REPORT

Effects of policy instruments on waste intensities

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Report Summary

Project title

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Title and subtitle of the report

Effects of policy instruments on waste intensities

Summary

As part of the research programme Towards Sustainable Waste Management, this report includes a discussion on how various policy instruments can affect the waste intensity coefficients in the general equilibrium model EMEC, when this model is used for calculating the Swedish waste quantity for the year 2030.

We find that information to households can be assumed to reduce the waste intensity of households by 10%, as a calculation example. Paper waste from households can be reduced by 20% if direct advertisements are distributed only to households that state that they want such information. We expect information to companies and organisations, tax on hazardous waste, and a differentiated Value Added Tax to have little effect on the waste intensity coefficients. For several other policy instruments discussed in this report, the effects on waste intensity coefficients can be significant, but we have no basis for making quantitative assumptions.

Keyword

Waste, waste quantities, policy instruments, future

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Foreword

The results presented in this report are a result of research done with support from the Swedish Environmental Protection Agency within the framework of the research programme "Towards Sustainable Waste Management". This research is part of the project "Future waste quantities", which deals with projections of future waste quantities and with waste prevention. The work presented in this report has been carried out in cooperation between IVL Swedish Environmental Research Institute and the consultancy Profu. Useful input has been provided by Maria Ljunggren Söderman and Åsa Stenmarck at IVL, by Göran Östblom and Tomas Forsfält at the National Institute of Economic Research, and by Maria Andersson and Chris von Borgstede at the Department of Psychology, University of Gothenburg. The final manuscript reflects the views of the authors only, however.

Summary

This report is part of the assessment of policy instruments in the research programme Towards Sustainable Waste Management. It presents a discussion on how various policy instruments can affect the waste intensity coefficients in the general equilibrium model EMEC, when this model is used for calculating the Swedish waste quantity for the year 2030.

These are our conclusions and recommendations in brief:

- Information to households: assume that the information reduces the waste intensities of households by 10%. This would be a realistic calculation example. In addition, it should be remembered that information to households can also reduce the waste intensity of the commercial sector.

- Information to companies and other organisations: we give no quantitative recommendations for the assessment of this policy instrument. However, the effect of the policy instrument will probably be small.

- Raw materials tax: we give no quantitative recommendations for the assessment of this policy instrument. However, it should be remembered that it can have a significant effect on the use of oil and plastics, and that it might also affect the use of bulk materials that are used without or with little pre-treatment, such as gravel, sand, and concrete. With further investigations, it might be possible to give a quantitative estimate on at least the first of these effects.

- Weight-based collection fee: this would affect the waste intensity coefficients in varying ways, depending on whether the policy instrument would result in A. waste prevention, B. increase in source separation, or C. increase in illegal waste treatment (see Section 3.4). Further investigation is required to judge which of these three responses are likely to dominate.

- Industrial waste-plan requirements: we give no quantitative recommendations for the assessment of this policy instrument.

- Advertisements on request only: assume a 20% reduction in the waste intensity coefficients for paper waste from households, and account for a corresponding reduction in paper production in EMEC (if possible) and in the LCA model SWEA. In addition, it should be remembered that:
    - the policy instrument reduces the environmental impacts of printing, transport, etc. of direct advertisements,
    - the estimated effect on direct advertisements is optimistic,
    - part of the effect will probably be offset by more paper being used for other purposes and/or in other countries,
    - the policy instrument in addition can increase the production of other types of advertisements, and
    - it can have an unknown effect on the consumption pattern of households, and associated economic and environmental consequences.

- Tax on hazardous substances: assume that waste intensity coefficients are not affected.

- Mandatory chemicals labelling: we give no quantitative recommendations for the assessment of this policy instrument. However, we conclude that it might reduce the waste intensity for hazardous waste, but also increase the intensity for total waste.

- Improved control by authorities: we give no quantitative recommendations for the assessment of this policy instrument.

- Differentiated VAT: assume that the waste intensity coefficients are not affected. However, it is likely to affect the household consumption of goods and services, and/or the expenditure of industry on capital, energy, staff, and materials. These effects should be modelled endogenously in EMEC, if possible.

We have found no basis for making differing recommendations in the different external scenarios defined for Towards Sustainable Waste Management. Instead, we believe the same recommendations are valid for all scenarios.

Contents

1 Introduction

1.1 The research program

Towards Sustainable Waste Management (TOSUWAMA) is an interdisciplinary research programme dedicated to investigating policy instruments and strategic decisions that can contribute to developing waste management in a more sustainable direction[1]. The primary target groups for the findings of TOSUWAMA is the Swedish Environmental Protection Agency and other policymakers in the field of waste management at European, national, regional and local levels, recycling companies, waste management companies and R&D organisations in waste management.

The ten research projects in TOSUWAMA are based on close co-operation and exchange of knowledge and results, see Figure 1. Each project adds important information and knowledge to the programme. These will be integrated in the project "Future-oriented synthesis", aiming at identifying decisions that contribute to the development of a more sustainable waste management system. In this way, the results of Towards Sustainable Waste Management will provide useful input to actual decision-making and strategy development in waste management and other related fields.

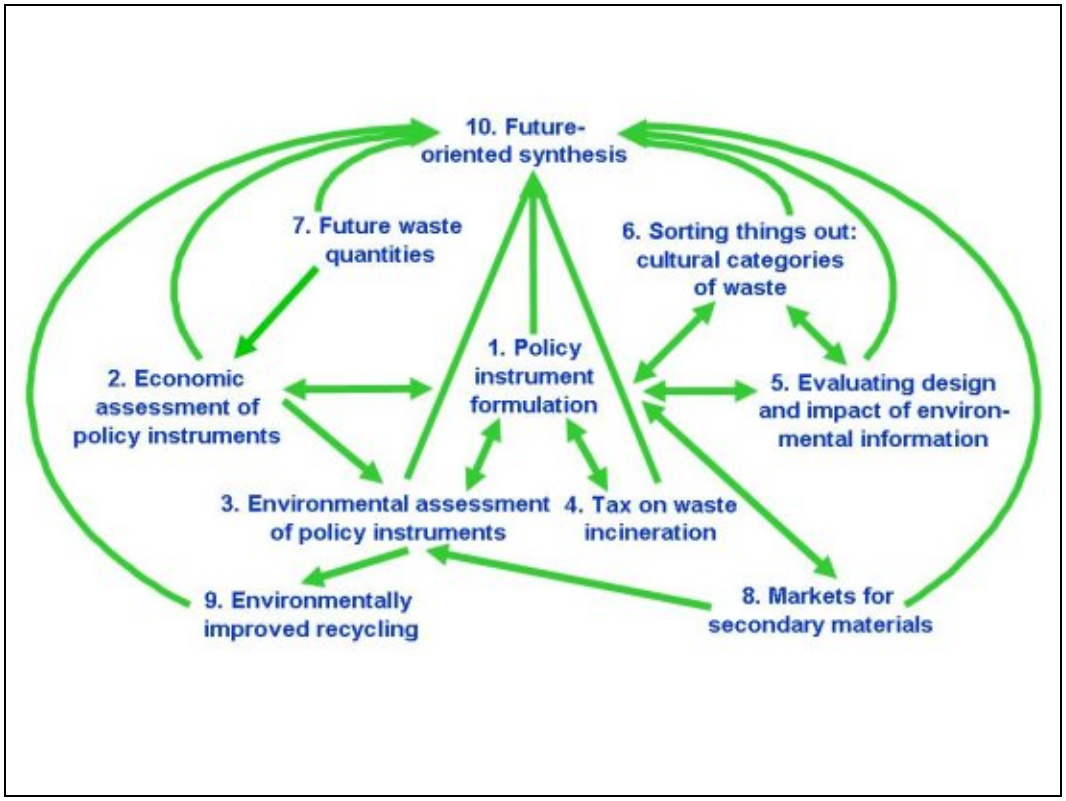

Figure 1. TOSUWAMA projects and the information flows between the projects.

[1] More information about the program is available at http://www.hallbaravfallshantering.se/

Project 1 "Policy instrument formulation" has a central role in that it generates ideas for policy instruments to be assessed in the other projects, and collects results and conclusions from these assessments. The following policy instruments have been selected and described in sufficient detail to facilitate assessment (Bisaillon et al. 2009):

- Information to households
- Information to companies and organisations
- Tax on raw materials
- Weight-based waste-collection fees
- Waste-collection fee differentiated for source-separation
- Industrial waste-plan requirements
- Advertisements on request only
- Recycling certificates
- Improved collection systems
- Climate tax on waste incineration
- General tax on waste incineration
- Green electricity certificates at waste incineration
- Tax on hazardous substances
- Mandatory chemicals labelling
- Improved control by authorities
- Differentiated VAT
- Incineration ban for recyclables

To achieve a basis for conclusions regarding the sustainability of these policy instruments, they will be assessed in five different external scenarios for the year 2030:

- Reference scenario
- Scenario 1: Global sustainability
- Scenario 2: Global markets
- Scenario 3: Regional markets
- Scenario 4: European sustainability

These scenarios were developed as a first task in TOSUWAMA Project 10 "Future-oriented synthesis" (Dreborg & Tyskeng 2008). The scenarios are distinguished by their degree of global cooperation and the degree of political control and influence in matters that concern the environment and natural resources.

1.2 Future Waste Quantities

This report is part of TOSUWAMA Project 7 "Future waste quantities", where we investigate how the quantity of waste develops in different future scenarios. Estimates of the future waste quantities are important for analyses of the long-term consequences of policy instruments in the waste-management sector.

For this analysis we refine and apply the Environmental Medium term EConomic model (EMEC), a general equilibrium model of the Swedish economy (Östblom & Berg 2006, Östblom et al. 2010). The model distinguishes between 48 waste types (hazardous as well as non-hazardous) and 20 sectors (19 industrial sectors plus households) where waste is generated. All in all, this covers, with few exceptions, the total generated waste in Sweden.

Our input data are from the current national waste statistics. They are divided by data on current activities in the various EMEC sectors to calculate current waste intensities in each sector. We estimate how these intensities will develop until the year 2030 in the different external scenarios (Sundqvist et al. 2010). The resulting estimates for future waste intensities are used in EMEC to calculate waste quantities in 2030. The quantities of each waste type will vary between scenarios, because the economic development and the waste intensities (waste coefficients in EMEC) will both vary. The results are refined in other TOSUWAMA projects and used as input to other models (Ekvall et al. 2009, Östblom et al. 2010).

In this project, we also investigate costs for waste prevention (Profu 2009), and describe strategies for an increase in material efficiency, aiming at reducing the quantity of waste (Ekvall 2008). Keeping the quantity of waste down is an important step towards sustainability since waste management affects the environment. Even more important, a reduction in waste flows often results in a reduction in the production of materials, which reduces resource depletion as well as emissions to the environment. Analysing the options for waste prevention is therefore an important part of the programme.

1.3 The report

This report presents our discussion on how the various policy instruments can affect the waste quantities and waste intensities in EMEC for the year 2030. The discussion is limited to those selected policy instruments that have a clear connection to waste prevention (Bisaillon et al. 2009):

- Information to households
- Information to companies and organisations
- Tax on raw materials
- Weight-based waste-collection fees
- Industrial waste-plan requirements
- Advertisements on request only
- Tax on hazardous substances
- Mandatory chemicals labelling
- Improved control by authorities
- Differentiated VAT

The report includes a section on each of these policy instruments. Each section includes a description of the instrument, as defined by Bisaillon et al. (2009), a discussion of the expected consequences for the waste intensities in the Reference scenario, and a statement on whether we expect different consequences in the other scenarios.

2 Method

The authors of this report discussed the selected policy instruments at two working meetings. Additional information was collected from other TOSUWAMA researchers to ensure that our discussion is consistent with the TOSUWAMA models EMEC (see above), NatWaste (our systems-engineering model of the Swedish waste-management system; Söderman 2000), and SWEA (our life-cycle assessment model; Ekvall et al. 2009).

3 Results

3.1 Information to households

3.1.1 Description of policy instrument

Bisaillon et al. (2009) describe the policy instrument "Information to households" as a package with three components:

1. Municipalities are required to inform citizens about waste quantities and waste treatment.
2. Various information campaigns are carried through to increase the motivation for source separation and waste prevention in households. The campaigns can also include advice on how, where and when to deliver each separate waste fraction. They can include good examples, and a link to environmental labelling.
3. Municipalities are required to inform households about source separation, and also to give assistance for example through waste coaches visiting households and offering practical guidance on source separation etc.

3.1.2 Impact in Reference scenario

Bisaillon et al. (2009) refer to cases where just information had little beneficial effect on the source separation (Rathje & Murphy 2001, Sundqvist & Stenmarck 2008). Bisaillon et al. argues that pure information is likely to be ineffective since consumers receive an overflow of information, which means that we do not even notice much of it. Information combined with practical guidance on source separation, however, resulted in an increase in source separation as well as in the quality of the separated material (Avfall Sverige 2005a&b, Bernstad et al. 2009).

Andersson (2010) adds that the information on waste quantities might be more effective if given in the form of feedback. We are more susceptible to information if it is given as feedback on our actions. Good examples with a clear link to descriptive social norms can also contribute to the effect of information.

Varying types of information is also likely to be effective in different contexts. Written procedural advice on, for example, how to prevent or separate waste is likely to effective only when the households are already interested. Waste coaches can be an important component in the policy instrument, particularly in areas with a low rate of source separation. For this reason, knowledge on the social and personal norms, environmental awareness and waste-related behaviour of the target audience is important when designing the information (Andersson 2010).

The effects of information on the waste quantities might be different from the effects on source separation. While source separation is a rather technical waste-management issue in the households, waste prevention relates more to the lifestyle. Changes in waste management still matters, for example an increase in the utilisation of food leftovers. But changes in consumption patterns are at least as important for the waste quantity. For this reason, practical guidance might be less important to obtain waste prevention. On the other hand, information carrying the message to consume less (e.g. "work less; spend more time with friends and family") is likely to stand out in the information flow. Messages to change the focus of consumption (e.g., "mend your bike"; "refurbish your

kitchen"; "don't throw out the baby with the bathtub water") might also be noticed more than information on why and how to source separate.

The development over time of household waste quantities suggests that part of this quantity can be affected by information. The quantities increase over time, but there are fluctuations in the rate of growth. In the year 2007 and the first half of 2008, the growth rate was unusually high. The quantity of household waste grew by 4.8% from 2006 to 2007 and by 0.3% from 2007 to 2008 (Avfall Sverige 2009). The low increase to 2008 was due to a significant decline in the waste quantity during the last quarter of 2008.

These fluctuations can be explained in part, but not completely, by changes in the economic growth. The growth in household spending was 3.0% between 2006 and 2007 and -0.2% between 2007 and 2008 (NIER 2009).

Other possible explanations concern our consumption patterns: in recent years it became fashionable to renovate and buy new kitchens etc. Such activities result in rather high quantities of waste per kSEK spent. This development was spurred by popular TV shows on renovation – a kind of information that affects lifestyles.

When the financial crisis struck in fall 2008, the quantity of waste declined quicker and more rapidly than the economy. It is reasonable to believe that the households postponed expensive activities such as renovation projects and purchase of capital goods. If so, this can be regarded as a reaction to information about a future economic threat.

These fluctuations illustrate that the quantity of household waste can easily vary somewhat. The magnitude of the change (first 2% more than the economic growth and then several percentages down) could possibly also indicate the expected effect on the waste quantity of information on lifestyles and future threats.

To estimate the effects of an information campaign aiming at waste prevention based on these recent fluctuations is problematic, however. Such a campaign could have significantly smaller or greater effect:

- Smaller, because the underlying environmental threat communicated in such a campaign is not an acute threat to ourselves as individuals. The imminent economic crisis was such a threat to many people.
- Greater, because the campaign would be designed with the specific aim to affect waste quantities and source separation. Some of the effects of the financial crisis and economic downturn may have contributed to keeping the waste quantity up: Swedish consumers did not travel as much abroad, but stayed home to consume and generate waste within the country. An information campaign can also be designed to be more persistent over time than a TV series or a financial crisis.

Our assessment, based on the discussion above, is that an effective and persistent information campaign could reduce the waste quantity from households in the year 2030 by 10%. If the campaign is successful in affecting the lifestyle and changing the consumption pattern of the general public, the effect on the waste flow can even be much greater than this. This assessment is consistent with the description on the external scenarios, where the waste quantity from households diverges greatly due to varying environmental awareness and consumption patterns (Sundqvist et al. 2010, Östblom et al. 2010).

It should be noted that the effects of this policy instrument is likely to depend heavily on the details in the design of the information and on other circumstances beyond the control of policy-makers. An ineffective information campaign will have an insignificant impact on the waste quantity.

Information to households might also have an indirect effect on the waste quantity of companies, since the persons in the household are also employees and consumers. If their values are affected by information on waste prevention, this might affect the quantity of waste they generate as employees. The quantity of waste generated in the production of consumer goods might possibly also be considered as a factor in purchasing decisions. If so, this would give companies an extra incitement to reduce waste quantities. We have no basis for quantifying these indirect effects, however, or to even state that they can be significant.

Our recommendation for the further assessment of this policy instrument is that a realistic calculation example be carried through, where the information reduces the waste intensities of households by 10%. In addition, it should be remembered that information to households can also reduce the waste intensity of the commercial sector.

3.1.3 Impact in other scenarios

Two of our external scenarios for the year 2030 have a high degree of political control on environmental issues: Scenario 1 (Global sustainability) and Scenario 4 (European sustainability). In these scenarios, the environmental awareness of many households is likely to be higher compared to the Reference scenario. The level of environmental knowledge is also likely to be higher. This is likely to make the households susceptible to information on waste prevention, particularly if this information on the environmental benefits of waste prevention is included. On the other hand, the general environmental awareness in these scenarios is reflected by less wasteful consumption and much lower quantities of household waste even without this information (Sundqvist et al. 2010, Östblom et al. 2010). Hence, further waste prevention, resulting from this specific policy instrument, will require significantly more commitment and sacrifices from the households, compared to the Reference scenario. We do not have a good basis for assuming that the impact of the policy instrument will be stronger or weaker, in terms of percentages of waste prevention, compared to the Reference scenario. Our recommendation for the further assessment of this policy instrument is that the calculation examples for Scenarios 1 and 4 are also based on the assumption that the information reduces the waste intensities of households by 10%.

The remaining two external scenarios have a low degree of political control on environmental issues: Scenario 2 (Global markets) and Scenario 3 (Regional markets). In these scenarios the environmental awareness of households is likely to be lower that in the Reference scenario, making many of them uninterested in information on waste prevention. On the other hand the consumption is more wasteful and generates more food leftovers than in the Reference scenario (Sundqvist et al. 2010). This makes it easy to reduce the quantity of waste in the households where the information do make an impression. Again, we do not have a good basis for assuming that the impact of the policy instrument will be stronger or weaker, in terms of percentages of waste prevention, compared to the Reference scenario. For this reason, we recommend that the calculation examples for Scenarios 2 and 3 are based on the assumption that the information reduces the waste intensities of households by 10%.

3.2 Information to companies and organisations

3.2.1 Description of policy instrument

Bisaillon et al. (2009) describe this policy instrument as a package with four components:

1. Municipalities are required to inform companies and other organisations about waste quantities and waste treatment.
2. Various information campaigns are carried through to increase the motivation for source separation and waste prevention in organisations. The campaigns can also include advice on how, where and when to deliver each separate waste fraction. They can include good examples, and a link to environmental labelling.
3. Municipalities are required to keep a number of "waste coaches" that provide practical guidance to organisations on source separation and waste prevention.
4. In addition to the waste coaches, companies and other organisations should receive support to establish waste minimisation clubs (Phillips et al. 2001) or similar.

This package is similar to the information suggested for households (see Section 3.1.1), with the addition of waste minimisation clubs.

3.2.2 Impact in Reference scenario

There are several reasons to assume that information to companies has significantly less impact on the waste quantity than information to households:

- The main driving forces of most companies are economic. Hence, they are probably not much affected by information directed to them if this information relates to lifestyle. They might be indirectly affected, however, by such information to households (see Section 3.1.2).
- It is reasonable to assume that large companies in Sweden are already well informed, compared to households. This means the information will fill less knowledge gaps.
- It is also reasonable to assume that small companies have little time to receive and understand information that does not concern the core of their business. They are also likely to have little time and resources to implement changes aiming at reducing waste quantities.

Despite these arguments, there might be simple measures that can be taken if companies and other organisations are informed about them. The waste minimisation clubs might contribute to additional waste prevention. However, we have no basis for quantifying these effects or to state that they can be significant.

We give no quantitative recommendations for the further assessment of this policy instrument. However, it should be remembered that the effect of the policy instrument is probably small.

3.2.3 Impact in other scenarios

We expect the effect of information to organisations to be small in all scenarios.

3.3 Raw material tax

3.3.1 Description of policy instrument

Bisaillon et al. (2009) describe this policy instrument as a package with two components:

- A 10 SEK/tonne tax on non-renewable materials (excluding oil and plastics) extracted or imported and then used in Sweden.
- A tax on all use of oil similar to the one currently applied on household heating oil (3804 SEK /m^3) and an associated SEK 4000 SEK/tonne tax on imported plastics.

3.3.2 Impact in Reference scenario

A raw-materials tax will make the use of non-renewable materials more expensive. This can affect the material flows on various levels of the economy. The economy as a whole will be shifted somewhat from the production of goods to production of services. Within each sector of the economy, the consumption will be shifted somewhat from the use of raw materials to the use of capital and staff. There will also be a shift from non-renewable to renewable materials, and from oil to other energy carriers.

A 10 SEK/tonne tax is small compared to the value of most materials. For these materials, the effect is likely to be more or less negligible. The effect might be noticed on the consumption of materials with little economic value per tonne. It is similar to the current tax on natural gravel, which is intended to reduce the use of this material. Hence, it could have effect on the use of gravel and on other bulk materials that are used without or with little treatment, such as sand and concrete. However, these effects are uncertain: it is not clear if the current tax on natural gravel has had the intended effect (Bisaillon et al. 2009).

The effects of the tax could also possibly be noticeable for metals, where a large quantity of rock and ore is extracted to produce a tonne of useful material. However, in iron mines the content of metal in the extracted material is high, and the tax would not be higher than 20 SEK/tonne metal, which is less than 2% of the value of the iron in the ore. For many other metals, the tax would be ten times higher, but then the economic value of the metal in the ore is also at least correspondingly higher. This means that the effect on the use of metals is likely to be very small and perhaps negligible. Part of this small effect is also endogenously calculated by EMEC (Östblom 2009), which means that there is no need to exogenously adjust the related waste coefficients.

The effect of the proposed tax on oil and plastics can be greater, since this tax is much higher: it corresponds to 3804*0.159 = 605 SEK per barrel of crude oil, which is higher than the oil price in most cases. This tax would not be an increase on the tax of all oil use, since it would replace or equalize current taxes on heating oil, petrol, etc. But it would make oil much more expensive as raw materials of plastics, probably shifting the raw material mix towards less oil and more natural gas. It could also make plastics significantly more expensive and increase the use of renewable materials instead of plastics, or as raw materials to plastics. It might be possible to quantify these effects, since there is an established literature on the own-price elasticity of oil and petroleum products. It has unfortunately not been possible to investigate this further within the frame of this report.

We do not have a basis for a quantitative estimate of the effects on waste intensities. However, it should be remembered that the tax might have a significant effect on the use of oil and plastics, and that it might also affect the use of bulk materials that are used without or with little treatment, such as gravel, sand, and concrete. With further investigations, it might be possible to give a quantitative estimate on at least the first of these effects.

3.3.3 Impact in other scenarios

We do not have a basis for quantitative recommendations in any of the scenarios. The effects on the use of oil and plastics and on the use of bulk materials are likely to occur in all scenarios.

3.4 Weight-based waste collection fee

3.4.1 Description of policy instrument

Bisaillon et al. (2009) propose to assess a waste collection fee for households with a fixed part (850 SEK/household and year) and a variable part (2.12 SEK/kg residual waste).

3.4.2 Impact in Reference scenario

Based on observations by Dahlén & Lagerkvist (2008), Bisaillon et al. (2009) assume that the weight-based collection fee will reduce the quantity of unsorted household waste by 20% in municipalities where it is introduced. They propose to calculate with three extreme scenarios on the reasons for this reduction:

A. Prevention of waste with the same composition as the average residual waste.
B. Increase in source separation, home composting and materials recycling.
C. Illegal treatment: burning of combustable waste in private stoves etc., and dumping of food and garden waste in the forest.

These events would affect the waste intensity coefficients in varying ways:

A. With waste prevention, the waste coefficient for household waste from households will be 20% lower when the waste-based collection fee is introduced.
B. With source separation, the waste coefficient for household waste from households will also be 20% lower. The coefficient for source separated waste will increase sufficiently to make the total waste flow from households the same as without the policy instrument. Alternatively, the increase in source separation can be modelled in NatWaste, the systems-engineering model to which EMEC is soft-linked (Östblom et al. 2010). In this case the waste coefficients in EMEC should be kept unchanged.
C. With illegal treatment, the waste coefficients in EMEC will not be affected. However, 20% of the household waste from households will be directed to illegal treatment in the NatWaste model and in the LCA model SWEA.

Further investigation is required to judge which of the three events are likely to dominate the reaction on a weight-based collection fee.

3.4.3 Impact in other scenarios

We expect the effects in all scenarios to be similar to the effects in the Reference scenario.

3.5 Industrial waste-plan requirements

3.5.1 Description of policy instrument

Bisaillon et al. (2009) describe several alternative versions of this policy instrument. One is to require a waste plan, including plans for waste minimization, from companies or plants that generate over 2000 tonne waste or over 2 tonne hazardous waste. Another alternative is to require applications for environmental permits and/or compulsory annual environmental reports to include a description of actions planned and taken to minimize waste. In all versions, the policy instrument aims at creating conscious deliberation on waste prevention and recycling in the companies.

3.5.2 Impact in Reference scenario

This policy instrument can be compared to information to companies (see Section 3.2): it aims at increasing the awareness of waste-related issues in the hope that waste management and waste prevention will be enhanced. There are important differences, however: mandatory waste-prevention plans etc. might on one hand be more effective than information, since it requires conscious deliberations in the company while information might not even be noticed by company staff. On the other hand, this policy instrument might also be less effective than information, since it does not contribute to creating business opportunities, which can be provided by the waste minimisation clubs that are part of the information package.

We agree with Bisaillon et al. (2009) that a requirement for waste plans etc. is likely to reduce the waste intensity of the industry. However, we have no basis for an estimate or qualified guess on the quantity affected. Hence, we give no quantitative recommendations for the further assessment of this policy instrument.

3.5.3 Impact in other scenarios

We expect the effects in all scenarios to be similar to the effects in the Reference scenario.

3.6 Advertisements on request only

3.6.1 Description of policy instrument

This policy instrument means that direct advertisements are distributed only to households that state that they want such information, for example through a notice on the mailbox or the door (Bisaillon et al. 2009).

3.6.2 Impact in Reference scenario

Bisaillon et al. (2009) estimate that the policy instrument would currently reduce direct advertisements by up to 12 kg per person and year. In Sweden as a whole, this corresponds to a reduction in the annual waste quantity by 0.11 Mtonne in the current situation. For simplicity, we suggest that all of this is recorded as a reduction in paper waste from households. Since the quantity of paper waste from households is 0.54 Mtonne in the EMEC model of the year 2006 (Sundqvist et al. 2010), the waste intensity coefficients for paper waste from households should be reduced by 20% (0.11/0.54 = 0.20) when calculating future scenarios with this policy instrument.

If the quantity of paper used for direct advertisements is reduced by 0.11 Mtonne/year, this will affect the international paper market on the margin. The production of paper is likely to be reduced. However, part of the paper might instead be used for other purposes and/or in countries other than Sweden. This will offset part of the effect of the policy instrument, making the reduction in paperwaste quantities and in paper production smaller than indicated in the previous paragraph. There are great uncertainties in this negative feedback mechanism: where and for what purpose will the paper be used, what materials and products (if any) will it replace, and where will the paper end up as waste? These uncertainties are unmanageable at this stage, and we cannot model the negative feedback in the research programme. Instead, we propose to keep the this information as a qualitative reservation and limit the quantitative model to the direct effects on Swedish paper waste and the associated paper production If possible, the reduction in paper production should be taken into account in the EMEC model. If so, we propose that it be assumed that the full reduction in paper production takes place in Sweden. This would allow the EMEC model to account for the full reduction.

Regardless of whether the EMEC model can take the reduction in paper production into account, this should be taken into account in the environmental assessment of the policy instrument. This can be done through expanding the system investigated in the SWEA model to include the reduction in paper production.

The production and distribution of direct advertisements includes several other processes besides the paper production: printing, transportation, etc. The economic and environmental effects of reducing these activities are probably not possible to quantify in this research programme.

The effects of reducing direct advertisements can be partly offset by an increase in advertisements through other channels. This indirect effect is difficult to quantify.

A reduction in direct advertisements might also affect the consumption pattern of households. This indirect effect is potentially important, but do unfortunately not have a basis for making an estimate or even a qualified guess on the magnitude and composition of this effect.

Our recommendation for the further assessment of this policy instrument is that:

- it is assumed that the policy instrument results in a 20% reduction in the waste intensity coefficients for paper waste from households,
- a reduction in paper production, corresponding to 20% of paper waste from households, is accounted for in EMEC, if possible, and in the SWEA model.

In addition, it should be remembered that:

- the policy instrument reduces the environmental impacts of printing, transport, etc. of direct advertisements,

- the estimated effect on direct advertisements is optimistic,
- part of the effect will probably be offset by more paper being used for other purposes and/or in other countries,
- the policy instrument in addition can increase the production of other types of advertisements, and
- it can have an unknown effect on the consumption pattern of households and associated economic and environmental consequences.

3.6.3 Impact in other scenarios

We expect the effects in all scenarios to be similar to the effects in the Reference scenario.

3.7 Tax on hazardous substances

3.7.1 Description of policy instrument

Bisaillon et al. (2009) describe this policy instrument as a 2 SEK/kg tax on hazardous substances, to be paid by producers of all products that contain more than 0.1% of such a substance.

3.7.2 Impact in Reference scenario

A 2 SEK/kg tax is small compared to the economic value of most hazardous substances. The tax will have very little effect on the price of most products, which means that the demand for these products will hardly be affected at all.

Fossil fuels such as petrol, diesel, and fuel oil are exceptions to this rule. Here, an increase in the price by 2 SEK/kg plus VAT would probably affect the demand for these fuels. On the other hand, this would not directly reduce the waste intensity, since the ash content of these fuels is very low. In fact, the waste intensity might increase, if the tax means that liquid fossil fuels are replaced by fuels with a higher ash content, for example by wood-based fuels for residential heating.

Since the tax makes petrol and diesel more expensive, it will probably affect the transport sector. This can affect the economy and, through the economy, the waste quantities. This effect can be endogenously modelled in EMEC. The effect on the waste intensity coefficients is likely to be quite small and not possible to quantify.

A beneficial effect of the tax can be that the toxicity of the waste flow can be marginally reduced. This would be defined as waste prevention in the broad definition of the EU Waste Directive (EC 2008). However, it would not affect the waste intensity of the economy.

For the further assessment of this policy instrument, we recommend to assume that the waste intensity coefficients are not affected.

3.7.3 Impact in other scenarios

We expect no noticeable effect in any scenario.

3.8 Mandatory chemicals labelling

3.8.1 Description of policy instrument

Bisaillon et al. (2009) describe this policy instrument as a requirement to label all goods containing at least 0.1 % substances with very high acute toxicity, allergenic, high chronic toxicity, etc.

3.8.2 Impact in Reference scenario

A mandatory labeling of products with hazardous substances can affect consumer choices, reducing the use of such products. This would reduce the waste intensity coefficients for hazardous waste.

The drawback is that the non-hazardous products are likely to have lower functionality in some cases. It has for instance been difficult to find good replacements for the now banned, toxic boat paints (Gustafsson 2005). This means a change away from the toxic paints would contribute to increasing total quantity of waste. There are probably also other cases where the hazardous substance is added to the product because it provides a function that is difficult to obtain at the same level without this substance. This means a change away from such products would contribute to increasing total quantity of waste. Boats and houses might need repainting more often, facade materials might need to be replaced with shorter intervals, etc.

We have no basis for quantifying any of these effects or to state that they can be significant. Hence, we give no quantitative recommendations for the further assessment of this policy instrument. However, the conclusion should be remembered that this policy instrument might reduce the waste intensity for hazardous waste, but on the other hand increase the intensity for total waste.

3.8.3 Impact in other scenarios

We expect the effects in all scenarios to be similar to the effects in the Reference scenario.

3.9 Improved control by authorities

3.9.1 Description of policy instrument

This policy instrument means that more resources are allocated to control of industry and other commercial activities, particularly regarding the waste management (Bisaillon et al. 2009). When controlling by visiting the facilities, authorities also give information and advice similar to waste coaches (see Section 3.2).

3.9.2 Impact in Reference scenario

This policy instrument has some similarities and connections to information to companies and to requirements on waste plans (see Sections 3.2 and 3.5). When a company has permission to landfill a limited quantity of waste, increased control can make these companies more likely to follow to the

rules. Bisaillon et al. (2009) states that the policy instrument is likely to reduce the quantity of hazardous waste, but do not present the basis for this statement.

We have no basis for an estimate or qualified guess on the quantity affected by an increase in the control, or even for stating that the effect is significant. Hence, we give no quantitative recommendations for the further assessment of this policy instrument.

3.9.3 Impact in other scenarios

We expect the effects in all scenarios to be similar to the effects in the Reference scenario.

3.10 Differentiated VAT

3.10.1 Description of policy instrument

Bisaillon et al. (2009) present an idea for changes in the Value Added Tax (VAT) to increase recycling. This idea means that the VAT is reduced for products produced from more than 50% recycled material.

Bisaillon et al. also present ideas for VAT changes to reduce the quantity of waste, by reducing the VAT for services and/or by increasing the VAT for all production sectors other than services, agriculture, fishery, forestry and real estate.

3.10.2 Impact in Reference scenario

If the VAT on recycled materials is reduced without a corresponding increase in the VAT on virgin materials, this might increase the total use of materials and, hence, the quantity of waste. We have no basis for estimating the magnitude of this effect. However, it might be possible to model endogenously in EMEC through a general reduction in the price of materials. This would shift the spending of all industrial sectors in the model from capital, energy and staff to materials.

A reduction in the VAT on services is likely to cause the economy as a whole to shift somewhat from the production and household consumption of goods to services. This shift can be endogenously quantified by EMEC (Östblom 2009) and is likely to reduce the quantity of waste. However, the waste intensity within each sector is not likely to be significantly affected.

For the further assessment of this policy instrument, we recommend that the waste intensity coefficients are assumed not to be affected. However, the shift from goods to services and the shift from capital, energy and staff to materials should be modelled in EMEC, if possible.

3.10.3 Impact in other scenarios

We expect no noticeable effect on the waste intensity coefficients in any scenario.

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