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# Improving Energy System Efficiency in the Czech Republic

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# IMPROVING ENERGY SYSTEM EFFICIENCY IN THE CZECH REPUBLIC

**ECONOMICS DEPARTMENT WORKING PAPERS No. 941**

**by Artur Radziwill**



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**English - Or. English**

## ABSTRACT/RÉSUMÉ


### Improving energy system efficiency in the Czech Republic

A carbon intensive energy system in the Czech Republic contributes to one of the highest ratios of greenhouse gas (GHG) emissions to GDP in the OECD. While EU emission reduction commitments provide the most visible and binding motivation for changing the way in which the country produces and uses energy, action is also required to improve energy security and public health and to avoid an adverse impact of emission reduction on economic growth and living standards. Energy system transformation requires ensuring a comprehensive, consistent and stable policy framework with stronger ex ante and ex post evaluation. A single carbon price should be achieved through the Emission Trading System (ETS) and carbon taxation. Excise tax rates on all fossil energy sources and products should be realigned, based on their carbon content and other environmental externalities, notably by increasing the relative taxation of diesel. Sectoral policies that complement carbon pricing in promoting greener energy sources, energy efficiency and less fuel intensive transport need to be strengthened.


*JEL Classification*: H23; O44; Q58
*Keywords*: Czech Republic; emissions; carbon taxation; carbon trading systems; energy efficiency; transport; infrastructure

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### Améliorer l'efficacité du système énergétique en République tchèque

Le système énergétique de la République tchèque, gros émetteur de carbone, est en partie à l'origine de l'un des plus hauts ratios d'émission de gaz à effet de serre (GES) dans la zone OCDE. Si les engagements pris dans le cadre de l'UE en matière de réduction des émissions sont la raison la plus évidente et impérative de changer les modes de production et de consommation de l'énergie dans le pays, il est également nécessaire d'agir pour améliorer la sécurité énergétique et la santé publique, ainsi que pour éviter que la réduction des émissions n'ait un impact négatif sur la croissance économique et les niveaux de vie. La transformation du système énergétique nécessite un cadre d'action global, cohérent et stable ainsi que des évaluations *ex ante* et *ex post* plus solidement étayées. Il faudrait aboutir à un prix unique du carbone au moyen du système communautaire d'échange de quotas d'émission (SCEQE) et de la taxation du carbone. Les taux des droits d'accise sur toutes les sources et tous les produits énergétiques fossiles devraient être réalignés, en fonction de leur teneur en carbone et d'autres externalités environnementales, notamment en relevant le niveau relatif de la taxation du gazole. Les politiques sectorielles qui complètent la tarification du carbone pour agir en faveur des sources d'énergie plus vertes, de l'efficacité énergétique et des transports moins énergivores doivent être renforcées.


*Classification JEL*: H23; O44; Q58
*Mots clés*: République tchèque; émissions; taxation du carbone; marchés des droits d'émission de carbone; efficacité énergétique; transports; infrastructures

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# Improving energy system efficiency in the Czech Republic

By Artur Radziwill[1]

The Czech Republic has one of the highest ratios of greenhouse gas (GHG) emissions per unit of output in the OECD, despite substantial reductions achieved in the last two decades (Figure 1), leaving important energy and emission saving opportunities underutilised due to insufficient incentives. This poses a risk to public health and energy security, increases the burden of agreed emission targets and might also mean foregone opportunities for growth. This chapter analyses what policies can improve how the country produces and consumes energy.

The first section considers two key sources of high emission intensity of the Czech economy, namely an unfavourable fuel mix and high energy intensity. The second section analyses the motivation for policy action, which is not limited to EU emission reduction objectives, but also includes energy security and public health considerations, it argues that negative economic and social impacts seem manageable. The third section outlines the required comprehensive policy framework, based on carbon pricing achieved through the Emission Trading System (ETS) and carbon taxation. The fourth section discusses the sectoral policies to complement carbon pricing and further promote greener energy sources, energy efficiency and less fuel-intensive transport.

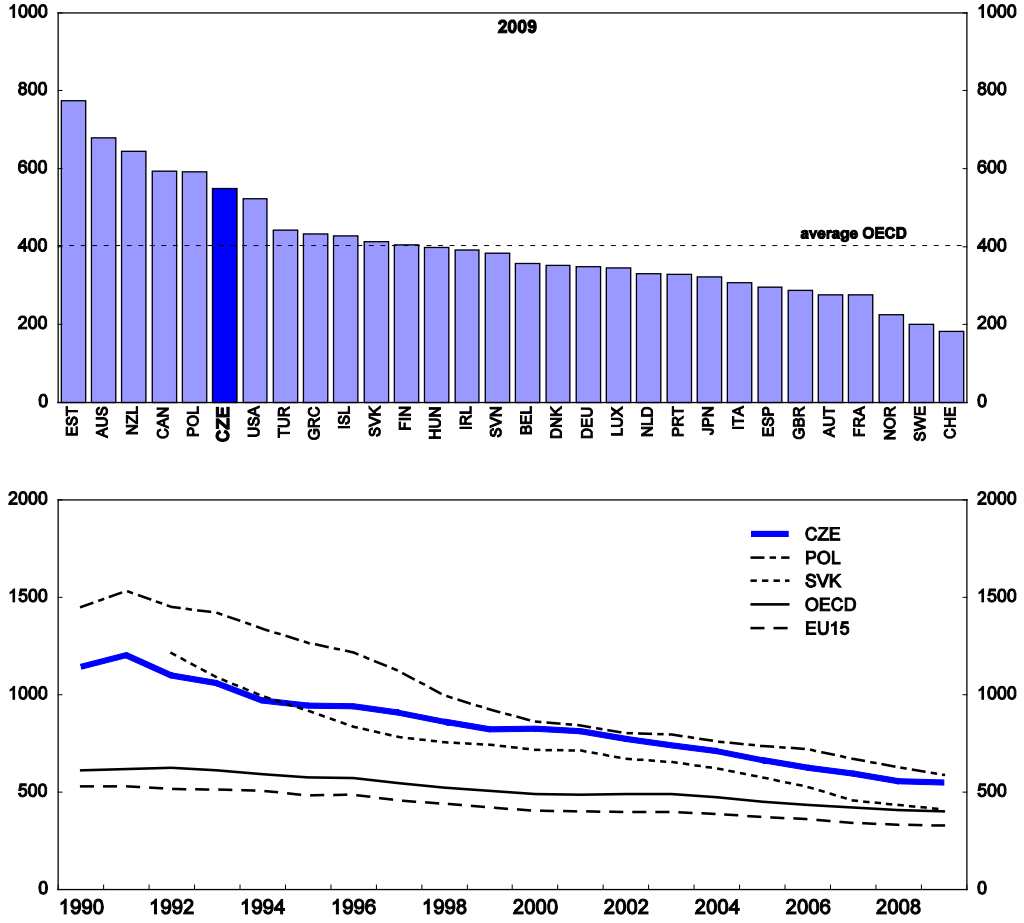
## High emissions are due to high energy intensity and an unfavourable fuel mix

GHG emissions in the Czech Republic declined by more than 30% between 1990 and 2009, well above the 8% Kyoto emission reduction target. The largest absolute emission reductions took place in the early 1990s, but the whole period was characterised by profound changes in the energy system due to stricter environmental legislation and the post-transition restructuring of the economy, based on an increasing share of services in GDP, a switch to less emitting energy sources, the closure of many energy wasting and inefficient manufacturing units, the more efficient allocation of energy resources and the introduction of new production technologies. This transformation is however far from complete, as evidenced by still high emission intensity.

1. Artur Radziwill is a Senior Economist in the Economics Department of the OECD. This paper was originally produced for the 2011 OECD Economic Survey of the Czech Republic and published in November 2011 under the authority of the Economic and Development Review Committee (EDRC) of the OECD. The author would like to thank the Czech authorities, as well as Andrew Dean, Bob Ford, Jorgen Elmeskov, Andreas Wörgötter, Zuzana Smidova, and members of the EDRC for valuable comments and discussions. The paper has benefited from valuable background research by Jan Korda and Elie Chachoua. The author would also like to thank Margaret Morgan for statistical assistance and Josiane Gutierrez and Pascal Halim for secretarial assistance.

**Figure 1. Emission intensity is high in the Czech Republic**

Tonnes of $CO_2$ equivalent per million USD of GDP




*Note*: Greenhouse gas emissions in physical units (such as tonnes) are converted to $CO_2$ equivalent by multiplying the number of physical units by the global warming potential conversion factor for a given emission and country. GDP used is in 2005 constant prices at purchasing power parity. OECD is the average of countries in the top panel.

*Source*: United Nations Framework Convention on Climate Change (UNFCCC); OECD, *National Accounts Database*.

High GHG emissions in the Czech Republic result from both a high energy intensity of economic activity and an unfavourable energy mix - two fundamental characteristics of the Czech energy system (Table 1). Despite steady improvement, energy intensity, which declined by 2.5% on average between 1990 and 2008, remains higher than in Poland and Slovakia, and significantly above the OECD and the EU averages. This is explained by structural features, including high share of energy-intensive sectors (Figure 2), outdated power stations and heat supply units, road-based transport, and the large stock of relatively inefficient buildings. The unfavourable energy mix also contributes strongly to emission intensity (Figure 3). Emission-intensive coal accounted for more than 40% of total primary energy supply in 2009, oil for 21% and gas for 16%. While the share of nuclear energy was relatively high at 16%, renewable energy remained underdeveloped at 6%, although its share has recently increased. As a result, $CO_2$ emissions per kWh produced from different energy sources are substantially higher than OECD and EU averages, although lower than in nuclear-free Poland.

**Table 1. Decomposition of GHG emission levels in 2009**

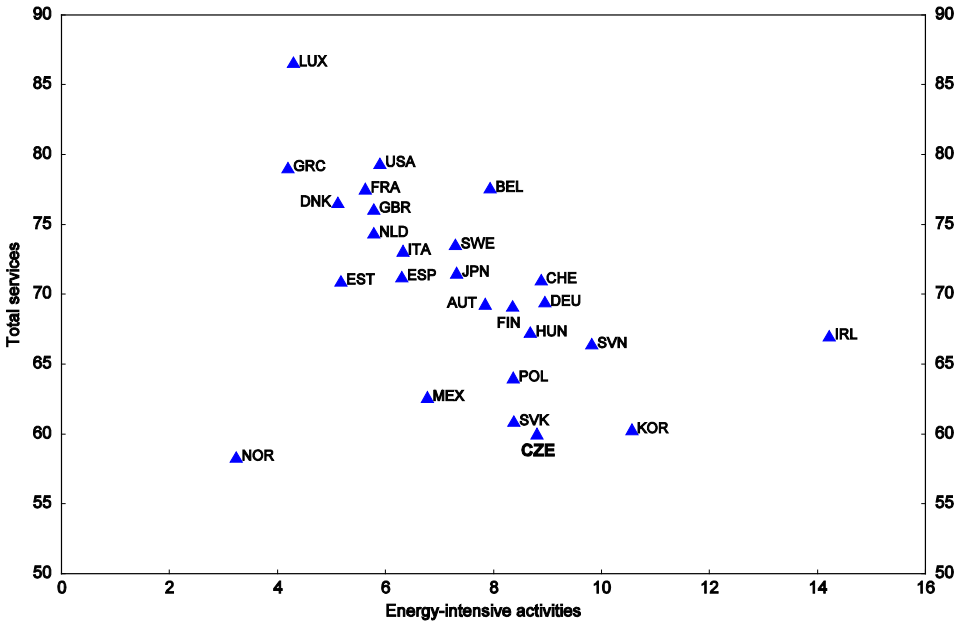
| | GHG/GDP | Energy consumption/ GDP | GHG/ energy consumption |
|---|---|---|---|
| Poland | 590.9 | 100.8 | 5.9 |
| **Czech Republic** | **549.3** | **106.4** | **5.2** |
| OECD average | 424.1 | 99.7 | 4.3 |
| Slovakia | 412.5 | 102.9 | 4.0 |
| Hungary | 398.0 | 106.5 | 3.7 |
| Germany | 349.0 | 85.0 | 4.1 |
| EU27 average | 340.5 | 85.2 | 4.0 |
| Austria | 276.0 | 90.6 | 3.0 |

*Note*: GHG emissions/GDP = (GHG emissions/energy) × (Energy/GDP). GDP is in thousand 2005 USD using PPP exchange rates, GHG in Mt $CO_2$ equivalent and energy consumption in ktoe.

*Source*: IEA and OECD calculations.

**Figure 2. Energy-intensive activities play an important role**

% of total value-added, 2009 or latest available

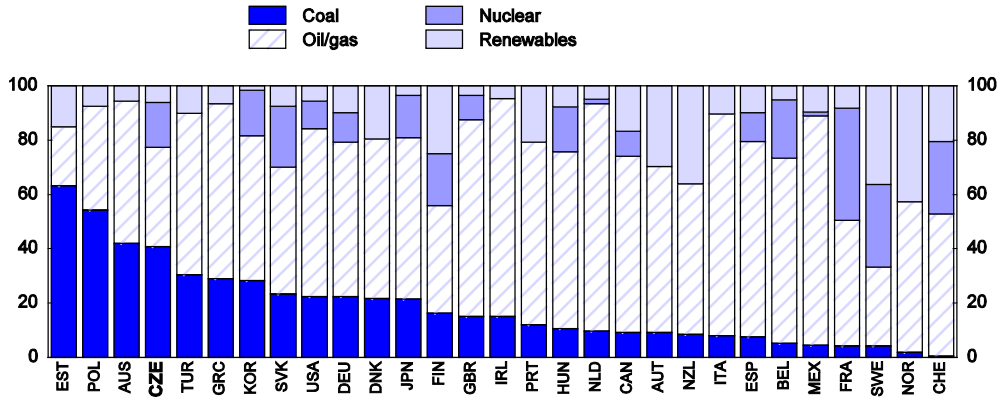



*Note*: Energy-intensive activities refer to pulp/paper, chemicals, minerals and metals (ISIC Revision 3 codes 21 to 28); services are codes 50 to 99.

*Source*: OECD, *STAN Database*.

**Figure 3. Share of coal in energy supply is high**

Distribution of primary energy supply, 2009, %




*Note*: Renewables are hydro, geothermal, solar/wind/other and combustible renewables and waste.

*Source*: OECD/IEA, *Energy balances of OECD countries* (2011 edition) and *OECD Dotstat Database*.

## Energy system transformation is needed

While EU emission reduction commitments provide the most visible and binding motivation for changing the way in which the Czech Republic produces and uses energy, both energy security and public health considerations point to the need for a more efficient energy system. At the same time, improvements in energy efficiency should ensure that the impact of emission reduction commitments do not have an adverse impact on economic growth and living standards.

### *Meeting EU emission objectives will be challenging*

While the Kyoto targets will be met without additional measures, the EU Energy and Climate Package agreed in December 2008 sets more ambitious objectives to be achieved by 2020. Specifically, this legislation requires the Czech Republic to:

- implement the third phase of EU Emissions Trading Scheme (ETS), which covers large installations in power generation and other industries (while an EU-wide cap for ETS emissions corresponds to a 21% emission reduction; the size of reduction at Czech installations will be determined through the ETS market mechanism and is likely to be higher than EU-wide cap due to the relatively low cost of emission reduction - see below);

- limit increases in its GHG emissions to 9% in the sectors not covered by the ETS, including transport, buildings, waste management, agriculture and small industrial installations;

- increase the share of renewable energy in final energy consumption to 13%, including a specific 10% target in the transport sector;

- achieve a national indicative target consistent with the 20% improvement in energy efficiency at the EU level (the European Commission might propose binding national targets following a review planned for 2013/14).

Meeting the EU objectives will be challenging. The largest emissions decline is required in large energy and industrial installations within the framework of the ETS (Figure 4). The decline requires a comprehensive transformation of the Czech energy system, embracing energy efficiency

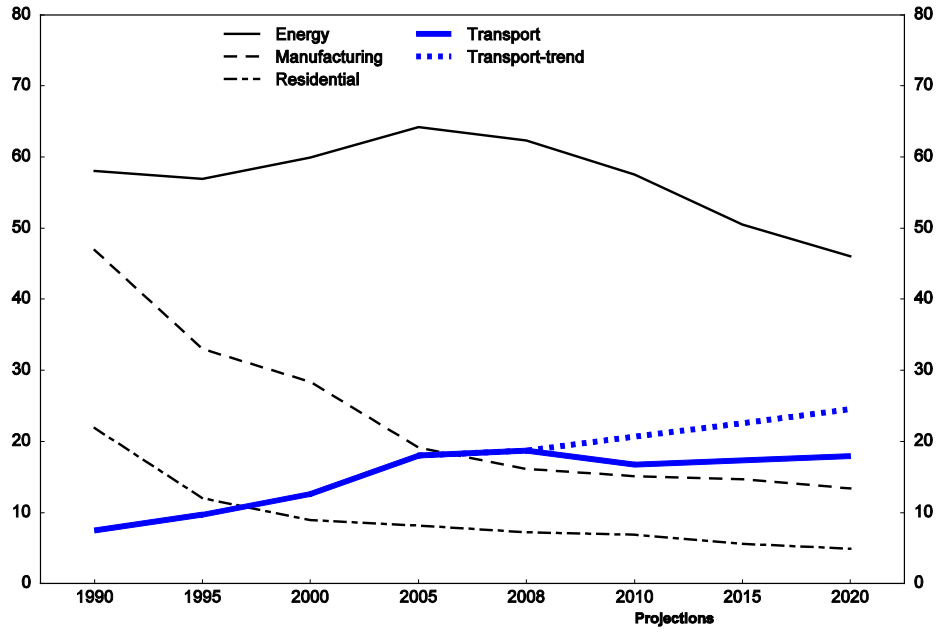
improvements across all sectors of the economy to reduce overall energy needs, and a substantial shift in the fuel mix towards greener energy sources and technologies. Neither of these changes will happen without further coordinated policy intervention, so that while the ETS cap will enforce compliance with the emission target for large installations, the design of national policy will determine its broader economic cost. Meeting the non-ETS emission objective might also prove challenging, as emissions in the transport sector continue to increase rapidly, when adjusted for cyclical variation.

At the same time, opportunities for economically profitable abatement in the currently inefficient energy system are abundant, diverse and spread over many sectors. The *National Energy Efficiency Action Plan* sets out a national energy savings target of 19.8 GWh or 9% in 2016 in relation to average energy consumption in 2000-06, with approximately 30% of expected savings in buildings and a quarter in the industrial and transport sectors. According to one study, of an estimated 16 Mt of economically profitable $CO_2$ abatement potential, buildings could account for roughly half and transport and industry for a quarter each (McKinsey & Co., 2008). Some of the most important items are insulating buildings, using more energy efficient lightening and driving more fuel-efficient cars. Establishing framework conditions which provide incentives to overcome obstacles to economically profitable abatement opportunities is crucial for minimising the economic cost of meeting environmental objectives.

Finally, meeting the objective of renewable energy sources and biofuels would be a costly element of energy system transformation, as the Czech Republic has only limited potential for growth of renewable energy generation, due to unfavourable sunshine, wind and hydropower conditions, while large-scale subsidised use of biomass and biogas for energy generation poses a risk to other sectors of the economy dependent on the same raw materials (IEA, 2010).

**Figure 4. GHG emission from selected sectors: past trends and national projections**

Mt of $CO_2$ equivalent




*Note*: Greenhouse gas (GHG) emissions in physical units (such as grammes) are converted to $CO_2$ equivalent by multiplying the number of physical units by the global warming potential conversion factor for a given emission and country. One Mt = one million tonnes. Manufacturing includes construction.

*Source*: Czech government, *Reporting of policies and measures under Article 3(2) of Decision 280/2004/EC*, March 2011.

***Energy security will require improvements in energy system efficiency***

Energy security concerns are another important motivation for designing a transformation strategy towards a low-emission energy system, as reflected in the draft State Energy Policy. While coal is produced domestically, apart from its negative environmental effects, reserves are diminishing and production cannot cover demand in the long run. Decisions about the share of coal in domestic energy use, its export potential and the expansion of mining sites are long overdue, and making them now would remove existing uncertainty at affected municipalities and companies. At the same time, the average age of coal-fired power plants, which accounted for 61% of electricity generation in 2009, was 50 years in 2009, making them among the least energy-efficient in OECD countries, and 4.7 GW out of 10.7 GW total coal-fired power plant installed capacity will be decommissioned already before 2020 (IEA, 2010). This provides an opportunity for a strategic switch to low-emission sources and technologies. Several options being considered by the authorities would improve energy security and lead to emission reductions.

- An improvement in energy efficiency that reduces domestic demand for energy sources is the least expensive way to enhance energy security and cut emissions.

- Expanding nuclear capacity, while ensuring strict safety regulation and standards, is an important strategic option. Although the switch to nuclear energy is unlikely to contribute to 2020 abatement objectives given very long lead times, it would be essential in the view of the authorities for long-term energy security and low-cost transition to low-emission economy. However, full lifecycle costs should be considered, taking into account all externalities of this option.

- Continued diversification of gas supplies and a strengthening of the regional gas market by enhancing cross-border gas transmission infrastructure will be essential in order to enhance energy security, during the shift from coal to less emission-intensive gas.

- Integrating the electricity market with other EU countries, which is an important element of energy security by broadening potential sources of energy supplies, should be deepened further by stepping up the contribution of the Czech regulators and transmission system operator to market coupling and the harmonisation of guidelines and network codes.

- An increase in competition at the generation level (where CEZ has a more than 70% market share), coupled with higher and more stable ETS carbon prices, would help to minimise inefficiency and losses in existing plants, reducing overall fuel needs.

- A higher share of domestically produced renewable energy would increase energy security and reduce emissions, but would entail relatively high costs.

Reflecting these considerations, the authorities are targeting a substantial change in the fuel mix. According to the most recent available draft of the State Energy Policy, the share of coal in Total Primary Energy Supply (TPES) would fall from 40% in 2009 to 30-32% by 2030, oil and other liquid fuels would fall from 21% to 11-12%, while the share of nuclear energy would rise from 16% to 20-22% and renewable sources (RES) from 6% to 15-16%. The share of gas would remain relatively stable at 20-22%. These targets are consistent with the indicative target for maximum dependence on energy imports of 50% in 2020 and 60% in 2030, compared with at 45% in 2010. At the same time, these targets would allow the necessary reduction of emissions from installations covered by ETS to be achieved.

***Energy system transformation can improve public health***

Energy system transformation would have a positive public health impact. Burning fossil fuels is not only a primary driver of GHG emissions, but is also linked to local air pollution, leading to problems such as smog, acid rain and indoor air pollution with a significant impact on human health, ecosystems, buildings and crops (Bollen *et al*., 2009). Among local air pollutants, particulate matter (PM), which travels through the air suspended in a gaseous form, has the largest negative impact, and it is widely recognised that small PM can cause heart and lung diseases. A significant share of the Czech population, between 15% and 67% dependent on climatic conditions and emission level during a given year, live in areas where the concentration of small PM exceeds EU limits. The problem is particularly acute in the Moravia-Silesian, Central Bohemian and Ustecky regions. Furthermore, in the case of the transport sector, negative local externalities include health-damaging noise pollution and accidents (Persson and Song, 2010). GHG emission reduction thus has important co-benefits in terms of public health improvements.

***Negative economic and social impacts can be controlled***

Manufacturing plays an important role in the economy and contributes strongly to economic growth, exports, investment and employment. It is also relatively energy intensive, and its competitiveness is thus sensitive to increases in energy prices which will be linked to emission abatement (Czech Industry and Transport Union, 2008). The risk of carbon leakage due to European abatement commitments is therefore among key concerns of the authorities. However, there are factors that mitigate the risk to the Czech economy. First, other EU countries face similar environmental challenges, including coal-dependent regional peers that are often viewed as direct competitors in terms of foreign direct investments, notably Poland. Second, leakage outside the EU is also likely to be limited for the EU on average, although pressure on individual companies could be significant. OECD model-based calculations suggest that the output losses in energy-intensive European industries (chemicals, non-ferrous metals, fabricated metal products, iron and steel, pulp and paper, and non-metallic mineral products) due to the EU unilateral carbon abatement would not exceed 1% by 2020, although estimates vary greatly (Burniaux *et al.*, 2010). Third, the provisions in current EU legislation should mitigate the risk for a relatively long list of industries that are most vulnerable to leakage. Nevertheless, the uncertainty about the size of leakage is large. To minimise the existing risk, the authorities need to concentrate on policies to reduce the sensitivity to energy prices through the more efficient use of energy and materials. Efficiency improvement is therefore not only essential for lowering emissions and energy security but also crucial for the growth and competitiveness of the Czech economy, as recognised by the 2011 *National Reform Programme*.

Environmental objectives can also affect social objectives. First, energy prices are likely to increase during the third phase of the ETS, and this may call for additional income transfers to low-income households. Second, the Czech Republic has the OECD's highest share of employment in polluting sectors (OECD, 2011b) and the issue of displaced workers is likely to be especially severe, calling for a set of labour market and training policies to promote re-employment prospects. Third, policy also needs to ensure that emission objectives do not translate into undue constraints on growth in living standards. For example, the higher emissions from road transport reflect increasing mobility and household energy consumption reflect an increasing number of domestic appliances. Promoting less emission-intensive transport modes or more energy efficient equipment can reduce emission growth linked to improving living standards.

## A comprehensive policy framework needs to be based on carbon pricing

The policy framework should lead to a cost-efficient and growth-friendly energy system transformation aligned with EU environmental objectives. Market based instruments, such as carbon pricing should play a central role in the overall framework, while non-market based instruments should be used sparingly in case of well-identified market failures. Such a framework should be comprehensive, stable and consistent, and have carbon pricing at its core, providing appropriate incentives for emission reductions (de Serres *et al.*, 2010). It should be based on an efficiently implemented ETS and carbon taxation for non-ETS sectors. So far neither policy has played a sufficiently important role. In its first two phases of implementation, ETS did not provide a clear price signal because of high price volatility of allowances due to system design problems and an over-allocation of allowances (Lawson, 2010). Energy taxation in the Czech Republic is currently not consistent with a single carbon price (as discussed below). An important benefit of the policy framework based on carbon pricing would be that the revenues from ETS auctions and carbon taxation will generate additional fiscal revenues. The earmarking of revenues from the ETS and carbon taxation should be avoided, in order to allow the government flexibility in financing policies with the highest marginal benefit across the full policy spectrum. However, according to EU legislation, 50% of revenues from ETS auctions must be used for measures related to climate change.

### *Consistency, stability and cost-effectiveness of the framework are essential*

The shift towards a more efficient energy system will require large investments, so that a stable long-term policy outlook is essential (de Serres *et al.*, 2010). Uncertainties regarding the degree of commitment surrounding climate policy and the instruments that generate a long-term carbon price path might substantially increase the cost of transformation, making it difficult for the private sector to finance investments in clean technologies even if they generate net medium or long-term benefits. This would lead to increased demand pressures for government-run support programmes. Broad political consensus and commitment to long-term policy goals and instruments at the national level are therefore necessary. For similar reasons, full consistency is essential among key strategic policies (Box 1), including the forthcoming strategies on State Energy Policy and State Environmental Policy. The improving coordination among key ministries offers an opportunity for comprehensively addressing the interactions between environmental and other national priorities.

**Box 1. Consistency of strategic documents has improved**

The sheer number of strategic documents relating to emissions reduction might lead to consistency problems. These documents include the National Reform Programme, Competitiveness Strategy, National Action Plan on Energy Efficiency, State Energy Policy, National Programme on Energy Management and Use of Renewable Energy Sources, State Environmental Policy, National Programme to Abate the Climate Change Impacts, Climate Protection Policy, National Programme for the Reduction of Emissions, Strategic Framework for Sustainable Development, Programme of Support to Environmental Technologies, Framework of Programmes on Sustainable Consumption and Production, State Transport Policy, and several other sectoral strategies with a strong environmental dimension.

Until recently, ensuring consistency was difficult, as strategic documents were prepared on a sectoral basis and updated at different times, while inter-ministerial coordination has not always been adequate. In particular, the coordination between the Ministry of Environment and the Ministry of Industry of Trade reflected differences in the prioritisation of environmental issues. Fortunately, this coordination has improved significantly more recently, as reflected in the current work on a revised set of key strategic documents.

Interactions among different instruments that address the same environmental objective - such as those between the ETS and carbon taxation; other environmental taxes and subsidies; regulations and standards, investment support and feed-in tariffs - should be better addressed when designing the policy mix. While the ETS directly affects large energy and industry installation and carbon taxation is directed at non-ETS sectors, the impacts of these two key instruments overlap significantly. Most importantly, higher electricity and district heating prices due to ETS affect energy efficiency in non-ETS sectors. Interactions between ETS and the carbon taxation determine the attractiveness of local energy generation. Instruments beyond ETS and carbon taxation should be used to address specifically agreed objectives, such as the share of renewables in the total energy mix, market failures, such as in buildings, and reflect the special role of public sector service provision, as in transport.

All policy instruments should be regularly evaluated so that differences in the marginal cost of emission abatement become visible and appropriate adjustments can be undertaken by policy makers, even though abetment costs are likely to be higher in some specific areas, notably renewable energy and transport. Increasing the use of cost-benefit analysis and strengthening the effectiveness of environmental impact assessments would be important steps in this direction. All environmentally oriented public spending should be subject to similar *ex ante*, on-going and *ex post* evaluations, based on a common methodology. Extending and publishing systematic *ex post* evaluations represent a means to improve *ex ante* assessments and may improve their credibility (Persson and Song, 2010). Avoiding overlaps and gaps between different support mechanisms can be achieved by merging instruments or clearly differentiating them, notwithstanding their source of financing, whether from EU funds, the national budget, the Environmental Fund or proceeds from sales of Kyoto allowances.

***ETS will be at the centre of energy system transformation***

The efficient implementation of the third phase of the ETS will provide an opportunity for energy system transformation which minimises the economic cost of emission abatement. Unlike in the first and the second ETS phases, when EU countries submitted national allocation plans that eventually determined the number of free allowances for each installation in their country, allowances will be increasingly allocated through auctioning in the third ETS period. Together with longer trading periods and an EU-wide emission cap, corresponding to a 21% reduction in 2020 compared to 2005, this should lead to a higher and more stable price of allowances, providing stronger incentives for abatement. The distribution of the annually declining amount of auctionable allowances to EU members will be based on emissions in the first ETS phase and the Czech Republic would also receive additional allowances as part of the redistributive mechanism for lower-income countries that reduce emissions by more than 20% compared with Kyoto reference year. The Czech Republic therefore has the possibility of receiving substantial fiscal revenues from the third phase of the ETS. Also, windfall gains linked to the remaining free allocation under the second phase of the ETS should be systematically taxed away.

The Czech Republic will be responsible for the technical implementation of auctions of allocated allowances. The incident of the theft of ETS allowance from the trading platform in January 2011 illustrated the potential risks of security breaches. Given the economies of scale in implementing infrastructure and platforms, it seems advantageous to develop auctioning facilities in cooperation with other countries, leading to either regional or EU-wide solutions, as it is currently planned by the authorities.

*Free allocation of ETS permits should be carefully monitored and evaluated*

The Czech Republic is among the countries that are allowed an optional and temporary derogation from the rule that no allowances are to be allocated free of charge to power plants after 2012. Under the derogation, the auctioning rate in 2013 is to be at least 30% of emissions in the first ETS period, and has to increase gradually to 100% by 2020. The authorities decided to use the derogation on the assumption that providing free permits constitutes an efficient mechanism for supporting energy system transformation. This is because the scale of investment in the energy generation sector, a very long-term horizon and the energy-security dimensions of fuel-mix decisions require, according to authorities, direct policy intervention. Free permits, which involve the use of companies' own funds for abatement projects, are seen by the authorities as more effective than funds drawn from the state budget and distributed through operational or state programmes. In 2010, companies wishing to take advantage of the derogation had to submit their investment plans and projects for reducing the negative environmental impact of equipment and technology. Czech installations have already submitted investment plans which could lead to abatement of about 15 million tonnes of $CO_2$ per year. Each plan was evaluated, and only firms with approved plans will be allowed free permits. The authorities are also considering using part of state revenues from permit auctioning to provide further support to industry. This support could be administered by a specialized fund and directed to projects aiming at effective energy resource management and environmental protection.

Granting free allowances would imply large costs for governments due to foregone fiscal revenues estimated at EUR 1.9 billion (or almost 1.2% of GDP in 2011) cumulatively between 2013 and 2020, according to the national authorities. The authorities should therefore carefully monitor and evaluate the implementation of the investment programmes. To inform future decisions, the efficiency of the free distribution of permits should be evaluated as most of the highly concentrated energy-generation sector in the Czech Republic enjoys high profitability and a good access to credit markets. Moreover, from the point of view of emission reductions, firms are likely to treat the opportunity cost of free allowances, which drives their economic decisions, in the same way as purchased allowances. The reduction of emissions would therefore be similar (this is determined by the number of allowances) and increases of energy prices - which in integrated EU electricity market would be increasingly determined at the European level - would still be passed on to final users.

The case for investment support could be stronger in the case of the district heating sector. Large investments are needed because of the upcoming shortage of brown coal, while regulated heat prices limit the possibility to pass on higher costs to consumers. However, the profitability and financial capabilities of the district heating sector would be increased significantly if heating prices were increased, while the existing well-developed system of social assistance could be appropriately expanded to mitigate the poverty impact. Such a change would increase the overall efficiency of the system and prompt energy savings in buildings. The risk of consumers switching to less efficient local heat sources with worse environmental parameters would be mitigated if current exemptions in fossil fuel taxation were phased out, as argued below.

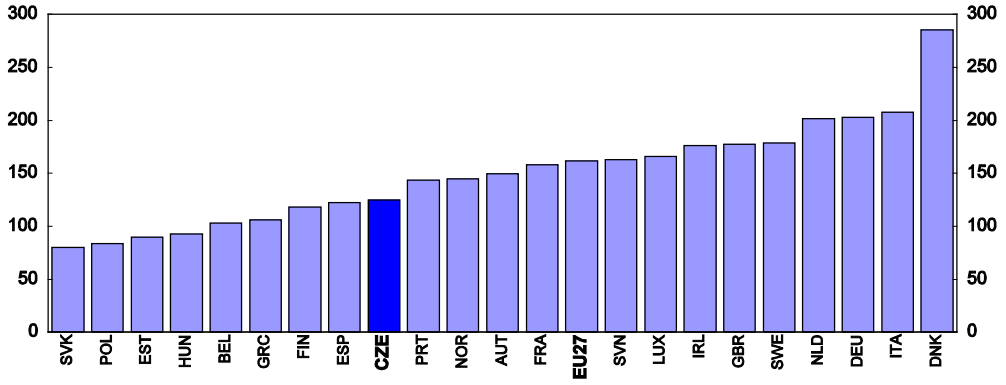
***Carbon taxation needs to be harmonised***

Energy taxation in the Czech Republic is currently not consistent with a single carbon price, so it cannot effectively complement ETS in providing adequate price incentives for energy system transformation. Carbon emission taxation should also minimise the difference in marginal cost of abatements between ETS and non-ETS sectors in order to level the playing field between large installations that are covered by the ETS and small installations that are exempted. This is particularly important in heating to avoid perverse incentives for switching from correctly priced district heating

towards emission-intensive and incorrectly priced local heating sources. Again, energy taxation in its current form does not prevent such distortions. At the same time there is a potential in the Czech Republic to generate additional fiscal revenues from rationalising energy taxation (Figure 5), potentially replacing some more distortionary taxes.

**Figure 5. Implicit tax rate on energy is moderate**

EUR/tonnes of oil equivalent consumed, 2009 or latest available




*Note*: The implicit tax rate is measured as the ratio of energy tax revenues (thousand EUR) to final energy consumption (thousands tonnes of oil equivalent).

*Source*: Eurostat.

Existing excise taxes implicitly provide a carbon price that varies considerably across different fossil fuels (Table 2). While taxation of energy products reflects considerations beyond environmental externalities, notably fiscal objectives that call for higher taxation of consumption of less price-sensitive products, some excise rate disparities might lead to perverse incentives. In particular, diesel is favoured compared to gasoline, as in several other EU countries (Egert, 2011). Taking non-GHG externalities into account (such as local air pollution noise, congestion and accidents) the implicit carbon price is negative in the case of diesel (and probably also for LPG - liquefied petroleum gas), even though uncertainty about the size of externalities is large (Persson and Song, 2010). An increase in diesel taxation is therefore justified. Other fossil energy sources in the Czech Republic are taxed at extremely low rates, meaning that many cheap abatement opportunities are potentially wasted as adequate price signals are not provided. Excise tax rates should be therefore realigned to provide a consistent carbon price. The adoption of the revised EU Energy Taxation Directive (Box 2) should limit leakage of fiscal revenues to neighbouring countries compared with a unilateral excise increase and the Czech government should therefore support the revised Directive.

**Table 2. Implicit taxes on fossil energy sources, EUR for kg of $CO_2$**

| Petrol | Diesel | LPG | Natural gas (households) | Natural gas (industry) | Light fuel oil | Coal |
|---|---|---|---|---|---|---|
| Implicit taxes (EUR/(kg of $CO_2$)) | | | | | | |
| 227 | 160 | 50 | 0 | 6 | 10 | 2 |
| Implicit taxes if the costs of local negative externalities are taken into consideration (EUR/(kg of $CO_2$)) | | | | | | |
| 49 | -62 | n.a. | n.a. | n.a. | n.a. | n.a. |

*Note*: The implied carbon price is computed as the amount of the tax levied per litre times the amount (litres) of fuel that needs to be burnt to reach a $CO_2$ emission of one tonne. The external costs of local air pollution are based on CE DELFT (2008, *Handbook on estimation of external costs in the transport sector*), and the external costs of noise pollution, accidents and congestion are taken from Persson and Song (2010).

*Source*: Energy Regulatory Office and International Energy Agency; OECD calculations based on Egert (2011).

Several tax reliefs distort the existing energy taxation system and should be phased-out. Among them, gas used for heating by households is exempted from excises, providing a wrong price signal that encourages energy use. It also encourages the switching out of district heating, just as a very low tax rate on coal encourages the use of coal. The taxation of heating fuel should therefore be rationalised, with excise rates increased according to the environmental externality. While increased prices could lead to social hardship, this should be managed by existing social assistance system. The current general exemption in excise taxes for fuels used in the production of electricity is appropriate for large installations covered by the ETS, but not for small installations that are not. Removal of the exemption for small installations is necessary to ensure a level playing field between installations of various size. There are exceptions for fuels for industrial processes, notably metallurgical processes and mineralogical processes, and the rationale for these exceptions should be reviewed, even if they are permitted under EU directive. The exemption for fuel for water navigation is not the most efficient way of promoting this mode of transport, as it reduces incentives for efficiency gains and therefore should be better replaced by direct subsidies. The same is true for the exemption for electricity used by railway, trams and trolley-buses. For similar reasons, the exemption for fuel losses during transportation, distribution and storage might lead to insufficient incentive for preventing such losses, particularly beyond standard norms.

**Box 2. EU Energy Taxation Directive**

The Czech government should support the recently proposed amendment to EU Energy Taxation Directive. The proposed changes will not only contribute to improving the tax incentives in the Czech Republic, but will also minimise competitiveness risks related with meeting the binding EU non-ETS emission objective. The main elements of the European Commission's proposal include:

- Taxes on motor fuels, heating fuels and electricity will be based on the energy content of the product and the amount of $CO_2$ it emits. More polluting products will be taxed more heavily, and the use of "cleaner" energy will be promoted.

- The EU will set a minimum rate for taxes based on energy and $CO_2$ content. To ensure fair treatment, the minimum rate will be the same for competing products (*e.g.* for all heating fuels or all motor fuels). The size of minimum tax is also expected to follow the market price of $CO_2$. Moreover, actual tax rates - set by national governments - will have to be the same for competing products.

- $CO_2$-related taxes will only apply to industrial plants not covered by the EU emissions trading scheme - so that all economic sectors share the burden of reducing $CO_2$ emissions fairly, either via the carbon tax in the Energy Taxation Directive or the emissions trading scheme.

According to the European Commission's estimate, the amended energy taxation could cut non-ETS taxation by 4% at the EU level, representing more than one third of total reduction required in non-ETS sectors. Provided, that additional revenues are recycled through reduced labour taxation, the amendment should have a positive impact on real household incomes in the EU by 0.3% by 2020.

*Source*: European Commission (2011).

**Addition sectoral policies should be strengthened**

While ETS and carbon taxation will play the central role in the overall policy framework, incentives delivered through carbon pricing will not be sufficient to drive energy system transformation in all areas, so that complementary instruments are needed (de Serres *et al.*, 2010). For example, the agreed objective for the share of renewable energy will not be met through the implementation of the ETS alone, owing to the cost of renewable energy. Even when price incentives are correct, market failures tend to prevent efficiency gains being reaped in residential buildings, and to lesser degree the SME sector. The role of infrastructure and public sector service provision in transport, as well as local externalities, justify additional policies. The following section discusses how to strengthen sectoral policies that complement carbon pricing.

***Rebalancing renewable energy support, grid improvements and more competition***

Support for renewable sources is provided mainly to meet the EU renewable share objective, which would not be ensured by carbon pricing itself. The Czech Republic is legally obliged to reach the target of 13% for renewable energy in its total energy mix by 2020. The 2010 share of renewable electrical energy in total gross electricity production reached 8.4%, a doubling compared with 2004. However, one fifth of the increase was due to a solar panel boom which absorbed substantial resources that could have been used to promote more economical sources such as biomass, biogas and wind (IEA, 2010). The high rate of support, primarily through feed-in tariffs, for new solar panel installations was not adjusted quickly enough when investment prices fell rapidly. It resulted in excessive returns, an explosion of solar panel investment in 2009 and 2010 and high overall implicit subsidies. This generated a strong upward pressure on electricity prices because of poor regulatory design, which allowed electricity retailers to recover high feed-in prices from final customers. Consequently, while solar panel power plants will produce one quarter of renewable energy in 2011, they will be responsible for three quarters of the financial burden of renewable energy generation (Box 3). Although it is important to allow more flexibility in setting feed-in tariffs in the future for all types of renewable energy sources, uncertainty should be avoided by setting clear rules regarding future changes in feed-in prices and volume constraints. Germany provides a good example of a policy framework allowing tariffs to be adjusted on a regular basis: feed-in tariffs decline depending on the installed capacity, with digression rates adjusted twice a year to smooth adjustments.

**Box 3. The solar panel boom**

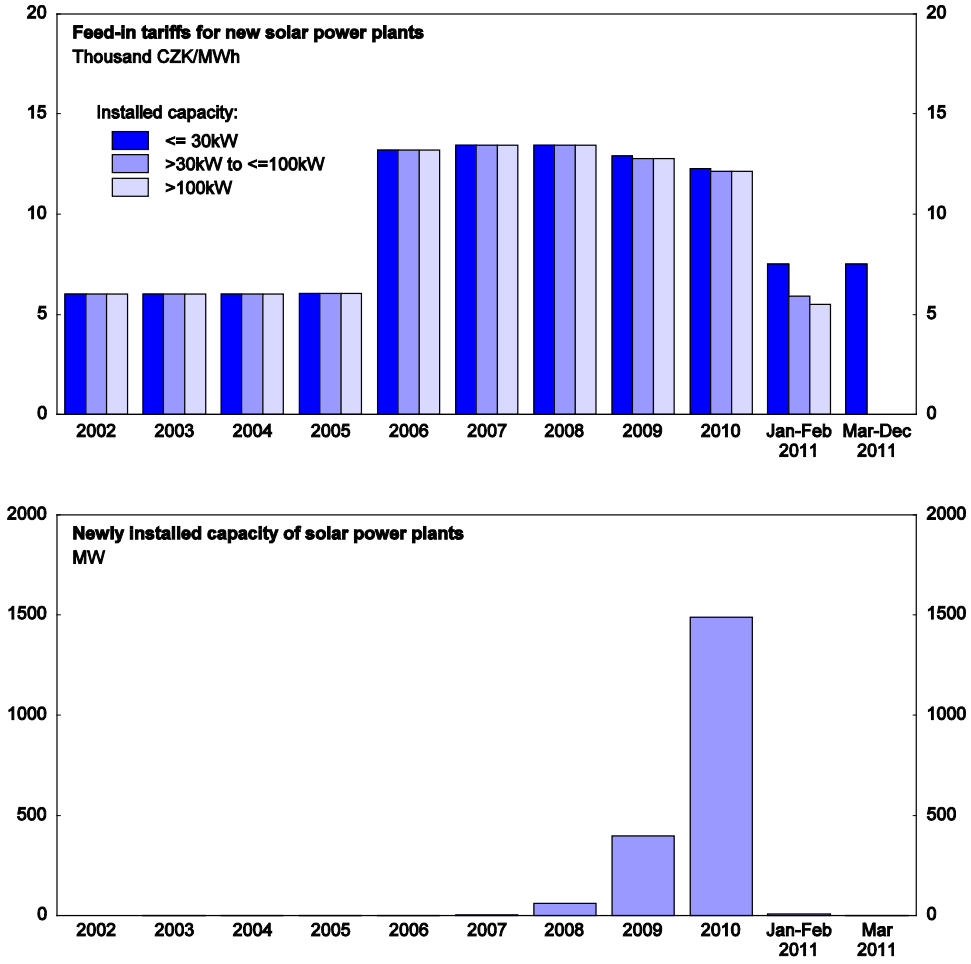
The grounds for the solar panel boom were laid by the Act on Promotion of Use of Renewable Sources by which EU directive 2001/77/EC was transposed into Czech legislation. Under this act, producers of renewable energy were entitled to feed-in prices, *i.e.* fixed purchase prices for the 20 year lifetime of a power plant by the Energy Regulatory Office (ERO) so that a 15 year repayment period was achieved. Distributors were remunerated for additional costs due to purchase requirements by a fee for renewable energy sources reflected in electricity price and regulated by the ERO.

Fatally, the ERO was not allowed to lower feed-in tariffs for new power plants by more than 5% a year, even as rapidly falling prices of solar panels made investments in solar power plants increasingly profitable, especially since feed-in tariff were doubled in 2006. As a result, the Czech Republic experienced a spectacular boom in investments in solar power plants in 2009 and especially 2010 (Figure 6). According to EPIA (2011) the Czech Republic was the third largest solar market worldwide in terms of newly installed capacity in 2010 and capacity is now the second largest in the world on per capita basis. As a consequence, a renewable fee and hence energy prices for consumers have started to rise considerably. In January 2011, the fee for renewable energy was expected to increase from 166 CZK/MWh to 578 CZK/MWh leading to increase of consumer prices of electricity by 11.2%.

To prevent a further explosion of investments and large increases in electricity prices that could pose a financial burden to consumers and undermine economic competitiveness, several emergency measures were adopted. The ERO was given the right to decrease feed-in tariffs by more than 5% a year when the expected investment repayment fell under 11 years. The eligibility of new solar installations for feed-in tariffs was restricted from March 2011 to power plants up to 30 kWh located on roof structures or the enclosure walls of buildings. These policies proved effective in stopping the boom.

In addition, to prevent the full pass-through of already credited higher fees into energy prices, the government introduced a partially offsetting subsidy for distributors of electrical energy in 2011 and possibly also in 2012. These subsidies are now financed by a 26% quasi-tax imposed for the years 2011 to 2013 on energy sales from larger solar power plants put into operation in 2009 and 2010. However, the last measure triggered threats of legal action from affected investors.

**Figure 6. Feed-in tariffs drove the solar panel boom**




*Note*: Capacity of solar power points is 0 or close to, for years other than 2008 to 2010. Feed-in tariffs for Mar.-Dec. 2011 are zero for other capacities.

*Source*: Energy Regulatory Office, Czech Republic.

The structure of feed-in tariffs reveals highly differentiated GHG abatement costs linked to different technologies, and particularly high costs in case of solar panel energy (Table 3). The support should therefore be redesigned to provide support in a technologically neutral way by lowering the dispersion in feed-in tariffs, so as to equalise marginal abatement costs and thus promote the

highest-potential and lowest-cost technologies. While subsidies for solar panel and other advanced technologies might lead to a learning curve effect and falling costs, the Czech Republic should not be so ambitious as to support expensive technologies before they become commercially viable. Setting targets for specific technologies should therefore be avoided. Moreover, tradable renewable certificates could be considered as a replacement for feed-in tariffs. Under such a scheme, electricity retailers would be required to purchase a minimum, rising proportion of their electricity from renewable generators in the form of tradable renewable energy certificates. The price of a certificate is then determined in the market and depends on the cost difference between renewable energy production and the average wholesale price of electricity. By design such a scheme offers implicit subsidies to renewable energy in a technologically neutral and economically efficient way (Lawson, 2010).

Streamlining permit procedures for the construction of renewable energy projects in municipalities is an example of a policy area where the authorities could reduce non-economic barriers to renewable production and hence reduce the cost of meeting the EU renewable energy share target (IEA, 2010). Other incremental improvements in the existing policy framework could result from the stricter evaluation of existing investment support schemes and closer coordination between the programmes financed by the EU structural funds *(e.g.* the Eco-Energy programme) and the State Programme for Energy Saving and the Use of Renewable Energy sources.

**Table 3. Feed-in tariffs and implied producer subsidies (2010)**

| Solar | Wind | Biogas | Biomass | Geothermal | Hydro |
|---|---|---|---|---|---|
| The ratio of feed-in tariffs to average market price of electricity production | | | | | |
| 10.5 | 1.9 | 3.2 | 3.1 | 3.9 | 2.6 |
| Direct producer subsidies implied by feed-in tariffs (EUR million) | | | | | |
| 268.6 | 14.1 | 51.8 | 144.4 | 0.0 | n.a. |
| Abatement costs (EUR/tonne of $CO_2$ equivalent) | | | | | |
| 436 | 42 | 102 | 96 | 132 | 36 |

*Note*: The amount of subsidy is calculated as an average feed-in tariff in excess of the market prices multiplied by electricity production from a given energy source. Abatement costs are computed feed-in tariff in excess of market prices and the amount of avoided $CO_2$ equivalent emissions.

*Source*: Energy Regulatory Office and Power Exchange Central Europe; OECD calculations based on Egert (2011).

*Investment in the grid and competition need to be stimulated*

Technical difficulties resulting from the solar panel boom have demonstrated that investments in improved management of the grid, quick-start peak power generation and energy storage are needed to increase room for decentralising renewable electricity production. Smart grids could ensure a more efficient use of electricity and energy savings in cities. For example, smart meters could provide accurate and real-time information on electricity prices and consumption at the customer level, providing incentives for reducing demand with a view to reducing electricity bills and switching suppliers to benefit from lower prices. Also, increasing currently low competition at the retail level (Box 4) could increase the opportunities for energy service companies to enter the market and promote innovation at the customer level (Jamasb and Pollitt, 2008).

**Box 4. Competition in the electricity market**

Czech electricity market performance is mixed. On the one hand, there have been major developments in liberalization. Within less than a decade (liberalization started in 2002), the Czech Republic has managed to achieve full liberalization in terms of unbundling and third party access and has increased market coupling with its neighbours. In particular, intra-day trading is now operational with Austria, Germany and Slovakia, and coordinated auctions are happening across borders with Germany, Slovakia and Poland. There has also been the establishment of a trading platform in Prague (as of 2007), with its price now well correlated with that of the European Energy Exchange for deliveries in Germany and Austria (NRO, 2010).

On the other hand, the situation in the Czech electricity market has remained far from competitive. At the wholesale level, the situation is close to being a monopoly, with only one company (CEZ) responsible for 75% of the power generation in 2008. CEZ - a partially state owned company - is the only company with a share of generation capacity of more than 5% and also owns all nuclear power plants. At the retail level the situation is one of oligopoly with 3 companies controlling 99% of the market share. Among them, CEZ Distribution owns 62% of the market share. Additionally, despite switching rates being high at the industrial level (28.6% in 2008 ), those at the household level are low compared with other EU countries (less than 1% in 2008) even though they are on the rise (IEA, 2010).

### *Policies to promote energy efficiency*

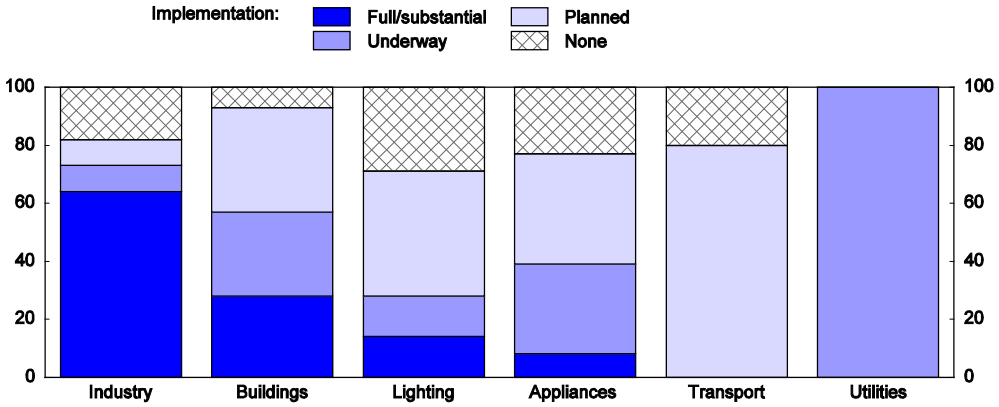
The Czech Republic successfully implemented several policies promoting energy efficiency and achieved an average annual reduction in energy intensity of 2.5% between 1990 and 2008. The *National Energy Efficiency Action Plan 2008–16* provides a non-binding target to achieve energy savings of 9% in 2016, the minimum level required by the EU Energy Service Directive. Another non-binding energy efficiency target will also be set in the longer run. Nevertheless, substantial room for policy improvement remains, as energy intensity remains among the highest in the OECD, and the unused potential for energy savings is substantial (McKinsey & Co., 2008). The IEA study on *Implementing Energy Efficiency Policies* (IEA, 2009) indentified several opportunities for improvement in the policy framework. At the time of evaluation, only one third of recommendations in buildings were fully or substantially implemented, two thirds in industrial sector and none in the transport sector, although there were plans to implement most of them (Figure 7). The implementation process should therefore be accelerated. Policy challenges in key sectors are discussed below, while the IEA cross-section recommendations, related to better coordination, public awareness, institutional capacity and monitoring are shown in Box 5.

**Box 5. IEA cross-sectoral recommendations for energy efficiency in the Czech Republic**

- Develop an integrated energy efficiency strategy, addressing both primary and final energy use and improving the co ordination of different energy efficiency schemes, so as to optimise their effectiveness.
- Identify specific policy measures to achieve particular energy saving targets, empower the responsible institutions, enable sufficient resource allocations and set time lines for implementation.
- Enhance public awareness of the benefits of energy efficiency as a means of improving energy security, saving money and reducing GHG emissions and local air pollution.
- Increase institutional capacity to improve implementation and monitoring of energy efficiency policies, and clearly define and better co-ordinate the respective roles and competencies of government institutions in implementing them.
- Improve data collection in energy efficiency policy, so that the interlinkages between policies and measures and expected savings in each sector can be examined and assess the costs and benefits of proposed measures, including through consultation and co-ordination with industry.

*Source*: IEA (2010).

**Figure 7. Progress with implementing IEA energy efficiency recommendations is slow**




*Note*: Information is current up to 31 March 2009.

*Source*: IEA, *Implementing Energy Efficiency Policies*, 2009.

*Support for efficiency in buildings should be continued but more closely evaluated*

Energy efficiency in buildings should be stimulated primarily by price signals linked to the ETS and carbon taxation. Nevertheless, some additional measures have to be used to overcome remaining obstacles, such as information and awareness barriers, split incentives between landlords and tenants and credit constraints (de Serres *et al*., 2010). The importance of these problems is illustrated by the large size of economically profitable investments in energy savings that have not been undertaken in buildings so far (McKinsey & Co., 2008). The Czech Republic has implemented several measures dealing with these challenges, but certain aspects might require strengthening or modification, as discussed below.

Building standards are an important element in ensuring higher energy efficiency in new buildings. The Czech Republic has fully implemented the EU Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC), which sets requirements for energy efficiency in building codes and includes provisions on mandatory energy performance certificates for both new and existing buildings. It has also implemented decrees on the Control of Heating Systems and the Control of Air Conditioning Systems, and Directives on Energy Labelling of Household Appliances and Eco design Requirements for Energy-Related Products. Nevertheless certification of the existing building stock is lagging behind (IEA, 2010). All new buildings will have to meet high standards consistent with the requirements of Directive 2010/31/EU at the end of 2020, however a more frontloaded application could be considered, to accelerate the convergence to economically profitable low energy consumption patterns. A forthcoming new EU Energy Efficiency Directive should also provide additional impetus to energy efficiency with a number of binding measures.

Given the large existing stock of relatively energy inefficient buildings, the government should and does provide incentives for retrofitting. Although no systematic evidence about energy efficiency of existing buildings stock is available, the scope for low-cost emission abatement is believed to be substantial (McKinsey & Co., 2008). The current focus of policies is rightly on improvements in the thermal properties of buildings and the insulation of houses and apartment buildings (*National Reform Programme*). The government provided such support primarily through two large-scale programmes:

- *The Green Investment Scheme*. Overseen by the Ministry of Environment and implemented by State Environmental Fund, this programme was financed entirely from the revenues from sales of emission allowances under the Kyoto flexible mechanism and provided subsidies and grants for energy saving measures in buildings, to a total amount in excess of CZK 20 billion. While intended to last until 2012, new applications were stopped in 2010 due to a high number of applications and over-commitment of available funds. The programme provided households with grants for insulating their homes, for the construction of passive standard housing and for the installation of heating equipment using renewable energy sources. It is estimated that the programme provided support for 8.4% of the total living area in the country and delivered energy savings necessary to meet the national household energy saving goal for 2010 (State Audit Office).

- *The PANEL programme*. Financed by the national budget, monitored by the Ministry of Regional Development and implemented by the State Housing Development Fund and the Czech-Moravian Guarantee and Development Bank, this programme provided interest rate subsidies and guarantees for loans for retrofitting apartments (reconstruction, modernization and insulation to improve energy parameters), primarily in prefabricated buildings, amounting to CZK 0.5-1 billion annually. More than 360 thousand flats have been retrofitted during the ten years the programme has been in operation; an estimated 30-50% of 2.2 million flats eventually require retrofitting, according to the Ministry.

While the government should continue providing support for improving energy efficiency in buildings, it is important that such programmes are rigorously and regularly evaluated and that cost-benefit analyses are conducted. This is particularly important in case of the PANEL programme, which was never systematically evaluated and the total energy saving of which was never rigorously estimated. The government has set aside funds to evaluate the impact of the Green Investment Scheme on energy consumption for heating. However, the audit of the Green Investment Scheme by the Supreme Audit Office provided evidence about systemic flaws linked to an insufficient attention to the evaluation of cost-effectiveness, information gaps, and the lack of adequate tools for interim monitoring. The key recommendations for improvement, which are likely to be relevant for other support programmes, included:

- Adopting the ratio of the amount of subsidies to the anticipated emission reductions as the project selection criteria. According to the audit, cost-effectiveness varied widely across the programme and its segments (Table 4).

- Creating a monitoring programme that would keep timely and complete information about the financed projects, to serve as a reliable basis for its management and evaluation.

- Monitoring and evaluating the other stated objectives of the programme, including reductions in the concentration of dust particles, emissions of other pollutants and household spending for heating.

- Improving rules for the administration of applications and project management to streamline the project implementation.

**Table 4. Cost effectiveness of one-year $CO_2$ emission abatement (2010)**

| Programme segment | Total investment | Subsidy | Share of subsidy |
|---|---|---|---|
| | CZK/1 t $CO_2$ | CZK/1 t $CO_2$ | % |
| Improved thermal isolation | 56 087 | 35 263 | 63 |
| Construction of a passive standard housing | 756 211 | 103 176 | 14 |
| Use of renewable energy sources for heating and hot water | 14 903 | 7 485 | 50 |

*Source*: Supreme Audit Office (2011), based on *ex ante* evaluations. The figures shown in the table do not take into account financial value of energy saving.

Decisions about the continuation of the Green Investment Scheme should be based on the initial insights from the *ex post* programme evaluation initially planned for 2013 but which can be accelerated given an earlier exhaustion of the programme funds. While no substantial future revenues from sales of Kyoto allowances are expected, the programme would need to be financed from general budgetary allocations under stricter cost benefit analysis. The use of EU structural funds for the support of energy efficiency under the next EU financial framework would also be justified. Loans and loan guarantees should be used more often than direct subsidies for supporting projects that are cost effective, but require high upfront investments. While the evolution of the State Environment Fund towards an environmentally oriented bank is being considered, deepening its cooperation with the Czech-Moravian Guarantee and Development Bank might be more appropriate to build on existing capacities and experience.

Various support programmes, notably the Green Investment Scheme and the PANEL, should be better coordinated with different government institutions given clearly defined roles and competencies. While the division between the two programmes has recently been clarified and the most important overlaps removed, a merging of these two programmes should be considered given the fact that both are likely to be financed from the general budget and the Green Investment Scheme is likely to evolve towards indirect measures of support. At the very least, standardized methods are needed for processing and evaluating the effectiveness of the administration of grant programmes aimed at similar goals (Supreme Audit Office, 2011).

Energy providers should also play a more active role in promoting energy savings. While pilot initiatives undertaken by CEZ on smart metering and smart grids in the town of Vrchlabi are a good first step (CENIA, 2010), the energy market incumbent should provide energy saving services more broadly. Indeed, the introduction of energy saving certificates should be considered (Box 6).

**Box 6. Energy saving certificates**

In order to accelerate energy efficiency gains, the government could define and mandate energy saving targets, at least in buildings, and introduce a tradable energy saving certificate scheme (white certificates) to ensure compliance. Under such a scheme, energy providers would be required to undertake energy efficiency measures for the final users achieving a pre-defined percentage of their annual energy deliverance. White certificates issued by an independent body would confirm the energy savings and the provider could use the certificate for their own target compliance or sell it to parties who cannot meet their targets (Capozza and Grattieri, 2006).

White certificates provide incentives to energy providers to promote energy-saving projects among its customers, correcting the basic incentive to sell more rather than to conserve energy. Energy providers have all the necessary knowledge, assets and tools to overcome typical barriers to energy saving investment, particularly in buildings, such as information, financial and coordination problems. Having close relationship with end-users, they are in a better position than the government to determine subsidy levels for end-users consistent with saving targets. As white certificates are tradable, energy providers can either achieve savings on their own or purchase certificates, encouraging the development of energy service companies and bringing down the effective cost of energy savings. In some countries, 80% of savings were in fact delivered by energy service companies (IEA, 2011).

Energy saving certificates have been implemented successfully in countries such as Australia, Denmark, France, Italy, the United Kingdom and the United States. For instance, in the United States, per capita residential electricity consumption is 31% lower in the half of states that have a history of such schemes (IEA, 2011). In France, energy savings during the first phase (2006-09) amounted to 60 TWh (compared to a goal of 54 TWh), *i.e.* 15% of the annual energy consumption of the housing sector, while 92% of white certificates were concerned with residential and commercial buildings (Egert, 2011). Similarly, the national energy saving target over 2005-09 was overachieved in Italy under the white certificate scheme (IEA, 2011).

*Promoting energy efficiency among SMEs*

An increasing number of countries and companies now perceive environmental challenges not as a barrier to economic growth but as an opportunity for increasing competitiveness (OECD, 2011c). While the carbon emission price should provide Czech companies with incentives to reap competitiveness gains due to higher energy efficiency in the production process and more energy efficient products, some additional policy instruments can effectively be implemented. Industrial companies, particularly small- and medium-sized that are not covered by the ETS, frequently fail to undertake energy and process efficiency projects that typically have a rather long payback period, particularly given existing financing constraints and energy price volatility that increases the risk of such investments (McKinsey & Co., 2008).

A new legal framework promoting Energy Performance Contracting (EPC) would be particularly useful in diffusing best practices in energy efficiency using market based instruments. EPC is a method of contracting of a broad range of energy services, including designing, implementing and maintaining energy savings projects, based on in-depth analysis of a customer's energy system, to be provided by specialised Energy Service Companies (ESCOs). The projects are financed through expected energy cost savings, overcoming problems of credit constraints. ESCOs might be financially responsible for failures to achieve targets, substantially reducing the risk faced by the customer. The government intends to promote ESCOs among small- and medium-sized companies as part of the *Competiveness Strategy*.

The ECO-Energy operational programme, financed primarily from the EU structural funds and implemented by CzechInvest, promotes energy efficiency among small- and medium-sized companies as well as the utilisation of renewable and secondary energy sources by all companies. Supported activities include the modernisation of existing own-energy generation facilities, upgrading systems of measurement and regulation, reducing electricity and heat losses and improving the thermal-technical

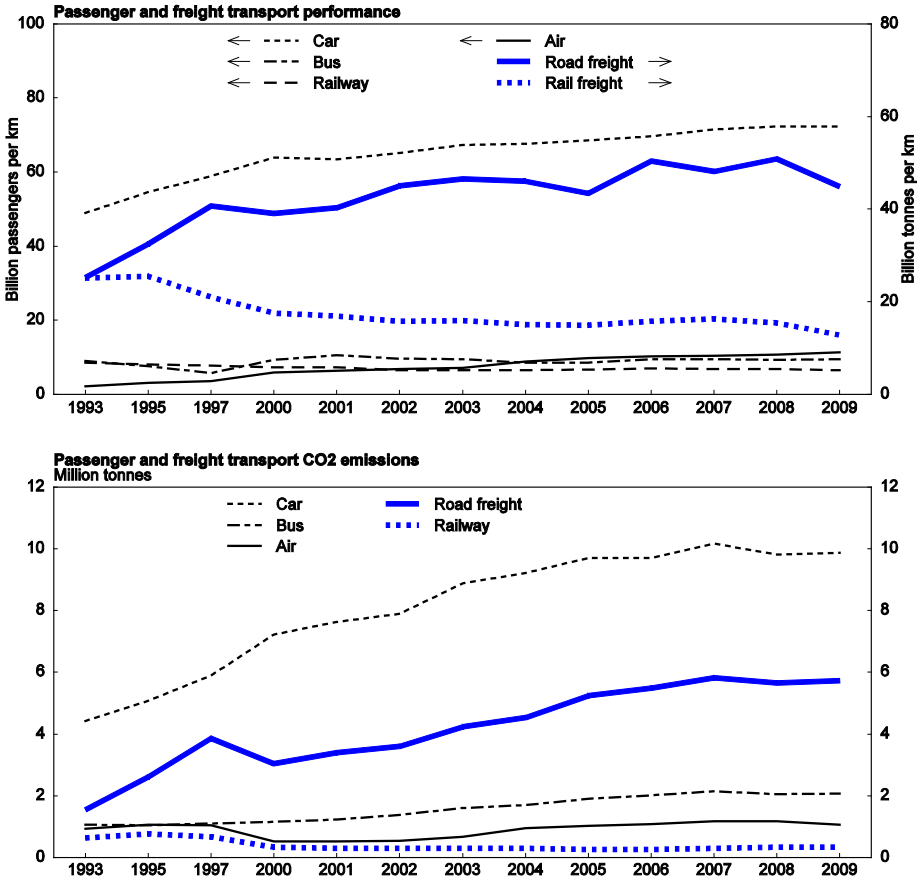
properties of buildings. It also promotes the utilization of waste energy, the combined production of electricity and heat and the increased energy efficiency of production and technological processes. The total amount of annual emission saving expected due to approved applications and subsides of CZ 3.3 billion amounts to almost 0.5 MT $CO_2$ since the inception of the programme. A similar programme of support for energy efficiency should also be foreseen under the new EU financing period.

The public sector should provide a strong signal about the government's commitment to improve the efficiency of its own energy use, yet no measures relating to the exemplary role of public sector were included in the *National Energy Efficiency Action Plan*. Unclear legislation and rules, and perverse incentives among public sector managers are major obstacles to realising EPC within this sector (SEVEn, 2011). The government is now preparing an amendment facilitating the use of EPC, which is a step in the right direction. All public buildings should be retrofitted to modern efficiency standards, as long as long-term savings justify up-front expenses and high efficiency standards are used in all public procurement. Such demand instruments should be combined with supply instruments such as research funding, the creation of networks, platforms and partnerships, and technology demonstration (OECD, 2011c). These policies should stimulate a refocusing from end-of-pipe pollution control to product life cycles and integrated environmental strategies and management systems. They should also promote the full integration of Czech firms into the supply chains of multinational firms producing environmentally friendly machinery and equipment. Strong linkages with the German machinery industry, which plays a leading role globally in this segment, provide favourable starting conditions for such an ambition.

***Preventing emission increases in transport will be challenging***

While carbon taxation should provide a basic incentive for emission abatement, additional measures need to be implemented in the transport sector, whose share of total emissions increased from 6% in 1990 to 15% in 2008, and whose share in total final energy consumption increased from 7% to 22%. These increases were linked primarily to the rapid increase in passenger car and road freight transport (Figure 8). Passenger air transport has also grown rapidly, but the volume remained relatively small. Meanwhile, less emission-intensive modes of transport performed weakly: passenger railway transport outputs have stagnated since 2000 and the importance of long-distance bus transport and urban bus transportation has been falling. In freight transport, the shift from water and railways to roads was only partly explained by the shift from bulk material to finished product transportation. Rather it was mostly due to the declining competitiveness of these less-emission-intensive modes of transport and their inadequate integration into full logistics chains.

**Figure 8. Growth in road transport outputs and emissions is rapid**




*Source*: Transport Centre, *Study on transport trends from environmental viewpoints in the Czech Republic 2009*, Brno, August 2010.

The Czech Republic is characterised by still low rates of motor vehicle ownership and low mileage. Road freight continues to be highly competitive, and emissions in transport are therefore expected to continue to grow rapidly once the impact of economic crisis on the trade and freight is overcome. This may threaten the achievement of EU environmental obligations (the non-ETS emission target) and pose a direct health hazard to the population due to local pollution, including dust, nitrogen oxides and polyaromatic hydrocarbons, as well as noise, congestion and accidents (Persson and Song, 2010). Several measures are currently being implemented or in preparation, which involve infrastructure development, incentives for public transport use, renewal of the car fleet and an increasing share of biofuels. The Ministry of Transport believes that these should allow a reduction in greenhouse gas emissions produced by transport of up to 5% by 2020. The in-depth review of the fifth national communication of the Czech Republic under the United Nations Framework Convention on Climate Change (UNFCC, 2010) noted, however, that Czech national transport emission projections were not in line with European Commission projections and were based on overly optimistic assumptions about energy efficiency improvements and the share of biofuels in 2020 above adopted targets. More broadly, estimates of emission growth in transport are subject to a large degree of uncertainty, with substantial upside risks. Emissions abatement in the transport sector tends to be difficult as it involves behavioural changes, such as a switch from private to public transport or

reduced commuting, which are often difficult to achieve given existing preferences and a relatively low sensitivity to price signals (World Bank, 2010).

*Upgrading transport infrastructure and public transport*

To limit emissions growth without constraining the mobility of citizens and the growth of freight, which are essential for economic growth, it is important to increase the consistency between transport infrastructure investment programmes and environmentally sustainable transport objectives, notably by strengthening environmental impact assessments. Higher priority should be given to road quality and to railways and other modes of public transport and combined transport rather than new road construction (Table 5). However, the basic network of Trans-European Transport Network (TEN-T) motorways and expressways needs to be completed. The *Competitiveness Strategy* and the *National Reform Programme* recognise these challenges and advocate a stronger focus on improvements in transport infrastructure quality management, repair and maintenance, particularly of lower class roads, and the more coordinated development of different transport modes. These goals need also to be reflected in the upcoming State Transport Policy up to year 2025. Private sector participation, notably through a wider use of public private partnerships (PPPs) would allow the acceleration of transport infrastructure projects, despite the reduced availability of public funds at a time of fiscal consolidation. However, the careful choice of first-round projects would be essential for the success of this mode of financing, as the Czech authorities have experienced problems in implementing PPPs so far (OECD, 2010a).

**Table 5. Quality of road and rail infrastructure**

Ranking among 30 OECD countries

| | Road | Rail |
|---|---|---|
| Austria | 4 | 9 |
| **Czech Republic** | **29** | **19** |
| Germany | 3 | 4 |
| Hungary | 27 | 24 |
| Poland | 30 | 26 |
| Slovak Republic | 28 | 17 |

*Note*: Relative ranking based on the following question: "How would you assess the quality of the rail and road infrastructure in your country?".

*Source*: *World Economic Forum 2009-10 global competitiveness index*.

Within road infrastructure development, investments directed at controlling road traffic within urban areas should be prioritised in line with the updated *Strategy for Sustainable Development*. This would mitigate a direct health hazard due to local pollution, noise and accidents, as well as reducing congestion in urban and suburban roads that further increases the economic and environmental costs of road transport (Persson and Song, 2010). An effective system of toll charges should reflect externalities related to road transport and provide a backbone for smart traffic engineering. Traffic management in urban areas should involve traffic restrictions in city centres, parking fees and incentives to commute by public transport. It should also include an expansion in the infrastructure for cycling, as well as the implementation of a congestion charge for Prague and, if appropriate, other cities.

Enhanced railway infrastructure, when combined with an adequate carbon price signal, could motivate a wider use of this means of transport. While the railroad infrastructure is dense by international comparison, some of the main corridors for long-haul passenger and freight transport have not been completed. Also the infrastructure for combined systems, including public logistical

centres and combined transport terminals lags behind countries with substantial freight transit transport, like Switzerland or Austria. The *National Reform Programme* rightly prioritises the completion of railway transit corridors, an upgrading of the TEN-T railway lines and junctions and commuter railway transport in densely populated areas. Two public logistical centres with a combined transport terminus are planned to enter service by 2015. Infrastructure improvement is, however, only a part of the solution as a sound competitive environment has not been created for the railways. Opening them further to competition, particularly in freight transport, could lead to lower prices and a better quality of services, shifting transport back to rail. The railway restructuring foreseen in 2011 is welcome in this respect, including the final step towards the separation of transport and infrastructure operations, which should ensure non-discriminatory access to the network for all operators within a fully transparent competitive environment.

Better integration of urban and suburban public transport is needed to improve the efficiency and attractiveness of public transport. The promotion of integrated transport systems is particularly important and requires a better coordination between national authorities, who are responsible for railway transport, and municipalities who are responsible for buses and other public transport elements. It should be also supported by strengthened territorial planning. According to the Ministry of Transport, there are currently 12 local integrated public transport systems in the Czech Republic, but they differ in terms of tariffs, timetables and organisational integration. In several cases, integration is presumably insufficient to decisively enhance the relative attractiveness of public transport.

*Fuel performance of car fleet needs to be improved*

The country has an old car fleet and its modernisation has been relatively slow. The Czech Republic was one of only two EU countries with a higher average emission of newly registered cars in 2008 than in 2004 (European Commission, 2009). The country continues to import a high number of used cars with weak emission performance, despite import duties on used cars and registration fees. Hence, enforcing vehicle inspection and maintenance obligations need to be strengthened, to better control emission from older vehicles and stimulate the renewal of cars, lorries and bus fleets. To make technical inspections for cars stricter and more objective, electronic records have been implemented for Technical Inspection Stations (CENIA, 2009). More recently, the Minister of Industry and Trade established a working group composed of representatives of various ministries as well as of the Automotive Industry Association and the Association of Car Importers to propose measures to improve the structure of the car fleet in the Czech Republic that should be submitted to the government for approval during 2011. On the other hand, tax incentives for vehicle renewal should be used sparingly, especially if an adequate price signal is provided through carbon taxation.

Higher fuel quality standards of new vehicles are in line with the European regulation. The EU target is to lower emissions of newly manufactured cars to 130 grammes $CO_2$ per km in 2012, 120 grammes in 2015 and 95 grammes by 2020, compared to a current 170 grammes, through improvements in engines, reductions in the rolling resistance of tires, recuperative brakes, etc. Fines will be imposed in cases of non-compliance, beginning with EUR 20 per gramme in excess of the limit in 2012 up to 95 EUR per gramme in 2015 and later. Although, the impact of tighter environmental standards for new vehicles on total fleet emissions will be slow to materialise, especially given high imports of used cars, it would be essential for longer-term emission containment.

The Czech Republic is facing the EU binding target of a 10% share of biofuels in all modes of transportation by 2020. Accordingly, producers, distributors and importers are obliged to include a gradually increasing percentage of biofuels in petrol and diesel, and face significant financial penalties in case of non-compliance. While there are no price subsidies, tax benefits applying to the use of pure biofuels and high-percentage blends in transport have been introduced. The Czech Republic is justified

in not seeking to establish more ambitious national target for biofuels share in transport, given the disputes about the gains in net emission reduction from the use of biofuels due to their full life-cycle emissions (Lawson, 2011), as well as very high marginal cost, estimated sometimes at EUR 350 per tonne of $CO_2$ (Steenblik, 2007). While the current production of biofuels is sufficient to cover present needs and existing refining capacity would allow production to increase sufficiently to reach the 2020 target, it important to ensure this expansion is conducted in environmentally sustainable manner (IEA, 2010).

**Box 7. Recommendations on energy system efficiency**

**Ensuring a comprehensive, consistent and stable policy framework**

- Ensure full consistency among strategic policies, including currently prepared documents on Environmental, Energy and Transport Policies to anchor private sector expectations about future policies.
- Strengthen the use of cost-benefit analysis and the effectiveness of environmental impact assessment for all policy instruments, independent of their source of financing. Ensure proper *ex ante*, on-going and *ex post* evaluations.
- Systematically estimate abatement costs and adjust public intervention and subsidies to ensure equalised marginal abatement costs. Avoid overlaps and ensure common standards among instruments financed from different sources, such as the national budget, EU funds, and proceeds from sales of Kyoto allowances.

**Providing incentives for abatement and raising revenues through the ETS and carbon emission taxation**

- Tax away all windfall gains linked to the remaining free allocations of allowances under the second stage of the ETS, including heat producers. Monitor and evaluate the efficiency of free ETS permit allocations to inform future decisions.
- Support implementation of carbon taxation at the EU level. Realign the excise tax rate on all fossil energy sources and products, based on their carbon content and other environmental externalities, notably by increasing the relative taxation of diesel. Remove several excise tax reliefs on fuel use.

**Rationalising sectoral policies**

- Use the opportunity given by the natural retirement of the coal-fired power and heating plants to plan a strategic switch to low-emission sources and technologies. Rebalance support for renewables to promote the lowest cost sources in a technologically neutral way, while avoiding setting targets for specific technologies.
- Enhance competition in the energy sector to increase market entry, minimise inefficiency and losses and stimulate emission-reducing innovations, including work on smart grids and meters.
- Continue investing in building energy efficiency measures under the Green Investment Scheme but improve its efficiency and improve coordination with the PANEL programme. Use loan support instead of investment subsidies for projects that require high upfront investments although being highly cost-effective overall. Increase the role of energy providers in promoting energy savings.
- Apply best practices in support of energy efficiency among SMEs, promoting Energy Performance Contracting and the development of Energy Service Companies. Continue providing support for the energy efficiency improvements from EU structural funds under the next EU financial framework.
- Increase consistency between transport infrastructure investment programmes and environmentally sustainable transport objectives. Improve the institutional co-ordination of transport and land use plans among the state level, regions and municipalities. Complete the restructuring of the railways.
- Further develop traffic management in urban areas, including traffic restrictions in city centres, parking fees and incentives to commute by public transport. Strengthen vehicle inspection and maintenance obligations to better control emission from older vehicles and stimulate the renewal of cars, lorries and bus fleets primarily through adequate carbon pricing, while using other instruments only sparingly.

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