English summary

The present report from the Chairmen of the Danish Council of Environmental Economics contains the following three chapters:

- Energy and Climate Policy, chapter I
- Car taxation, accidents and environment, chapter II
- Waste, chapter III

Chapter I: Energy and Climate Policy

Energy is an essential production factor, since secure access to cheap energy is a prerequisite for a stable economic development. However, energy consumption also causes negative effects like climate change and air pollution, while at the same time volatile energy prices affect the stability of the economy. Those negative effects are not related to energy consumption as such, but to the consumption of certain types of energy, particularly fossil fuels, and the dependence on a few suppliers.

The chapter gives a critical review of the arguments for current energy policies, with emphasis on climate change and security of energy supply, and of the design of European and Danish energy policy. The main conclusions are:

- A unilateral ambitious climate policy in Denmark or the EU is costly and will only have very limited effects on global warming. To make sense, such an effort must be considered as a first contribution to an expected future global climate treaty that is equally ambitious
- The European Emissions Trading System (EU ETS) ensures target fulfilment in a cost effective manner. Ambitions for the fourth phase should be determined as soon as possible to strengthen the carbon market
- The EU ETS should be extended by including distributors of fossil fuels to cover small businesses, transport and households. This will ensure uniform marginal reduction costs in large parts of the EU

economy and thus reduce the overall costs of reaching the climate targets in Denmark and EU
- Targets for renewable energy and energy savings in sectors covered by EU ETS contribute to the current low prices for CO_2 allowances. The targets do not reduce total emissions of CO_2 and from a climate point of view, these targets are redundant
- Denmark has a number of unilateral energy and climate policy targets. These targets are more ambitious than Denmark's EU obligations and affect directly or indirectly the EU ETS sectors. Danish energy and climate policy should focus on areas not covered by the EU ETS while targets directed at EU ETS sectors should be removed
- A transition to renewable energy will not protect Denmark or the EU from price increases on fossil fuels. The focus on renewable energy beyond what is justified by climate objectives therefore implies that Denmark and the EU incur substantial costs now without a future benefit from lower energy prices

Climate policy

Combustion of fossil fuels leads to emissions of greenhouse gases, which contribute to climate change. It is important to reduce greenhouse gas emissions as climate change can lead to large damages world-wide.

Climate change is a global problem and is caused by global emissions of greenhouse gases independent of where they are emitted. The solution therefore is a global climate treaty covering a large part of global emissions. The Kyoto Protocol from 1997 is an important milestone but covered only a small part of global emissions. The Kyoto Protocol was extended in 2012 to a commitment period from 2013 to 2020, however, with participation of fewer countries and therefore covering an even smaller part of global emissions.

In the Kyoto Protocol, the EU had committed itself to reduce average annual emissions in the period 2008-12 by eight per cent compared to 1990 and Denmark had committed itself to a reduction of 21 per cent. It is important that

the EU and Denmark participate in international climate agreements and comply with their obligations but a unilateral ambitious climate policy will not have significant impact on the expected temperature increase since Danish and even EU's greenhouse gas emissions only represent a small part of global emissions.

Unilateral ambitious climate policies in some countries will lead to higher emissions in other countries, an effect known as carbon leakage. Demand for fossil fuels in countries with an ambitious climate policy will decrease, causing lower global fossil fuel prices, which in turn leads to higher demand in countries without ambitious climate policy. At the same time, ambitious climate policy will increase production costs especially for the energy intensive goods. Production will therefore partly move to countries with a less ambitious climate policy. Analyses show that these leakage effects offset 20 to 30 per cent of emission reductions. For some energy intensive sectors this leakage effect might be as high as 50 per cent.

This does however not imply that reduction efforts made so far by the EU are superfluous. As global warming increases it can be expected that more countries will be willing to take on binding reduction targets. EU's efforts to date can be seen as a first step in this direction. At the same time it may be beneficial for EU countries to have acquired experience with regulatory systems for greenhouse gas emissions. These systems take time to develop and can typically be improved over time. There can also be ethical and moral arguments for early action. The EU is a wealthy area with large historical emissions, why it may be fair to start here.

Denmark and the EU pursue a more ambitious climate policy than international agreements oblige them to. One argument given for this ambitious climate policy is that pioneer countries are needed in order to show that an ambitious climate policy can be carried out without high costs to the economy. However, it is not obvious that this argument is correct. Generally, all information about the benefits and costs of an ambitious climate policy is equally available to all countries. Thus, an ambitious climate policy in one

country will not lead to further information to other countries. A positive demonstration effect requires that there is uncertainty about the costs and that an ambitious climate policy can indeed illustrate that costs are less than perceived. The uncertainty about the costs implies however that the costs of an ambitious climate policy could just as well be higher than expected.

An ambitious climate policy in one country or region can speed up development of clean technology, which afterwards can be used in other countries. However, the effect will be small for a small country. If the aim is to develop new and cleaner technologies for use throughout the world, public research support can be enhancing. In that case, it would be best to support technological development where most progress can be expected. This suggests that research should be internationally coordinated and located in the most efficient research environments which are not necessarily in Denmark or the EU. However, support for the development of clean energy technology must be combined with global regulation of greenhouse gas emissions to ensure that the new technologies are used.

There is a strong politically desire for the development and production of clean technologies to take place domestically, in order to gain a market share in the market for clean technologies, as this market is expected to grow in the future. It is often argued that support is necessary in the initial phase for an industry to become competitive (the "infant industry argument"). At the same time it is presumed to be an advantage to be the first to develop and produce a new clean technology, as this would lead to a lasting advantage over competitors (the "first mover argument"). This leads to a demand that the state should support the development and production of clean technologies. Neither theoretically nor empirically is there much support for the infant industry or the first mover argument. Both arguments are based on the presumption that the state is better situated than private investors to point out those sectors with the greatest potential. This "pick the winner argument" is problematic. There is every reason to believe that companies and private investors, who act on markets on

a daily basis, will be better informed with regards to which markets it would be most profitable to invest in.

In order to meet the objective of limiting global warming it is necessary to reduce greenhouse gas emissions. Ideally, there should be the same cost or price on emissions for all greenhouse gases from all sources. In this way the objectives can be reached at lowest costs. This can be obtained by either a uniform CO_2 tax or with a system of tradable quotas, covering all greenhouse gas emissions.

The European Emissions Trading System (EU ETS) therefore is a cost-effective instrument to reduce emissions of greenhouse gases. The EU ETS is covering about 40 per cent of total EU greenhouse gas emissions. The system primarily covers energy production and energy intensive industries. The EU ETS has been criticized for not functioning, a critique mainly based on the low carbon prices in recent years. The purpose of the trading system is to keep total emissions of greenhouse gases below a certain level. This aim is met and is the ultimate proof that the system is working. The high trading volumes and the fact that there is a market of futures also indicates that the EU ETS is well developed.

The low carbon prices are mainly a result of the economic crisis that has caused the demand for emission permits to decline and not a result of a market not functioning. At the same time, the use of international credits for compliance increased the surplus of permits. In addition, support for renewable energy and the energy efficiency requirements contribute to the low carbon prices.

The low carbon price only gives a limited incentive to develop new clean technologies, but is also an indicator that current target of CO_2 reductions can be achieved at low costs with existing technology. However, there is a political desire to increase the incentive to develop new clean technologies. Therefore the EU Commission has proposed to hold back some of the permits in the beginning of the third phase and instead put them on auction in the end of the trading phase. This so-called back-loading plan does not

affect the total emission ceiling for the third phase and will have a very limited effect on the carbon price. The back-loading plan may therefore not be expected to have any significant effect on investments in clean technologies.

Ultimately, it is the level of ambitions for reductions in the EU ETS that controls the carbon price and thereby the incentive to invest in clean technology. It would therefore be most appropriate if the EU as soon as possible determines the ceiling for emissions in the period after 2020. An announcement about the fourth phase in the near future would give a clear signal about the intensions of the EU in the area of climate policy and the carbon prices would react to this by reflecting the cost of achieving these targets.

There is a possibility that the current low carbon prices are not only reflecting present and expected cost to reduce greenhouse gas emissions, but also reflect a lack of confidence in whether the market will continue to exist. In that case it may be necessary to increase the credibility of the EU ETS in the short run. A quick announcement of the future plans for the system is essential, but credibility might be enhanced by removing a substantial amount of permits permanently already in the third phase.

In the EU ETS it is possible to use international credits from projects in countries without an emissions ceiling. The use of international credits is in theory cost-effective if the greenhouse gas can be reduced cheaper in less developed countries. Trade with international CO_2 credits is therefore in theory beneficial both to the involved parties and for the climate. There are, however, serious problems in securing that reductions are additional and many of the projects also experience problems of sustainability. It is therefore appropriate to limit the use of international credits as long as these problems cannot be controlled better.

CO_2 leakage reduces the effect of EU climate policy and affects certain energy intensive sectors particularly hard. It could therefore be considered to implement an import duty reflecting the CO_2 emissions related to the production of goods on all energy intensive goods imported from coun-

tries without a CO_2 emissions reduction commitment. This measure will ensure equal conditions for equal goods on the European market. To ensure equal conditions on the international market it is necessary to supplement this with a subsidy for exporting energy intensive goods relative to the energy used to produce the good. Such a subsidy is preferable to continued grandfathering of emission permits, which is a much less effective way of controlling the leakage and competition issues.

By regulating certain sectors through the EU ETS and others through national regulation, costs of attaining the target are increased. Not only are there differences in marginal abatement costs between the EU ETS and non-EU ETS sectors, but marginal costs also differ within the non-EU ETS sectors due to the multitude of national goals and regulations.

The efficiency of EU climate policy can therefore be enhanced by including as many sectors as possible in the EU ETS. An obvious possibility is to include distributors of fossil fuels by imposing a quota obligation on sales for purposes that are not already included in the EU ETS. In this way, CO_2 emissions from transport, households and small industries can be regulated through the common European system. This will not only increase cost-effectiveness but also make many national targets for the non-ETS sectors redundant.

Besides the EU ETS other European climate policies to a large degree determine Danish energy policy. The EU has an overall target of reducing greenhouse gas emissions by 85 to 90 percent in 2050 relative to 1990. To reach this target a subset of targets for 2020 is defined. Greenhouse gas emissions must be reduced by 20 per cent relative to the 1990-level, the share of renewable energy in total energy consumption must be increased to 20 per cent and energy consumption must be reduced by 20 per cent relative to the expected level for 2020.

The targets for energy savings and increased use of renewable energy are not directly aimed at reducing global warm-

ing. However, the targets determine how reductions of greenhouse gasses should take place. Other things being equal, this will make it more expensive to reach the given climate target.

The renewable energy targets in the EU are primarily aimed at the EU ETS sectors. The result is that the regulators partly determine how reductions of emissions in the EU ETS sectors are to be obtained. This is against the aim of the EU ETS, which is to obtain reductions cost-effectively, which can only be achieved by letting polluters free in their choice of abatement technology. An increased share of renewable energy together with high demands of energy efficiency means that companies will need fewer permits to fulfil their obligations. Therefore the EU targets on renewable energy and energy efficiency are lowering EU ETS carbon prices. The conclusion is therefore, that from a climate point of view, EU's renewable energy and energy efficiency targets in the EU ETS sectors are redundant. They will not result in CO_2 emission reductions beyond what the EU ETS would have brought about by itself. Without the two targets, the carbon price would ensure that both renewable energy and energy efficiency would come about in the appropriate amount given the climate target.

Denmark has an obligation towards the EU to reduce emissions in the non-EU ETS sector by 20 per cent in 2020 and to increase the share of renewable energy in final energy consumption to 30 per cent and in the transport sector to 10 per cent in 2020. In addition, Denmark has a national determined target to reduce total greenhouse gas emissions in Denmark by 40 per cent in 2020, that wind power should cover 50 per cent of the electricity consumption in 2020, that coal is phased out from the electricity and heat sectors by 2030 and that these sectors are based on 100 per cent renewable energy by 2035.

The chapter on energy and climate policy presents an energy consumption projection for the period 2013-2035. This projection shows it is likely that the target for the share of renewable energy in 2020 will be more than met. This is especially a result of the intended expansion of offshore

wind power, decided in the Danish Energy Agreement from March 2012. The expected increase in carbon prices also contributes to achieving the renewable energy target, but the target for 2020 will also be achieved if carbon prices for instance turn out to be only half as high as assumed in the projection.

Danish climate policy should be focused at achieving the targets for the non-EU ETS sector in the most cost-effective way. Presently the Danish targets are to a high degree aimed at the EU ETS sectors, e.g. the target of 50 per cent wind power in electricity consumption in 2020 and 100 per cent renewable energy in the electricity and heat sectors in 2035. Together with the target for reductions in the non-EU ETS sector the target of 40 per cent reduction of total Danish emissions in 2020 is an implicit target for the EU ETS sector. The energy projection shows that Denmark is far from achieving this indirect target. Danish reductions within the EU ETS sector will just lead to increased emissions of exactly the same size in other countries committed by the EU ETS. The targets mentioned above therefore make little sense from a climate perspective. Purely Danish targets aimed at the EU ETS sector should therefore be removed and focus should instead be on actions in the non-EU ETS sector and on improvements of the EU ETS.

According to the energy projection, emissions of the part of the economy not covered by the EU ETS will be reduced by around 17 per cent in 2020 compared to 2005. This implies an estimated shortfall of 1.1 tonne CO_2 equivalents relative to the reduction obligation in the non-EU ETS sector. The most appropriate way to achieve the target will probably be to buy emission rights in other EU countries where reduction costs are lower than in Denmark. If the whole shortfall should be dealt with purely by domestic actions the most cost-effective measure would be to increase the existing tax on CO_2 in the non-EU ETS sector and impose an equivalent tax on agricultural greenhouse gas emissions. Model calculations indicate that a CO_2 tax of around DKK 350 could lead to compliance with the 2020 target for the non-EU ETS sector.

Security of energy supply

Security of energy supply is about maintaining a stable supply of energy at a price that is not considered to be too high or too volatile. Thus, security of supply is about both volumes (i.e. availability) and prices. Energy is a key factor in production and fossil fuels make up the vast majority of energy consumption. A failure of energy supply will affect the whole economy and not just certain sectors. At the same time the economy is more highly affected by volatility in energy prices than by price volatility of other goods, which explains the political focus on energy.

Problems with security of energy supply stem from a lack of competition in the energy market. Coal, oil and gas markets are dominated by few countries with large reserves and large production of the fuels. In addition, many of the major exporters of gas and oil are characterized by an unstable political climate, which increases risk of fluctuations in the supply of these fuels. Also, transport of gas is associated with high costs, implying that monopolies easily emerge. Large changes in especially gas and oil prices can therefore occur due to changes in production and some countries may even be cut off from energy supply.

Risk of supply failure can to some extent be offset by a flexible energy market. This requires the use of several different types of fuels and forms of energy and many different suppliers. As long as consumers are able to choose their energy supply freely, they will in principle be able to take the risk of supply failure into account in their choice of Energy type, and therefore there is no direct need for government action. However, the government may have a role to play in maintaining emergency storage for the most vulnerable fuels and in coordinating the expansion of the energy network, both domestic and international. Better international energy networks will increase flexibility and thereby make it easier to avoid an energy supply failure in one place by increasing supply from another. It is therefore sensible that the EU focus on creating an internal energy market, increasing the competition on energy markets and expanding the energy infrastructure within the EU.

Both in European and Danish energy policy there has been a focus on increasing the share of renewable energy in the supply of energy to strengthen security of energy supply. As such, a diversification of energy supply can increase security of supply. However, failure of energy supply mostly occurs due to a high dependence on one or a few suppliers of energy or fuel. Using only one type of renewable energy can therefore also lead to a supply problem. For example, the use of solar and wind power imply a risk of failure of supply due to lack of wind or sun, and the amount of energy produced can vary greatly from year to year. A conversion to renewable energy will thus not necessarily increase security of supply.

No matter how flexible the energy market is and how diversified the energy supply, fluctuations in prices cannot be avoided. The fluctuating prices will affect the economy because energy is such an important input in production. The impact on the economy can be magnified by wage rigidities in the labour market and capital market imperfections. The macroeconomic effect of fluctuating energy prices is best counteracted by a suitable stabilizing fiscal and monetary policy, in the same way that these kinds of policies respond to fluctuations in economic activity and inflation for other reasons.

Increasing energy prices over the long term is also seen as a security of supply problem that energy policy should address. An expected price increase should not give rise to special political action, as markets will adapt to the general expectation. Uncertainty about how much prices will increase in the future can cause a need to guard against especially higher prices than expected. Uncertainty is, however, normal on many other markets. Therefore, there is no apparent reason, why there is a need for government action especially in the energy markets.

The Danish government has argued that the transition to renewable energy will contribute to ensuring low energy prices for households and industry in case of a higher price increase on fossil fuels than expected in the long run. Ac-

cording to this argument, the transition to renewable energy can be seen as an insurance against future higher prices than expected. It is however, doubtful whether this argument is valid. Prices on different energy types are connected as the different energy types are substitutes. This implies that prices on wind power and biomass will increase with increasing prices on fossil fuels. A transition to renewable energy will therefore not secure low prices to consumers and industries but will only lead to higher profit for the owners of the windmills and the producers of biomass. Since part of the windmills situated in Denmark are foreign owned and a significant portion of the biomass is imported, part of the increased profits go abroad. The transition to renewable energy therefore implies large costs now without certainty of a return later. In addition, costs of the expansion of renewable energy may prove to be even less favourable if the price of fossil fuels does not increase more than originally expected.

Chapter II: Car taxation, accidents and environment

An efficient transport system is essential for the functioning of society. A good transport system is important in order to match workplaces with employees who have the relevant skills. Similarly, transport of goods and services is important for specialization and competition. Transport is also important in order to make use of recreational opportunities. Thus, there are a number of benefits of transport.

Traffic also has a number of negative effects in terms of environmental impacts, congestion and accidents. It is important to find an appropriate balance between the benefits for the individual and the cost to society of increased traffic.

The purpose of the chapter is to assess whether the size and composition of taxes on car ownership and car use are appropriate taking the environmental impact and other external costs of car traffic into account.

The chapter leads to the following main conclusions and recommendations concerning car taxation:

- Road user charges should be introduced while the current car purchase tax (i.e. registration tax) should be abolished or greatly reduced
- In the short term, road user charges can be simple odometer based charges. This is desirable in itself and will also facilitate any future transition to differentiated road pricing like GPS-based road pricing
- The new road user charges should be differentiated according to certain car characteristics. As an example, heavier cars which are more dangerous for other road user should pay a higher tax
- If road user charges are not introduced the current high car purchase tax should be converted into a higher annual car ownership tax, which should be CO_2-differentiated according to car weight but not CO_2-emission
- Overall car taxation appears to be too high compared to the external cost of car use. Car taxation should therefore generally be reduced in favor of taxation of broader tax bases like income tax or VAT
- The regulation of CO_2 should only be done by CO_2-taxes on petrol and diesel. The current differentiation of the car purchase and ownership taxes should therefore be abolished

External costs of car use

The chapter presents a reassessment of the value of the most important marginal external costs of car traffic. The reassessment suggests that the marginal external costs of car use are somewhat lower than previously estimated. The difference between the marginal external costs of car use in urban and rural areas is larger than found in previous Danish assessments. More specifically, the marginal external costs of car use in urban areas are slightly higher than found in previous Danish assessments, but the external costs of car use in rural areas are somewhat lower. Taken

together, this means that the average marginal external costs (for both urban and rural areas) are lower than previously found.

There are different explanations for the lower level of the marginal external costs of road use compared to previous Danish studies. In some cases it is due to a decrease in the burden of traffic, while in other cases it can rather be attributed to better data or revised methods for calculated the marginal external costs. As an example of the first case, the estimated marginal external accident costs are significantly lower than previously found. This reflects the fact that there are fewer injuries and deaths on the roads today than 10-15 years ago. As another example, improved medical treatment has reduced the severity of the perceived health impacts of noise. With respect to congestion a recent Danish study suggests that the marginal external congestion cost are lower than suggested by previous studies. This is hardly due to reduced overall congestion levels - rather the contrary - but instead because new data and modeling have given a revised picture of the relationship between increases in car traffic levels and the reduction in speed.

The chapter also presents a new analysis of the marginal external accident costs of car use. Traditionally, the accident costs have been calculated for different categories of road users (e.g. passenger car, van and truck), but without distinguishing between different sizes of passenger cars. In order to assess whether there are differences in the marginal external accident costs for different cars, an analysis has been carried out on the importance of passenger cars weight for the risk of being killed or (seriously) injured when a car collision occurs. The analysis is based on data from the Danish Road Directorate register for traffic accidents covering the period 2003-11 merged with information on car characteristics from the Danish motor vehicle register coupled and socioeconomics characteristics of the involved car drivers. Overall the empirical analysis follow the approach in Anderson og Auffhammer (2011), though the statistical model applied here is extended in order to also utilize information on the severity of injury (death, severe injury, light injury, no injury). The original approach in

Anderson and Auffhammer only include the probability of dying in the collision.

The empirical analysis shows that heavy passenger cars are more dangerous to other road users than light passenger cars. Old cars are also at increased risk when two cars collide. The increased risk is, however, especially for drivers and passengers of the older car and not for drivers and passengers in the other involved car.

Problems with the design of existing car taxation

There are a number of problems with the design of the current car taxation. First of all, most of the taxes are not directly targeting the external costs of driving. In addition, it appears that the overall tax level is higher than what can be motivated by the level of the marginal external costs of driving.

When comparing the overall car tax level with the marginal external costs of car use it is necessary to take into account that there may be considerable uncertainty regarding the size of the external effects measured in monetary units. However, a number of sensitivity analyses for the most significant contribution to the marginal external costs – congestion, accidents and CO_2 – suggest that the marginal external costs are lower than the overall car taxation level even with significant changes in the underlying assumptions used in the calculation of the marginal external costs.

A significant part of the current taxes consist of taxes on the purchase and ownership of the car. Although these taxes affect the number of cars – and thereby indirectly overall car traffic – there is no close link between the tax and the negative impact of driving. This is especially the case for the current high car purchase taxes, which also contributes to an old car fleet with low replacement rates. This results in a delay of the benefits from technological improvements that increase vehicle safety and reduces pollution.

A CO_2-tax on petrol and diesel is generally a targeted instrument with regards to reducing CO_2 emissions. Despite

this, both the Danish car purchase tax and the car ownership tax are also differentiated according to the CO_2 emission of different passenger cars. The CO_2-differentiation of these taxes does not seem appropriate.

Furthermore, the CO_2-differentiation of the car purchase and car ownership taxes are disproportionately high compared to the expected reduction costs in the non-ETS sector. Thus, the differentiation corresponds to a shadow price of CO_2 at around DKK 5,000 per tonne even without including the CO_2 tax on petrol and diesel. This is many times larger than relevant points of comparison. For example, the expected price of CO_2 allowances in 2020 is about DKK 165 per tonne in the ETS sector, and the marginal reduction cost in the non-ETS sector for Denmark to meet the 2020 target is estimated to be around DKK 350 per tonne. The incentive to reduce CO_2 emissions should be uniform across the different subsectors of the non-ETS sector. The high level of CO_2-differentiation of car taxes along with the generally high taxation of private transport means that there are significantly greater incentives to reduce CO_2 for private transport compared to other parts of the non-ETS sector. This means that the marginal abatement costs are not equalized across the different parts of the non-ETS sector, which raises the overall cost to society of reaching the CO_2-reduction target in the non-ETS sector.

Of the instruments used today the tax on petrol and diesel is the instrument, which is most directly targeting the external effects. However, it is not possible to differentiate the fuel tax according to where and when the driving takes place. Another limitation of fuel taxes is that many of the external effects of driving depend to a greater extent on the miles driven than the fuel consumption of vehicles. This is for instance the case for congestion and accidents, which are the most important components of the external costs of driving. This means that fuel taxes are not a specifically targeted instrument to regulate some of the most important external effects of traffic. Cross-border trade with fuel also contributes to fuel taxes being less effective in limiting for example congestion and accidents.

Simple road user charges of differentiated road pricing?

The limitations of current taxes suggest that it might be very beneficial to convert a substantial part of the taxes to road user charges.

Road user charges should ideally be differentiated so the charge is higher when driving in cities where there are more congestion, increased risk of accidents and more people affected by noise and air pollution. Furthermore, the road user charges should be greater during peak hours. Finally, charges should be higher for heavier vehicles and more polluting cars. Introducing simple road user charges, which only depends on how much the different cars overall are driving, is however estimated to bring significant benefits as well. With simple road user charges the fee should be differentiated according to vehicle weight and contribution to local air pollution etc.

In the short run, it is hardly realistic to introduce differentiated road pricing. Therefore, it seems natural to initially introduce simple road user charges based on for example odometer readings. The introduction will also facilitate any later transition to GPS based differentiated road pricing.

There are a number of technical and enforcement challenges by charging both simple and differentiated road pricing. These challenges need to be clarified and handled in connection with the transition to road user charges.

Restructuring of car related taxes

The introduction of road user charges requires a major reform of the existing car-related taxes. Overall, the taxes should be shifted from car purchase to car use. Specifically, the tax-reform should involve the following changes:

- Introduction of road user charges
- Reduction of taxes on petrol and diesel such that they only reflect the marginal cost of reducing CO_2 in the non-ETS sector

- Removal of current taxes on car purchase and annual car ownership

A restructuring of car-related taxes as sketched above will generally lower revenues from car-related taxes. There would be a socio-economic gain from financing the transition by higher taxes on earned income. However, if a reform for political reasons needs to be revenue neutral – in the sense that the revenue from car related taxes is unchanged – the above taxes can be complemented by a new annual revenue-based tax on car ownership.

Given that the road user charges are differentiated with respect to environmental impacts, safety, etc. of the various vehicles and fuel taxation reflects the CO_2 reduction cost, the new revenue tax on car ownership should not depend on the car's characteristics. In this case there is no need to also differentiate the tax on ownership in relation to CO_2-emission, weight of car and so on. Thus, if the goal of the new tax on car ownership is only to obtain a given revenue in the least distorting way the charge should be designed as a fixed, uniform annual fee for all vehicles regardless of its price or other characteristics.

A uniform annual tax on car ownership, which replaces the car purchase tax, will benefit high income households. If the government wants to counter this redistributive effect the annual car ownership tax can vary according to the sales price of the vehicle. A car-price differentiation of the ownership tax can, however, cause a too large incentive to choose smaller and cheaper cars given that the road user charge and fuel taxes have an appropriate level. Another alternative to a uniform, revenue-based tax on car ownership is to add an additional revenue-based tax component to the road user charges. In contrast to a uniform annual tax on ownership, an additional tax on the road user charges would indicate that car owners that use their cars more frequently have to pay more taxes. This may seem fair. However, an additional revenue-based tax on road user charges will cause an inappropriately high incentive not to drive.

Road user charges are based on the basis of the review of the marginal external costs made in this chapter. The charge should have an average level of around DKK 0.32 per km for a normal, newer car. The road user charges should range from around DKK 0.30 to 0.34 per km depending on the weight of the car; the higher charge is on the heavier cars, which are more dangerous to other road users. In addition there should be a higher charge on older (diesel) cars, which give rise to more air pollution.

Taxes on fuel should be around DKK 0.9 and 1.0 per litre of petrol and diesel respectively, corresponding to a reduction in cost of around DKK 350 per tonnes of CO_2 in the non-ETS sector. This is significantly lower than the current fuel taxes of DKK 4.3 and 3.2 per litre of petrol and diesel respectively.[1]

The new road user charges and the reduced taxes on petrol and diesel for an average newer car have a level that is approximately twice as high per km driven as the current taxes on petrol and diesel. The difference between the new and current taxation will vary for different cars depending on the particular their fuel efficiency.

Seen in isolation, a restructuring of car-related taxes as described above would reduce the incentives to reduce CO_2 emissions from transport, as it removes the current inappropriately high incentive to buy cars with low CO_2 emissions. This indicates that other sectors of the non-ETS sector must reduce their emissions of CO_2 equivalent in order to reach the 2020 target. These sectors include commercial transport, households, manufacturing companies outside the quota sector and agriculture.

If it is not possible to introduce road user charges the car purchase tax should instead be converted to an annual tax on car ownership. Taxes on vehicle purchase make it more

[1]) The lower taxes on fuel can give an inverse border-issue where more drivers want to buy fuel in Denmark. On the one hand more trade with fuels will contribute to increased revenue. On the other hand this will make it more difficult to achieve the target for CO_2 emissions from the Danish non-ETS sector.

likely that the car owners postpone replacing their car. A restructuring like this will therefore encourage the replacement of the vehicle fleet, providing safer and less polluting vehicles.

In a major restructuring of the car-related taxation there will be transitional problems for both the government budget balance and the car owners.

A shift of taxes from car sales to car use will in the short term reduce the government revenue from car related taxes, since taxes on car purchases are paid up front while road user charges are paid regularly. This problem will be temporary in nature and will not affect the long term sustainability of public finances. The same applies to restructuring the tax on car purchase to an annual car ownership tax.

In case of a shift from taxes on car purchase to road user charges car owners with newer cars will suffer a capital loss, while all car owners will benefit from the lower prices on new cars. There are various options for transitional arrangements in order to ensure that car owners with newer cars are not double taxed due to the high purchase tax and road user charges. A simple transitional arrangement, which that does not have adverse behavioural effects, is a full or partial refund of the unamortised car purchase tax. However, it requires a very large amount if the entire unamortised car purchase tax is to be refunded.

Level of car taxation

As mentioned above, the current taxation of cars is higher than can be justified by the marginal external costs of car use. The high car taxation level probably reflects a desire to ensure revenue for public expenditures. However, it is not appropriate to have a high tax on a single good in order to obtain revenue. Revenue motivated taxes should rather be on broader tax bases such as a VAT or taxation of income.

A reduction in car-related taxes will increase the total amount of kilometres driven. A cautious estimate indicates that traffic will increase by up to 20 per cent. This increase

is probably partly due to a shift from other modes of transport (e.g. public transport), but the overall passenger transport is expected to increase as well.

A reduction of the taxation of cars will also increase the amount of cars in the vehicle fleet, which in itself can lead to an increased scarcity of public parking spaces in cities. Therefore, in addition to the restructuring of taxes it may be appropriate to increase the parking charges.

A restructuring that reduces the total revenue from car-related taxes can, as mentioned, be financed by a higher tax on a broader tax base (e.g. VAT or income tax). If the total restructuring of car related taxes have adverse distributional impacts across income groups, these can be neutralized by an appropriate combination of increases in the lower tax rate and the top tax bracket. Such a restructuring can generally not be expected to influence labour supply.

Chapter III: Waste

Waste is an inevitable part of economic activity. Waste is generated from the production of goods and households consumption, and thus the amounts of waste tend to increase when the activity in society increases. If waste is not managed, but simply discarded, it leads to environmental costs such as the spreading of infectious diseases and toxic substances. This affects human health and damages nature and the environment. It is therefore necessary to have a system where virtually all waste is collected and handled.

In this chapter the Danish waste sector and waste management principles are examined from an economic point of view. The starting point is the environmental effects from waste and a consideration of the possibilities to implement a tax-based regulation that better reflects the environmental effects. Furthermore, the organization of the waste sector is described, partly to evaluate whether the current split between private and public ownership can be expected to lead to a resource efficient waste management sector.

The main conclusions of the chapter are as follows:

- One should be cautious to introduce volume-differentiated fees for households and small businesses, since such fees may result in a higher risk of illegal disposal
- Waste management for households and small businesses should be based on fees on solid waste disposal, easily accessible facilities for recycling and disposal of waste and information on recycling etc.
- It should be considered to introduce a deposit-refund system for portable batteries and small electronic equipment in order to prevent too many of these waste types ending up in mixed household waste
- To increase effectiveness it is recommended to convert ownerships in the waste incineration and landfilling sector into public or private limited companies, and to repeal the non-profit principle

Incentives for waste treatment

In principle, the cost of getting rid of waste should reflect both the direct handling costs and the environmental costs resulting from waste management. Imposing a tax that reflects all environmental costs ensures that firms and consumers include the external costs from waste in their behaviour. This will create an incentive for producers of waste to sort waste and reduce the amount of waste.

The above principle is to a certain degree reflected in the way large firms handle waste. These firms typically produce large quantities of relatively uniform waste, which can be sorted and recycled. They will therefore benefit from agreements with waste collection firms, whose disposal can be controlled through documentation requirements. Provided the environmental costs of disposal are reflected in the prices, this will ensure a socially appropriate handling of waste from large firms.

Payments based on waste types and volumes are recommended by the OECD, and are used in certain Danish

municipalities regarding household waste. However it may not be advisable to use such fees on the collection of waste from households and small businesses. The main argument for this is that it gives incentive for illegal disposal of waste, and that it is impossible to enforce a ban on illegal disposal due to significant control problems in this sector. This has also been the experience when regulating small firms' use of community recycling centres. When payment was made dependent on the size of the firm or the amount of waste taken to a community recycling centre, it resulted in a positive marginal price for waste disposal. This allegedly led to an increase in illegal disposal. In order to reduce the incentive for illegal disposal solid waste disposal fees in combination with a low marginal price should be used. This should be supplemented by easily accessible facilities for waste disposal and information. Thus, the most widely used system for household waste in Denmark consisting of a fixed payment that depends only on the container size and sometimes the collection frequency seems reasonable.

Targets for waste

Waste legislation reflects the close interaction between EU regulation and national regulation. EU regulation determines the overall framework and principles but has also some quantitative targets. The organization and the actual implementation into national legislation is a task for the Danish authorities. The overall objectives are pursued by for instance setting quantitative targets for waste treatment methods and waste fractions.

Recycling of waste is a high priority on the political agenda both in Denmark and the EU, which is reflected in the EU waste hierarchy. This hierarchy requires that recycling should be preferred to incineration, which in turn must be preferred to landfill. The national target for 2012 is that at least 65 per cent of the total volume of waste is to be recycled, while a maximum of 6 per cent can be landfilled.

It must however be questioned whether the waste hierarchy in the current interpretation, where recycling always precedes burning, is economically sensible since the choice of

waste management should reflect the environmental effects and the direct handling costs. It is therefore recommended both to include life cycle analysis and socio-economic analysis (cost-benefit analysis) in order to assess the suitability of moving waste up the waste hierarchy.

However, the problem with introducing a proper pricing in the handling of households and small businesses waste makes additional regulation necessary. Such regulation should provide incentive for waste sorting and reduction of volumes. Therefore it seems sensible to have waste reduction targets and cost-benefit-based guidelines for waste treatment, based on the ranking in the waste hierarchy.

Taxes and producer responsibility

The problem associated with the pricing of household waste is also an important argument for regulating producers of goods in order to internalize the costs of waste management. The purpose of regulating manufacturers is to ensure that the cost of disposal of the products is internalised in the manufacturers' decisions and communicated to consumers through the prices of the products. This may be particularly important for products where the design or choice of method of disposal is of great importance for the final waste treatment cost. The current product regulation primarily covers packaging, batteries and electrical and electronic equipment.

Taxes on packaging were introduced in 1978 and have since increased and expanded to cover more types of packaging. However, there are a number of problems with taxes, including that they are not sufficiently differentiated with respect to environmental costs and therefore primarily leads to less demand, but not to more environmentally friendly design. The weight-based packaging charges are an exception as they are differentiated based on an environmental index. This index should be updated to reflect current environmental effects, and the taxes should be price adjusted in the future.

There is a producer responsibility for batteries, which means that manufacturers and importers of batteries have the physical and financial responsibility for the final waste treatment. The objective is to minimize the negative environmental effects from batteries. This can be done either by using more environmentally friendly batteries or by increasing the collection and recycling of batteries. In practice, there is a well-functioning market for the recycling of automotive and industrial batteries, and the vast majority of these are recycled. Therefore, the only effort needed in this area is monitoring that the recycling rate remains close to 100 per cent.

The collection rate of portable batteries represents a bigger problem since only half of the volume of portable batteries is collected. A large proportion is therefore assumed being incinerated with mixed household waste, leading to pollution with heavy metals. Producer responsibility can reduce the demand for portable batteries through higher prices, but it is not obvious that this in itself ensures a higher collection rate of batteries. If the main purpose is to ensure a high collection rate a deposit-refund system should be considered. It is recommended to assess the overall environmental benefits and costs of a deposit-refund system in order to decide whether such a system is socio-economically beneficial.

Producer responsibility for WEEE (Waste Electrical and Electronic Equipment) was introduced in 2006 with the intention of transferring costs and responsibility for disposal and recycling of electronic products to manufacturers. However, it is uncertain whether the collection scheme provides the right incentives to proper waste management, since small WEEE to an unknown extent ends up in mixed household waste, which typically is incinerated. By introducing a deposit-refund system on small electronics, it would be possible to ensure higher collection rates and treatment in the future. It is recommended, as for portable batteries to carry out a socio-economic analysis of a deposit-refund system for small electronics.

To the extent that electronic products contain scarce raw materials, it is expected that increasing scarcity and thus increasing prices provide incentives to increase recycling, to develop substitutes to the resource and to develop alternative technologies. The argument that increasing resource prices should give reason to political action is therefore doubtful. The issue of resource scarcity is the foundation for the Danish government's upcoming resource strategy. However, it is recommended not to introduce targets and mechanisms that block price signals. Instead, efforts should be made to ensure the appropriate institutional framework that enables recycling, for example through easily accessible mechanisms for sorting households' waste.

Waste sector organization

The municipalities have the overall responsibility for waste management, which is divided into waste collection and waste treatment. In the area of waste management, there are both private and public actors. If the goal is economic efficiency, it is essential that competition is present, and that this competition is equal for both public and private actors. For these reasons there are some important issues regarding the organization and regulation of the waste sector. These have previously been addressed in a committee of officials who made a number of recommendations for increased privatization and market exposure of waste incineration and landfilling. There is good reason continuing to work towards implementing the main recommendations, which are:

- Convert ownerships in the waste incineration and landfill sector into public or private limited companies. The purpose is to reduce the mix of local interests and to ensure more fair competition
- The non-profit principle should be repealed, and the companies should be operated on a commercial basis to give incentive to reduce costs
- Possibly a privatization of waste incineration, but continued public ownership of landfilling
- Increased competition for combustible waste by abolishing the municipalities' right to allocate firm's

combustible waste, and by making it mandatory to do a call for tenders for household waste

Underlying the recommendations is the risk that the non-profit principle for municipal waste incineration and landfill facilities leads to unnecessarily high disposal costs, partly due to lack of capacity adjustment. Since the principle ensures coverage of costs, regardless of the technology used in waste disposal, there is also a risk that investment in new and cheaper technologies will be too low. Furthermore, the flexibility of waste handling should be increased, such that capacity utilization is optimal.