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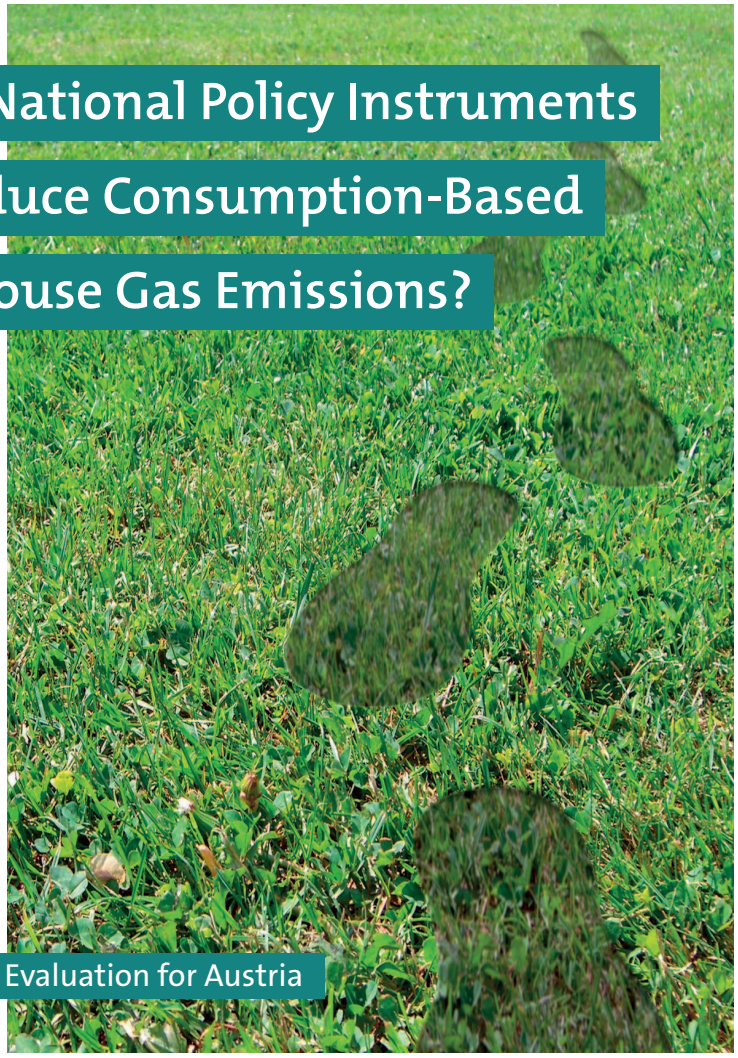
Which National Policy Instruments Can Reduce Consumption-Based Greenhouse Gas Emissions?



A Qualitative Evaluation for Austria

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ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

WHICH NATIONAL POLICY INSTRUMENTS CAN REDUCE CONSUMPTION-BASED GREENHOUSE GAS EMISSIONS?

A qualitative evaluation for Austria

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SUMMARY

This report summarises the results of Work Package 3 (Tasks 3.1, 3.2 and 3.4) of the INNOVATE project, an international research project supported with funds from the Austrian Climate and Energy Fund. The project was carried out from 2015 to 2018 by researchers from the Wegener Center for Global and Climate Change at the University of Graz (project lead), the Sustainable Europe Research Institute (SERI), the Environment Agency Austria (Umweltbundesamt GmbH) and international partners from Bonn, Oslo and Manchester.

The aim of the INNOVATE project was to analyse Austria's consumption-based greenhouse gas emissions and to design and evaluate possible policy instruments for mitigating them. Compared to the traditional, production-based principle of emissions accounting, consumption-based accounting captures not only the emissions produced on national territory, but rather the total emissions arising along the entire production chain of the goods and services consumed within a country, both nationally and internationally. Thus, policy instruments addressing consumption-based emissions target the global emission consequences of domestic consumer behaviour, which is particularly relevant given today's international production and trade patterns. Accordingly, Austria's emissions using consumption-based accounting are about 50% higher than those recorded using the production-based principle (MUÑOZ and STEININGER, 2015).

In this report, a set of 15 possible policy instruments suitable for mitigating Austrian consumption-based emissions is described and evaluated qualitatively. The instruments address the "hotspot" sectors driving Austrian consumption-based emissions identified in Work Package 1 of the project: construction, mobility and public healthcare (see STEININGER et al., 2018).[1] The design of the policies builds on a survey of international good-practice examples of policy instruments undertaken in Work Package 2 and takes into account Austria's specific circumstances in terms of its economy, demography, housing, transport, welfare and healthcare systems (KAMMERLANDER et al., 2018). The policy instruments are evaluated according to the following criteria: environmental and cost effectiveness, distributional impact, political feasibility and flexibility. Experts from Environment Agency Austria as well as external stakeholders from regional governments, NGOs and other interest groups were involved in designing and evaluating the instruments.

The results of the qualitative evaluation suggest that incentive-based instruments – e.g. a carbon-added tax on construction materials and higher vehicle taxes for emission-intensive cars – as well as instruments targeting infrastructure provision and the healthcare sector are most effective in terms of emissions reduction. The most cost-effective instruments tend to be regulatory – such as an information obligation on vacant dwellings and regulatory changes regarding the healthcare sector – but also incentive-based. Information-based instruments like certification schemes perform best in terms of feasibility and flexibility.

The appraisal of the latter two "soft" evaluation criteria is an advantage of qualitative evaluation methods. On the policies' environmental and cost effectiveness, this study is to be seen as complementary to the quantitative, model-based assessment in Work Package 4 of the INNOVATE project (NABERNEGG et al., 2018), which partly builds on Work Package 3.

[1] https://www.sciencedirect.com/science/article/pii/S0959378017304508?via%3Dihub

1 INTRODUCTION

EU-wide emission reduction targets by 2050

To limit global warming to below 1.5-2°C above pre-industrial levels, the European Union has set itself the target of achieving a reduction of 80-95% in greenhouse gas emissions by 2050 relative to 1990 levels (EUROPEAN COMMISSION, 2011). Intermediate EU milestones for 2020, 2030 and 2040 are reductions of 20%, 40% and 60%, respectively. The 2030 target of minus 40% has also been submitted as the Nationally Determined Contribution of the EU and its member states towards the fulfilment of the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC). Austria's national targets according to EU effort sharing legislation are reductions by 21% by 2020 and 36% by 2030 compared to 2005 (in the non-ETS sectors).

Production- vs. consumption-based emission accounting

The parties to the UNFCCC must report their greenhouse gas (GHG) emissions annually. For this purpose, emissions are estimated as they arise within the borders of each nation, which is known as the production-based accounting (PBA) principle. Thus only the emissions caused by the activities occurring *within the national territory* count towards national emissions, such as those arising from the use of fossil fuels in domestic transport, industry, households and offices. In today's globalised world however, where production chains are international, part of the emissions associated with the production of goods and services consumed in one country actually occur in other countries. Hence the main alternative accounting approach, the so-called consumption-based accounting (CBA) principle, instead takes as its starting point a country's final consumption and attributes all emissions arising *along the entire production chain* of the goods and services to the country where they are consumed.

Austrian consumption-based emissions are about 50% higher than production-based emissions

The difference in national GHG emissions recorded using these two principles is large and has been growing for developed countries like Austria with their integration into increasingly global trade networks since the 1990s. As Figure 1 shows, Austria's consumption-based GHG emissions are about 50% higher than those recorded according to the territorial, production-based principle used for reporting procedures under the UNFCCC. Thus, Austrian consumption of final goods and services adds to the production-based emissions of other countries, a phenomenon that is also known as weak carbon leakage. The fact that mitigation expectations under the Paris Agreement are less stringent for developing countries than industrialised countries (the principle of "common but differentiated responsibilities") further aggravates the problem.

The INNOVATE project

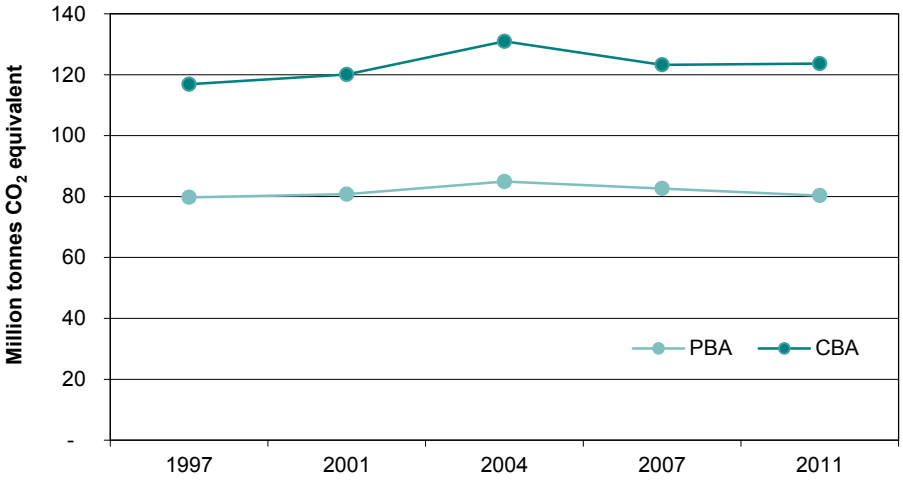
The divergence between territorial emissions and those induced in the rest of the world through domestic consumption behaviour has implications for the design of effective climate change mitigation policy instruments. To fully address the consequences of economic activity in developed countries, additional instruments targeting consumption-based emissions are needed to complement existing, production-based measures. The aim of the INNOVATE project, funded by the Austrian Climate Research Programme ACRP, was to develop and evaluate such instruments for Austria.

"Hotspot" sectors of consumption-based emissions

To this end, in a first step, Austria's consumption-based emissions were computed and the "hotspot" sectors driving these emissions identified (STEININGER et al., 2018): of the country's total consumption-based emissions in the year 2011, 62% were released outside Austria – 28% of which in other EU countries and 34% in non-EU countries like China, Russia and the US. The remaining shares arise on

Austrian territory (35%) and in international transport (3%). In terms of agents of final demand, the activities and consumption decisions of households are the main driver (68%), followed by companies and government. From the perspective of economic sectors, much of Austria's consumption-based emissions can be allocated to the "hotspot" sectors construction; public administration including defence, health and education, of which the public health sector constitutes the largest share; and sectors related to mobility, namely land transport, other machinery and equipment, and motor vehicles and parts (see Figure 2). From a production-based perspective, the top sectors driving emissions are different (electricity, iron and steel, non-metallic minerals), underlining the need to develop specific policies addressing consumption-based emissions.

Figure 1: Consumption- (CBA) and production-based (PBA) GHG emissions for Austria



Source: adapted from MUÑOZ & STEININGER (2015)

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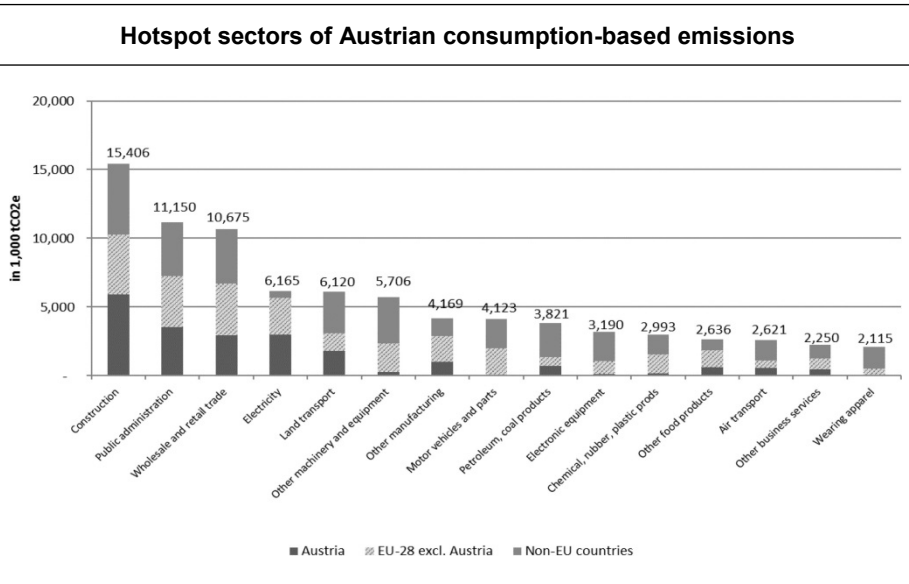
Figure 2: Hotspot sectors of Austrian consumption-based emissions, 2011



Source: STEININGER et al. (2018); available under a Creative Commons License

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Developing policy instruments to mitigate Austrian consumption-based emissions

The remainder of the project was concerned with the development and evaluation of possible policy instruments suitable for mitigating Austrian consumption-based emissions, focussing on the hotspot sectors identified above. The theoretical basis chosen for policy development is social practice theory, which considers human behaviour as largely habitual, consisting of routines and practices that are performed unconsciously and shaped by infrastructure, social norms and knowledge (e.g. SHOVE et al., 2012). In order to achieve less emission-intensive consumer behaviour therefore, a promising approach according to this theory is to intervene into the social practices producing the unwanted outcome, either by changing (re-crafting) an individual practice, replacing (substituting) it or by changing how several practices interlock (SPURLING et al., 2013). For the INNOVATE project, the focus sectors construction, mobility and public health were translated into the social practices of dwelling/working (private and office buildings), travelling/delivering (private mobility and commercial logistics) as well as healthcare provision, and international good-practice examples of policy instruments in these areas were collected. From these, a set of policy recommendations was distilled that is considered suitable given Austria's specific circumstances in terms of its economy, demography, housing, transport, welfare and healthcare systems, among others (KAMMERLANDER et al., 2018). These 15 possible policy instruments come from the classes of incentive-based (economic), regulatory, information-based (voluntary) and infrastructure provision instruments. In several cases, two types of instruments were combined (e.g. a regulatory instrument with an incentive-based one) in order to increase their performance.

Qualitative evaluation

This report describes the policy instruments addressing Austrian consumption-based emissions that were developed as part of the INNOVATE project and evaluates them qualitatively. A quantitative, model-based evaluation of a selection of these instruments is carried out in NABERNEGG et al. (2018). Compared to the latter, a qualitative evaluation has the advantage that the instruments can also be assessed according to "soft" criteria that are difficult to quantify, such as their feasibility and flexibility. On the other hand, regarding quantifiable criteria like cost effectiveness and environmental effectiveness, a model-based evaluation is able to capture the full general-equilibrium chain of effects, taking into account linkages and feedback between sectors along national and international production chains. The qualitative evaluation presented here instead provides an appraisal of the instruments' direct effects at the level of individual (economic or emission) sectors. Input was provided both by experts from Environment Agency Austria as well as external stakeholders from regional governments, NGOs and other interest groups who were involved in the project. The latter also provided suggestions for improving the policies' implementation and their public acceptance.

Structure of the report and results

The report is structured as follows. In the next section, a set of criteria for assessing the suitability of policy instruments in addressing consumption-based emissions is elaborated. These comprise the instruments' environmental and cost effectiveness, distributional impact, feasibility and flexibility. In section 3, the 15 policy instruments developed in the project are evaluated qualitatively according to these criteria, and the instruments are also described in detail. The results of the evaluation suggest that incentive-based instruments and instruments targeting infrastructure provision and the health sector are most effective in terms of emissions reduction; the most cost-effective instruments tend to be regulatory but also incentive-based; and information-based instruments perform best in terms of feasibility and flexibility. Finally, section 4 draws conclusions on the comparative performance of the instruments and identifies avenues for further research.

2 POLICY EVALUATION CRITERIA

Policy evaluation

The evaluation of policy instruments is a key component of the policy design process. In the early stages of this process, ex-ante evaluation supports the initial selection of suitable policy instruments according to a stated set of criteria; interim evaluation helps to identify and improve implementation issues; and ex-post evaluation provides a final judgement on the success of the chosen policy based on data gathered after implementation. Evaluation therefore serves, among others, the goals of accountability (demonstrating whether the policy "works" and the resources on it were well-spent) as well as learning and policy improvement (fixing what "doesn't work"). The practice of evaluating public policies, initially established in the second half of the 20th century in the United States and Canada, has by now become an integral part of EU policy-making (e.g. EUROPEAN COMMISSION, 2015; EUROPEAN COMMISSION, 2013).[2]

Definition of a consumption-based policy instrument

This section is concerned with establishing criteria for an ex-ante assessment[3] of potential policy instruments to mitigate consumption-based emissions in Austria. For our purposes, a consumption-based policy instrument is defined as one that influences consumption patterns in such a way that both national and global GHG emissions are reduced.

Minimum criteria

In our list of criteria, we include both minimum requirements for suitable policy instruments and additional beneficial principles that facilitate the instrument's successful implementation. Following the literature on environmental policy evaluation (e.g. PERMAN et al., 2011; GOULDER and PARRY, 2008; MICKWITZ, 2006) the minimum requirements are:

- **Environmental (climate) effectiveness:** Can the proposed policy instrument achieve the objective of reducing Austria's consumption-based emissions?
- **Cost effectiveness** (in lieu of economic efficiency)**:** Can the policy instrument achieve this objective at minimum cost?
- **Good governance:** Are the costs and benefits of the policy instrument ***distributed equitably*** across all social groups that are affected by the policy?

Additional criteria

Additional beneficial criteria we consider are:

- **Feasibility:** Is the instrument likely to be implemented in current circumstances?
- **Flexibility:** Can the policy instrument adjust to changing circumstances?

The first two criteria on effectiveness as well as the distributional consequences of the policy can be assessed using data on emissions, costs and benefits. The remaining criteria require qualitative judgements obtained through interviews with experts and stakeholders, for example. The following sections describe these minimum and additional criteria in more detail. We also discuss which emission mitigation instruments are most likely to meet the different criteria.

---

[2] See also http://ec.europa.eu/smart-regulation/evaluation/index_en.htm.

[3] Since the aim of INNOVATE is to develop new policy instruments for mitigating Austrian consumption-based emissions, *ex-post*, i.e. retrospective, evaluation is beyond the scope of the project, as this would require data on the actual effects of implemented policies. However, the comparison of policy impacts *ex ante* and *ex post* suggests that there is a reasonable degree of accuracy in the estimates of both approaches (HARRINGTON et al., 2004).

2.1 Minimum criteria

2.1.1 Environmental (Climate) Effectiveness

A policy is said to be environmentally effective if it achieves a specific environmental quality goal better than other policies. In the context of this project, a policy will be judged environmentally effective if it succeeds best in reducing – or at the least, not increasing – the GHG emissions embodied in Austrian consumption. Given this focus on emissions rather than other environmental outcomes, we will henceforth also refer to climate effectiveness.

According to the IPCC (2007), the environmental effectiveness of a policy "is contingent on its design, implementation, participation, stringency and compliance. For example, a policy that seeks to fully address the climate problem while dealing with only some of the GHGs or some of the sectors will be relatively less effective than one that aims at addressing all gases and all sectors." It is therefore, according to the IPCC, reasonable to assume that

- the more appropriate the design of a policy;
- the greater the likeliness and the degree of its implementation;
- the more participatory its creation and implementation process;
- the stronger or more appropriate its stringency and
- the greater the degree of compliance,

the better a policy will perform with regard to environmental effectiveness. Some of these points will be covered by other criteria below (likeliness of implementation covered under "feasibility", participatory issues covered under "good governance").

Ex ante, the climate effectiveness of consumption-based emissions mitigation policies is not easy to judge. In contrast to cost effectiveness, for which various cost parameters can reasonably be estimated in advance, the final effect on emissions – especially those arising in other countries – depends on a number of factors related to the production chain of the good or service affected by the policy. Hence applying a general approach across all policies, like specifying CO_2 mitigation potentials per annum, is difficult. Therefore our evaluation of climate effectiveness will, where the data are available, be based on ex-post figures from countries where similar policies have already been implemented or on case studies. An adaptation of the effects to the Austrian circumstances allows conclusions about their likely impacts. In summary, the relevant questions are:

Is the policy instrument generally suitable to achieve a reduction – or at least to prevent an increase – in consumption-based GHG emissions in Austria?
Does the policy actually achieve this goal when applied in practice?

2.1.2 Economic efficiency and cost effectiveness

Economic efficiency

In economic theory, the ideal criterion for policy evaluation is optimality. An optimal policy is one that is both economically efficient and maximises social welfare. Since measuring social welfare requires full knowledge of society's preferences however, economic efficiency alone is generally used when evaluating policies (PERMAN et al, 2011).[4] An economically efficient emissions abatement policy achieves an outcome that maximises the net benefits of emissions – i.e., their benefits minus their costs.[5] At the efficient level of emissions therefore, the marginal cost of an additional unit of emissions must equal its marginal benefit. At this point, there is no incentive to either lower emissions further or to raise them: the former would incur additional net costs, while the latter would leave net benefits to be exploited from reducing emissions. At the efficient level of emissions, all emitters face the same price for their emissions – that which equates emissions' marginal costs with their marginal benefits and therefore "internalises", by setting a price for, their previously unpriced negative effect on the environment ("externality"). Another characteristic of the efficient level of emissions is that it minimises their total cost. In practice however, achieving economic efficiency requires a level of information that is difficult to come by due to measurement problems regarding costs and benefits. Therefore, for some policy instruments, the efficiency criterion is only of theoretical interest.

Cost effectiveness

In this case, cost effectiveness is an alternative, weaker criterion that is frequently applied in policy evaluation. It will also be the main economic criterion for assessing the proposed policies in this work package. A cost-effective policy is one that achieves the desired amount of emissions abatement at least cost to society, i.e. one that minimises the total cost of emissions reduction over all emitters for a given amount of abatement. Like efficiency, cost effectiveness requires that all emitters face the same marginal cost of emissions reduction (but unlike efficiency, this marginal cost is not necessarily equal to marginal benefit). If emitters' marginal abatement costs were not equal, further cost savings could be obtained if the emitter with the higher marginal cost reduced abatement by one unit and the emitter with the lower cost increased abatement by one unit. In practice, the condition of equal marginal abatement costs is usually not implemented across all economic actors due to difficulties related to information and enforcement. Instead, a sectoral approach is chosen; for instance, the European Union's Emissions Trading System (ETS) only applies to emitters from energy-intensive industries, the energy generation sector and civil aviation. Cost effectiveness is a necessary condition, i.e. a prerequisite, for achieving an economically efficient outcome, which is one reason for the popularity of cost effectiveness as a policy evaluation criterion.

Different types of costs to evaluate

When assessing the cost effectiveness of a policy instrument, there are several different types of costs to consider. The most immediate ones are the costs of compliance with the emissions reduction policy by the actors in the targeted sec-

[4] Economic efficiency can be described loosely as a state of the world (an allocation of resources) such that every economic actor involved is as well off as possible; that is, no one can be made better off without making someone else worse off. This concept is also called Pareto efficiency after PARETO (1897).

[5] The benefits of emissions are equivalent to the cost savings accruing to firms when there is no policy constraining them to reduce emissions (abatement costs); the costs of emissions are the damages to the environment and human health.

tor, which could be businesses or households. These are evaluated from an overarching social perspective, that is, only real resource costs count, whereas transfers from one sector of society (e.g. firms) to another (e.g. government) do not. For example, the EU ETS requires companies to record their emissions and purchase emissions certificates for (some of) them at auctions. The cost of the first of these activities to the affected firms would fall under compliance costs, as would the costs of any other measures they implement to reduce their emissions, like a new technology or production process. Firms' expenses for purchasing emissions certificates would not be counted, as these represent a transfer of income to government rather than a real resource cost.

In addition, there are the administrative costs of monitoring and enforcing compliance to the policy. These cover the costs incurred by regulators and government agencies to implement the policy, such as setting up a registration platform for the ETS at national level, overseeing the certificate auctions, and employing staff to verify companies' recorded emissions as well as administering fines for non-compliers. These are also evaluated from society's point of view.

At the broadest level, there are economy-wide costs that arise as the changes triggered by the policy have knock-on effects on other sectors and factor markets. On the one hand, if firms pass on their compliance costs to consumers through the prices of goods and services and the general price level rises as a result, real factor returns decline, inducing a reduction in factor supply and hence an efficiency loss ("tax-interaction effect"). On the other hand, if the revenue raised by policies like taxes or the ETS is used to lower distortionary taxes, for instance in the labour market, factor supply will increase, leading to an efficiency gain ("revenue-recycling effect"). These general-equilibrium impacts can be substantial and even overturn the cost ranking of different policies before their inclusion (GOULDER and PARRY, 2008). In this report, only the first two types of costs will be included to assess policies' cost effectiveness. NABERNEGG et al. (2018) also evaluate the third, general-equilibrium type of cost, since they employ a full CGE model for policy assessment.

Overall therefore, the relevant question is:

> Does the policy instrument achieve its emissions abatement objective at minimum (compliance and administrative) cost to society?

2.1.3 Good Governance

Basic principles of good governance

Good governance underpins democracy and the rule of law. A European Commission White Paper (EUROPEAN COMMISSION, 2001, p. 7) has identified five basic principles of good governance which should underlie EU decision-making and the policy formulation process in general. These principles are the following:

- *Openness* is a characteristic of the way institutions work, take decisions and communicate with the general public. Among others, this requires using easily understandable language.
- *Participation* in the policy-making process – from conception to implementation – is important for creating confidence in the end results and the institutions delivering them. This requires an inclusive approach by governments.

- *Accountability* requires a clear division of tasks between legislative and executive processes, but also an acceptance of responsibility by Member States and other bodies that develop and implement EU policy.
- *Effectiveness* of policies is ensured if they are timely and deliver what is needed on the basis of clear objectives and an evaluation of future impact. Implementing policy in a proportionate manner and taking decisions at the most appropriate level is also important.
- *Coherence* requires that the policies in the increasingly numerous and complex tasks that the EU addresses, from climate to demographic change, must be mutually consistent and easily understood.

For this project, we consider from the policy evaluation literature (e.g. MICKWITZ, 2006) three common criteria that each require the policy-making process to be open, participatory and accountable. They are all linked to democracy and are as follows:

- **Distributional equity:** Are the costs and benefits of the policy equitably distributed across the social groups affected by it?
- **Transparency:** Are the processes of policy selection and implementation as well as the outcomes of the policy fully observable to outsiders?
- **Legitimacy (acceptability):** Does a broad range of individuals, firms and organisations – e.g. non-governmental organizations (NGOs) and interest groups – accept the policy?

The White Paper's "effectiveness" criterion is covered by climate and cost effectiveness above; "coherence" is not specifically included here but should be ensured by the overarching objective shared by all policies considered in this project, namely to reduce Austria's consumption-based GHG emissions.

Focus on distributional equity

For the evaluation in this report, the focus will be on distributional equity, as transparency and legitimacy depend on the particular circumstances of implementation. Hence the main question on good governance to be answered for each policy instrument is:

> Does the policy comply with the good governance criterion of distributional equity?

2.1.4 Comparing policy instruments across the minimum criteria

Types of policy instruments

When designing the policies suitable for addressing consumption-based emissions in Austria, care was taken to include different types of instruments: incentive-based (or economic) instruments, like taxes and subsidies – the EU emissions trading system ETS also belongs to this category; regulatory (or command-and-control) instruments, such as standards for abatement technologies (technology standards) or emission output (performance standards); and information-based instruments, e.g. labelling or information schemes and platforms; infrastructure provision was considered as an additional instrument in the mobility sector. This section offers a brief overview of the literature on the relative merits of these different instrument types across our minimum criteria, namely climate and cost effectiveness as well as good governance.

Comparison regarding cost effectiveness

Regarding cost effectiveness, if only the costs of complying with a policy from the point of view of e.g. firms are considered, incentive-based (economic) instruments are generally thought to fare best, in particular taxes on emissions. This is because a tax per unit of emissions generates equal marginal abatement costs across firms (equal to the tax), the condition for cost effectiveness as established above. Furthermore, this can be achieved without requiring knowledge of individual firms' abatement costs; knowledge of aggregate costs over all firms is all that is needed to achieve a given emissions reduction target via a tax, because individual firms will respond to the price incentive it provides. By contrast, regulatory instruments do require information on individual firms' production technology or emissions, depending on the instrument, to set the policy such that firms' marginal abatement costs are equalised. Given firm heterogeneity, it is unlikely that regulators have available the necessary information to achieve cost effectiveness. Another common type of incentive-based policy instrument, subsidies for emissions abatement measures, can in principle achieve an equivalent emissions reduction to a tax. However, by providing additional income to firms, subsidies may be an incentive for incumbent firms to expand output or for new firms to enter into the industry, so that in the longer term, the initial emissions reduction may be offset. Overall, subsidies are therefore considered less cost-effective than taxes. The same holds for taxes that do not target emissions directly but are instead levied on production inputs or on the final output (goods and services) the production of which causes the emissions. Examples include taxes on fossil fuels, electricity or air travel. Taxing emissions directly would be more effective both environmentally and in terms of costs.

These theoretical considerations on the merits of incentive-based instruments are based on the strong assumption that markets work efficiently, for instance in processing information (PERMAN et al, 2011). The case for regulatory and information-based instruments is more powerful in the more realistic setting of incomplete or asymmetric information and missing markets.

Once administrative costs are taken into account, the verdict on the relative cost-effectiveness of incentive-based and regulatory instruments may change. Some regulatory instruments, like technology standards, are inexpensive to implement, while gathering the information necessary to monitor and enforce an emissions tax may be quite costly. For example, imposing an emission per-mile standard on car manufacturers is cheaper than taxing a car's exhaust emissions based on information from periodic odometer readings and data on per-mile emissions from car inspection programmes (GOULDER and PARRY, 2008). Information-based policy instruments, as long as they are publicly sponsored, incur mainly administrative costs. They aim to foster a culture of environmental responsibility by increasing actors' awareness of the environmentally harmful consequences of their choices as well as of the available environmentally-friendly alternative options. Since they are generally not very costly but can have powerful long-term effects in altering behaviour, they are judged relatively cost-effective. However, this is more likely to hold in the long term than in the short term.

Comparison regarding climate effectiveness

Both regulatory instruments and taxes are generally thought to be climate effective if implemented well. Regulations stipulate the desired emissions reduction directly and therefore provide the most certainty regarding the abatement to be achieved. However, the effectiveness of regulations depends on deferrals granted and on compliance. For a tax on emissions to achieve the desired reduction target, it needs to be set at the right level to induce the required change in be-

haviour. Subsidies are considered less climate effective than taxes because of the incentive to expand output that the additional income might provide to firms, potentially overturning the initial emissions reduction. For information-based instruments, there is only limited evidence that they can induce substantial emissions reductions, but used jointly with other instruments, they can improve the effectiveness of the latter (IPCC, 2007).

Comparison regarding distributional impact

A policy instrument can have a distributional impact on different actors: on the one hand, on emitters vs. the government or other parties affected by emissions; and on the other hand, on households and the distribution of incomes between them. Both impacts have potentially large implications for the feasibility of the policy. Regarding the first group of actors, any instrument that imposes substantial losses on an industry or other interest group is likely to encounter considerable resistance. For example, a tax implies a cost for firms, while a subsidy implies additional income. Equivalently, a tax generates income for the government, while a subsidy requires additional expenditure. A similar argument holds for an emissions trading system where CO_2 allowances must be purchased by firms at auction compared to one where certificates are allocated to them for free by the government. Any instrument that entails a cost for firms can have long-term effects on the size of the industry: if profitability is reduced by a tax, the industry may shrink; if profitability increases due to additional income from a subsidy, the industry may expand. Therefore, taxes have the potential to engender strong resistance and tend to be less feasible. Accordingly, regulatory instruments, which impose smaller costs on emitters, are substantially more common today than emissions taxes.

Regarding household incomes, (emissions) taxes that are related to electricity and heating fuels tend to have regressive distributional effects, i.e. they take up a proportionally higher share of income for households at the bottom end compared to the top end of the income distribution. In general, policies with regressive distributional impacts should be avoided or neutralised by using the tax revenues to compensate social groups that are negatively affected by the policy ("revenue recycling"), for instance through tax rebates or transfers. This can help minimise resistance and thus ensure that implementing the policy is feasible. However, there are considerable difficulties involved in designing a distributionally neutral policy package while maintaining the incentive effects of e.g. a tax (PERMAN et al, 2011).

2.2 Additional criteria

2.2.1 Feasibility

This criterion refers to the ease with which a policy can be implemented. This depends on the degree to which the policy is adapted to the existing institutional constraints in society as well as the degree of support for the policy among various stakeholder groups (IPCC, 2007). The more agreement there is on the benefits of the policy across a diverse range of social and interest groups, the more likely it is to be successfully implemented. On the other hand, the more resistance the policy is met with by important stakeholders, the less chance it has to achieve its objectives. Therefore, the feasibility criterion is significantly affected by the policy's distributional impact: the larger the perceived financial burden on firms

or households, especially those that are already disadvantaged, the more likely the policy is to be regarded as "unfair" and thus encounter resistance. In general, incentive-based instruments like taxes are more difficult to implement than are regulations and information-based instruments.

2.2.2 Flexibility

This criterion captures the ease with which a policy can be adjusted in terms of stringency or scope as new information emerges. In general, it can be said that market-based instruments like the EU emissions trading system can adapt more quickly to new information than taxes, subsidies or regulations, which require enacting changes to a law and may be more difficult adjust (GOULDER and PARRY, 2008). Information-based instruments are also more flexible. However, all policies can be designed in a flexible manner, so that they allow scope for differential application according to the circumstances of the firms or households concerned.

2.3 Issues in selecting policy instruments

Trade-offs between criteria

As is clear from the preceding discussion, there is no single policy instrument that performs best on all criteria. On the contrary, choosing an instrument may require accepting significant trade-offs between criteria: regulatory instruments generally do well on climate effectiveness and distributional impact but may not be cost-effective; taxes are effective along both the cost and environmental dimensions but come at the cost of a possibly negative (regressive) distributional impact. Regarding feasibility, regulations and subsidies are easier to implement than taxes and are likely more distributionally equitable, but this also comes at the price of forgoing cost effectiveness.

The selection of policy instruments depends on the relative importance that policy-makers attach to the different criteria and is therefore subjective. In the case of regulations versus taxes for example, the choice is (broadly speaking) between cost effectiveness and distributional impact. The particular country-specific circumstances will determine which criterion is considered most important.

"Hybrid" instruments

In practice, individual policy instruments are rarely implemented in isolation. Because several policy areas are usually interlinked (climate, transport, energy etc.) and several market failures may need to be addressed at once (climate change, information problems, credit market failures, knowledge spillovers), it is often desirable to implement a mix of complementary policy instruments in their "pure" form tailored to the specific circumstances. These "hybrid" instruments may even lead to a superior outcome where several criteria are met simultaneously. However, achieving this is difficult and requires considering a multitude of potential consequences, both intended and unintended.

3 QUALITATIVE EVALUATION

In this section, the minimum and additional criteria outlined above are applied to the 15 possible policy instruments for mitigating consumption-based emissions in Austria that were developed as part of the INNOVATE project. Several of them are hybrid instruments, combining different instrument classes. They address consumption-based emissions in the Austrian hotspot sectors construction (policies #1 to #6), mobility (#7 to #12) and healthcare (#13 to #15).

Qualitative evaluation

The minimum criteria – the instruments' climate effectiveness, cost effectiveness and good governance (distributional impact) – are evaluated using data from case studies and official statistics where available. While a full model-based quantitative evaluation of a selection of the instruments according to these criteria – including general equilibrium feedback effects – is provided in NABERNEGG et al. (2018), the analysis here can be understood as an appraisal of the instruments' direct effects at the level of individual (economic or emission) sectors regarding cost and climate effectiveness. The additional, "softer" criteria – feasibility and flexibility – are evaluated qualitatively. Overall, a descriptive approach is employed, using a simple evaluation scale ranging from ++ (criterion met fully) to -- (criterion not met at all). The evaluation was reviewed by Environment Agency Austria's sector experts in October 2016 and by external stakeholders at a workshop in March 2017.

3.1 Policy #1: Change in the safety and fire regulations for construction materials raising the maximum admissible building height for wood frame structures

Short description: A policy change that relaxes restrictions on building with timber helps to make this construction material more attractive. In Austria, the maximum building height for wood structures is limited by fire safety regulations. In 2015, the requirement that the construction material be non-combustible was waived for buildings of up to six storeys in height (SIMMEL, 2017).[6] Extending the admissible height even further means that wood can substitute concrete, which has a much larger carbon footprint, for higher multi-storey and high-rise buildings. This is already the case in the UK, where there are no height restrictions, and in Canada, where the world's tallest timber-structure building was opened in July 2017 (Tallwood House, an 18-storey student residence at the University of British Columbia in Vancouver). As the results of the hotspot analysis in STEININGER et al. (2018) showed, construction is the largest source of consumption-based emissions in Austria (see Figure 2). Concrete and cement are the primary causes within this sector. Wood, on the other hand, acts as a natural carbon sink and, if harvested sustainably, can even reduce emissions. Wood construction technology has advanced considerably in recent years and the material has become highly fire-resistant and resilient, so that this policy could have substantial leverage in the face of climate change.

Type of instrument: *Regulatory*

[6] http://www.proholz.at/bauphysik/brandschutzbestimmungen-in-oesterreich/

3.1.1 Climate effectiveness

Regarding single-family homes, regulations are already in place for building with timber in Austria, so residential timber structures are already state of the art.[7] However, there is still potential to reduce consumption-based emissions by substituting concrete with wood in the construction of multi-storey, multi-occupancy and (high-rise) office buildings.

In order to assess climate effectiveness in a qualitative way, a substitution approach was employed. The relevant parameters are changes in the composition of the construction materials. When timber structures are constructed instead of conventional (reinforced concrete) multi-storey buildings, the amount of steel and concrete (high consumption-based emissions) required declines significantly, while the use of wood (low emissions) increases.

However, it is unlikely that the policy will cause rapid changes in the construction methods of multi-storey buildings. In addition, the durability of wood buildings is usually considered lower than that of conventional construction, for instance in building insurance calculations. This means that wood buildings must be repaired or reconstructed more frequently, which requires more wood and thus reduces the climate effectiveness of the policy.

Evaluation: + (moderately effective)

3.1.2 Cost effectiveness

Administrative costs

In terms of administrative costs, this policy requires a) a change in regulations, i.e. a legal change, and b) its monitoring and enforcement. These costs are small: enacting and enforcing laws is the government's daily business, and building regulations are regularly monitored already. Some coordination costs may arise since the regulatory change would have to be applied in each of Austria's nine federal states (Bundesländer), given that building law is regulated at federal state level.

Compliance costs

Regarding compliance costs, the regulatory change would not oblige but allow developers to use wood for higher buildings, so compliance costs are small. The answer to the question of a cost-effective achievement of a given emissions reduction hinges on the acceptance of the material and therefore on the relative costs of using wood compared to conventional construction materials. Considering the different stages of the construction process, the advantages of wood construction are that it is light, dry and often relies on pre-fabricated components. Hence it requires less heavy-duty machinery on construction sites and allows for speedier construction with fewer staff on-site. Therefore, building with wood saves capital and labour as well as transport costs. Canadian wood frame construction pioneer MICHAEL GREEN (2012) compares the average project costs for constructing a 12-storey and a 20-storey building using concrete and wood with two different types of fire protection methods (charring and encapsulation) in different regions of Canada. Wood frame construction with the charring method turns out to be equally costly or cheaper than using concrete (around CAN$ 300 per square foot). KOPPELHUBER et al. (2014) compare the costs of using wood and mineral-based construction materials for a three-storey and an eight-storey building in

[7] In 2008, the share of wood-built residential houses was 40% overall but only 13% for multi-occupancy residential houses (KOPPELHUBER et al., 2014, p. 96).

the city of Graz. They find that for those construction phases where wood is more expensive, this is due to excessively strict and outdated regulations and a high market price for wood. The latter can be expected to change in future relative to concrete when carbon-intensive materials become more expensive due to taxation and/or emission trading. In addition, building with wood saves space due to thinner wall units, so that an increase in apartment or office space is achieved, which in turn leads to higher achievable rents or sales prices compensating any cost disadvantage in the construction phase. The main disadvantage of wood construction is its reduced longevity compared to conventional materials.

Overall, given its cost advantage in case of revised regulation and its improved safety, wood is likely to find acceptance as a construction material for high-rise buildings. Therefore, its emission reduction potential is likely to be realised and in light of the lower longevity of wood buildings, the policy is judged to be moderately cost effective.

Evaluation: + (moderately cost effective)

3.1.3 Good governance: distributional impact

The distributional impact of the policy is likely positive. First, households benefit if the cost of housing declines as wood frame construction becomes more common. Second, the regulatory change represents an extension of construction possibilities and does not impose major costs on any actor (as for instance taxes would). Among the likely consequences are revenue shifts from the cement to the wood industry, potentially leading to a reallocation of resources between the two and hence to some structural change. There may also be some income losses for construction workers given that wood frame construction is less labour-intensive. On the other hand, more labour is required in the production of wood frame units, so that the overall supply-side effect on households should be neutral as a reallocation of labour between industries takes place.

Evaluation: + (moderately progressive)

3.1.4 Feasibility and flexibility

As a regulatory policy with only a small distributional impact, comparatively little resistance to implementation is likely. Wood construction also has positive properties, such as an improved indoor climate, that could enhance acceptability among homeowners. However, changing fire regulations may require some convincing of the public. The stakeholders involved in the project agreed with this judgement and emphasised the importance of appropriate fire regulations to increase the subjective sense of safety of potential inhabitants.

Evaluation: + (moderately feasible)

Changing a regulation requires a legal change, so as elaborated in section 2.2, it is not a very flexible instrument. However, regulations are generally more feasible in comparison to incentive-based instruments and hence, once implemented, also easier to adapt. In addition, this policy raises flexibility compared to the status quo. Hence, the instrument is judged to be moderately flexible.

Evaluation: + (moderately flexible)

3.2 Policy #2: Information obligation on vacant dwellings tied to a renovation subsidy

Short description: This policy would make it obligatory for owners of dwellings to report vacancies after a period of six months. Since one reason for flats remaining vacant for long periods of time is that they are not in good condition, the policy includes an investment subsidy for renovation as an incentive to restore them to a utilisable state if needed. The policy should help reduce the amount of new dwellings that must be built to accommodate growing demand for affordable housing in cities, which would in turn lower consumption-based CO_2 emissions arising from construction. Tying the subsidy to refurbishment measures that increase energy-efficiency can act as an additional lever to lower construction-related emissions. To gauge the size of the problem, in 2015 the city of Vienna investigated the number of vacant flats and found an overall number of 35,000 inhabitable but unoccupied flats (3.5% of the total), of which 10,000 had been vacant for more than 2.5 years.[8] This is a significant number at a time when the population is projected to grow by 250,000 people until 2035 and current development rates in construction are considered insufficient to meet needs.

Type of instrument: *Regulatory combined with incentive-based*

3.2.1 Climate effectiveness

The climate impact of this policy mainly results from a reduced annual rate of required new construction because vacancies are put to use. To assess climate effectiveness, the potentially avoided new living space (square metres) was calculated. To this end, the annual average number of newly completed flats was set in relation to the population trend for one representative Austrian urban region and extrapolated. The policy can only be judged as moderately effective since the renovation subsidy induces some increase in construction activity, which dampens the overall consumption-based emissions reduction.

Evaluation: + (moderately effective)

3.2.2 Cost effectiveness

Administrative costs

Regarding administrative costs, this measure requires setting up an online platform that provides information on vacancies and puts owners and potential users of the dwellings in contact; and an office with staff that monitor vacancies and manage the renovation subsidy funds and funding applications. The policy will thus incur costs that go beyond the current administrative functions of government.

Compliance costs

In terms of compliance costs, the renovation subsidy represents a transfer from the government to the private households and businesses applying for it. Hence from society's point of view, it is not a real cost, but instead a gain to the private sector financed by government. Using data on Austria's existing subsidy scheme for (thermal) building refurbishment together with data on the number of vacant apartments in Vienna as well as the country-wide total, the cost of subsidising the

[8] https://wien.orf.at/news/stories/2728618/

renovation of all vacant dwellings in need of renovation is estimated to range between EUR 67 million and 178 million per year. This is in the same ballpark as the government's current annual expenditures on the thermal insulation subsidy.

Overall, since from a social perspective, the policy incurs primarily administrative costs that are relatively small given the likely emissions reduction achieved, it is judged to be very cost effective.

Evaluation: ++ (very cost effective)

3.2.3 Good governance: distributional impact

The (small) costs of setting up the online information platform on vacancies will be borne by government, while the subsidies for renovation primarily accrue to property owners who decide to invest in refurbishing their vacant dwellings. If successful, the policy should bring down the cost of housing, especially in larger cities, as pressures on supply are relieved. On the whole, the distributional impact of the policy is therefore estimated to be neutral to moderately progressive.

Evaluation: 0/+ (neutral to moderately progressive)

3.2.4 Feasibility and flexibility

The policy instrument is regulatory combined with a subsidy (which is less difficult to implement than a tax) and it has a neutral to moderately positive distributional impact without imposing significant costs. Therefore, the policy is thought to be feasible. The stakeholders involved in the project agreed but suggested a penalty for unreported vacancies to be included in the policy for greater effectiveness. This would however reduce its feasibility.

Evaluation: + (moderately feasible)

Both the regulatory and the incentive-based aspects of this policy require legal changes, and especially incentive-based instruments are considered less flexible. However, the policy is feasible, and it can be designed in a way that makes it relatively easy to adapt. Overall, the verdict is therefore moderately flexible.

Evaluation: + (moderately flexible)

3.3 Policy #3: Directive on proportional share of dedicated spaces for co-housing projects combined with a subsidy

Short description: A directive to reserve a given share of new housing space to co-housing projects is another instrument with which to reduce the total amount of new dwellings that must be built. The idea of the co-housing concept is that some communal areas like laundry rooms, kitchens and living rooms are shared between occupants of a building, so that the total amount of living space required per individual flat can be reduced. Setting up co-housing requires a group of people who actively want to pursue this kind of living arrangement. Generally, more time is required to organise all financial and legal issues compared to reg-

ular, individual housing arrangements. Hence to increase acceptance, the directive is complemented with a subsidy tied e.g. to energy efficiency-enhancing measures or low-carbon construction materials.

Type of instrument: *Regulatory combined with incentive-based*

3.3.1 Climate effectiveness

The climate effect of this policy on consumption-based emissions in construction hinges on the overall reduction in required living space that is achieved by the co-housing directive. The Austrian experience indicates that projects labelled as co-housing do not actually save much living space, as they are still frequently tailored to self-contained family units, with only minor adjustments like spaces dedicated to leisure activities being explicitly communal. Furthermore, to increase the take-up of co-housing, its implementation must be facilitated by more wide-ranging changes to the planning, financial and legal system (JARVIS et al., 2016), so that the directive alone is probably insufficient. Hence the overall climate effect is thought to be negligible.

Evaluation: 0 (no effect)

3.3.2 Cost effectiveness

Administrative costs

In terms of administrative costs, besides setting up the directive, the policy requires a change in regulatory guidelines like land use plans. In addition, compliance with the directive must be monitored, which requires additional staff.

Compliance costs

Regarding compliance costs, the policy obliges developers to reserve a given percentage of newly built-up space for co-housing, so compliance costs depend on the costs of building co-housing apartments compared to regular ones. Existing co-housing projects in Austria are targeted at environmentally and socially aware home buyers, who tend to be higher-income social groups, and are typically built to a high standard. Also, the planning process surrounding a co-housing project is more resource-intensive, so that overall, they are more expensive to build. Hence compliance costs are likely to be considerable. Finally, the subsidy tied to measures raising energy efficiency does not count as a cost from a social perspective, as it represents a transfer from government to households.

On the whole, since the policy incurs administrative as well as compliance costs but is not thought to be effective in reducing emissions, it is judged not to be very cost-effective.

Evaluation: - (not very cost effective)

3.3.3 Good governance: distributional impact

Given that that co-housing is primarily taken up by better-off segments of society and the subsidy would thus also go towards this group, the policy is likely to have a moderately regressive impact, i.e. benefit higher-income households relatively more than lower-income ones.

Evaluation: - (moderately regressive)

3.3.4 Feasibility and flexibility

On the one hand, the instrument is a regulatory policy combined with a subsidy, which should in principle make it feasible. On the other hand, its regressive distributional impact represents a barrier. In addition, without wider changes in legal and financial arrangements, co-housing is unlikely to become a living arrangement with broad appeal in the near future. Hence imposing a co-housing share for new projects is judged not very feasible. The stakeholders involved in the project also considered co-housing a niche product. They suggested to instead focus building regulations on reducing living space per person in communal housing projects while enhancing possibilities for individualised design, citing examples from Denmark.

Evaluation: - (not very feasible)

Both the regulatory and the incentive-based aspects of this policy require legal changes in order to adapt them. However, it can be designed in a way that makes it relatively easy to adapt ex-post, so that on the whole, the verdict is neutral in terms of flexibility.

Evaluation: 0 (neutral)

3.4 Policy #4: Subsidy for retrofitting and redesign of vacant commercial buildings tied to energy-efficient refurbishment

Short description: This policy consists of a subsidy serving as an incentive for commercial vacancies to be retrofitted and redesigned as residential buildings, tied to an obligation to increase the buildings' energy efficiency. The purpose of this measure is to reduce the amount of newly built flats and houses that are required and instead put to renewed use existing vacant commercial buildings. UMWELTBUNDESAMT (2004) estimated the total land area covered by vacant and/or derelict industrial (brownfield) and commercial sites at 130 km^2, some of which offers potential for conversion into dwellings.

Type of instrument: *Incentive-based combined with regulatory*

3.4.1 Climate effectiveness

As for policies #1 to 3, the positive climate impact mainly stems from avoiding the construction of new buildings. According to Environment Agency Austria's experts, the current stock of vacant industrial and commercial buildings in Austria covers 27.3 km^2 (21% of the above-mentioned total brownfield area of 130 km^2). Hence this measure clearly has potential. One issue is that not all industrial and commercial vacancies are likely to be located in areas that residents consider desirable to live in, i.e. in or near cities or their greenbelt. Hence the climate effectiveness of retrofitting and redesigning vacant commercial buildings is judged as moderate.

Evaluation: + (moderately effective)

3.4.2 Cost effectiveness

Administrative costs

Regarding administrative costs, the policy requires enacting the necessary regulatory changes, such as a rededication of urban land use plans to facilitate converting commercial buildings into residential ones, which is not a large cost. The current regulatory framework is considered a hurdle in this regard.

Compliance costs

In terms of compliance costs, the owners of vacant buildings incur the higher costs for energy-efficient refurbishment that the policy makes obligatory. To the extent that the government subsidy – which again represents a transfer – does not cover these additional costs, they represent a real cost to the economy, which is likely to be small. More substantially, brownfield sites may be contaminated and require clean-up, but this is only thought to be the case for 2-3% of the total brownfield area.[9]

Overall, from a social perspective, the policy incurs mainly administrative costs that are relatively small, and potentially some clean-up costs. Since the likely consumption-based emissions reduction achieved is also moderate, the policy is judged to be moderately cost-effective overall.

Evaluation: + (moderately cost effective)

3.4.3 Good governance: distributional impact

The subsidy as well as potential clean-up costs accrue to the property owners who retrofit and/or redesign their buildings, but if effective the policy should bring down the cost of housing, so overall it is judged to be neutral to moderately progressive.

Evaluation: 0/+ (neutral to moderately progressive)

3.4.4 Feasibility and flexibility

The policy instrument is regulatory combined with a subsidy, and it has a neutral to moderately positive distributional impact. It was also considered highly desirable by the stakeholders involved in the project, who pointed out its relevance for town centres. Therefore, the policy is judged to be feasible.

Evaluation: + (moderately feasible)

Both the regulatory and the incentive-based aspects of this policy require legal changes. However, the policy is considered feasible, and it can be designed to be relatively adaptable to changing circumstances, making it moderately flexible overall.

Evaluation: + (moderately flexible)

[9] http://www.umweltbundesamt.at/umweltsituation/altlasten/flaechenrecycling/

3.5 Policy #5: Labelling scheme on consumption-based emissions for conventional and sustainable construction materials

Short description: The aim of this measure is to allow consumers, e.g. homebuilders, to compare construction materials in terms of their embodied CO_2 emissions per unit, thus providing them with more information on the climate impact of e.g. concrete vs. wood. Although the labelling scheme would be voluntary, implementing it requires the availability of standardised, comparable data on consumption-based emissions for various construction products. Currently, these are either provided voluntarily by firms, who must bear the considerable costs of carrying out a life-cycle assessment for their product, or computed by external experts based on license databases providing generic information on different product types.[10] Consequently, methods vary and data are not provided by many companies. Hence to implement the measure and to ensure that the label can cover as many products as possible, what is required is a) a comprehensive, internationally harmonised life-cycle assessment methodology for the calculation of product environmental footprints, b) publicly available databases for the purpose (in contrast to the existing license databases), and c) funding to support product environmental footprinting. Regarding the first point, efforts are ongoing at DG Environment of the European Commission to develop a standardised methodology; pilot schemes are currently run for different product groups.

Type of instrument: *Information-based (voluntary)*

3.5.1 Climate effectiveness

The climate impacts of voluntary/information-based measures are difficult to assess and likely smaller than those of incentive-based or regulatory instruments. However, even if no direct outcome can be linked to them, awareness-raising measures are necessary to induce behavioural change. Overall, the policy is considered neutral in terms of climate effectiveness.

Evaluation: 0 (no effect)

3.5.2 Cost effectiveness

Administrative costs

The policy incurs the administrative costs of setting up and running the labelling scheme, which would also need to be promoted by government. To implement the scheme effectively, the government would also need to fund public databases with emissions information that can be used by life-cycle assessors, as well as provide financial incentives for companies to undertake environmental footprinting of construction material products. These represent an intra-society transfer and are not relevant from an economic perspective.

[10] www.baubook.info collects and makes available product-specific emissions data on construction materials and components for the use of construction companies and certifiers of labels for sustainable buildings.

Compliance costs

The compliance costs for companies wishing to attain the label involve the remaining cost of the product emissions assessment as well as any potential resources spent on reducing the emissions impact. Overall, these costs are likely to be small, but given that the policy is also expected to generate a negligibly small climate impact, the verdict is neutral in terms of cost effectiveness.

Evaluation: 0 (neutral)

3.5.3 Good governance: distributional impact

The policy is not expected to have any notable distributional effects.

Evaluation: 0 (neutral)

3.5.4 Feasibility and flexibility

The policy is voluntary and has no distributional impact to speak of. However, as was pointed out by the stakeholders involved in the project, establishing a standardised method is complex; also, the producers of conventional construction materials would not be easy to get on board for this policy.

Evaluation: -- (infeasible)

A consumption-based emissions label is, as an information-based/voluntary measure, likely easy to adjust, i.e. very flexible.

Evaluation: ++ (very flexible)

3.6 Policy #6: Carbon-added tax (CAT) on construction materials

Short description: A carbon-added tax or CAT would tax the carbon footprint of construction materials similar in principle to the value-added tax (VAT). That is, the additional greenhouse gases (CO_2 equivalent) emitted during each production stage would be taxed, so that companies at each point in the production chain pay CAT only on their own added emissions, while the end user pays the full cost of the emissions associated with the product. The effect of this policy is a change in the relative price of construction materials: emission-intensive materials like construction steel and aluminium would become more expensive, while less emission-intensive ones like wood would become cheaper, providing an incentive for the use of more sustainable construction materials.

Type of instrument: *Incentive-based*

3.6.1 Climate effectiveness

This policy directly targets the emissions associated with construction inputs and provides a price incentive to switch to less emission-intensive materials. Impacts in the construction sector heavily depend on costs. Given the price pressures in the sector, a cost increase will trigger a quick transition to materials with lower emissions. DE BRUYN et al. (2015) estimate the effect of adapting the current VAT system to a CAT for various construction materials in the Netherlands based on their emission intensity. Table 1 shows the simulation results for 2030 and 2050. The current VAT tariff on these materials in the Netherlands is 21%. The tax rates on aluminium, construction steel and cellular concrete would increase, sometimes considerably, while some more sustainable materials like wood would become cheaper.

Table 1: CAT rates as percentage of pre-taxed sales for building materials (Source: DE BRUYN et al, 2015)

	2030	2050
Concrete (mortar)	6%	9%
Bricks	13%	17%
Limestone (brick)	10%	13%
Cellular concrete	21%	28%
Sand	2%	3%
Gravel	0%	0%
Asphalt	5%	7%
Roof cladding (excl. roof tiles)	5%	7%
Reinforcing steel	15%	20%
Construction steel, galvanized	24%	32%
Aluminium	92%	122%
Copper	11%	15%
Lead	10%	14%
Zinc	37%	49%
Flat glass	6%	8%
HDPE	18%	24%
LDPE	20%	27%
PP	19%	25%
PET	28%	37%
PVC	20%	27%
EPS	29%	38%
Sawn hardwood	0%	1%
Sawn softwood	1%	2%
Cardboard	18%	24%

CAT rates assuming a 15% reduction in GHG intensity in 2030 and 35% in 2050

Hence the CAT on construction materials should a very large impact on consumption-based emissions. Therefore, this policy can be seen as very effective.

Evaluation: ++ (very effective)

3.6.2 Cost effectiveness

Administrative costs

A CAT would likely lead to considerable administrative costs as well as some practical implementation hurdles. First, it requires setting up a system whereby firms must monitor and report the CO_2 emissions arising from their production as well as the amount of CAT paid and charged, and both should then be verified independently (DE BRUYN et al., 2015). The system must also be flexible and dynamic enough to allow for CAT rates to be adjusted when a firm reduces its emissions through e.g. new low-carbon processes. Second, differential CAT rates across countries must be dealt with for imports and exports. To prevent unequal treatment of imports and domestic products under VAT, for example, so-called border tax adjustments are applied. MCLURE (2010) argues that because the emission intensity of products cannot be observed from their physical appearance nor easily estimated, border tax adjustments for the CAT would be very difficult to implement.

Compliance costs

The compliance costs for firms involve the above-mentioned monitoring and reporting of CO_2 emissions arising in production, which are substantial as most firms would have to set this up from scratch. In addition, construction firms must also bear the initial higher costs of traditional, emission-intensive materials, until less emission-intensive materials and construction techniques have become standardised.

Hence given these costs, the CAT is considered to be neutral to moderately cost effective, despite its large potential to reduce consumption-based emissions.

Evaluation: 0/+ (neutral to moderately cost effective)

3.6.3 Good governance: distributional impact

The short-term price increase of emissions-intensive construction materials would be borne by building developers and construction companies, who will ultimately pass (parts of) it on to buyers or renters of newly built homes, i.e. higher-income groups. The cost of living in existing buildings should be unaffected; however, any extensions to them would be impacted. In the long term, the increase in the cost of housing due to the CAT should decline as low-emission materials become standard. Hence the policy is evaluated as neutral to moderately progressive overall, depending on the time horizon.

Evaluation: 0/+ (neutral to moderately progressive)

3.6.4 Feasibility and flexibility

Implementing any new tax is difficult. The CAT raises the price of steel as well as input costs for the construction industry, so opposition is likely. Moreover – weighing more heavily – given international production chains, the policy would have to be implemented on an international level in order to work. Overall, the policy is therefore considered infeasible. The stakeholders involved in the project agreed and added that the short- to medium-term increase in the cost of housing due to the tax would hinder its implementation, given the current focus of the national debate on affordable housing.

Evaluation: -- (infeasible)

To adjust the CAT framework, legal changes are necessary. The flexibility of the system in dealing with individual firms' CAT rates needs to be ensured for the policy to work, but this will come at additional administrative costs. Thus the policy can be designed so that it is neutral in terms of flexibility.

Evaluation: 0 (neutral)

3.7 Policy #7: Obligation to implement employee mobility plans, joint with public subsidies and other support measures

Short description: Companies with 50 or more employees would be legally obliged to provide financial incentives to employees using bicycles and/or public transport for their daily commute to work, while car use would be penalised by e.g. charging for the company car parking space. This policy would enlist firms to encourage a modal shift away from cars for commuting, making mandatory schemes that already exist on voluntary basis, like those supported by the klimaaktiv mobil programme run by the Austrian Federal Ministry for Sustainability and Tourism. Under this programme, the ministry provides subsidies, training programmes, certifications and advice for companies and public bodies. Minimum standards should be defined for the policy, and it should be monitored and enforced.

Type of instrument: *Regulatory combined with incentive-based*

3.7.1 Climate effectiveness

In 2014, 1 462 609 Austrians worked for a company with more than 50 employees (STATISTIK AUSTRIA, 2018). Commuting to work constitutes a large part of daily traffic volumes, so the potential emissions reduction that could be achieved through mandatory mobility plans is very large. Climate effectiveness is assessed by passenger kilometres saved via mobility plans. The evaluation took into account only measures that have a direct impact on the mobility behaviour of employees (e.g. the number of trips taken by bicycle between home and workplace). The figures are taken from the klimaaktiv mobil programme (BMLFUW, 2009).

Evaluation: ++ (very effective)

3.7.2 Cost effectiveness

Administrative costs The administrative costs of the policy concern the running of an expanded klimaaktiv mobil programme, which would disburse subsidies and other support measures. Monitoring and enforcing the obligation also requires infrastructure and personnel.

Compliance costs The compliance costs for firms involve financial incentives to employees as well as infrastructure investment: sufficient bicycle parking space must be provided, showers installed, and any other necessary changes made. For example, the company Anton Paar, which has implemented a comprehensive mobility scheme

("Anton Paar in Motion"), has installed a system whereby cyclists electronically register each day they cycle to work and get a reward, while motorists pay for the use of the car park. Anton Paar spends about EUR 158,000 per year on the entire scheme (PRESSL et al, 2015). In 2014, there were 6,584 companies with more than 50 employees in Austria, so even after subsidies, the costs to firms caused by the policy are considerable. Given its strongly positive climate impact, the policy is still judged to be moderately cost effective.

Evaluation: + (moderately cost effective)

3.7.3 Good governance: distributional impact

The initial impact of the policy is on companies, while their employees benefit from e.g. subsidised public transport tickets, so that they can reduce their expenditures on car fuel. In the longer term, there is the risk that firms pass on some of the costs to consumers; this would affect low-income households relatively more, since the policy impacts firms across the economy, including those providing basic goods and services like supermarket chains. Overall, the policy is likely to be neutral.

Evaluation: 0 (neutral)

3.7.4 Feasibility and flexibility

The policy instrument is regulatory combined with a subsidy, which should make it relatively feasible. On the other hand, it imposes costs on firms and is therefore likely to encounter resistance. The stakeholders involved in the project argued that given the envisaged measures supporting implementation (advice) and the subsidy, the policy should be feasible. Hence overall, it is evaluated as neutral. The stakeholders also suggested additional measures aiding implementation, like minimum requirements for the mobility plans, sanctions for non-compliance and tax relief as an additional incentive.

Evaluation: 0 (neutral)

As a regulatory policy, the employee mobility plan obligation requires legal changes to adapt ex-post. However, the obligation can be designed in a way that is relatively open, so that companies can develop mobility plans that apply to their own circumstances, possibly also depending on indicators like turnover. Thereby, the policy can be made moderately flexible.

Evaluation: + (moderately flexible)

3.8 Policy #8: Higher vehicle taxes for emission-intensive cars, linked to consumption-based CO_2 labels

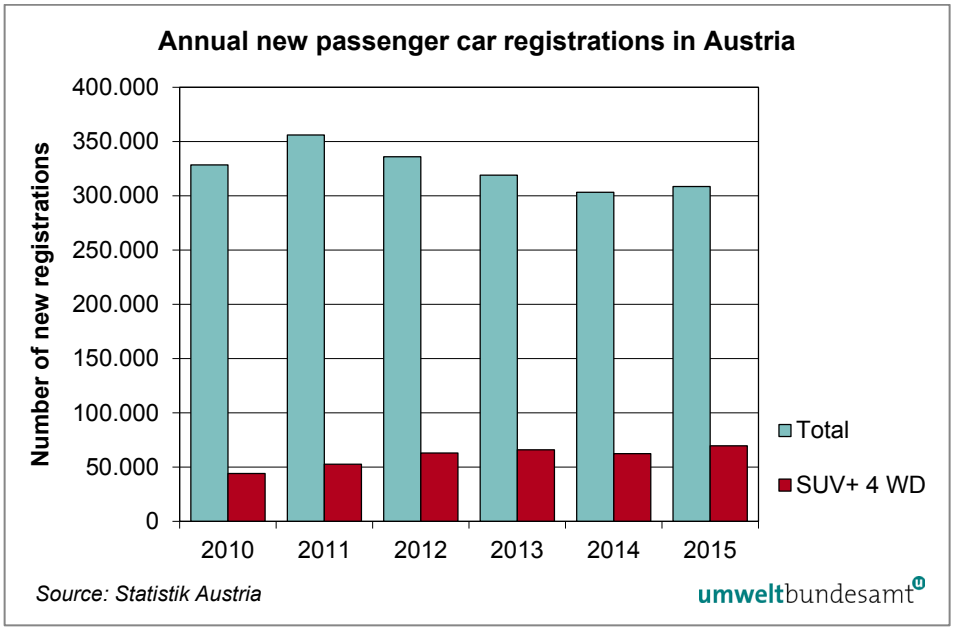
Short description: This measure would make motor vehicle taxes, especially those that must be paid annually (the "motorbezogene Versicherungssteuer", an annual insurance tax), dependent on cars' CO_2 emissions, such that higher emitters must pay proportionally more and owners of less emissions-intensive cars proportionally less. Thus, larger cars such as SUVs, which are also more relevant regarding consumption-based emissions, would be hit harder. This policy would help to reduce the purchase of new emissions-intensive cars, increase car-sharing and reduce the average size of the car fleet. The tax would also be linked to (consumption-based) CO_2 labels for cars, thereby raising consumers' awareness of the emissions status of their cars and providing incentives for car manufacturers to launch more low-emission models. Hence the policy addresses both consumers and producers.

Type of instrument: *Incentive-based*

3.8.1 Climate effectiveness

In 2015, 20.7% of the newly registered cars were SUVs and 1.9% were four-wheel drive cars (4WD). Figure 3 shows the number of newly registered cars from 2010 until 2015. The categories SUV and 4WD experienced a notable increase over the last years. Due to their construction, these car categories are heavier; this additional weight is the main driver of their higher CO_2 emissions. An annual payment linked to the CO_2 status of the car will have a negative impact on the number of newly registered cars in these categories, which should lead to a substantial emissions reduction overall. Additional positive impacts on the environment of smaller cars arise from material and fuel savings.

Figure 3: New passenger car registrations, total and SUV + four-wheel drive



The numbers in Figure 3 show that there is a high potential to reduce new registrations in the SUV+4WD category. The design of the policy as an annual payment guarantees a long-term reduction via a continuous burden on consumers. Therefore this policy can be judged as very effective.

Evaluation: ++ (very effective)

3.8.2 Cost effectiveness

Administrative costs

The administrative costs of implementing this policy involve the costs of setting up the CO_2 label and monitoring and enforcing the tax. For the latter, the infrastructure and personnel that administer the existing motor vehicle tax could be built on and expanded. Hence the main expenses arise from implementing the CO_2 label; they are probably moderate.

Compliance costs

The compliance costs are borne by the buyers of cars and take the form of tax revenue for the government. Hence they represent a transfer and are not a cost to society at large.

Overall, since the policy incurs only moderate administrative costs but has a potentially large climate impact, it is considered to be very cost-effective.

Evaluation: ++ (very cost effective)

3.8.3 Good governance: distributional impact

A tax that penalises large, expensive cars and rewards buying smaller cars can be distributionally progressive if less emission-intensive cars are available that target lower-income groups. Recycling the tax revenue towards lower-income households can further enhance the policy's distributional impact.

Evaluation: + (moderately progressive under certain conditions)

3.8.4 Feasibility and flexibility

Austria has a comparatively high rate of car ownership, so raising taxes on cars is a sensitive issue. The policy involves a change to an existing taxation regime rather than introducing an entirely new tax, so it should not be entirely infeasible. However, efforts to advocate for this policy have encountered strong resistance for years. EU directives are seen as one way forward, but for now, the policy is considered infeasible. The stakeholders involved in the project suggested some additional measures to aid implementation, like exemptions for large families in need of larger cars, waiving the higher tax for zero-emission vehicles and explaining the co-benefits of smaller cars, like lower parking costs.

Evaluation: -- (infeasible)

Taxes and incentive-based instruments in general are not very flexible, but they can be designed in an open fashion that allows for flexibility in the way the policy is applied and for adaptability to new information.

Evaluation: + (moderately flexible)

3.9 Policy #9: Infrastructure investment to expand and improve Park + Ride facilities and their accessibility

Short description: This measure aims to increase the number of high-quality and easily accessible Park and Ride (P+R) facilities. One of the main issues currently, besides the fact that some existing P+R facilities are running close to full capacity, is their integration into the public transport network. New P+Rs should be located where demand for them exists, i.e. at public transport interchanges such as train stations; ideally, public transport interchanges should be multimodal hubs, including cars, trains and other public transport as well as bicycles ("Park+Bike"), providing convenient transfer opportunities for passengers. Existing P+Rs should be better connected through an expansion of public transport to serve them. This requires infrastructure investments in public transport as well as P+Rs (where construction above ground is less CO_2-intensive than construction below ground).

Type of instrument: *Infrastructure provision*

3.9.1 Climate effectiveness

This policy has considerable potential to reduce consumption-based emissions, which results from reduced passenger kilometres per year due to the P+R facilities. For the evaluation, data of the P+R facility Murpark in the city of Graz, which is considered a success story, were analysed and extrapolated. There were savings on fuels and material as well as additional aspects that can be taken into account as positive side effects in an urban area (e.g. reductions in particulate matter pollution). The expansion of public transport infrastructure can also be expected to have positive climate effects. Overall this policy could be very effective if fully implemented.

Evaluation: ++ (very effective)

3.9.2 Cost effectiveness

Administrative costs Regarding administrative costs, the policy likely incurs significant planning costs on the part of private developers or city/regional administrations, depending on who owns the facilities.

Compliance costs In terms of compliance costs, the policy requires large investments on the part of private or public owners and developers in the construction of new garages and/or the expansion of existing ones; also, a good connection to the public transport network must be provided. Furthermore, there are the daily costs of operating the P+R facilities and the public transport links. For example, the cost of constructing the P+R facility Murpark in Graz was just above EUR 3.9 million. Including operating costs and depreciation for the next 25 years, SCHEFCIK (2014) calculates a present value for Murpark of close to EUR 5.6 million. With 480 parking spots in the facility, this yields a present value per slot of EUR 11,612.29. Given the good performance of the Murpark example, this can be considered a lower bound for setting up and running a P+R facility (not counting the costs of connection to the public transport network).

Overall, improving Austria's P+R infrastructure will thus incur substantial costs. Because of its large climate impact, the policy is considered moderately cost-effective overall.

Evaluation: + (moderately cost effective)

3.9.3 Good governance: distributional impact

Investments in public infrastructure and transport benefit lower-income groups more than higher-income groups, since the former are more dependent on using public facilities for their mobility needs. Therefore, the policy is evaluated as moderately progressive.

Evaluation: + (moderately progressive)

3.9.4 Feasibility and flexibility

Infrastructure investments are costly but also a popular policy instrument. The ease with which it can be implemented depends on which level of government must bear the financial costs: if a national authority, local governments are more likely to agree to the policy. The stakeholders involved in the project also regarded the policy as feasible (and partly already being implemented). However, they considered additional measures necessary to make the policy effective, such as combining it with a price reduction for public transport tickets, a congestion charge for cities and car-sharing stations.

Evaluation: + (moderately feasible)

Infrastructure investments involve large up-front sunk costs and are therefore not very flexible.

Evaluation: - (not very flexible)

3.10 Policy #10: Integrated transport ticket across regions, linked with comprehensive online information platform

Short description: This policy is modelled after the Swiss Pass, a single integrated transport ticket that covers several regions and modes of transport (private and public, sharing schemes etc.). In addition, a comprehensive online platform provides information on taking trips using all available modes of transport with this ticket. This scheme facilitates travelling by means other than the private car and thereby encourages a modal shift. It requires coordination across Austria's provinces and transport operators (scheduling etc.) as well as potentially a significant expansion of public transport, especially in rural areas and across provinces.

Type of instrument: *Regulatory combined with information-based*

3.10.1 Climate effectiveness

By offering an interface between different existing modes of transport, the policy makes available alternatives to the private car. However its effectiveness depends on a concomitant expansion of the public transport network, especially in rural areas. If this is implemented, the policy could contribute significantly to a reduction in car travel, leading to considerable climate effects.

Evaluation: ++ (very effective)

3.10.2 Cost effectiveness

Administrative costs In terms of administrative costs, the policy requires negotiating and organising the integrated ticket across Austrian regions and between different operators, public and private, in terms of schedules and tariffs (this has proven difficult so far); second, setting up and operating a mobility centre that administrates the ticket and runs the information platform; third, producing the ticket.

Compliance costs Compliance costs involve expanding the public transport network across regions to make the integrated ticket operational. These costs are potentially large, so the policy is assessed as neutral in terms of cost effectiveness overall.

Evaluation: 0 (neutral)

3.10.3 Good governance: distributional impact

The expansion of public transport will benefit low-income groups more than high-income groups since the former are more dependent on public transport for their daily mobility needs. The distributional impact of the integrated transport ticket itself will depend on its formulation. If it is tailored to income groups by offering different pricing options (as is the case e.g. with ÖBB's "Sparschiene"), the ticket would be progressive, but less so otherwise.

Evaluation: + (moderately progressive)

3.10.4 Feasibility and flexibility

In general, the integrated transport ticket is considered desirable in policy circles but its feasibility depends on who would fund the potentially large costs. If the public purse, the transport ticket would not be very feasible. In addition, coordinating the scheme across Austria's federal states and between transport providers may not be easy. The stakeholders involved in the project suggested testing the policy in some regions or instead offering temporary combination tickets e.g. for weekends.

Evaluation: - (not very feasible)

In principle the policy is regulatory and information-based, which should make it moderately flexible. However, the infrastructure required – from ticket machines to public transport expansion, as well as the necessary assimilation and coordination of transport administration between provinces – makes it less flexible.

Evaluation: - (not very flexible)

3.11 Policy #11: Certification scheme for online retailers offering a sustainable (green) delivery option

Short description: The purpose of this policy is to reward retailers who also sell online (e.g. supermarket and clothing chains, book and furniture stores) for offering an environmentally friendly shipping option. Online shopping is becoming increasingly popular, and some logistics companies have already introduced a green option, e.g. UPS in 2010. Certification and award schemes as well as software tools helping logistics companies identify sustainable means of transport already exist. However, additional impact can be gained from offering consumers a sustainable choice at the point of sale, raising their awareness of the environmental consequences of their choices. A national certificate, award or label for companies offering a green delivery option would act as an incentive to do so. It could be linked to (consumption-based) emissions saved.

Type of instrument: *Information-based (voluntary)*

3.11.1 Climate effectiveness

The climate impacts of voluntary/information-based measures are difficult to assess and likely smaller than those of incentive-based or regulatory instruments. However, even if no direct outcome can be linked to them, awareness-raising measures are necessary to induce behavioural change. Overall, the policy is considered neutral in terms of climate effectiveness.

Evaluation: 0 (no effect)

3.11.2 Cost effectiveness

Administrative costs

The policy incurs the administrative costs of setting up and running the certification scheme, which would also need to be promoted by government. Additional staff may need to be hired in order to monitor compliance with the scheme's requirements.

Compliance costs

Compliance costs for companies aiming to attain the certificate or award involve the costs of implementing the green delivery option, which requires reviewing and re-organising delivery processes and tracking progress in accordance with the scheme's requirements, e.g. on emissions saved. On the other hand, recent experience shows that transporting goods by train is cheaper than air freight and shipping and also quicker than the latter (cf. train connections between Europe and China). Companies can therefore also save money by implementing a green delivery option.

Overall, given that the policy is expected to have only a negligible climate impact, it is assessed as neutral in terms of cost effectiveness.

Evaluation: 0 (neutral)

3.11.3 Good governance: distributional impact

The policy is not expected to have any notable distributional effects.

Evaluation: 0 (neutral)

3.11.4 Feasibility and flexibility

Since the policy is voluntary and has no distributional impact to speak of, it is considered to be highly feasible. The stakeholders involved in the project agreed but also pointed out the importance of cooperation between delivery companies to reduce empty trips.

Evaluation: ++ (highly feasible)

A certification scheme is, as an information-based/voluntary measure, easy to adjust, i.e. very flexible.

Evaluation: ++ (very flexible)

3.12 Policy #12: Increased subsidies for purchasing and using cargo bikes along the entire transport chain

Short description: Currently, cargo bikes are used mainly for the “last mile” of deliveries to urban households in the logistics sector, which has seen transport volumes increase substantially in recent years due to online shopping. In Austria, they are also mainly used by alternative, eco-friendly businesses like some food delivery services. In 2017 and 2018, the Austrian government subsidises the purchase of cargo bikes with at most EUR 250 for electrified bikes and EUR 200 for non-electrified ones (KPC, 2017). This represents a reduction compared to the subsidy rates of EUR 500 and EUR 400 respectively that were granted until 2016 via the klimaaktiv mobil programme. Raising the subsidy would provide an incentive for more businesses to use cargo bikes, and also along the entire transport chain, thereby upscaling the practice and substituting more cars. To operationalise the policy however, making the necessary changes to the public infrastructure is equally important: cargo bikes require broader lanes, bigger parking spaces as well as charging stations.

Type of instrument: *Incentive-based*

3.12.1 Climate effectiveness

The current transport mode on the last mile of deliveries is very inefficient. Delivery vans, which are often only half-loaded, deliver the goods in a stop and go way. Using cargo bikes instead has several positive effects. Fuel as well as material for cars can be saved and the traffic volume in urban areas can be decreased. In projects like cyclelogistics or “Ich ersetzte ein Auto”, companies achieved a share of up to 8% of deliveries by cargo bike already in the pilot phase. Simulations showed that 18% of the annual transport mileage can be

substituted by cargo bikes (DLR, 2016). Based on the outcome of these studies and the reduction of the potential for the policy given weather circumstances (no deliveries in winter time), the policy is moderately effective.

Evaluation: + (moderately effective)

3.12.2 Cost effectiveness

Administrative costs

In terms of administrative costs, the policy requires an expansion of the klimaaktiv mobil programme that currently manages the subsidies, to anticipate rising demand for them.

Compliance costs

Regarding compliance costs, the subsidies represent a transfer and do not count from a social perspective. However, the required changes to the public infrastructure (broadening lanes, charging stations) could incur substantial costs. The companies purchasing the cargo bikes would have to invest in infrastructure like logistics centres to accommodate reloading freight onto the bikes. These costs would however partly be compensated by considerably lower operating costs compared to lorries and cars: according to a report for Germany, (DLR, 2016), the cost advantage is around EUR 2,700 per year for a cargo bike (compared to an engine-driven microcar). This moderates the compliance costs.

Overall, given the policy's potential costs, it is judged to be neutral in terms of cost effectiveness.

Evaluation: 0 (neutral)

3.12.3 Good governance: distributional impact

The subsidies and some of the costs of the policy fall on businesses, while the public sector bears the infrastructure costs. As long as these are not passed through to consumers (households), the policy is distributionally neutral.

Evaluation: 0 (neutral)

3.12.4 Feasibility and flexibility

Expanding an existing subsidy is less difficult to implement than a tax. However, funding the necessary infrastructure adjustments makes it neutral in terms of feasibility overall. The stakeholders involved in the project also considered it feasible, given that it is partly already being implemented.

Evaluation: 0 (neutral)

The policy requires a legal change but if it is designed such that it can be adapted easily, it is moderately flexible.

Evaluation: + (moderately flexible)

3.13 Policy #13: Obligatory Environmentally Preferable Purchasing Programmes (EPP) for hospitals and health institutions

Short description: Mandatory environmentally preferable purchasing in hospitals requires prioritising environmental (and possibly economic and social) considerations in all procurement decisions, from cleaning products, food, IT hardware, energy, vehicles and construction materials to medical and laboratory equipment. To support the procurement process, the Austrian government has developed an action plan for sustainable public procurement with a list of environmental criteria for 16 common product groups (BMLFUW, 2010). These contain for example energy efficiency requirements for IT and white goods or technical specifications for environmentally friendly cleaning products and electricity. The EPP "ÖkoKauf Wien" is mandatory for the entire city administration of Vienna, including the Vienna hospitals association KAV. Finally, some hospitals in Austria operate EPP or similar schemes voluntarily. For instance, nine hospitals are currently registered for the European Union's EMAS (Eco-Management and Audit Scheme), which requires them to develop an environmental policy, as part of which several have adopted EPP (e.g. the Carinthian state hospitals operator KABEG and both the SMZ North and South in Vienna). The policy suggested here would make EPP obligatory for all Austrian hospitals.

Type of instrument: *Regulatory*

3.13.1 Climate effectiveness

Some indication of the policy's effectiveness can be taken from the environmental reviews that EMAS requires participating institutions to publish. These contain statistics on energy and material consumption as well as CO_2 emissions. Almost all hospitals were able to achieve a reduction in CO_2 emissions from energy consumption between 2010 and 2014, one even at an average annual rate of 12% (see KABEG, SOZIALMEDIZINISCHES ZENTRUM SÜD, SOZIALMEDIZINISCHES ZENTRUM FLORIDSDORF, A. Ö. KRANKENHAUS DER BARMHERZIGEN BRÜDER ST. VEIT AN DER GLAN, various years). Material consumption was reduced too, although here success was less pronounced and more heterogeneous across institutions. EMAS is a comprehensive policy of which EPP is only one part, so these effects may overestimate those of an EPP alone. An evaluation of the EPP of the city of Vienna, "ÖkoKauf Wien", which also covers the Vienna hospitals association KAV, found that a reduction in CO_2 emissions of 103,000 tonnes was realised between 2004 and 2007 (STADT WIEN, 2014). Overall, given the high potential for emissions reductions in the health sector in Austria and the sizeable impact of procurement decisions on energy and material inputs, the policy is judged to be very effective.

Evaluation: ++ (very effective)

3.13.2 Cost effectiveness

Administrative costs

EPP can be expected to incur some costs in the initial phase of implementation. Regarding administrative costs, guidelines need to be compiled in line with the needs of different departments and groups and implemented accordingly. An environmental coordinator may need to be appointed for this purpose and external consulting services hired that give advice and train staff.

Compliance costs

Regarding compliance costs, environmentally beneficial products may initially be more expensive, especially when technology is new and demand is limited. In the longer term however, these costs can be expected to fall and savings of energy and materials start to dominate hospital balance sheets. For instance, due to its market power as a large procurer, the Vienna hospitals association KAV was able to obtain significant price reductions on cleaning and disinfection products.[11] EPP and general environmental management systems like EMAS also help hospitals identify inefficiencies in material use and find ways to realise energy and resource savings. The evaluation of "ÖkoKauf Wien" mentioned above found that the programme led to cost savings of EUR 44.4 million across the city administration between 2004 and 2007. Given these potential savings and its large climate effect, the policy is considered to be very cost effective.

Evaluation: ++ (very cost effective)

3.13.3 Good governance: distributional impact

Requiring hospitals to implement an EPP will lead to shifts in demand towards products from more sustainable providers. The resulting shift in revenue will also induce additional structural change towards "greener" producers, a process that is already underway. For hospitals, the costs of implementing an EPP should be neutral or even negative. Households should remain unaffected as long as hospitals do not pass on the initially higher prices of environmentally beneficial products to patients and health insurers. In case of substantial cost savings through the EPP, households could even be positively affected since the gains can be used in the interests of patients. Since the less well-off are more likely to be treated in the public healthcare system, they would gain disproportionately. Overall, we therefore judge the distributional impact to be neutral to moderately progressive.

Evaluation: 0/+ (neutral to moderately progressive)

3.13.4 Feasibility and flexibility

A number of Austrian regional hospital associations (Vienna, Carinthia, Styria, Upper Austria) either run an EPP, participate in EMAS or have implemented environmental strategies. Many individual hospitals have already started their own initiatives. Following the discussion of costs above, it can be inferred that an environmental outlook is in the interest of hospitals. Since green public procurement is supported by the national government and has been ongoing in some cities and regions for many years, the policy is thought to be feasible. The stakeholders

[11] See https://www.wien.gv.at/umweltschutz/oekokauf/pdf/wirkungsanalyse-zusammenfassung.pdf

involved in the project pointed out that the policy has particular leverage in the private healthcare sector, which is not covered sufficiently yet, and that its effectiveness could be raised by covering also external service providers in hospitals (e.g. cleaning firms) as well as medical equipment.

Evaluation: + (moderately feasible)

The policy can be designed such that individual hospitals' circumstances can be taken into account. For instance, the actions hospitals must take under EMAS must be targeted towards their own problem areas. An EPP could be similarly designed to be address procurement areas that hospitals consider key for their environmental performance.

Evaluation: + (moderately flexible)

3.14 Policy #14: Change in regulations to allow the reprocessing and re-use of single-use medical tools and equipment

Short description: In principle, the EU medical device directive allows the reprocessing and re-use of single-use medical supplies and tools, such as surgical gloves and masks or saw blades, trocars and catheters. In Austria however, the current interpretation of the medical products law by the Austrian Federal Ministry of Health and Women's Affairs prohibits it. Health and safety concerns are often cited in support of the ban. Germany on the other hand permits it for some products under certain conditions. Single-use tools and supplies are responsible for a substantial share of medical waste. For instance, in 2004 the Vienna hospitals association KAV found that 60% of hospital waste consists of single-use products (TRUPPE et al., 2007). There are indications from the experience in Germany that as long as adequate standards are maintained and monitored, reprocessing does not constitute a health risk for certain single-use products. Therefore, one option for Austria would be adjusting regulations to allow reprocessing and re-use for all suitable single-use products. Simultaneously, guidelines for what constitutes adequate reprocessing should be developed and a system for monitoring and inspecting reprocessing facilities set up.

Type of instrument: *Regulatory*

3.14.1 Climate effectiveness

Each time medical supplies and tools are reused rather than discarded, the production of new supplies and tools and associated emissions are reduced. A comprehensive study on the re-use of single-use medical goods in Austria, estimates that possible re-use rates range between two and 12 times, depending on the product (TRUPPE et al., 2007). This implies that emission savings can be large, considering the 60% share of single-use products in medical waste for the city of Vienna mentioned above. Reprocessing does cause some emissions, for instance from transport, energy use and the chemicals used for cleaning, disinfection and sterilisation, but these are small compared to new production. In addition, TRUPPE et al. (2007) find an average reduction in waste of 80% per re-use.

Although the policy does not oblige but rather allows hospitals to re-use equipment, cost pressures may induce many hospitals to take up this practice. Overall therefore, the policy is considered to be very effective.

Evaluation: ++ (very effective)

3.14.2 Cost effectiveness

Administrative costs

This policy incurs some small administrative costs for setting up the required system of validating and monitoring reprocessing providers. For this purpose, additional staff may need to be hired.

Compliance costs

The compliance costs of this policy are very likely negative. That is, hospitals can expect significant cost savings from re-using equipment compared to purchasing new products, which also entails paying for more waste. TRUPPE et al. (2007) estimate that if state-of-the-art reprocessing capabilities were fully applied, particularly in the segment of high-tech, high-cost medical tools which are increasingly marketed as single-use products, potential cost savings in the region of 8-12% of total expenditures for medical devices could be realised. For Austria, this implies potential savings between EUR 60 million and 100 million – note that the year of the study is 2006, so the figure is likely now higher – and for the Vienna hospitals association KAV, potential savings are EUR 20 million. For individual hospitals, TRUPPE et al. (2007) report savings ranging from EUR 45.000 for smaller hospitals to several million euro for large hospitals.

Overall, given that costs are negative, this policy is judged to be very cost effective.

Evaluation: ++ (very cost effective)

3.14.3 Good governance: distributional impact

The policy would induce gains for reprocessing companies at the expense of the medical device industry, which has an interest in marketing products as single-use. Hospitals' savings would disproportionately benefit less well-off households if they free up funds for improving public healthcare services in other areas. Overall, the policy is therefore considered to be moderately progressive.

Evaluation: + (moderately progressive)

3.14.4 Feasibility and flexibility

TRUPPE et al. (2007) cite opposition by producers of medical devices, public concerns for health and safety and political disinterest as key barriers to the implementation of this policy. Although due to cost pressures, hospitals are interested in evidence on the feasibility of re-using equipment, a general lack of information leads health and safety concerns to prevail. Hence this policy is considered not to be very feasible. The stakeholders involved in the project suggested information campaigns in order to raise awareness among the public and create momentum for change.

Evaluation: - (not very feasible)

The policy changes regulations from prohibiting to allowing (but not obliging) hospitals to re-use equipment. Hence it increases flexibility compared to the status quo. The policy can also be designed such that the monitoring authorities can react quickly to new information regarding health and safety.

Evaluation: + (moderately flexible)

3.15 Policy #15: Voluntary commitment by hospitals to reduce food waste, with label and tracking

Short description: Discarded food is a major component of hospital waste. The initiative "United against Waste"[12] found that one primary cause is that meal portions tend to be too large because for lack of time: communication allowing individualised ordering of meals is difficult. Hence hospital canteens produce standardised meals in bulk to ensure demand is satisfied. Correspondingly, soups and starchy side dishes are the most frequently discarded meal components in hospitals. A comparison between restaurants, lodgings and large canteens (the latter mainly in hospitals but also in care homes and companies) also showed that large canteens produce the most avoidable food waste (22% on average compared to 14-19% in the other two categories). In hospital canteens specifically, about 50% of food waste consists of leftovers from plates that could be avoided through smaller or better tailored portions (HRAD et al., 2016). A voluntary commitment mechanism would reward hospitals that take measures to track and reduce their food waste with a label or certification, thus making their efforts visible. This measure could be set up and promoted by the Austrian Federal Ministry for Sustainability and Tourism.

Type of instrument: *Information-based (voluntary)*

3.15.1 Climate effectiveness

HRAD et al. (2016) estimate that 61,000 tonnes of avoidable food waste accumulates in Austrian large-scale canteens every year – many of which are hospitals – compared to 50,000 tonnes in lodgings and 45,000 tonnes in restaurants. The food waste in these three sectors causes 400,000 tonnes of CO_2 emissions. Taken together, these figures indicate that the potential for consumption-based emissions reduction from targeting hospital food waste is large. In general, awareness among hospitals in Austria is rising and several have introduced their own initiatives (e.g. the Vienna hospitals association KAV or the Elisabethinenspital in Linz). Hence there should be willingness to take up a voluntary commitment device such as a label. In general, information-based or voluntary policy instruments are less effective than incentive-based or regulatory ones, so the policy is considered to be only moderately effective overall.

Evaluation: + (moderately effective)

[12] See https://united-against-waste.at/.

3.15.2 Cost effectiveness

Administrative costs

The measure incurs administrative costs for setting up the label and its requirements and promoting it by government, which may require hiring new staff.

Compliance costs

The compliance costs involve setting up ways to identify the sources of hospital food waste and to reduce it, as well as the costs of implementing tracking mechanisms for chosen indicators in order to attain the label. On the other hand, hospitals can also be expected to save money by reducing food waste.[13] On the whole, the benefits should equal or outweigh the costs of compliance. Therefore, the policy is considered moderately cost effective.

Evaluation: + (moderately cost effective)

3.15.3 Good governance: distributional impact

The policy is not expected to have any notable distributional effects.

Evaluation: 0 (neutral)

3.15.4 Feasibility and flexibility

Since the policy is voluntary and has no distributional impact to speak of, it is considered to be highly feasible. The stakeholders involved in the project agreed but suggested expanding the policy to include also food procurement in hospitals, which should be seasonal, regional, fair and organic. Hospitals could be supported in the implementation of the policy with public subsidies.

Evaluation: ++ (highly feasible)

Voluntary measures are easy to adapt. No laws must be changed, and the label can be adjusted to new circumstances.

Evaluation: ++ (very flexible)

[13] United against Waste estimates that by saving the food waste found in HRAD et al. (2016), an average business could save EUR 8,000 per year (https://united-against-waste.at/erheben/ergebnisse-der-testerhebung/).

4 CONCLUSIONS

This report has presented a qualitative evaluation of a set of 15 possible policy instruments for the mitigation of Austrian consumption-based GHG emissions that was developed as part of the INNOVATE project. The policies were assessed on their climate effectiveness (reducing consumption-based GHG emissions), their cost effectiveness, distributional impact, feasibility and flexibility. Where available, data from case studies and official statistics were used for the first three criteria. For the last two criteria, Environment Agency Austria's sector experts and external stakeholders from regional governments, NGOs and other interest groups were consulted.

Incentive-based instruments are most climate-effective

Overall, ranking the policy instruments according to the criteria considered, the following conclusions can be drawn (see also Table 2 below). Regarding climate impact, the instruments that were considered most effective in reducing Austrian consumption-based emissions are incentive-based instruments like the carbon-added tax (policy #6) and higher vehicle taxes for emission-intensive cars (#8); and those instruments that target infrastructure (#9 and #10) and the public health sector (#13 and #14), where the potential for emission reduction is considered large in Austria. In general however, these instruments score less highly on feasibility and flexibility, because they would either induce substantial changes in consumer behaviour and production structures; or require considerable public and private expenditures; or require international policy co-ordination in order to work effectively (especially the carbon-added tax).

Regulatory and incentive-based instruments are most cost-effective

The most cost-effective instruments tend to be regulatory but also incentive-based. These include the information obligation on vacant dwellings (#2), the vehicle tax for emission-intensive cars (#8), and the regulatory changes regarding the health sector (#13, mandatory EPPs, and #14, allowing reprocessing and re-use of single-use medical tools and equipment). Particularly the last two measures are thought to bring large cost savings for hospitals while incurring comparatively small administrative costs, making them particularly cost-effective from a social point of view.

Information-based instruments are most feasible and flexible

Regarding the "soft" criteria feasibility and flexibility – where the former is often influenced by a policy's distributional impact – it is information-based instruments that perform best. These include the certification scheme for online retailers offering a sustainable delivery option (#11) and the voluntary commitment by hospitals to reduce food waste in the form of a label or other certification scheme (#15). Their advantage is that they cost little and are voluntary, but the disadvantage is that they are also relatively ineffective in reducing emissions.

Further research

The qualitative evaluation presented in this report should be seen as complementary to model-based, quantitative assessments especially regarding the climate and cost effectiveness of the policy instruments. While in this report, the direct, sectoral effects of the policies on emissions and costs in Austria were considered, an evaluation based on a multi-regional macroeconomic model can give an indication of the likely size of the full general equilibrium impact, taking into account both domestic and international linkages, feedbacks and potential rebound effects. This kind of quantitative analysis is carried out in NABERNEGG et al. (2018) for a selection of the 15 policy instruments described in this report.

Table 2: Summary of evaluation results (Source: Umweltbundesamt)

POLICY		Climate effectiveness	Cost effectiveness	Good governance: distributional impact	Feasibility	Flexibility
#1	Change in the safety and fire regulations for construction materials raising the maximum admissible building height for wood frame structures	+	+	+	+	+
#2	Information obligation on vacant dwellings tied to a renovation subsidy	+	+ +	0/+	+	+
#3	Directive on proportional share of dedicated spaces for co-housing projects combined with a subsidy	0	-	-	-	0
#4	Subsidy for retrofitting and redesign of vacant commercial buildings tied to energy-efficient refurbishment	+	+	0/+	+	+
#5	Labelling scheme on consumption-based emissions for conventional and sustainable construction materials	0	0	0	- -	+ +
#6	Carbon-added tax (CAT) on construction materials	+ +	0/+	0/+	- -	0
#7	Obligation to implement employee mobility plans, joint with public subsidies and other support measures	+ +	+	0	0	+
#8	Higher vehicle taxes for emission-intensive cars, linked to consumption-based CO_2 labels	+ +	+ +	+	- -	+
#9	Infrastructure investment to expand and improve Park + Ride facilities and their accessibility	+ +	+	+	+	-
#10	Integrated transport ticket across regions, linked with comprehensive online information platform	+ +	0	+	-	-
#11	Certification scheme for online retailers offering a sustainable (green) delivery option	0	0	0	+ +	+ +
#12	Increased subsidies for purchasing and using cargo bikes along the entire transport chain	+	0	0	0	+
#13	Obligatory Environmentally Preferable Purchasing Programmes (EPP) for hospitals and health institutions	+ +	+ +	0/+	+	+
#14	Change in regulations to allow the reprocessing and re-use of single-use medical tools and equipment	+ +	+ +	+	-	+
#15	Voluntary commitment by hospitals to reduce food waste, with label and tracking	+	+	0	+ +	+ +

+ + … highly; + … moderately; 0 … neutral; - … less; - - - … not at all

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The INNOVATE project analysed Austria's consumption-based greenhouse gas emissions. This report summarises the results of Work Package 3, which focused on designing and evaluating policy instruments for mitigating consumption-based greenhouse gas emissions.

A set of 15 instruments addressing the sectors construction, mobility and public healthcare is described and evaluated qualitatively according to the criteria climate and cost effectiveness, distributional impact, political feasibility and flexibility. The results indicate that incentive-based instruments as well as instruments targeting infrastructure provision and the healthcare sector are most effective in reducing emissions. The most cost-effective instruments tend to be regulatory but also incentive-based, while information-based instruments perform best in terms of feasibility and flexibility.

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