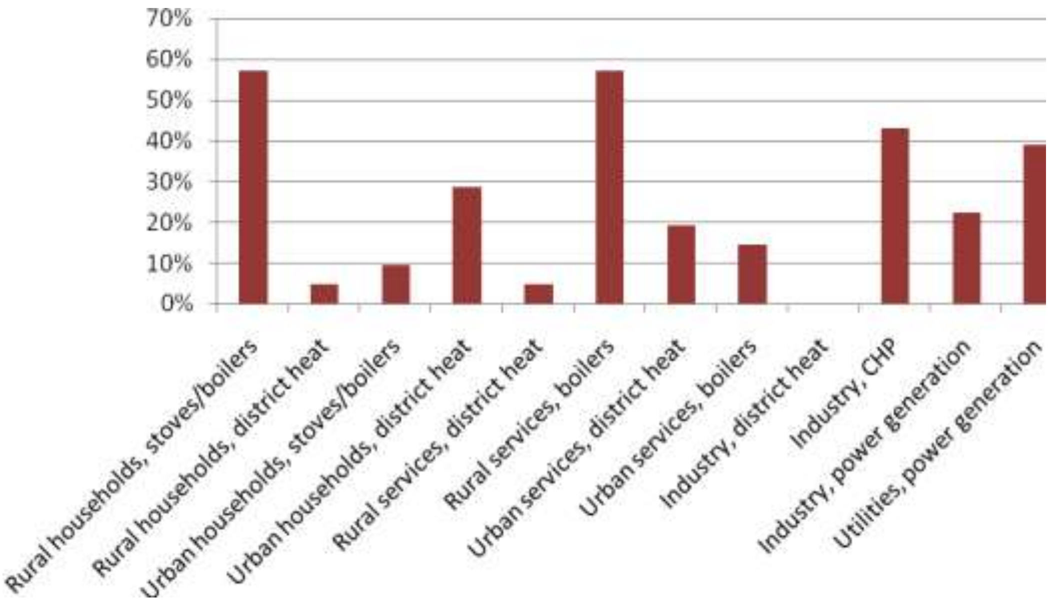
These segments score between 30-55% of the maximum available score. This is a qualitative assessment so there are limits to numerical interpretation. However, the scoring does indicate that, while these segments are relatively attractive, there remains a lack of really strong drivers and a presence of some barriers throughout these sectors.

The other six sectors are relatively poorly disposed to biomass penetration. In descending order of attractiveness, these are:

- rural services, district heat
- industry, district heat
- industry, power generation
- rural households, district heat
- urban services, boilers (heat)
- urban households, stoves/boilers (heat)

These six segments, with scores of around 20% or less than the maximum attainable score, have clearly got few strong drivers and a predominance of barriers. The matrix of all the factors and segments above shows several instances of strong barriers (scores of -3). Further examination would help establish if these are showstoppers in perpetuity or whether further actions by policy-makers, industry etc. could reduce or remove these barriers.

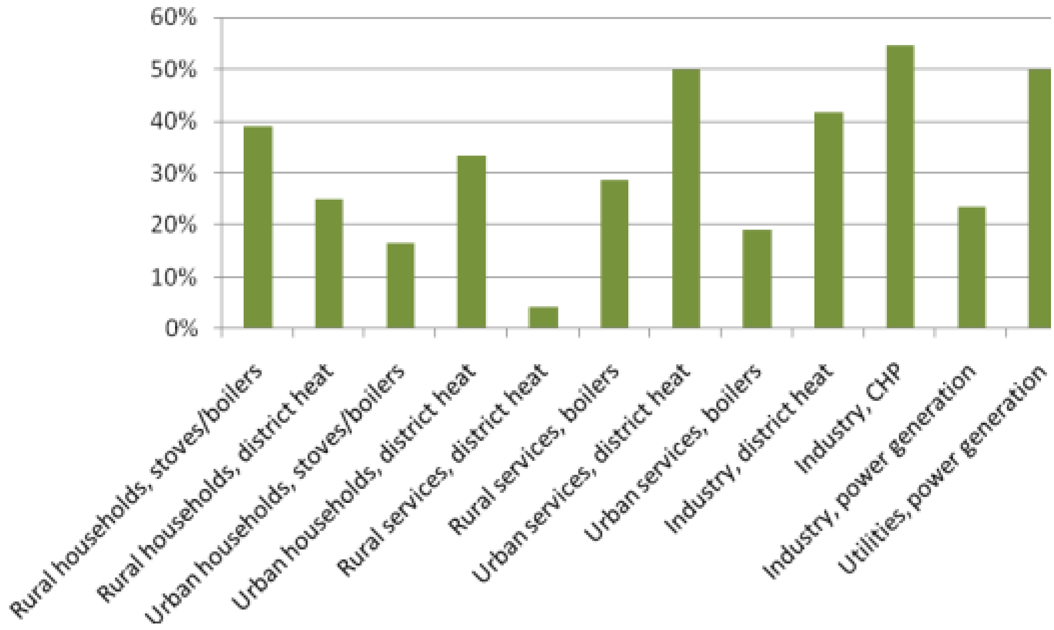
Influencing Factors and Market Segments – Technical Percentage



The technical scores broadly correspond with the overall scores. The two segments rural households, stoves/boilers and rural services, boilers have particularly high scores. This reflects the fact that these are well-proven applications, good opportunities to match the technology to the energy demand, and fuel supplies are local. Among the six segments with favourable overall scores, the segment urban services, district heat, has a relatively low technical score. This partly reflects the fact that often these buildings could have heat supplied via natural gas boilers, which are a convenient and proven alternative.

Low technical score for district heating in rural areas reflects the fact that households or buildings are more widely distributed, and less easy to connect. Industry, district heat scores low because the temperature requirements for industrial processes are higher than the low temperature hot water distribution (e.g. flow 80oC, return 55oC) that is typically used for district heat schemes.

Influencing Factors and Market Segments – Economic Percentage Score

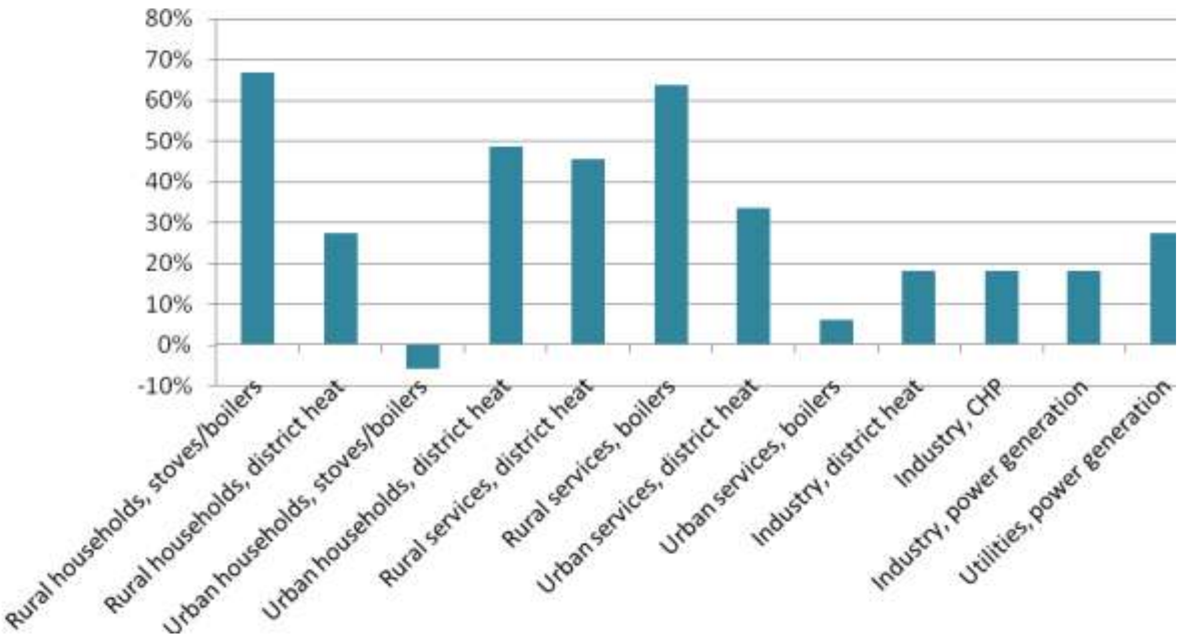


Economic scores are high for three segments, in descending order of attractiveness:

- industry, CHP
- utilities, power generation
- urban services, district heat

It is evident that there are good economic drivers for installing CHP in industry, particularly those whose business is the processing of wood or agriculture products. For these companies, with high energy demands, access to low cost secure fuel, available space etc. there is already uptake and this can be expected to increase. Similarly, trends also confirm that power generation using biomass fuels is a promising economic opportunity. The high score for urban services, district heat is notable. Public buildings etc. can form that anchor loads for district heat schemes that cover a mixture of domestic and service users – this not a new idea for many Member States, but needs to be re-examined in other States with low uptake to date of district heat.

Influencing Factors and Market Segments – Organisational Percentage Score



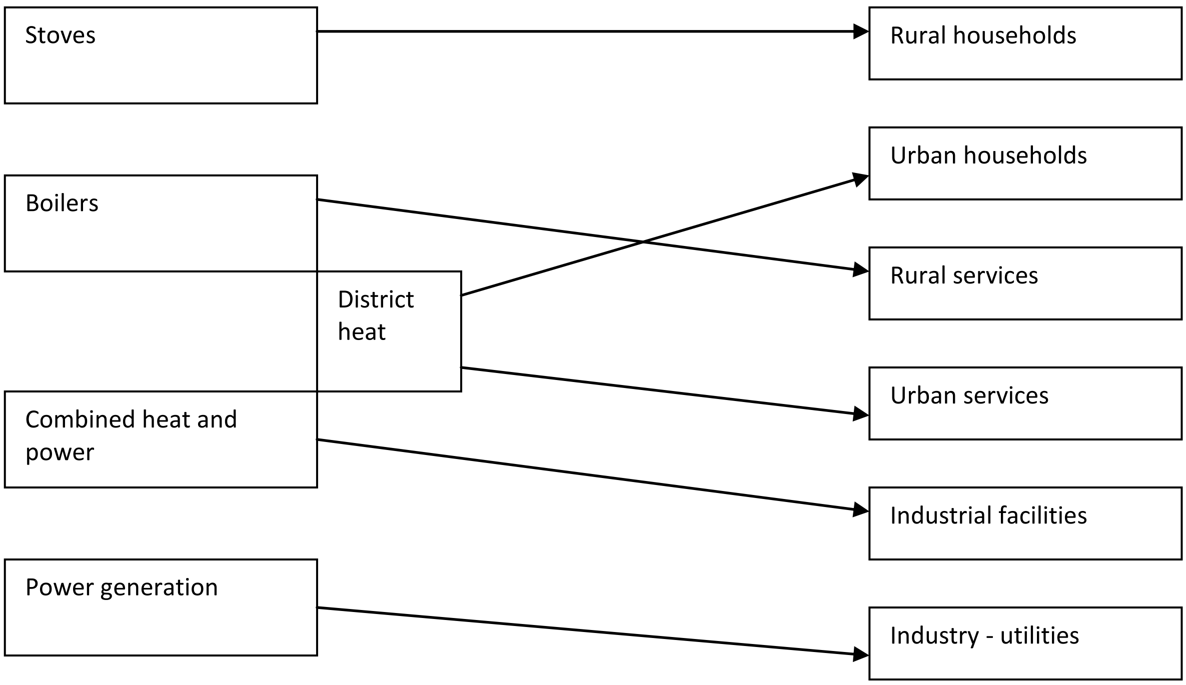
The organisational scores show some differences to the other categories of influencing factors. The two segments industry, CHP and utilities, power generation show significantly low scores. The reasons appear to be regulatory and administrative related such as planning and access to the grid. The implication is that, while the economic case appears to be good, there are various issues that make project development slow and problematic.

The aesthetic, noise (of deliveries) and air quality issues that individual installations face in urban areas, whether stoves in individual households or boilers in individual buildings, are clearly reflected in the low scores.

2.4 Market Segments for Biomass Uptake by 2020

The six market segments with best potential for penetration by 2020 are illustrated in the following diagram.

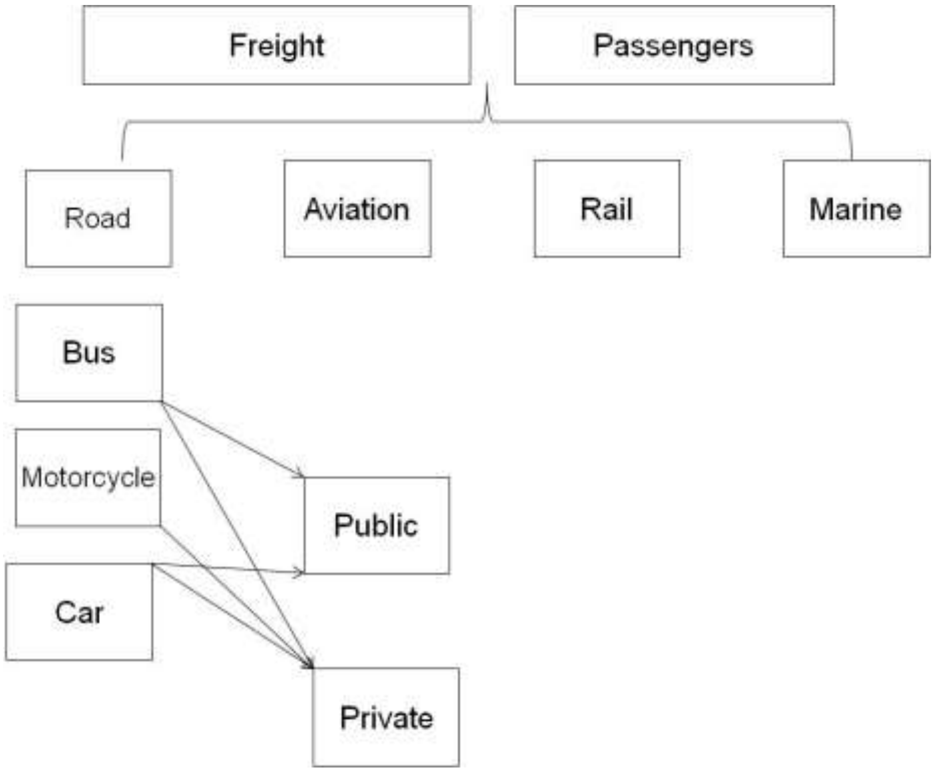
Market Segments with Best Potential for Biomass in the EU27 Heat, Electricity/CHP Sectors



3 Transport

3.1 Potential Market Segments

The segmentation of the transport market is illustrated below.



Aviation, rail and marine segments are all clearly potential applications for biofuels. Public and private sector road transport is also an opportunity. “Public” segment refers to large fleets owned by single government authorities or private sector companies. “Private” refers to individual ownership.

3.2 Market Data

Road transport constitutes the most sizeable market segment, with the largest share in total km driven. Road cars represent the biggest segment both in passengers and freight.

The tables below present the size of each selected segment in terms of person km (passengers) & tonnes km (freight), as well as the size of each one according to available data for 2008.

Market size of selected transport segments for passengers

Segments	Description/ Comments	Market Size (2008) *thousand mio pkm*
Aviation	Estimates of domestic and intra-EU-27 transport	561
Rail		409
Marine	Estimates of domestic and intra-EU-27 transport	41
Road(total)		5427
Road-Bus	Data are not fully comparable, while many data for 2008 are provisional.	547
Road- Motorcycles		155
Road Cars	Data are not harmonised and hence not fully comparable, while many data for 2008 are provisional.	4725

Market size of selected transport segments for freight

Segments	Description/ Comments	Market Size (2008) *thousand mio tkm*
Aviation	Estimates of domestic and intra-EU-27 transport	2.7
Rail		443
Marine	Estimates of domestic and intra-EU-27 transport	1498
Road	National and international haulage by vehicles registered in the EU-27	1878

For road transport, two main categories can be identified for road vehicles, i.e. the engine size, which normally classifies the vehicles into light vehicles, referred as “passenger cars”, and buses, lorries or vehicles weighted over 6 tons, known as “commercial vehicles” and the engine type of the vehicles, which is related to the fuel that can be consumed. Some interesting issues regarding their market uptake are presented below.

Heavy Duty Vehicles

According to statistics from the International Association of Public Transport, VITP, with reference data since 2005, over 90% of the urban buses are powered by diesel, whereas the remaining fleet is fuelled by CNG (compressed natural gas), LPG (liquefied petroleum gas), biodiesel and biogas. Bioethanol trucks (waste and distribution) and buses are offered by Scania.

Stockholm Public Transport Authority, SL, has started operating its fleet with bioethanol fuel since 1990. The basic differences between bioethanol buses and conventional diesel ones are the different injection timing, the fuel pump with bigger flow capacity and the existence of filters made of materials more resistant to alcohol Biofuels Cities (2008b). In this category of heavy duty vehicles, bioethanol blends of ED95 and E100 constitute the key substitutes of diesel and petrol. In the terms of BEST project (Bioethanol for Sustainable Transport), approximately 130 buses were demonstrated in three sites across Europe, proving that ED95 is a safe fuel with the prospective for larger use in vehicles like trucks. As the bioethanol fuel contains less energy than diesel, bioethanol buses require more fuel by volume, although the energy consumption remains the same. In addition, despite the fact that bioethanol buses enclose increased operation costs compared to diesel buses and need maintenance more frequently, they are considered as a reliable and greener mean of transport both by drivers and passengers. On the other hand, biodiesel buses are less popular, standing for 29% of the fleet in Luxembourg, 18% in Austria and 6% in Spain (VITP 2010).

According to the same study, if projections were to be made for the future of European bus fleets, a realistic figure would consist of around 15,000 bioethanol buses, due to the fact that there is only one manufacturing company, while the case of Sweden is a highly optimistic scenario for the rest of the Europe. As for bioethanol fuelled trucks, the uncertainty of future projections is higher, as they are still in a pre commercial market stage and despite the increased interest of transportation companies estimations are hard to be made.

Passenger Cars

Biodiesel and bioethanol still constitute the two prevailing choices for green fuels and are anticipated to be the dominant alternative fuels for at least the next decade. When used as mass fuels (low blends) in diesel or gasoline, none or negligible adaption of the existing vehicles is required. When it comes to higher blends, Flexible Fuel Vehicles (FFVs) which are compliant with various combinations of biofuels and fossil fuels, tend to be the most easily accepted alternative choice.

FFVs are mostly available in the Swedish market, but also in Germany, Netherlands, UK and France. With the initiative of Ford car manufacturer, in late 2000 about 2,000 medium sized FFV models, Ford Focus Flexi Fuel, were brought into market. This resulted to the rapid growth of FFV, so today they account for 140,000 on the whole Europe, both in captive fleets but mostly as private ownership. In 2008, approximately 250,000 of new passenger cars were recorded in the Swedish market; among which 68% of the environmentally friendly cars were FFV/E85 (Biofuels Cities 2008c).

In addition, the launch of a legislation making compulsory the establishment of a fuel pump for biofuels at every oil tank station is the main reason why Sweden is the leading European country in the distribution and end use of E85. If the rest of the European Member States follow the example of Sweden, then the market of FFV can become really successful in a period of 10-15 years, as today it is hard to sell this type of vehicles due to low or no market demand and no refuelling stations.

Diesel Vehicles

Diesel, compression ignition, engines are still the dominant type of powertrains, used in road vehicles. They can easily be fuelled by biodiesel blends, which do not have significant differences in terms of energy density, cetane number, heat of vaporisation and stoichiometric air/ fuel ratio of biodiesel (A. K. Agarwal 2007) compared to conventional diesel.

Biodiesel can be used either blended in diesel oil or pure (100%), usually without any engine modification required. The European Commission has set a diesel fuel specification (EN590), according to which 5% is the maximum level for blending of biodiesel in fossil diesel (B5). Nevertheless, amendments established by the Fuel Directive 2009/30/EC, allow the blend level to be up to 7%.

Higher blends, of up to 30% (B30) are also scarcely used, whereas some car manufacturers allow the use of pure biodiesel (B100).

In general, when using biodiesel B5 the modification of vehicles' technology is not required and the majority of car manufacturers accept this fuel type. Nevertheless, the vehicles adaption by using relevant materials is indispensable when pure biodiesel B100 or even B10 is used. Existing commercial cars designed for Euro 5 emission criterion and passenger cars meeting Euro 3, are compatible vehicles with B100 fuel, opposed to Euro 4 diesel vehicles. However, since 2009, vehicle manufacturers do not fully approve pure biodiesel for the newly introduced car engines.

Biodiesel fuel availability in the European Union differs, depending on each country. Germany is using pure biodiesel as a fuel since 1993 (SUGRE 2005). Indeed, in 2005 the B100 market of the country was flourishing, reckoning 1,900 filling stations, although that today, due to modifications in the taxation system, the B100 consumption is presenting a certain decline. However, in order for the country to fulfil its commitments to the EU Directives the proportion of blends has to be over 5%, so a future opportunity for Germany is to use either B7 or B7+3, which contains 7% biodiesel and 3% HVO blended to diesel oil (European Biofuels Technology Platform). B30 on the other hand, is often used in Member states such as France and the UK.

Gasoline Vehicles

Almost half of the passenger cars that are available in the current market run on gasoline (petrol) engines. These types of engines are internal combustion engines with spark ignition, which use spark plugs so as to start the combustion procedure, and are intended to run on volatile fuels, like petrol.

As bioethanol is a biodegradable fuel and less toxic than petrol, it can be utilized as an alternative fuel. The European standards (EN228) as well as the Fuel Directive 98/70/EC, permit a 5% vol. of anhydrous bioethanol to be blended in petrol. Various amendments though, made after 2009, allow the use of E10 (10% anhydrous bioethanol and 90% petrol).

Low blends of bioethanol can be utilized without any engine adjustments; certainly all the filling stations in Sweden and Germany at the moment distribute E5, whereas higher blends of 15% and 20% can still be compatible with European exhaust gas instructions and operate without any engine adaption. Moreover, E10 blend is compatible to almost all the vehicles, except only from for DI gasoline cars with first generation fuel injection systems provided with rails made of aluminium (European Biofuels Technology Platform).

High blends of bioethanol, due to their significant differences with fossil fuels, necessitate certain changes to the engine technology as well as modifications to the fuelling infrastructure. Flexi Fuel Vehicles (FFV), are recently developed vehicles, capable of running on either petrol only, or any blend of the two fuels burned into the same fuel tank. E85 is the highest bioethanol blend available on the market, because of the difficulties encountered when striving to start a gasoline engine fuelled by pure bioethanol, particularly in low temperatures.

Sweden is one of the dominant actors in the bioethanol market, with already 160,000 bioethanol cars available in public. Furthermore, in Sweden, since mid 2008 it is also permitted to retrofit gasoline vehicles to bioethanol, with the restriction to meet the same emissions standards after the retrofitting

(Biofuels Cities 2008b). “Taxi Stockholm” is running its fleet on bioethanol as well, as E85 is easily refuelled in almost every filling station without any special financial restrictions.

Aviation

Today, the fuel used for aviation is kerosene, a blend of hydrocarbons of crude oil. However, lately, due to the high jet fuel prices, which provoke a large impact on airlines’ operating costs, and to the need for emissions savings, as the fines to be paid by airlines for exceeded CO_2 emissions since 2012 would be huge, constitute imperative the need for jet fuel replacement. Despite the fact that there exist a great variety of alternative fuels, the fuels used in the aviation industry have to meet certain specifications in order to be considered as attractive options. Indeed, the airlines can accept only “drop-in” fuels, meaning that the fuel should be in accordance with the existing fuel specifications, such as the energy content, the freeze point or the thermal stability, the engine technology and the infrastructure (E4tech 2009).

Most of the biofuels used in road are not in all cases suitable for jet fuel replacements. The most popular biofuels for aviation are biomass-to-liquids (BTL) and hydro treated renewable jet (HRJ). The former is deriving from Fischer Tropsch (FT) synthesis after gasification of biomass feedstock, whereas the latter involves the use of either conventional vegetable oils like palm and soy, or lately new ones like jatropha and camelina. When used as an aviation fuel, BTL should ideally be used as a 50% blend in petroleum derived jet fuel, due to the differences on their performance features. The biomass derived synthetic fuel is lacking of napthenes and aromatics and is likely to operate worse in lower temperatures compared to original jet fuel. In a similar way, the upgrading of vegetable oils as well, shall ensure the freeze point specification for the jet fuel, while a blend of about 50% of HRJ with fossil jet fuel is expected to be permitted since 2012 (E4tech 2009).

3.3 Analysis of Influecing Factors

This section of the report provides results from thorough analysis of stakeholder inputs. The team contacted a representative range of experts throughout Europe and conducted detailed interviews with duration typically two hours. The qualitative analysis used a set of subjective assumptions to gauge the influence that each key factor has for each segment. This was largely based on the evidence gathered in the semi-structured interviews.

The qualitative analysis of the EU27 transport market was conducted in a systematic manner by constructing a matrix in which the key factors and market segments are listed in columns and rows respectively. Scores are assigned based on whether the factor is a driver (1 to 3) or barrier (-1 to -3) or neutral (0). For some segments, factors are not applicable (na).

A matrix of the qualitative analysis is presented below.

Summary percentage scores by each of the categories – technical, economic and organisational – are shown below. Percentages scores are based on the maximum attainable score, making an allowance for factors that are not applicable to any particular segment.

Finally, the results are described in four graphs, showing overall total percentage score and the score for each category of influencing factor, namely technical, economic and organisational.

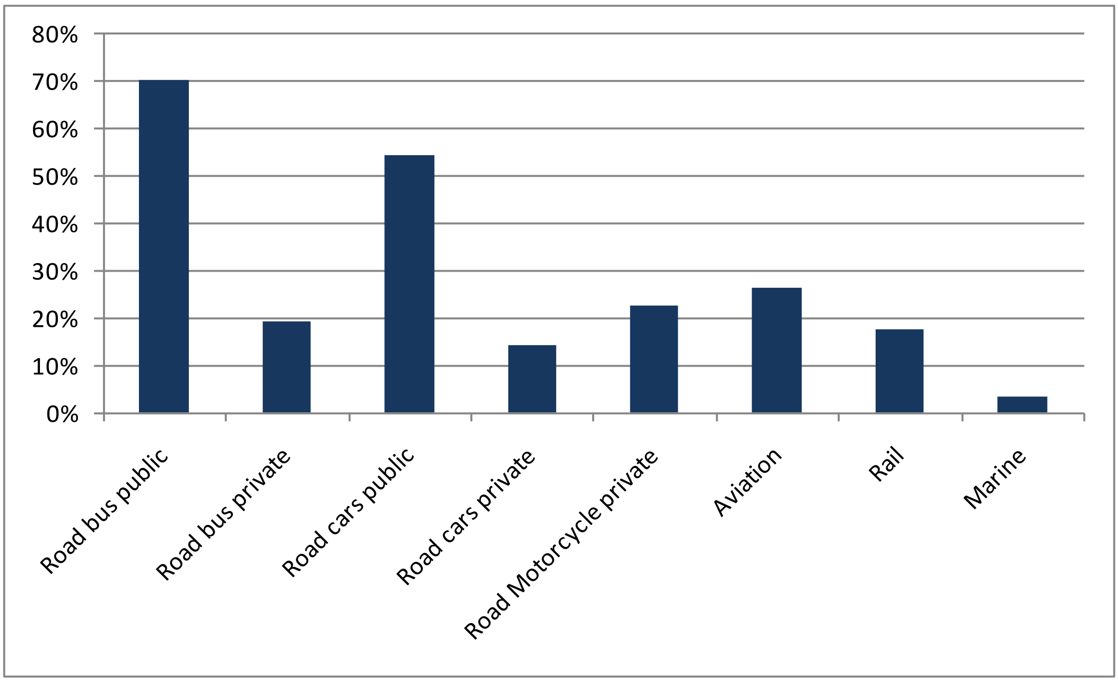
Influencing Factors and Market Segments Matrix

	Road bus public	Road bus private	Road cars public	Road cars private	Road Motorcycle private	Aviation	Rail	Marine
Technical								
Reliable technology	3	3	2	2	1	2	2	2
Biofuel content in mass market	3	1	3	1	1	3	1	1
GHG savings from full chain	2	2	2	2	2	3	2	2
Extensive refuelling infrastructure requirements	3	2	2	2	2	-1	-1	-2
Safety and standardization	2	2	2	2	2	2	2	2
Ensure compatibility of new engines in higher blends	3	0	2	-3	-2	-2	-2	-3
Labelling	1	-2	1	-2	-1	1	-1	0
SUBTOTAL	**17**	**8**	**14**	**4**	**5**	**8**	**3**	**2**
Economic								
Financing new technology	1	-1	1	-1	-1	-3	-2	-1
Capital costs	1	-1	2	1	1	-3	-2	-1
Variable subsidies and grants	2	2	2	0	0	0	0	2
Oil and gas price increases	3	2	3	2	1	3	3	na
Operating and maintenance costs	na	na	na	na	na	0	1	-1
Access to loans-cost of capital	1	-1	1	0	-2	-3	na	na
SUBTOTAL	**8**	**1**	**9**	**2**	**-1**	**-6**	**0**	**-1**
Organisational								
Variable reliability of incentives	2	2	2	3	3	2	2	2
Lack of joined-up Government policy across different ministries	3	1	2	1	3	3	2	1
Security of feedstock supply	3	2	2	-2	2	3	2	-1
Good organizational capability	2	-1	0	1	0	1	0	0
Administrative issues and planning	2	0	2	-3	1	2	-1	-2
Challenge of balancing short-term interests and environmental agenda	3	-2	0	2	0	2	2	1
SUBTOTAL	**15**	**2**	**8**	**2**	**9**	**13**	**7**	**1**
GRAND TOTAL	**40**	**11**	**31**	**8**	**13**	**15**	**10**	**2**

Influencing Factors and Market Segments – Summary Percentage Scores

	Road bus public	Road bus private	Road cars public	Road cars private	Road Motorcycle private	Aviation	Rail	Marine
Technical	81%	38%	67%	19%	24%	38%	14%	10%
Economic	44%	6%	50%	11%	-6%	-33%	0%	-6%
Organisational	83%	11%	44%	11%	50%	72%	39%	6%
Total Score %	70%	19%	54%	14%	23%	26%	18%	4%

Influencing Factors and Market Segments – Total Percentage Score



The overall scores indicate two segments which are relatively well predisposed for biomass. In descending order of attractiveness, these are:

- road bus public
- road cars public

These segments score between 55-70% of the maximum available score. This is a qualitative assessment so there are limits to numerical interpretation. However, the scoring does indicate that, while these segments are relatively attractive, there is a presence of some weak drivers and barriers throughout these sectors.

The aviation segment is ranked third in attractiveness, substantially below the above-mentioned segment. However, the analysis below of the individual categories of influencing factors will show that the low score is due largely to economic considerations, which it is argued could be overcome.

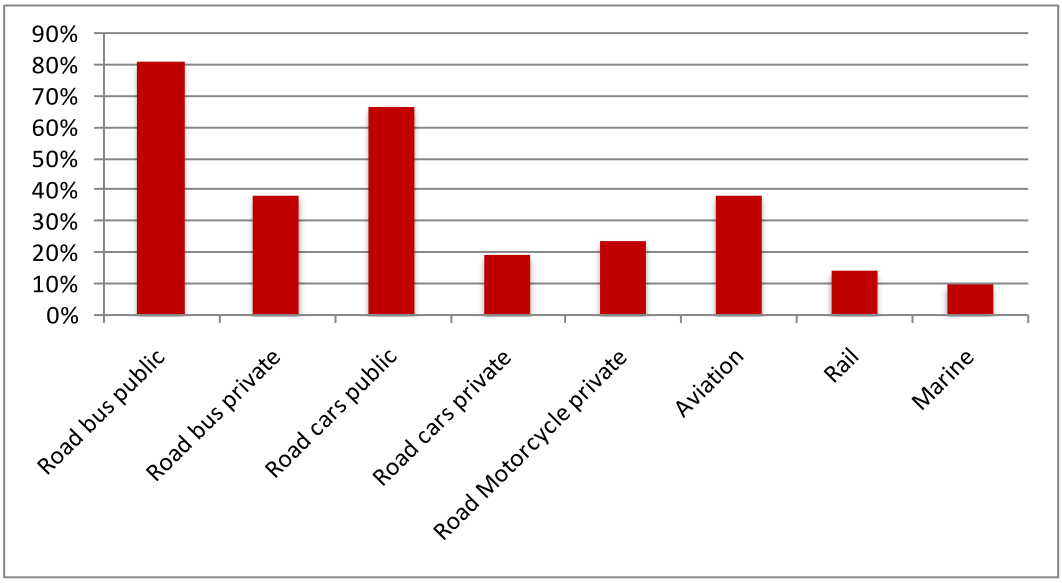
The other five sectors are relatively less disposed to biomass penetration. In descending order of attractiveness, these are:

- road motorcycles private
- road bus private

- road cars private
- rail
- marine

These five segments, with scores below 20% than the maximum attainable score, have clearly got few strong drivers and a predominance of barriers. The matrix of all the factors and segments above shows several instances of strong barriers (scores of -3). Further examination would help establish if these are showstoppers in perpetuity or whether further actions by policy-makers, industry etc. could reduce or remove these barriers.

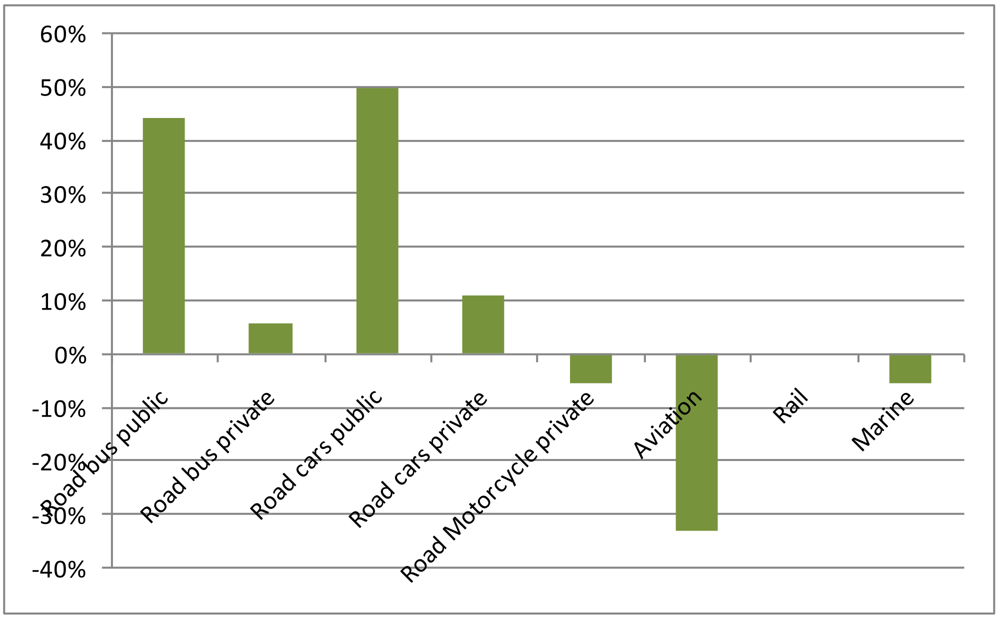
Influencing Factors and Market Segments – Technical Percentage Score



The technical scores broadly correspond with the overall scores. The two segments road bus public and road cars have particularly high scores. This reflects the fact that these are well-proven applications, with good refuelling infrastructure, and fleets are centrally controlled so decisions to switch to biofuels are easier to take. The market share for biofuels is potentially very high. Road bus private also indicates a good score in the technical factors, mainly due to proven technology and good refuelling infrastructure.

Low technical scores in the rail and marine sectors reflect the fact that this sector has a lot of inertia; technical development in these industries is rather slow. Individual investments - the ships and vehicles and their engines – are large. The ships and vehicles have long life expectancies – perhaps 15-25 years. Hence, penetration of this market with new technologies would take a relatively extended period of time, compared with road vehicles or even with aviation.

Influencing Factors and Market Segments – Economic Percentage Score



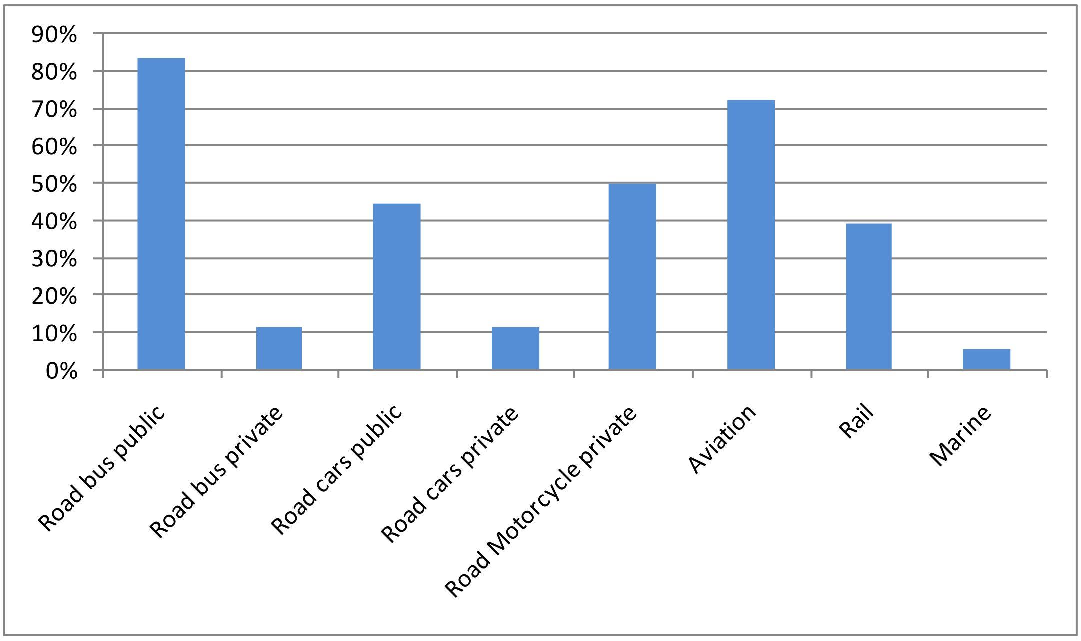
Economic scores are high for only two segments:

- road cars public, and
- road bus public

As far as the economics of biofuels are concerned, the costs depend mostly on feedstock prices. Regarding first generation, as production process technology is mature and widely used, there exist modest chances for costs reductions. However, in the longer term, lingo-cellulosic feedstock and processes like gasification and hydrolysis for biofuel production are projected to have lower costs.

The replacement of jet fuel by biomass derived fuels constitutes a matter of debate. The cost implications that aviation alternative fuels pose are quite high. On the other hand the emission savings that could be achieved from fuel replacement are also very high. Moreover, aviation remains a ”premium” type of travel, where passing on increased costs to customers may be easier to achieve.

Influencing Factors and Market Segments – Organisational Percentage Score

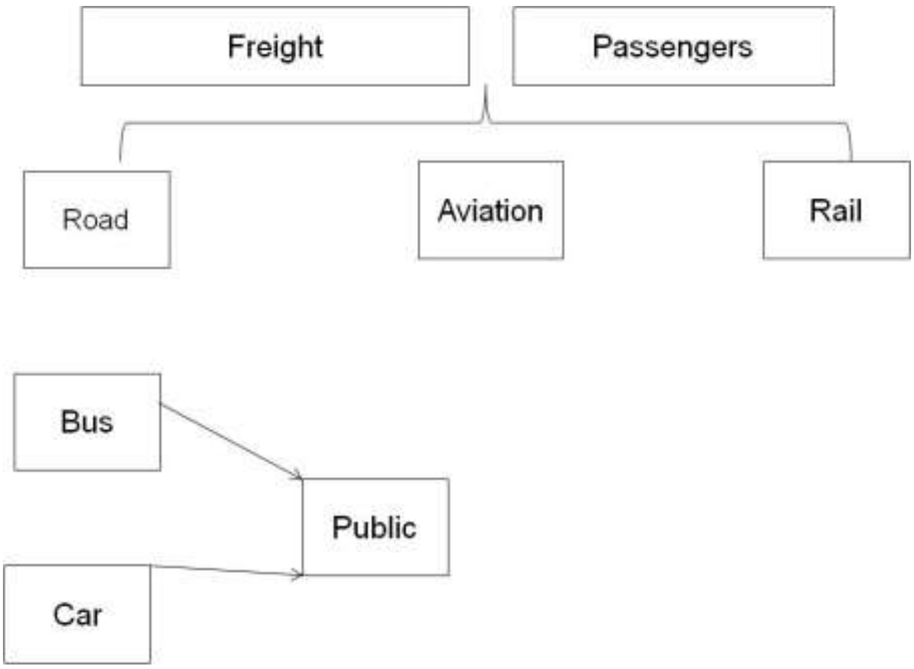


Road bus public scores highly with regards organisational factors. This is due to the facts that owners of bus fleets are likely to have environmental priorities, and are well placed to make decisions affecting large numbers of vehicles. Aviation also scores well, which is also due to the priority given to the environemtal agenda and for the ability for decisions by the Boards of Directors of a few very large companies to make profound changes. Aviation is in the public eye with regards its environmental impact, and most companies are seeking to improve their image.

3.4 Market Segments for Biomass Uptake by 2020

The four market segments with best potential for penetration by 2020 are illustrated in the following diagram.

Market Segments with Best Potential for Biomass in the EU27 transport sector



Stakeholders (interviewed)

Biofuels for transport

	Name	Organisation	Contact Details
1	Patrik Klintbom	Volvo Technology Corporation	patrik.klintbom@volvo.com
2	Dorothee Lahaussois	Toyota	Dorothee.Lahaussois@toyota-europe.com
3	Véronique HERVOUET	Total	veronique.hervouet@total.com
4	Jukka-Pekka Nieminen	Neste Oil Oyj	Jukka-Pekka.Nieminen@nesteoil.com
5	Beatriz Alonso Martínez	Abengoa Bioenergy New Technologies	beatriz.alonso@bioenergy.abengoa.com
6	Gloria Gaupman	EBIO	gaupmann@ebio.org
7	Rainer Janssen	WIP	rainer.janssen@wip-munich.de
8	Kyriakos Maniatis	DG TREN	Kyriakos.maniatis@ec.europa.eu
9	Eric van den Heuvel	ECOFYS	e.vandenheuvel@ecofys.com
10	John Rimmer	Shell	j.rimmer@shell.com

Heat & Electricity

	Name	Organisation	Contact Details
1	Lena Dahlman	SVEBIO	Lena.dahlman@svebio.se
2	Luc Pelkmas	VITO	luc.pelkmans@vito.be
3	Gustav Resch	Technical Univ. Vienna	resch@eeg.tuwien.ac.at
4	Thomas Boudet	COGEN	thomas.bouquet@cogeneurope.eu
5	Esa Sipila	Poyry	esa.sipila@poyry.com
6	Kai Sipila	VTT	kai.sipila@vtt.fi
7	Jose Riesgo	DG TREN	Jose.Riesgo@ec.europa.eu
8	Andrew Lamb	Scottish and Southern Energy plc	andrew.lamb@sse.com