Assessment of Policy Impacts on Sustainability in Europe

The Austrian transposition of the EU Renewable Energy Directive and its interactions with other environmental objectives (focussing on biofuels for transport)

Daniel Steiner, Andreas Tuerk, Maria Hingsamer, Dorian Frieden

JOANNEUM RESEARCH

daniel.steiner@joanneum.at

Graz 2013

Table of Contents

List of Tables

List of Figures

1. Background and problem description

The CO_2-emissions in Europe from the transport sector have increased by 50 % between 1990 and 2010 to 1,113 billion tonnes (European Commission, 2010). For making the mobility sector more sustainable and climate friendly biofuels as bioethanol, biodiesel and biomethane are intended to contribute to this aim. This aim is achieved in the member states in different ways, because country-specific characteristics and conditions have to be taken into consideration.

The promotion of biofuels leads, however, potentially to interrelations with other environmental goals regarding biodiversity, water bodies' protection and waste reduction. Furthermore agriculture and climate protection issues are of interest in this respect. Thus, the case study will explore how the aims of the EU Renewable Energy Directive (with special focus on biofuels for transport) are achieved in Austria, which national policy framework has been established for transposition and what are the (positive and negative) interactions with other (mentioned) environmental policy objectives (biodiversity, water bodies' protection, etc.). The basis of this analysis on the Austrian level is the EU Renewable Energy Directive ("RES Directive", 2009/28/EC) as well as the repealed Biofuels Directive (2003/30/EC).

Starting position and general conditions in Austria:

The Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport („Biofuel Directive") has established a goal of reaching a 5.75 % share of renewable energy in the transport sector by 2010. Under the Directive 2009/28/EC ("RES Directive") this goal was increased to 10 % until 2020. In addition the RES Directive includes also provisions to ensure the use of sustainable biofuels only.

In 2012, the targeted RES share of 5.75 %[1] was exceeded to 6.77 %[2] (energy content) in Austria. The aim of increasing the share of biofuels in the transport sector is achieved in Austria mainly by blending biofuels to conventional fuels to a certain extent. There are separate substitution obligations (energetically) for biodiesel (6.3 %) and bioethanol (3.4 %), which can be achieved by blending 7 % biodiesel and 5 % bioethanol.[3]

In 2012 around 265,445 tons of biodiesel were produced in Austria.[4] The domestic production was composed by 69.3 % from (fresh) vegetable oil (e.g. from rapeseed oil), 19.5 % used cooking oil and 10.3 % animal fat.[5] In the domestic production no fresh palm oil was used.[6] However, taking into account that around 498,761 tons were sold in Austria in 2012[7], the share of net-imported biodiesel is substantial[8] (although the Austrian production capacity of 645,000 tons exceeds annual domestic demand).

1 There are no interim targets between the target of 2010 (5.75 %) and 2020 (10 %).
2 In 2010, the RES target was exceeded to 6.57 %.
3 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.
4 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.
5 Information ARGE Biokraft – Biokraftstromproduktion 2011 auf konstantem Niveau.
6 Information ARGE Biokraft – Biokraftstromproduktion 2011 auf konstantem Niveau.
7 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.

Regarding bioethanol, around 105,715 tons[9] have been used in Austria in 2012. In the only bioethanol production plant around 171,000 tons where produced.[10] This implies that, despite some imports, Austria is a net-exporter of bioethanol. The domestically produced bioethanol was produced to 55 % by maize and to 45 % by wheat.

Biogas/ biomethane play only a minor role in the Austrian biofuel sector for transportation purposes. In Austria biogas/ biomethane is mostly used for the generation of electricity and heat.[11] In 2011 only 22.5 tons biomethane have been used for transportation purposes, in 2012 this amount increased to 540 tons.[12] This signals a high growth rate of using biomethane for transport purposes, although it is still on a very low level.

The amount of vegetable oil directly used for transportation purposes is difficult to survey and of very minor importance in Austria. Therefore it will not be considered in the analysis. Also e-mobility will not be considered in the analysis (counts to the share of 5.75 %), as it goes beyond the focus of this case study.

The Austrian energy strategy considers all types of biofuels as possible contribution to achieve the 10 % target. For that, also 2nd generation biofuels are intended to be pushed.

Which interrelations are assumed:

For the production of biofuels several interactions with other environmental goals are anticipated, which have to be analysed in detail. In general the same environmental interactions related to growing feedstock (maize, wheat, oil crops) arise which would also arise if the same feedstock would be used for food.

Regarding protection of water bodies, it has to be analysed whether cultivation of feedstock for biofuels crowds out plants which are in less need for fertilization. This possibly implies that increasing need for feedstock for biofuels increases also fertilization and therefore potentially increases eutrophication and greenhouse gas (GHG) emissions (N_2O from fertilization). Also the potential use of pesticides and its impacts on the groundwater has to be analysed. In some countries the water need for growing feedstock used for biofuels might be an issue. Regarding biodiversity it has to be analysed whether an intensified need for feedstock adversely impacts biodiversity ("intensified agriculture").

However, positive impacts on the soil quality might arise if oil plants (e.g. rapeseed) are grown by practicing crop rotation as the leaching of the soils might be decreased. Processing used cooking oil reduces waste. The residuals from bioethanol production can be either used as high quality (high-protein) animal feed or as input for biogas/ biomethane production. This cascadian use of raw materials increases the resource efficiency of natural resources.

---

8 See also Information ARGE Biokraft – Biokraftstoffproduktion 2011 auf konstantem Niveau; or National Renewable Action Plan for Austria, p. 66.

9 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.

10 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.; The annual production capacity is 191,000 tons.

11 Umweltbundesamt (2013a); Biokraftstoffe im Verkehrssektor 2013.

12 Austrian Federal Environment Agency (2013); Biokraftstoffe im Verkehrssektor 2013.

One main intention of biofuels use is the reduction of fossil fuel originated GHG in the transport sector. Therefore, the anticipated reductions of GHG by intensified use of biofuels have to be compared with GHG emissions connected to the growth of feedstock and the processing of the feedstock to biofuels. A special focus has to be laid on the environmental (and climate) impacts from biofuels being imported.

2. From EU directives to national policy instruments

2.1 EU Directives and corresponding national policy instruments

In achieving a renewable energy share in the transport sector of 10 % by 2020 the aforementioned "**Renewable Energy Directive**" (2009/28/EC) forms the key policy framework of this analysis. This directive includes the obligation to achieve this 10 % target, among others via biofuels which have to fulfill certain sustainability criteria. In understanding the evolvement process of this policy framework and its characteristics, also its "predecessor directive", the "**Biofuels Directive**" (2003/30/EC) has to be taken into consideration. This directive included a target for the share of biofuels of 5.75 % by 2010. Besides these directives also the following political frameworks affect the efficiency and effectiveness of the 10 % renewables target in the transport sector:

The "**Energy Taxation Directive**" (2003/96/EC) enables EU member states to allow an energy tax exemption by up to 100 %.

The "**Quality of Otto- and Dieselfuels Directive**" (2011/63/EU) defines the quality standards of fuels for protecting human health and ensuring a sound status of the environment.

The "**Fuel Quality Directive**" (2009/30/EC) aims to reduce life cycle GHG emissions from production, transport and usage of transport fuels by 10 % by 2020. Suppliers of transport fuels are responsible for reducing life cycle GHG emissions by 6 % by 2020 either by mixing conventional fuels with biofuels or by flaring residual gases from the oil production and processing.

The **European Common Agricultural Policy** (CAP) works as the major instrument for steering, protecting and supporting the EU agriculture sector. It influences the prices for agricultural goods (via subsidies and quotas), thereby e.g. determining which agricultural goods are used for biofuel generation. It also sets standards for agricultural practices, thereby affecting other environmental issues like biodiversity as well as soil and water quality.

The "**Waste Framework Directive**" (2008/98/EC) forms (beside other European legislation regarding waste) a main basis for national waste legislation. It amends directive 2006/12/EC. Its improvement is the introduction of a 5-step "waste hierarchy" and an obligation to develop a waste avoiding strategy/programme. Furthermore it extends the responsibility for waste producers and –holders to make sure that waste is treated in a proper and environmental friendly way.

The "**Groundwater Quality Directive**" (2006/118/EC) complements and concretizes the Water Framework Directive. It intends to protect the groundwater against pollution and deterioration. It is the legal basis for national water protecting legislation.

The "**Nitrate Directive**" (91/676/EEC) intents to protect water bodies against pollution caused by nitrates from agricultural sources. It is the legal EU basis for national decrees and action plans to restrict nitrate entry into soil (and groundwater).

The “**Habitats Directive**” (92/43/EEC) intents establishing areas to promote and protect wild animals and plants. The main instrument is the attribution of land to Natura 2000 areas (in combination with the Birds Directive, 2009/147/EC). As it defines specially protected areas it rather indirectly affects the case study as these areas might be not eligible for growing feedstock for (necessary sustainable) biofuel generation.

Based on these directives national policy instruments have been created or influenced respectively or existing national policy instruments have been adapted. In addition national policy instruments exist which where not implemented due to certain EU directives, but nevertheless serve targets of EU directives.

Table 1: *National policy framework around "The Austrian transposition of the EU Renewable Energy Directive (focusing on biofuels for transport)"*

Environmental policy theme	National Policy instruments				
Energy	**Fuel decree** Änderung der Kraftstoff-VO 1999, i.d.F.398/2012)	**Decree regarding agricultural outputs for biofuels** (VO über landwirtschaftliche Ausgangsstoffe für Biokraftstoffe und flüssige Biobrennstoffe, 250/2010)	**Mineral oil tax law** (Mineralölsteuer-Gesetz 1995; geändert durch Budgetbegleitgesetz 2007 (§9), Abgabenänderungs-Gesetz 2009 (§5) und Budgetbegleit-Gesetz 2011 (§83))	**Decree for bio-ethanol mix** (Bioethanolgemisch-VO 2005, i.d.F. 2007)	**Programme „Klima:aktiv"**
Climate		**Law for ecologisation** (Ökologisierungsgesetz 2007)	**Environmental support subsidies**		
Agriculture	**European Agricultural Fund for Rural Development (EAFRD)** (Österreichisches Programm für die Entw. des ländlichen Raums 2007-2013)				
Waste	**Waste management act** (Abfallwirtschafts-Gesetz 2002, i.d.F. 9/2011)				
Water	**Decree for "action plan nitrate"** (Verordnung über das Aktionprogramm Nitrat 2012, 87/2012)	**Styrian agricultural soil protection act** (Steiermärkisches landwirtschaftliches Bodenschutzgesetz, i.d.F. 08/2004)	**Water act, Quality target decree – chemistry groundwater** (Wasserrechtsgesetz 1959 i.d.F.123/2006)		
Biodiversity	**Styrian Nature Conservation Act** (Steiermärkisches Naturschutzgesetz i.d.F. 84/2005)	Decree regarding agricultural outputs for biofuels SEE ABOVE			

- ■ ***Renewable Energy Directive (2009/28/EC)***
- ■ ***Energy Taxation Directive (2003/96/EC)***
- ■ ***Directive on Quality of Otto and Dieselfuels (2003/17/EC)***
- ■ ***Fuel Quality Directive (2009/30/EC)***
- ■ ***Groundwater Directive (2006/118/EC), Nitrate Directive (91/676/EEC); Habitats Direcitve (92/43/EEC)***
- ■ ***European Common Agricultural Policy***
- ■ ***Waste Framework Directive (2008/98/EC)***

Fuel Decree: Defines (a.o.) required minimum blending shares of biofuels to conventional fuels; possibilities for double counting of biofuels from waste and other non-food materials; required minimum GHG reductions of biofuels compared to conventional fuels; determines requirements and processes for certification of biofuels to be eligible for counting as contribution to the RES share and the blending obligation.

Decree regarding agricultural outputs for biofuels: Defines sustainability requirements of feedstock production for biofuels, in order to comply with the cross-compliance obligations (Common Agricultural Policy) and natural habitat laws. It concerns the producers of agricultural feedstocks for biofuel production as well as producers of biofuels who are using these agricultural feedstocks.

Mineral oil tax law: Defines the tax rates on mineral oil products. Includes tax exemptions for blended biofuels, i.e. includes different tax rates for 100 % fossil versus partly blended fuels.

Decree for bioethanol mix: Defines tax refundings for superethanol (conventional liquid fossil fuels blended to a high degree with bioethanol); concerns enterprises in charge of producing, processing and delivering of superethanol.

Law for ecologisation: Law gives tax incentives at the initial purchase of cars to promote cars with “unconventional” engines (natural gas/biogas-, hybrid-, pure biofuels-, electric cars). Also it includes a kind of bonus-malus system to reward cars with low GHG emissions and penalize cars with high GHG emissions.

Environmental support subsidies: Subsidize on the one hand facilities producing biofuels, but subsidize also the purchase or conversion to “alternative” engines (subsidies only eligible for businesses).

European agricultural fund for Rural Development: Funds certain agricultural practices (e.g. intertillage) which have impact on the supply of raw materials for biofuels (esp. biogas) production; includes “cross-compliance obligations” for environmental sustainable agricultural practices; includes subsidies for farmers willing to construct biogas production plants for upgrading to biomethane quality.

Waste management act: Includes the 5-steps “waste hierarchy”. Defines how waste has to be treated, and therefore provides the basis that certain fractions of waste are available for biofuel/biogas production. In principal all waste holders are affected, because they are responsible for a proper treatment of waste.

Decree for “action plan nitrate”: Intends to protect water bodies potentially contaminated by nitrate from agricultural sources (also by fertilizers); also relevant for biogas production plants putting digestates on fields (also for fertilization).

Agricultural soil protection act (for the exemplary case of the Federal Austrian State of Styria: Defines in principal prohibitions for fertilisation (date, sites) and necessary actions for preserving the quality of agricultural land (soil fertility, protection against soil erosion and soil compacting). Each Austrian Federal State defines its soil protection act; therefore the example of one Federal State (Styria) has been taken.

Water act, Quality target decree – chemistry ground water: Decree defines minimum quality standards for groundwater (=maximal pollution) and actions for limiting the pollution of groundwater. In the case of extensive pollution, the governor has to define an area where intensified actions for groundwater protection have to be accomplished.

Styrian nature conservation act: Identifies nature protection areas (also Natura 2000 areas), therefore relevant for the production of feedstock for biofuels in eligible areas ("sustainability criteria")

Klima:aktiv: The initiative „Klima:aktiv" intends to promote climate protection by developing and providing quality standards and by eductating and consulting agents implementing certain technologies (e.g. installers of heating systems)

„Pendlerpauschale": It provides a certain tax refund for commuters to mitigating their cost burden for travelling to their workplace. This is not a specific environmental action and therefore not included in the table above, however it influences the transport volume. It impacts the volume of transport fuels consumed and therefore also the biofuel use and indirectly the biofuel share.

„Pendlereuro": It offers the possibility for commuters to annually set off one Euro per kilometer to the office and back against tax liability. It can be used additionally to the aforementioned "Pendlerpauschale". It is also not an environmental action, but influences the transport volume.

„Jobticket": With the "Jobticket" employers (voluntarily) can promote using public transport by their employees. They can do so by providing their employees tax free public transport tickets for the way to the office and back. Thereby companies can set the costs for these tickets off against their tax liabilities.

Income tax law: The income tax law contains tax differentiations between using private or enterprise owned cars. It therefore influences the use of cars.

2.2 Selection of national key policy instruments

Refering to the tables above achieving the renewable energy (RES) target in the transport sector is influenced by many different policy instruments. For a detailed evaluation of policy instruments (PIs) being responsible for achieving the RES target in the transport sector those national PIs are selected which directly refer to the EU directive 2009/28/EC, (the "flagship directive" for achieving the RES target in the transport sector). National PIs that directly refer to EU directive 2009/28/EC are the Austrian **Fuel decree** and the **Decree regarding agricultural outputs for biofuels**. For these national key policy instruments a detailed analysis regarding their effectiveness, efficiency and efficiacy is carried out in subsequent chapters. All other national PIs are not analysed in that detail but are included in analysing their impacts on the effectiveness, efficiency and efficiacy of the key policy instruments.

In order to understand why national key policy instruments where designed in a certain way it is necessary to be informed about the evolvement of the corresponding EU directives (2003/30/EC and 2009/28/EC). Therefore, subsequently the evolvement of corresponding

EU directives is outlined. This is followed by an overview of their effect on the design of the two analysed national key policy instruments.

Process of evolvement of EU directives 2003/30/EC and 2009/28/EC

Content and transposition of predecessor directive 2003/30/EC:

In 2003 the EU „Biofuel Directive“ (2003/30/EC) has determined specific biofuel blending targets. It aimed to “promote the use of biofuels or other renewable fuels to replace diesel and petrol for transport purposes”. This directive was introduced in view to “contributing to objectives such as meeting climate change commitments, environmentally friendly security of (fuel) supply and promoting renewable energy sources”. It included (legally not binding) indications of biofuel blending shares of 2 % in 2005 and 5.75 % in 2010. Austria has transposed this EU directive in November 2004 (Fuel Decree, “Kraftstoffverordnung”) by specifying specific, more stringent and mandatory targets (2.5 % by October 1st 2005, 4.3 % by October 1st 2007 and 5.75 % by October 1st 2009)[13] – although it was not required by the directive to state legally binding targets, it was just a political duty (COM (2006) 845 final).

The strong focus on biofuels originated already from other documents like the EC’s Green Paper “Towards a European Strategy for the Security of Energy Supply”, which sets the objective of 20 % substitution of conventional fuels by alternative fuels in the road transport sector by the year 2020. Also there was no strong belief that alternative fuels like hydrogen can substantially contribute until 2010. However, when first discussion about specific measures in the transport sector in 2001 started, the market share of biofuels was 0.3 % and most member states did not have experiences in biofuels. This was also not economically necessary and attractive because of the relatively low mineral oil prices. Because of this lack of knowledge the EC decided to choose a careful approach of setting indicative rather than mandatory targets, and frequently evaluate the progress of MS to decide whether adapted – or binding – targets are necessary.

First intentions of using only sustainable biofuels were already included in this Directive by requiring the EC to frequently report cost-effectiveness, economic and environmental aspects, the effect of biofuels on climate change (ILUC) and the long-term options concerning energy efficiency options in the transport sector. In the biannually provided progress report regarding biofuels from 2007 (COM (2006) 845 final), the EC stated already that biofuels could also effect greenhouse gas emissions adversely in the case that land areas with high ecological value are used for growing biofuel’s feedstock.

Sucess of predecessor directive 2003/30/EC:

Since 2003 the mineral oil price increased substantially, also oil and gas supply interruptions showed that the European transport sector is vulnerable because of its dependence on foreign energy sources (COM (2006) 845 final). Although the market share of biofuels doubled in two years and has reached a share of approx. 1% in 2005, the indicative target of 2% was still not met. Nearly all MS had respective legislation in place, but only few had

[13] Umweltbundesamt (2012b)

achieved the indicative target (COM (2006) 845 final). However, since 2005 the unevenness between MS has diminished.

Most EU member states tried to achieve the aims by tax exemptions. France and Austria had longer-lasting experiences with obligatory substitution shares. The effectiveness of this instrument can be shown by the example of Austria, where the share of biofuels in the first three quarters in 2005 has been 0.2 %, whereas after introducing the substitution obligation, the biofuels share raised to 3.2 % in the fourth quarter.

However, based on information of MS, expert consultations and modelling exercises, it was anticipated that the target of 5.75 % by 2010 would not be achieved by all EU member states.

Rationale for directive 2003/30/EC (COM (2006) 845 final):

- Fuel supply security for transport sector (avoided costs at short-term oil embargos are € 1 billion at 14 % biofuels share)
- Protection against too high mineral oil prices (signal to oil markets that Europe is seeking for alternatives - mandatory target is a more powerful signal)
- Economic value added (if most of biofuels are produced within EU, a 14 % blending rate would lead to 144,000 new employment opportunities).
- CO_2 reduction, as it is anticipated that feedstock production is made on set-aside land, or it protects land from being set-aside (up to 14 mio. t. CO_{2eq})
- Etc.

The way to directive 2009/28/EC:

The development from the „Biofuel Directive" (2003/30/EC) to the transport related part of the Renewable Energy Directive (2009/28/EC) was essentially influenced by the new findings of the "Biofuels Progress Reports" (European Commission (2007), European Commission (2009)), which summarized all new findings and biofuels' respective knowledge after the Biofuels Directive.[14]

These first "Biofuels Progress Reports" stated that biofuels will remain the only realistic option for the next years on the way of reducing oil dependency of the transport sector. The assumption of these reports was furthermore that biodiesel would be competitive at USD 60 per barrel mineral oil and bioethanol at USD 90. Other internal papers assume similar prices for the break-even of biofuels. This assumption about the break-even of biofuels might be too optimistic, as in such a case European production capacities would produce at peak production capacity.

Also, these reports assume that second generation biofuels will be in the market in 2020. Some market agents doubt that second generation biofuels (apart from biofuels from waste) will be provided to a large extent by 2020. The potential problem with ILUC was noticed, but

[14] Also combining all sectors (transport, electricity, heating) in one Directive tackling renewable energy targets was a reason for including the transport sector in the RES Directive

it was assumed that no unsuitable land will be needed to achieve a biofuel share of 14 %. For ensuring sustainable biofuels, these reports proposed respective provisions for protecting biodiversity and promoting future generation biofuels.

Summing up, the progress reports have underlayed optimistic assumptions about competitiveness of and potential for biofuels, also they see them as the only realistic option for making the transport sector less vulnerable. They considered potential problems related to biofuels (e.g. ILUC) and therefore proposed possible solutions countering these problems. However, regarding target achievement of certain MS, the progress reports were pessimistic.

The transport related part of the amending Directive 2009/28/EC took account of the findings of the progress reports. Specific features and improvements are:

- It determined binding targets for MS by 2020, both for ensuring target achievement and for providing security of investment.
- It emphasized that the target of 10% is not a required blending share of biofuels, but rather a share of renewable energies in relation to the gross energy demand in the transport sector.
- It included specific requirements about eligible areas for growing biofuel's feedstock in order to be accounted for biofuels eligible to be counted towards the target of the RES Directive.
- It included minimum GHG emissions resulting from biofuels in relation to reference fuels.

Regarding the potential problem of induced ILUC, the EC commissioned a respective analysis to explore the extent of ILUC from European biofuels. The study concluded that a specific ILUC cannot be determined. To be on the safe side, the study proposed a limitation of food-based biofuels to 5 %. Currently the EC is proposing a respective legislation.

National transposition of EU law

Austria transposed Directive 2009/28/EC by an amendment of the Fuel Decree ("Kraftstoffverordnung"). Based on a buttom-up analysis of potentials in the transport sector, it decided for requiring a biofuel share of 8.45 %, the rest is covered by other fuel types – with assistance of energy efficiency in the transport sector. This Fuel Decree also refers to sustainability and minimum GHG savings requirements. To ensure sustainability of biofuels produced by agricultural feedstock, the decree regarding agricultural outputs for biofuels (Verordnung "Landwirtschaftliche Ausgangsstoffe für Biokraftstoffe und flüssige Biobrennstoffe") was introduced.

<u>National implementation:</u>

In the same manner as implementing Directive 2003/30/EC, also the now binding targets of Directive 2009/28/EC are nationally implemented in Austria by an obligation for market agents to substitute conventional fuels with biofuels by a certain extent. This command & control measure includes only obligations for biofuels, but not for other types of fuels (e-mobility, hydrogen, etc.).

For achieving the biofuel share target, Austria has defined a minimum substitution target of 3.4 % for bioethanol and 6.3 % for biodiesel (energetically), where each fuel supplier is committed to. Converting this substitution obligation in terms of volume (not energy content), this substitution obligation can be achieved by E5 (95 % fossil, 5 % bioethanol) and B7 (93 % fossil, 7 % biodiesel). It has to be pointed out at this stage that market agents are committed by a substitution obligation and not by a blending obligation. This implies that market agents are free to decide whether they want to comply with this obligation by trading fossil fuels and biofuels separately, or offering blended fuels. They are restricted by maximum blending rates viable for the vehicle fleet. Also the mineral oil tax law provides tax exemptions for biofuels, but fiscal incentives are designed in a way that economically attractive blending shares are between a certain range. For instance, for a certain type of gasoline attractive tax rates are provided if at least 4.6 % bioethanol is added. However, for a higher blending share, tax incentives are not adjusted, so that market agents – taking into consideration higher production costs of biofuels – will not add more biofuels than necessary to gain tax advantages and to oblige to substitution targets.

Additional to that the decree regarding agricultural outputs for biofuels defines specific sustainability criteria for agricultural based feedstock for biofuels as required in Directive 2009/28/EC.

For achieving the Austrian national biofuel target of 8.45 %, an introduction of E10/B10 was considered to be necessary. Including this in the Fuel Decree each market agent would be obliged to this substitution rate. However, due to political reasons, targets for each type of biofuel have not been added in the Fuel Decree, but just an overall target of 8.45 %, which does not commit specific market agents.

In 2012 Austria was intending to expand the use of bioethanol by introducing E10, which was postponed as a result of bad experiences in Germany and the ILUC related analysis commissioned by the EC. Also B10 could not be introduced so far as no technical approval from car manufacturers has been given.

National monitoring and reporting:

For ensuring sustainability of biofuels Austria established a two-step monitoring system. The monitoring/certification system of the “Agrarmarkt Austria” (AMA) is responsible for monitoring sustainability of feedstock from agriculture and at processing this feedstock to intermediate goods. The monitoring/certification system of the Austrian Environmental Agency (UBA) is responsible for processing agricultural or intermediate goods to usable biofuels and at placing them on the market. However these national monitoring/certification systems need not be chosen by market agents, they could also get certification from other schemes like voluntary certification schemes as ISCC or RED Cert.

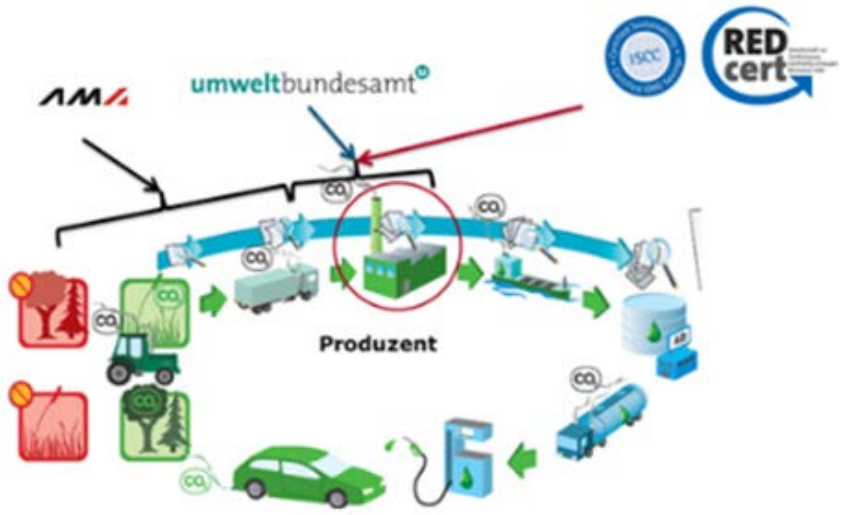

Figure 1: *Illustration of responsible institutions for sustainability certification within the process chain of producing feedstock till trading biofuels (source: Austrian Environment Agency)*

Regardless of selected monitoring/certification systems producers of biofuels have to insert data into the web application "elNA", which ensures to keep overview about produced, imported and traded biofuels. "elNA" generates "sustainability certificates" which are connected to respective amounts of biofuels.

National inspection and enforcement:

Due to the positive tax discrimination of blended fuels it is financially attractive for fuel suppliers to offer blended fuels rather than 100 % fossil fuels. In other words, the financial attractiveness of blended fuels ensures compliance. Without such a financial incentive penalties for non-compliance might be too low as they are just "administrative penalties" and therefore their maximum amount might be below excess costs of biofuels (depending on the respective biofuels' prices). However, large companies have installed compliance management systems which require compliance with national laws even if financially unattractive.

Market agents' evaluation:

Market agents report from high bureaucratic burden for monitoring/certification when Austrian biofuels are intended to be exported to other MS (due to necessary multiple certification).

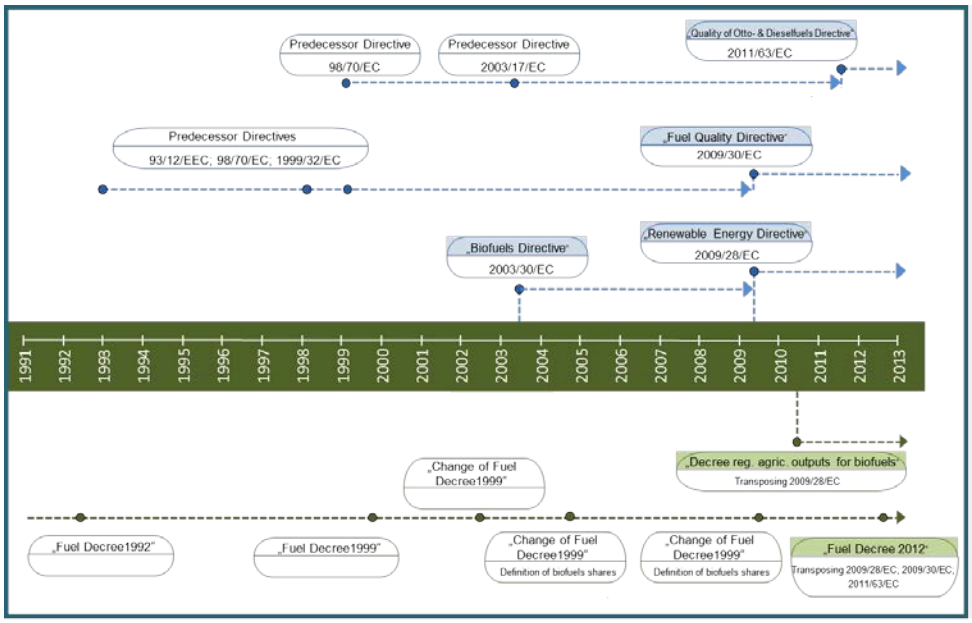

Figure 2: *Schematic illustration of history of crucial policies and policy instruments*

2.3 Identification of affected stakeholders

Effects from national policy instruments do not evolve from PIs per se, but from changing behavior of affected stakeholders caused by the incentives coming from national PIs. Subsequently an elaboration of stakeholders affected by the selected key policy instruments is carried out.

Fuel decree: The Austrian Fuel Decree directly refers to the whole sale and the retail sale sectors of liquid transport fuels by imposing obligations of blending biofuels to conventional fuels. Also it directly affects refineries of petroleum products as they are – on the one side – also often market agents of the fuel sale sector at the same time. On the other side they are affected by the Fuel Decree in a sense as the decree imposes obligations regarding to the environmental friendliness of transport fuels and includes sustainability criteria which have to be considered by refineries (= producers of transport fuels) in order that non-fossil fuels can be counted towards their biofuel obligations according to EU directive 2009/28/EC. Within the process chain of biofuels the Fuel Decree both affects manufacturers of oil-based biofuels and facilities to collect and treat waste (e.g. used cooking oil), as the decree provides the incentive that biofuels made by used cooking oil can be counted twice towards the biofuels target. This makes both collection and treatment of old cooking oil financially more attractive. This in turn affects the original holders of used cooking oil and their efforts to get rid of their waste. Also both private as well as business consumers are affected by the Fuel Decree as the obligations of the Fuel Decree finally influence the price of transport fuels.

Decree regarding agricultural outputs for biofuels: This decree imposes obligations in order that biofuels can be assigned to be environmentally sustainable. It mainly affects the biofuel's feedstock production (agricultural sector). However, also manufacturers of biofuels are affected by this decree as environmentally non-sustainable biofuels cannot be counted towards the biofuel target and therefore this decree affects whether, how and at what price produced biofuels are sellable on the market.

3. Effectiveness and efficiency of policy instruments

3.1 Effectiveness

Effectiveness of the Austrian Fuel Decree

The analysis of the effectiveness of the Austrian Fuel Decree assesses whether the required blending share is achieved and whether the trends lead to anticipation that targeted blending shares in the future are likely to be achieved. Furthermore the Fuel Decree demands minimum GHG savings compared to the fossil reference.

Developments in the past:

For achieving a RES share of 10% in the transport sector (required by 2009/28/EC) it is up to EU member states to decide to what extent biofuels should contribute to this target. Austria has decided that the share of biofuels needs to be increased to at least 8.45 % (energetically) until 2020[15]; the rest to the target of 10 % for the transport sector has to be achieved by other measures (e.g. e-mobility). The Austrian Fuel Decree does not refer to the 10% RES target, but – due to political decisions – to the required contribution of biofuels (8.45 % substitution rate).

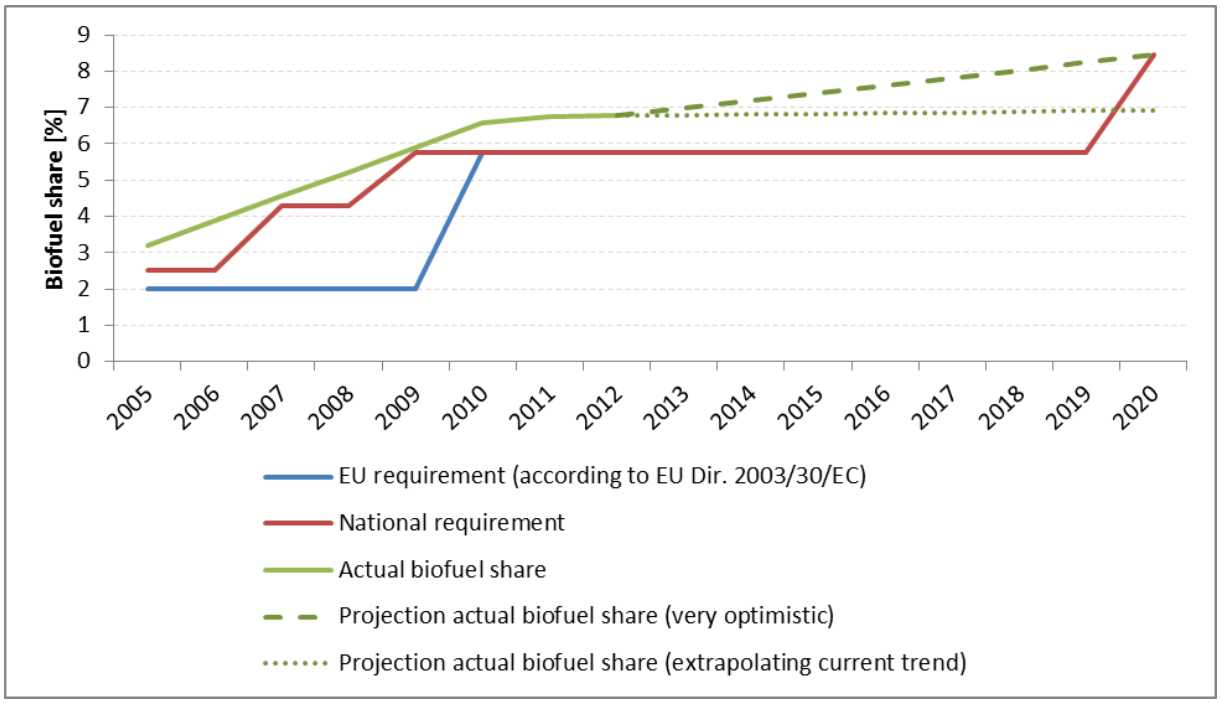

Figure 3: *Development of biofuel shares (EU requirements, national requirements, actual biofuel shares and projected trends); Source: Annual reports of „Biokraftstoffe im Verkehrssektor“ by Umweltbundesamt (Austrian Environment Agency)*

[15] These 8.45 % correspond to the substitution of fossil fuels by biofuels. The 10 % RES target of the transport sector also includes other fuels than biofuels (e.g. electricity for e-mobility), i.e. the calculation base for calculating the 10 % RES target differs from the calculation base for necessary substitution of fossil fuels by biofuels (8.45 %). “Converting” the 8.45 % towards the same calculation basis used for calculating the 10 % RES target achievement, the biofuels contribution towards the 10 % RES target is approx. 73 %.

In Directive 2003/30/EC ("Biofuels Directive") the EU has defined indicative targets of biofuel share of 2 % by 2005 and 5.75 % by 2010. In the repealing Directive 2009/28/EC ("RES Directive") the target of 10 % renewable energy share in the transport is defined, whereas the contribution of biofuels to this target is kept open to member states (i.e. the 5.75 % biofuel share required by the "Biofuels Directive" is not maintained).

Austria transposed corresponding EU directives and defined a minimum biofuels share of 2.5 % by October 1st 2005, 4.3 % by October 1st 2007 and 5.75 % by October 1st 2009. So the national targets for biofuel share have been always a bit more ambitious than the EU requirements. For 2020 Austria defined a minimum biofuels share of 8.45 %, which was determined by a bottom-up calculation process based on anticipated potential for biofuels and other alternatives. It was not anticipated that all biofuels used in Austria can be produced domestically.

The actual observed biofuels shares in Austria have exceeded every year the ambitious Austrian requirements. For instance in 2010 the actual biofuels share amounted at 6.58 % (target 5.75 %) and in 2011 it increased to 6.75 %. However, the growth rate diminished considerably. In 2012 the biofuel share has reached 6.77 %, which is just 0.02 % more than the year before. Reasons for this flattening of the increase in biofuel share are manifold and are discussed in detail in chapters 4-6.

Future outlook:

For achieving the Austrian biofuel target of 8.45 % by 2020 the flattening trend of the last two years would need to be reversed considerably. Extrapolating the growth rate of 2012 over the coming years a biofuel share of approx. 7 % would be reached by 2020. Under current substitution obligations in the Fuel Decree (6.3 % and 3.4 % respectively) in combination with corresponding fiscal incentives a target achievement of 8.45 % is not likely. In the bottom-up calculation process, for achieving the national biofuel target of 8.45 % an introduction of E10/B10 (conventional fuels with 10 % blended shares of bioethanol/biodiesel) was considered to be necessary at the initial bottom-up calculation of the government.

The EC proposed a limitation of first generation biofuels in COM(2012) 595 final[16] (detailed description in subsequent chapters), the European Parliament accepted a limitation to 6 % (European Commission COM(2012) 595 final). However, the Ministerial Council has not approved these limitations; discussions are still on-going. However, filling this gap from the potential limitation of first generation biofuels by a more accelerated shift to future generation biofuels to a sufficient extent for target achievement in 2020 is not likely. The possibility to multiple counting future generation biofuels towards the target achievement easens the problem but makes potential fraud by converting virgin feedstocks to waste and produce biofuels from waste more attractive. Also, B10 cannot currently be introduced as no approval from car manufacturers is provided so far. Last but not least: the initial plan to include E10/B10 in the Fuel Decree would have led to commitments for market agents (substitution obligation). However, due to political reasons no specific substitution rates for bioethanol and biodiesel have been determined, just an overall biofuel target of 8.45 % has been fixed, which, however, does not impose specific obligations to single market agents. These aspects jeopardize the Austrian biofuel target achievement considerably.

[16] European Commission COM(2012) 595 final

For changing track for achieving the biofuel target in 2020 (and for filling the gap between E5/B7 to E10/B10) “co-treatment” at the production of biofuels and intensified efforts for future generation biofuels and biofuels from waste might be options.

Environmental requirements:

Beside a biofuel share, the Fuel Decree defines – by following the requirements of the corresponding EU Directive 2009/28/EC – minimum GHG savings of biofuels compared to their fossil counterparts. Biofuels which do not achieve this minimum GHG savings are not eligible for being counted towards the biofuels share target. All producers of biofuels therefore have an incentive to produce only biofuels which are eligible, and are potentially forced to adjust the production process accordingly or even to shut down business if adjustment is not profitable. The thresholds for minimum GHG savings are increased over time. This promotes research in second and third generation biofuels which in turn works in favour for achieving the Austrian biofuel target.

The Fuel Decree also states that biofuel production has to comply with sustainability criteria according to Art. 17 of EU Directive 2009/28/EC. These are not only environmental sustainability criteria for growing agricultural feedstock (included in the “Decree regarding agricultural outputs for biofuels”) but also social sustainability criteria as prohibition of child labour or the obligation that land ownership (of indigenous people) must not be violated. These aspects are discussed in the subsequent chapter because it has to be seen close to aspects regulated in the “Decree regarding agricultural outputs for biofuels”.

Effectiveness of the Austrian Decree regarding agricultural outputs for biofuels

This decree intends to ensure the ecological sustainability of biofuels, i.e. it intends a.o. to avoid that agricultural feedstock for biofuels are not grown on non-agricultural land areas with high ecological value and requires that standards for grants under the Common Agricultural Policy are met. It corresponds directly to the EU Renewable Energy Directive (2009/28/EC) and has to be considered in connection with sustainability aspects of the Austrian Fuel Decree.

Cultivation of biofuels’ feedstocks on non-agricultural land with high ecological value is not likely in Austria (due to a dense net of environmental protection laws)[17]; it is rather assumed in developing countries (e.g. converting rain forest to agricultural land). However, to ensure WTO conformity, sustainability requirements have to be in force for all countries.

To monitor biofuels’ trades and to certify sustainability to be counted towards the biofuel target Austria has a very dense system. Starting from growing feedstock until the conversion process and placing on the market – two national certification systems ensure the compliance with required sustainability requirements. However, it is up to market actors to use – alternatively to national certification procedures – accepted voluntary certification systems like ISCC or RED Cert. Whatever certification system is used committed market actors are required to hand in data to the web application “elNA”. “elNA” generates

[17] However, Österreichische Landesumweltanwaltschaften (2013) state that although Austria has a dense network on environmental protection legislation, it does not sufficiently protect „highly biodiverse grassland (according to Art. 17, Sect. 3c of EU Dir. 2009/28/EC) as well as wetlands and peatlands (according to Art. 17, Sect. 4a and 5 of EU Dir. 2009/28/EC).

sustainability confirmations which refer to the corresponding amounts of sustainable biofuels. With these procedures it is ensured that only biofuels which comply with sustainability requirements are counted towards the Austrian biofuel target.

Problems in Austria:

Although legislation in Austria ensures that only sustainable biofuels are counted towards the Austrian biofuel target (and therefore also towards the 10 % RES target), the decree does not exclude that "non-sustainable" biofuels are traded in Austria[18]. This is required by WTO-rules ("free movement of goods"), where nobody can be forced to trade only sustainable biofules according to the definition of EU Dir. 2009/28/EC. This does not imply directly that "non-sustainable" biofuels cause environmental damages; it just means that these biofuels have not been covered by a certification process and are therefore titles as "non-sustainable" per se. Nevertheless environmental damages from these biofuels can not be excluded as their environmental integrity is not certified

Thus, although the use of "non-sustainable" biofuels cannot be prohibited, EU Dir. 2009/28/EC requires that financial incentives have to be linked with achievement of sustainability requirements. However, the mineral oil tax law, which positively discriminates blended fuels over 100 % fossil fuels, does not distinguish between "sustainable" and "non-sustainable" biofuels. In other words, financial incentives are currently also granted for non-sustainable biofuels.

Potential international problems:

Also biofuels or corresponding feedstocks from outside Austria and outside the EU are required to comply with these sustainability criteria (according to EU Directive 2009/28/EC). However, certain stakeholders doubt their actual effectiveness and complain about following problems:

- As long as food production is not required to comply with sustainability criteria too, there is always potential for leakage, meaning that food production might be dislocated from biofuels' feedstock production to other land areas, potentially including land areas with high ecological value. This implies that indeed biofuels comply with sustainability criteria, but negative ecological effects arise from food production in land areas with high ecological value which would otherwise be grown in areas where feedstock for biofuels is grown now. This potential problem of increasing pressure on agricultural resources is also recognized by the EC (see European Commission COM (2013) 175 final, p.11).

- Apart from this problem, stakeholders argue that citizens in certain regions never had land ownership but they just have used the land for growing their food since centuries. Increased land demand for producing biofuel feedstock potentially forces citizens to move to less fertile regions for growing their food. That means, although increased feedstock demand might not lead to land grapping, it could still dislocate inhabitants and lead to lower living standards for inhabitants as they need to get along with now less fertile land.

[18] These biofuels are just not countable towards the biofuel target

- The EC is aware of this potential problem (see European Commission COM (2013) 175 final, p.11). The EC states in its 2013 renewable energy progress report that “it is not yet clear if EU biofuels demand contributes any abuse of land use rights”. This aspect might not be investigatable on a pure legal basis as – like stated above – potentially due to biofuel feedstock cultivation dislocated citizens did not have land ownership for land they used. Thus no abuse of land use rights might be observable.

- Fallow land for extended planting of feedstock for biofuels might be available especially in the southern hemisphere. However these land areas are often kept idle as soil might degrade quickly when intensively used for agricultural purposes, even if land areas are not assigned to be vulnerable. This might imply that degraded land will not be usable for later generations even if land areas might not be needed any more (e.g. at further development of future generation biofuels, etc.) – although this is intended why respective EU law includes sustainability requirements for biofuels’ feedstock.

- Related to that is the question of water scarcity. In dry regions (e.g. Sub-Saharian Area) intensive agriculture might deteriorate availability of water for other purposes like agriculture for local nutritional purposes.

- At the evaluation process to clarify whether a certain country complies with (also social) sustainability criteria, only the responsible ministries would be required to give information, other institutions (e.g. NGOs) have no possibilities to contribute in the evaluation process. This problem is also induced by the fact that the check of social aspects and a subsequent potential limitation on trade lacks WTO-conformity. Also, affected countries like Brasil have been reluctant to be controlled from “outside”.

Summary:

This information leads to the conclusion that the respective European legislation includes the need for protecting the environment and working conditions etc., also the corresponding Austrian laws (Fuel Decree, decree regarding agricultural outputs for biofuels) have transposed these requirements and controlling institutions have been introduced. However, the financial incentives provided by the mineral oil tax law do not distinguish between “sustainable” and “non-sustainable” biofuels. Also the application of sustainability criteria for biofuels especially from certain foreign countries might not guarantee that the intentions of the respective EU legislation are met (e.g. social minimum standards, avoidance of child labour, etc.). Also the potential “leakage problem” is not addressed sufficiently that biofuels’ feedstock is indeed grown on “eligible” land (according to EU sustainability requirements) while food production thereby tends to be crowded out/replaced to areas with high ecological value (see Österreichische Landesumweltanwaltschaften, 2013, p. 31).

3.2 Efficiency

3.2.1 Cost-benefit assessment

Efficiency of the Austrian Fuel Decree

Efficiency refers to the question whether specific targets are achieved at lowest costs. The question of efficiency of the Austrian Fuel Decree has to be splitted in 3 aspects:

- How efficient is the 10 % renewables share target of Directive 2009/28/EC achieved by requirements of the Fuel Decree?
- How efficient will the biofuels' share target of 8.45 % by 2020 be achieved by the Fuel Decree?
- How efficient is the certification process for guaranteeing environmentally sustainable biofuels?

Ad 1.: The Fuel Decree refers to the aspect of achieving a 10 % renewables share in the transport sector only by determining the minimum contribution of biofuels. The key question in this respect is whether there exist alternatives to a sufficient extent to achieve the 10 % target at lower costs than with biofuels.

According to former calculations of the Austrian labour association the economic costs of blending biofuels are approx. € 200 mio., whereas € 150 mio. are paid by the consumers directly and € 50 mio. are paid by the government in form of tax exemptions for biofuels. Alternatives are either an increasing contribution of alternative engine types (e.g. (individual) e-mobility, because of high RES share in Austrian electricity generation) or lowering the energy demand in the transport sector.

Increased (individual) e-mobility can for instance be achieved by a fuel shift from individual conventional cars to e-cars. The answer whether it is more efficient to achieve the RES target by individual e-mobility rather than by biofuels is not straightforward, as e-cars face in fact lower operating costs than conventional cars[19], but higher asset costs[20]. Also the range and therefore the applicability are much lower.[21]

The other option – also not included in the Fuel Decree – is an enhanced modal shift to public transport or more energy efficient individual mobility. For both options it can be anticipated to be more efficient than biofuel blending both from an internal as well as an external costs point of view. In fact, both energy demand as well as greenhouse gas emissions in the transport sector declined in previous years (see Statistik Austria, 2012;

[19] The average electricity costs for individual e-cars amount for approx. € 300,-/10,000 km; http://www.klimaaktiv.at/mobilitaet/elektromobilitaet/elektromobilitaet.html ; June 24, 2013

[20] 30-50 %; Ibid.

[21] Nevertheless it has to be stated that biomass has a considerably low energy yield per ha compared to other alternatives like photovoltaic (PV), wind power or hydro power. Whereas plants can only convert 0.5 % of radiative energy to biomass, PV has an efficiency of 17%. Therefore using biomass for transport results in a much lower energy yield of used land than using electricity. (see Deutschen Akademie der Naturforscher Leopoldina, (2012))

Pötscher, 2011). However, certain stakeholders assume that these options may take only a minor role in achieving the RES target in the transport sector.

Therefore it can be concluded: By focusing on biofuels instead of focusing on lower cost options, the Fuel Decree is not designed to achieve the 10 % RES target most efficiently. However, a surrounding network of other PIs promoting e.g. accelerated modal shift tries to balance this "weak point". Furthermore, the focus on biofuels is based on a bottom up survey for potential on renewables and energy efficiency in the transport sector. Therefore the focus on biofuels might not be the most efficient way to substantially contributing to the 10 % RES target, but it is the most efficient way taking into account the (in the short and medium run) limited potential of e-mobility and energy efficiency anticipated to be deployed within less than one decade under given political circumstances and societal willingness for changes. This, however, does not give any conclusion to whether it might be possible to raise more efficient options in the transport sector.

Additional to that: It is acknowledged that increasing the biofuel share in the transport sector serves the target of making the transport sector less vulnerable against fossil fuel shortages. However, increasing the biofuel share is considered to serve also the target of GHG savings[22]. In terms of efficient use of funds for GHG savings various studies (e.g. Kranzl et al., 2008) argue that reducing GHG emissions in the transport sector is a highly inefficient way compared to other options like using biomass for residential heating.

Ad 2.: The Fuel Decree determines a minimum share of biofuels of 8.45 % by 2020. Currently minimum substitution obligatoins for diesel and gasoline are different and amount 6.3 % for diesel and 3.4 % for gasoline (due to technical reasons). In principal an efficient achievement of the target for 2020 would require that highest burden is borne by those market agents (= transport fuel suppliers) which are able to substitute biofuels at lowest costs. However, this might not be possible/practical for three reasons: First, efficient burden sharing requires a market system ("certificate trading") which also imposes administrative costs to market actors. This approach is used in the UK with – so far – limited success (see corresponding case study of UK). Second, there is a technical limit for cars of using fuels blended to a certain extent. So market agents could not blend arbitrarily high shares of biofuels, even if they were able to do so, while still remaining competitive. Third, many different blending shares of fuels within a market might lead to uncertainty for consumers whether a certain blending share is compatible with the technical requirements of their specific cars. Under uncertainty consumers might tend to fuels with lower blending shares, leading to a competitive advantage of market actors blending only small amount of biofuels to fossil fuels.

Concluding, covering all market agents with the same „blending burden" – irrespective of their abilities – is inefficient per se. However, as mentioned, specifying strict percentages per fuel type might be necessary for these three aformentioned reasons.

Ad 3.: The Fuel Decree defines certification processes to ensure that biofuels fulfil required sustainability criteria. Directive 2009/28/EC leaves it up to member states on the mechanisms to ensure that biofuels fulfil sustainability requirements and how to acknowledge sustainability certificates from other member states. Market actors can choose to comply with

[22] At least as long potential ILUC factors are not taken into consideration.

EU sustainability requirements by either certifying biofuels under corresponding national schemes, multinational schemes or "voluntary schemes" that are recognized by the EC. This freedom leads to many different certification systems within the European market ("certification system mess") and therefore to high administrative burden for the biofuels' industry. This certification system mess is also caused by missing recognition among many certification schemes.[23]

Producing and trading biofuels within Austria can be considered as rather efficient, as the Austrian certification procedures try to use existing synergies to lower burden on market agents as much as possible. However, trading Austrian biofuels transnationally lead to unequally higher costs for market agents. Taking an example according to the Austrian Chamber of Commerce: An Austrian producer of biofuels from used cooking oil has to run through multiple certification processes in order to be able to sell produced biofuels as "biofuels from waste" in Germany. On the one hand the producer has to run through the Austrian certification procedures ("two-step-procedure" handled by "Agrarmarkt Austria" and "Umweltbundesamt"). On the other hand, biofuels need to be certified by ISCC-EU, which is a voluntary certification system acknowledged by Germany, in order to bypass the difficult bilateral acceptance of Austrian biofuels in Germany. Finally produced biofuels need to be certified by ISCC-DE which is necessary to sell waste based biofuels as such biofuels in Germany. This "certification mess" inevitably leads to efficiency losses.

Certification might be necessary to guarantee the compliance with EU sustainability criteria of biofuels. The costs for certification, internal adaption to the certification requirements and auditing fees might be unavoidable costs[24] and might be lower than the social value of e.g. protected biodiversity ensured by certification. Therefore these certification costs should not be assigned to make sustainable transport policy less efficient, rather the opposite should be the case. However, need for multiple certifications because of lacks of acknowledgements and bilateral acceptance make this certification procedure unnecessarily costly. This adversely impacts the efficiency of respective legislation. A more detailed guidance within the Directive 2009/28/EC, or even just one European-wide certification system, have the potential to reduced "certification confusion" and therefore making the provisions to ensure environmental sustainability of biofuels more efficient.

Efficiency of the Austrian Decree regarding agricultural outputs for biofuels

This decree specifies a.o. sustainability criteria for agricultural outputs used for sustainable biofuels according to Directive 2009/28/EC. Sustainability of feedstock is certified by the institution "Agrarmarkt Austria" (AMA), which also controls the compliance of the agricultural sector with requirements and rules of the Common Agricultural Policy (CAP). This implies that synergies exist between control activities for compliance with rules of the CAP and control activities to monitor sustainability of biofuels' virgin feedstocks. (Loss of efficiency arises also from a lack of bilateral acceptance of certifications (see "Efficiency of Fuel Decree" above)).

[23] Currently, international certification schemes must not recognize national certification schemes because this is considered as an automatic recognition of national schemes by the EC

[24] See for costs of certain certification systems Pacini & Assuncoa (2011)

3.2.2 Impacts of Co-Effects on efficiency

The main intentions of the EU „Biofuels Directive“ (2003/30/EC) were defined as “contributing to objectives such as meeting climate change commitments, environmentally friendly security of (fuel) supply and promoting renewable energy sources. These targets have been taken over by its successor directive, the transport related part of the EU “Renewable Energy Directive” (2009/28/EC) with minor adaptions. These adaptions relate to the focus of increasing the renewable energy share by different technologies rather than only focusing on biofuels (although biofuels still mainly contribute in meeting the renewable energy targets) and to put stronger focus on sustainability and minimum GHG reduction requirements of biofuels.

Main intended effects

Table 2: *Overview of main effects (primarily intended) of Directives 2003/30/EC and 2009/28/EC*

Main effects	Description
Meeting climate change commitments	Reduced GHG of biofuels compared to fossil fuels. However, including emissions from Indirect Land Use Change (ILUC) may worsen the GHG advantage of biofuels
Environmental friendly security of fuel supply	Biofuels reduce mineral oil imports; however, Austria also highly depends on importing biofuels or its respective feedstock. At least, a certain amount of biofuels assures that at least the agricultural sector can normally produce in the case of mineral oil shortages ➔ domestic food production security
Promoting renewable energy sources	Achieved due to incentivizing renewable energy sources and demanding higher energy efficiency
Economic strengthening of rural areas	Biofuels improve economic perspectives for farmlands/rural areas (e.g. increased purchasing power)

Meeting climate change commitments:

The actual contribution of biofuels to this main intention of Directive 2009/28/EC is discussed highly controversially. Several calculations state that substituting fossil fuels by biofuels result in reduced greenhouse gas emissions. For instance, Umweltbundesamt (2012) state that on average biodiesel reduces 61 % and bioethanol reduces 40 % of greenhouse gas (GHG) emissions compared to their fossil counterparts, taking into account the entire life cycle but excluding land use change. Including direct (DLUC) and indirect (ILUC) land use change Umweltbundesamt (2012) declares only a 5 % GHG advantage for biodiesel over fossil diesel. For bioethanol a 7 % GHG advantage is stated when including DLUC, but an increase in GHG emissions by 2-44 % is calculated by including also ILUC. Including DLUC and ILUC shows therefore a shrinking GHG advantage of biofuels over their fossil counterparts. Also Plevin et al. (2010) confirm that the effect of ILUC is most likely non-negative and non-zero. The extent of this worsening of biofuels’ GHG balances is highly uncertain as scientific development in this area is rather at the beginning. So Plevin et al. (2010) state for US corn ethanol that the effect on GHG emissions induced by ILUC ranges “from small, but not

negligible, to several times greater than the life cycle emissions of gasoline". Bowyer & Kretschmer (2011) are much more pessimistic but also more precise as they state that conventional biofuels "would lead to between 81% and 167% more GHG emissions than meeting the same need through fossil fuel use". Considering the scientific uncertainties of effects from ILUC the EU Commission has proposed to limit the use of first generation biofuels. Hereby the EC takes concerns seriously that biofuels might increase global GHG emissions rather than reducing them although within the EU biofuels are contributing to EU GHG reduction targets (see European Commission, SWD(2012) 344 final).

Environmental friendly security of fuel supply:

Austria possesses about sufficient production capacities for (theoretically) producing its current demand both for biodiesel as well as bioethanol domestically (see Austrian Federal Environment Agency, 2012). This provides certain independence from fossil fuels, whose import rate is much more than 90 % for Austria (Statistik Austria, 2012). However, also in respect to biofuels Austria depends on imports to a considerable extent. The "Grüner Bericht" ("Green Report", Lebensministerium, 2012) state that 85,000 ha have been used in Austria for growing feedstock for bioethanol and biodiesel production. Due to by-products from biofuel production like DDGS, which partially enables substitution of agricultural areas otherwise been used for growing animal feed, the net area for biofuels' feedstock cultivation in Austria is stated at approx. 50,000 ha (Österreichische Landesumweltanwaltschaften, 2013). In comparison to that, the agricultural area necessary for satisfying the Austrian demand for biofuels is estimated from 285,000 ha (calculations of Welthaus) to 460,000 ha (Kalt et al., 2011). This implies, although biofuels enable to substitute fossil fuels (from sometimes politically less stable regions) Austria also highly depends on feedstock imports to cover its biofuels' demand. However, from the overall supply security point of view, biofuels are advantageous as with current production capacities Austria can produce at least these amount of biofuels domestically which are required in the agricultural sector. In the case of longer-term oil shortages, at least the functioning of the agricultural sector (with current technologies) can be guaranteed and therefore the food supply is assured (see also Österreichische Landesumweltanwaltschaften, 2013, p. 6).

Promoting renewable energy sources:

This main effect is promoted by promoting biofuels and other RES technologies in the transport sector as well as by energy efficiency.

Economic strengthening of rural areas:

The agricultural situation is essentially affected by volatile and low prices for agricultural goods. Producing feedstock for biofuels offers an option for the agricultural sector to cultivate types of plants which provide acceptable prices or to improve bargaining power against takers of yield respectively. It therefore may improve the income situation of the agricultural sector and thus may improve purchasing power of rural regions. These improved economic perspectives might also affect emigration from rural to urban areas.

Observed Co-Effects

Co-Effects are not primarily intended by a certain policy (instrument) but are in many cases welcomed. However, Co-Effects might also be disadvantageous (negative). We distinguish between environmental and economic Co-Effects.

Table 3: *Overview of co-effects of Directives 2003/30/EC and 2009/28/EC*

Co-Effects	Description
Water protection	Intensified use of biofuels reduces spills of mineral oils. Whether feedstock for biofuels requires higher amounts of fertilizers and pesticides is discussed controversy among experts.
Air protection	Reduction of air pollutants like CO, HC and particles by biofuels. In certain cases slightly higher NOx emissions.
Waste reduction	Biofuels are an additional option of using waste cooking oil
Protecting biodiversity	No problems in Austria. However, biofuel use additionally to current agricultural production could lead to a dislocation of food production to non-sustainable ares.
Effects on economic indicators	Impacts on economic indicators like GDP, employment, etc. depend on where the funding for biofuel related actions/measures comes from
Reduced spendable income (budget effect)	Applying an economically non-competitive technology (biofuels in comparison to fossil fuels) leads to higher costs at the same level of service

Water protection:

One aspect of water protection refers to reduced oil spills: Biofuels are biodegradable substances.[25] Therefore their increased use especially in the agricultural sector could reduce oil spills from fossil fuels. Another aspect refers to the use of fertilizers and pesticides for biofuel production, which is a controversy issue: Österreichische Landesumweltanwaltschaften (2013) for instance state that the cultivation of energy plants is often accompanied by a high use of pesticides and fertilizers. Other stakeholders reply that feedstock for biofuels are not cultivated differently than plants for food purposes. That means the production of feedstock for biofuels are as harmful or harmless to the environment as the production of food.

Air protection:

According to the Austrian Federal Environment Agency biodiesel leads to a reduction of several harmful air polluting substances like CO, HC and particles. However, at technical high performance levels biodiesel could lead to slightly higher NOx emissions.[26] Furthermore Zulka & Streissler (2011) do not see higher ozone levels because of biofuels.

[25] http://www.umweltbundesamt.at/umweltsituation/verkehr/kraftstoffe/biokraftstoff1/bio-diesel/ ; July 24, 2013
[26] http://www.umweltbundesamt.at/umweltsituation/verkehr/kraftstoffe/biokraftstoff1/bio-diesel/ ; July 24, 2013

Waste reduction:

Biodiesel can also be produced from waste vegetable oil. This is another[27] option for a meaningful use of waste vegetable oil.

Protecting biodiversity:

Austrian law (based on European law) ensures that areas with high biodiversity value are not used for biofuels' feedstock production. According to stakeholders, also intensified cultivation techniques in the Austrian agricultural sector could not be observed in the last years. However, in a global system an increased need for biofuels will require additional agricultural land. This extention might also affect areas with high biodiversity value. These areas will indeed to a major extent not be used for biofuels; however biofuel production might lead to a dislocation of food production to these areas as food does not need to comply with sustainability criteria.

Effects on economic indicators:

Investment into domestic production capacities and intensified demand on domestic labour force affects economic value added, employment as well as tax revenues and costs for unemployment benefits. Also lower mineral oil imports but also potentially higher feedstock imports will affect the trade balance. Quantifying these effects is not straightforward and requires sophisticated economic models. This will be done to a later stage at assessing the effectiveness, efficiency and efficacy of the Austrian renewable energy policy in the transport sector. However, it has to be pointed out that economic effects of biofuel related actions are not automatically positive. This is on the first hand, that financial funds related to biofuels (e.g. for building biofuel production capacities) and tax exemptions could have been used for alternative investments – which also lead to economic effects. On the second hand, the so-called budget effect (explained below) might reduce overall economic attractiveness of biofuels (see also Steiner, 2011).

Reduced spendable income (budget effect):

Applying an inefficient technology leads to higher costs at the same level of service. Assuming that biofuels are more costly than their fossil counterparts would lead to the effect that households & businesses would be forced to spend more money now for blended fuels compared to pure fossil fuels. In that households & businesses (with a limited budget) would be required to reduce expenditures elsewhere. This reduction in other expenditures has negative economic effects ("budget effect"). The question, whether blended fuels would lead to higher costs for consumers cannot be ultimately clarified as it depends also on the price for crude oil. Certain stakeholders and the Austrian mineral oil refinery OMV argue that blended biofuels lead to additional costs of 1.9 Cents per litre blended diesel[28] and 2.1 Cents per litre blended gasoline[29]. These higher costs of biofuels compared to their fossil counterparts would lead to the negative economic effects of the budget effect. However, it can be observed that petrol stations comprehensively comply with substitution obligations.

[27] Beside the use in the cosmetics industry

[28] http://www.ots.at/presseaussendung/OTS_20050930_OTS0210/omv-diesel-ab-1-oktober-mit-bis-zu-5-biogenem-anteil ; July 24, 2013

[29] Based on a consultation of the Austrian Chamber of Labour to OMV

According to stakeholders this is also because of the attractiveness of tax exemptions for the biofuel share of blended fuels. This in turn leads to the assumption that the tax exemption already completely covers the additional costs from biofuels (as otherwise blended fuels would not be economically attractive). Therefore the existence of a budget effect in that case cannot ultimately be assured (see also Steiner, 2011).

4. Expected and observed system context

4.1 Defining the system context and identification of context factors

Rationale for increasing the RES share in the transport sector

The political objective to increase the biofuel share in the transport sector is embedded in a wider system context that takes into account fundamental political, economic, environmental and social developments on a national and global level, as well as the public debates reflecting upon strategies how to deal with these developments. Expected or unexpected changes of the system context can influence the legitimacy of policy instruments over time and their ability to achieve their stated objectives. Based on this reasoning, this chapter will briefly lay out some fundamental developments and debates that seem to be of relevance for increasing the biofuel share in the transport sector and the corresponding policy instruments.

One major rationale for introducing biofuels was an **increased independence from fossil fuels** in the transport sector, therefore also an increased independence from the market power of oil exporting countries. The EU wanted to send a signal to oil markets that Europe is seeking for alternatives (see COM (2006) 845 final). This lowered dependence on fossil fuels intended on the one side higher market power over the price policy of oil exporting countries ("Europe has alternatives"), on the other side lowered oil dependence was intended to be an insurance against fuel supply interruptions (see COM (2006) 845 final and chapter 2.2). Especially fuel supply for the food and feedstock-producing agricultural sector can be guaranteed in cases of oil supply disruptions, and so the domestic (European) food production can be assured to a greater extent.

Another rationale was to provide **new income opportunities especially for the European agricultural sector**. However, at least in Austria, policy makers did not expect that the major fraction of feedstock for biofuels used in Austria is grown domestically. Nevertheless, usability of farmers' products also for other purposes than feeding increases the farmers' bargaining power against purchasers of agricultural goods.

The third rationale was a contribution of the transport sector to **climate change mitigation**. Attention for this topic and knowledge about the contribution of biofuels possibly changed the most in the last decade. At the beginning of the discussion about biofuels, just few EU-MS had some experiences with biofuels (see chapter 2.2). It was considered that biofuels are by all means contributing to GHG mitigation, although already directive 2003/30/EC included a passus that the EC will further explore potential negative effects from ILUC ("indirect land use change"). In the meantime, additional scientific knowledge about potential negative effects from biofuels on global climate and ecology evolved, and reports about e.g. rainforests destroyed by palm oil production for biofuels made the general public more sensible about potential disadvantages of biofuels. These aspects certainly steered the further development of the European "biofuel policy" (discussed below).

Context factors

Certain context factors have influenced the effectiveness and efficiency of the two national key policy instruments focused in this analysis. The following context factors have been identified to significantly influence the success of these policy instruments:

Table 4: *Overview of system context factors*

Context factors group	Context factors
Economic	Change in final energy consumption in transport sector
	Development of fossil fuel prices relative to crop prices
Environmental	Scientific knowledge on impacts of biofuels on climate protection and biodiversity
Technological	Technical usability of biofuels in current car engine technologies
Good Governance	Initial lack of guidance for market actors to achieve obligations
	Investment uncertainty

Change in final energy demand in transport sector:

Achieving a share of renewable energy in the transport sector of 10% by 2020 can be achieved by expanding renewables and/or reducing final energy demand in the transport sector. Thus an increase in final energy demand would require a respective increase in non-fossil fuels used in the transport sector, which in turn might cause problems related to a higher absolute supply of non-fossil fuels (availability and thus prices of non-fossil fuels).

The final energy consumption in the Austrian transport sector has been rather stable in the last few years with a slight downward trend since 2007. Before 2007 final energy demand increased steadily with just few exemptions (based on Energiebilanzen Österreich 1970-2011).

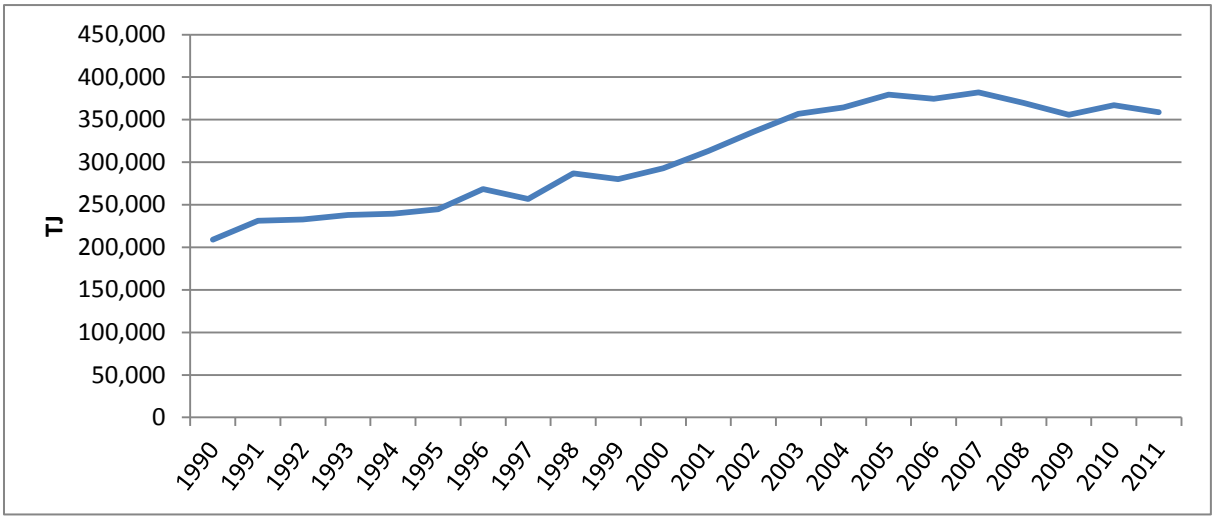

Figure 4: *Development of energy demand in the Austrian transport sector (TJ); Source: Statistik Austria (2012)*

This downwarding trend from 2007 was already anticipated in 2007 by the adapted version of the Austrian climate strategy (see Lebensministerium, 2007, p. 56). It was caused among others by increasing fuel prices (Umweltbundesamt, 2013, p. 29), thereby causing also reduced fuel consumption from citizens of surrounding countries, who often took advantage from fuel price differentials between Austria and their countries in the past.

Development of fossil fuel prices relative to crop prices:

The economic attractiveness of non-fossil fuels highly depends on fossil fuel prices relative to production costs of non-fossil fuels. In our consideration we focus on the spread between mineral oil prices and crop prices for biofuel production. Within the last decade mineral oil prices have increased considerably (inflation adjusted). Whereas in the years 2003/2004 (where European biofuel policies started) the mineral oil price has been similar to the level of the early 1990ies (inflation adjusted), it increased considerably in subsequent years. In 2012 the oil price had already achieved a level which is nearly threefold of the early 1990ies-level.

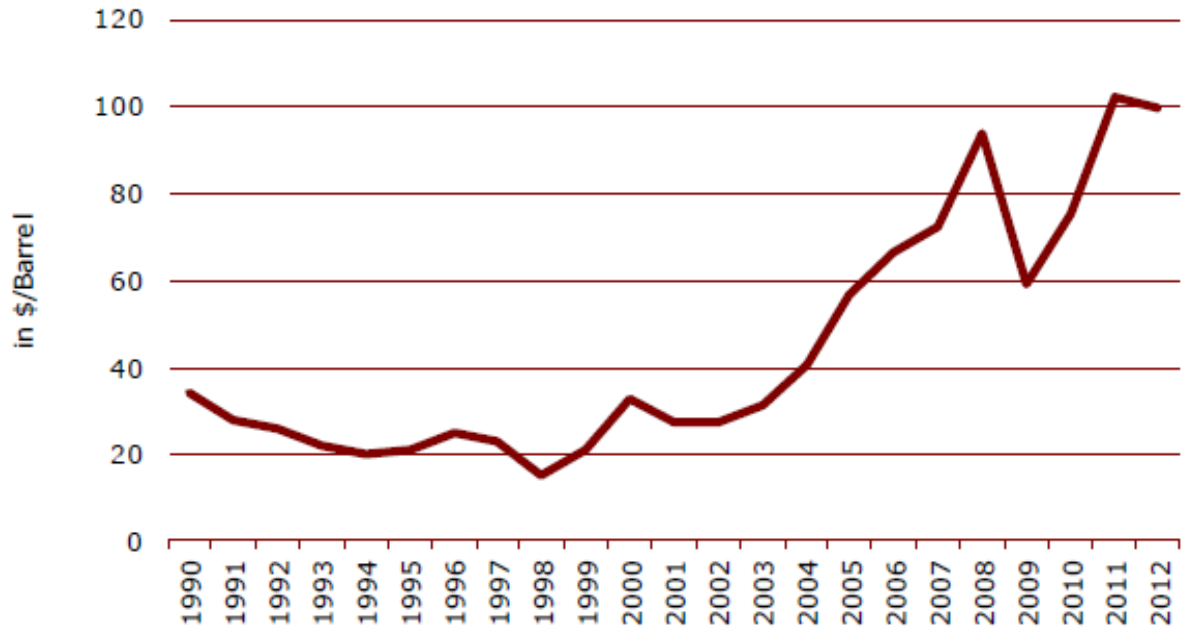

Figure 5: *Development of mineral oil prices (inflation adjusted, base year 2007); Source: Bundesministerium für Wirtschaft, Familie und Jugend (BMWFJ) (2013) based on Österreichische Energieagentur*

However, for gaining economic attractiveness for biofuels compared to fossil fuels not only the mineral oil price is essential, but rather its development compared to (feedstock) prices for biofuels. Generally prices for agricultural raw materials did not increase to the same extent than for mineral oil. However, taking a closer look to agricultural materials especially used for biofuels, the picture changes somehow. In the last decade price developments for rapeseed oil have been similar to price developments for mineral oil. The price for maize (majority input for bioethanol in Austria), however, raised to a higher extent than mineral oil in the last few years.

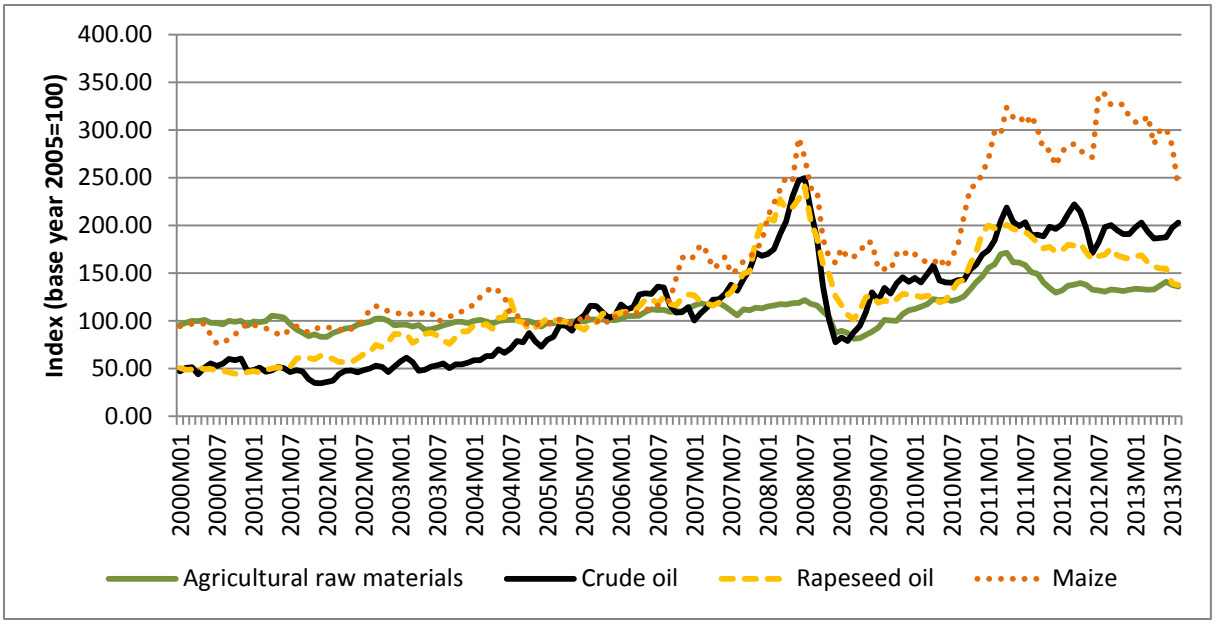

Figure 6: *Development of price index for mineral oil, agricultural raw materials (general), rapeseed oil and maize (base year 2005); Source: International Monetary Fund*

Therefore a relative price advantage of biofuels over mineral oil from the perspective of commodity prices cannot be observed in reality. Cost advantages might arise from technology learning effects.

The “Biofuels Progress Reports” (European Commission (2007), European Commission (2009)) of the European Commission assumed that biodiesel would be competitive at USD 60 per barrel mineral oil and bioethanol at USD 90. These assumptions about competitiveness of biofuels might have been too optimistic as current mineral oil prices of around USD 100/110 per barrel still require a tax discrimination of conventional fuels.

Scientific knowledge on impacts of biofuels on climate protection and biodiversity:

Public acceptance for biofuels certainly depends on ecological impacts of biofuels, as the entire society faces higher costs for blending biofuels (external effects not included in this consideration). When the discussion about specific measures in the transport sector started in 2001, the market share of biofuels was 0.3 % and most member states did not have experiences with biofuels (see chapter 2.2). Beside the other arguments for biofuels (increased independence from fossil fuels, income opportunities for agricultural sector), biofuels were considered to be advantageous for climate protection. Specific scientific knowledge had been limited. For that reason the Biofuels Directive (2003/30/EC) included the request to the EC to explore the “life-cycle perspective of biofuels”.

In subsequent years scientific knowledge about impacts of biofuels on climate protection and biodiversity has grown. The potential of biofuels for protecting the climate and impacts of potentially intensified agriculture (for covering demand for feedstock for biofuels) on biodiversity have been investigated to a greater extent and are discussed controversially. Especially the net GHG impacts of biofuels due to “indirect land use change” (ILUC) are uncertain. This induced the EC to restrict the use of first generation biofuels (see for instance

COM(2012) 595 final) in order to avoid potential adverse effects of biofuels on climate protection.

Technical usability of biofuels in current car engine technologies:

The compatibility of engines with biofuels is not given in all cases; use of biofuels might be damaging for components of engines. Therefore the compatibility has to be approved by car manufacturers.

Currently B7 (maximum of 7% biodiesel in conventional diesel) and E5 (maximum of 5% bioethanol in conventional gasoline) are provided on the Austrian fuel retail market[30]. These fuel types are technically approved by car manufacturers. When designing the Austrian strategy for achieving a 10 % RES share in the transport sector, E10/B10 were anticipated to be introduced for achieving the RES target – taking also into account other options (modal shift, e-mobility, etc.). E10 is technically viable for most of currently used cars. However, for B10 approval of car manufacturers is still missing.

Initial lack of guidance for market actors to achieve obligations:

The Renewable Energy Directive (2009/28/EC) does not provide specific administrative guidelines in respect to ensuring the sustainability of biofuels (sustainability according to the definition of Dir. 2009/28/EC is necessary that biofuels can be counted towards the RES share). Especially the question of certifying sustainability of biofuels induced much confusion among market agents. For certifying sustainability, no single, European-wide certification scheme was established (referring to the subsidiarity of EU). This required bottom-up actions of market agents and EU MS. In order to do so certain market agent groups, but also certain EU member mtates (as Austria) established certification schemes. According to feedback from market agents, the Austrian certification scheme is as little bureaucratic as possible. However, compatibility among certification schemes in Europe (both established by EU MS and industry groups) is not given in many cases.

Investment uncertainty:

Directive 2003/30/EC established for the first time targets for introducing biofuels. This legislative framework formed the basis for investment decisions into production capacities for biodiesel and bioethanol. The decision of making the transport sector less dependent on fossil fuels was renewed by the Renewable Energy Directive (2009/28/EC). This Directive, however, offered the possibility to EU-MS of achieving the 10 % RES target in the transport sector also by other non-biofuel options. Nevertheless, Austria determined a high contribution of biofuels for achieving its RES target in the transport sector – this was necessary also because of limited non-biofuel options in the near future. However Directive 2009/28/EC established binding sustainability requirements and minimum GHG reductions by biofuels compared to their fossil counterparts (over the entire life cycle). Especially the second obligation was/is problematic for certain facilities of “biofuels pioneers” as older facilities partly used fossil fuels for running the production process to a greater extent than newer facilities. However, it is expected that Austrian biofuel production plants will meet

[30] Other options as E85 or pure bioethanol use are also possible for specific purposes.

these requirements partly by making production processes less GHG emitting (e.g. heating systems in production process).

In respect to the discussions about the real GHG reduction of biofuels if effects from indirect land use change (ILUC) are included the EC assessed the impacts of ILUC (European Commission, SWD (2012) 343 final). The assessment came to the conclusion that setting a robust factor for ILUC is not possible (with current knowledge), however, as a best strategy to reduce the risk of ILUC the assessment proposed a limitation of first generation biofuels to 5 %. Based on this suggestion the EC proposed an amendment of Directive 2009/28/EC (European Commission COM(2012) 595 final). In September 2013 the European Parliament has decided that first generation biofuels should be limited to 6 %[31], i.e. thereby covering a maximum share of 60 % of the renewable share. This reflects approximately the production capacities of current biofuel processing facilities in Europe (including a "safetly valve"). This trend against first generation biofuels – especially the policy volatility of the past two years – alienates investors who have already invested in first generation biofuels. Also the intended obligation for MS to report effects of ILUC to the EC is interpreted by affected stakeholders as data gathering for an obligatory inclusion of ILUC factors in calculating GHG savings of biofuels beyond 2020. However, some biofuel production facilities are not depreciated until 2020 and the coming years beyond 2020. This potential loss discourages investors in investing into new biofuel production facilities (even when producing future generation biofuels). Currently this limitation of first generation biofuels was not accepted by the Ministerial Council and this issue is still further discussed. However this potential limitation increased investment uncertainty.

4.2 Impact of expected and observed context factors on effectiveness/ efficiency of policy instruments

Changing contextual influences can considerably change the success of policy instruments. In this section it is surveyed to what extent changes in context factors discussed above have influenced the effectiveness and efficiency of the two considered key-policy instruments ("Fuel Decree", "Decree regarding agricultural outputs for biofuels").

Austrian Fuel Decree

Economic

Change in final energy consumption in transport sector

Transport fuel demand decreased in the last few years, which was also anticipated. This decreased transport fuel demand does not affect achieving the biofuel target (apart from the positive fact that less biofuels are needed in absolute terms for fulfilling the substitution obligation of fuel suppliers). For achieving the RES target in the transport sector, however, a decreasing fuel demand is highly advantageous. ("effectiveness").

As mentioned in chapter 3.2 there are other efficient options for increasing the RES share in the transport sector (e.g. e-mobility), however they have not been proved to be sufficiently

[31] http://www.europarl.europa.eu/news/de/news-room/content/20130906IPR18831/html/Parlament-bef%C3%BCrwortet-Umstellung-auf-fortschrittliche-Biokraftstoffe ; Oct. 7, 2013

available for achieving short- and medium RES targets in the transport sector. Or arguing the other way around, blending biofuels to conventional fuels might not be the most efficient option in the transport sector, but the only sufficiently viable in the short- and medium term. Therefore, lowering the demand for conventional fuels lowers also the demand for biofuels (at stable blending targets). Considering biofuels not as the most efficient option in the transport sector, lowering the absolute demand for biofuels requires less public funds for subsidizing biofuels and therefore makes the biofuels' target achievement more efficient.

Development of fossil fuel prices relative to crop prices

The relative price development of fossil fuels over crops is an applicable indicator for estimating the competitiveness of biofuels over conventional fuels. The competitiveness of biofuels, in turn, gives an indication of how "easy" the biofuel target could be achieved, and it is certainly an indicator how efficient the use of biofuels is in achieving the transport sector's RES target.The competitiveness was anticipated to be achieved by USD 60 and USD 90 for biodiesel and bioethanol respectively. This might have been too optimistic as market competitiveness cannot be observed yet.

However, the not achieved competitiveness of biofuels over conventional fuels does not impact the effectiveness of the Fuel Decree as fuel suppliers are obliged to the required substitution shares regardless of thereby induced fuel price increases. Also, current incentives of the Austrian mineral oil tax, which discriminates conventional fuels over biofuels, make a substitution also financially attractive (at current prices for mineral oil and biofuels' feedstocks).

Regarding the price developments' impacts on efficiency of the Fuel Decree, no judgement can be made as price developments are highly volatile both for mineral oil and biofuels' feedstocks. However, an increasing trend of prices both for mineral oil as well as biofuels' feedstocks lead to lowering efficiency of biofuel compared to achieving the 10 % RES target by other options.

Table 5: *Economic context factors' impacts on effectiveness and efficiency (Fuel Decree)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Change in final energy consumption in transport sector	No impact on target achievement	No impact on target achievement; reduced subsidy demand compared to non-decreasing energy consumption	Energy demand in transport sector has no impact on effectiveness as long as enough biofuels can be supplied; Slightly positive impact on efficiency as less subsdies for biofuels are necessary (compared to a non-decreasing energy consumption)	No impact	Slightly positive

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Development of fossil fuel prices relative to crop prices	Anticipated competitiveness of biodiesel and bioethanol is achieved at USD 60 and USD 90 per barrel mineral oil	Competitive-ness not achieved yet (currently USD 100/110 per barrel mineral oil)	Although competitiveness of biofuels is not achieved, substitution obligations ensure target achievement, incentivized by tax incentives; No assessment regarding to efficiency as price increases of different feedstocks are different. Increase of prices for fossil fuels and feedstock has certainly negative impacts on efficiency of RES target	No impact	No impact

Environmental

Scientific knowledge on impacts of biofuels on climate protection and biodiversity

More comprehensive knowledge about potential adverse impacts of biofuels on climate protection has led to a restriction of first generation biofuels. This is basically a restriction of now available technical options for achieving the Austrian biofuel target, and it therefore impedes the effectiveness of the Fuel Decree. This is true especially because second and future generation biofuels are not considered to be sufficienty sophisticated until 2020, also near-term potential of other modes as increased e-mobilitiy and hydrogen is considered to be rather limited.

The impact on efficiency of the Fuel Decree might be also highly negative at least in the short and medium run, as the gap from first generation biofuels has to be filled by types of biofuels, which are partly still in the process of developing and therefore relatively expensive. This may require high amounts for R&D to make future generation biofuels available to a sufficient extent by 2020. Certainly, in the long term, such a "stimulated" development of future generation biofuels may reduce their costs earlier than without this stimulation, which might increase efficiency once again.

Table 6: *Environmental context factors' impacts on effectiveness and efficiency (Fuel Decree)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Scientific knowledge on impacts of biofuels on climate protection and biodiversity	Biofuels are the technically most viable option for achieving the RES target	Improved scientific knowledge has led to a restriction of first generation biofuels	Restriction of first generation biofuels has considerably hampered RES target achievement; Potential use of future generation biofuels for 2020 requires accelerated R&D and therefore additional funds.	Highly negative	Highly negative

Technological

Technical usability of biofuels in current car engine technologies

E10/B10 is expected to be necessary for achieving the targeted RES share in the Austrian transport sector – taking into account the anticipated development of other non-biofuel related options (modal shift, e-mobility, etc.). Thus, not introducing E10/B10 would require higher contributions of non-biofuel related options, which is considered to be not likely (as the RES strategy for the Austrian transport sector has been designed based on likely developments). E10 would be applicable for most of current cars; however, it was not introduced finally (due to bad experiences with the introduction of E10 in Germany and the proposal of the EC to limit application of first generation biofuels). Also B10 was not introduced as its applicability for diesel engines was not confirmed by car manufacturers. Especially not introducing B10[32] is considered as highly negative impacting the target achievement.

The lack of technical usability of especially B10 jeopardizes achievement of the 8.45 % biofuel target of the Fuel Decree considerably. Only biofuel types (e.g. from waste, lignocellulose) eligible to be multiple counted towards the target achievement could lead to a target achievement. However, their potential is highly limited as these materials are used already now for biofuel production. If technically possible, it might be highly expensive to achieve the biofuel target by these biofuel types, as also currently inefficient resources would need to be raised.

Table 7: *Environmental context factors' impacts on effectiveness and efficiency (Fuel Decree)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Technical usability of biofuels in current car engine technologies	E10/B10 can be introduced	E10 applicable for most cars, B10 currently not applicable	E10/B10 have been expected to be necessary for RES target achievement. Not introducing E10/B10 jeopardize RES target achievement in transport sector	Highly negative	Highly negative

Good governance

Initial lack of guidance for market actors to achieve obligations

When EU Directive 2009/28/EC came into force no specific guidance to certify sustainability of biofuels was provided, which is essential for biofuels to be counted towards the RES target. Because of the absence of an EU-wide certification scheme Austria has established a comprehensive scheme for certifying the sustainability of domestically produced and imported biofuels. Due to the final establishment of certification schemes (either established by MS or industry agent groups) the Austrian biofuel target achievement ("effectiveness") might not be affected by bureaucratic requirements (necessary for certification) as long as

[32] As the energetic content of B10 is higher as for E10

anticipated profits from biofuels trade are still provided. However, the splitted landscape of certification schemes in Europe and their partial incompatibilities have led to inefficiencies due to partial need of certifying biofuels twice or even more often (especially in case of transnational trade). A switch of market agents to European wide acknowledged certification schemes ("voluntary schemes") is possible for biofuels producers – however, for feedstock producers (agricultural sector) certification by voluntary schemes is more expensive than using the national certification scheme (synergies with control activities for the CAP).

Investment certainty

Investment certainty was reduced by a volatile energy policy in respect to first generation biofuels. In fact, as use of first generation biofuels has been limited (approx. on the level of current production capacities) an additional capacity expansion in first generation biofuels processing capacities seems not necessary. In other words, reduced investor certainty does not lead to a worsened supply with first generation biofuels. However, the limitation of first generation biofuels has led to a gap as non-biofuel options have restricted potential in the near future. This gap needs to be filled by future generation biofuels. Worsened investors' certainty might also influence the investors' willingness to invest in new R&D and production capacities of future generation biofuels adversely.

As reduced investment certainty might reduce investors' willingness to invest in new R&D, efficiency gains from cost reductions of future generation biofuels might take place only at later stages.

Table 8: *Good governance context factors' impacts on effectiveness and efficiency (Fuel Decree)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Initial lack of guidance for market actors to achieve obligations	No Europe-wide certification scheme	Different certification schemes in Europe lead to partial incompatibilities between them and often to higher costs especially in the case of transnational trade	Splitted landscape of certification schemes might not influence effectiveness adversely, but negative impacts on efficiency	No impact	Highly negative
Investment uncertainty	Sufficient biofuels' production capacities will be established	Sufficient capacities of 1st generation biofuels, however, high investment uncertainty (due to frequently changing rules); Therefore limited willingness to invest in future generation biofuels' R&D. This makes achieving the RES target with higher shares of future generation biofuels more expensive	Investor certainty was worsened with potential impacts on their willingness to invest into future generation biofuels production capacities. However, future generation biofuels will not be technically viable (to a considerable extent) until 2020 anyway	Slightly negative	Slightly negative

Decree regarding agricultural outputs for biofuels

Economic

Change in final energy consumption in transport sector

Reduced demand for transport fuels reduces also demand for biofuels (at constant blending rate). This reduces in theory the pressure on land with high ecological value to be converted to land for cultivation of biofuels' feedstocks. However, the "Decree regarding agricultural outputs for biofuels" protects these land area irrespective of demand for biofuels (i.e. no impacts on effectiveness). Also the efficiency of the decree is not affected as costs of complying with the decree stay the same irrespective of changing energy consumption.

Development of fossil fuel prices relative to crop prices

Development of crop prices might affect the intensity of agriculture. In other words, high crop prices might increase the pressure on land with high ecologic value. However, the decree clearly states which land areas are excluded from being used for biofuel feedstock cultivation, therefore effectiveness might not be affected due to crop prices.

In order to be eligible for being counted towards the RES target, sustainability of biofuels has to be proved and certified. The certification process leads to certain costs. At rising crop prices – which is true especially at maize for the last 2-3 years – the costs for certification decrease in relative terms. This means at increasing crop prices the requirements of the decree become less costly in relative terms and therefore the efficiency increases. However, this picture changes as crop prices go down once again. Therefore current developments of fuel and crop prices are not interpreted as efficiency gains as prices are volatile and price differentials are different for all kinds of biofuels' feedstocks.

Table 9: *Economic context factors' impacts on effectiveness and efficiency (Decree regarding agricultural outputs for biofuels)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Change in final energy consumption in transport sector	No impact	No impact	Neither effectiveness nor efficiency of the decree are affected	No impact	No impact
Development of fossil fuel prices relative to crop prices	No impact	Generally no impact; Current positive impacts on relative certification costs as price for maize increased in the past 2-3 years	Currently increased efficiency due to lower costs of certification (in relative terms)	No impact	No impact

Environmental

Scientific knowledge on impacts of biofuels on climate protection and biodiversity

Improved scientific knowledge on impacts of biofuels on climate protection and biodiversity might confirm the importance of protecting nature with high ecologic value. However it has no impact on effectiveness or efficiency of the decree.

Table 10: *Environmental context factors' impacts on effectiveness and efficiency (Decree regarding agricultural outputs for biofuels)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Scientific knowledge on impacts of biofuels on climate protection and biodiversity	No impact	No impact	No impact in functioning and costs of the decree	No impact	No impact

Technological

Technical usability of biofuels in current car engine technologies

Improving technical usability of biofuels may increase the demand for biofuels: On the one hand by time E10 could technically be used by the entire Austrian car fleet, on the other hand a shift from B7 to B10 might technically be feasible in the future. In such a case demand for agricultural land might rise. However – in line with argumentations of prior context factors – the decree protects land areas with high ecological value; even at higher land demand these land areas would be protected. Therefore no impacts on effectivity of the decree are anticipated. Also improved technical usablitiy of biofuels do not change the costs associated with the decree, therefore no impacts on efficiency are anticipated.

Table 11: *Technological context factors' impacts on effectiveness and efficiency (Decree regarding agricultural outputs for biofuels)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Technical usability of biofuels in current car engine technologies	No impact	No impact	Improved technical usability of biofuels do not impact the functioning of the decree and costs associated with it	No impact	No impact

Good governance

Initial lack of guidance for market actors to achieve obligations

Provisions included in the decree to assign an authority in charge for controlling sustainability of virgin feedstocks were induced by initial lacking of an EU-wide sustainability certification scheme. However, this initial lack had no adverse impacts on effectiveness or on efficiency of the decree.

Investment uncertainty

Investment certainty might be reduced due to frequently changing regulations on EU level (e.g. minimum GHG mitigation duties of biofuels, potential limitation of first generation biofuels, etc.). However, increased investment uncertainty itself does not affect the functioning of the decree, nor its costs and therefore efficiency.

Table 12: *Good governance context factors' impacts on effectiveness and efficiency (Decree regarding agricultural outputs for biofuels)*

System context factor	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Initial lack guidance for market actors to achieve obligations	No impact	No impact	Decree is a result of governmental guidance, but guidance has not any impacts on the functioning of the decree	No impact	No impact
Investment uncertainty	No impact	No impact	No impacts of investor uncertainty on functioning of decree	No impact	No impact

5. Expected and observed policy transposition and implementation

Not only context factors – discussed in the chapter before – influence the success of policy instruments and therefore the success of a respective policy, but also the national policy transposition and implementation is crucial for a policy's success.

In this chapter certain aspects ("evaluation factors") of national transposition and implementation of the two considered national key policy instruments ("Fuel Decree", Decree regarding agricultural outputs for biofuels") are discussed which seem crucial for efficiently achieving the RES target in the transport sector. More specifically it will be focused on those aspects which have been developed differently than initially expected.

5.1 Expected and observed policy transposition and PI implementation

National PIs of the past few years targeting on carbon reductions in the transport sector are based on the Renewable Energy Directive (2009/28/EC) and its "predecessor directive", the "Biofuels Directive" (2003/30/EC). The process of national transposition and implementation of these directives is described in detail in chapter 2.2. At this stage certain aspects of policy instruments' implementations and differences between initial plans for transposition and observed outcomes will be discussed.

Biofuel E10

For achieving the RES target possible contributions of all options in the transport sector have been surveyed in a bottom-up analysis. Subject to the anticipated potential of all non-biofuel options the necessary contribution of biofuels was determined to be 8.45 % (based on energy content) in the Austrian Fuel Decree. As the energy content of bioethanol and biodiesel differs from their fossil counterparts, this "national biofuel target" can only be achieved by the introduction of the biofuels E10/B10 (fuel with 10% blending share of ethonal and biodiesel respectively).

The introduction of E10 was scheduled in Austria for October 2012. However, this introduction was canceled in September 2012 due to the missing success of the E10 introduction in Germany[33] and intentions of the EC to limit food-based biofuels (based on – at this time currently published – scientific results about effects from ILUC; European Commission SWD(2012) 343 final).

Biofuel B10 could not be introduced so far due to limited technical usability for the current diesel car fleet.

Administrative set up of certification system

The „Renewable Energy Directive" (2009/28/EC) left administrative questions of how to certify sustainability of biofuels open. To ensure a timely certification of crop yields industry groups established their own certification schemes which asked for acceptance by the EC. Among EU-MS it was not clear whether EU-MS had to establish their own certification schemes. Some countries – like Austria – interpreted directive 2009/28/EC in a way that it is

[33] See for instance http://www.spiegel.de/wirtschaft/unternehmen/streit-um-treibstoff-biosprit-einfuehrung-vorerst-gestoppt-a-748899.html ; October 8, 2013.

mandatory for EU-MS to establish their own certification schemes. Thus, additionally to industry based certification schemes also MS established schemes have been introduced. These schemes are not somehow connected and often do not acknowledge each other, therefore high administrative efforts of market agents due to often necessary double/multiple certification arises.

Thus, also Austria had to establish its own certification scheme. According to stakeholders the Austrian certification scheme works time and resource efficiently. For controlling that biofuel feedstock is not cultivated on land areas defined as non-eligible by directive 2009/28/EC, the AMA ("Agrarmarkt Austria") has been assigned as responsible institution. AMA acts already now as a „controlling institution" of agricultural practices and products. For other tasks within the controll process the Austrian Environment Agency (UBA) is responsible.

Coordination and management among institutions

As mentioned above the 10 % RES target is considered to be achieved in Austria mainly by biofuels, but also by other non-biofuel options like increased e-mobility, accelerated modal shift, etc. Responsibility for promoting of all these options is shared among different ministries and different political parties. Only for the biofuels' share within this target it was decided to implement binding targets for market agents. For all other options not binding targets have been fixed, but action plans have been developed.

An example for good coordination between institutions is the tax incentive provided for blended transport fuels. The reverse tax discrimination of blended transport fuels makes it more profitable for market actors to sell blended transport fuels instead of 100 % fossil fuels. Good coordination between the Federal Ministry for Environment with the Federal Ministry for Finance made this tax reverse tax discrimination possible.

Table 13: *Overview of transposition and implementation factors*

Evaluation factors group	Evaluation factors
Political & Social Acceptance	Biofuel E10
Implementability	Administrative set up of certification system
Policy coherence	Coordination and Management among institutions

5.2 Impact of expected and observed policy transposition and PI implementation on effectiveness/efficiency of policy instruments

In chapter 5.1 the development of certain aspects of the implementation process of considered key PIs have been discussed. Now, at this stage, the impacts of these aspects (and their developments) on effectiveness and efficiency of the two considered key PIs are analysed.

Austrian "Fuel Decree"

Biofuel E10

In a bottom-up analysis about necessary contributions of different options to achieve the RES target in the transport sector, the introduction of E10 was expected to be necessary. However, due to aforementioned reasons, the introduction of E10 was cancelled. Therefore still E5 is mostly used in the market. This difference between scheduled and observed blending share of bioethanol certainly worsens the effectiveness of the Austrian Fuel Decree. However, bioethanol has much lower energy content than gasoline (approx. 7.4 kWh/kg for bioethanol vs. 11.1-11.6 kWh/kg for gasoline)[34], therefore the leverage by blending bioethanol with gasoline is lower compared to blending biodiesel to conventional diesel. Moreover, the Austrian demand for gasoline is rather little compared to demand for diesel: In 2012 1,714,586 tons of gasoline and 6,093,841 tons of diesel have been used.[35] Therefore the impact of not (yet) introducing E10 on the effectiveness of the Austrian Fuel Decree is determined as only slightly negative.

The impact on efficiency of limiting the use of food-based biofuels is not straightforward. Assuming that this gap has to be filled by – partly not market-ready – future generation biofuels, the costs might be higher than using maket-ready bioethanol. This would impact the efficiency of RES target achievement adversely. However, assuming that this gap could be filled by increased efforts for non-biofuel options (e.g. accelerated modal shift) potential efficiency gains could be achieved.

Administrative set up of certification system

The mutual non-acceptance of different national certification schemes among Europe has led to a confusing certification system within Europe and the need of double/multiple certification, especially at cross-border trade. These extra bureaucratic efforts – evolved due to a lack of coordination among MS or a lack of guidance by directive 2009/28/EC respectively – might not lead to a reduced effectivity in achieving the RES target in the transport sector as long as potential profits from biofuels production and trade can still be gained. However, this confusion and additional bureaucratic efforts have negative impacts on the efficiency of using biofuels in achieving the RES target in the transport sector.

However, Austria has filled this "lack of guidance" and provided an administrative system for certifying sustainability of biofuels. By using existing competences and synergies of AMA and UBA costs for certification are held as low as possible. For an effective target achievement the Austrian certification scheme might be benefitial but not mandatory as market agents could have used also other, international/voluntary certification schemes.

Coordination and management among institutions

For increasing public acceptance of the Austrian biofuel target the Fuel Decree was accompanied by positive tax discriminiations for blended fuels. This tax discrimination is included in the mineral oil tax law. These tax incentives for blended biofuels exist since September 2007 and are adapted by time. They are designed in a way that it is financially

[34] See e.g. http://de.wikipedia.org/wiki/Heizwert ; October 8, 2013

[35] Data based on Umweltbundesamt (2013a), p. 17

attractive for fuel suppliers to offer blended fuels. This coordination between two ministries (finance, environment) substantially contributed to the success of the Fuel Decree.

The tax discrimination only increases public acceptance of biofuels as consumers' faced costs for blended fuels are lower compared to a case without tax discriminiation. However, overall costs stay the same and tax refunds by the government are paid by consumers in the end. Therefore this action is not considered to impact efficiency of the Fuel Decree

Table 14: *Impact of policy transposition and implementation on effectiveness and efficiency (Austrian Fuel Decree)*

Policy context factors	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Biofuel E10	E10 will contribute to achieve the Austrian RES target in transport sector	Introduction of E10 failed, biofuel target harder to achieve without E10	Worsening of effectivity; however limited leverage of bioethanol anyway because of low energy content and lower market penetration of gasoline powered cars	Slightly negativ)	Not to be deter-mined
Administrative set up of certification system	---	Confusing and non-connnected system of different certification schemes among Europe	Potentially no impact on effectiveness; Lack of mutual recognition among European certification schemes causes highly negatively impacts on efficiency (in certain cases multiple certification is necessary) , however, domestic set up of certification scheme causes little administrative burden only, therefore domestic implementation of sustainability certification scheme impacts efficiency slightly positive	No impact	Slightly positive
Coordination and management among institutions	---	Tax differentiation for blended transport fuels increases public acceptance for biofuels	Due to tax differentiation an economic benefits appears if blended transport fuels are applied	Highly positive	No impact

Austrian "Decee regarding agricultural outputs for biofuels"

Biofuel E10

The introduction of "non-introduction" of biofuel E10 does not affect the functioning and thus the effectiveness of the decree nor its efficiency.

Administrative set up of certification system

The certification system in Austria is set up in a way, that sustainability of biofuels' feedstocks' cultivation is controlled by the AMA ("Agrarmarkt Austria"), which already now controls agricultural cultivation e.g. in respect to cross-compliance obligations of the Common Agricultural Policy (CAP). Effectiveness of the decree does not depend on the control by this institution; controls could certainly be carried also by other institutions. However, in respect to efficiency it might be the least cost option, as the AMA is present at farms anyway, so synergies evolve.

Coordination and management among institutions

Coordination and management among institutions (e.g. between AMA, Umweltbundesamt (Austrian Environment Agency) and Federal Ministry for Environment) certainly work in favour for achieving the targets of the decree. However there might be no substantial impact on effectiveness, as protection of land areas not eligible for feedstock cultivation has to be guaranteed by all means. Also for efficiency: coordination and management among institutions certainly leads to a more efficient protection of land areas with high ecological value, however, apart from efficiency gains within the certification process, no considerable efficiency gains have been detected.

Table 15: *Impact of policy transposition and implementation on effectiveness and efficiency (Austrian Decree regarding agricultural outputs for biofuels)*

Policy context factors	Expected "impact"	Observed "impact"	Explanation	Impact on effective-ness	Impact on efficiency
Biofuel E10	No expected impact	No observed impact	---	No impact	No impact
Administrative set up of certification system	---	Austrian certification system uses existing control resources (synergies with AMA activities) and therefore works efficient	Slight efficiency gains due to synergies of certification activities with other control activities of the AMA	No impact	Slightly positive
Coordination and management among institutions	---	Smooth coordination & management among institutions – no difference between observed and expected impact	No considerable impact on effectiveness and efficiency apart from good coordination at certification process	No impact	No impact

6. Explore policy instrument interaction including an analysis of stakeholder behaviour within the application system

6.1 Expand and describe the stakeholder system

In this section the basic stakeholder system of biofuel production and biofuel use is described. The basic stakeholder system starts at suppliers of feedstock. The next stakeholder group is the raw material collection and processing sector. This is followed by the biofuel supplying sector. This sector supplies conventional fuels and biofuel to the sector “end use”. The two latter sectors are considered as the key sectors in this analysis. The behaviour of all stakeholders is steered by profit or utility maximazing intentions subject to incentives arising from policy instruments (regulatory, market based, etc.) and behaviour of other market agents.

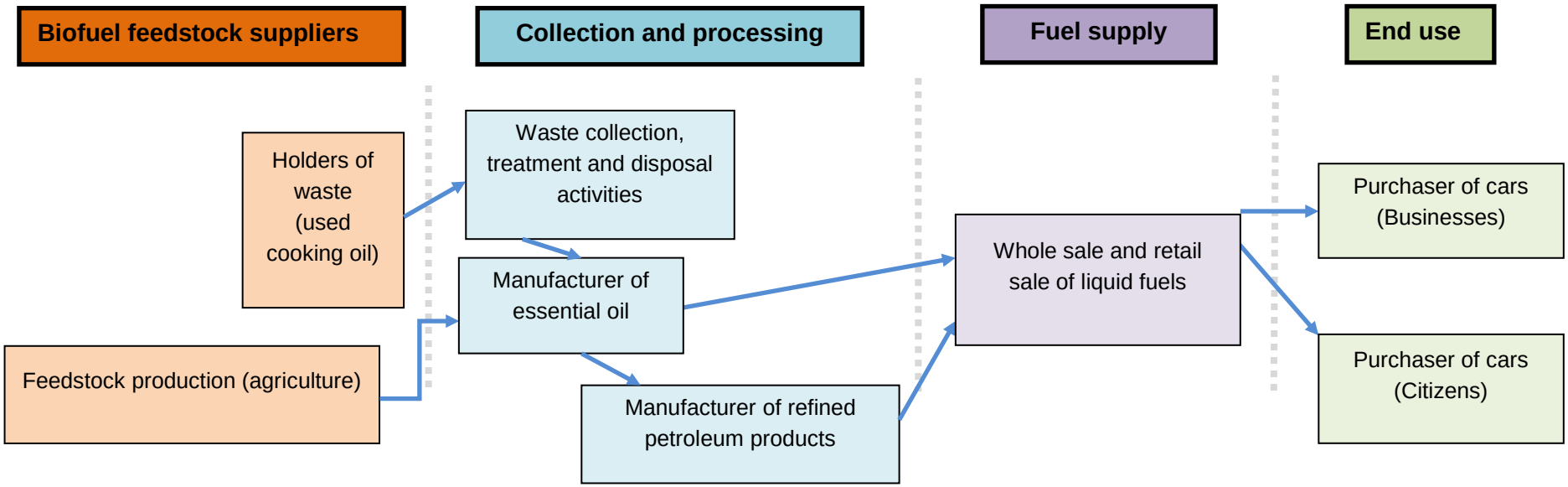

Figure 7: *Stakeholder system of biofuel production and biofuel use*

Biofuel feedstock suppliers

The biofuel feedstock suppliers consist both of virgin feedstock suppliers as well as suppliers of waste usable for biofuels. The main intention of virgin feedstock suppliers is selling their products for making profits; their actions are steered by incentives and restrictions of the European Common Agricultural Policy (CAP) and environmental protection regulations. The main intention of suppliers of waste (= holders of waste) is to get rid of their waste (e.g. used cooking oil from restaurants) potentially free of charge, potentially even getting some earnings from it. This intention is due to the duty of holders of waste be make sure that waste is handed over to professional waste treaters.

Collection and processing

The collection and processing sector includes both industries colleting biofuels' feedstocks and processing them as well as industries processing conventional fuels. The market agent "waste collection, treatment and disposal activities" takes over waste from waste holders. Its activities are motivated by waste regulations and the opportunity to generate profits from waste by potentially treating and selling it as feedstock for biofuels. Collecting waste for biofules becomes even more attractive due to the option to double count biofuels a.o. from waste towards the biofuel target achievement.

A connected market agent is the "manufacturer of essential oils". This market agent obtains its feedstock from virgin feedstock suppliers (agriculture) and from the "collection and processing sector". Its activity is motivated by the demand for biofuels of the transport fuel market and profits generated by this demand.

The third market agent in this category is the manufacturer of refined petroleum products. Due to regulatory requirements this market agent is forced to use biofuels and/or making its product less carbon emitting over the entire life cycle of the product. This market agent is driven by least-costly activities for achieving these regulatory requirements.

Fuel supply

The fuel supplying sector consists of both whole sale and retail sale of liquid transport fuels. In some cases this sector is identical with manufacturers of refined petroleum products. Its activities are also determined by regulatory requirements and tax incentives.

End use

The end use sector consists of both business users of vehicles as well as private individuals. Activities of end users – both in respect of vehicle choice as well as in the intensity vehicles are used – are determined by a profit and utility maximizing behaviour. This behaviour is steered mostly by fiscal incentives but also by risk minimization and habits. Both risk minimization and habits might lead to certain scepticism for new technologies like E10 or non diesel/gasoline powered engines.

6.2 Identifying possible policy interactions based on impact on stakeholders

In the coming sections the expected impacts of PIs for achieving the RES target on the behaviour of market agents are discussed. In a first step the expected impacts of separate PIs are analysed, whereas in the second step the assumed impacts on stakeholders' behaviours of a bundle of PIs is discussed.

The basis question in this analysis is how the achievement of the RES target in the transport sector is affected by stimulating effects of considered PIs impacting mentioned stakeholders. In other words: What impacts do these PIs haveto achieve the RES target in the transport sector (synergies or trade-offs), how are these PIs helping/assisting to achieve the RES target?

6.2.1 Expected impact of a single PI on direct stakeholders' behaviour

The behaviour of the identified stakeholder system is influenced by certain regulations and fiscal incentives as well as of the behaviour of other market agents, who are in turn also influenced by regulations and fiscal incentives. The entire considered stakeholder system and its influencing regulations and incentives are displayed in the following map and discussed below. Certainly, PIs might affect behaviour in multiple ways, however, in this analysis it is focused on the effects of PIs for achieving the RES target in the transport sector.

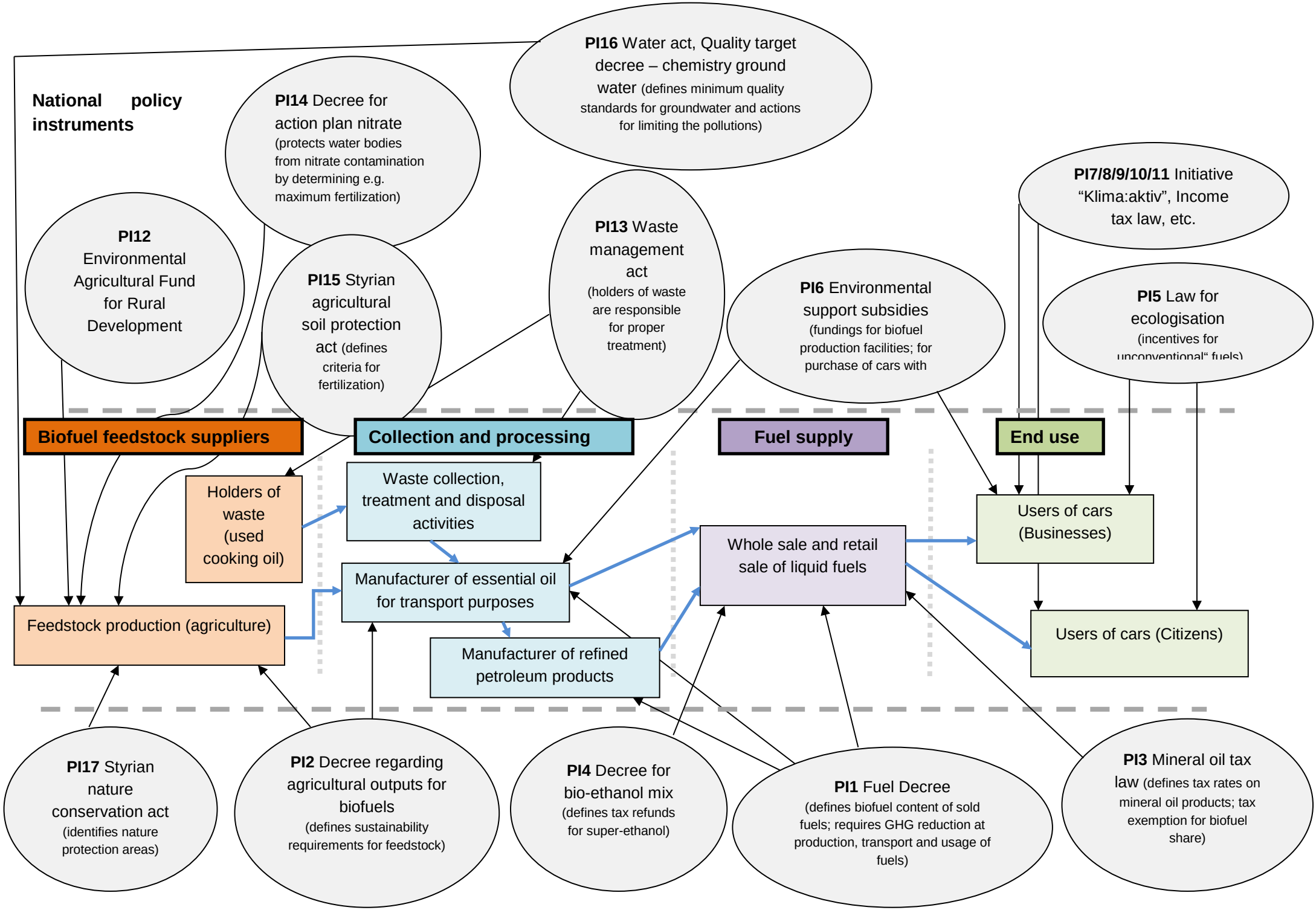
National policy instruments
PI16 Water act, Quality target decree – chemistry ground water (defines minimum quality standards for groundwater and actions for limiting the pollutions)
PI14 Decree for action plan nitrate (protects water bodies from nitrate contamination by determining e.g. maximum fertilization)
PI12 Environmental Agricultural Fund for Rural Development
PI15 Styrian agricultural soil protection act (defines criteria for fertilization)
PI13 Waste management act (holders of waste are responsible for proper treatment)
PI6 Environmental support subsidies (fundings for biofuel production facilities; for purchase of cars with
PI7/8/9/10/11 Initiative "Klima:aktiv", Income tax law, etc.
PI5 Law for ecologisation (incentives for
Biofuel feedstock suppliers
Collection and processing
Fuel supply
End use
Holders of waste (used cooking oil)
Waste collection, treatment and disposal activities
Users of cars (Businesses)
Manufacturer of essential oil for transport purposes
Whole sale and retail sale of liquid fuels
Feedstock production (agriculture)
Users of cars (Citizens)
Manufacturer of refined petroleum products
PI17 Styrian nature conservation act (identifies nature protection areas)
PI2 Decree regarding agricultural outputs for biofuels (defines sustainability requirements for feedstock)
PI4 Decree for bio-ethanol mix (defines tax refunds for super-ethanol)
PI1 Fuel Decree (defines biofuel content of sold fuels; requires GHG reduction at production, transport and usage of fuels)
PI3 Mineral oil tax law (defines tax rates on mineral oil products; tax exemption for biofuel share)

Table 16: *Overview of impacts of analysed national policy instruments on affected stakeholders*

Policy instrument	Directly affected stakeholder	Targets of PIs and Impacts
PI1 "Fuel Decree" (Kraftstoff VO)	• Stakeholders in the sector "Biofuel supply" • Stakeholders in the sector "Collectoin and processing"	• Key PI to transpose Directive 2009/28/EC, includes targets for biofuel blending shares and 2020 targets; • Obliges suppliers of transport fuel to substitute a certain percentage of conventional transport fuels by biofuels ➔ ***in practice blended transport fuels are sold on the mass transport fuel market;*** • Improves economic position of biofuel producers using waste (e.g. used cooking oil) by the possibility to double count the substitution effect of waste-based biofuels ➔ ***makes biofuels from waste more attractive, encourages collection of waste and processing it to biofuels (synergies with waste legislation);*** • By fixing a high blending rate achievement of requirements under the Fuel Quality Directive (FQD) is made easier. If blending rate would be lower higher efforts would be needed for making the transport fuel production process more carbon-extensive ➔ ***easing for transport fuel suppliers to achieve the carbon reductions of supplied fuels required by the FQD***
PI2 "Decree regarding agricultural outputs for biofuels" (VO über landwirtschaftliche Ausgangsstoffe für Biokraftstoffe und flüssige Biobrennstoffe)	• Virgin feedstock producers • Manufacturer of essential oil for transport purposes	• Key PI to transpose Directive 2009/28/EC; includes sustainability requirements for agricultural feedstock intended as input for eligible biofuels; • Incentivizes directly affected stakeholders to cultivate biofuels' virgin feedstock only on eligible land areas and cultivated in line with this regulation ➔ ***makes cultivation of biofuels' virgin feedstock on non-eligible land areas unattractive as in that case biofuels' would not be eligible for being counted towards the RES target, therefore just limited demand for these "non-eligible" transport fuels and therefore lower market price***
PI3 "Mineral oil tax law" (Mineralölsteuergesetz)	• Stakeholders in the sector "fuel supply"	• Positive tax discrimination for transport fuels which contain a certain minimum amount of biofuels ➔ ***Increases social acceptance for biofuels as excess costs for biofuels are cushioned (as consumer do not have to bear (directly) all costs of biofuel blending);*** • Positive tax discrimination supports required substitution rates by the fuel decree. ➔ ***Reduced tax makes it profitable for fuel suppliers to offer just blended fuels (no economic rationale for providing 100% fossil fuels at current tax discrimination);*** ➔ ***By making fuel less expensive than without tax exemption, this particular aspect of the mineral oil tax law leads to higher fuel consumptions (if price-elasticity of consumption >0) than without tax***

Policy instrument	Directly affected stakeholder	Targets of PIs and Impacts
		exemption and so – in turn – works in disfavour for achieving the 10 % RES target in the transport sector (as extending fuel use requires higher amounts of biofuel supply); ***➔ Design of mineral oil tax is indifferent to amount of oil use, i.e. no progressive tax, therefore no special incentive for less oil use; however, it makes oil generally more expensive than without a tax, therefore it tends to reduce oil demand in general and therefore – from that viewpoint – serves the 10 % RES target.*** • Positive tax discrimination is granted also for "non-sustainable" biofuels ***➔ Financial incentives also for "non-sustainable" biofuels***
PI4 "Decree on bioethanol mix" (Bioethanol-Gemisch VO)	• Stakeholders in the sector "fuel supply"	• Tax refunds for biofuel shares of E75 and E85 respectively ***➔ Affects in the same way as mineral oil tax law (PI3), however, tax incentives are often not sufficient taking the price of bioethanol, also bioethanol has much less energy content compared to gasoline;*** ***➔ However, mineral oil industry does not push for E75/E85 as it is not their product and it would require additional fuel dispensers (leads to costs).***
PI5 "Law for ecologisation" (Ökologisierungsgesetz)	• Stakeholders in the sector "End use"	• Provides financial bonus for purchasing "non-conventional" cars (natural gas, biogas, hybrid, pure bioethanol, etc.) and a bonus-malus system regarding energy efficiency of cars; ***➔ Works in general in favour for achieving the 10 % RES target, as it makes non-conventional engine types more attractive. However, according to stakeholders price incentive is not sufficient in order to balance certain disadvantages of non-conventional cars or smaller cars, as*** *-Net of petrol stations for natural gas or hydrogen not dense enough,* *-No entry for gas-powered cars in underground garages (difficulties to distinguish between CNG and LPG)* *-No technical warranty when using fuels with high biofuel share* *-Long charging time (e-mobility)* *-Potential financial losses do not outweight financial bonus from that law.* ***➔ For higher steering impact, PI5 would need a progressively increasing tax incentive***

Policy instrument	Directly affected stakeholder	Targets of PIs and Impacts
PI6 "Environmental support subsidies" (Umweltförderung Inland)	• Manufacturer of essential oil for transport purposes • Users of cars (businesses)	• Provides financial assistance for biofuel production plants (e.g. biogas), as well as financial assistance for mobility management systems and a switch to "non-conventional" cars. ➔ ***Therefore works in favour to the 10 % RES target***
PI7 Initiative "Klima:aktiv"	• r "End users"	• Initiative stimulates ecologically-sustainable mobility by consulting for mobility management systems for municipalities, regions, public facilities etc; by assisting in submitting applications for financial support for respective measures; by awarenessbuildings; by education and certification; by awarding active engagement for climate protection; ➔ ***Therefore works in favour to the 10 % RES target***
PI8 "Pendlerpauschale"	• Private users of cars	• Provides a certain tax refund for commuters to mitigating their cost burden of travelling to their workplace; ➔ ***Easens mobility of work force and therefore – indirectly – increases fuel demand*** ➔ *(little ecologisation aspects of current amendments as exempting users of business cars)*
PI9 "Pendlereuro"	• Private users of cars	• Offers the possibility for commuters to annually set off one Euro per kilometer to the work place and back against tax liability ➔ ***Easens mobility of work force (in the same manner as "Pendlerpauschale") and therefore – indirectly – increases fuel demand*** ➔ *(No ecologisation aspect included as no differentiation between use of public or individual transport)*
PI10 "Jobticket"	• Private users of cars	• Employers (voluntarily) can promote using public transport by their employees by providing a ticket for using public transport (tax exempted) ➔ ***Tax privileged incentive for using public transport, therefore works in favour to the 10 % RES target***
PI11 "Income tax law" (Einkommenssteuergesetz)	•"End users"	• Limit of € 40,000 for companies of setting off the costs of business cars against their tax liabilities; ➔ ***Not sufficient incentive for companies to purchasing small business cars (approx. 50 % of cars sold)*** • If transport fuel for private use of the business car is provided by the company, then the employee does not have to pay income taxes for this in kind contribution of the company. ➔ ***So the employee has no incentive to save fuel (up to a certain km-limit potentially imposed by the company)***

Policy instrument	Directly affected stakeholder	Targets of PIs and Impacts
PI12 Environmental Agricultural Fund for Rural Development (Österreichisches Programm für ländliche Entwicklung)	• Virgin feedstock producers	• Incentivices (among others) environmentally sustainable cultivation methods in the agricultural sector (e.g. non-intensive agricultural practices); ➔ ***Promoted non-intensive agricultural practices potentially are in conflict with increased virgin feedstock demand due to increased biofuel demand (potentially minor importance)***
PI13 "Waste management act" (Abfallwirtschaftsgesetz)	• Holders of Waste • Waste collection, treatment and disposal activities	• Obligation for holders of waste to collect waste and to deliver this waste to professional waste treatment; ➔ ***This enables to increase the potential amount of waste usable for biofuel production, therefore works in favour for achieving 10 % RES target;***
PI14 "Decree for action plan nitrate" (VO über das Aktionsprogramm Nitrat 2012)	• Virgin feedstock producers	• Intends to protect water bodies potentially contaminated by nitrate from agricultural sources; ➔ ***Indirectly impacting potential for virgin feedstock production, but potentially limited impact on the RES target***
PI15 "Styrian agricultural soil protection act" (Stmk. Landw. Bodenschutzgesetz)	• Virgin feedstock producers	• Defines in principal prohibitions for fertilisation (date, sites) and necessary actions for preserving the quality of agricultural land (soil fertility, protection against soil erosion and soil compacting); ➔ ***Indirectly impacting potential for virgin feedstock production, but potentially limited impact on the RES target***
PI16 "Water act, Quality target decree – chemistry ground water" (Wasserrechtsgesetz 1959 Qualitätszielverordnung – Chemie Grundwasser)	• Virgin feedstock producters	• Decree defines minimum quality standards for groundwater (=maximal pollution) and actions for limiting the pollution of groundwater. In the case of extensive pollution, the governor has to define an area where intensified actions for groundwater protection have to be accomplished; ➔ ***Indirectly impacting potential for virgin feedstock production, but potentially limited impact on the RES target***

Policy instrument	Directly affected stakeholder	Targets of PIs and Impacts
PI17 "Styrian nature conservation act" (Stmk. Naturschutzgesetz)	• Virgin feedstock producers	• Identifies nature protection areas (also Natura 2000 areas), therefore relevant for the production of feedstock for biofuels in eligible land areas ("sustainability criteria"); ➔ ***Restricting land areas for "eligible" biofuels, therefore complicating supply for biofuels, but in line with sustainability requirements demanded by RES-Directive (2009/28/EC)***

6.2.2 Expected impact of combined PI on direct stakeholders' behaviour including indirect stakeholders

In this section the **impacts of a bundle of PIs** on the behaviour of direct stakeholders/stakeholder groups **on achieving the Austrian biofuel target (and indirectly the 10 % RES target) in the transport sector** will be analysed. The analysis will cover all groups of the stakeholder system. In a qualitative manner the direction of impacts (positive/negative to stimulate behaviour for achieving the biofuel/RES target respectively) will be displayed by arrows. The assumed strength of the impacts will be depicted by different lengths of arrows.

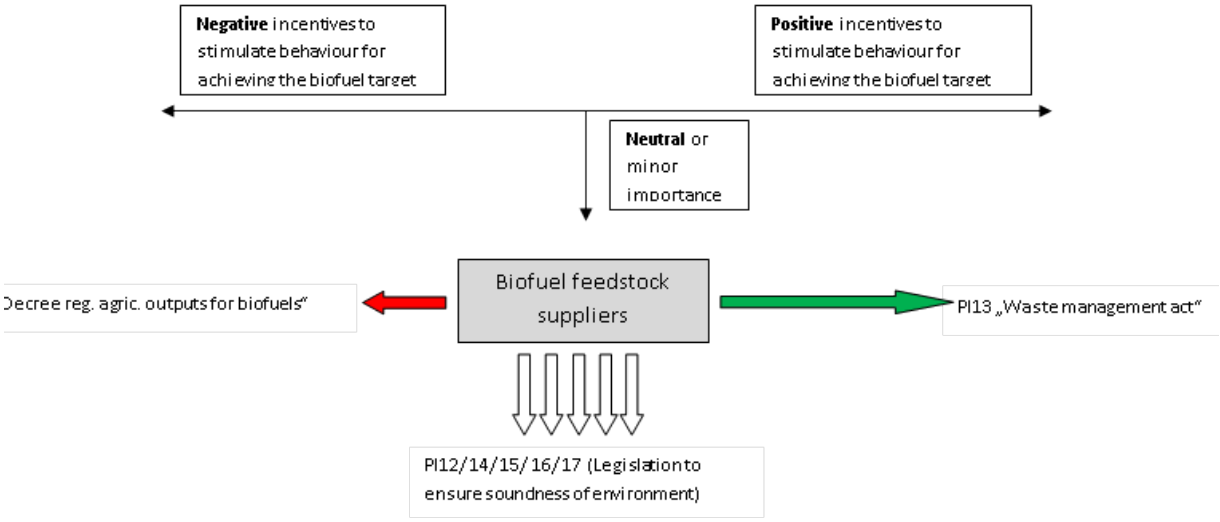

Figure 8: *Incentives of national policy instruments on biofuel feedstock suppliers for achieving the national biofuel target*

Activities of the first stakeholder group considered – the biofuel feedstock suppliers – are regulated by environmental quality regulations for soil and ground water protection. These regulations cannot be seen in direct connection to achieve the biofuel- or RES target but are rather regulations to ensure the environmental soundness of agricultural practices. The waste management act (PI13) works in favour for providing waste for biofuel production (especially relevant for biodiesel production from used cooking oil). On the other side the "decree regarding agricultural outputs for biofuels" (PI2) limits "eligible" land areas for biofuel's feedstock cultivation. However, exempting negative environmental effects of biofuels is required by biofuel use per se. Therefore it cannot be seen as a barrier for achieving the biofuel- and RES target but rather as a prerequisite when using biofuels in general.

Collection and processing:

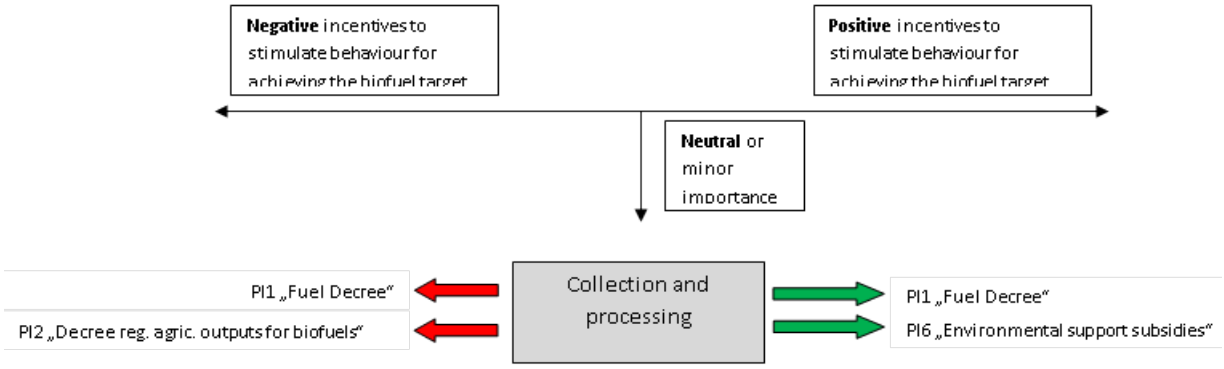

Figure 9: *Incentives of national policy instruments on sector „collection and processing" for achieving the national biofuel target*

Within the "collection and processing" sector legislation which intends to ensure environmental soundness of biofuels inevitably leads – due to an exclusion of certain "non-sustainable biofuels" and therefore a limitation of eligible biofules – to a "barrier" for achieving the biofuel target. The Fuel Decree defines for instance minimum GHG reductions for biofuels compared to the reference (conventional fuels), whereas the "decree regarding agricultural outputs for biofuels" defines non-eligible land areas for biofuels' feedstock cultivation. Both regulations inevitably lead to a reduction of potential for biofuels, however, they are necessary that biofuels result in real GHG reduction targets and that biofuels (or biofuels' feedstock cultivation) do not harm the environment.

On the other hand, the Fuel Decree also includes the obligation for manufacturers of refined petroleum products to reduce GHG emissions of their products over the entire life cycle (obligation based on Fuel Quality Directive 2009/30/EC). Using biofuels is one option for achieving this obligation. Therefore, this aspect – included in the Fuel Decree – pushed the use of biofuels by refineries.

Environmental support subsidies promote – among others – investments of biofuel production facilities. It therefore reduces the barrier of conducting such investments and therefore works in favour of achieving both the biofuels as well as the 10 % RES target.

Fuel supply:

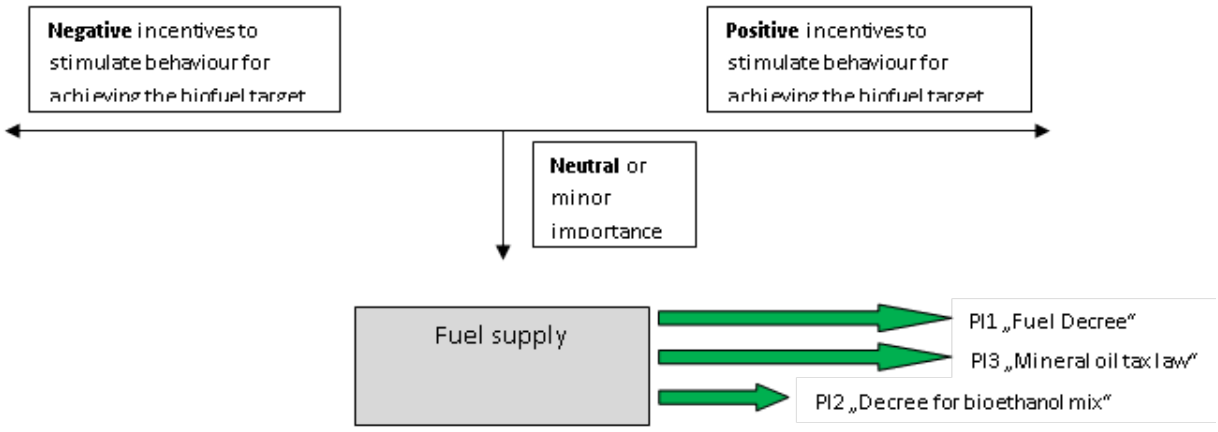

Figure 10: *Incentives of national policy instruments on sector „fuel supply" for achieving the national biofuel target*

The fuels supply sector faces just incententives advantageous for blending and selling biofuels. Actually, the Fuel Decree includes a substitution obligation but not a blending obligation for fuel suppliers. However, blending biofuels to conventional fuels offer the highest leverage (=easiest way) of achieving the substitution obligation. Also the mineral oil tax law incentivizes the use of blended fuels over 100 % conventional fuels due to a positive tax discriminiation for blended fuels. The same tax incentive is provided by the Decree for bioethanol mix, however the market for E75/E85 is much smaller than the mass market for transport fuels. Introducing E75/E75 therefore provides a lower leverage effect for achieving the biofuel- and RES target. Also E75/E75 is not pushed by the mineral oil industry as it is not a product produced by them and it would need additional fuel dispensers, which implies additional cost.

End use:

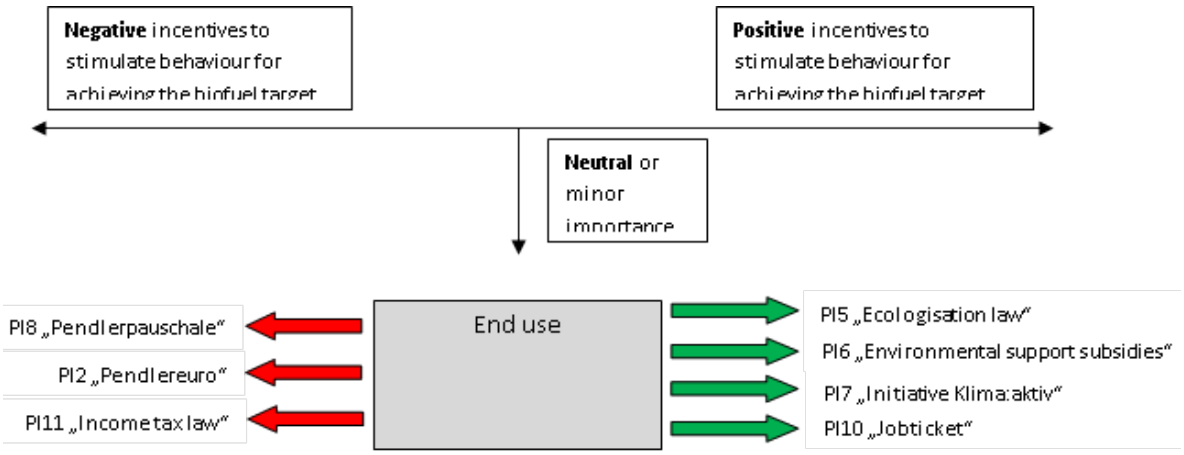

Figure 11: *Incentives of national policy instruments on end users for achieving the national biofuel target*

The end use sector of transport fuels is influenced by many and mutually contradicting incentives for achieving the RES target. Stimuli in both directions are exclusively fiscal incentives and awareness building measures. It is anticipated that none of these measures are crucial enough for achieving or not achieving the biofuel target. However, in sum their impacts on target achievement might be considerable. For determining the net impact of all these contradicting incentives, further investigations are necessary.

On the side of incentives advantageous for achieving the biofuel and RES target respectively four national policy instruments have been identified. The "Ecologisation law" includes a fiscal bonus-malus system incentivizing the purchase of energy efficient cars and provides a financial bonus for non-conventional engines (e.g. engines applicable for pure biofuels, e-mobility, etc.). However, stakeholders feed back that current design of incentives are far not sufficient for steering actions of consumers accordingly ("low efficiacy"). The environmental support subsidies promote the exchange of the car fleet of companies. The "Jobticket" also provides an incentive for employees to shift to public transport, which reduces individual transport and therefore fuel demand. The initiative "Klima:aktiv" stimulates awareness building and education for an ecologically sustainable transport and therefore also serves the RES- and biofuel targets.

On the side of disadvantageous incentives for achieving the RES and biofuel target respectively are policy instruments which do not serve mainly environmental interests, but rather social and labor market policy interests. The fiscal incentives "Pendlerpauschale" and "Pendlereuro" reduce costs for especially long transport distances from home to workplaces. Although especially the "Pendlerpauschale" includes some ecological aspects these incentives facilitate moblitiy and therefore – indirectly – induce increased fuel demand. The same is true for the income tax law, which lacks of special incentives for efficient fuel use.

Summary

For reducing the fuel demand of the transport sector, incentives have to be provided at the level of end users. In fact many incentives are provided for end users to lower their energy demand for transport purposes. However, the extent of transport fuel consumption of end users is also influenced by other – non-environmental – policy instruments (e.g. PI8 "Pendlerpauschale", PI11 income tax law). Their impacts on transport fuel use are contradicting to aforementioned incentives intending to reduce transport fuel use. Therefore, although multiple instruments to reduce transport fuel use are provided, contradicting incentives from other policy instruments reduce their effectiveness and therefore also their efficiency.

For substituting fossil transport fuels by biofuels most leverage can be anticipated in the fuel supplying sector. Incentives are designed in a way that regulatory requirements are mixed with fiscal incentives. Regulatory requirements ensure compliance with substitution shares (compared to voluntary agreements), whereas fiscal incentives "motivate" to comply with regulatory requirements. These incentives are not contradicted by other policy instruments.

To the "collection and processing" sector also incentives for especially the biofuel target are provided. They include legislation which improves availability of used cooking oil for biodiesel production as well as special incentives for biofuels from waste. The sector of "biofuel

feedstock suppliers" is mostly regulated by environmental protection legislation, which indirectly serves the environmental integrity of used biofuels.

6.2.3 Conslusion on interaction analysis: Expected impact of stakeholder interaction in a multi-PI environment on the ability to achieve policy objectives

As shown above, behaviour of analysed stakeholder groups are influenced by biofuel-related PIs in both directions – advantageous and disadvantageous for achieving the biofuel target. Now it is interesting whether a changing behaviour of one stakeholder group or stakeholders have influences on other stakeholders or stakeholder groups, which in turn influences the biofuel target achievement once again (interactions within the stakeholder system).

Furthermore, achieving the biofuel target is influenced also by other environmental targets and corresponding legislations. These are targets and legislations corresponding to biodiversity protection, climate protection, waste reduction as well as water/soil quality protection.

Austrian "Fuel Decree"

Impacts due to interactions within the stakeholder system:

Although many national PIs impacting the system are contradicting, interactions between stakeholders and subsequent impacts on achieving the Austrian biofuel target (and thereby also an essential part of the RES target) are rather rare. Interactions can be anticipated coming from the obligation of fuel suppliers to substitute conventional fuels by biofuels to a certain extent. This certainly stimulates demand for biofuels, which in turn stimulates waste collection (as biofuels from waste are allowed counting double towards the biofuel target) and usage of agricultural products for biofuel production. Certainly there are also other users of waste (e.g. cosmetic industry) and agricultural products (food "industry"). Adding to their demands also feedstock demands for biofuels might increase the price of feedstock and raw materials for biofuels and therefore subsequently also the price of biofuels. Theoretically increased price for biofuels could also increase the price for transport fuels in general and might therefore influence fuel consumption of end users. However, the magnitude of such impacts is not expected to steer consumer behavior intensively, as price fluctuations for mineral oil might have much more influence on the end user price and end users are – regarding to the demand for transport fuels –very price-inelastic anyway. Therefore it is considered that interactions between stakeholders do reduce neither effectiveness nor efficiency of the Austrian Fuel Decree.

Nevertheless, although (rare) interactions inside the stakeholder system do not considerably affect achieving the Austrian 2020-biofuel target of 8.45%, other environmental policies (e.g. biodiversity related policies) and their targets interact with the biofuel target and impact its effectiveness and efficiency. It is therefore analysed below how these other environmental targets impact the effectiveness and efficiency of the Fuel Decree:

Impacts due to interaction with biodiversity protection:

Biodiversity requirements lead to a limitation of land areas eligible for biofuels' feedstock production. However, this might not lead to a reduced supply of biofuels, but only to higher prices for biofuels. Therefore, biofuel target achievement required by the Fuel Decree might

not be jeopardized by biodiversity protection legislation, as the targets set by the decree are not adaptive to biofuel prices. However, higher costs for target achievement influence the efficiency of the Fuel Decree adversely in principle. Also costs for certifying sustainability of biofuels impact efficiency. Nevertheless, the Fuel Decree does not only include a biofuel target but requires also environmental sustainability of biofuels. Therefore, higher costs for ensuring environmental sustainability of biofuels do not harm efficiency of the Fuel Decree itself but are rather costs which appear in achieving the environmental sustainability requirement of the decree.

Impacts due to interaction with climate protection:

The magnitude of indirect land use change (ILUC) was and is discussed controversially. Bowyer and Kretschmer (updated) (2011) for instance stated that – taking into account ILUC – the use of conventional biofuels "would lead to between 81% and 167% more GHG emissions than meeting the same need through fossil fuel use". In an analysis (European Commission SWD (2012) 343 final) the EC concluded that the magnitude of ILUC cannot be estimated with certainty. To reduce the potential risk of increased GHG emissions due to biofuels' feedstock cultivation the EC proposed to limit the use of first generation biofuels. Currently this limit has been set at 6 % by the European Parliament and still has to be accepted also by the Council.

This limitation has – however – considerably impacts on the biofuel target achievement requested by the Fuel Decree. The biofuel target was considered to be mainly achieved by first generation biofuels as future generation biofuels are considered to be not technically available to a sufficient extent. Therefore it is doubted by many stakeholders that future generation biofuels are viable for filling the gap of first generation biofuels. Increased efforts for pushing future generation biofuels might require higher financial funds and thus might increase costs for achieving the biofuel target included in the decree.

Impacts due to interaction with waste legislation:

The legislations on increasing the renewable energy share and waste treatment are mutually beneficial. The Renewable Energy Directive (2009/28/EC) – and also its Austrian transposition – privilege biofuels from waste material. The option for a profitable use of waste (for biofuels) makes the collection of waste more attractive. On the other side, waste legislation requires the collection of waste and a proper treatment. This collection from households and businesses facilitates and easens the usage of waste for biofuel production.

Also from the efficiency point of view waste legislation is beneficial for efficiently achieving the biofuel target. As biofuels from waste can be counted twice towards the target achievement, the biofuels target can be achieved at lower costs.

Impacts due to interaction with water/soil quality protection:

Austria has a dense net of water and soil quality protecting legislation. In respect to biofuels, water and soil protecting legislation mainly refers to agricultural practices as well as treatment of waste. In other words: Water and soil quality protecting legislation defines environmental minimum standards for agricultural practives, provisions in cases of environmental pollution (e.g. at ground water pollution due to excessive fertilization), as well

as rules for collection and treatment of waste. Regulating agricultural practices is considered to have no or only minor impacts on biofuel supply and therefore on the effectiveness of the Fuel Decree. Rules regarding the collection and treatment of waste are considered to be beneficial for biofuels, however not considered at this stage as it was considered above already.

It is also considered that water and soil quality protection legislation does not jeopardize efficiency of the Fuel Decree as these legislations describe rather good agricultural practices. Certainly, ignoring water and soil quality protection legislation might lead to lower costs for agricultural products and therefore to lower costs for biofuels in the short-term. However, in the long term this could cause environmental damages, which in turn could cause higher costs for biofuel cultivation once again.

In the following a summary of interactions is given as well as the impacts on effectivenss and efficiency of interactions with the Fuel Decree:

Table 17: *Impact of interactions on effectiveness and efficiency of "PI1 Fuel Decree"*

Intercations	Impact	Impact on effectiveness of key PIs	Impact on efficiency of key PIs
Interactions within the stakeholder system	Theoretic feedback effects from biofuel demand on price for agricultural products, which in turn makes transport fuels more expensive, which could reduce demand for transport fuels. In practice no considerable impact on effectiveness/ efficiency from this interaction is expected	No impact	No impact
Interactions with biodiversity protection target	No impact on effectiveness as biofuel supply might not be reduced due to biodiversity protection legislation as long as high enough margins can be ensured for biofuels. Sustainablility certification leads to costs, however sustainability certification is also required by the Fuel Decree, therefore certification costs are considered as costs for achieving requirements of the decree rather than costs which reduce efficiency.	No impact	No impact
Interactions with climate protection target	New scientific knowledge about ILUC questions the climate protection potention of biofuels. The limitation of first generation biofuels jeopardizes RES target achievement considerably as future generation biofuels cannot fill this gap until 2020. Accelerating research in future generation biofuels and their accelerated market implementation might impose considerably higher costs.	Highly negative	Highly negative
Interactions with waste legislation	Waste legislation stimulates waste collection, this increases supply of raw materials for biofuels not inducing ILUC	Highly positive	Highly positive
Interactions with water/soil quality protection target	Water/soil quality protection legislation might not reduce supply of biofuels' feedstocks as long as financial margin for biofuels is ensured. Water/soil quality protection legislation certainly causes short-term costs for biofuels, but this is necessary for protecting the productivity of ecological services.	No impacts	No impacts

Austrian "Decree regarding agricultural outputs for biofuels"

Impacts due to interactions within the stakeholder system:

Biofuels are just eligible to be counted towards the biofuel target if their feedstocks are cultivated on land areas not excluded by the decree. However, the tax differential for biofuels is currently also applied to "non-eligible" biofuels. Therefore – depending on the mineral oil price – it could also be financially attractive to use "non-eligible" biofuels. Therefore, there is a theoretic possibility that feedstocks for ("non-eligible") biofuels are cultivated on land areas actually excluded by the decree. This – in theory – counteracts the effectiveness of the decree. However, protection of land areas with high ecologic value is aimed and ensured not only by the analysed decree, but also by other environmental protection legislations and incentives (e.g. by the Common European Agricultural Policy). Therefore it can be assumed – even if there is a "gap" in legislation for providing non-eligible biofuels the same tax incentive as for eligible biofuels – that no significant harms on land areas with high ecologic value appear.

Impacts due to interaction with biodiversity protection:

Biodiversity protection legislation and the analysed decree are mutually reinforcing. Therefore effectiveness of the analysed decree is positively affected by biodiversity protection legislation. Also controlling efforts for other biodiversity protecting legislation is synergetic with controlling obligations for the analysed decree.

Impacts due to interaction with climate protection:

The potentially coming regulation to limit first generation biofuels is intended to reduce demand for agricultural land in order to lower the risk of ILUC. This also reduces pressure on land areas with high ecologic value. Therefore effectiveness of the analysed decree is slightly increased; no impacts on efficiency are expected.

Impacts due to interaction with waste legislation:

Waste legislation promotes collection and reuse of waste, also in favour for producing biofuels (e.g. biodiesel from used cooking oil). This reduces demand for land areas for cultivating biofuels' feedstocks. Therefore effectiveness of the analysed decree is slightly increase by waste legislation. Efficiency is not expected to be affected as costs for certifiying that biofuels have not been cultivated on protected land areas do not decrease.

Impacts due to interaction with water/soil quality protection:

Water and soil quality protecting legislation is certainly also in favour for protecting the environmental quality of land areas with high ecologic value. However, these legislations do not have impacts on the effectiveness of the analysed decree nor on its efficiency.

In the following a summary of interactions is given as well as the impacts on effectivenss and efficiency of interactions with the Decree regarding agricultural outputs for biofuels:

Table 18: *Impact of interactions on effectiveness and efficiency of "PI2 Decree regarding agricultural outputs for biofuels"*

Policy intercations	Impact	Impact on effectiveness of key PIs	Impact on efficiency of key PIs
Interactions within the stakeholder system	Theoretic impact on effectiveness does not prohibit the cultivation of feedstock for "non-eligible" biofuels. However, this is prohibited (or made unattractive) by other environmental protection legislation of agricultural related subsidies.	No impact	No impact
Interactions with biodiversity protection target	Analyzed decree has same intentions as other biodiversity protecting legislation, therefore mutually beneficial. Controlling efforts for other biodiversity protecting legislation is synergetic with controlling obligations for the analysed decree.	Slightly positive	Slightly positive
Interactions with climate protection target	Potentially coming limitation of frist generation biofuels generally reduces pressure on land, also on land with high ecologic value.	Sligthly positive	No impact
Interactions with waste legislation	Waste legislation stimulates waste collection, this reduces pressure on land areas, also on land with high ecologic value	Slightly positive	No impacts
Interactions with water/soil quality protection target	Certainly positive impacts on environmental status of protected land areas, but no impacts on effectiveness or efficiency of the analysed decree	No impacts	No impacts

The interaction analysis shows that no considerable impacts on effectiveness and efficiency of RES related PIs arise from interactions within the stakeholder system. However, interactions with other environmental policy targets lead to impacts on effectiveness and efficiency of RES related PIs. It turns out that PIs related to reducing waste and proper treatment of waste are highly advantageous also for achieving the RES target in the transport sector. On the other side, potential problems of biofuels for really reducing GHGs (induced by ILUC) and the subsequent limitations of first generation biofuels might considerably jeopardize the RES target achievement in Austria.

7. Assessing the 3Es/Synthesis

This chapter brings together know-how gathered in previous chapters for assessing the 3Es of the analysed policy instruments (PIs). It starts with synthesis on effectiveness and efficiency of analysed PIs as a short reminder. This is followed by a synthesis on impacts from contextual factors, implementation factors and interactions. Based on this knowledge the chapter is finalized by conclusions.

7.1 Conclusion on effectiveness and efficiency

In achieving the Austrian biofuel target (as a "sub-target" of the RES target in the transport sector) many PIs are affecting the transport system and therefore many PIs are affecting the effectiveness and efficiency of the biofuel target. However, two PIs – the Fuel Decree (PI1) and the Decree regarding agricultural outputs for biofuels (PI2) – have been filtered out as key policy instruments for achieving this target.

Fuel Decree

The Austrian Fuel Decree has defined certain rates of biofuel substitution targets in the transport sector. Substitution rates have been introduced in 2005 for the first time. These substitution rates have been increased in subsequent years. Achieved substitution rates have always been above the requirements of EU law and also of the more strict requirements of national law (Fuel Decree). This success was also enabled by the tax differential of the mineral oil tax, which makes blended fuels finically more attractive than 100 % fossil fuels. However, the actual increase in biofuel substitution shares has considerably flattened in the near past. From 2011 to 2012, the biofuel substitution share rose only by 0.02 %.

For 2020 a biofuel substitution share of 8.45 % is aimed, however it is just a general target and does not assign any specific duties to market agents. This target was intended to be aimed by introducing E10/B10. The introduction of E10 failed in 2012. Also, for B10 approval of car manufacturers is still missing, which has impeded its introduction so far. However, if an introduction of E10/B10 would be finally successful, the intended (but so far not approved) limitation of first generation biofuels might lead to biofuel shortages for achieving E10/B10.

Achieving this target is certainly not free of charge as long as biofuels are more expensive than fossil fuels. Exact excess costs of biofuels depend on prices for fossil fuels and changing prices for biofuels' feedstocks. The magnitude of costs for national budget and consumers depend on the substitution rates, the magnitudes of the tax differential as well as on the production costs for biofuels. Imposing the same substitution obligation to all market agents might not be efficient according to economic theory, but also market based systems are considered to have high transaction costs taking into account the high number of potential agents.

EU legislation leaves it up to EU MS of how to achieve the 10 % RES target in the transport sector; biofuels are only one possible option. Biofuels might not be the least cost option to reduce GHGs or to increase the share of renewables, neither in the transport sector nor in general. However, they are often seen as the only viable option in the transport sector in the

short run with sufficient potential. (This does not imply that other options in the transport sector like providing stronger incentives for energy efficient vehicles, improved spatial planning, etc. are less important.) Beside the advantage of reducing GHGs and increasing the share of renewables in the transport sector, biofuels are an option for improving fuel security and reducing oil spills. Beside that biofuels provide another income opportunity for the Austrian agricultural sector.

Decree regarding agricultural outputs for biofuels

The Austrian "Decree regarding agricultural outputs for biofuels" intends to protect land areas with high ecological value from being used for cultivating feedstocks for biofuels. It therefore defines land areas where biofuels are considered of not being eligible to count towards the biofuel target if feedstocks come from these areas.

According to stakeholders it can be observed that land areas with high ecological value are not destroyed in Austria. However, it is not only the merit of this decree as these land areas are also protected by a dense net of other environmental protection legislation. Although the decree ensures that biofuels are not certified (which is necessary to be acknowledged to be eligible for counting towards the biofuel target) if feedstocks for biofuels have been cultivated on respective land areas, it does not prevent the cultivation of feedstocks for biofuels which whose certification is not intended. Certainly, non-certified biofuels might have a lower value; however, taking into account efforts for certification, using non-certified biofuels might make sense for certain market agents.

According to stakeholders, however, it was never anticipated and it cannot be observed that feedstock cultivation for biofuels would harm respective land areas in Austria. This is rather assumed for land areas in other countries outside Europe. However, in order to being conform to WTO regulation, this aspect of protecting certain land areas from cultivating biofuels' feedstocks has also to be introducted domestically.

In fact, many problems arise with biofuels' feedstock production abroad. These problems correspond to potential leakage of food cultivation to land areas with high ecological value and potential problems regarding harming of land ownerships, etc. These problems cannot be solved by this decree.

The certification process – which is a necessary requirement in order to classify biofuels as eligible – has been established in Austria least bureaucratic as possible. However, the existence of many certification schemes among Europe, which in many cases do not recognize each other, imposes high transaction costs for biofuels, especially at transnational trade of biofuels or respective feedstocks.

7.2 Synthesis on contextual factors, implementation factors and interactions

In previous chapters the impacts of contextual factors, transposition & implementation factors, and interactions on effectiveness and efficiency of the analysed national key policy instruments have been discussed in detail. Now, at this stage, these findings are synthesised for getting a comprehensive picture about crucial impacting factors on the performance of national key-policy instruments.

Table 19: *Synthesis of impacts of contextual factors, transposition & implementation factors, and interaction factors on effectiveness and efficiency of national key policy instruments*

		PI1 "Fuel Decree"		PI2 "Decree regarding agricultural outputs for biofuels"	
		Effectiveness	Efficiency	Effectiveness	Efficiency
Context factors	*Highly negative impacts on RES-target achievement due to limitation of 1st generation biofuels; lack of technologies for introducing B10 or using other non-biofuel technologies to a considerable extent; efficiency losses due to confusion in certification processes*				
	CF1 Change in final energy consumption in transport sector				
	CF2 Development of fossil fuel prices relative to crop prices				
	CF3 Scientific knowledge on impacts of biofuels on climate protection and biodiversity				
	CF4 Technical usability of biofuels in current car engine technologies				
	CF5 Initial lack of guidance for market actors to achieve obligations				
	CF6 Investment uncertainty				
	OVERALL ASSESSMENT				
Implementation factors	*Failure of introducing E10 slightly jeopardizes biofuel target achievement, however tax differential for biofuels makes blended fuels finacially attractive. Domestic certification system is as least bureaucratic as possible, which impacts efficiency slightly posititve*				
	IF1 Biofuel E10				
	IF2 Administrative set up of certification system				
	IF3 Coordination and Management among institutions				
	OVERALL ASSESSMENT				
Interaction factors	*Biofuel target is highly jeopardized by potential limitation of first generation biofuels, waste legislation works in favour for achieving the biofuel target*				
	INT1 Interactions within the stakeholder system				
	INT2 Interactions with biodiversity protection				
	INT3 Interactions with climate protection				
	INT4 Interactions with waste legislation				
	INT5 Interactions with water/soil quality protection				
	OVERALL ASSESSMENT				

The table above shows a synthesis of impacts of contextual factors, transposition & implementation factors, and interaction factors on effectiveness and efficiency of national key policy instruments. Impacts on effectiveness and efficiency are labelled by colours, whereas dark green implies that a certain factor has been "highly positive" for effectiveness or efficiency respectively, whereas dark red implies "highly negative" effects. Light green and orange show "slightly positive" and "slightly negative" impacts respectively, whereas white indicates "no impacts".

Fuel Decree

The table shows that mostly context factors are impacting the achievement of the Austrian biofuel target negatively. Especially currently evolved scientific knowledge about potentially negative impacts of biofuels on the global climate (ILUC) and the subsequently planned limitation of first generation biofuels have seriously jeopardized the achievement of the high Austrian biofuel target. Sufficient alternatives are currently rarely available, increased efforts for promoting an accelerated introduction of future generation biofuels would be more costly and impact therefore efficiency of target achievement also highly negatively. Another crucial aspect is the technical limitation to use biofuel B10. This fuel type was anticipated to be introducible and was expected to be absolutely necessary for achieving the high Austrian biofuel target. This limitation also impacts efficiency highly adversely as alternatives (future generation biofuels) are currently more costly. Because of these two crucial issues the

overall impact of context factors on effectiveness and efficiency is considered to be highly negative.

Compared to context factors implementation factors and interaction factors have minor importance on effectiveness and efficiency of the Fuel Decree. Slightly negative impacts on effectiveness arise due to the failure of introducing E10. However, the use of biofuels is stimulated by tax differentials. Therefore the overall impact of implementation factors on effectiveness of the Fuel Decree is considered to be neutral. Efficiency is considered to be impacted slightly positive due to the least bureaucratic Austrian sustainability certification scheme. (However, the initial lack of European guidance regarding sustainability certification schemes has lead to a splitted landscape of certification schemes in Europe, with lack of mutual recognition. This leads to high inefficiency.). The interaction with climate protection efforts, namely the limitation of first generation biofuels is highly jeopardizing for the biofuel target (as mentioned above). On the contrary waste legislation works in favour for the intentions of the Fuel Decree. It is anticipated that the negative impacts of limiting first generation biofuels has stronger impacts on the biofuel target achievement than the positive impacts from waste legislation as there is only limited potential for improved waste collection in Austria (and therefore the additional positive impact might by small).

Decree regarding agricultural outputs for biofuels

In contrast to the Fuel Decree, context factors do not affect the effectiveness or the efficiency of the Austrian decree regarding agricultural outputs for biofuels. In the group of implementation factors: the Austrian sustainability certification system uses existing bureaucratic and controlling structures. This reduces costs for certifying sustainability of biofuels and is therefore considered as advantageous for the efficiency of the decree. Most impacts arise from the third considered group of factors, the interaction factors. Most environmental targets have positive impacts on effectiveness and efficiency of the decree. It can therefore be observed that all these factors had no or slightly positive impacts on the effectiveness and efficiency of the decree.

Condensed view

Condensing all these effects of impacting factors the following pictures arise. The classification stays the same as above, i.e. dark green means highly positive impacts of a factor group on the effectiveness or efficiency of respective PIs, whereas dark red means highly negative impacts.

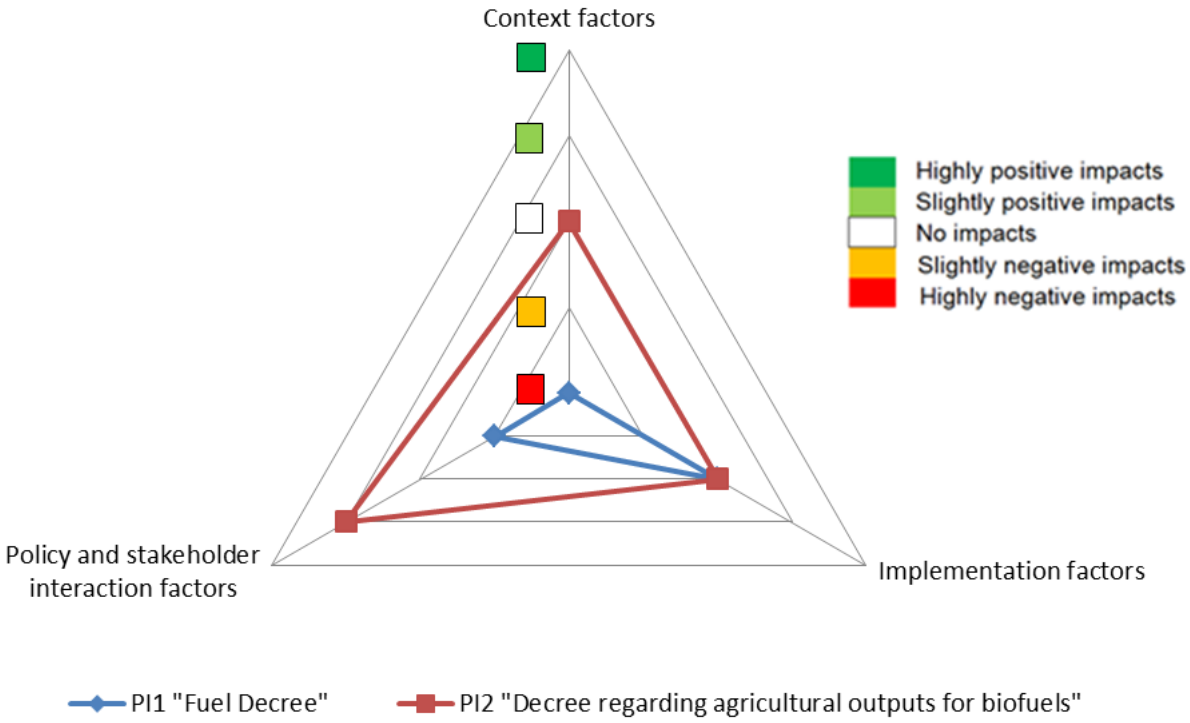

Figure 12: *Impacts of factor groups on effectiveness of key policy instruments*

The figure above shows the impacts of factor groups on effectiveness of assessed key policy instruments. This figure shows clearly, that the different factor groups had mostly negative impacts on the effectiveness of PI1 “Fuel Decree”, whereas effectiveness of PI2 “Decree regarding agricultural outputs for biofuels” was either not or slightly positively affected by different factor groups.

A similar picture arises when looking at the impacts on efficiency (figure below). Once again context factors have highly negative impacts on the efficiency of PI1 “Fuel Decree”, whereas the impact of implementation factors on the efficiency of PI1 is slightly positive (mainly due to the efficient Austrian sustainability certification system). The impact of different factor groups on efficiency of PI2 is neutral or slightly positive respectively.

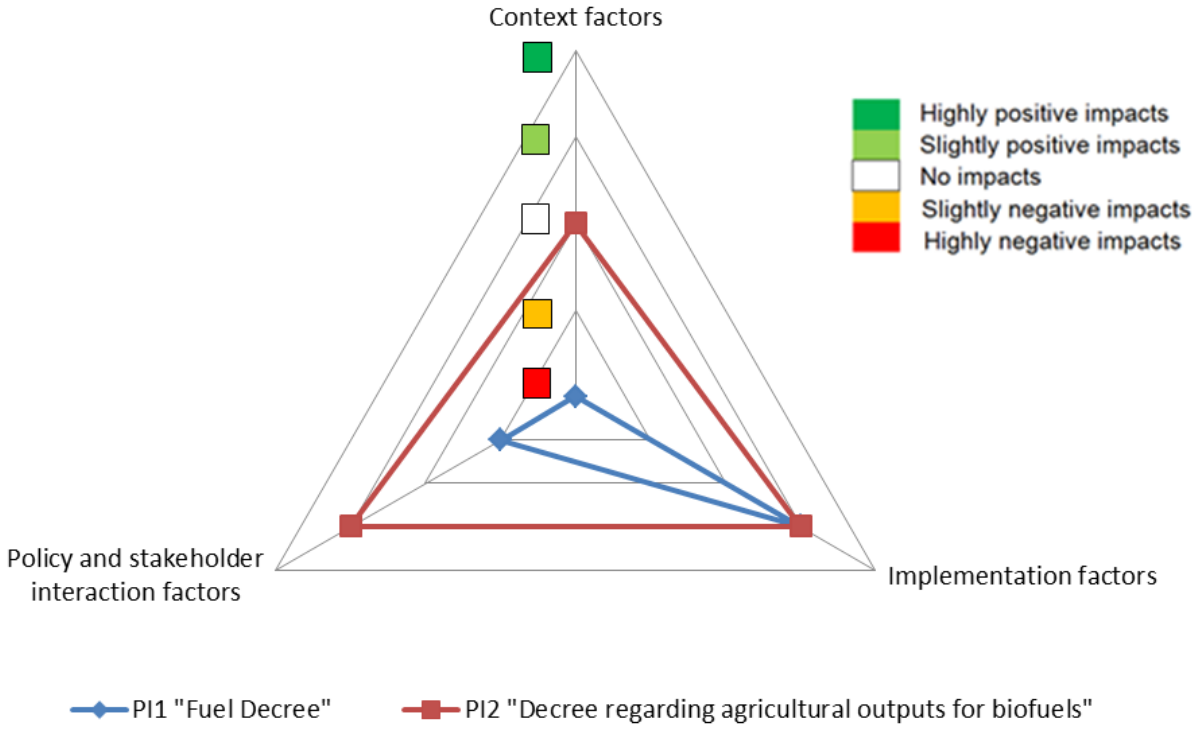

Figure 13: *Impacts of factor groups on efficiency of key policy instruments*

Another option of analysing the effects of impact factors is the simultaneous view of impacts both on effectiveness and efficiency. The figure below shows this for PI1 “Fuel Decree”, whereas the classification “highly positive impacts – highly negative impacts” stays the same as before.

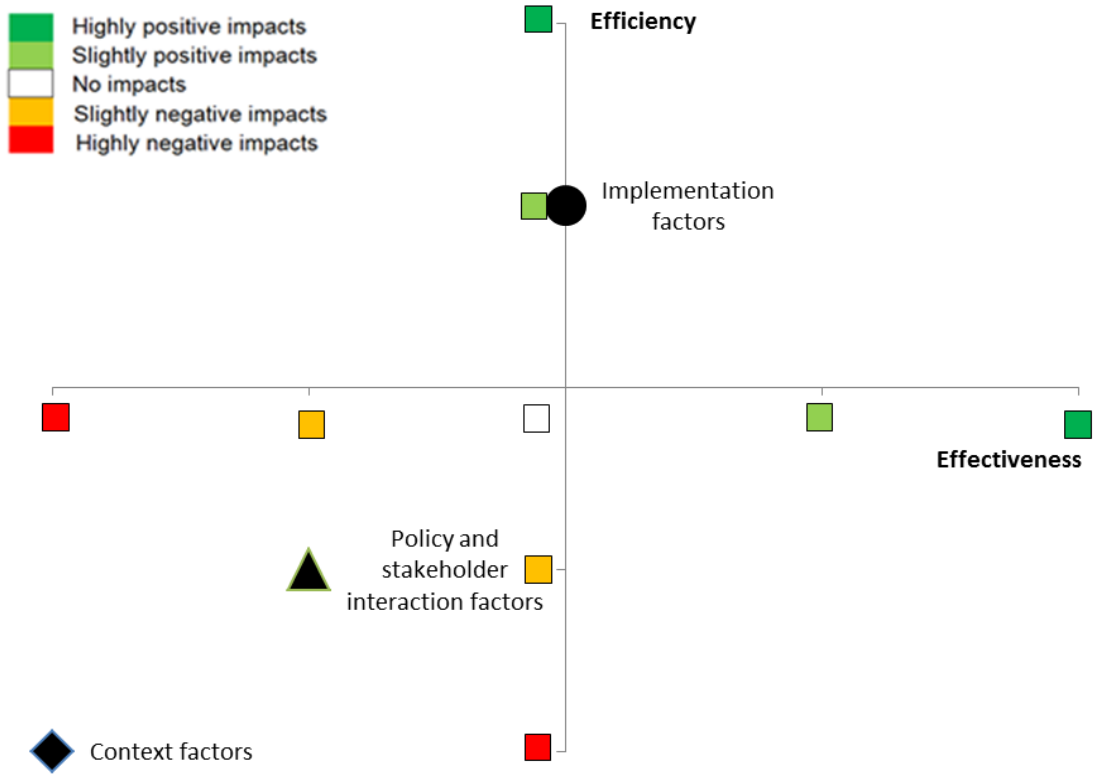

Figure 14: *Impact of the factor groups on effectiveness and efficiency of PI1 “Fuel Decree”*

The figure above shows the impact of factor groups on effectiveness and efficiency of PI1. It shows that implementation factors have been positive or neutral on efficiency and effectiveness respectively. The remaining factor groups have affected effectiveness and efficiency adversely, especially the context factors. This is caused – as stated above – by the intended limitation of first generation biofuels, the missing technical usability of B10 as well as efficiency losses due to incompatible sustainability certification schemes in Europe.

The figure below shows the situation for PI2. It can be seen that none of the factors had negative impacts on effectiveness or efficiency of PI2. Especially policy and stakeholder interaction factors have positive impacts both on effectiveness and efficiency due to synergies with biodiversity protection, climate protection as well as waste legislation.

Figure 15: *Impact of the factor groups on effectiveness and efficiency of PI2 "Decree regarding agricultural outputs for biofuels"*

7.3 Conclusions

This report analyses the national transposition of European policies to make the transport sector ecologically more sustainable. It includes the status quo of national targets and their achievement, pros and cons of the design of national legislation transposing respective EU laws, as well as promotive and adverse circumstances for an effective and efficient target achievement.

Starting point of analysed European policies and national policy instruments was the intention in Europe, to steadily increase the share of biofuels in the transport sector. One motivation for that was the contribution of the transport sector for reducing greenhouse gases

(GHGs), but this was not the only rationale. Also an increase of transport fuel supply security via a reduction of import dependency for fossil fuels as well as improved income opportunities for the European agricultural sector have been arguments for the step towards an introduction of biofuels. Austria has been quite successful in meeting these targets. Actual biofuel shares have not only exceeded biofuel shares required by EU law at any time, but also the more strict national substitution shares.

In 2009 the European targets for the transport sector have been adapted. The focus on biofuels was reduced; new attention was laid on a general increase of renewables in the transport sector (via e.g. increased hydrogen, reduced fuel demand). Although this new freedom for member states on how to making their transport sectors more ecologically sustainable, Austria still focused on a high share of biofuels. This was based on a bottom-up analysis, which required a strong role of biofuels taking into account anticipated potential of alternative options in the transport sector (e.g. e-mobility). The main national policy instrument (PI) for achieving the nationally required biofuel share is the “Fuel Decree” (Command&Control instrument). It fixes substitution rates (not blending rates) for bioethanol and biodiesel and determines minimum GHG reductions of biofuels compared to their fossil reference. Sufficiently high tax differentials for blended fuels ensure the economic attractiveness of blended fuels over 100 % fossil fuels. Another key policy instrument is the “Decree regarding agricultural outputs for biofuels”. It requires that no land areas with high ecological value are used for biofuels’ feedstock cultivation. Both national key policy instruments have been observed to work as intended.

However, the future outlook might not be that optimistic. Due to a lack of new requirements for higher substitution shares the increase of the substitution share has been flattened considerably in the near past. The national 2020 target for biofuel shares is rather general without assigning specific requirements to single market agents. Therefore political consensus and societial willingness for higher substitution rates would be needed in order to achieve the national 2020 target. However, this is uncertain, remembering the failure of introducing E10. Also the discussion about ILUC (indirect land use change) and the going along intention for limiting first generation biofuels as well as technological limitations for introducing B10 considerably jeopardize the Austrian target achievement in the future. That shows: even if Austria could “easily” achieve its RES target by pushing biofuels, this disproportionate strong focus on one option – namely biofuels – makes target achievement must vulnerable if new circumstances evolve.

It was mentioned above already that using biofuels is certainly not the most efficient option of reducing GHGs. However, reduction of GHGs was not the only rationale for biofuels. Also in the transport sector more efficient options would be available (e.g. accelerated modal shift), but biofuels might be the only sufficient option to achieve national targets at justifyable costs in the short and medium term, taking into account societal willingness to accept structural changes (e.g. in the area of spatial planning). However, this does not mean that other options should be neglected. Also, in the analysed system many incentives for not lowering transport fuel demand exist (conflicting policy instruments). Adapting these policy instruments could lower fuel demand and therefore biofuel demand, which certainly reduces costs for national target achievement. However, these adaptions could be in conflict with other policy targets (social, economic, industry policy). Certain efficiency gains could be achieved in improving the partial incompatibilities of sustainability certification schemes in

Europe, which lead to unnecessary bureaucratic burdens due to partially necessary multiple certifications. Efficiency of RES target achievement in the transport sector by biofuels might also be lowered by reduced willingness of investors to invest into R&D. This is induced by the frequently changing policy framework, which makes it difficult for investors to estimate whether biofuels would be still needed in a few years.

Initially in this report certain hypotheses about the interactions of biofuels with other environmental targets have been introduced. Based on expert interviews and information/data gathered in the course of this study, the following statements can be given in respect to these interactions: No considerable changes of the Austrian agricultural sector could be observed in spite of increased needs for biofuels' feedstocks. This implies that no adverse environmental impacts from biofuels' feedstock cultivation arise in Austria. In the case of environmental damages, these damages cannot be assigned to certain crops/plants used for biofuel production, but rather to wrong agricultural practices (e.g. over-fertilization), which also could appear at the cultivation of crops used for food. As the agricultural sector did not change in Austria and land areas with high biodiversity value are protected by respective legislations, no considerable adverse impacts on biodiversity can be assumed. However, cultivation of biofuels' feedstocks might have adverse environmental impacts abroad, especially in countries with a less dense network of environmental protection legislation. This potential adverse impacts abroad (cultivation feedstock in dry regions, induced displacement of inhabitants which do not have legal ownership on land due to historical reasons, etc.) could/are hardly been detected by the sustainability check. Positive interactions can be observed with waste legislation. The issue whether biofuels lead to real GHG reductions is highly controversial and cannot be answered satisfactorily with current scientific knowledge. Regarding to air pollution, slight deviations in emissions of harmful air pollutions could appear in both directions. This problem might be an issue of technological progress; however, steadily changing rates in the composition of transport fuels might complicate the optimization of engines regarding their polluntants emissions.

Therefore to sum up:

Austria has chosen an initially highly effective command&control instrument for achieving the biofuel target. It is supported by tax differentials for blended transport fuels. However, new scientific knowledge about ILUC and the intended limitation of first generation biofuels (and connected with that the failure to introduce E10) and technical limitations for B10 are considerably jeopardizing target achievement. Efficiency gains could be achieved by abolishing incentives from other policy instruments, whose incentives work against the intentions of analyzed policy instruments.

Environmental protection for land areas in Austria with high ecological value is sufficiently ensured by respective legislation. The Austrian sustainability certification scheme is designed to put as least burden on market agents as possible. However, making the many existing certification schemes in Europe more compatible would lead to efficiency gains. Although these certification schemes are intended to exclude adverse impacts from biofuels' feedstocks cultivation, adverse environmental and societial impacts abroad were not invalidated. This problem might be solved by pushing future generation biofuels. However, for stimulating R&D investors need investment certainty for a sufficient time period. This required investment certainty was harmed in the past according to biofuel producers.

8. Literature

Bowyer, C., Kretschmer, B. (update) (2011): Anticipated Indirect Land Use Change Associated with Expanded Use of Biofuels and Bioliquids in the EU – An Analysis of the National Renewable Energy Action Plans; Institute for European Environmental Policy; 03/2011; http://www.ieep.eu/assets/786/Analysis_of_ILUC_Based_on_the_National_Renewable_Energy_Action_Plans.pdf

Bundesministerium für Wirtschaft, Familie und Jugend (BMWFJ) (2013): Energiestatus Österreich 2012; Vienna; http://www.bmwfj.gv.at/EnergieUndBergbau/Energieeffizienz/PublishingImages/Energiestatus%202013.pdf

European Commission (2007): Biofuels Progress Report; Report on the progress made in the use of biofuels and other renewable fuels in the Member States of the European Union; COM(2006) 845 final; Brussels; http://ec.europa.eu/energy/energy_policy/doc/07_biofuels_progress_report_en.pdf

European Commission (2009): The Renewable Energy Progress Report; COM(2009) 192 final; Brussels; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0192:FIN:EN:PDF

European Commission (2010): European transport policy for 2010: time to decide; White Paper; ISBN 92-894-0341-1; http://ec.europa.eu/transport/themes/strategies/doc/2001_white_paper/lb_texte_complet_en.pdf

European Commission SWD(2012) 343 final: Executive Summary of the impact assessment on Indirect Land-Use Change related to biofuels and lioliquids ;Commission Staff Working Document; Brussels; Oct. 17 2012; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0344:FIN:EN:PDF

European Commission COM(2012) 595 final: Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources; Brussels; Oct. 17 2012; http://ec.europa.eu/energy/renewables/biofuels/doc/biofuels/com_2012_0595_en.pdf

European Commission COM(2013) 175 final: Renewable energy progress report; March 27, 2013, Brussels.

Kalt, G., Kranzl, L., Adensam, H., Zawichowski, M., Stürmer, B. & Schmid, M. (2010): Strategien für eine nachhaltige Aktivierung landwirtschaftlicher Bioenergiepotenziale. Energie der Zukunft – Final Report.

Lebensministerium (2007): Anpassung der Klimastrategie Österreichs zur Erreichung des Kyoto-Ziels 2008-2012; Vorlage zur Annahme im Ministerrat am 21. März 2007; Vienna.

Lebensministerium (2012): Grüner Bericht 2012; Bericht über die Situation der Österreichischen Land- und Forstwirtschaft; 53. Edition; Vienna.

Österreichische Landesumweltanwaltschaften (2013): Nachhaltige Nutzung von Bioenergie in Österreich; Faktenlage und Forderungen der Landesumweltanwaltschaften Wien, Niederösterreich, Oberösterreich, Burgenland, Steiermark, Salzburg, Kärnten, Tirol und Vorarlberg; 03/2013.

Pacini & Assuncoa (2011): Sustainable biofuels in the EU: the costs of certification and impacts on new producers; Journal Biofuels (2011) 2(6), 595–598; http://www.fao.org/fsnforum/sites/default/files/resources/Pacini.pdf

Plevin, R., O'Hare, M., Jones, A., Torn, M., Gibbs, H. (2010): Greenhouse Gas Emissions from Biofuels' Indirect Land Use Change are uncertain by may be much greater than previously estimated; Environ. Sci. Technol. 2010, 44, 8015-8021.

Pötscher, F. (2011): CO_2-Monitoring 2009. Zusammenfassung der Daten der Republik Österreich gemäß Entscheidung Nr. 1753/2000/EG für das Berichtsjahr 2010; Austrian Federal Environmental Agency; on behalf of Austrian Ministry for the Environment; Vienna.

Statistik Austria (2012): Energiebilanzen Österreich 1970-2011; Vienna.

Statistik Austria (2013): Vorläufiger Pkw-Bestand am 31.08.2013 nach Kraftstoffarten bzw. Energiequelle; Kfz-Statistik; Vienna.

Steiner D. (2011): Domestic Offset Projects in Austria – Possibilities for implementation and resulting economic impacts; Suedwestdeutscher Verlag fuer Hochschulschriften; Saarbruecken, Germany; ISBN: 978-3-8381-0258-0.

Umweltbundesamt (2012): Ökobilanzen ausgewählter Biotreibstoffe; Autors: Lichtblau, G., Pölz, W., Stix, S., Winter R.; report made within the project „PROVISION: Biokraftstoffe – Potentiale, Risiken, Zukunftsszenarien; ISBN 978-3-99004-163-5.

Umeltbundesamt (2012a): Elektromobilität in Österreich. Determinanten für die Kaufentscheidung von alternativ betriebenen Fahrzeugen: Ein diskretes Entscheidungsexperiment; Report REP-0398; In cooperation with Institute for Advanced Studies Vienna; commissioned by the Austrian Climate and Energy Funds; Vienna.

Umweltbundesamt (2012b): Biokraftstoffe im Verkehrssektor 2012; Author: Ralf Winter; commissioned by the Austrian Federal Ministry for Environment; 06/2012; Vienna.

Umweltbundesamt (2013a): Biokraftstoffe im Verkehrssektor 2013; Author: Ralf Winter; commissioned by the Austrian Federal Ministry for Environment; 06/2013; Vienna.

Umweltbundesamt (2013b): Klimaschutzbericht 2013; Report REP-0420; Vienna.

Zulka, K., Streissler, A. (2011): Raffinierte Feldfrüchte. Biokraftstoffe in inter- und transdisziplinärer Betrachtung; notice from the Austria-Consortium GAIA; GAIA 20/3 (2011): 206-208.