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TRANSFERABLE MOBILITY RIGHTS: AN ANALYSIS OF FEASIBILITY, SOCIO-ECONOMIC EFFECTIVENESS AND LEGITIMACY
CP-35

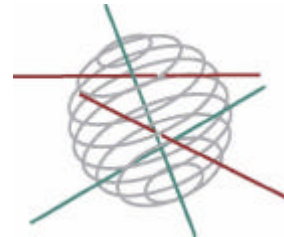LUC - VUB - LV

SPSD II

PART 1
SUSTAINABLE PRODUCTION AND CONSUMPTION PATTERNS

GENERAL ISSUES

AGRO-FOOD

ENERGY

TRANSPORT

This research project is realised within the framework of the Scientific support plan for a sustainable development policy (SPSD II)

Part I "Sustainable production and consumption patterns"

The appendixes to this report are available at :
http://www.belspo.be (FEDRA)

1. Project title

Transferable mobility rights: an analysis of feasibility, socio-economic effectiveness and legitimacy (CP/07/351).

2. Introduction

2.1. Context and summary

Tradable mobility rights (TMR) are a sustainable, innovative and practical approach to the problem of mobility. By endowing each citizen with a quota of TMR, a number of social, economic and ecological goals can be obtained and reconciled. Regardless of their financial situation, TMR guarantee each citizen a minimum of basic mobility. Those who need more transportation, will buy TMR from those who are more mobility-conscious. In that way, a market is set up and a market price arises. The government can determine the total amount of TMR, hence the total amount of pollution it deems acceptable.

This research project will describe the different systems of TMR and assess their feasibility, effectiveness and legitimacy.
In the feasibility part, a selection and evaluation is made of alternative TMR- systems. Obviously, attention is paid to a similar system that is already in use, the co-called emission rights. Crucial to the project is the design of a practically implemented system that holds all qualities from the theoretical model.
In the second part, system-dynamic modelling is used to access the socio-economic effectiveness of TMR on the transportation system.
Finally, the legitimacy is studied by pursuing research into public and political support for TMR.

Also much attention will be spent into the dissemination of the research result. Although TMR is one of the most attractive options for a sustainable transportation and mobility policy, the system as well as its impacts remain relatively unknown. Unknown, unloved, this research project attempts to tear down the walls of silence or even misinformation to spur implementation in the future.

2.2. Objectives

Although the market system is superior in making the demand of consumers and the supply of producers meet, there are certain effects which the price system spontaneously does not take into account. These external effects or externalities are not reflected in the price. The best-known example of a negative externality is environmental pollution. Mobility also creates external costs that are not accounted for, such as congestion, pollution and stress. The market needs a correction. Property rights can be established in these negative effects, more precisely, markets for pollution or mobility rights can be set up. If defined correctly, the system can combine and attain social, ecological and economic goals.

There are areas in the public domain where transferable and tradable individual rights are heavily discussed and even successfully introduced in practice. The most prominent example is pollution or emission rights. We can learn from this experience to develop tradable mobility rights. As stated before, there are ecological, economic and social advantages to the system. First of all, the government fixes ex ante the level of pollution since they issue the emission rights. In a system of ecological taxes or even environmental regulation, the amount of pollution will become clear ex post and may well exceed the optimum level. Secondly, the price is determined by the market, hence truly reflects the (marginal) willingness-to-pay of the polluter. Thirdly, the initial allocation can be used to pursue general and specific social goals. If, for example, all citizens and businesses would get a basic endowment of emission rights, everybody has a right to pollute. Unlike with ecological taxes, even the poor can pollute or sell their emission rights. Fourthly, advances in e-technology greatly reduce the administrative costs of a tradable emission rights system, which was for a long time held to be the biggest obstacle of the system.

2.3. Expected outcomes

Transferable Mobility Rights are an innovative approach to the increasingly urgent question of mobility. Unlike other approaches, it reconciles economic, ecological and social interests. TMR offer a promising route for sustainable development in transportation. Given the success of a largely similar system in abating pollution, the so-called emission rights, this research project will attempt to demonstrate the feasibility, socio-economic effectiveness and legitimacy of the system when applied to transportation.

The results can be classified in five categories:
1. Consistent and communicable theory of TMR;
2. Classification and evaluation of alternative TMR schemes;
3. Assessment of the mobility effectiveness of TMR;
4. Concrete implementation scenarios;
5. Public information, discussion and acceptability of TMR.

3. Detailed description of the scientific methodology

3.1. Feasibility – Theoretical Literature

There is practically no theoretical literature on the subject of tradable mobility rights. However, TMR share their theoretical strand with emission rights. Their theoretical origin can be traced back to Ronald Coase's seminal article on the 'Problem of Social Cost'.[1]
A rather huge literature on emission rights developed quickly after the introduction of the Clean Air Act in the U.S. in 1990. Moreover, all textbooks on environmental economics hold chapters on tradable emission rights.

The first part of this research project consisted of studying and building upon the emission rights literature to develop a sound theoretical framework for TMR.

3.2. Socio-Economic Effectiveness

System-dynamics (SD) is a method of analysis in which the evolution in time (dynamics) and the recognition that the whole is more than the sum of its parts (system) are the two key elements. Studied are how a system reacts to dynamic forces and how those reactions shape its behaviour as it moves into the future. Off course SD is not the only kind of operational research that incorporates time in its analysis. But the high aggregate level of analysis without making lots of suppositions is seldom. With the SD methodology long term analysis is more then the extrapolation of some isolated trends. It will be possible to propose policies that attack underlying causes of a problem rather than treating symptoms.

A SD model is composed of a chain of closed, feedback loops which trace the faulty behaviour and the stabilising factors of the system. For illustration, additional infrastructure as a policy to tackle congestion (stabilising) may be offset by the new traffic induced (reinforcing). Rising pollution in cities induces the suburban attractiveness, but this increases on the one hand commuter distance and on the other hand the difficulty of the use of public transport as an alternative for car use, inducing pollution again (reinforcing loop). Further, land use (density, connection with infrastructure, …), socio-economic (income distribution, economic growth, unemployment,…) and demographic (ageing, population, …) elements, just like the various externalities can be included in the model to analyse their mutual impact on each other. Another element of SD is to check the robustness of the system against external shocks (oil crisis, inflation, …).

Having said this, it is obvious that SD is very useful for our purposes to analyse the complex nature of the transport system and the interaction between the economic, social and ecological dimensions of durable development. We will be able to trace trade off mechanisms and tax Transferable Mobility Rights (TMR) on its achievement to cope with the various transport externalities like emission, congestion, light and noise pollution, traffic accidents, and so on. The system of stabilising and destabilising feedback loops will also show its usefulness in portraying the working of the market of TMR and the establishment of the TMP equilibrium price.

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[1] COASE RONALD H., *The problem of social cost,* Journal of Law and Economics, vol. 3, 1960, p. 1-44

The advantages of SD are though not without problems. Defining the proper variables, identification of causal relations and feedback mechanisms is crucial. In a first phase those are shown in a so-called "causal loop diagram", or "influence diagram". This diagram shows the interaction between most import variables and also the underlying feedback structure by which a first idea can be made of the causes of the problem in order to formulate policies. In the diagram one can come to new insights and see causalities which before were difficult to recognize. This may even be a step towards a redefinition of the policy to approve its effectiveness.

The making of the influence diagram is usual a group process through debate between the partners. The identification of variables and relations are made up with the help of common sense, empirical material and historical evolution of some variables. The input will first be drawn from the general introduction to TMR, after which follows interaction between the partners. Also the comments of the "counsel group" will be used to the end of constructing the influence diagram.

In a second phase the variables, the relations between them and the impact of the feedback loops are quantified. To that end, equations are constructed and data is integrated in the model. Final, the various possible designs of TMR are simulated and propositions for amelioration of the policy instrument are made.

3.3. Legitimacy

3.3.1. Research activities in year 1

With respect to the study of the public and political support for TMR, this first research year can be seen as a preparatory year in which three activities took place:
- Exploration of the TMR-instrument focussing on important aspects from a public support point of view;

- Exploration of the public & political support for instruments to control transport demand;

- Elaborating the research tools to investigate the public and political support for TMR.

1. Within the first year of the project, considerable time has been invested in exploring the instrument of TMR. We went through the literature both on existing tradable rights systems in other policy fields (such as environment) and on existing systems, plans and possibilities to introduce tradable rights in the mobility sector. Main focus was on all relevant aspects of a TMR-system from the point of view of public and political support. The literature review was also valuable as input for the construction of the three scenarios (task A2) and to fine-tune the research hypotheses with respect to public and political support for TMR.

2. We also tried to gain insight into the state of affairs of the public and political support for the overall target of controlling mobility demand and of the role of different kind of instruments aimed at controlling the mobility demand in general and to control road traffic more specifically. For this purpose, we read through most important international, European, federal and regional policy documents, attended several seminars on the topic of controlling

transport demand (see 'seminars' in the references) and reviewed recently finished studies on the public & political support for instruments to control the mobility demand and. This research step was important as a background to elaborate the research instruments for the public and political support study as stated in the technical annex.

3. Thirdly, we explored the methodologies to be used to measure the public and political support for TMR. More concretely, we went through the more technical literature on how to use the Policy Delphi-technique (in what cases feasible, what can be reached, how to set up the questionnaires, who to involve as group of experts, how to process the information obtained from the survey, etc.). We also have had several brainstorming sessions on how to combine the Delphi-technique for studying the political support on the one hand with the focus groups aimed at studying the broader social support of different target groups on the other hand: how to combine these two in timing, who to involve in which way, etc. Several scenarios were taken into consideration. This step resulted in the first round Delphi-questionnaire, a working plan for the following rounds, a selection of the expert team. For the focus groups, a first concept of the methodology is set up.
In the following sections 3.1.2 and 3.1.3 we report on these first research steps.

3.3.2. Research hypotheses and research questions

3.3.2.1.   Refinement of the research hypotheses

Taxation schemes, although considered by many scientists as the most efficient instrument to internalise extern mobility costs (such as congestion, environment, traffic safety) don't receive many support neither from politicians nor from the broader public. People consider it as just another tax, having not much effect and last but not least being unfair. In discussions on road pricing it is often heard that it is not fair that essential car trips made by 'poor' people should be priced off the road at the expense of non essential trips made by 'rich' drivers.
In this respect, tradable mobility rights have the potential as an attractive alternative for taxation schemes as they can combine the efficiency of pricing mechanisms with a fair social redistribution mechanism (between car users and non car users, between people living in cities near to their job and people the country and being more dependent on car use, between low income and high income groups).

Some preconditions that need to be fulfilled, are:
- There must be a consensus/an agreement about the **problem formulation** and about the **targets** to be set. What do we want to achieve with this TMR-system and what is the time path to achieve this?

- The public and political support is likely to depend on the **target group** aimed at (are we addressing the system towards the economic agents (companies, car manufacturers, …) or towards individual road users, are we focussing on freight transport and/or transport of persons, and on the **target area** (are we speaking about a solution for a congested area/road or for Europe as a whole).

- The **initial distribution of the mobility rights** is highly important; can we come to a 'fair' initial distribution of the mobility rights all stakeholders agree with?

- Public and political support is highly dependent on the **transparency of the system**: who will take which responsibility in the new system: Registration of rights, enforcement, etc. (Institutional questions).

3.3.2.2. Research questions

We repeat here the research questions as taken up in the technical annex of the network project:

1. What are the differences in political support between different actors in the policy field of mobility? What is the opinion of the private economic sector with respect to tradable mobility rights? How do policy makers react on this new policy tool? Are there differences in opinion between different policy levels (federal, regional, local)?

2. What is the political support for tradable mobility rights compared with other (market and non market) policy instruments that are aiming to steer the mobility towards more sustainable transport modes?

3. What kind of arguments are advanced for and against tradable mobility rights? Are there differences between the different types of actors?

W.r.t. the study of the public support:

4. Are there differences in public support between different subgroups within society? For example, is the public support from urban population different from the public support from the population living in the country? Are there differences between different age groups, between socio-economic groups, etc.?

5. What can government create a large public support for a TMR-systems? What arguments can government use to counter prejudices and resistances?

3.3.3. Research methods: developing research instruments

The political support for a system of tradable mobility rights (TMR) is investigated in depth by means of a Policy Delphi type-method. The broader public support for TMR is investigated within focus groups with preliminary individual interviews.

3.3.3.1. Policy Delphi research for the study of the political support (Task C1 technical annex)

A Policy Delphi method is a systematic method for expert interviewing which is used to handle conflicting ideas and to analyse all pros and cons. It makes it possible to deduce the different groupings of opinions. Three elements are typical for a Delphi research:

1. The guarantee of anonymity of the participating experts and their opinions during the research. No direct confrontations are taking place as opposed to round table conferences;

2. Indirect communication between participants by means of a structured feedback of information obtained from the preceding interview round. The expert interviews are

conducted by means of semi structured written questionnaires in different rounds with the findings of the preceding round are submitted to the expert in the following round.

3. A statistical representation of the answers of the total group of experts. In this way, each expert can rank his own opinions within the whole group and makes him possible to revise its argumentation based on the information from others.

For the investigation of the political support for a new policy tool such as TMR, the Policy Delphi method is of special interest. It offers good opportunities to further develop the instrument based on input from the experts. More over, the interviewing in different phases provides the opportunity to introduce new information sources from outside (such as interesting cases and research findings with respect to feasibility and socio-economic effectiveness, study object of the other network partners of this project).

The following six steps in a Policy Delphi research are distinguished:

1. Problem formulation. What issues are essential and need to be brought under attention? How do these have to be formulated?

2. Given the problem, what are all different policy options available?

3. Determining the initial positions of the group on the issues (problem perception + alternatives). Which are the ones everyone already agrees upon and which are the unimportant ones to be discarded? Which are the ones exhibiting disagreement among the respondents?

4. Research of the different arguments and reasons for disagreement. What are the underlying assumptions, views or facts used by the individual respondents to support their respective positions?

5. Assessment of the underlying reasons. How does the group of respondents assess the separate arguments used to defend various positions and how do they compare to one another on a relative basis?

6. Re-evaluation of the options. Reevaluation is based upon the views of the underlying 'evidence' and the assessment of its relevance to each position.

In the current Delphi-type research on public and political support, we try to adopt these steps into two written Delphi-type questionnaire rounds followed by a round table conference.

A. Composition of the group of experts for the Delphi research

The two most important requirements for the composition of the group of respondents within a Policy Delphi survey is that this group represents a wide spectrum of opinions about mobility policy. At the same time a minimal expertise in the field of mobility policy issues and the relation with the society are needed.

Roughly speaking, we aim to reach a quotum of 60 effective respondents that will participate in the policy Delphi research in the two interview rounds. Therefore we select a group of 100 experts to take account of possible drop-out in the first round. As we are not fully informed on who are the persons most suited to involve in the survey, we opt for what is called the snowball-procedure in combination with the 'reputation method'. This means that about 50% of the sample (50 persons) is selected on the basis of their formal role or function within their organisation. They will be contacted both by e-mail (or mail) and by telephone to ask for their

participation. All other respondents are traced via information on their reputation based on these first contacts.

We distinguish three groups within the sample: policy actors, mobility actors and user's organisations. Each group will be represented more or less proportionally.
Policy actors. First of all, experts from the policy field need to be represented. Differentiation with respect to policy domain (mobility, infrastructure, finance and environment), administrative level (federal, regional, local) and type of responsibility (inspection, administration and policymaking) is important. Based on this classification, we hope to find an interdisciplinary group with respect to educational background.

Within the group of **mobility actors**, we distinguish three subgroups: employer's organizations representing the biggest transport generators, the suppliers/representatives of the different transport systems (train, bus, private car, bike) and knowledge centres (universities and study centres).

The group of **user's organisations** need to give a large spectrum of different groups in society (youth associations, association of young families, senior organisation, etc.). Next to this subgroup, representatives of the users of the different transport systems are an import subgroup (the public transport users associations, bikers' association, car drivers associations, ..). A third important subgroup are trade unions, as they represent one of the most important group of road users and therefore stakeholders.

B. Questionnaire structure

We opt for a policy Delphi type survey in two written rounds followed by a seminar in a third round.

ROUND 1

In the first written survey round, three blocks of questions are taken up.
- In **Block 1**: we want to know the opinion of the panel members with respect to the relation of transport and sustainable development. How important do panel members perceive the negative effects of transport on the environment? To what extend can problems of traffic unsafety, traffic noise, air pollution, … be related to the sharp increase in car use. Is a stricter control of the mobility demand needed to bring about a change in these negative trends. Do we need to travel less by car?

  Questioning method: statements about seriousness of problem fields, about the strength of the link between car use and problem fields; about the extent to which control of the mobility demand can tackle the problems. The respondents can answer on a 4-point scale and are invited to give their underlying argumentations.

- **Block 2**: We want to know from the panel members which are perceived effective instruments to control the mobility demand and which are not? We give a summation of different types of instruments and ask expert's opinions about effectiveness, possible side effects and feasibility.

Questioning method: statements about 5 types of measures and their effects towards controlling the mobility demand are given. We ask for their perceived effectiveness, possible side effects and feasibility. Also here, respondents are invited to answer on a 4-point scale with the explicit invitation to found their answers.

- **Block 3**: focus on the instrument of tradable mobility rights. A short explanatory text is provided about this instrument, its main principles, inspiration and ways for concrete implementation. First reactions are asked about feasibility, effectiveness and possible side effects (negative and/or positive).

Questioning method: open questioning round. Purpose is to have first reactions of all respondents about this instrument.

ROUND 2

In the second questioning round, all group results from round 1 (especially **blocks 1 and 2**) are processed and presented for further argumentations and/or possible revisions of opinions (minimal statistical concepts such as the group median, .. are applied). All argumentations are taken up as new statements to ask for their relevance.
The answers to the open questions in **block 3** are regrouped into statements with underlying argumentations so that all respondents can take position in each other's opinions. Respondents can respond on these statements on a four point-scale.
An additional **block 4** is taken up in round 2 in which intermediary results from the other network partners can be 'seeded' as part of a reaction to comments made by panel members to the TMR-system in the first round. This new 'seeded' material from outside is subject again for argumentations by the respondents.

ROUND 3

In a third round, we would like to invite all respondents to a round table conference to allow for direct interaction between the network partners of the research project and the respondents of the Delphi survey. At this round table:
- the results from the past two Delphi-rounds will be discussed upon

- the results from the other research parts of the network project, namely the findings of the effectiveness study, the feasibility study and of the study of the broader public support (results from the focus groups) can be discussed.

This third round in the form of a round table will be part of the dissemination activities taken up under task D (of the technical annex).
In the following scheme, we summarize the Delphi-survey –structure.

Question rounds→ ↓Questions/items	*Delphi round 1*: written questionnaire	*Delphi round 2*: written questionnaire	*Round 3*: Round table with network partners and Delphi participants
Block 1 questions: Perceptions on problem formulation+ objectives	Statements on a 4-point scale demand for argumentations	Presentation of group position, refinement of arguments, repositioning of	Summary results: problem perception + objective formulation: end

		respondents	comments of the panel
Block 2 questions: Perceived effective-ness of policy alternatives	Statements on a 4-point scale demand for argumentations	Presentation of group positions, refinements of arguments en/or repositioning of opinions	Summary of results on perception of policy solutions: end comments of panel members
Block 3 questions: Perceived effective-ness of TMR	Explanation of the TMR-instrument + open questioning for first reactions	Formulation of statements + demand for further arguments	Presentation of group viewpoints, refinement of arguments and/or re-positioning of opinions
Block 4 questions: Integration with research results VUB and LUC, LV		'Seeding' of results of the research (as part of reactions on block 3/round 1)	Refinement of arguments and/or repositioning of argumentations

3.3.3.2. Focus groups with preliminary individual interviews (task C2, technical annex)

To investigate the broader public support for the TMR-system, we plan to organise focus groups. These focus groups are group discussions in which the researcher offers the theme or focus for discussion and moderates the group. Because of the considerable complexity of the mobility theme and the proposed policy tool of TMR, it seems useful to first organize an individual written interview round. In this way, the researcher can better compose the focus groups and can use some individual discussion points within the group discussions. For the participants in the focus group, the preceding individual interview is needed to get used to the main elements of the TMR-system before discussing it in group.

A. Concept for the focus group meetings

PREPARATORY STEP

In this preparatory step to the focus group, we let participants think about their actual mobility situation, and more concretely about their own car use (themselves and other household members if any). All participants should collect and provide information about:
- the total amount of car-kilometres (approximately) currently driven by all household members on an annual basis; rough indication about current use of PT, bike, etc..

- the total amount of car-kilometres, roughly split up by travel motif (e.g. commuting, leisure, shopping, …) and by member of the household. Rough indication of use of PT and bike by travel motif.

- Information about living environment - car dependency: distances between home and school, cultural facilities, sports club, bakery, etc.

In this way, participants have taken a first step in thinking about their car use. For the researcher, it provides important background information of all participants.

FOCUS GROUP MEETING

Introducing and structuring the discussion of TMR by the following questions:
1. Imagine that the government decides to rationalise car kilometres per person per year to X kilometres (every one has the right to drive XX kilometres):

- what would this imply for your personal/household situation? (deficit – surplus situation?)

- Possibility to shift mobility from car to other modes? For what kind of trips? Restriction of overall mobility?

- Is there something government can do to make this 'drastic' measure' more acceptable?

2. Imagine that you could buy extra mobility rights in case of deficit or sell your surplus of rights, would you do this? Does this make this measure acceptable to you?

B.   Number of focus groups and their composition

The ideal number of participants within a focus group is between 6 (a minimum to have a good discussion) and 10 (a maximum for a good moderation) persons. About 4 different focus groups are needed to draw relevant conclusions with respect to public support for MOR. The first focus group will be composed of a heterogeneous group of participants (different living conditions, socio-economic profile and age structure). Afterwards, we will evaluate whether or not to segment the focus groups into more homogeneous groups.

4. Detailed description of the intermediary results, preliminary conclusions and recommendations

4.1. Feasibility

4.1.1. Theoretical Literature

In the first part of the research project, we have studied the theoretical literature available on tradable (emission) rights. Within the wide range of policy instruments to reduce emissions, transferable permits are currently gaining interest. They have been analysed largely (and positively) in the literature from a general and theoretical perspective. Tradable permits seem to be an effective instrument for the emission reduction of larger point sources (sources which are well-defined, such as a factory smokestack) and for air and water pollution (for instance the U.S. Acid Rain Program), while taxes can be used to reduce the emission of smaller or non-point sources (sources whose emission points are not readily identified, such as fertilizer runoff from farms). Virtually nothing has been written about the practical implementation in specific industries such as transport. Therefore, we have analysed the available literature

about emission rights to obtain all the design elements of introducing a tradable permit system.

Economists divide the different policy instruments to obtain environmental goals in two categories: the 'command-and-control' and the 'market-based' instruments. The traditional command-and-control policy sets standards, norms or technical regulations and so imposes environmental behaviour on firms. Already during decennia economists believe in a market-based approach in protecting the environment. In the literature review, all different market-based instruments are discussed and a comparison is made between taxes and tradable permits with their advantages and disadvantages. We can conclude that a trading system should be designed to the following general principles:

- Effectiveness, which requires a successful evaluation, monitoring and verification;
- Economic efficiency, which demands minimization of transaction costs;
- Equity, which means that no interest groups should gain an unfair advantage;
- Social and political acceptability, which is an indispensable condition for practical implementation.

Secondly, the academic theory on emission rights is discussed in detail. Different design elements are taken into account: geographical distribution, allocation aspects (free distribution, grandfathering, auctioning, updating), cap and trade, banking and borrowing, transaction costs, technology, implementation path, target group and monitoring & enforcement. The most important design elements are summarized in the following table:

Design elements	Examples	Remarks
Nature of the permit	- SO2 permits - Fishing permits - Water permits - Mobility permits	- Duration of the permit - Right to use, to consume, to pollute,… - Banking versus borrowing (inter-temporal trade)
Initial allocation	- Grandfathering - Auctioning - Free - Updating	Who obtains the tradable permits and at what cost?
Reporting / Monitoring	- Continuous measurement of SO2 emissions - Voluntary reporting	- Transaction costs - Measurement costs
Enforcement	- Fines - Reduction of permits in the next year	- Enforcements costs - Who is responsible for the enforcement? - Upstream versus Downstream

Finally, already existing cap-and-trade programs, such as the U.S. Acid Rain Program and the California RECLAIM program, have proven that emissions trading have considerable impact in practices, as well as in theory. They are also analysed in the literature review.

The most important conclusion of the literature review is that efficient competitive markets for tradable permits can arise from a good development and implementation of the program.

The experience in the U.S. Acid Rain Program has learned us that a tradable permit program on a large scale can work as described in the literature. By giving flexibility at polluters together with a good enforcement regime, the program will attain the environmental objective and will reduce the compliance costs. An important remark is that tradable rights are only suitable for some environmental problems. When an isolated firm will emit harmful substances in a residential quarter, it is not recommended to use tradable permits. In this case an effective regulation is more adequate, even for economists.[2]

4.1.2. Classification and evaluation of alternative TMR systems

In our modern world, sustainable development has become a worldwide policy goal. The E.U. states that sustainable development must be the central goal in all policies. The standard definition of sustainable development is: 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland report (1987): United Nations World Commission on Environment and Development). It is a strategy that requires the integration of economic growth, social equity and environmental management. Meteorological observations show that since 1900 the European average annual temperature has increased with 0,3 to 0,6°C. Furthermore, climate models predict a further increase of approximately 2°C in 2100 compared to the 1990 level. To make sure that the further increases in temperatures are limited to maximum 0,1°C each decennium, the industrial countries have to limit their green house emissions (Carbon Dioxide, methane,…) by the year 2010 with at least 30-55% with regard to the level of 1990.

These reductions are much higher than agreed in the Kyoto protocol. It is unlikely that the E.U. will achieve these CO2-reductions since the most recent 'business-as-usual' scenario of the European Commission (made before Kyoto) indicates an increase in CO2 emissions of about 8%, with the largest increase in the transport sector (39%). Since these trends are not sustainable, the necessity of a sustainable transport network is obvious. This will only be possible by combining technical solutions for reducing emissions, enhancing the energy efficiency of engines and slow down the growth of vehicle kilometres travelled. Therefore, in this research project, we develop three scenarios of TMR.

Tradable car kilometre rights
A first scenario (first-best option) is the system of tradable car kilometre rights (TCKR). The cap is determined based on the total amount of car kilometres of the reference year (here: 1998). The target group is the individual European fuel user. The allocation to individuals can occur based on different criteria, such as age, location, income, economic activity, family composition, etc. Here we opt for an allocation based on age, with a division in three age categories: from 0 to 18 years (youngsters), from 18 to 65 years (active) and above 65 (retired). The allocation will occur as followed:

Number of permits = Total amount of car kilometres of all drivers in Europe in 1998
                    Distribution among the different age categories

One tradable car kilometre permit corresponds with one car kilometre. The permit duration of the TCKR is set on one year. Imposing a time limit on the use of TCKR offers a convenient administrative mechanism for monitoring and controlling on an annual basis. TCKR issued at

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[2] References that are used in the literature review are included in annex.

the beginning of a year would simply expire at the end of the year, and new ones would be issued for the next period. Banking (transfer of the rights to the next year) and borrowing (borrowing TCKR of the next year to use this year) is not allowed. Banking could have as a consequence that the tradability after some time would show a cyclical pattern. TCKR can be traded on a specific auction, where the laws of demand and supply apply. For reasons of social justice, the TCKR should be distributed for free. Individuals who do not use their annual rights, can sell them partly or entirely to others who need more at the daily market price. These prices are established by the traditional stock market exchange principles. Financial institutions act as an intermediate player between buyers and sellers. By using these existing institutions, transaction costs and other operational costs are minimized.

Existing technologies can be used for the implementation of a TCKR system. The system of depreciation and recharging of permits should ensure that privacy is not invaded, that it is interoperable between Member States and that all users are treated in a non-discriminatory way. Furthermore, it should be a cost-effective (low maintenance and transaction costs), easy to use, fraud-resistant, safe, physical accessible and reliable system. The technology is an electronic card that is put inside the car and without this it is impossible to start the car. The depreciation will occur automatically. When there are not enough TCKR available on the chip card, the car will block automatically.

The monitoring will occur downstream, this means at the level of the different consumers. The system has already an internal monitoring mechanism because the individual will not be able to drive without enough rights. The existence of severe penalties has a deterrence effect, and individuals will want to avoid offences.

The system described above is a scenario that only can be implemented on a long term, this because of the necessary technological developments (for instance, all the cars need a GPS-system), but also because of the political and public support of the system.

Tradable fuel permits
The second scenario is a system of tradable fuel permits (TFP). The cap of the system is set on the total vehicle kilometres of the reference year (1998). The allocation to each Member State will occur based on the average energy efficiency of fuel, divided in gas, diesel and LPG. This average may vary because of discrepancies in used technology between the Member States. The permit duration is also set on one year. Banking and borrowing is not allowed. The TFP will be distributed for free. Not everybody will receive the same number of permits but different age categories will be distinguished: between 0 tot 18 years (youngsters), between 18 and 65 years (active) and above 65 years (retired). Organising this system this way does not necessarily imply a tax and gives a certain amount of freedom to individuals. We choose for an implementation on a European scale because of the greater number of market players and to vindicate the free movement of goods and persons in the E.U. Moreover, the European Commission aims at an integrated approach of the mobility problems in all the Member States.

The technology is an electronic card that discharges TFP when refuelling. Terminals will be situated at gas stations. Crucial is that it will be impossible to refuel without using this discharge card. Public transport operators can integrate the TFP into the ticket price or passengers can transfer the rights by discharging their card when buying a ticket. Recharging the card can take place at bank terminals at sales offices and via an individual internet account

number. Due to the already widespread use in the E.U. of chip cards, operational costs will be minimal.

The monitoring in the TFP system should be organised upstream, at the level of the different fuel producers and importers. For their fuel sold, they have to present a proportional amount of TFP. Under the TFP system, the main enforcement issue is the avoidance behaviour. Although the system will be introduced on a European scale, the problem remains of people who cross the border to refuel. Because it can be expected that all the incoming traffic will have a full gasoline tank, the problem can be solved by forcing all the outgoing transport to refuel before they cross the border.

The actual introduction of the system will be set up in a well defined pilot area. This pilot project of 2 or 3 years will test the effectiveness and will give an estimation of the expected administrative costs. Besides the political acceptance on a European level, the administrative costs and the social acceptance are from a decisive importance. The introduction of the TFP system will require a lot of political courage. The costs of the administrative preparation, the political conclusion formulation and lobbying are very difficult to estimate. After the first agreement between the Member States, the necessary legislation also has to be developed. As an indication for the actual introduction of the system, a period of 5 to 10 years can be expected.

Tradable Access Rights
Initially the tradable access rights (TAR) apply to Antwerp and Brussels. These cities have each day traffic jams to enter and leave the city centre. This reduces the liveability in the cities. A system of TAR can be expanded to the ring around Brussels, the ring around Antwerp and other areas. The target group is the car driver but also the lorry traffic is included. The residents of Antwerp and Brussels will receive a certain amount of rights for free, in comparison with non-residents. They have to buy their rights at the auction. The TAC are valid from 7 a.m. to 8 p.m. and for all private cars and lorry traffic during week days to enter the city. No rights are necessary for leaving the city centre. The cap will be determined based on the number of residents above 18 years old in the city centre. One TAR is equal to the access to the city centre during one day.

The monitoring of the use of TAC will occur downstream, at the level of the different consumers. Automatic cameras will check the presence of TAC to enter the city. Vehicles without an access right will receive a fine at home. The fine has to be high enough to enforce the permit system.

4.2. Socio-Economic Effectiveness

Defining the scope, variables and relations of the system was a difficult task and was the subject of much debate between the collaborating partners of the project. A debate that is certainly not unusual in the light of the characteristics of the system dynamics methodology. As mentioned this phase is a crucial step to formulate an effective policy.

The difficulty raised especially in finding the links between the derived, the fragmented, and time-and-place bounded character of the demand for transport and a specific design of TMR in order to reduce the externalities. After cooperation and the insights delivered by initial influence-diagrams some decisions were made with regard to choice and design of TMR and

elements that should receive particular attention. In the following sections some of the discussion issues will be described.

With regard to tradable permits in car kilometres (TCKR) aiming at reducing CO2-emission special attention in the model should be given to what kind of transport will be reduced. Probably working people will in the first place cut their car use for leisure ends. When the growth mechanism of traffic in peak hours, and thus congestion, are not affected, the paradoxically effect may be that that emission will not be reduced, or even may be rising. A specific element of importance for tradable fuel permits (TFP) is to include the different consumption and pollution of gasoline and diesel. Tradable permits in driving days and tradable permits in car property were considered to have too less direct impact on externalities. Tradable Congestion Kilometre Permits (TCP) were also discussed. Commuter traffic takes the biggest part of car transport and the change in commuter traffic by car is the most difficult to achieve. Moreover, rush hour traffic is more tangible than emission which can result in a warmer welcome of the policy measure. TCP will avoid emission paradoxes, but on the other hand attention should be made if reducing congestion (and thus reducing emission in peak hours) reduces total emission. Reducing congestion has also a direct relation to economic costs by reducing time waste, stress and the hindering of business and freight transport. The same is true for tradable parking permits (TPP), on the condition it concerns parking places at the work place.

What ever design of tradable permit chosen the impact of the TMR on social welfare and well-being should receive attention since TMR leads to important reorganization of the activities and has income distribution effects. Also the availability of alternatives (like for example public transport and organisation of car pooling) should be integrated in the model to evaluate if mobility possibilities are not radically hurt. Final the redistribution in car use along the heterogeneous car users (retirees, students, working people, unemployed, …) needs also attention to evaluate social welfare effects. By integrating these elements in the model propositions for a social equitable distribution of TMR can be done.

Concerning the organisation of the market the conditions of perfect competition, should be given reflection. Those conditions are the economic agents should be more or less equal as well as in budgets as in information and access to the market. Trade should be in a uniform, homogeneous product so side effects (and thus externalities) on other "products" are prevented. In the case of TMR all those elements are important in the light of the mentioned characteristics of the demand for transport and to choose amongst other the elements of the TMR like the geographical scope and the distribution in target group (age income, economic activity, family, and so on. Finally the setting up and functioning of a market, just like the building of control mechanism brings transaction costs, which should be integrated in the model to evaluate efficiency.

Concluding, the discussion has led to, although some uncertainties remain, to define variables, scope, and some relations. Those can now relatively easy be used to correct the existing influence diagrams on modal split, congestion and working of a market for TMR, and be used to set up other influence diagrams.

4.3. Legitimacy

Not available yet.

5. Future Prospects and future planning

5.1. Feasibility

In the next year the literature review will be finalized. Also the three scenarios will be further described, especially the last scenario of TAR.

The three approaches (feasibility, socio-economic effectiveness and legitimacy) need to be summarized in an integrated and consistent report. Also the policy conclusions need to be made. This integrating and concluding final report will be mainly done by the LUC.

5.2. Socio-Economic Effectiveness

The mentioned existing influence diagrams will be adapted and other influence diagrams portraying some specific interactions and causes of main variables will be made. A standard influence diagram will be made for the working of a market in TMR. In first instance this will result in various influence diagrams but they will then be integrated in one model for each design of TMR.

The quantification of the relations and effects will be realised, by defining measure units, setting up equations and integrating the necessarily data. The validity of the model will be tested. Finally the behaviour of the system in time will be simulated, the robustness of the system against external shocks will be checked, and the elements of the TMR (geographical scope, trade system, attribution, validity term, and so on) will be analysed in order to optimise the policy instruments.

Each step will be presented at the "counsel group" of experts and the collaborating partners for comments.

5.3. Legitimacy

- Conducting the two written questionnaire rounds of the Delphi-research, as described within 3.1.3.1
- Organizing the 4 focus groups, as described within 3.1.3.2.