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Project report:

Reducing automobile CO_2 emissions - can the EU draw lessons from Japan?

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Abstract

The mitigation of climate change caused by greenhouse gas emissions such as CO_2 is a key policy challenge. Within the context of Global Governance it is important to involve diverse actors on different levels as well as to integrate the policies in different sectors such as the transport sector.

This research project focuses on passenger car emissions, a significant contributor to total CO_2 emissions, making up 12% of the EU total and rising. The core policy within a broad strategy to reign in rising transport sector CO_2 emissions, Regulation (EC) 443/2009, came into effect in 2012, setting binding emission standards for new passenger cars. In contrast, Japan has already gained more than 10 years experience in vehicle emissions/fuel consumption policy with its “Top Runner” fuel efficiency standard. This has contributed to a decline of passenger fuel emissions in Japan, accounting for 9.5 % of total CO_2 emissions in 2008.

This research paper examines whether experience gained from Japan can be utilised to draw lessons to improve the EU's passenger vehicle CO_2 emissions policy. Accordingly, the research question is “Reducing automobile CO_2 emissions - Can the EU draw lessons from Japan?”

This question is to be answered using ex-ante and ex-post evaluations along with the concept of lesson-drawing. Primary and secondary documents will be analysed to obtain the necessary information, complimented by information gathered from semi-standardised interviews with experts in the field.

The research shows that the EU’s policy seems to have better prospects in reducing automobile CO_2 emissions than the Japanese Top Runner fuel efficiency standard. As such, the Regulation should be not be changed within the coming decade at least and certainly not as part of the planned review in 2013. Nevertheless, modifications of some policy characteristics such as technical parameters, targets and sanctions could improve fuel efficiency and push technological change. Even post 2020 a complete change of EU fuel efficiency policy is neither likely nor desired, but several positive and negative lessons can be learned from the Japanese experience.

For example, the Japanese experience shows that additional instruments such as labelling and taxation are crucial and should be closely linked with the targets. Although EU-wide tax-harmonisation represents a significant challenge, lessons in this area could be drawn from Japan.

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ACEA	European Automobile Manufacturers' Association
BEUC	The European Consumers' Organisation
CLEPA	European Association of Automotive Suppliers
CO_2	Carbon dioxide
DG	Directorate-General
E85	Ethanol fuel blend of up to 85% ethanol fuel and gasoline
EC	European Commission
ECCJ	The Energy Conservation Center, Japan
ETRMA	European Tyre & Rubber Manufacturers' Association
EU	European Union
FIA	Fédération Internationale de l'Automobile
FY	Fiscal year
GHG	Greenhouse Gas
ICCT	The International Council on Clean Transportation
JAMA	Japan Automobile Manufacturers Association
LPG	Liquefied petroleum gas
METI	Minister of Economy, Trade and Industry (Japan)
MLIT	Ministry of Land, Infrastructure, Transport and Tourism (Japan)
MOE	Ministry of the Environment (Japan)
NEDC	*New European Drive Cycle* from which emissions values are measured
NGO	Non-governmental Organisation
NOx	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
SEPA	Swedish Environmental Protection Agency
SOx	Sulphur oxides
TR	Top Runner
UN-ECE	United Nations Economic Commission for Europe
WWF	World Wide Fund for Nature

1. Introduction

Climate Policy

The mitigation of climate change is a key policy challenge in the current and coming decades (UNFCCC 2010). The EU has committed to “adopt the necessary domestic measures and take the lead internationally to ensure that global average temperature increases do not exceed pre-industrial levels by more than 2°C” (EU Com 2007, 2). Achieving this goal requires a drastic reduction in the emission of carbon dioxide (CO_2) and other greenhouse gases by developed countries; a requirement reflected in the EU’s *Energy and Climate Package*, adopted by the *European Council* in December 2008. This Package introduced the so called 20-20-20 goals: by 2020 (relative to 2005) greenhouse gas emissions should be reduced 20%, energy efficiency should be improved 20% and the share of total electricity generated from renewable sources should be increased to 20% (EU Com 2007, 5).

Global Governance

Given the global causes and impacts of climate change and the overall tendency of globalisation, effective and efficient[1] governance globally plays a key role to meet the climate related goals. Global Governance can be defined as a continuing process to balance diverse interests and refers to the various pathways and possibilities through which individuals as well as public and private institutions deal with their common concerns. The concept is based on the idea that due to globalisation, political steering and the scope of actors has become more complex, with the consequence that problems cannot be solved by traditional political actors such as national governments alone. Instead, formal and informal institutions, such as governments, international organisations, businesses and civil society, at the local, national, regional and global level have to be addressed and involved (CGG 1995, 2; Zadek 2004, 91). In this research the main focus will lie on the European Union, the Japanese Government, automotive industry, environmental organisations, scientific actors and consumers.

Under a Global Governance approach, not only must a multiplicity of actors be acknowledged, but it is also crucial that the policies have a trans-diciplinary scope and are integrated into different sectors (e.g. building or agriculture sector).

1. Effective means to fulfil a function and to deliver a desired result (Vallejo/Hauselmann 2005: 4). Efficient is understood by the authors as fulfilling the function or delivering the result at least cost or with lowest resource input as possible.

Automotive sector

This research focuses on the transport sector and more specifically on automobiles. In Japan the term *automobile* refers to vehicles with a riding capacity of 10 persons or fewer (METI 2010, 28), whereas in Europe an *automobile* is defined as one seating 8 or fewer passengers (excluding driver) (VCA 2012). Both "automobile", "passenger cars" and "automotive" are used synonymously. Passenger cars are of particular relevance because they emit 12% of the EU total CO_2 emissions and their share is still rising (EU Com 2007a, 2). The fact that passenger cars are not included in the EU's emissions trading scheme (ETS) makes other policy measures even more important.

In Japan, passenger transport emissions have been declining since 2001 and in 2008 cars accounted for 9.5% of total CO_2 emissions (Naono 2011, 3; own calculation), a development at least partially attributed to fuel efficiency improvements stimulated by the Japanese *Top Runner* fuel efficiency policy (JAMA 2010, 7).

These reductions lead to Japan leading the world in its whole-fleet vehicle emissions; leadership which is forecast to remain until 2015 (ICCT 2007, 23). Despite not having binding targets until the recent past, the EU is a close second place behind Japan (ibid.). The fore-runner role played by Japan and the EU is a particular reason for the interest in studying them.

EU vs. Japanese institutional structure

An important issue to consider is the level of the relevant governments in the research. While Japan is a sovereign state with jurisdiction over all policy-areas (industry, environment, taxation etc) within Japan, this is not the case for the EU. It is a supranational institution, with jurisdiction over only some of the relevant policy-areas. Of particular note is the limited jurisdiction over taxation, over which the Member States retain control (see chapter 3.2.3).

Objective and research question

Given these developments in the EU and Japan, this research project aims to provide advice for ways to improve EU passenger car CO_2 emissions reduction policy by ascertaining if lessons can be drawn from the Japanese Top Runner fuel efficiency program that could be applied in the EU. Of particular interest is the *EU Regulation (EC) 443/2009 setting emission performance standards for new passenger cars* which entered into force in January 2012. Based on this aim, the research question is: "Reducing automobile CO_2 emissions - Can the EU draw lessons from Japan?"

Increasing the fuel efficiency, i.e. reducing the CO_2 emissions per kilometre driven seems to be the most promising measure to achieve this. CO_2 is one of the main greenhouse gases (causing climate change), created and emitted through the combustion of fossil fuels. Other greenhouse gases (e.g. methane, nitrous oxide) and environmentally harmful substances (e.g. nitrogen oxide, sulphur oxide) will not be the focus of this research. This also applies to potential non-climate related effects of increased fuel efficiency such as improved air quality, energy security or international competitiveness of the European automotive industry (EU Com 2007a, 2-4).

Structure

The research is structured as following. As part of this introductory chapter the main Japanese and EU fuel efficiency policies will be described briefly to provide some background for readers unfamiliar with this topic. Further issues addressed in this chapter are the state of research, the analytical approach and the methodology.

Next, the second chapter contains an analysis of the Japanese fuel efficiency policy based on key (supporting or hindering) factors identified during the literature research. In chapter three, EU policy will be evaluated using the key factors derived from the Japanese policy analysis. To answer the research question in the fourth chapter, the possibility and plausibility of drawing lessons from the Japanese Top Runner fuel efficiency standard for EU policy will be assessed. In addition, further recommendations to improve the policies on CO_2 emissions from automobiles in the EU and Japan will be provided. Subsequently, in the fifth and last chapter, overall conclusions will be discussed.

1.1. Overview of the relevant policies

1.1.1. Japanese fuel efficiency policy

Background

Throughout the 1990s, Japanese transport greenhouse gas emissions were on a steadily increasing trajectory, plateauing between 1996 and 2001, finally peaking in 2001 (see illustration 1.1, below).

As a proportion of Japan's total CO_2 emissions, the entire transport sector contributes 19.4%, however, 49% of that is made up by passenger car emissions. Thus CO_2 emissions from passenger cars make up 9.5% of Japan's total (JAMA 2011, 9; Naono 2011, 3).

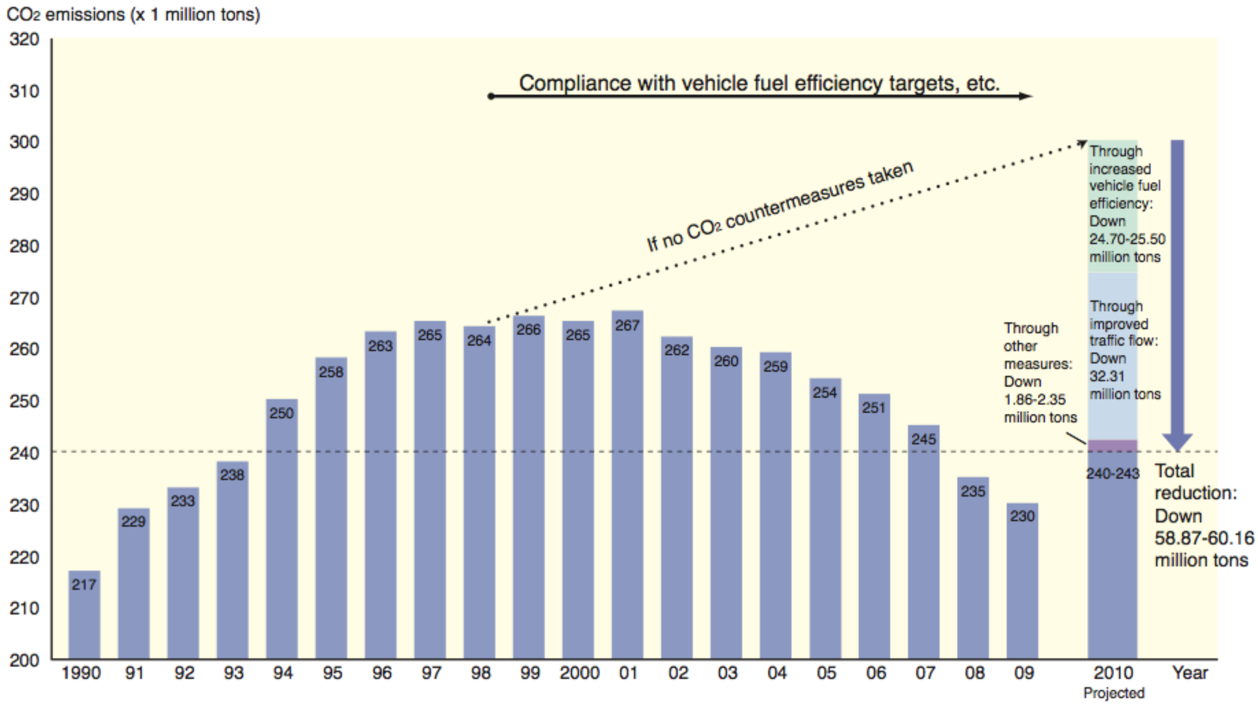

Illustration 1.1: Total Japanese CO_2 emissions (JAMA 2011, 8)

According to METI, the problem of increasing energy usage across the whole Japanese economy was becoming ever more acute: "The residential and commercial sector and transportation sectors' final energy consumption have risen continuously except during the oil crisis periods" (METI 2010, 5). Introduced in 1999 by the Japanese Government, the Top Runner was the Government's answer to this development. The Program was thus conceived with the explicit aim of improving the energy efficiency and total energy consumption of household and transportation products during their end-usage (Hamamoto 2011, 91), setting minimum efficiency targets for 10 categories of household appliances and, crucially for this paper, passenger cars (METI 2010, 9).

Specifically for passenger cars, the Program introduced the *Top Runner Fuel Efficiency Standard* already at the Program's commencement in 1999, setting, as the name suggests, binding fuel efficiency targets for automobiles, which were eventually joined by with tax incentives and labelling, commencing in 2001 and 2004 respectively (Hamamoto 2011, 93).

Since its introduction, the Program has resulted in three particular positive developments in the passenger car sector. Firstly, absolute CO_2 emissions from the transport sector have steadily declined since peaking in 2001 (see illustration 1.1, above). Secondly, the rate of passenger car efficiency improvement has markedly increased. Increased so much, in fact, that the 2010 target was met in 2005, five years ahead of schedule (JAMA 2011, 7). Thirdly, the compliance with the targets is very high: the penetration rate of Top Runner compatible gasoline-powered passenger vehicles into the new market reached over 96% in 2010 (JAMA 2011, 7).

Targets

The Top Runner program sets separate targets for gasoline, diesel and LPG powered cars, with specific targets for vehicles depending on their weight. The unit for these targets is kilometres per litre (km/L), which is somewhat confusing for those accustomed to typical units used in Europe (L/100km, gCO_2/km which will be used in this report where possible), but the units may be easily converted (see chapter 2.1.2.). One further complication is the necessary different targets for vehicles powered by different fuels due to the different volume of CO_2 emitted per litre of fuel burned.

The target setting process is that which makes the Top Runner program of particular interest. Instead of the EU-style top-down procedure (albeit with extensive stakeholder participation), the Top Runner program utilises an industry-driven process whereby the fuel efficiency of the best vehicle in each weight class – the *top runner* – is taken on as the target for the next target-cycle (5 years) (Onoda (OECD/IEA) 2008, 17). Thus, if the class-leading vehicle's fuel consumption were 25 km/L (4 L/100km) in 2005, this value would become the minimum target for all vehicles in this weight class for 2010. Using this method, projected technological advances are taken into account to determine the new target values (JAMA 2011, 9). Although often seen as quick and automatic, the process is neither, taking at least 1-2 years from the beginning until the targets are officially published (int. Matsuo, MLIT). Furthermore, the target setting procedure, led by the Japanese Government, is criticised for its lack of transparency (int. Muto, Yamanashi University)

The targets settled upon were (for gasoline powered vehicles): 14.4 km/L (159.7 gCO_2/km) in 2010 – met in 2005, 16.8 km/L (136.9 gCO_2/km) in 2015 and 20.3 km/L (113.3 gCO_2/km) in 2020 (JAMA 2011, 8-9; METI/MLIT 2011, 8).

Monitoring and sanctions

The monitoring of manufacturer compliance and the progress of the Program in general is based on data provided to the MLIT by the manufacturers themselves. This data is collated by the MLIT and published in an annual catalogue, available online, however only in Japanese (MLIT 2011, website). Despite this measure, itself based upon anything but independent information provided by the manufacturers, there is a general lack of transparency regarding the monitoring scheme.

The sanctions system is a four-step process: (1) advise, (2) public proclamation, (3) order and (if manufactures don't obey the order, they have to pay) (4) penalty (METI/MLIT 2011, 1). The second step, also known as *name and shame* is interestingly very effective due to an interesting aspect of Japanese culture, that of *saving face* (Nordqvist 2006, 21; int. Matsuo, MLIT 2011). Because manufacturers (and presumably their employees) are mindful of maintaining the respect of others, *name and shame* sanctions are particularly effective at ensuring compliance with the targets. This is a positive factor, as the monetary sanctions applied to manufacturers for non-compliance are low, being capped at 1m Yen (METI/MLIT 2011, 1) (≈ 9,150 €).

1.1.2. Regulation EC 443/2009 summary

Background

The EU has committed itself to reducing its overall CO_2 emissions 20% to 30% (from 1990 level) by the year 2020, contingent on international reductions target negotiations. Achieving this target without undermining progress made in other sectors requires a reduction in the currently high (12% of EU total (EU Com 2007b, 9) passenger car emissions. In 1998, the European Automobile Manufacturers' Association (ACEA) voluntarily agreed to an average new car emissions target of 140 gCO_2/km, to be achieved by 2008. In 1999, ACEA's Japanese (JAMA) and Korean (KAMA) counterparts committed to the same target, although with a 2009 deadline (European Union 2009, 2). In 2007, it was concluded "that the Community objective of 120 gCO_2/km would not be met by 2012 in the absence of additional measures" (European Union 2009, 2). At the same time, the Commission announced a Regulation including mandatory manufacturer targets (below).

Targets

Regulation EC 443/2009 mandates a reduction in average new car emissions to 130 gCO_2/km in 2015 "by means of improvements in vehicle motor technology" (those measured in the *NEDC* drive-cycle), with another 10 gCO_2/km to be achieved through other measures (technology and biofuels) (European Union 2009, 2). For 2020 the Regulation also introduced a target of 95 gCO_2/km. The emissions target "should ensure competitively neutral, socially equitable and sustainable reduction targets which take account of the diversity of European automobile manufacturers" (European Union 2009, 2). To achieve this goal, targets are defined by a linear curve, with increasing targets for heavier vehicles (see illustration 1.2).

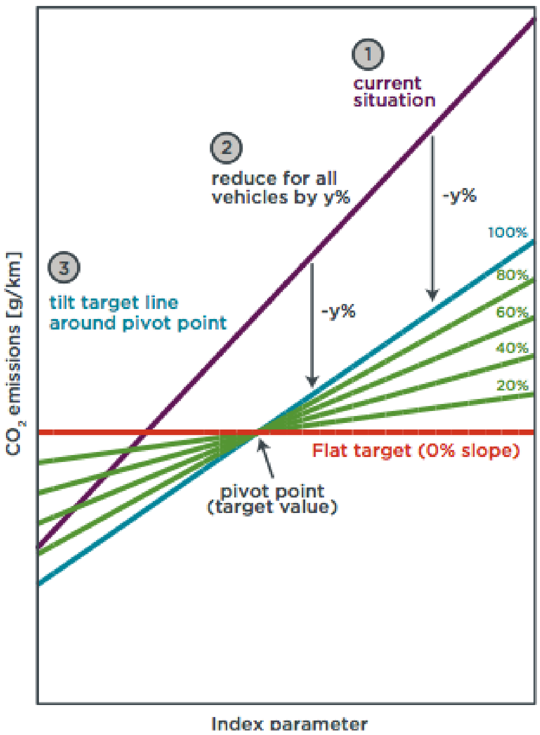

Illustration 1.2: EU emissions limit curve (Mock (ICCT) 2011, 22)

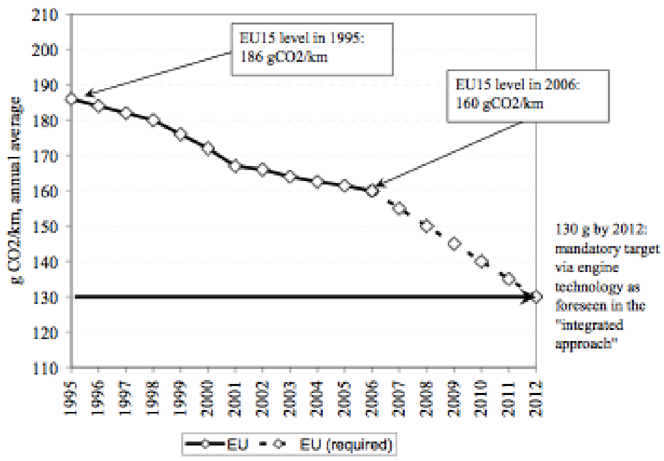

Illustration 1.3: Past and projected average EU passenger car emissions: (EU Com 2007b,15)

Achieving the 130 gCO_2/km target set by the regulation requires a return to the highest reductions rates achieved in the recent past (EU Com 2007b, 15). Assuming full compliance, the 130 gCO_2/km target will be met (EU Com 2007b, 87), resulting in a CO_2 emissions reduction of over 630 Mt between 2006-2020, or ≈ 45 Mt/a (EU Com 2007b, 35).

Flexibility instruments

Various instruments are provided for to allow manufacturers flexibility in meeting their targets and/or encourage innovation: *super-credits* for very low emissions vehicles, easing of targets of E85 compatible vehicles, *eco-innovations* (extra-test-cycle reductions), derogations for low-volume manufacturers and finally, pooling (see chapter 3.2.1).

Monitoring & sanctions

The informational basis of the regulation is to be collected by the Member States from 2010 on and disseminated to the manufacturers and the Commission, who shall administer a central, publicly available register of relevant information (European Union 2009, 7). Along with the aforementioned publicly available register of vehicle sales information, the Commission shall publish a "name & shame" list showing each manufacturer's compliance status along with the whole-EU progress toward the target (European Union 2009, 8). Failure to comply is also punished monetarily, progressively for increasing divergence from the target: 5-95€/g payable for *every* vehicle sold by the non-compliant manufacturer (European Union 2009, 7-8).

Review and report

A review of the Regulation should be completed before the start of 2013, considering the emissions targets, derogations, penalties and, cost effective reaching of the 2020 target (95g), along with other implementation issues. Furthermore, an impact assessment should be completed before 2014 considering the usage of footprint area to determine vehicle utility (European Union 2009, 10).

1.2. Current state of research

Upon starting this research, the authors came across much literature which served as useful background information, including research on policy instruments in general, on analytical approaches and methodologies as well as on technical issues. However, answering the research question required more specific sources on topics such as European and Japanese policy instruments in the automobile sector, which were available to a more limited degree.

Global Governance and research approaches

There is no lack of literature from social or political scientists dealing with global governance (Kirton/Trebilcock, 2004; CGG 1995, 2; Zadek 2004, 91) and the appropriate scientific approach in the research process. For example, Stockmann (2006) wrote about policy evaluation while Rose (1991) dealt with the topic of lesson-drawing.

As one of the key methodologies in qualitative research, there is plenty of literature on the role of interviews and practical guidance on how to hold and evaluate interviews with experts (Hopf 2004, Meuser/Nagel 1991).

Policy instruments in general

There is a myriad of literature on governance and general policy instruments investigating, among other aspects, the comparative advantages and disadvantages of standards, taxes, voluntary agreements and others policy tools (Abrell 2010; Héritier 2002; von Linder/Peters, 1989; Windhoff-Heritier 1987). Other authors, such as Goulder/Parry (2008) and Jänicke et al. (2000), take a slightly more narrow focus, concentrating more on environment policy instruments.

Technical issues

Given the highly technical nature of the automotive industry, there is also abundant literature concerning technical measures to reduce the fuel consumption of automobiles and harmful emissions (Saito et al. 2011; Sarangi et al. 2010; de Carvalho et al. 2009). The same goes, albeit to a much lesser degree, for the utilisation of biofuels in automobiles (Fontaras et al. 2009).

International comparisons

However, neither policy instruments in a broad sense, nor technical issues are at the core of this research. Instead, more attention is paid to international comparisons on fuel efficiency and automobile CO_2 emissions. Much literature (e.g. An et al. 2011; Onoda (OECD/IEA) 2008; Kuik 2006; Minato 2004; An & Sauer 2004) is devoted to the introduction and comparison of the different regulatory regimes around the world, although these tend to focus on the three (historically) main automobile markets: the EU, Japan and the USA. Occasionally, the EU and Japanese standards have been treated as one for comparison with the USA's Corporate Average Fuel

Economy (CAFE) standard. For example, Plotkin (2001) examined the European and Japanese fuel economy initiatives with regard to their usefulness as a guide for US action. Onoda (OECD/IEA) (2008) surveyed the G8 countries and their vehicle fuel efficiency policies, developing recommendations on the use of voluntary versus regulatory measures, standards and additional policies. Taking an even broader view, a recent overview of worldwide fuel-economy policy by *The Innovation Center for Energy and Transportation* (An et al. 2011) culminated in the report *Global overview on fuel efficiency and motor vehicle emission standards: policy options and perspectives for international cooperation*.

EU automobile sector policy instruments

The EU policies to reduce CO_2 emissions from automobiles have been extensively analysed by think tanks, universities, interest groups and the EU institutions themselves.

A broad overview of the EU policies is contained within the *European Commission's* (2010) *Progress report on implementation of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles*.

Several publications describe the voluntary agreement between the EU and the automobile industry (Kuik 2006, An et al. 2006), including some criticism soon after the agreement's enactment (Keay-Bright, 2000). Its failure, however, which pressured the EU to introduce Regulation (EC) 443/2009, garners surprisingly little attention.

Research on Regulation (EC) 443/2009, a key policy in this paper, is still limited, possibly due to its entering into force only this year (2012). For this reason also, only ex-ante, rather than ex-post evaluations are available. One of the most comprehensive ex-ante evaluations is the *European Commission Impact Assessment* (EU Com 2007c) of this Regulation. Other studies examine the legislative process and negotiations between stakeholders for the Regulation, dealing with the (particularly German) resistance to the regulation, which led to significant clauses weakening the targets for industry (Deters 2010). Other authors (Bampatsou/Zervas 2011; Frondel et al. 2011; Mock (ICCT) 2011), challenge the alleged unambitious level and configuration of the emissions limits as well as the low non-compliance penalties. Many of these papers suggest improvements to the policy-design such as size- rather than weight-based parameters (Mock (ICCT) 2011; Wells et al. 2010).

Some researchers deal with instruments such as taxation that could support the effect of Regulation (EC) 443/2009, for example Hemmings (2011), who proposes a revision of the EU Energy Taxation Directive.

Policy instruments automobile sector Japan

The Japanese *Top Runner Program*, which targets the 'use-phase' of a wide range of energy-using equipment such as electronic household appliances and passenger cars, has attracted the attention of many researchers. Consequently, research on the program is plentiful, including ex-post evaluations (Nordqvist 2006). Several European researchers and institutions (e.g. the German Federal Environment Agency (UBA) 2011; Nordqvist 2006; The Swedish Environmental Protection Agency 2005) consider the Top Runner approach to be a successful model for increasing energy efficiency and have investigated whether and how the Top Runner approach could be useful for EU policy-design.

In contrast to the extensive material on Top Runner in general, surprisingly little up to date academic research was found on the specific Top Runner (passenger car) fuel efficiency policy, although isolated examples can be found (Muto et al. 2006; Muto et al. 2004), containing evaluations of the Top Runner fuel efficiency regulation and related green taxes. Minato's (2004) comparison of fuel economy standards in Japan, Europe and the USA, and his analysis of green taxes is another scientific article, reviewed by the International Association of Traffic and Safety Sciences.

In contrast to the limited academic research found, there are several private and official reports detailing the program's progress, such as reports by the *Japanese Automobile Manufacturing Association (JAMA)* or by the responsible Japanese Ministries *METI* and *MLIT*. Both together published a *Final report on new passenger vehicle fuel efficiency standards (Top Runner Standards) (2011)* providing information on the decision-making processes, the standards for the next target year – 2020 – and other relevant issues. With regard to the standard-setting procedure for 2020, a useful position letter from the International Council on Clean Transportation (ICCT) is also available, which includes recommendations to MLIT.

Despite the availability of several pieces of the puzzle to help answer the research question, there is a lack of detailed direct comparisons, or even possible lesson-drawing between the EU and Japanese approaches to fuel economy/emissions policy.

1.3. Methodology

Necessary information for the research was obtained through document analysis, and by interviewing (semi-standardised) experts in the field.

1.4. Analytical approach

This research is based upon available policy-analyses and evaluations, as well as the concept of lesson-drawing, adapted here to the specific requirements. It builds upon the assumption that lessons can be drawn from the Japanese experience which may provide help improving EU automobile emissions policy.

The starting point for the research is a description and evaluation of the Japanese fuel efficiency policy based on existing studies and (self held) interviews with experts. This allows the identification of intermediate results: key supporting and hindering factors influencing the policy output of Japan's fuel efficiency policy; thus also the subsequent outcome and impact[1]. These key factors and corresponding sub-factors then serve as guiding criteria for the evaluation of the EU fuel efficiency policy. In particular, the analysis of these key factors in the EU will help to discern if lessons can be drawn from Japan, and to provide suggestions for the review of the existing EU automobile CO_2 emissions policy. In the following, the two main parts of the analytical approach, evaluation and lesson-drawing, will be explained.

Evaluation

In general, the objects of evaluation can be persons, organisations, programs, reforms, laws, policies, projects or even other evaluations (Stockmann 2006, 17). In this research the clear focus will lie on policies, in particular on the Japanese Top Runner fuel efficiency standard and EU's Regulation (EC) 443/2009 regulating fuel efficiency and CO_2 emissions respectively.

Both policies find themselves at a different stage of the policy cycle (Jänicke et al 2000, 52). While the Top Runner fuel efficiency policy has been implemented for more than 10 years, Regulation (EC) 443/2009 entered into force only in 2012. For this reason, the two policies-of-interest are evaluated[2] ex-ante and ex-post, respectively (Jann 1994, 311; Stockmann 2006, 19). Ex-post evaluations are used to analyse the Japanese fuel efficiency policy and to identify the key (supporting and hindering) factors, defined here as key factors, whose presence or absence in the policy positively or negatively influenced the output and impact of said policy.

These key factors then serve as evaluation criteria for the EU policy and potential lesson drawing and are listed in table 1 below.

1. In this case, output = regulation (EC) 443/2009. Outcome = (possibly) reduced average passenger car emissions. Impact = (possibly) reduced total passenger car emissions
2. Evaluation can be defined as "the application of social science theory and methodology in order to assess both ex-ante and ex-post implementation, the impact and the side-effects of programs, policies, strategies and other 'tools of governments' ... including the explanation of those impacts/side-effects" (Leeuw 2006, 64).

Framework conditions

- **Characteristics of the Japanese automotive sector**
- **Climate policy**
- **Socio-cultural factors**

Policies on fuel efficiency of passenger cars

- **Key policies (Top Runner + Regulation (EC) 443/2009)**
  - *Stakeholder involvement*
  - *Targets*
  - *Promotion of innovation*
  - *Monitoring and sanctions*
- **Additional instruments**
  - *Taxation*
  - *Labelling*

Table 1: Japanese key factors and EU evaluation criteria

Lesson drawing

Based on the evaluations of the policies, the authors intend to promote a learning process between Japan and the EU that goes beyond the usual political-science conception of "whether programs can transfer from one place to another" (Rose 1991, 5). Since the EU has already regulated automobile CO_2 emissions, this research aims not to assess the transferability of Japanese policy to the EU. Instead, a broader conception of lesson drawing is applied. This is in line with Rose's more general considerations regarding the nature of policy-making and the high value attributed to experience: "A policymaker is not a theorist but a social engineer seeking knowledge instrumentally. In policy-making circles, experience has a unique status as a justification of effectiveness" (Rose 1991, 5). Following this view, this research aims to contribute to social engineering by ascertaining whether experiences from the Japanese fuel efficiency policy, in particular the supporting and hindering factors, can be used as lessons that may help to improve or complement EU fuel efficiency policy, in particular Regulation (EC) 443/2009. Such changes could be conceivably included in the Regulation during its review in 2013 or at a later date.

1.4.1. Document analysis

Documents were the primary source of information at different stages of the research process. **Primary** documents, such as EU directives, national laws and programs were scrutinised and represented the fundamental information source. **Secondary** sources such as reports, academic publications and available evaluations provided the information needed to identify the key factors.

Engagement in the scientific debate was facilitated by examining academic publications on the Japanese and EU fuel efficiency policy, as well as literature on general framework conditions such as the industry sector. Moreover, by analysing secondary literature on the Japanese and the EU policy, academic knowledge gaps concerning the European legislation could be identified and integrated into the interview guidelines. As far as possible, differently authored and commissioned reports were considered in order to ensure that different views on the topic were represented (Miles et al. 1994, 263).

1.4.2. Semi-standardised interviews with experts

Experts were interviewed to cross-check the results of the document analysis and to explore issues not (adequately) dealt with in publications. Experts are understood to be professionals who belong to the respective policy arena (Meuser/Nagel 1991, 73).

In line with the main actors mentioned above, four types of organisations for the interviews were identified during the initial research: ministries/public institutions, automotive associations, scientific actors and non-governmental organisations. First an institution was chosen, from which a contact person was identified. The choice of interviewees was based on different criteria according to the nature of the organisation. When considering experts from research institutes and environmental organisations, attention was paid to the expertise in the specific policy field, attested to by the publication of reports or position papers. Representatives of public institutions were chosen according to their personal involvement in the legislative process of the relevant Japanese or EU fuel efficiency policy. To find experts representing industry, departments dealing with sustainability issues were contacted.

Experts interviewed

Type of organisation	Organisation	Interviewee	Function and department
Ministries/Public Institutions	Japanese Ministry of Land, Infrastructure, Transport and Tourism*	Tsuneki Matsuo	Road Transport Bureau
	EU Commission	Susanna Lindvall	Policy Officer, *DG Climate Action, C.2 Transport & Ozone*
Research institutes and foundations	University of Yamanashi	Shinichi Muto	Associate Professor
	European Climate Foundation	Dr. Martin Rocholl	Programme Director Transport
Non-governmental organisations (NGOs)	No Japanese environmental organisations available		
	International Council on Clean Transportation (ICCT)	Dr. Peter Mock	Senior Researcher, Regional Lead Europe

Type of organisation	Organisation	Interviewee	Function and department
Car industry lobby groups	Japan Automobile Manufacturers Association, Inc. (JAMA) unavailable		
	European Office European Automobile Manufacturers Association (ACEA)	Petr Dolejsi	Director Mobility & Sustainable Transport

* Mr. Matsuo spoke in a personal capacity: his statements do not represent the position of the Ministry.

The interview approach

The selected experts were interviewed in a semi-structured manner: a pre-prepared interview guideline provided some structure and orientation for the questions but spontaneous question formulation and follow-up questions about any unexpected issues were possible (Hopf 2004, 204).

The basic structure of the interview guidelines was the same for all interviews and based on the key factors identified through the research on Japanese fuel efficiency policy (see chapter 1.3 and 2). The questions were adapted only slightly to the specific context of the interview-partner and to progress of the research project.

The interview guidelines contained both open and closed (yes or no) questions. Open questions allowed the identification of additional policy key-factors and the cross-checking of those previously identified during the literature analysis. Closed questions were used to check specific findings. Questions were kept as neutral as possible rather than suggestive but occasionally assumptions obtained through research or previous interviews were reflected in the questions.

The guidelines for interviewees from the EU and Japan can be found in Annex I.

The interview setting

Given that this is a very international topic and that many of the relevant experts are based in Brussels or Japan, most of the interviews were conducted via telephone in December 2011, with the exception of the interview with Martin Rocholl (ECF), which took place at his workplace. All interviews commenced with some organisational issues such as requesting the interviewees consent to record the interview, and if they wished to be sent their statements for approval before the research paper is finalised. Some background on the master's degree (for which the research was carried out) and the research project was also provided at the beginning.

Unsurprisingly, the EU actors were more familiar with the EU policies, while the Japanese had more insights into their national policies. Hence, it was considered to be reasonable to adapt the questions slightly depending if the interviewees work in the EU or Japan.

As previously mentioned, the interviews were semi-structured and as such, did not exactly follow the pre-prepared guideline. Instead, further questions were asked about interesting or relevant topics raised by the interviewees, issues were dealt with in a different sequence or could not discussed due to lack of time. All interview partners were very open and interested in the topic and asked to receive the final research paper.

Interview analysis

Based on the recordings of the interviews, key issues were transcribed. Since content rather than the manner of communication was deemed important, non-verbal expressions such as harrumphing or laughing were not noted down.

The statements were summarised or, in case of particular significance, directly quoted befitting the broad structure laid out in the key factors and interview guideline. Thus the categories for the analysis of the interviews were generated in a deductive way based on previous document analysis.

As a next step the statements of all interviewees were brought together in a matrix whose structure was based upon the key factors and additional issues raised in the interviews (not published to maintain privacy of off the record statements). This allowed the identification and interpretation of the interviewees' common and divergent positions. Finally, the results of the interviews were combined with previous findings from the document analysis.

Due to the focus on qualitative rather than quantitative interviews the results can only reflect views of certain key people and will not be representative of all relevant actors.

1.5. Chapter summary

To meet the challenges linked to climate change, the *European Council* adopted the *Energy and Climate Package* in December 2008. To meet the so-called 20-20-20 goals in the Package, a reduction of CO_2 emissions from passenger cars, which contribute 12% (and rising) of the EU's total CO_2 emissions is needed; in Japan CO_2 emissions from passenger cars have declined since 2001 and accounted for 9.5 % of total CO_2 emissions in 2008, at least partially attributed to fuel efficiency improvements stimulated by the Japanese *Top Runner fuel efficiency program,* introduced in 2001.

Given the different developments in the EU and Japan, the objective of this research is to provide advice on how to improve EU automobile CO_2 emissions policy by answering the following research question: “Reducing automobile CO_2 emissions - Can the EU draw lessons from Japan?”

The EU is not starting from scratch and has already a relevant policy, *EU Regulation (EC) 443/2009 setting emission performance standards for new passenger cars*, which recently entered into force in 2012. Taking this into account, the research will examine whether some elements of the EU policy can be improved based on the experience from Japan rather than to assess a potential wholesale transfer of the overall policy from Japan to the EU.

When studying the current state of research, it was discovered that extensive literature on policy instruments in general, on analytical approaches and methodologies as well as on technical issues is available. All this research served as useful background but to answer the above mentioned research question, information on European and Japanese automobile sector policy instruments were also

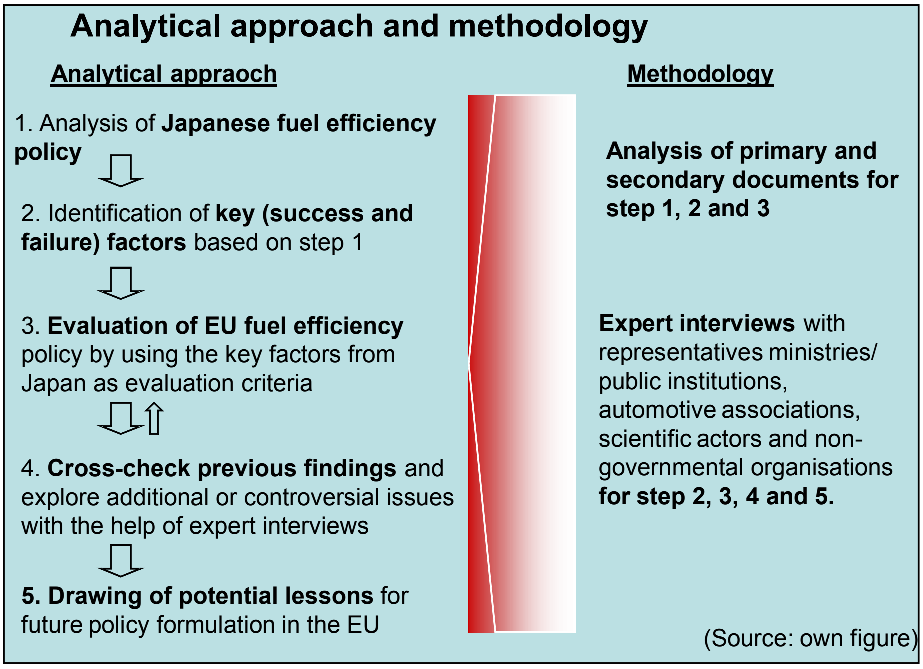

Illustration 1.4: Analytical approach and methodology (own representation)

needed. These fields are less well researched and direct comparisons, or even possible lesson-drawing between the EU and Japanese approaches to fuel economy/emissions policy were not found at all.

The analytical approach is based on a description and evaluation of the Japanese fuel efficiency policy with the aim to identify key (supporting and hindering) factors. These key factors later serve as guiding criteria for the evaluation of the EU fuel efficiency policy. With the help of the policy evaluations it will be assessed whether the EU can learn from the Japanese experience. Methods for obtaining the necessary information are the analysis of primary and secondary documents as well as semi-standardised expert interviews.

2. Key factors for the Japanese fuel efficiency policy

This chapter analyses and evaluates (ex-post) Japanese fuel efficiency policy based on the identified key factors. These factors are categorised into two parts and describe how and why they contribute to (or hinder) fuel efficiency improvement (CO_2 emission reduction). Firstly, framework conditions are examined by analysing Japanese climate policy, automobile sector characteristics and socio-cultural factors. Secondly, the main policy, the Top Runner fuel efficiency standard, is examined with respect to four criteria: stakeholder involvement, targets, promotion of innovation, and monitoring and sanctions. In this part, additional instruments are also scrutinised; both of which are developed based on the Top Runner standard. Japanese supporting and hindering factors identified in this chapter go on to be used as criteria to evaluate (ex ante) the EU fuel efficiency policy.

2.1. Framework conditions

2.1.1. Japanese climate policy

Under the Kyoto protocol Japan has committed to reduce its GHG emissions by 6% compared to 1990 levels in the first commitment period between 2008 and 2012 (Asselt et al. 2009, 320). Additionally, former Prime Minister Yukio Hatoyama announced in September 2009 that Japan would aim to cut its GHG emissions to 25% below 1990 levels by 2020.

However, due to economic growth, Japan's GHG emissions grew steadily until 2007, as shown in the illustration (2.1) below. Especially CO_2 emissions – which account for around 90% of the total GHG emissions – increased, while other emissions such as methane and N_2O decreased (Ogawa 2008, 3).

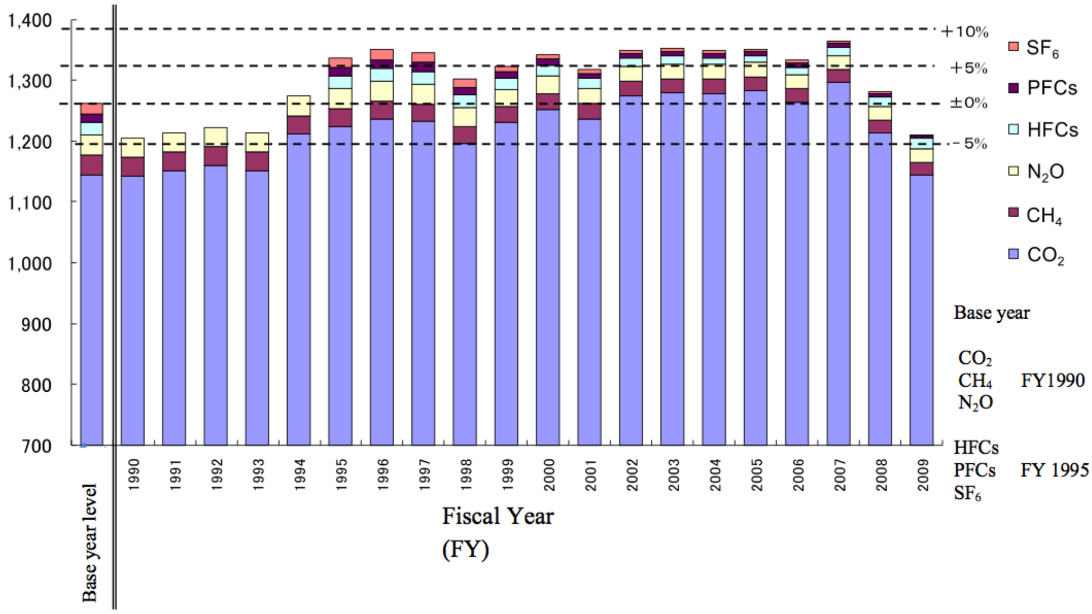

Illustration 2.1: Japanese GHG emissions 1990-2009 (Mt CO_2 eq.) (MOE 2011, 3)

To comply with its Kyoto Protocol goal, the Japanese Government formulated the *Kyoto Target Achievement Plan* in 2005. The plan set out emissions reductions targets and measures for individual sectors (JAMA 2011, 8). While stringent emissions reductions targets were set for major industrial sources, especially electricity production, increased emissions from offices, households and transportation were allowed (IEA 2005, 1). The *Kyoto Target Achievement Plan* was revised in March 2008 with several additional measures, including some for households and transportation such as house and building energy efficiency improvement, measures to improve the efficiency of household equipment under the Top Runner program, implementation of energy saving measures in factories and offices as well as improvement of vehicle fuel efficiency (MOE 2008, 46). The revised plan aimed to limit the (aggregate) CO_2 emissions increase from the transport sector from 1990 until 2010 to 10.3% - 11.9% (MOE 2008, 15).

After peaking in 2007, the total GHG emissions in Japan have since declined. In 2009, GHG emissions totalled 1,209 million tons (4.1 % lower than 1990 levels) (MOE 2011, 3).

2.1.2. Characteristics of the Japanese automobile sector

Japanese passenger car market

Brand	Market Share
Daihatsu	11.3%
Fuji (Subaru)	2.9%
Honda	14.3%
Isuzu	0.0%
Mazda	4.6%
Mitsubishi	3.1%
Nissan	13.4%
Suzuki	11.5%
Toyota & Lexus	34.4%
Others	4.4%
Total sales (2010)	4212267

Table 2: Japanese market figures 2010 (Own calculation from JAMA 2011b, 10-11)

In 2010, 4.21 million passenger cars were sold in Japan, 7.5% of all cars sold worldwide, making it the fourth biggest market in the world, behind the EU, the USA and China (JAMA 2011a, 8; ACEA 2011, 56). A particular characteristic of the Japanese market is the near total dominance by local manufacturers and locally produced vehicles. All imports (including Japanese-manufacturer imports) make up a meagre 5.1% of total sales (JAMA 2011a, 7 & 9). This market is not just dominated by local manufacturers in general: market share is concentrated on a few big players. The three biggest manufacturers, Toyota, Honda and Nissan, command over 60% of the market, while the top five (top three plus Suzuki and Daihatsu) command almost 85% of the market (JAMA 2011b, 10-11).

Japanese passenger car CO_2 emissions

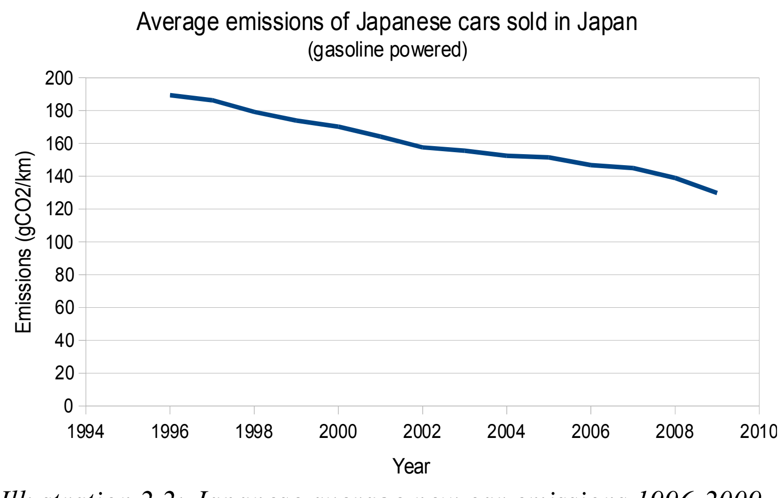

Illustration 2.2: Japanese average new car emissions 1996-2009 (Own conversion & representation of figures from JAMA 2011a, 24)

Passenger cars are a significant contributor to Japan's total CO_2 emissions. JAMA (2011, 24) states that the transport sector contributes 19.4% of the total, with 48.9% of that coming from passenger cars (Naono 2011, 3), thus cars were responsible for 9.5% of Japan's total emissions in 2008. This compares favourably to the EU, where passenger cars contribute 12-14% of total emissions (see chapter 3.1.2). In total, Japanese transport sector emissions have dropped from their peak of around 265 Mt/a, in the period around 1996 to 2001, to 229 Mt in 2009 (JAMA 2011a, 23).

This decrease is attributable to various measures as part of the so-called *three in one approach* (JAMA 2008, 8; Minato 2004, 104):

- Greater fuel efficiency through technology improvement
- Improved traffic flow mainly through improved road infrastructure
- Eco-driving behaviour

On the issue of improving vehicle fuel efficiency, the industry has made significant progress (see illustration 2.2)[1], notably the significant over-achievement of the 2010 average fuel efficiency (emissions) target for gasoline vehicles, ahead of time even (in 2009)[2] (JAMA 2011a, 24). Furthermore, the penetration rate of Top Runner compatible gasoline-powered passenger vehicles into the market reached over 96% in 2010 (JAMA 2011, 7).

Another significant, but little acknowledged, factor in the fuel efficiency improvement achieved is the rapid growth of sales of cars in the so-called *kei car* (mini car) segment. The purchase of these especially small[3] cars is encouraged by preferential tax rates (JAMA 2011a, 41-44), and their sales have accordingly steadily increased from 11.9% of all new registrations in 1993 to 27% in 2011 (own calculation from data from JAMA 2012). Given the physical size (and thus indirectly weight) and engine capacity restrictions applied to this segment, these vehicles are, almost by definition, very fuel efficient, and the high sales mean they exert significant influence over the average of all vehicles sold.

Japanese passenger car industry

Producing over 8 million cars in 2010, 14.2% of the world's cars originated in Japan, making it one of the world's prolific car manufacturing countries (ACEA 2011, 37). Germany, by comparison, produced only 5.6 million cars in the same year (ACEA 2011, 40). The Automotive industry is one of Japan's key industries, both domestically and for export. In 2009, automotive (including motorcycles) products contributed 18.7% of the country's total exports. Furthermore, the sector employs 8.5% of Japan's total workforce and contributes 18.5% of total national R & D spending (JAMA 2011a, 1, 2 & 4).

Japanese industry stakeholders actively participate in the policy-making process there, and “used to and at ease with close collaboration with national regulators”, which “also ensures that targets are feasible and not overly ambitious.” (Nordqvist 2006, 28). As one would then expect, the industry is largely supportive of the Top Runner fuel efficiency standard. The industry's supportive stance is made the more evident by the positive tone regarding fuel efficiency regulation of JAMA's annual publication on the state of the industry (JAMA 2011a), which, amongst other information, catalogues the industry's achievements in relation to the regulation.

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1. km/L to gCO_2/km converted assuming 2,310 gCO_2/L for gasoline (Davies 2012)
2. 2009 average fuel efficiency (emissions): 15.1 km/L (≈ 155 gCO_2/km). 2010 target: 18.1 km/L (130 gCO_2/km)
3. both externally (max. 1.48m wide, 3.4m long) and in engine size (max. 660cc) (JAMA 2011a, 59)

The industry also highlights its significant progress in developing *alternative-energy* and low emissions vehicles. 4.03 million such vehicles were produced in 2009 (JAMA 2011a, 25), with almost one million hybrid vehicles (all sizes) in circulation in Japan by 2009, 1.3% of the total vehicle fleet (JAMA 2011a, 25 & 11).

Similar to the EU car industry, another significant strand of argumentation employed by the industry to reduce the emissions from its products is that of infrastructure improvement. These include "measures to mitigate congestion at intersections, ... and the greater use of expressways" (JAMA 2011a, 26). They argue that improving road infrastructure improves traffic flow, which, in turn, "enables increased vehicle speed and increased fuel efficiency, which in turn contributes to CO_2 reduction" (JAMA 2011a, 26). This position is hardly a surprising one, given that such measures and the accompanying emissions reductions reduce pressure on the manufacturers to improve their products, saving them investment. Moreover, improved infrastructure improves the competitiveness of passenger cars compared to other transport modes, thus possibly increasing car sales.

2.1.3. Socio-cultural factors

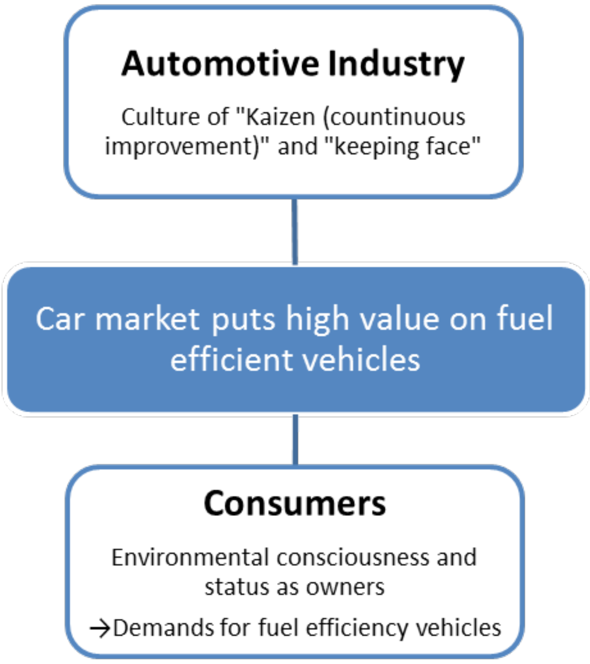

Illustration 2.3: Japanese socio-cultural factors (own representation, int. Matsuo, MLIT; Muto, Uni. Yamanashi)

This chapter focuses on Japanese socio-cultural factors and analyses them from two perspectives; that of the automotive industry (supply side) and consumers (demand side) respectively. The authors separated the socio-cultural factors from the general characteristics of the Japanese automotive sector described in last chapter because socio-cultural factors were stressed by both Japanese interviewees as supporting factors with high impact.

Automotive Industry (Supply side)

In the Japanese automotive industry, the culture of *Kaizen* is well established. This Japanese word can be literally translated as *continuous improvement*, but it goes beyond the understanding of the English word "improvement". *Kaizen* refers to "continuous accumulation of small betterment activities rather than innovative improvement", according to Monden and Hamada

(Monden/Hamada 1991, 17). Japanese interviewees affirmed that the spirit of *Kaizen* led to the improvement of average fuel efficiency. Mr Muto argued that Japanese engineers are highly motivated to continuously improve and develop technologies to foster fuel efficiency and better traffic safety (int. Muto, Uni. Yamanashi).

Another relevant factor seems to be the culture of *keeping face*. Japanese manufacturers tend to think that they will lose their honour if they fail to achieve the Top Runner fuel efficiency targets. Mr Matsuo repeated that manufacturers take compliance with the Top Runner fuel efficiency targets seriously to keep their face (int. Matsuo, MLIT).

Consumers (Demand side)

According to the report written by SEPA, awareness on challenges related to climate change is growing within Japanese society and improving energy efficiency is a societal demand (SEPA 2005, 49). Mr Muto commented that there are environmentally conscious Japanese customers who are prepared to pay a high premium for fuel efficient vehicles. He assumed that such consumers enjoy both their status as owners of these vehicles, and also showing them to other people (int. Muto, Uni. Yamanashi).

In summary, Japanese socio-cultural factors such as *Kaizen* and *keeping face* play a significant role for the environmental effectiveness of the Top Runner. There is national common understanding – not only from the demand side but also from the supply side – that Top Runner target compliant vehicles enjoy special status in the market (int. Matsuo, MLIT).

2.2. Specific Japanese fuel efficiency policies

This chapter begins by describing and analysing the Top Runner fuel efficiency standard, which plays a central role of the Japanese fuel efficiency polices. Afterwards, two additional instruments (labelling and financial instruments) based on the standard are followed. The standard and additional instruments and closely linked with each other, as shown graphically, below (see illustration 2.4).

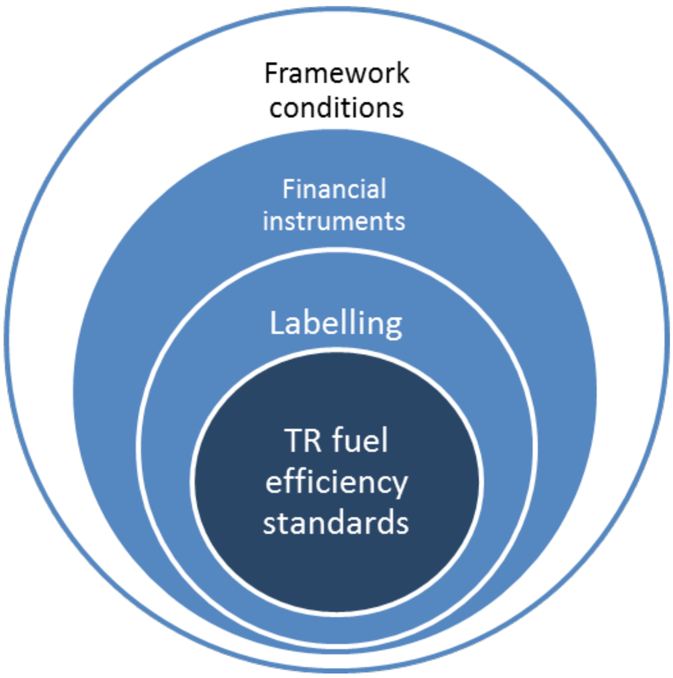

Illustration 2.4: Links between Japanese key factors (Own representation, 2012)

2.2.1. Top Runner fuel efficiency standard

The Top Runner program is the central Japanese policy instrument to stimulate the improvement of energy efficiency in products' end use phase (Nordqvist 2006, 5). In accordance with the revision of the law concerning the rational use of energy (*Energy Conservation Law*), the program was introduced in 1999 with 11 product items including automobiles and expanded to 23 product items by 2010 (METI 2010, 5). The most important measure for this research is the part of the program dedicated to passenger car fuel efficiency; so far successful in effecting CO_2 emissions reductions. The main characteristics of the Top Runner program in general is the dynamic, industry-driven target-setting process, through which the most efficient available product (in this case, car) determines the efficiency level that all manufacturers must attain by the end of the following policy cycle.

In this chapter, the key (supporting and hindering) factors of the Top Runner program for passenger vehicles are illustrated; in the related paragraphs the reasons for the relevance of each key factor are explained. These factors will then serve as evaluation criteria for Regulation (EC) 443/2009, the central EU policy instrument to reduce CO_2 emissions.

Stakeholder Involvement

In Japan, the fuel efficiency standard setting is driven by the industry that, being at the same time the main addressee of the policy, plays a central role during the most stages of the policy-cycle. Because the most efficient vehicle in each weight class is taken as a reference to set the next target, the standard setting procedure tends to be seen as an automatic and quick process (SEPA 2005, 53). In reality it requires further decisions, for example about the target-scope and the method for measuring fuel efficiency, which are made by the government in strong cooperation with industry stakeholders. This fact was stressed by Mr Matsuo, who mentioned that "if a whole procedure is taken into account including time for discussion of problems (e.g. weight based or size based discussion) and time to estimate technology innovation, it takes at least of 1-2 years from the beginning of the preparation phase over public hearing until targets are published in an official text" (int. Matsuo, MLIT).

Both primary and secondary stakeholders (car manufacturers and retailers, and users respectively) are involved (Nordqvist 2006, 19), although a lack of transparency and information in the documents available from the Japanese Government does not allow examination of the extent of consumers' participation in the policy-making procedure. Mr Muto also criticized the target setting procedure led by the Japanese Government as being not transparent enough for all stakeholders and in need of improvement (int. Muto, Uni. Yamanashi).

Among the industry stakeholders, manufacturers play the prominent role in the cooperation with the government. Such a high level of carmakers' participation is a guarantee for target feasibility (Nordqvist 2006, 26) and, as an interviewee remarked, it can have positive consequences on innovation: "the trusting and strong relationship between the government and manufacturers makes it easier to predict the extent of technology development in the future" (int. Matsuo, MLIT).

In the above-mentioned cooperative framework, the manufacturers' position is the result of negotiations between manufacturers (SEPA 2005, 54), which should be considered as individual stakeholders. Automobile manufacturers associations play only a marginal role because of "the assumption that branch representatives, in these cases, would tend to defend the interests of the least good performer" (Nordqvist 2006, 28).

An important fact emerges from the previous considerations: the policy arena is dominated by two principal actors, the government and the carmakers, whereas no environmental NGOs are involved in the decision-making processes. Compared to other industrialized countries, NGOs in Japan are not particularly active and enjoy little support from the population. Japanese environmental NGOs are mostly involved in nature protection issues; few environmental organisations work specifically on the transport sector or fuel efficiency (int. Matsuo, MLIT), making the inclusion of Japanese NGOs' perspectives impossible for this research project.

In summary, the traditional strong collaboration between the Japanese industry and the government leads to a strong involvement of carmakers in the standard setting procedure that ensures the feasibility of targets and the predictability of technology development but is not necessarily a guarantee for target-stringency. Carmakers participate individually in discussions, whereas the role of branch associations is limited. The absence of NGOs concerned with the environmental impact of the transport sector and/or with fuel efficiency can be considered as a weakness under the assumption that their involvement in the policy making process would increase target-stringency, thus enhancing the environmental protection level.

Targets

The emissions reduction potential of a policy is determined by the level at which its targets are set. In this part, three main characteristics of the Top Runner fuel efficiency targets were identified and categorised, partly according to Onoda[1] (Onoda (OECD/IEA) 2008, 10, 11): target-object (what is measured and on which base), standard-stringency (what level of environmental protection is targeted) and target-flexibility.

1. Onoda (2008, 44-48) identifies the following "attributes for effective standards": scope, test procedures, regulatory flexibility, technology neutrality and target stringency. In this chapter, technology neutrality is considered as an aspect of *promotion of innovation* and test procedures are mentioned as an aspect of the monitoring process.

Remarkably, documents solely focusing on Top Runner fuel efficiency targets were lacking. For this reason, a great part of the information about targets was obtained through interviews with experts.

Target-object

Japanese fuel efficiency targets are formulated periodically every 5 years using the so-called Top Runner method which was first introduced in 1999. There have been three groups of targets so far: for 2010, 2015 and 2020. Targets are set up to 8 years in advance to allow car makers enough time to develop their new and/or revised models. For example, the 2020 targets were published at the end of 2011; almost 8 years before they have to be achieved. Target values are provided in the unit of kilometre per litre (km/L) using a weight-based approach. In accordance with the approach, targets for gasoline powered passenger cars are divided into more than 15 weight categories.

According to the Top Runner method, the fuel efficiency of the best performing vehicles in each weight category in the Japanese market are used as the basis for the target all other vehicles in that weight category must achieve by the target year (Onoda (OECD/IEA) 2008, 17). Thus, the Top Runner approach considers the relevant impacts of projected technological progress when determining the new target values (JAMA 2011, 9).

Japan's weight differentiated approach can be seen as advantageous, as (1) it can set fair fuel efficiency target values for different sized vehicles and (2) has not so far resulted in a shift to heavier or lighter cars (int. Matsuo, MLIT). The second point may, however, be criticised because a shift to lighter and therefore less emitting cars would allow a higher level of environmental protection, whereas the Japanese Government seems to accord higher priority to industry's and consumers' needs at present, although different indexes on which targets could be based in the future are under discussion, such as size, which would also improve traffic safety. Nonetheless, the Japanese Government has decided to continue to have weight-based targets at least until 2020 in order to ensure the fairness of target values among different sized vehicles, (int. Matsuo, MLIT). A further criticism of the second point raised here may also be levelled given the increase in sales of light *kei cars* (see chapter 2.1.2.). If sales of these cars have increased, yet the overall average weight remained steady, the weight of the other cars must have increased to compensate for the lighter cars. Thus the maintenance of average vehicle weight may have more to do with the encouragement of *kei car* sales than the Top Runner method itself.

Target stringency

As mentioned above, Japan has had three fuel efficiency target cycles, with the target years 2010, 2015 and 2020. The stringency of Japanese targets are re-evaluated every 5 years in accordance with the target setting process. Gasoline fuelled passenger cars were required to reach an average efficiency level of 14.4 km/L (159.7 gCO_2/km) in 2010, which at that time was regarded as the lowest fleet average CO_2 emissions target for new passenger cars in the world (ICCT 2007, 7): This target was already met in 2005. This kind of early and massive over-compliance implies that the agreed compliance period may have been too long and/or that the standards may have been too lax (Nordqvist 2006, 19).

As a result of the too early target achievement, the government decided to raise the target stringency for 2015. The average 2015 target for passenger cars, 16.8 km/L (136.9 gCO_2/km), signifies a fuel efficiency increase of around 24% compared to 2004 levels (JAMA 2011, 9), and seems to be much more difficult to achieve than the 2010 target.

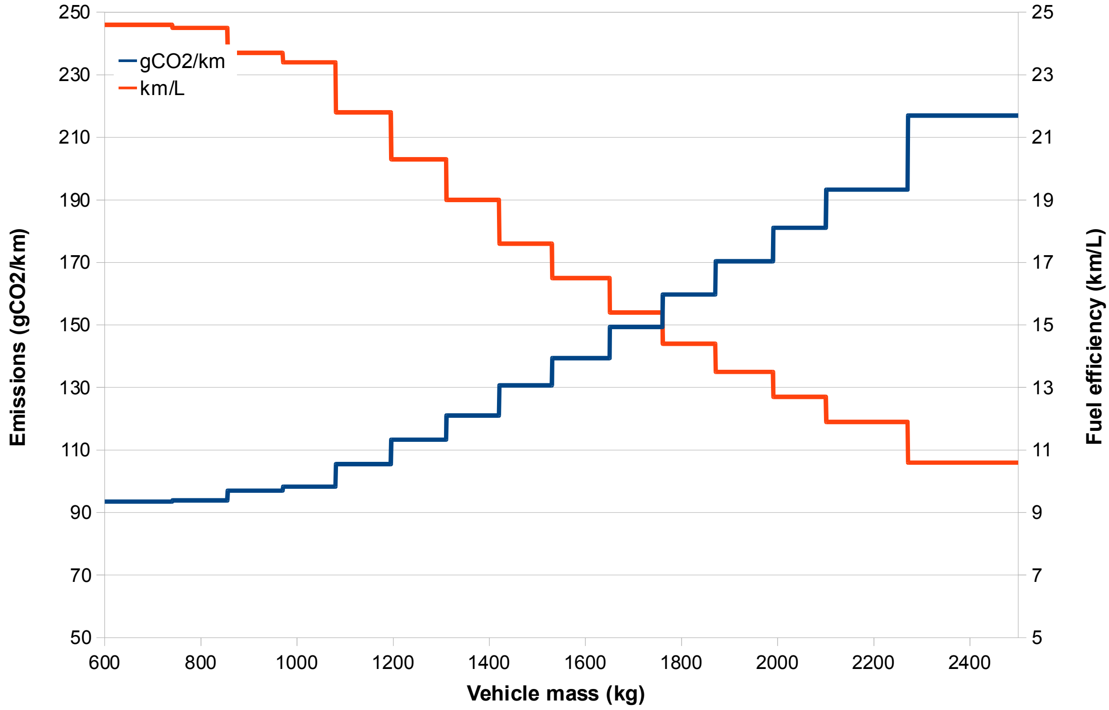

Illustration 2.5: 2020 Top Runner fuel efficiency targets for passenger cars (own calculation and representation) (METI/MLIT 2011, 5)

Furthermore, in October 2011, the Japanese Government strengthened the 2020 target to 20.3 km/L (113.3 gCO_2/km) (METI/MLIT 2011, 8). Compliance for the 2020 target calls for not only further increases in the fuel efficiency of conventional (gasoline and diesel powered) vehicles, but also an expanded supply of next generation vehicles such as electric and hybrid cars (JAMA 2011, 9). In spite of the more stringent target, Japan gave up its world-leading position to the EU, which declared, in Regulation (EC) 443/2009, the willingness to set a more stringent target of 95 gCO_2/km for 2020. Although Japan's targets are no longer the most stringent worldwide, it has clearly played a leading role in this field with its ambitious targets over the last ten years.

A change under discussion is the use of overall average values instead of the best (Top Runner) performance values in weight categories to determine targets, which, if done, would further weaken the Japanese target stringency. Critics claim that the Top Runner method takes solely technical aspects into account (int. Matsuo, MLIT) and that targets are set without considering aspects such as the car's design which could also lead to efficiency improvements (anonymous). If these points were considered in setting the targets, stringency could be increased.

Target flexibility

The following paragraphs give an overview on the flexibility instruments used in Japan.

The Japanese regulator checks the target achievement of each manufacturer using its average fuel efficiency value across all weight categories, meaning manufacturers may compensate their fuel efficiency performance among weight classes. For example, if a carmaker sells many of efficient vehicles classified in a light weight class, it is then able to sell a greater number of inefficient (often more powerful) cars from other weight classes. In this way, the Japanese regulator tries to protect the market's diversity allowing for consumers' demands (int. Matsuo, MLIT). Although there are relatively many environmental conscious consumers in Japan, as mentioned in chapter 2.1.3, there are also consumers who want to purchase powerful, less fuel efficient cars.

Although such a flexibility instrument may have a negative environmental impact, through the continued production and use of heavy or powerful (and thus more highly emitting) vehicles, this is compensated by the broad target-scope of the Japanese fuel efficiency targets.

In order to ease the burden on smaller manufacturers with fewer resources to invest in the necessary fuel efficiency research, manufacturers which produce fewer than 2000 vehicles per year are excluded from the regulation and are not expected to meet any targets (METI 2011).

The targets regard not only a large number of manufacturers but also a wide range of vehicle technologies. The standards include gasoline, diesel and LPG passenger vehicles (METI 2010, 28). In addition, since 2006, freight vehicles (gross vehicle weight of 3.5t or less) are subjected to a target for 2015, making Japan the first country in the world to set targets for freight vehicles (JAMA 2011, 6). This research focuses on passenger vehicles, however, and as such freight vehicles are beyond its scope. Nevertheless, their inclusion in the Top Runner scheme demonstrates the Japanese fuel efficiency policy's broad range of vehicles included, thus its broad target-scope.

Hybrid vehicles are treated as gasoline powered vehicles for the manufacturer's overall fuel efficiency calculation, although they are excluded from being selected as the *top runner* in the target setting procedure (until the 2020 cycle) (METI/MLIT 2011, 19), even if they offer the highest efficiency in a certain weight category, as their efficiency would be impossible for other standard gasoline-powered vehicles of equal weight to achieve (int. Matsuo, MLIT). This allows manufacturers producing a great number of hybrid vehicles such as Toyota to more easily achieve the targets than carmakers producing none or fewer hybrid cars.

However, Japan lacks other economic instruments for target flexibility, such as banking and trading systems, used by other countries. Mr Matsuo pointed out that a fuel efficiency credit trading system between manufacturers would not be appropriate because of Japanese culture, as Japanese manufacturers are not willing to solve problems by buying credits, through which might their reputation could be damaged. As an alternative to such economic instruments, *original equipment* *manufacturer* (OEM) arrangements may be used, whereby a manufacturer sells vehicles originally produced by other manufacturers rebranded as their own. An expert interviewed for this project expects that some manufacturers may use this instrument shortly before the target year 2015 in order to achieve the targets (int. Matsuo, MLIT).

Promotion of innovation

As stated in the report *The Top Runner Program in Japan – its effectiveness and implications for the EU* published by SEPA, "the analysis of the perceptions of manufacturers suggests that the Top Runner program plays a crucial role in promoting technological development. It has clearly accelerated the commercial application of previously unused technologies or the wider application of technologies (diffusion)" (SEPA 2005, 53). In other words, the dynamic nature of the Top Runner approach sets incentives for continuous innovation activities. This role of the Top Runner approach is confirmed by statements of further experts such as Mr Yokoyama from the *Japan Environmental Management Association for Industry* (JEMAI) and Professor Yamamoto from the *University of Tokyo*.

If one examines the kind of innovation promoted by the Top Runner program, it can be seen that only incremental technical changes are encouraged. In practice existing technologies are improved, as incentives for radical innovations or development of totally new technologies are not set by the policy (Nordqvist 2006, 29). This can be attributed to the lack of specific instruments for ecological innovations, and/or to the characteristics of the emissions targets themselves. Being set in km/L of gasoline and diesel, thus addressing only (current) fluid fuels, they are biased toward "traditional" technologies (not technology neutral).

Monitoring and sanctions

The monitoring of fuel efficiency improvements is based on manufacturer self-monitoring, wherein each Japanese manufacturer must submit the results of its own fuel efficiency improvement to MLIT each year. After collecting and analysing this data, the MLIT publishes an annual (since 2004) car fuel efficiency catalogue to show the fuel efficiency trend for the Japanese automotive industry. It is difficult, especially for non-Japanese speakers, to follow monitoring processes since these catalogues are available online in Japanese only (MLIT 2011), leading to the process being criticised as in non-transparent. In addition, MLIT publishes a monthly table cataloguing the number of vehicles sold and their fuel efficiency on its website (int. Matsuo, MLIT).

Despite the above-mentioned monitoring efforts by MLIT, the automobile sector is not included in the comprehensive monitoring instruments used for other product categories within the Top Runner program. For example, the (METI subordinate) organisation, ECCJ (*Energy Conservation Center, Japan*), publishes biannual comprehensive product catalogues for the Top Runner program, from which passenger cars have been excluded to date, with only the progress status of energy saving household appliances being monitored (METI 2011a, 2; Nordqvist 2006, 20).

The sanction system for the Top Runner fuel efficiency standard is carried out in four steps: (1) the Japanese Government issues so-called advice to the manufacturer concerned, (2) if the manufacturer fails to respond to advices, a public proclamation will take place. This phase is generally called the *name and shame* sanction, since the transgressors are officially named and shamed (Nordqvist 2006, 21). After this, (3) the regulator may expressly order an erring company to comply and, (4) if manufacturers don't comply with the order, the regulator levies penalties, which account for less than one million yen, corresponding in March 2012 to ca. 9.150 € (METI/MLIT 2011, 1). Mr Matsuo argued that the *name and shame* sanction in the second phase has more impact than the low monetary penalty itself and it is so far very effective due to the carmakers' desire to save face (int. Matsuo, MLIT), as already described in relation to the socio-cultural factors (see chapter 2.1.3). In fact, whether the sanctions process has progressed to the third stage of monetary sanctions as a consequence of non-compliance with Top Runner regulations has not been published, making the *name and shame* instrument one of the most important Japanese supporting factors (Nordqvist 2006, 21). The effectiveness of this instrument is difficult to confirm, however: it is a disputed point amongst the interviewees and little literature concerning this matter is available.

2.2.2. Labelling

This and the following chapter illustrate two important additional instruments: labelling and financial incentives. As stated briefly at the beginning of chapter 2.2, the additional instruments are based on and complimentary to the Top Runner fuel efficiency standard.

The labelling system for vehicle fuel efficiency was introduced as the first additional instrument in 2004 to improve information for consumers, subsequently revised in 2006 and 2008 (Hamamoto 2011, 93; JAMA 2011, 10). Vehicles which achieve or exceed the Top Runner fuel efficiency standard are entitled to display the green fuel efficiency labels on the rear of the bodywork at the point of sale together with blue low emission labels[1] (see illustration 2.6). The contrary also holds that cars which fail to reach the standard are not allowed to display the fuel efficiency labels. The labels contain the following information (in Japanese):

1. The low emissions labels inform consumers of the emission of environmentally harmful substances emission such as Nitrogen oxides (NOx) and particulate matters (PM). Depending on the performance levels, vehicles are entitled with star signs.

- By how many percent the car exceeds the Top Runner fuel efficiency standard
- The target year[1] (SEPA 2005, 35)

Illustration 2.6: Fuel efficiency label (above) and low emission label (below) (own picture, 2012)

Depending on whether and how many vehicles exceed the target, they are certificated in six levels under the absolute labelling scheme (exceeded up to 5%, over 5%, over 10%, over 15%, over 20% or over 25%) (MOE 2009, 1). The labels were initially categorised into two levels, and expanded into six levels with the revision in 2008. As a consequence of the six levels and their uniform green colour design, consumers have difficulty reading the entailed fuel efficiency figures on the labels. Nevertheless, in the view of Mr Matsuo, the labelling program provides clear information on fuel efficiency levels and stimulates consumers to choose vehicles which fulfil the requirements for financial incentives explained in the next chapter (int. Matsuo, MLIT).

2.2.3. Financial instruments

As noted above, the Japanese labelling program is coupled with financial instruments consisting of two elements. The first is tax reduction incentives and the second is subsidisation.

1. The target year is described in Japanese periodisation system which shows how long the present emperor has ascended the throne. Current Japanese era is called as "heisei". Heisei 22 as a target year in the picture can be converted in 2010.

Tax incentives

	Fuel Efficiency	Emissions Performance	Incentives		
			Automobile Tax	Acquisition Tax	Tonnage Tax
Alternative-Energy/ Next-Generation Vehicles	Electric (including fuel cell), plug-in hybrid, clean diesel, hybrid and natural gas vehicles that meet certain performance requirements		50% reduction	Exempt	Exempt
Passenger Cars and Mini-Vehicles	Compliant +25% compared to 2010 fuel efficiency standards	Emissions down by 75% from 2005 standards	50% reduction	75% reduction	75% reduction
	Compliant +15% compared to 2010 fuel efficiency standards		–	50% reduction	50% reduction
Trucks and Buses (2.5t<GVW≤3.5t)	Compliant with 2015 fuel efficiency standards	[Diesel vehicles:] Compliant with 2009 emission standards	–	75% reduction	75% reduction
		[Gasoline vehicles:] Emissions down by 50% from 2005 standards	–	50% reduction*	50% reduction
Heavy-DutyVehicles (GVW>3.5t)	Compliant with 2015 fuel efficiency standards	Compliant with 2009 emission standards	–	75% reduction	75% reduction
		Compliant with 2005 emission standards, with NOx and/or PM emissions down by 10% from those standards	–	50% reduction	50% reduction

Illustration 2.7: Tax incentives for fuel-efficient & low-emission vehicles (JAMA 2011, 10)

As previously mentioned (see chapters 1.1.1 and 2.2.1), the average 2010 target was already reached in 2005. This can largely be attributed to the policy design linking the Top Runner targets with tax reductions stimulating customers demand for fuel efficient vehicles (Onoda (OECD/IEA) 2008, 42; SEPA 2005, 55-57).

The tax reduction incentives for fuel efficient cars known as *green taxes* were introduced in 2001. Based on the *green taxes* scheme, the government offers tax relief for cars that exceed the Top Runner standards (Nordqvist 2006, 10). Currently, cars that over-comply with the Top Runner target by 15% or more, and that emit only a small amount of harmful substances (such as NOx) qualify for reduced acquisition and weight taxes (JAMA 2011, 10). Whether and by how much a car has exceeded the target (or not) is shown by the labels on the vehicles (see also chapter 2.2.2).

While providing financial advantages for efficient cars, conversely this tax scheme puts a high tax burden on owners of highly emitting cars, more than 11 years old (MLIT 2008, 1). The detailed requirements for tax reductions are illustrated with the examples of labels in illustration 2.7.

The two Japanese interviewees and other sources emphasised the importance of the tax incentives as a complement to the fuel efficiency standards due to their obvious contribution to improvement of fuel efficiency and CO_2 emissions reduction (int. Matsuo, MLIT; int. Muto, Uni. Yamanashi; Minato 2004, 108; Tokunaga et al. 2008, 59) through their stimulation of demand for fuel efficient cars (in combination with good labelling systems) (Onoda (OECD/IEA) 2008, 10, 11).

In particular, the Japanese tax incentive scheme is thought to promote the purchase of lighter vehicles with smaller engines (ICCT 2007, 11). JAMA estimates that as owner of a heavier (1,100 kg) passenger car must pay approximately 4,000 euros more in taxes over the vehicle's lifetime compared to an owner of a subcompact car (750 kg curb weight) (JAMA 2007, 1).

Subsidies

Introduced in 2009, the second element of the Japanese financial incentives are *eco-car subsidies* for fuel efficient vehicles. The subsidy consists of a 100,000 yen (around 800 euro) grant mainly for the purchase of new generation vehicles, such as hybrid and electric vehicles, increasing if a purchaser of an environmentally friendly car scraps his or her old car (NGVPC 2009, 53).

This measure has increased sales of hybrid cars such as the Toyota Prius and helped bolster the struggling Japanese automobile industry during the financial and economic crisis following the bankruptcy of the US investment bank Lehman Brothers in 2008 (MLIT 2012, 1).

However, as a consequence of the focus on new generation vehicles, such as hybrid and electric vehicles, the subsidies have little direct influence on non-hybrid fuel efficiency improvements. In addition, being a relatively new approach, it may be too early to evaluate their effectiveness compared to other policy instruments.

2.3. Chapter summary

To comply with Japan's Kyoto protocol goal, the Japanese Government formulated the *Kyoto Target Achievement Plan*, addressing several sectors such as buildings, households and transportation. Utilising the Top Runner approach, with its industry-driven target-setting process, Japan's total GHG emissions have been successfully reduced. Passenger cars retain a significant 9.5% contribution to the total, however.

Japan is the fourth biggest passenger car market in the world (behind the EU, the USA and China), dominated by a handful of local manufacturers, the market share being amongst a few big players such as Toyota, Honda and Nissan.

The weight-based Japanese fuel efficiency targets, set through the Top Runner process set every 5 years and announced 8 years before being enforced. Partly due to the limited stringency of the targets, only incremental changes rather than technological breakthroughs are encouraged.

To provide some flexibility, the targets address each manufacturer's average fuel efficiency across all weight categories, excluding manufacturers which producing fewer than 2000 vehicles per year. The fuel efficiency targets are complimented by closely subsidiary labelling and financial incentive schemes. Based on the labelling scheme, consumers may qualify for tax reductions on cars that exceed the fuel efficiency targets. These tax incentives are seen as a very supportive factor in Top Runner’s success.

The scheme's monitoring is completed by MLIT, who collect and publish the manufacturer's progress annually, however this data is collected only by the manufacturer themselves, and is therefore not independent. This information serves as a base for the four-phase sanctions process, of which the *name and shame* sanctions in the second phase are considered the most effective.

Socio-cultural factors such as *kaizen* and *keeping face* seem to also be key factors for the efficiency improvements achieved under and compliance with the Top Runner program respectively.

3. Evaluation of the EU policy against key factors from Japanese policy

In this chapter, the EU emissions reduction policy for the automotive sector is evaluated by using the criteria identified as key factors for the Japanese automotive policy (chapter 2). First of all, the framework conditions influencing the emissions reduction policy are examined by analysing the automobile sector (3.1.1), the climate policy (3.1.2) and the cultural factors in the EU (3.1.3). Next, the specific policy instruments for passenger cars are examined. In chapter 3.2.1, the main EU policy instrument in this field, Regulation (EC) 443/2009 is evaluated against the four aspects derived from the Top Runner program (chapter 2.2.1): stakeholder involvement, targets, promotion of innovation, and monitoring and sanctions. The last section is investigates the role additional instruments (labelling and financial instruments) play in this field (3.2.2 and 3.3.3). It should be remarked that, differently than in Japan, where the fuel efficiency standards and additional instruments link closely with each other, the main EU emissions reduction policy and additional instruments such as labelling and taxation exist independently.

3.1. Framework conditions

3.1.1. EU climate policy

Proposed by the European Commission in January 2008, voted into law by the Parliament in December of that year and formally adopted on the same date as Regulation (EC) 443/2009 (23/04/2009), the European *Climate and Energy Package* (the *20-20-20 goals*) set binding targets to achieve a 20% cut in greenhouse gas emissions, a 20% share for renewable energy and a 20% improvement in energy efficiency by the year 2020 (European Union 2008), through four climate change and energy related laws:

- a revision of the EU emissions trading scheme (ETS);
- two *effort sharing* decisions
  - setting binding national targets for non-ETS sector emissions (including road transport) and;
  - the share of renewable sources in the energy mix, and finally
- a directive setting the framework for the use of carbon capture and storage (CSS) technology (European Union 2009a).

The extension of these goals was reconfirmed by the European Council in 2011, setting the target of an 80-95% greenhouse gas emissions reduction by 2050 (EU Com 2011, 3).

Of particular interest in the Commission's proposal for the *Climate and Energy Package* from 2008 (EU Com 2008) is the linkage of climate change and non-climate change issues. Already on the third page of the document, non-climate issues are used to promote climate change policy, such as “prosperity”, “secure energy supplies”, “growth and jobs”, “using skills and technology to boost innovation and growth through exploiting first-mover advantage” and finally “... will make the EU much less dependent on imports of oil and gas ... reduces the exposure of the EU economy to rising and volatile energy prices, inflation, geopolitical risks and risks related to inadequate supply chains” (EU Com 2008, 3).

The particular opportunities offered by climate change policy are mentioned in the proposal (EU Com 2008, 4):

- Reduced oil and gas imports with attendant improvements in energy security and reduced costs
- Job creation from renewable energy and energy efficiency technologies
- First-mover advantage for europe in these technologies.

A similar trend is also noted, specifically for automotive industry regulation, by Whitmarsh and Köhler (Whitmarsh/Köhler 2010, 429). They remark that the regulation of the industry has shifted from “... concerns over local air quality, to concerns over GHG emissions, and now encompasses a broader sustainability agenda ...”. The rationale behind this regulation is not (only) environmental, however: “Often the objectives behind these policy interventions do not relate solely, or even principally, to environmental improvement, but include broader social and (particularly) economic aims.”. To illustrate their position, the authors draw upon the examples of recent attempts to establish a *hydrogen economy*, driven by energy security and economic rather than environmental concerns, biofuel promotion to support the agricultural industry, and the automobile *scrappage schemes*, which were known as *environmental* in both Germany and the UK, but which were, in reality, demand stimulating measures to assist the automobile industry struggling with a sales collapse stemming from the 2008/2009 financial/economic crisis.

The automobile industry is, however, dissatisfied with the overall climate and energy strategy, seeing itself as being out for attention to achieve the necessary improvements. They demanded a greater contribution to emissions reduction from other stakeholders, particularly to improve road infrastructure to reduce traffic congestion, and thus emissions per kilometre (int. Dolejsi, ACEA).

3.1.2. Characteristics of the EU automobile sector

European passenger car market

The European automobile market is one of the largest in the world, with 13.4 million newly registered vehicles in 2010 — almost one quarter of the world market dominated by local manufacturers, with imports constituting only 16.9% of new registrations (all figures from ACEA 2011, 27 & 70). The market is also characterised by a multitude of diverse manufacturers with a correspondingly diverse product range, leading to a more fragmented market than in Japan. This fragmentation is well illustrated by the market share of the Volkswagen Group, the dominant player by a significant margin. With its 7 brands (VW, Audi, SEAT, Skoda amongst others), the group

Group	Average weight (kg)	CO_2 emissions (g/km) 2010	2015 target	Distance to target	Market Share
Toyota (Toyota & Lexus)	1329	129.6	128.3	1.0%	4.4%
PSA (Citroen & Peugeot)	1318	131.2	127.8	3.0%	13.4%
Fiat (Alfa-Romeo, Fiat, Iveco & Lancia)	1140	125.9	119.7	5.0%	7.6%
BMW Group (BMW & Mini)	1548	147.5	138.3	6.0%	5.4%
Hyundai (Hyundai & Kia)	1344	138.2	129	7.0%	4.5%
Renault (Dacia & Renault)	1295	135.9	126.8	7.0%	10.2%
General Motors (Chevrolet & Opel)	1359	139.3	129.7	7.0%	8.6%
Ford	1293	136.6	126.7	7.0%	8.2%
Volkswagen (Audi, Seat, Skoda, Volkswagen)	1416	143	132.3	7.0%	21.3%
Volvo Cars	1663	156.8	143.6	8.0%	1.7%
Honda	1448	146.9	133.8	9.0%	1.4%
Suzuki	1153	136.7	120.3	12.0%	1.4%
Nissan	1348	147.2	129.2	12.0%	2.9%
Mazda	1319	149.5	127.9	14.0%	1.3%
Daimler (Mercedes-Benz & Smart)	1533	161.3	137.7	15.0%	4.9%
Average	1365	140.3	130	7.3%	
Total sales (2010)					13.8m

Table 3: 2010 European market information (Own reproduction of data from T&E 2011K, 21. "Market share" data added from ACEA 2010, tab "PC (2)")

Manufacturers with smaller than 1% market share omitted for clarity.

manages a market share of only 21.3% combined. Furthermore, only two other manufacturer groups manage a market share exceeding 10% (see table 3).

European passenger car CO_2 emissions

In line with the EU's Kyoto Protocol commitment to improve its greenhouse gas emission rate and energy efficiency, total CO_2 emissions diminished by 7% between 1990 and 2008 across the EU. Over the same time period, the road transport sector bucked this trend, increasing its CO_2 emissions by 26% (EU Com 2010a). Furthermore, this increase added to already high emissions, making road transport the second highest greenhouse gas emitting sector in the EU, with around 20% of the total (ibid.). Despite fuel efficiency improvements in the european passenger car fleet, these improvements have not been sufficient to counteract the effect of increased vehicle size, weight (see illustration 3.1) and increased traffic volume (EU Com 2007c, 2). These factors lead to passenger cars making up the majority of EU road transport emissions and contributing 12% of the EU total (EU Com 2010a), 14% according to the European Environment Agency (in Dings (T&E) 2011, 6).

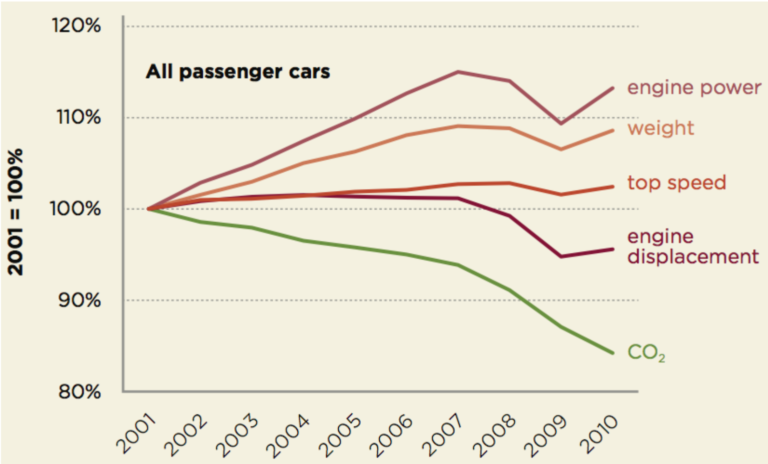

Illustration 3.1: European car performance development 2001-2010 (Campestrini/Mock 2011, 14)

European passenger car industry

The European automobile industry is one of the worlds largest, turning out 26% of the 15 million cars produced worldwide in 2010. In doing so, it provides 2.3 million jobs directly (7% of the EU-27 manufacturing workforce), and a total of 12.6 million jobs (6% of total EU25 employment) (ACEA 2011, 27).

Given the desirability of both market and industry diversity, along with the significant employment they both provide, the protection of both was taken into consideration for Regulation (EC) 443/2009: "... take account of the diversity of European automobile manufacturers and avoid any unjustified distortion of competition between them" (European Union 2009, 2), "the strategy will promote highly qualified jobs in Europe." (EU Com 2007c, 9)

Industry position

As a consequence of the manufacturer diversity, mentioned above, the industry lacks a unanimous position on emissions standards and their stringency, as the different manufacturers are effected differently, positively or negatively, depending on the emissions performance of their vehicles (see table 3). This internal dissonance, coupled with a desire not to be seen as *climate laggards*, seems to have forced the industry advocacy body, ACEA, to adopt a twin-tracked strategy. Firstly, they maintain opposition to the demands imposed by the regulation and thus demand financial assistance (ACEA 2012). Secondly, they promote peripheral issues such as road-infrastructure improvement and general industrial/trade policy (int. Dolejsi, ACEA) as key issues for improving passenger car emissions. The industry also complained of being over-burdened with environmental and safety regulations in Europe, to the point where the European market is no longer significantly profitable (int. Dolejsi, ACEA). It seems highly unlikely, however, that the manufacturers will wilfully give up on a quarter of the world passenger car market due to stringent emissions regulations, especially in light of similar regulations in several other major markets (Japan, the USA, South Korea).

In response to criticism that the industry has lagged behind in developing lower emissions vehicles, they have, to a large extent, deflected this criticism on to other parties. In the first instance, as noted by Wells et al. (Wells et al. 2010, 102), the industry shifts the blame onto its customers for demanding heavier, faster, more powerful and more comfortable vehicles. Wells et al. go on to repudiate this idea, however, based on discussions with vehicle designers. The designers made the point that customers have neither the time nor information required to make purchasing decisions based on the whole-lifetime costs (i.e. including fuel usage) of the products they purchase, thus calling into question the industry's elevation of its customers to the status of all-knowing *homo-economicuses* who consider fully their purchasing decisions. Customers cannot, however absolve themselves of all responsibility for current trend of “automotive excess that has led to many modern cars being more akin to mobile boudoirs or mobile offices than true driving machines or even basic means of ‘getting from A to B’.” (Wells et al. 2010, 102). Indeed, supply and demand are critical to R&D decision-making within the industry, and until recently the mainstream market has “... continued to demand more energy-intensive products (for example, sports utility vehicles), with increased functionality, comfort and safety as primary concerns above environmental performance.” (Adamson 2003, in Whitmarsh/Köhler 2010, 429), a trend which confirms, to some degree, the industry's assertion of its blamelessness in this matter.

The second deflective argument from the industry is that of safety. They argue that achieving the demanded enhanced safety necessitates the addition of — heavy — equipment such as (ever greater numbers of) airbags and ABS (anti-lock braking system), which worsen emissions performance (int. Dolejsi, ACEA). While this argument is pertinent according to Wells et al. (Wells et al. 2010, 22), they argue its importance is over-estimated by the industry. This is demonstrated in the example of a Bosch ABS (anti-lock braking) system, which, at its introduction in the 1980s weighed 5kg, but the weight of which has been pared down to 1.1kg in the smallest version of the latest generation (Wells et al. 2010, 102; Bosch 2010).

As previously mentioned, parallel to deflecting culpability for its poor environmental performance, the industry argues against (too) stringent emissions targets and their associated costs by highlighting social factors which these costs would bring about, such as the endangerment of production (employment) in Europe or lobbying for financial assistance complying with the regulation (ACEA 2012; int. Dolejsi, ACEA). This threat of a shift of production out of Europe should be regarded with caution, as the regulation applies to producers from all countries, and the majority of major car imports into the EU are from countries who themselves have stringent regulations (int. Rocholl, ECF). Additionally, moving production to countries outside of the EU may be accompanied by lower productivity and in most cases will less proximate to the market (EU Com 2007c, 35), thus giving rise to extra transport and logistical costs. This argumentation also ignores the effects of the extra R&D spending, which will drive the industry's innovation process, likely creating (better) jobs (EU Com 2007c, 9; European Union 2009, 2), and improving the environmental performance of European vehicles, and thus their competitiveness in the world market (Whitmarsh/Köhler 2010, 432; European Union 2009, 2).

Another aspect of the automotive industry relevant to the Regulation is its complexity and adaptability. It is feared that, the R&D investment required to meet the emissions targets, will be passed onto end customers. This leads on to the concern that the increased vehicle purchase price will disproportionately affect low-income earners, thus violating the Renewed Sustainable Development Strategy (RSDS) of the European Union "to ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment" (EU Com 2007c, 9). According to Wells et al. (Wells et al. 2010, 101), these concerns are unfounded, as the complex cost structure of the car industry suggests that the costs are likely not to be passed onto the customer in their entirety. The costs of regulation compliance are also "systematically overestimated" (Dings (T&E) 2011, 16), which suggests that the costs may be lower than suggested by studies.

3.1.3. Socio-cultural factors

In contrast to the situation in Japan, socio-cultural factors play a less significant role in the emissions reduction policies in the EU. One exception is presented by the *name and shame* provisions, which are effective in the EU for slightly different reasons. In the EU manufacturers are more concerned with maintaining a *green* image for marketing reasons, rather than the Japanese honour or face-saving aspects (see chapter 1.2.1). In general, however, climate change is considered to be a serious problem by the European public: the *Special Eurobarometer 372* (EU Com 2011a, 14) quoted 89% of participants as considering climate change to be a *very serious problem* (68%) or a *fairly serious problem* (21%). In light of this, CO_2 reductions policy enjoys something of a tail-wind within the EU.

3.2. Specific EU fuel efficiency policies

3.2.1. Regulation (EC) 443/2009

Regulation (EC) 443/2009 is the main EU policy instrument to reduce CO_2 emissions in the automotive sector (see brief description chapter 1.1.2). It will be assessed in this chapter by using the four key factors identified for the fuel efficiency measures included in the Japanese Top Runner program (stakeholder involvement, ambition of targets, promotion of innovation, and monitoring and sanctions).

Stakeholder involvement

The way different actors are involved in the European policy-making process is different than the approach used for the Top Runner standards in Japan, where a strong cooperation between the government and the carmakers limits the influence of public opinion, coupled with a paucity of environmental NGOs active in the transport sector (see chapter 2). In the EU policy-making and review processes, a wide range of stakeholders is involved in different steps along the way. In the case of Regulation (EC) 443/2009, the first step took place in 2006 and consisted in a questionnaire submitted to 1215 citizens on a voluntary basis, whose results are summarised in the *Report on the Public Consultation June-August 2006* (EU Com 2006). This initiative permitted exploring citizens' awareness about fuel consumption, their purchase criteria for cars, possible approaches to reduce CO_2 emissions from road passenger transport and the willingness to pay more for more efficient vehicles. The great majority of participants agreed that more efforts for climate protection in the transport sector are needed and that private and public actors should do their part. Among the preferred approaches to improve fuel efficiency, technology improvement, tax differentiation, consumer information and the promotion of alternative fuels were favoured by the majority of respondents and 70% declared their willingness to pay (in most cases up to 1000 €) more for a vehicle for an annual fuel cost reduction of 150 €. Participants' open comments emphasised the necessity of binding regulatory measures and fiscal instruments to reduce CO_2 emissions from passenger cars. However, as remarked in the above-mentioned report, the positions emerging cannot be considered representative for the whole EU population, given the participants' heterogeneous geographical distribution and above-average environmentally friendly attitude (EU Com 2006, 3).

In 2007, *DG Climate Action* held a public hearing with the aim of gathering the views of major stakeholders on different policy options to lower CO_2 emissions in the transport sector (EU Com 2007d). The public hearing was structured in two parts. During the first part, the actors involved were those directly affected by the regulation: automotive industry associations from the EU (ACEA) and Japan (JAMA), supplier organisations (CLEPA and ETRMA), the NGO Transport and Environment and consumer's associations (BEUC) and (FIA), with the ICCT providing an international perspective. In the second part of the consultation process, further stakeholders linked to the automotive industry (the carmaker Volkswagen, trade union federations, consumers' groups and representatives from the oil, international automotive and LPG industries) or those engaged in climate change issues (WWF, Greenpeace, Friends of the Earth) were given the opportunity to make their positions public. On this occasion, the automotive industry remarked upon the necessity to share responsibilities and compliance costs and suggested an integrated approach including fiscal measures and eco-driving, while trade union federations expressed concerns about possible impacts on employment resulting from emissions reduction measures. Environmental organisations supported the Commission's initiative to force an emissions decrease through binding legislation and demanded more stringent targets. Various stakeholders agreed on the necessity of longer lead times (time from target publication to when it must be achieved) to guarantee investment security and allow the industry to better distribute investment costs.

The third initiative for stakeholder involvement was undertaken in 2011 as part of the revision of Regulation (EC) 443/2009, due in 2013. At this stakeholder meeting the report on the Regulation commissioned by DG Climate Action was presented (EU Com 2011b).

In summary, the Commission allows stakeholders to take part in the legislative process in a transparent way (int. Lindvall, EU Com; int. Mock, ICCT) by submitting questionnaires and organising meetings with concerned groups. Moreover, before the revision process was undertaken, different actors were given the opportunity to make their opinions public.

Targets

The following paragraphs are concerned with the most relevant content of Regulation 443/2009: emissions reduction targets. Given the disharmony between experts' opinions, an in-depth analysis of this aspect is warranted. For this purpose, the three aspects already identified for the Japanese case, target-object, target stringency and target flexibility are examined in the EU Regulation by considering the supporting and hindering factors identified for the Japanese standards (chapter 2.2.1).

Target-object

Regulation (EC) 443/2009 sets a limit for the average emissions of the cars sold by each car manufacturer. To avoid unduly penalising vehicles with higher *utility* (≈ usefulness), the Regulation allows for higher emissions from vehicles with higher *utility*. At this stage, vehicle utility is measured, as well as in Japan, via its weight. Thus each manufacturer's limit depends on the average weight of its vehicles. The specific emissions target T_s for a manufacturer is calculated with the following formula:

$T_s = 130 + a \times (M - M_0)$

where M is the average utility (mass) of all vehicles sold by the manufacturer, a is the gradient parameter, denoted by $a = 0.0457$, and M_0 the assumed future average new car mass ($M_0 = 1372$).

Average vehicle mass (kg)	Emissions limit (gCO_2/km)
1000	113
1500	136
2000	159
2500	182
3000	204

Table 4: Example EU emissions limits (own calculation)

This results in a target curve/line which allows higher emissions for heavier cars.

For this reason the gradient parameter, *a,* of the target line is of utmost importance. If it is set too high, e.g. the slope is too steep, manufacturers may have the perverse incentive to increase their cars average mass to take advantage of the attendant emissions target increase (EU Com 2007c, 75). If it is set too low (slope too flat), vehicles with higher utility are penalised, potentially diminishing market-diversity.

In either case, the choice of the line's slope can be an advantage for some manufacturers or a disadvantage for others, depending on the average weight of their vehicles. This fact became evident during the Regulation's target negotiation process, as some national governments supported the slope curve expected to be the most favourable for their own automotive industry (Deters 2010, 18).

The choice of weight as the (only) parameter to define vehicle *utility* does not find broad consent among experts. Given that reducing vehicle mass is one of the most effective ways to reduce emissions, the Regulation's more demanding standards for lighter cars are seen as an obstacle to a shift to lower weight vehicles (int. Rocholl, ECF; int. Mock, ICCT). Moreover, as underlined in a position paper from the *European Federation for Transport and Environment* (T&E), weight-based standards favour diesel engines, which weigh 50-80 kg more than petrol engines, and are therefore subject to less stringent limit values, with attendant negative impacts on local air quality (T&E 2008, 8).

In addition, the Regulation does not take into account two significant factors, or does so insufficiently. Firstly, it does not consider that heavier cars are, on average, driven further over a given period (e.g. a year), and therefore emit a higher total amount of CO_2 (Bampatsou/Zervas 2011, 7796). Secondly, a mass-based approach could influence the distribution of emissions among the population, as this allows those people who can afford heavy cars to pollute more than the typically less affluent drivers of light vehicles. Not only the social, but also the geographical, CO_2 emissions distribution is expected to be far from homogeneous, generating inequity among Member States, whereby countries producing (and whose inhabitants typically drive) heavier cars, such as Germany and Sweden, are allowed to pollute more than others (Bampatsou/Zervas 2011, 7800).

To prevent these consequences, some experts suggest setting the same upper limit for each vehicle (Bampatsou/Zervas 2011, 7795) or for each manufacturer (T&E 2011, 9). Contrary to this view, the desire to preserve market differentiation to meet the needs of costumers (a large family may want a larger – and heavier – car) and considering manufacturers specialisation in different market segments, these solutions would disadvantage both buyers and producers (Mock (ICCT) 2011, 10) and are therefore unlikely to be taken into account for a future policy formulation (int. Mock, ICCT).

To overcome the problems of a weight-based approach, different indexes are under discussion, from footprint (track width multiplied by wheel-base) or pan area, volume, performance based approaches or combined-characteristic utility assessment (Mock (ICCT) 2011).

Considerations of the Regulation's target-object should be concluded with the observation that a drastic revision will be necessary in the medium term. If the possible future development of the automotive sector will include, as expected, the proliferation of electric and hybrid cars, CO_2 cannot remain the (only) way to measure car engine efficiency and technologically neutral (including upstream emissions) legislation will be necessary (int. Rocholl, ECF).

Despite this necessity, no radical change in the fundamental approach – measuring CO_2 *exhaust* emissions – is expected in the next revision of Regulation (EC) 443/2009. Nonetheless, modifications to the utility parameter are under discussion, although changes to this could have a negative impact on the planning security needed by the automotive industry (int. Dolejsi, ACEA). In a recent report prepared for the Commission (TNO 2011), the mass and footprint approaches are compared and two main advantages of the latter are underlined. First, the footprint-approach does not constitute an obstacle for mass reduction (fundamental step towards overall emission reductions), which is currently "punished" with lower emission targets. Second, footprint is a good proxy for vehicle size, a visible characteristic and purchase criterion. For this reason a footprint-based approach could increase the purchasers' acceptance for utility-based targets (TNO 2011, 15). A third, related, advantage was mentioned by Dr. Mock, who said footprint based targets would likely reduce compliance costs by allowing more flexibility in the emissions reduction technologies (int. Mock, ICCT).

Target stringency

The average emissions limit for new passenger cars set by Regulation (EC) 443/2009 is 120 gCO_2/km, to be reached by 2015. 10 gCO_2/km should be saved through additional (extra-test cycle) measures and 130 gCO_2/km must be reached by means of improvement in vehicle motor technology (intra-test cycle). A 95 gCO_2/km target was suggested for 2020, which is to be confirmed during the policy revision in 2013.

The limit value for 2015 is considered as likely to be reached by each of the experts that were interviewed for this research project. As shown in table 3, many manufacturers were already close to reaching their target, in 2010. For this reason, some researchers and organizations consider the 2015 target to be too generous and would have preferred a target of 120 gCO_2/km, to be reached only by means of improvements in vehicle motor technology (T&E 2008, 6; int. Rocholl, ECF). Although this option was taken into account during the policy-making process, the 130g value had to be accepted as a compromise in order to ensure the inclusion of binding, rather than indicatory targets (Deters 2010, 16).

Experts' opinions on the stringency of the 2020 target (95 gCO_2/km) diverge. Three interviewees defined it unanimously as more stringent than that for 2015 but still achievable (int. Lindvall, EU Com; int. Mock, ICCT; int. Rocholl, ECF), even with already developed technologies (int. Mock, ICCT). The economic feasibility of the 95g target was also stressed (int. Mock, ICCT), supported by the argument that cost increases for producers, even if wholly passed onto consumers, can be amortized in two to four years through fuel savings. This would satisfy the criterion that a standard should ideally “be set at a level that maximizes social benefit” (Onoda (OECD/IEA) 2008, 11). In the following section, two studies leading to different conclusions on the Regulation’s target stringency are examined.

By projecting the average CO_2 emissions from the last three years into the future, Bampatsou and Zervas (2011, 7799) obtained an emissions value of 109.9 gCO_2/km for 2020. Accordingly, if the present emissions improvement rate is continued until 2020, the automotive industry will reach a value that is almost 20 gCO_2/km above the EU target. This fact reduces the acceptance for the 2020 target among representatives of the European automotive industry, which defines targets as “tough” and “very ambitious” (ACEA 2012) and feels left alone to cope with the ambitious targets set by the EU (int. Dolejsi, ACEA).

An opposite result emerges from an assessment of different scenarios that could allow lowering the 2020 target, as the title of the report in question, *Lowering the bar*, suggests (Wells et al. 2010). If improvements in conventional technologies, the proliferation of electric and hybrid vehicles, vehicle performance reduction and segment-shifts are combined properly, 80 gCO_2/km can be reached by 2020. Such incongruences in studies that, at first view, aim to assess the same development, can be accounted for by different methodologies and, above all, to contrasting approaches used. The fundamental difference can be expressed as follows: should the present trend determine the target or should the target determine the trend and introduction of innovations necessary to achieve it? These two different views will probably play an important role for the revision of the 2020 target in 2013, in which forcing technological development on the one side and avoiding too high compliance costs on the other could be used as arguments for lowering or raising the bar.

As mentioned above, a fundamental factor influencing target stringency are the compliance costs, which can be lowered by allowing longer lead times (Onoda (OECD/IEA) 2008, 9). Since model development cycles can take up to five years (TNO 2011, 10), the TNO report concludes that legislation on this sector should be finalised at least five years in advance, giving manufacturers the opportunity to distribute emissions reduction costs over time. Interviewees and reports agreed on the importance of lead time for planning security: the next target for 2025 or 2030 should be set as soon as possible (T&E 2008, 6; int. Mock, ICCT; int. Rocholl, ECF). Medium-term targets were also proposed by the European Parliament, which proposed a 70 gCO_2/km limit for 2025 (EU Com 2010, 13).

Target flexibility

Two main flexibility measures regarding the target-scope are included in Regulation (EC) 443/2009: pooling and derogations.

Manufacturers can decide whether to comply with the target individually or to form a pool with other manufacturers. Their emissions target will be calculated from the average mass of their combined fleets. This measure drew criticism from some experts. Wells et al. (2010, 18) defined it as a way to delay technological innovation and spread the burden: if a "virtuous" manufacturer pools with a "polluter", the latter will not be forced to undertake significant efforts to reduce emissions.

Moreover, low-volume manufacturers (those producing less than 10,000 vehicles per year) may apply to the Commission for derogations, under which they must negotiate an individual target given their market and organisational limitations. Carmakers producing between 10,000 and 300,000 newly registered cars per calendar year may apply for a target 25% lower than the average specific emissions in 2007. Some experts consider this measure as a threat to fair competition, since flexibility is already provided by fleet-average and utility-based limits as well as by the pooling option (T&E 2008, 10; Bampatsou/Zervas 2011, 7801). Also a comparison with the Japanese legislation, which includes a different treatment only for manufacturers producing less than 2000 vehicles per year, confirms the lenience of the EU approach regarding special rules for "small" manufacturers.

Further flexibility is provided by *super credits*. In calculating the average specific emissions of a manufacturer or pool, each new passenger car whose emissions are lower than 50 gCO_2/km will be counted multiple times (as 3.5 cars in 2012 and 2013, as 2.5 in 2014 and as 1.5 in 2015). This measure is expected to increase the production of low-emitting cars and accelerate their proliferation. A further exception is made for E85-compatible vehicles, whose specific emissions will be subjected to a 5 % credit (contingent on the availability and sustainability of appropriate fuel). Regulation (EC) 443/2009 stresses the necessity of incentives for technological innovation and contains many such incentives, however, these also can be seen as problematic, as objections to target-scope flexibility measures on the grounds of their compromising the achievement of the targets apply to all such flexibility measures, including those directly promoting innovation, e.g. *super-credits*.

In summary, the Regulation contains various measures allowing for flexibility regarding its scope (pooling and derogation), a well as technology-based relief mechanisms. Although the stronger derogations apply only to a (relatively) small number of manufacturers (and therefore vehicles), allowing the weaker derogation for manufacturers producing up to 300,000 registered new vehicles per year potentially includes significant producers such as Volvo, Honda, Mazda and Porsche, thus reducing the actual policy-scope significantly (to ten manufacturers). For this reason, policy-makers should recognise that such measures can be an obstacle to real emissions reduction.

Promotion of innovation

To set incentives for innovation and technological development, fuel efficiency measures should be technology neutral (Onoda (OECD/IEA) 2008, 45). Especially in light of the swift development and anticipated market penetration of electric vehicles, technological neutrality of environmental measures in the automotive sector is becoming a highly topical subject among experts (int. Rocholl, ECF).

Against Onoda's recommendation, both the targets set by Regulation (EC) 443/2009 and the test cycles used to assess emissions performance take into account only the emissions and characteristics of vehicles powered by traditional fuels. However, specific measures to promote innovation are included in Regulation (EC) 443/2009, such as the aforementioned super credits and eco-innovations, which allow for manufacturers to apply for a further credit of up to 7 gCO_2/km for non-mandatory technological developments which save CO_2 but are not included in the test cycle or the "additional measures". In this way innovative technologies are treated by the EU emissions reduction policy as a "plus" allowing carmakers to reach their specific target more easily and thus to reduce their efforts for incremental improvement of existing technologies in exchange for a limited application of certain innovations. To overcome the contradiction between incentives for eco-innovations and the risk of slower technology development, Mr. Rocholl suggested avoiding special incentives for new technologies and increase standard-stringency, for example setting targets below 70 gCO_2/km. In order to reach such a level, manufactures would be forced to further develop low-emissions technologies, making specific provisions (e.g. *eco-innovations)*, as well as the connected monitoring efforts unnecessary (int. Rocholl, ECF).

Monitoring and sanctions

Monitoring and sanctions play a key role in ensuring policy compliance, and are thus fundamental to successfully reach the targets.

With *DECISION No 1753/2000/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 June 2000*, the EU established a *monitoring scheme for the average specific emissions of new passengers cars*.

According to this, Member States are to collect information on each new car sold in their territory in a transparent manner from 2010 on and make this information available to vehicle manufacturers and their importers or representatives. Information to be collected includes the manufacturer, type and variant, specific emissions and physical dimensions (mass, wheelbase length & track width), along with aggregated information for each manufacturer including total number of new registered cars, their average specific emissions and average mass. A subset of this information is also to be submitted to the Commission each year, who shall administer a central, publicly available register of relevant information. With this information, target compliance can be verified and the overall emissions trend in the European Union can be seen. However the whole process requires such a high degree of coordination among different stakeholders that it was defined in an interview as a “huge paper collection exercise” (int. Lindvall, EU Com). Initially, some problems were reported with the monitoring scheme, however many of these have since been solved (e.g. inconsistent reporting of vehicle mass across Member States), resulting in the expectation of a smoother running process and better quality information from this year on (int. Mock, ICCT).

Apart from the bureaucratic burdens, data reliability as well as the choice of the parameters measured has been criticised by some. Representatives of the automotive industry complained of the information provided to them by Member States often being incorrect (int. Dolejsi, ACEA). This is a weakness in the Regulation (EC) 443/2009 which could threaten the achievement of its targets and consequently the EU's transport sector climate goals. A possible solution was suggested by Dr. Mock of the ICCT, in which the EU would be empowered to test the CO_2 emissions of a random sample of cars and have them recalled if the test values were divergent, similar to the situation in the USA (int. Mock, ICCT). Further data disparities can also arise from different methods to measure vehicle mass across manufacturers and Member States. In some cases the mass of driver, fuel and wheel/tools (≈ 75kg) is included, sometimes not (Mock (ICCT) 2011, 8).

The driving cycles used for test measurements of CO_2 emissions are also criticised, as delivering lower results than real on road driving (int. Mock, ICCT). An interesting development in this sense is represented by an on going work of the UN-ECE (United Nations Economic Commission for Europe), currently defining a new light-duty vehicles test procedure (TNO 2011, 27). The results of this work are expected to be promising for two reasons. Firstly, depending on the factors included in the calculations, the gap between test values and on road fuel consumption could be closed (int. Mock, ICCT). Secondly, a worldwide harmonisation of test cycles would facilitate the comparison of improvements in fuel consumption and of emissions reduction targets, thus stimulating countries in a race-to-the-top.

The monitoring system described above allows collecting data on manufacturers' emissions values, which are made public by the Commission. Such a *name and shame* method, which represents the primary sanction instrument in Japan, informs consumers and the general public on manufacturers' emissions reductions efforts and probably motivates carmakers to achieve their targets, primarily to avoid being stigmatised as polluters which would damage their image (int. Mock, ICCT). Regulation (EC) 443/2009 also imposes monetary sanctions (excess emissions premiums) for manufacturer or pool non-compliance with their respective targets. Beyond 2019 these amount to 95 €/g CO_2. Until then the first three grams are subjected to lower fine (5 €, 15 € and 25 € for the first, second and third gram respectively).

In general, the purpose of sanctions is to motivate the addressee of a measure to comply with it. To be effective, it should be significantly higher than the compliance costs. From this point of view, experts' opinions on the adequacy of the current excess emissions premiums are disparate. Three interviewees see them as adequate (int. Lindvall, EU Com; int. Mock, ICCT; int. Rocholl, ECF), while other organisations criticised them, such as the Dutch research institute TNO (2011, 13), who calculated average marginal costs to meet the target of 91 €/gCO_2. Thus, paying sanctions for the first three excess grams would be "cheaper" than emissions reduction efforts (until 2019), thus threatening target-achievement. By extension, the same argument applies to further emissions reductions beyond the last 3g. For this reason, TNO suggests imposing sanctions of 200 €/gCO_2. T&E also proposes increasing the sanctions, suggesting 150 € per gCO_2 exceeded as a desirable level (T&E 2008, 10).

The opposite point of view is held by the automotive industry, which complains of the high costs the transport sector is supposed to pay for CO_2 emissions compared to the current CO_2 certificate price in the European Emissions Trading Scheme (EU ETS) (ACEA 2012).

Another aspect to be taken into account while considering sanctions is the distribution of compliance costs, as Bampatsou and Zervas (2011, 7797-8) remarked. Assuming sanctions will be included in the final car price, they will have a stronger impact on buyers of small cars, for whom lower prices could be a reason to buy less polluting vehicles, while buyers of heavy (and generally more expensive) vehicles will be affected much less by such a price increase, thus once more having the possibility to pollute more.

In summary, both the monitoring process and the level at which sanctions are set should be discussed during the policy revision in 2013. Both the measurement reliability and uniformity of the monitoring scheme need to be improved. Sanctions should be adapted to real compliance costs to represent an incentive for compliance.

3.2.2. Labelling

According various sources, the provision of emissions information to consumers is a further important instrument in support of emissions regulation (int. Mock, ICCT; int. Lindvall, EU Com; Gärtner (ADAC) 2005, 99; AEA Technology plc. 2011), though as third most important behind emissions limits and taxes according to Mock (ibid.).

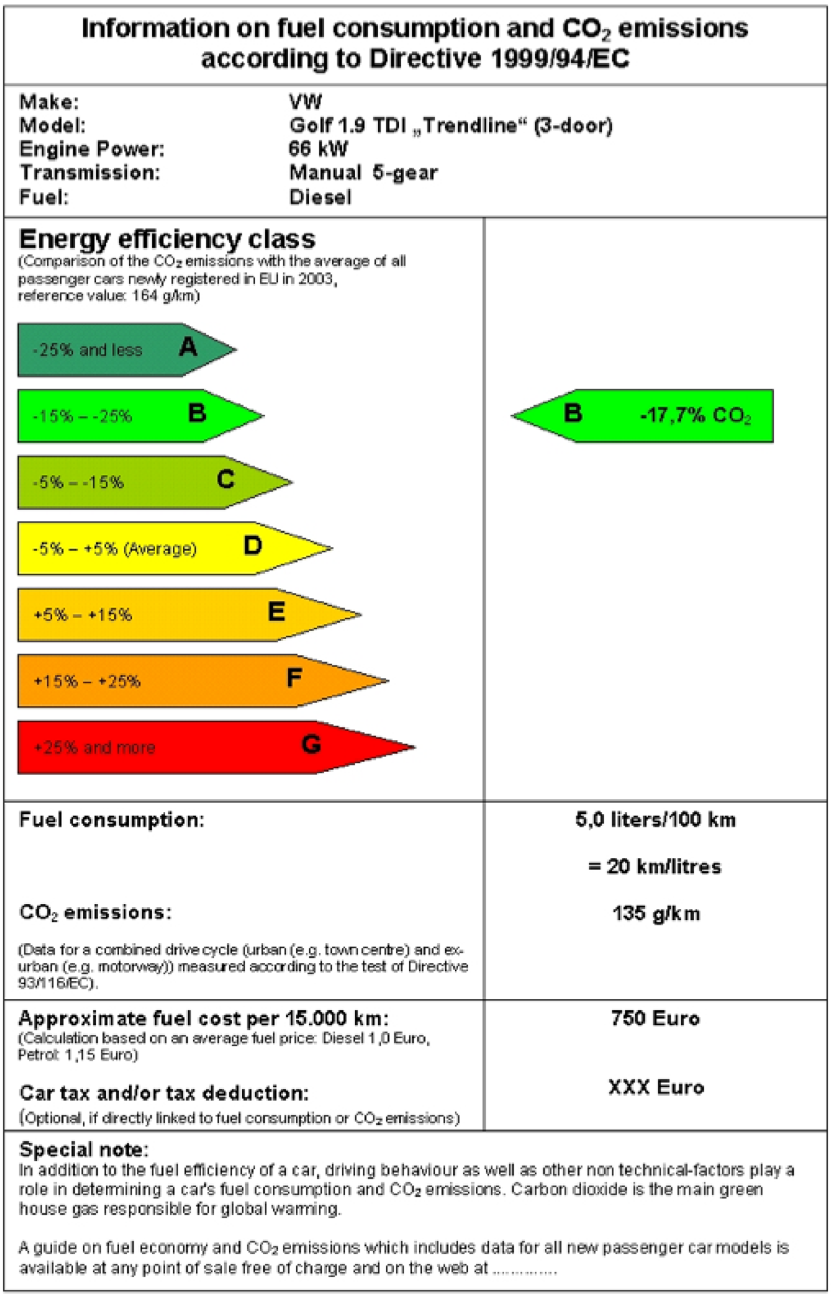

Illustration 3.2: Example EU car label (Gärtner (ADAC) 2005, 91)

The legal basis for the provision of CO_2 emissions and fuel economy information is provided for in the EU by Directive 1999/94/EC, which requires the provision of this information by the following means: “attaching a fuel consumption and CO_2 emissions label (see illustration 3.2) to the vehicle[s' windscreens], producing a fuel consumption and CO_2 emissions guide, displaying posters in car showrooms, and including fuel consumption and CO_2 emissions data in promotional material.” (European Union 2010).

The principle of information provision for customers is well supported, even if its effectiveness is difficult to measure, and the European scheme under Directive 1999/94/EC is too infrequently studied (int. Mock, ICCT). One of the available studies of the Directive's effectiveness is uncomplimentary, concluding it to be ineffective in informing and influencing consumers and criticising its contribution to the reduction of passenger car CO_2 emissions (Gärtner (ADAC) 2005, 99). One possible reason for this failure is the presence of behavioural *lock-in effects*, whereby “Information will be ignored in the presence of strong habits ...” (Whitmarsh/Köhler 2010, 436), another is the deficient awareness of fuel economy and its environmental issues, along with deficiencies in the informational tools themselves, such as the different labels in each country (Gärtner (ADAC) 2005, 100-101), a criticism also levelled by Mock (ibid). One particular difference in the Member State's labelling schemes is their usage of *absolute* or *relative* vehicle classification (into the A-G classes). In relative schemes, not only the vehicle's emissions contribute to its classification, but other factors, such as the vehicle's utility (weight, see chapter 3.2.1 Target-object) or floor area are also considered (Gärtner (ADAC) 2005, 71). Thus, in effect the vehicle is put into a class related to comparable vehicles. In absolute classification, the classification is carried out based only upon the vehicle's emissions. As such, each vehicle is put into a class compared to *all* vehicles, not only those similar to it (ibid., 63).

Both systems have advantages and disadvantages. Absolute classification is simpler to define and understand, and encourages overall emissions reductions, but tends to lump similar sized vehicles together, making comparison of similar vehicles difficult or impossible and furthermore can be seen as unfairly favouring small cars, which by their nature accumulate at the low-emissions end of the classification (Gärtner (ADAC) 2005, 82; Grünig et. Al 2010, 44). In comparison, relative classification enables finer comparison of the vehicles of comparable size (consumers normally first choose a vehicle size then model), but is more difficult to implement and, critically, for consumers to understand, especially as the message send by such classification may contradict that of fiscal measures based on absolute emissions (Gärtner (ADAC) 2005, 83; Grünig et. al 2010, 45). A further consideration in favour of relative classification is the usage of relative limits (based on utility, weight) in the main legislation in this area, Regulation (EC) 443/2009. Thus to be consistent with Regulation (EC) 443/2009, labels would have to display a relative classification.

A further problem is posed by the CO_2 emissions values themselves. According to some sources, the displayed values are currently 21% lower than achieved in real-world driving conditions, an increase from around 8% in 2001. This test-cycle vs. real-world gap has a negative influence on the credibility of the labels and other information (Mock et al. 2012, 10; int. Lindvall, EU Com).

An interesting effect of the labelling system is its effect on manufacturers rather than consumers. The information in promotional material and elsewhere fuelled the competition between manufacturers for a *green* image, whereas the information is one of the many influential factors in consumer's decision on which car to buy (Whitmarsh/Köhler 2010, 12).

As an accompaniment to the labelling scheme for complete vehicles, Regulation (EC) 1222/2009, introduced in November 2009, stipulates a similar labelling regime for passenger car (and other) tyres commencing November 2012. The labels will display the rolling resistance and wet grip class (from A -G) of the tyre along with its measured external noise level (European Union 2009b, 49). These labels should assist consumers in purchasing more fuel efficient (and safe) replacement tyres for their vehicles. The importance of this measure is underlined by the significant (20-30%) role played by tyres in the total fuel consumption (and thus CO_2 emissions) of vehicles (European Union 2009b, 46). The potential of the tyre labelling scheme was also confirmed by Mock (int. Mock, ICCT), who also noted the EU-wide nature of the labelling scheme for tyres, which offers it advantages over that for passenger cars. The industry representative, however, was dismissive of the likely effectiveness of the scheme as he asserted consumers are more interested in the performance of the whole vehicle, which, if relevant at the time of vehicle purchase, disregards tyre replacement later in the vehicles life.

3.2.3. Financial instruments

Several financial instruments may be effective in reducing passenger car emissions: taxes, subventions, research & development grants and tax reductions, amongst many others. This section deals with taxes, the main instruments applied within the EU. There are two main forms which environmental taxation of passenger cars may take on: those based on the vehicle's characteristics, levied the time of purchase and periodically thereafter (*registration*), alongside those levied on fuel consumption per unit volume (e.g. €/L). An important aspect of the European automobile taxation regime is its being under the Member States' control. Therefore, for EU-wide harmonisation of automobile and/or fuel taxes to be achieved, consensus with all 27 (28 with Croatia) Member States must be obtained; likely to be a herculean task. For this reason, three of the four experts interviewed (int. Mock, ICCT; int. Rocholl, ECF; int. Dolejsi, ACEA) considered such harmonisation, whilst sensible (Mock), unrealistic within the coming years, if ever.

Purchase and yearly taxes

Taxation, as argued by two of the interviewees, represents an important supporting measure to the targets introduced in the Regulation (int. Mock, ICCT; int. Rocholl, ECF), although Dr. Rocholl argued that while introducing such taxes is an important first step, their magnitude of such taxation measures exerts significant influence over their effectiveness.

Emissions (gCO_2/km)	Yearly tax (first registration 2012)		
	France	UK	Germany
50	0	0	0
100	0	0	0
200	0	245	180
300	300	460	380

Table 5: Yearly tax levied in France, the UK and Germany (Own calculation from ADEME 2012, Directgov 2012 and BMF 2011)

In 1995, the European Commission introduced a proposal, COM(2005) 261, for the inclusion of an EU-wide CO_2 element to car taxes, which, for the aforementioned reason, has not yet been passed. Nevertheless, several countries have introduced such taxes by 2011: Austria, Belgium, Cyprus, Spain, Finland, France, (Greece), (Hungary), Ireland, Latvia, Malta, the Netherlands, Portugal, Romania, Slovenia. Registration: Cyprus, Germany, Denmark, Finland, Greece, Ireland, (Italy), Luxembourg, Portugal, Sweden, United Kingdom (Greven (ACEA) 2011, 2-3)[1].

Fuel taxes

Taxing fuel has the advantage of taxing the consumption of resources directly, thus addressing a weakness in the regulation of CO_2 emitted per kilometre, which ignores the number of kilometres driven, and therefore the total CO_2 emitted (e.g. per year). Taxes of this sort reduce the likelihood of the Regulation causing rebound effects, whereby better fuel efficiency encourages increased and/or more frequent driving.

In contrast to ownership and purchase taxes, the EU has semi-harmonised taxation for motor and heating fuels for non-commercial uses, i.e. including private passenger car use. Directive 2003/96 EC (*the Energy Taxation Directive, ETD*) sets <u>minimum</u> rates of excise duties to be progressively introduced by the Member States (European Council 2004, 5, 6, 15-18). Illustration 3.3 shows the excise rates for the various countries as applied in 2011. As the minimum rates set by the ETD are based on the volume of products consumed, rather than their energy content or the CO_2 emissions

1. Country names in brackets indicate indirect inclusion of CO_2/fuel efficiency via engine size or power, whose diminishment tends to be attended by lower CO_2 emissions.

they produce, the Directive “lead[s] to inefficient energy use and distortions in the internal market” (EU Com 2011c, 2). Furthermore, the ETD and EU ETS lack coordination, lowering the efficiency of the system as a whole (EU Com 2011c, 2). To address these issues and in order to (further) encourage environmentally friendly consumption patterns, the European Commission proposed changes to the ETD in 2011, to come into effect in 2013, which would tax energy products based on their energy content and CO_2 emissions (20 €/t) (EU Com 2011d, 34), at a higher rate than emissions within the ETS, which traded at between 6.50€ and 16.84€ /t in 2011 (EEX 2012).

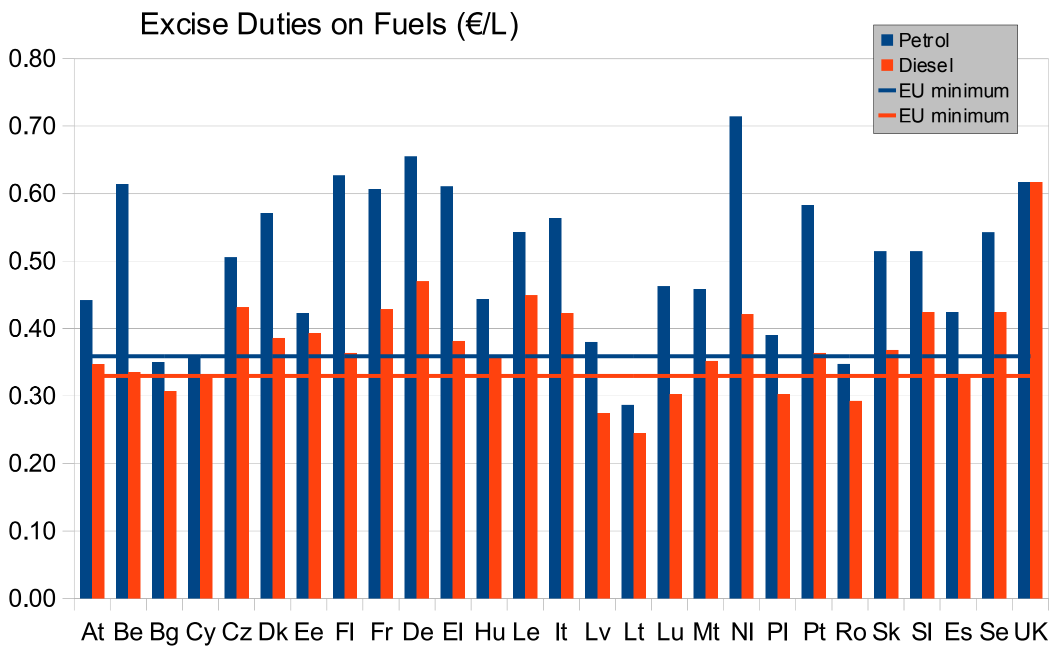

Illustration 3.3: Excise duty levied on fuels in EU countries (own reproduction of data from ACEA 2011, 81)

3.3. Chapter summary

The EU has several climate policy initiatives with the *Climate and Energy Package* (the *20-20-20 goals*) being the most relevant, also affecting the passenger car sector which contributes 12% of the EU total CO_2 emissions. The European automobile market and industry belong to the largest in the world. The market is dominated by a multitude of local manufactures with a correspondingly diverse product range, leading to a more fragmented market than the Japanese. This manufacturer diversity is the main reason why the industry lacks a unanimous position on emissions standards and their stringency. The lowest common denominator promoted by the industry advocacy body, ACEA, is opposition to strict environmental regulation and passing on of responsibility to consumer demand and industrial/trade policy, including road-infrastructure. Socio-cultural factors play a less significant role than in Japan.

Regulation (EC) 443/2009 “setting emission performance standards for new passenger cars” is the main EU policy instrument to reduce CO_2 emissions in the automotive sector, the creation of which was subject to a broad stakeholder participation and input process.

The Commission decided to allow for higher emissions from vehicles with higher utility. At this stage, vehicle utility is measured via its weight; a contentious topic amongst experts, some of them promoting a footprint rather than mass based approach.

In addition to the just referred to target-object, the target-stringency is another decisive key factor. The average emissions limit for new passenger cars set by Regulation (EC) 443/2009 is 130 gCO_2/km, to be reached by 2015. A 95 gCO_2/km target was suggested for 2020, which is to be confirmed during the policy revision in 2013. While the 2015 target is relatively easy to reach the provisional/envisaged 2020 target is more ambitious. Pooling and derogations are measures allowed which increase the target flexibility but which both are disputed by experts due to their weakening of target-ambition.

As incentives for innovation, super credits allow for innovative technologies to be treated as a “plus” allowing carmakers to reach their specific target more easily. However, similar to the Top Runner fuel efficiency standard so far, the Regulation's relatively easy initial target may only foster incremental innovation rather than breakthroughs, although he 95g target for 2020, if retained, is likely to require more innovative solutions. Regardless, there is a risk, that the Regulation's targets may simply encourage shifting emissions to other phases (production and/or electricity production).

The monitoring scheme to collect data on manufacturers’ emissions values has major weaknesses, in particular low data reliability and inconsistency among Member States. High quality data collection is a prerequisite for sanctions and is thus decisive for enforcing target compliance. Regulation (EC) 443/2009 imposes both so-called *name and shame* sanctions as well as monetary sanctions (excess emissions premiums) for non-compliance. Since these sanctions are too low and based on weak monitoring, both should be subject to discussion during the policy revision in 2013.

Beyond the main policy, Regulation (EC) 443/2009, additional instruments can contribute considerably to the overall success, particularly financial incentives, especially taxation. Although a joint European automobile taxation regime would be sensible, it is unlikely to be implemented because to do so requires consensus amongst all Member States; likely to be a herculean task.

Labelling is a further important additional instrument. EU Directive 1999/94/EC and Regulation (EC) 1222/2009 require the provision of several types of information such as fuel consumption and CO_2 emissions on labels attached to vehicles, but the effectiveness of this measure is contested for several reasons.

4. Lessons and recommendations

This chapter aims to answer the question at the centre of this research: whether the EU can draw lessons from Japan to reduce its automobile CO_2 emissions. The evaluation of the EU fuel efficiency policy based on the Japanese supporting and hindering factors revealed many interesting positive and negative lessons that should be taken into account by EU policy makers.

In the following, some important differences and similarities between the two sets of framework conditions will be outlined due to their impact on the lesson drawing. Subsequently, the positive or negative lessons from Japanese fuel efficiency policy will be presented; possible for many, but not each of the evaluation criteria.

4.1. Framework conditions

When assessing the feasibility of drawing lessons in this case, framework condition similarities and differences are one of, and here the first, factors to be considered.Both Japan and the EU have relatively high CO_2 emission reduction targets for the period between 1990 and 2020 of 25% and 20% respectively, although the Japanese targets are non-binding. While the Japanese transport sector CO_2 emissions have dropped in recent years, the EU's increased by 26% between 1990 and 2008 (JAMA 2011, 24; EU Com 2010a). The EU market is characterised by a multitude of diverse manufacturers, leading to a more fragmented market compared to that in Japan (T&E 2011, 21; JAMA 2011a, 10-11). Thus close collaboration between industry and national regulators is a more feasible prospect in Japan and is widely carried out, leading to targets with high acceptance but a tendency to low ambition (Nordqvist 2006, 28).

In Japan, socio cultural factors such as *Kaizen* and *saving face* play a significant role for the environmental effectiveness of the Top Runner method. Whilst not so strongly present in the EU, similar factors *do* play a role, if for different reasons, for example the manufacturer's desire to maintain a green image. Differences in the institutional structure are another factor limiting the applicability of lessons from Japan. Many measures are easier to introduce in a national state like Japan than in a supranational organisation where 27 Member States have to agree and implement the policies, for example tax reform.

4.2. Fuel efficiency policies

4.2.1. Main policies: Top Runner and Regulation (EC) 443/2009

During the research work, several lessons and recommendations for the future formulation of the central policy to reduce automobile CO_2 emissions, Regulation (EC) 443/2009, came to light and are presented in the following.

Target object

Both the Japanese and EU targets are based on weight as a proxy for vehicle utility, allowing higher emissions for higher utility (weight). Consequently there is a risk of the industry not pursuing emission reduction through vehicle weight reduction. In response, using alternative parameters to define utility are under discussion. The most promising of which seems to be footprint (wheelbase x track width), the usage of which EU policy-makers should consider using from 2020 rather than weight.

Target stringency

Target-stringency is, of course, of central importance to emissions reductions policy. A balance must be found between targets which are achievable without further effort, typically favoured by industry, reflecting no more that business as usual improvements, and at the other extreme, unachievable targets which discourage manufacturers from attempting to reach them. The 2010 Japanese targets provide an example of the former. The targets, negotiated almost exclusively between industry and government, were obviously undemanding by virtue of their being met five years ahead of schedule. In contrast, the European targets, set with input from a wide range of stakeholders, including industry and environmental NGOs, have since overtaken Japan's in their stringency. Thus one method of finding the target-stringency balance appears to be, together with a strong political will, broad stakeholder inclusion in the policy making process.

Target scope

Given lower-volume manufacturers lesser resources to invest in research and development in emissions reduction technology, setting such manufacturers less ambitious targets is justified. The devil is in the detail, however. In Japan manufacturers which produce fewer than 2000 vehicle per year are exempt from all targets. In the EU, the conditions are much less ambitious: manufacturers producing fewer than 300,000 cars per year are eligible for reduced targets, whilst those producing fewer than 10,000 are eligible for even lower targets.

Such derogations lower the environmental effectiveness of emissions reductions policies. As such, the EU's 300,000 cars/a derogation is a point in which it could learn from Japan.

Lead time

The importance of planning and investment security for industry was stressed by various actors. Such security can be provided by setting short, medium and long term targets allowing the industry to efficiently distribute the costs required in developing the necessary incremental and radical technological innovations.

Setting a long-term target, even if very strict, without intermediate targets or monitoring, e.g. 0 gCO_2/km for 2050 and otherwise "leav[ing] the industry to cope with that" (int. Dolejsi, ACEA), would be insufficient. Instead, the legislation should force intermediate action by setting medium-term targets for the period between 2020 and 2030, as already envisaged by Regulation (EC) 443/2009: 95 gCO_2/km for 2020 (subject to confirmation in 2013) The urgency in setting binding targets for the next 10-15 years is determined by the long time (up to 5 years) needed for the development of a new model (TNO 2011, 10). Thus, confirming the 2020 target in 2013 along with setting more stringent, progressive and binding targets for 2025 (and beyond, if possible) on the same occasion would provide both investment security and the possibility for the European Commission to determine and monitor the carmakers' emissions reduction efforts step by step on the way to the final target.

Promotion of innovation

Neither Regulation (EC) 443/2009 nor the Top Runner for cars are technology neutral. In Japan this can be seen in the prevalence of only incremental improvements to existing technology rather than the introduction of new technologies. Although the EU policy contains specific incentives for alternative technologies, these are considered as a "plus" allowing carmakers to reach the targets more easily rather than solely to encourage innovation. The risk of supporting only incremental innovations – as in Japan – or of setting incentives to innovate only in certain fields should be avoided through a technologically neutral policy combined with increased target stringency which would force the industry to invest in clean technology research and development.

Monitoring and sanctions

Effective monitoring and sanctions are both crucial to ensure compliance with the central policy. The monitoring process in Japan relies on data provided by the automotive industry and consequently lacks transparency and independent verification, ruling out lesson drawing for the EU on this aspect. The same applies to financial sanctions, which are very low in both Japan and the EU. The authors suggest the EU should set incentives for compliance by adapting monetary sanctions to actual compliance costs. In practice, the sanctions stipulated by Regulation (EC) 443/2009, currently almost equal to compliance costs, should be at least doubled (TNO 2001, 13).

Name-and-shame sanctions (publishing the names of non-compliant manufacturers); efficacious in Japan, may also be so in the EU. To support this, more information on the environmental impact of the transport sector should be integrated into environmental education programs.

4.2.2. Additional instruments

Experience in Japan showed that the central policies, i.e. the Japanese fuel efficiency standards and Regulation (EC) 443/2009, can have a stronger impact if they are accompanied by additional instruments such as labelling and financial incentives. In Japan this tripartite policy mix is well conceived, with all three instruments being linked with each other in mutually reinforcing manner (see illustration 4.1). Consistency between the main policy and the additional policy instruments is thus an important lesson for the EU, although difficult to implement due to limited EU authority in these areas.

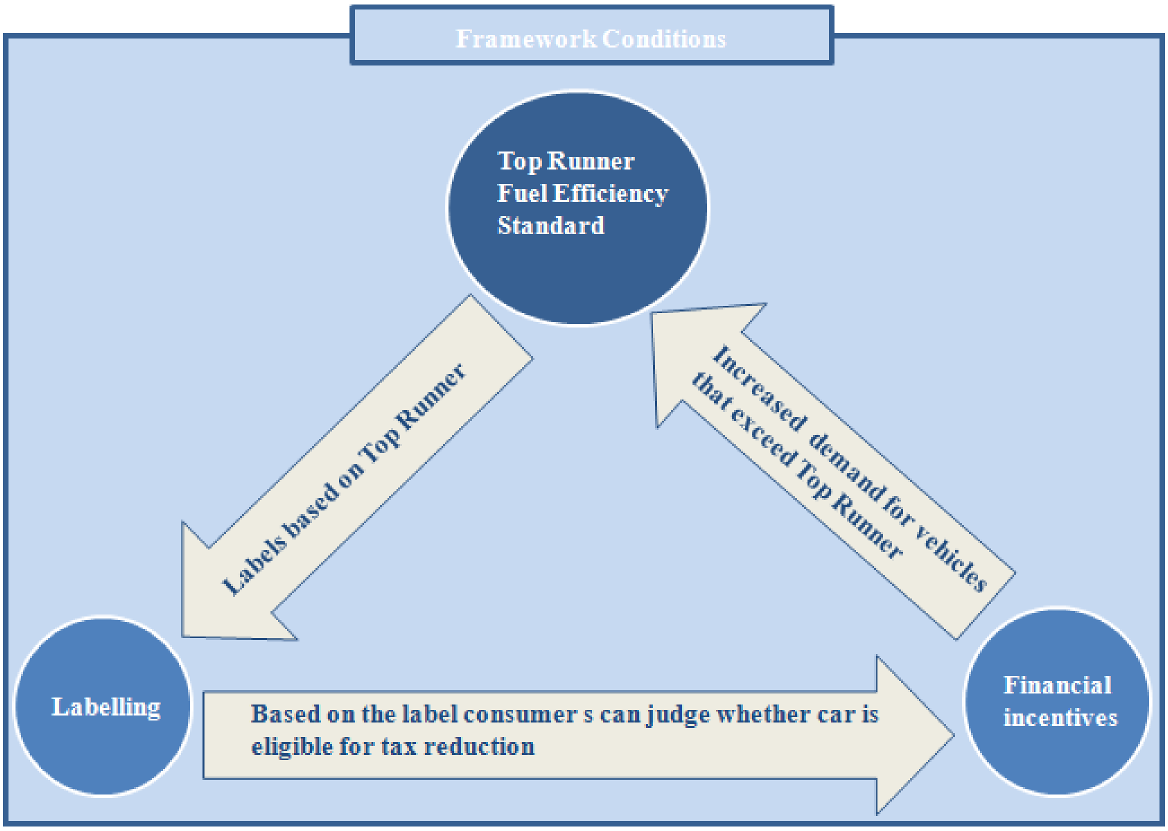

Illustration 4.1: Linkage of Japanese policies

Labelling

Labelling is an important, if difficult to assess informational instrument which influences overall emissions by affecting purchase decisions. Japans labelling is based on the Top Runner fuel efficiency standards and is applied uniformly. This can be seen as a lesson for the EU where Member State's labelling schemes differ in their layout, monitoring and approach (absolute or relative labelling) (Grünig et al. 2010, 14-22).

Learning from the Japanese system, consistency between the Member State's labelling systems and with the (utility-based) EU Regulation (EC 443/2009) should be realised. Displaying both absolute and relative values, the latter based on the same utility parameter chosen for the main policy instrument, seems to be a reasonable compromise in influencing purchasers' choices, though possibly at the price of confusing consumers. If this confusion cannot be avoided through an easily understandable layout, an absolute scheme should be adopted, as only such a system is able to impart upon consumers the importance of total emissions reductions in preventing climate change. These changes should be considered during the (already commenced) revision of *Directive 1999/94 relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars*.

Financial incentives

In Japan, tax reductions for very fuel efficient cars are a key supporting factor through their encouraging environmentally friendly purchase patterns in combination with the labelling scheme, contributing to the CO_2 emissions reduction. This is an important lesson for the EU, as mentioned by two Japanese interviewees. EU decisions on fiscal matters (tax) must be with unanimous support of the Member States, however, making any policy making in this area difficult. This difficulty notwithstanding, Member States should agree on high (minimum) emissions-based components for vehicle purchase and/or yearly taxation.

Unlike ownership taxes, fuel taxes are already semi-harmonised in the EU through the Energy Taxation Directive, which sets minimum rates of excise duties, although the taxation rate based on volume rather than on energy content, resulting in biofuels being the most highly taxed energy source, while coal is the least taxed. This approach creates “unjustifiable tax benefits for certain types of fuel compared to others” (EU Com 2011b). For this reason, a shift of the general approach from a volume consumption-basis to an energy-content and CO_2 emissions-dependent parameter, as already envisaged by the European Commission (ibid.), is a realistic target and could have a significant impact on overall emissions.

4.3. Outlook

The lessons and recommendations presented above are related to possible future development of Regulation (EC) 443/2009 and are made under the assumption of the maintenance of the current legislative framework. The following recommendations go beyond that and suggest changes to the fundamental approach of EU policy in this field.

4.3.1. Standard setting procedure

Dynamic, top-down approach

From a defined emissions limit in a specific year as starting point (e.g. 95 gCO_2/km in 2020), the limit is reduced by a fixed proportion (e.g. 3%) each year, or alternatively linear progress toward a future target could be made from the same starting point (e.g. 0 gCO_2/km in 2050). Either progression could be completed in steps of a predefined length, e.g. 3 or 5 years. This system would ensure long-term planning security for the industry, whilst also removing the need to renegotiate targets for each new target cycle, as is currently the case in the EU.

Mixed approach

A further possible approach is a mixture of the two approaches studied here, the basic concept for which was suggested to by Dr. Rocholl (int. Rocholl, ECF), but expanded by the authors to the following. In this approach, the average target would be set in the same manner as presently in the EU, with the same utility based curve, albeit separated into classes. A predefined number of years in advance of the target date, the emissions of the best vehicle in each utility class, if lower than the class-limit, would be implemented as the next limit in place of the previous limit.

For example, the average limit could be set at 60 gCO_2/km for 2030. 60 g would be the middle point of the curve, with higher or lower limits for higher or lower-utility vehicles respectively. Utility would be broken into classes of a fixed width, e.g. 300 kg (600-900 kg, 900-1200 kg etc.). In 2022, 8 years before the target date, the emissions of the least emitting vehicle in each class would be found. If this were lower than the existing class limit, the emissions limit would be lowered to the least-emitting vehicle's emissions level. Thus if technology moves faster than forecast in the policy-making process, this would not result in unambitious targets. Likewise, a certain amount of stringency can be ensured, forcing the industry to develop innovative solutions. Like the dynamic, top-down approach, this approach also has the advantage of removing the need to renegotiate targets for each new target cycle.

Life-cycle emissions and rebound effects

One of the main objections to the target-object of the Top Runner fuel efficiency standard and Regulation (EC) 443/2009 is their setting targets for CO_2 *exhaust* emissions *per kilometre* (or equivalent). Passenger cars are responsible for CO_2 emissions over their entire life-cycle: including raw material extraction, material and component manufacturing, vehicle assembly, use-phase (including the fuel's life-cycle emissions), disposal and recycling. Emissions from all of these phases should be considered for two reasons. Firstly, knowledge of the total emissions caused by passenger cars is a necessary condition to conceive wider (non-use phase) reduction strategies.

Secondly, the development of new technologies can lead to a shift of emissions to other phases. As remarked in the *Support for the revision of Regulation (EC) No 443/2009 on CO_2 emissions from cars*, “for hybrid, plug-in hybrid and battery-electric vehicles GHG emissions in the production and end-of-life phase are significantly increased compared to conventional vehicles. For battery-electric vehicles the additional GHG emissions divided by the lifetime distance driven are estimated to amount between 5 and 20 g[CO_2]/km” (TNO 2011, 21). These considerations do not apply only to power-train (engine, gearbox, etc) innovations. The environmental impact of other innovations, such as weight lowering materials should also be assessed, as these could lead to lower use-phase emissions at the cost of higher energy intensity production processes. In such cases, as well as for electric vehicles, electricity generation type (coal, gas, wind etc) plays a crucial role for total life-cycle emissions.

Thus, in order to ensure technological innovations actually make a positive contribution to emissions reduction, the entire life-cycle must be considered to reject innovations which simply shift emissions to life-cycle phase not considered by current laws.

Moreover, improvements are needed in the method used to evaluate the use-phase emissions themselves. The current legislation, Regulation (EC) 443/2009, sets limits only for CO_2 emissions <u>per kilometre.</u> Total emissions are a product of efficiency per kilometre <u>and</u> the total number of kilometres driven, however, yet the latter aspect is not considered. The lower emitting (more fuel efficient) vehicles mandated by this approach consequently have lower driving costs (fuel consumption), which may encourage longer distance and/or more frequent driving. Such effects in response to resource efficiency policies are called *rebound effects,* since they can (at least partly) compromise the otherwise positive impact of such policies. As the TNO-report remarks, if significant changes in fuel prices do not occur, rebound effects could reduce gains made via fuel efficiency improvements (emissions reduction) from 27% to 22.1-15.2% if fuel prices remain unchanged, while a concurrent 15% fuel price increase would lead to additional fuel savings of 1-2% (TNO 2011, 21-22).

To reduce total passenger car CO_2 emissions, policies need to focus not only on efficiency but also on sufficiency, i.e. reducing the use or consumption. Although integrating rebound effects in an emissions reduction policy is difficult, a policy mix including emissions limits, taxation reductions for very efficient cars and increased fuel taxation and public transport improvement would have significant potential to reduce the rebound effect.

Further areas of research

Three main areas have been identified which would be relevant and interesting to study further. Firstly, research into possible ways of defining utility and their respective advantages and disadvantages, such as weight, footprint area, plan area, volume or combinations of some or all of these would be a valuable contribution to this particular debate. This is relevant for EU, Japanese and all other passenger car emissions/fuel consumption policies. Secondly, further research into the necessary characteristics, advantages and disadvantages of the “mixed approach” suggested above would be required before such an approach could be implemented. This would be relevant in the first instance for the EU only, but if implemented and successful possibly for other countries/systems also. Thirdly, strategies to successfully implement and design policies and policy-mixes in a manner avoiding rebound effects would be helpful. This would be relevant for the EU, Japan and elsewhere.

5. Literature

Abrell 2010: Abrell, J. 2010: Regulating CO_2 emissions of transportation in Europe: A CGE-analysis using market-based instruments. Transportation Research Part D 15 pp.235–239

ACEA 2010: ACEA 2010: New Vehicle Registrations - Year 2010 by manufacturer and by vehicle category (Enlarged Europe) http://www.acea.be/news/news_detail/new_vehicle_registrations_by_manufacturer/ accessed on 27/11/11.

ACEA 2011: ACEA 2011: The Automobile Industry Pocket Guide. http://www.acea.be/images/uploads/files/20110921_Pocket_Guide_3rd_edition.pdf

ACEA 2012: ACEA website 2012: http://www.acea.be/collection/CO_2_emissions_faq_on_CO_2/ accessed on 23/01/2012

ADEME 2012: Agence de l'Environnement et de la Maîtrise de l'Energie (French Environment and Energy Management Agency, ADEME) website: http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=13712&m=3&catid=17154 accessed on 29/02/2012

AEA Technology plc. 2011: AEA Technology plc. 2011: Report on the implementation of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars, Report for European Commission, DG Climate Action, AEA/R/ED56923 Issue Number 2. ec.europa.eu/clima/policies/transport/vehicles/labelling/docs/final_report_2012_en.pdf accessed on 29/02/2012

An & Sauer 2004: An, F. & Sauer, A. 2004:Comparison Of Passenger Vehicle Fuel Economy And GHG Emission Standards Around The World

An et al. 2011: An, F., Earley, R. & Green-Weiskel, L. 2011: Global Overview On Fuel Efficiency And Motor Vehicle Emission Standards: Policy Options And Perspectives For International Cooperation. United Nations Department Of Economic And Social Affairs: Background Paper No.3, CSD19/2011/BP3

Asselt et al. 2009: van Asselt, H, Kanie, N. and Iguchi M. 2009: Japan's position in international climate policy: navigating between Kyoto and the APP. Int Environ Agreements 9: 319–336.

Bampatsou/Zervas 2011: Bampatsou, Christina and Zervas, Efthimios 2011: Critique of the regulatory limitations of exhaust CO_2 emissions from passenger cars in European union. Energy Policy 39, 7794-7802.

BMF 2011: German Federal Finance Ministry (BMF) 2011: Übersicht zur Kraftfahrzeugsteuer für Personenkraftwagen (Passenger car tax overview). http://www.bundesfinanzministerium.de/nn_86592/DE/Wirtschaft__und__Verwaltung/Steuern/Veroeffentlichungen__zu__Steuerarten/Kraftfahrzeugsteuer/Merkblaetter__und__Uebersichten/001__a,templateId=raw,property=publicationFile.pdf accessed on 29/02/2012

Bosch 2010: Robert Bosch GmbH: Chassis Systems Control 2010: ABS und ESP® Generation 9. http://www.bosch-kraftfahrzeugtechnik.de/en/de/component/component_1_1664.html?compId=1066 accessed on 23/01/2012

Campestrini/Mock 2011: Campestrini, M. and Mock, P. 2011: ICCT Pocketbook - European Vehicle Market Statistics. www.theicct.org accessed on 22/01/2012

CGG 1995: CGG - Commission on Global Governance 1995, 1. Ed.: Our global neighbourhood, Oxford University Press.

Davies 2012: Davies, T. 2012: Calculation of CO_2 emissions. http://people.exeter.ac.uk/TWDavies/energy_conversion/Calculation%20of%20CO2%20emissions%20from%20fuels.htm. Accessed on 15/03/2012

de Carvalho et al. 2009: de Carvalho, R., Villela, A., da Silva, A., and de Melo, T. 2009: Technologies for CO_2 Mitigation on Light-Duty Vehicles — An Overview. SAE Technical Paper 2009-36-0079

Deters 2010: Deters, H. 2010: Legislating on Car Emissions. What Drives Standards in EU Environmental Policy? Sfb597 „Staatlichkeit im Wandel“ − „Transformations of the State“ Bremen. ISSN 1861-1176

Dings (T&E) 2011: Dings, J. (T&E – European Federation for Transport and Environment) 2011: How clean are Europe's cars? An analysis of carmaker progress towards EU CO_2 targets in 2010. www.transportenvironment.org

Directgov 2012: Directgov website 2012: http://www.direct.gov.uk/en/Motoring/OwningAVehicle/HowToTaxYourVehicle/DG_10012524 accessed on 29/02/2012

EEX 2012: European Energy Exchange (EEX) website: http://www.eex.com/en/Market%20Data/Trading%20Data/Emission%20Rights/EU%20Emission%20Allowances%20|%20Spot/EU%20Emission%20Allowances%20Chart%20|%20Spot/spot-eua-chart/2011-12-31/0/0/1y accessed on 28/01/2012

EU Com 2006: European Commission – DG Environment, Review of the EU strategy to reduce CO_2 emissions and improve fuel efficiency from cars. Report on the Public Consultation June – August 2006. URL: http://ec.europa.eu/clima/policies/transport/vehicles/docs/public_consultation_report_en.pdf

EU Com 2007: European Commission 2007: COM (2007) 2 final: Limiting Global Climate Change to 2 degrees Celsius The way ahead for 2020 and beyond

EU Com 2007a: European Commission 2007a: COM(2007) 19 final: Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles

EU Com 2007b: European Commission 2007b: Accompanying document to the PROPOSAL FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND COUNCIL for a regulation to reduce CO_2 emissions from passenger cars. Impact Assessment

EU Com 2007c: European Commission 2007c: COMMISSION STAFF WORKING DOCUMENT accompanying document to the COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles Impact Assessment

EU Com 2007d: European Commission – DG Environment, DG Enterprise and Industry, Public hearing "Reducing CO_2 from passenger cars and light-commercial vehicles". Brussels, 11 July 2007. Final Report. URL: http://ec.europa.eu/reducing_CO2_emissions_from_cars/index_en.htm

EU Com 2008: European Commission 2008: COM(2008) 30 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS 20 20 by 2020 Europe's climate change opportunity

EU Com 2010: European Commission 2010: COM (2010) 656 final: Progress report on implementation of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles

EU Com 2010a: European Commission DG-Climate website: http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm accessed on 22/01/2012

EU Com 2011: European Commission 2011: COM(2011) 112 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Roadmap for moving to a competitive low carbon economy in 2050

EU Com 2011a: European Commission 2011c: Special Eurobarometer 372, Climate change

EU Com 2011b: European Commission, DG Climate Action, Stakeholder meeting on CO_2 from light duty vehicles, Brussels 06.12.2011. Summary of the meeting by the Commission. URL: http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm

EU Com 2011c: European Commission 2011c: SEC(2011) 410 - SUMMARY OF THE IMPACT ASSESSMENT Accompanying document to the Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity.

EU Com 2011d: European Commission 2011d: COM(2011) 169/3 Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity.

European Council 2004: European Council 2004: COUNCIL DIRECTIVE 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity (consolidated version) European Commission 2011a: Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity

European Union 2008: European Union 2008: Climate change: Commission welcomes final adoption of Europe's climate and energy package. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1998&format=PDF&aged=1&language=EN&guiLanguage=en

European Union 2009: European Parliament and Council 2009: REGULATION (EC) No 443/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles

European Union 2009a: European Union 2009a: Commission welcomes adoption of climate and energy package. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/628&format=PDF&aged=1&language=EN&guiLanguage=en

European Union 2009b: European Union 2009b: REGULATION (EC) No 1222/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters.

European Union 2010: European Union 2010: Information on the fuel consumption and CO_2 emissions of new cars. http://europa.eu/legislation_summaries/internal_market/single_market_for_goods/motor_vehicles/interactions_industry_policies/l32034_en.htm accessed on 28/01/2012

Fontaras et al. 2009: Fontaras, G., Karavalakis G., Kousoulidou, M., Tzamkiozis T., Ntziachristos L., Bakeas, E., Stournas S. & Samaras Z., 2009: Effects of biodiesel on passenger car fuel consumption, regulated and non-regulated pollutant emissions over legislated and real-world driving cycles. Fuel 88 pp.1608–1617

Gärtner 2005: Gärtner, A. (ADAC e.V.) 2005: Study on the effectiveness of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars.

Greven (ACEA) 2011: Greven, M. (ACEA) 2011: TAX GUIDE 11 – EU. http://www.acea.be/images/uploads/files/20110330_TaxGuide2011Highlights_update.pdf

Hamamoto 2011: Hamamoto, M. 2011: Energy Efficiency Regulation and R&D Activity: A Study of the Top Runner Program in Japan. Low Carbon Economy 2: 91-98.

Hemmings 2011: Hemmings, B. 2011: The CO2 Taxation Option for an EU Shipping Measure, ECCP WG Ships – Meeting 2 on 22-23 June 2011, Background Document, European Commission Transport & Environment. http://ec.europa.eu/clima/events/0036/taxation_en.pdf, accessed on 29/02/2012

Héritier 2002: Héritier, A. 2002: New Modes of Governance in Europe: Policy-Making without Legislating? http://papers.ssrn.com/abstract=299431 accessed on 16/08/2011

Hopf 2004: Hopf, Christel 2004: Qualitative Interviews: An Overview, in: Flick, Uwe/von Kardorff, Ernst/Steinke, Ines 2004: A companion to qualitative research, Sage Publications, London, pp.203 -208.

ICCT 2007: ICCT 2007: Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update.

IEA 2005: IEA 2005: Climate Change Database. Kyoto Target Achievement Plan. http://www.iea.org/textbase/pm/?mode=cc&action=detail&id=2369 accessed on 14/11/2011

JAMA 2007: JAMA 2007: Taxes and Automobiles. http://www.jama.or.jp/tax/tax_system/tax_system_3t1.html. accessed on 02/10/2011

JAMA 2008: JAMA 2008: Looking to the Future.

JAMA 2011: JAMA 2011: 2011 Report on Environmental Protection Efforts – Promoting Sustainability in Road Transport in Japan. http://www.jama-english.jp/publications/env_prot_report_2011.pdf.

JAMA 2011a: Japan Automobile Manufacturers Association, Inc. (JAMA) 2011: The Motor Industry Of Japan 2011

JAMA 2011b: Japan Automobile Manufacturers Association, Inc. (JAMA) 2011b: Motor Vehicle Statistics of Japan 2011

JAMA 2012: Japan Automobile Manufacturers Association, Inc. (JAMA) 2012: JAMA Active Matrix Database System. New Registrations – Sales. http://jamaserv.jama.or.jp/newdb/eng/index.html

Jänicke et al. 2000: Jänicke, Martin/Kunig, Philip/Stitzel, Michael 2000: Lern- und Arbeitsbuch Umweltpolitik, Politik, Recht und Management des Umweltschutzes in Staat und Unternehmen, Lizenzausgabe für die Bundeszentrale für politische Bildung, Bonn.

Jann 1994: Jann, Werner 1994: Politikfeldanalyse, in: Noblen, Dieter: Lexikon der Politik. Bd. 2: Politikwissenschaftliche Methoden, (hrsg. von Jürgen Kuz/Dieter Nohlen/ Rainer-Olaf Schulze), Beck, München.

Kuik 2006: Kuik, Onno 2006: Environmental Innovation Dynamics in the Automotive industry. http://ec.europa.eu/environment/enveco/policy/pdf/2007_automotive.pdf (15/08/11)

METI 2010: METI 2010: Top runner program: Developing the World's best Energy-Efficient Appliances. Tokyo, Japan. http://www.enecho.meti.go.jp/policy/saveenergy/toprunner2011.03en-1103.pdf.

METI 2011a: METI 2011a: Energy saving performance catalogue. Tokyo, Japan.

METI 2011b: METI 2011b: Survey on energy efficiency in 2011. Tokyo, Japan. http://www.enecho.meti.go.jp/policy/saveenergy/tokuteikiki/tokuteikikityousa.htm accessed on 27/03/2012

METI/MLIT 2011: METI/MLIT 2011: Final report on new passenger vehicle fuel efficiency standards (Top Runner Standards). Tokyo, Japan.

Meuser/Nagel 1991: Meuser, Michael/Nagel, Ulrike 1991: Experteninterviews – vielfach erprobt, wenig bedacht – Ein Beitrag zur qualitativen Methodendiskussion, in: Bogner, Alexander/Littg, Beate/Menz, Wolfgang (eds.) 2002: Das Experteninterview – Theorie, Methode, Anwendung, Leske&Budrich, Opladen, p. 71-93.

Miles/Huberman 1994: Miles, Matthew B./Huberman, A. Michael 1994: Qualitative data analysis. 2. Edition, Sage Publications, Thousand Oaks London New Delhi.

Minato 2004: Minato, K 2004: Fuel Economy Standards and Effect on CO_2 reduction. IATSS Review 29(2): 103–108.

MLIT 2008: MLIT 2008: Overview of the green taxes measures. Tokyo, Japan. http://www.mlit.go.jp/jidosha/green/gaiyou0804.pdf. accessed on 20/03/2012

MLIT 2011: MLIT 2011: Catalogues of vehicles fuel efficiency. Tokyo, Japan. http://www.mlit.go.jp/jidosha/jidosha_mn10_000002.html accessed on 21/03/2012

MLIT 2012: MLIT 2012: Report on "eco-car subsidies" system. Tokyo, Japan. http://www.mlit.go.jp/common/000191784.pdf. accessed on 20/03/2012

Mock (ICCT) 2011: Mock, Peter (ICCT) 2011: Evaluation of parameter-based vehicle emissions targets in the EU: How regulatory design can help meet the 2020 CO_2 target. White Paper Number 10, Fuel Economy and GHG Standards Design Series.

Mock et al. 2012: Mock, P., German, J., Bandivadekar, A. & Riemersma , I. (ICCT) 2012: Discrepancies between type-approval and "real-world" fuel-consumption and CO2 values, Assessment for 2001-2011 European passenger cars. http://www.theicct.org/sites/default/files/publications/ICCT_EU_fuelconsumption2_workingpaper_2012.pdf accessed on 29 April 2012.

MOE 2008: MOE 2008: Kyoto Protocol Target Achievement Plan (Provisional translation). Tokyo, Japan. http://www.env.go.jp/en/earth/cc/kptap.pdf. accessed on 20/03/2012

MOE 2009: MOE 2009: Overview of fuel efficiency label. Tokyo, Japan. http://www.env.go.jp/policy/hozen/green/ecolabel/a04_22.html. accessed on 20/03/2012

MOE 2011: MOE 2011: Japan's National Greenhouse Gas Emissions for Fiscal Year 2009 (Final Figures). Tokyo, Japan. http://www.env.go.jp/press/file_view.php?serial=17385&hou_id=13722. accessed on 20/03/2012

Monden/Hamada 1991: Monden, Y and Hamada, K. 1991: Target Costing and Kaizen Costing in Japanese Automobile Companies. JMAR 3(Fall 1991): 16–34.

Muto et al. 2004: Muto, S, Tokunaga, S and Okiyama, M. 2004: Actual Evaluation of Automobile Environmental Policies Focusing on the Control of CO_2. Dobokukeikakugakukennkyuu kouennsyuu 30(4(164)): 1–4.

Muto et al. 2006: Muto, S, Tokunaga, S and Okiyama, M. 2006: Evaluation of Regulatory Effects of CO_2 Emissions by Implementing Environmental Policies Related on Automobiles: For Mileage Regulation by Top Runner Method and Green Taxes. Studies in Regional Science 36(3): 683–696.

Naono 2011: Naono, T. 2011: Overview of Japan's HDV Fuel Efficiency. http://www.iea.org/work/2011/hdv/naono.pdf.

NGVPC 2009: Next Generation Vehicle Promotion Center 2009: Rules to deliver eco-car subsidies. http://www.cev-pc.or.jp/NGVPC/subsidy/eco/eco_PDF/kofukitei.pdf. accessed on 25/03/2012

Nordqvist 2006: Nordqvist, J. 2006: Evaluation of Japan's top runner programme within the framework of the AID-EE project.

OECD 2011: OECD 2011: Japan Development Assistance Committee (DAC) peer review.

Ogawa 2008: Ogawa, J. (IEEJ) 2008: Revised Kyoto Protocol Target Achievement Plan - Overview and History of Revision -. The Institute of Energy Economics, Japan (IEEJ).

Onoda (OECD/IEA) 2008: Onoda, T. (OECD/IEA) 2008: Review Of International Policies For Vehicle Fuel Efficiency. IEA Information Paper.

Rose 1991: Rose, Richard 1991: "What is Lesson-Drawing?" Journal of Public Policy 11(01): 3.

SEPA 2005: SEPA 2005: The Top Runner Program in Japan – its effectiveness and implications for the EU. Stockholm, Sweden.

Stockmann 2006: Stockmann, Reinhard (ed.) 2006: Sozialwissenschaftliche Evaluationsforschung Band 1, Grundlagen und ausgewählte Forschungsfelder, 3. Edition, Waxmann Verlag GmbH, Münster.

T&E 2008: T&E (European Federation for Transport and Environment) 2008: CO_2 Emissions from New Cars. Position paper in response to the European Commission proposal.

T&E 2011: T&E (European Federation for Transport and Environment) 2011: How clean are Europe's cars? An analysis of carmaker progress towards EU CO_2 targets in 2010.

TNO 2011: TNO 2011: Support for the revision of Regulation (EC) No 443/2009 on CO_2 emissions from cars. Final report.

Tokunaga et al. 2008: Tokunaga, S, Muto, S and Fan, Y 2008: Model analysis of environmental policies related on automobiles. Tokyo, Japan: Bunshindo.

UNFCCC 2010: UNFCCC 2010: Fact sheet: The need for strong global action on climate change. http://unfccc.int/files/press/fact_sheets/application/pdf/fact_sheet_climate_deal.pdf accessed on 15/08/11

VCA 2012: United Kingdom Vehicle Certification Agency website 2012: http://www.dft.gov.uk/vca//vehicletype/definition-of-vehicle-categories.asp Accessed on 29/03/2012

Wells et al. 2010: Wells, Peter, Nieuwenhuis, Paul, Nash, Hazel and Frater, Lori 2010: Lowering the bar: options for the automotive industry to achieve 80g/km CO_2 by 2020 in Europe

Whitmarsh/Köhler 2010: Whitmarsh, L. and Köhler, J. 2010: Climate change and cars in the EU: the roles of auto firms, consumers, and policy in responding to global environmental change. In Cambridge Journal of Regions, Economy and Society 2010, 3, pp. 427–441

Windhoff-Heritier 1987: Windhoff-Heritier, Adrienne 1987: Policy-Analyse – Eine Einführung, Campus Verlag, Frankfurt/New York.

5.1. Interviews

Abbreviation in text	Interviewee	Organisation	Date	Form/ Location
int. Matsuo, MLIT	Tsuneki Matsuo	Japanese Ministry of Land, Infrastructure, Transport and Tourism	03/12/2011	Skype
int. Lindvall, EU Com	Susanna Lindvall	EU Commission	9/12/2011	Telephone
int. Muto, Uni. Yamanashi	Shinichi Muto	University of Yamanashi	20/12/2011	Skype
int. Rocholl, ECF	Dr. Martin Rocholl	European Climate Foundation	30/11/2011	Berlin
int. Mock, ICCT	Peter Mock	International Council on Clean Transportation (ICCT)	12/12/2011	Telephone
int. Dolejsi, ACEA	Petr Dolejsi	European Office European Automobile Manufacturers Association (ACEA)	9/12/2011	Skype

Table 6: Interview dates and form/location

6. Annexes

6.1. Annex I: Interview guidelines

Interview Guideline: EU

Reducing automobile CO_2 emissions in the EU: can lessons be drawn from Japanese fuel efficiency policy?

1. Introductory Questions

- Background to research project
- Chance to read Research Design?

>>> Summary topic and objectives, reasons why we have chosen you as interview partner

Organisational issues

How much time?
Can we record and/or mention your name in the paper or anonymous?

Questions about the interview partner and its organization

Since when have you been working for your organisation and since when have you dealt with CO_2 efficient cars/Top Runner/…

2. Japanese Top Runner fuel efficiency standard

- Any insights on how it works and whether environmentally effective?
- If yes, what lead to this success and what can Europe learn from that?

>>> Summarise our findings

3. Specific questions about the EU

Which key factors would you expect to be relevant for an environmentally effective EU policy on fuel efficiency?

3.1. Framework conditions

Industry sector

- Are the any trends regarding the purchasing criteria of consumers towards more efficient cars? If so, does this have a considerable impact?
- The producers of almost 17 % of the vehicles sold in the EU are non-European. Could this fact represent an obstacle to compliance?
- Can we expect better compliance from manufacturers whose countries have already introduced ambitious regulations in this field (e.g. Japan)?

Societal factors

- To what degree are societal factors playing a role in the EU? E.g. in Japan two key factors are the strong desire to save the face, i.e. to fulfil the standard, as well as Kaizen, i.e. the management philosophy of continuous improvement.

3.2 EU Regulation (EC) 443/2009 "setting emission performance standards for new passenger cars"

- Which are in your opinion the strengths and weaknesses of the regulation?

Target setting EU Regulation (EC) 443/2009 "

- Weight-based targets can penalise small car manufacturers and could set an incentive for a shift to heavier vehicles, depending on the configuration. Does the regulation's configuration do this?
- Regardless of the debate about measuring utility via weight/area, is the weight development (AMI) considered in the Regulation realistic?
- Do think it is a problem that the emission limits regard car manufacturers, not every single vehicle and that average travelled distance per car (bigger for heavy cars) is not considered?
- Are the targets (130 gCO_2/km in 2012 and 95 g/km in 2020) likely to be reached?
- Do you consider the EU targets stringent or generous?
- Is the target setting procedure in your opinion reasonable? If not, why not?
- Is the derogation for small manufacturers acceptable? If not, why not?
- Do you agree with allowing pooling? What consequences could that have on the total emissions reduction?
- Is it already known or can you foresee which manufacturers/groups could pool?

The regulation will be reviewed 2013 in order to reach the 2020 95 gCO_2/km target.

- Do you expect any modifications/adjustments other than M0?
- What do you think about medium and long-term targets?

Monitoring and Sanctions

- What do you think of the monitoring scheme of the regulation?
- Should pooling manufacturers report separately?
- Sanctions: Is the name-and-shame method likely to be effective in the EU as it is in Japan? (publication of ACEA's failure had little effect)(?)
- Do you think the non-compliance sanctions are sufficient to create an incentive to comply?
- Do you think the sanctions are discriminatory to small-car manufacturers due to their lower per-car margins?

Innovation

- How will the regulation influence automotive industry innovation activities?

Stakeholder involvement

- Do you think stakeholder had the possibility to influence the legislative process? If yes, how did this take place during the official public hearing?

3.3 Policy mix/supporting measures

- Which supportive measures are necessary, in your opinion, in order to reduce emissions from the automotive sector?

Taxation

- Does taxation in general influence costumer choices in this sector, given the low price elasticity?
- Is a harmonisation of vehicle taxation schemes regarding consideration of CO_2 emissions: realistic in the next years?
- Is the EU fuel tax proposal to harmonise the inclusion of CO_2 emissions in fuel tax realistic?

Public procurement

- What role do you see for public procurement to stimulate the market for efficient cars?
- Do you think there will be mandatory EU law in the future?

Information (Labelling and Promotion)

- What is you view on Directive 1999/94/EC? (legislates the availability of related to the fuel economy of new passenger cars offered for sale or lease in the Community is made available to consumers).
- Do you think the tyre labelling scheme which will enter into force in 2012 (as required in Regulation (EC) No 1222/200924) will be effective (in reducing emissions)?

Final Questions

- What is your view on a potential combination of a market driven Top Runner approach and a regulative standard setting procedure such as in Regulation EC 443/2009? E.g. that a Regulation determines a scope from 80-90 g/km and the market decides where the limit will lie exactly.
- Increasing efficiency is often linked to Rebound effects. Do you have any advice how this could be solved?

Interview Guideline: Japan

Reducing automobile CO_2 emissions in the EU: can lessons be drawn from Japanese fuel efficiency policy?

1. Introductory Questions

1.1. Background Research Project

- Did you have chance to read Research Design?

>>> Summarise topic and objectives, reasons why we have chosen him/her as interview partner

1.2. Organisational issues

- Would you mind if we record this interview?
- Can we mention your name in the paper or would you prefer to remain anonymous?

1.3. Questions about the interview partner and their organisation

- Since when have you been working for your organisation and since when have you dealt with vehicle efficiency/emissions/Top Runner/…?
- What is your role?

2. Key factors of Japanese Top Runner fuel efficiency standard

- Do you think the Top Runner fuel efficiency regulation has been environmentally effective/ successful so far?
- If yes, what lead to this success?
- If not, what are factors leading to its failure?

3. Specific questions about Japanese Top Runner fuel efficiency standard

3.1. Framework conditions

Industry sector

- Are the any trends regarding the purchasing criteria of consumers towards more efficient cars? If so, does this have a considerable impact?
- The Japanese automobile market is dominated by domestic producers such as Toyota, Honda and Nissan etc. Has this fact lead to better compliance (/contribute to any CO_2 emissions reduction in Japan)?

Societal factors

- Did/Do cultural factors like the spirit of "Kaizen" influence Japanese fuel efficiency regulation?

3.2. Top Runner fuel efficiency standard itself

- Which are in your opinion the strengths and weaknesses of the standard?

Target setting

- Are the targets (16.8km/l in 2015 and 20.3km/l in 2020) likely to be reached?
- How did/do manufactures react to be set the Top Runner targets? Are they willing to be set targets in order to increase their competitive advantage or are they rather reluctant to set them?
- Is the target setting procedure in your opinion reasonable? If not, why not?
- Fuel consumption values are displayed on new vehicle catalogues in Japan using the 10-15 cycle and in the JC08 cycle. Are these driving cycles realistic?

Monitoring and Sanctions

- What do you think of the monitoring scheme of the TR fuel efficiency standard?
- Sanctions: Is the name-and-shame method effective?

Innovation

- How did/does the standard influence automotive industry innovation activities?

Stakeholder involvement

- Industrial stakeholders are themselves involved in setting targets and they collaborate closely with national regulators. Do you think that stakeholder involvement is important?

3.3. Policy Mix/Supporting measures

- Which supportive measures were/are effective, in your opinion, in order to enhance the standard in reducing emissions from the automotive sector?

4. Question about the EU regulation

- Any insights on EU regulation 443/2009?
- Do you consider the EU targets (130gCO_2/km in 2012 and 95g/km in 2020) stringent or generous in compare to the Japanese targets (16.8km/l in 2015 and 20.3km/l in 2020)?
- How can the different approaches (bottom-up in Japan, top-down in the EU) affect the standard-setting procedure and the standard stringency?
- Which key factors would you expect to be relevant for an environmentally effective EU policy on fuel efficiency?
- What can Europe learn from Japanese fuel efficiency regulation? What can Japan learn from European regulation?
- If the EU would introduce the Top Runner approach, do you foresee any obstacles in doing so?

5. Final Questions

- Increasing efficiency is often linked to rebound effects. Do you have any advice how these may be avoided?

6.2. Annex II: Personal reflection

Interviews

The interviews have been the most suspenseful/interesting part of the thesis. Firstly, issues not yet explored by researchers could be addressed and secondly, it was a personal challenge to manage the interview-situation.

Most experts we had asked agreed to the interviews and frequently, a fluent conversation instead of a strict question and answer situation developed. This contributed to a positive and open atmosphere and revealed interesting issues, but it took more time and thus not all issues in the interview-guideline could be discussed.

Most of interviews were done per telephone, as the interviewees live far away from Germany (for example: USA, Japan and Belgium). Due to poor connections, it was sometimes very difficult to hear clearly and understand the answers of interviewees. Nevertheless, our international backgrounds made it possible to conduct interviews in three languages (German, English and Japanese) through which we could obtain detailed information.

A critical point within the preparation of the interviews was the operationalisation of the questions which could probably have been improved. However, most of the questions were neither sensitive nor personal.

Group work

We were unfamiliar with working so closely with one-another for such a long time on a joint project. Coordination of various elements (e.g. working style, meetings, computer systems) was at times challenging, but after a warm-up phase the advantages of team work became obvious. The work in a group was very stimulating, provided useful feedback through the team members' complementary strength and weaknesses, and last but not least was fun (and great coffee ;-))

The group consists of diverse national backgrounds: New Zealand, Japan, Italy and Germany, thus intercultural sensitivity/competencies were required to facilitate the group work. Not only different nationalities, but also different professional backgrounds ranging from engineering, physics to european studies and political science.

Weekly meetings of 3-4 hours duration were held, subsequently many issues were dealt with in pairs with a third person proof-reading the results. The most useful tools for the team: skype conferences, dropbox and a coloured-coded to-do list detailing the progress of the paper: pink = text still to be written, orange = first draft finished, yellow = text lies is being proof-read and green = text is finished. Achieving “green status” on our sections was a significant motivation.

The group organisation would have been greatly assisted by using a central literature management program.

Presenting our progress and the subsequent review process in the seminar was very helpful, especially explaining it to others not involved helped to orient the work and increased the clarity and relevance of the final report. Reviewing the research designs and other work of others and discussing potential challenges was also instructive.