European Commission

ISSN 2443-8030 (online)

Decline in energy intensity in the Czech Republic: due to structural change or energy efficiency improvement?

Magdalena Spooner

ECONOMIC BRIEF 007 | FEBRUARY 2016

EUROPEAN ECONOMY

Economic and Financial Affairs

European Economy Economic Briefs are written by the staff of the European Commission's Directorate-General for Economic and Financial Affairs to inform discussion on economic policy and to stimulate debate.

The views expressed in this document are solely those of the author(s) and do not necessarily represent the official views of the European Commission.

Authorised for publication by Anne Bucher, Deputy Director-General for Economic and Financial Affairs.

This paper exists in English only and can be downloaded from http://ec.europa.eu/economy_finance/publications/.

More information on the European Union is available on http://europa.eu.

Luxembourg: Publications Office of the European Union, 2016

KC-BE-16-007-EN-N (online)
ISBN 978-92-79-54467-5 (online)
doi:10.2765/278701 (online)

KC-BE-16-007-EN-C (print)
ISBN 978-92-79-54466-8 (print)
doi:10.2765/686169 (print)

European Commission

Directorate-General for Economic and Financial Affairs

Decline in energy intensity in the Czech Republic: due to structural change or energy efficiency improvement?

By Magdalena Spooner

Summary

The Czech economy has one of the highest energy intensities in the EU. Although it has been decreasing, the rate has been rather slow compared to other countries in the region. While before the crisis in 2008 improvements in energy intensity were largely attributable to improvements in energy efficiency, since 2009, the restructuring of the economy has played an important part. In this more recent period, energy intensity has decreased mainly thanks to the declining importance of transport in total GVA.

Moreover, a sectoral analysis reveals that the restructuring of industrial sectors has been the most important driver of the decrease in industrial energy intensity, a fact which masks the relatively modest improvement in energy efficiency. Furthermore, the analysis focuses on the efficiency of the energy sector and on the energy intensity development of the transport sector.

Acknowledgements: The note benefited from comments by Milan Lisicky, Renata Hruzova, Marek Dobrovolny, Zdenek Cech, Irene Pappone, Asa Johannesson Linden and Emmanuelle Maincent.

Contact: Magdalena Spooner, European Commission, Directorate General for Economic and Financial Affairs, Growth, competitiveness and structural reforms, Economic Infrastructure and Sustainable Growth, Magdalena.Spooner@ec.europa.eu

Energy intensity and energy efficiency

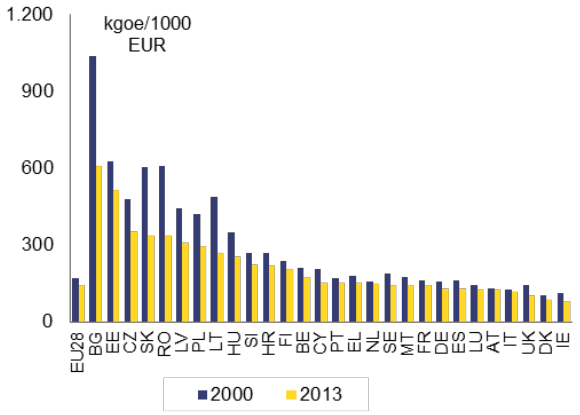
One of the priorities of the Europe 2020 strategy for energy and climate policy is to achieve sustainable growth by moving towards a low-carbon economy. The policy includes a target to improve energy efficiency by 20% (compared to projections made in 2007). In this context, the Czech Republic has committed to contribute to the overall EU target by saving 13.27TWh of final energy[1] (Czech Ministry of Industry and Trade, 2014).

Energy efficiency is often measured by energy intensity, i.e. the amount of energy used per one unit of GDP. This measure allows to overcome the effect of a possible slowdown of the economy (which automatically leads to a lower energy consumption) and to show a decoupling of energy consumption and output growth. However, it is acknowledged that this measure entails some caveats as energy consumption is influenced by other factors such as structural changes of the economy, energy prices, climate, weather or even ageing of population.

High energy intensity of the Czech economy

The Czech Republic has one of the highest energy intensities in the EU-28. Although energy intensity has followed a downward path in line with the EU-28 evolution, and, in particular, the catching-up economies of the 'new' Member States, it still remains well above the EU level. Moreover, the rate of decline of energy intensity is moderate compared to Slovakia and in 2013 the Czech Republic recorded the highest level of energy intensity of all Visegrad countries[2] (Graph 1).

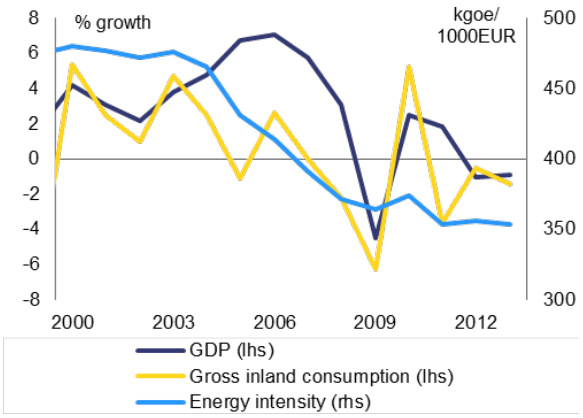
Graph 1. Energy intensity in the EU-28 and MSs - total economy



Source: Eurostat, own computations.
Note: Ranked by energy intensity in 2013.

By definition energy intensity reflects the development of gross inland consumption of energy and GDP. Up until the crisis in 2008, GDP was recording higher increases than energy consumption (Graph 2). At the time of the 2009-2010 recession energy consumption outgrew GDP which led to a small increase in energy intensity.

Graph 2. Energy intensity decomposition

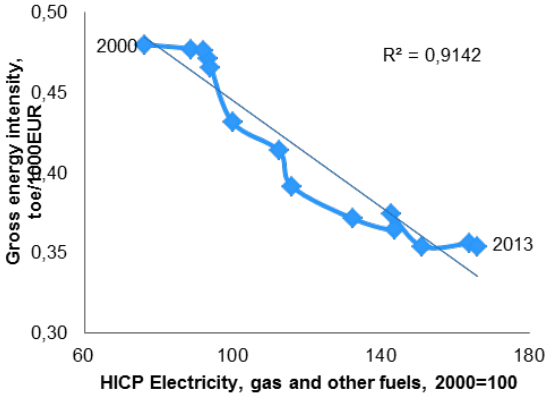


Source: Eurostat, own computations.

Drivers of energy intensity improvement: energy prices

Energy prices count naturally among the key drivers (and incentives) of energy intensity improvements, especially for industrial consumers (European Commission, 2014a). Economic agents react on rising energy prices by trying to minimize their energy costs through reducing their consumption of energy while not influencing negatively their output (and therefore ensuring that energy intensity does not worsen). Indeed, correlation between gross energy intensity and HICP of fuels reached -0.96 over the period 2000 to 2013 (Graph 3).

Graph 3. Energy intensity vs. energy prices



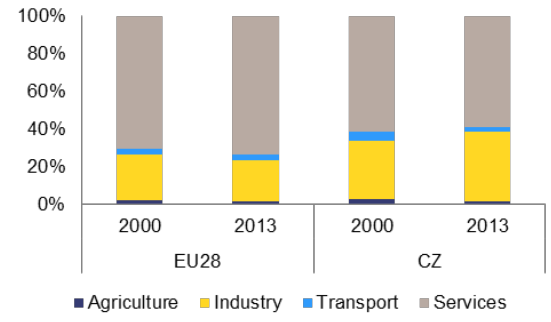
Source: Eurostat, own computations.

Energy prices seem to have fostered the change in energy consumption and contributed to its decline. However, it is difficult to disentangle the true impact of energy prices from the role of specific national energy efficiency policies. Interestingly, over the 2000-2012 period energy intensity in the Czech Republic decreased on average by 2% per year while HICP prices of electricity, gas and other fuels increased by the same amount. In this context it is worth noting that energy prices are not regulated in the Czech Republic[3].

Accounting for structural changes

The structure of the Czech economy has changed significantly over the reported period, also in respect to the EU-28. The size of industrial output has grown while the tertiary sector has decreased in its importance. This is an opposite outcome than for the EU-28 (Graph 4).

Graph 4. Sectoral shares in total gross value added



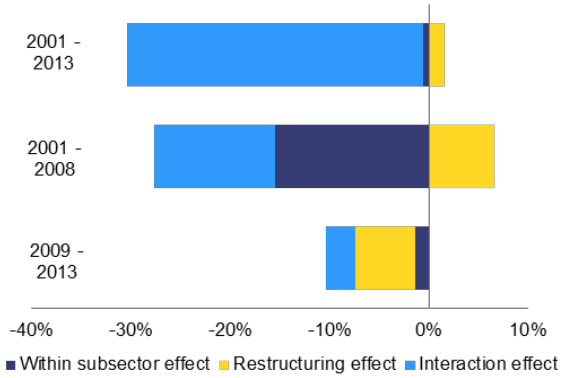
Source: Eurostat, own computations.

In order to assess the impact of structural changes on the energy intensity of the total economy a shift-share analysis is conducted. To be able to distinguish between different sectors the computation uses energy intensity based on gross value added (GVA), rather than GDP[4]. The sectors covered in this analysis are aggregated in order to match energy consumption with value added[5]. Restructuring of total economy reflects changes in the GVA share of the following six sectors: Agriculture, forestry and fishing; Manufacturing; Mining and quarrying; Construction; Transport and Services.

The shift-share analysis differentiates three effects: the within sector effect, the restructuring effect and the interaction effect. The within sector effect, in this analysis also called energy efficiency effect, takes account of the pure energy intensity improvements within the sectors. The restructuring effect presents the amount of energy intensity gains achieved through sectoral reallocation, expressed as changes in GVA shares. Finally, the interaction effect measures the co-movement of energy efficiency and GVA composition[6].

The results of the analysis suggest that while energy intensity decreased since 2001, the contributing factors changed. In the first half of the 2000s and before the crisis hit the economy in 2009 the improvement in energy intensity was mainly supported by increases in efficiency of energy consumption (declining within sector effect) while the restructuring of the economy pushed up the overall energy intensity (Graph 5). This reflects the substantial structural shift of the Czech economy towards manufacturing sectors. However, in the more recent period (2009-2013), energy intensity improvements have been driven by all three effects, among others by the decreasing importance of transport.

Graph 5. Energy intensity growth total economy: shift-share analysis



Source: Eurostat, own computations.

Varied sectoral evolution

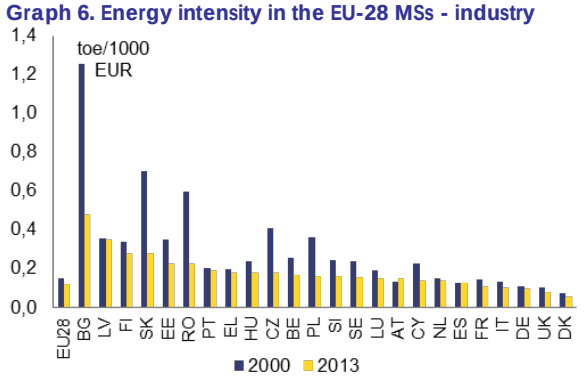
The sectors to be looked at in more detail are derived by their significance and their scope to improve energy intensity via sector-specific measures. While industry is in the spotlight already for quite some time, the power (sub-)sector deserves a closer look as its energy consumption is not part of the industrial energy consumption and as such does not contribute to its energy intensity. Further, transport has a large potential for increased energy efficiency[7].

1. Industry

Energy intensity of industry[8] in the Czech Republic has significantly improved since 2000 but it still counts among the higher ones in the EU (Graph 6). The energy intensity of the industrial sector follows a persistent downward path (with the exception of

the crisis year of 2009) and in 2012 recorded an all-time low. This development is partly a reflection of its high initial level and catching-up in respect to the consumption of energy.

Graph 6. Energy intensity in the EU-28 MSs - industry



Source: Eurostat, own computations.
Note: Ranked by energy intensity in 2013. Data for PL are for years 2003 and 2012, respectively, and for ES the later period is 2012.

While the overall energy intensity of industry is gradually decreasing, this does not apply to all sectors. Metals, Mining and quarrying and Wood and wood products increased their energy intensity over the period 2000-2013. At the same time, though, a group of sectors with the highest energy intensities covers only a small share of GVA (Table 1).

Table 1. Industrial sectors - Energy intensity and share in GVA

	Energy intensity	GVA share	EI growth	GVA share growth
	toe/1000 EUR	%	%	pp
	2013	2013	2000-2013	2000-2013
Metals	1,675	3%	22%	-6,0
Chemical and Petrochemical	0,650	4%	-47%	-1,3
Non-Metallic Minerals	0,631	4%	-21%	-2,1
Food and Tobacco	0,224	6%	-21%	-4,9
Textile and Leather	0,225	1%	-37%	-1,8
Paper, Pulp and Print	0,511	3%	-28%	0,1
Transport Equipment	0,056	20%	-61%	11,6
Machinery	0,060	30%	-60%	12,7
Wood and Wood Products	0,331	2%	103%	-0,7
Non-specified (Industry)	0,115	10%	-84%	3,0
Total Manufacturing	*0,216*	*83%*	*-60%*	*10,6*
Mining and Quarrying	0,103	2%	119%	-3,4
Construction	0,031	16%	-43%	-7,2
Total Industry	*0,185*	*100%*	*-54%*	*0,0*

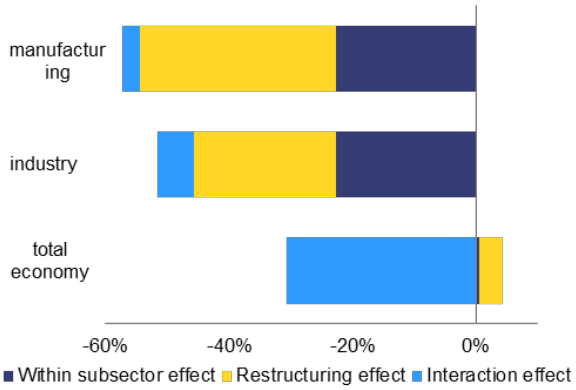
Source: Eurostat, own computations.

Over the period 2000-2013, Metals recorded one of the highest increases of energy intensity among manufacturing sectors while its share in total GVA declined at the quickest pace. This counter-movement could possibly be explained by some fixed energy inputs when decline in energy use cannot fully reflect the decline in output (Metals recorded the largest decline in GVA of all industrial sectors).

Importantly, industries with the highest growth of GVA share (Transport equipment and Machinery) also recorded a very large decline in energy intensity. In these sectors the evolution of energy intensity is explained by the large increases in GVA. However, an exception is the Construction sector which slashed its GVA share more than all other industrial sectors and at the same time recorded a large decline in energy intensity. While Construction output kept on growing (albeit less than in other sectors), its energy consumption decreased.

Industrial restructuring towards less energy intensive industries seems to have had a substantial impact on energy intensity. The outcome of the shift-share analysis confirms this especially for manufacturing but also for industry at large: the observed decrease in energy intensity is caused mainly by restructuring within the sector and only to a smaller part by better energy efficiency of production processes (Graph 7). This contrasts with the results for total economy. In particular, it reflects the fact that manufacturing sectors which are not very energy intensive increased the share in GVA substantially over this period (e.g. automotive industry). At the same time, the sectors which actually increased the energy intensity (Metals and Wood) contribute very little to the overall GVA.

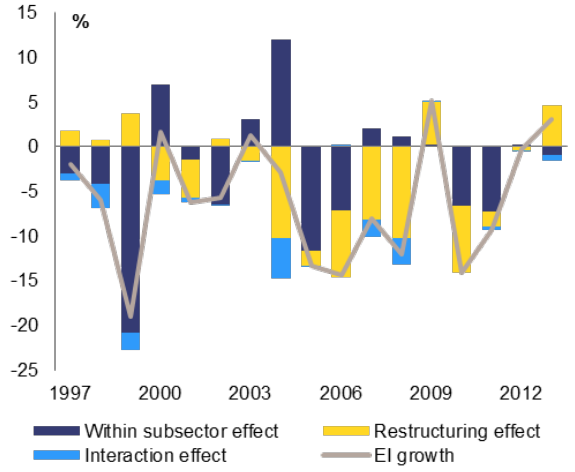
Graph 7. Energy intensity growth: shift-share analysis (2001-2013)



Source: Eurostat, own computations.

Restructuring contributed to a desired decline of energy intensity in manufacturing only from 2000. During the late 1990s, energy intensity in manufacturing fell thanks to a decrease of energy consumption within given subsectors (Graph 8).

Graph 8. Energy intensity growth manufacturing

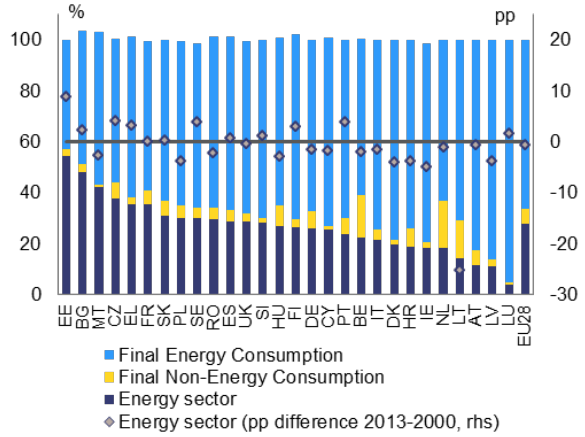


Source: Eurostat, own computations.

Energy sector

The energy sector[9] in the Czech Republic covers one of the largest shares in gross energy consumption of the EU countries (Graph 9). Moreover, from 2000 to 2013 the share recorded the second largest increase. This was mainly due to increasing transformation losses.

Graph 9. Energy sector – shares in gross inland consumption, 2012

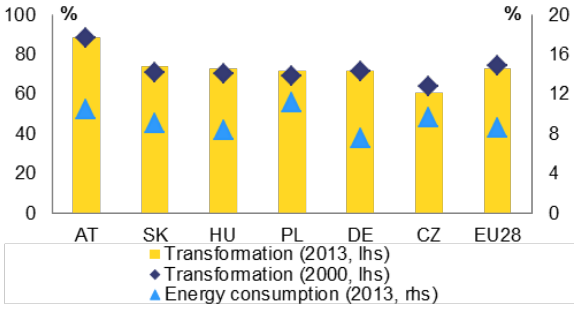


Source: Eurostat, own computations.
Note: Ranked by share of energy sector.

Indeed, over the period 2000-2013 transformation input increased more than transformation output which indicates a worsening of the transformation process. At the same time, the energy sector in the Czech Republic displays the worst performance in the region as almost 40% of energy input is lost during the transformation (Graph 10). This can be partly explained by the large reliance of the country's energy mix on solid fuels (40% in 2012, the third largest share after Poland and Estonia (European Commission, 2014)) and the low efficiency of the solid-fuel power plants (in 2012, transformation loss covered almost 90% of transformation input in the Czech Republic).

Moreover, relative energy consumption of the energy sector (as percentage of transformation output) is quite high compared to other countries in the region and 1pp above the EU-28 average.

Graph 10. Performance of energy sector



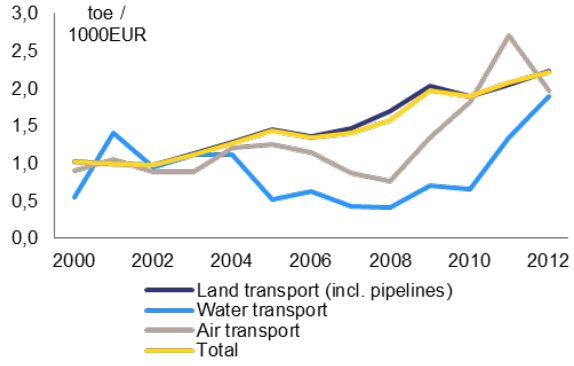
Source: Eurostat, own computations.
Note: Transformation output as percentage of transformation input; consumption in energy sector as percentage of transformation output.

Transport

Energy intensity of transport[10] follows an increasing trend (Graph 11). While energy intensity of land transport (road, rail, pipelines) in 2013 was some 120% above the level from 2000, sectoral energy consumption reached its peak in 2008. However, the gross value added follows a continuously decreasing trend.

On the other hand, water and air transports cover only a small share of GVA and energy consumption and therefore do not have a big impact on overall energy intensity of transport. This being said, energy intensities of water and air transports were initially decreasing and started to increase again after the trough in 2008.

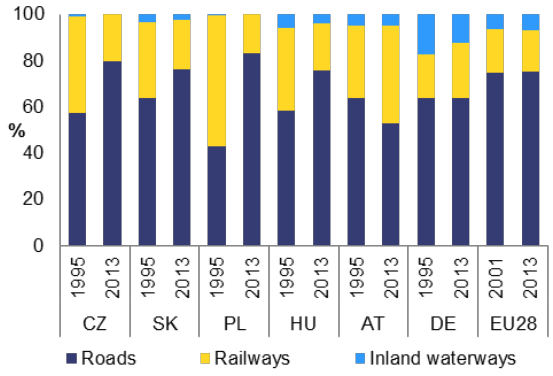
Graph 11.Development of energy intensity in transport - Czech Republic



Source: Eurostat, own computations.

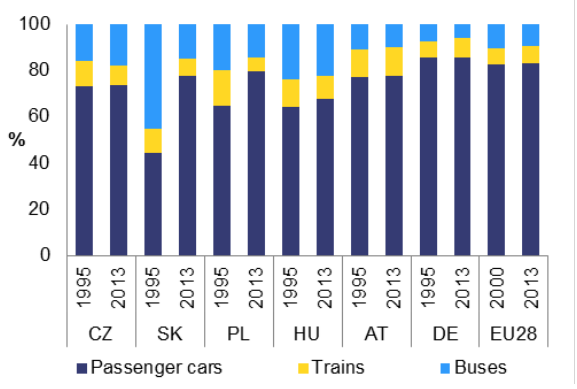
In the land transport sector there has been a shift towards road transportation (Graph 12), mainly in the case of freight. Over the last 18 years the share of road freight mode in total freight increased by more than 20pp. This is the sixth largest increase among the EU countries. However, a similar pattern was observed across other EU countries, in particular in new Member States. The modal split in passenger transport, on the other hand, recorded a limited change in the Czech Republic. Since 1995 cars cover roughly 75% of total passenger transport (some 8pp below the EU-28 average and the second lowest share in the EU just after Hungary, Graph 13).

Graph 12. Modal split of freight transport



Source: Eurostat, own computations.

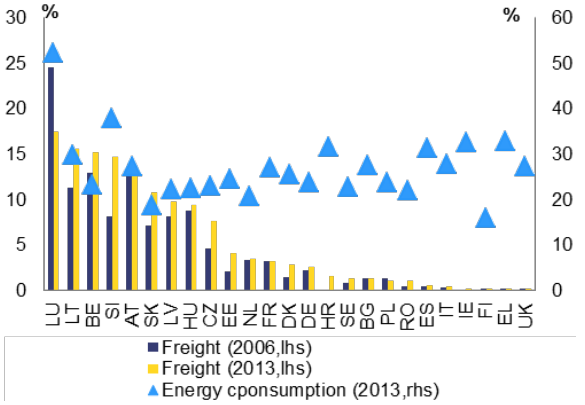
Graph 13. Modal split of passenger transport



Source: Eurostat, own computations.

When assessing energy consumption of transport, one has to take into consideration the fact that some of it might be due to cross-border transport. The Czech Republic ranked 9th in the EU in 2013, as transit road freight transport covered some 8% of total road freight transport (Graph 14). On this basis the countries with large shares of transit road freight transport and final energy consumption in road transport can be regarded as transit countries. The Czech Republic seems to be a borderline case as the importance of the transit freight traffic grows while at the same time it does not reach the shares of other countries. In addition, a country needs to have a geographic disposition in order to become a transit country. However, there are also other relevant factors that influence the energy consumption of the transport sector including e.g. fuel prices, energy efficiency of the fleet and passenger traffic.

Graph 14. Transit freight transport and road energy consumption



Source: Eurostat, own computations.
Note: Annual road freight transport vehicle transit movements as percentage of total freight transport; Energy consumption in road transport as percentage of total energy consumption.

Conclusions

Within the Energy Union package[11], energy efficiency has been called upon to be treated as an energy source in its own right. It has been argued that increasing energy efficiency means reducing dependence on imported energy and as such increasing energy security. Energy efficiency has also its importance in combatting energy poverty.

Despite certain improvements, the Czech economy has one of the highest energy intensities in the EU. Up to the crisis in 2008 improvements were mostly driven by energy efficiency gains. Restructuring of the economy, on the other hand, has contributed substantially to the decreasing energy intensity since 2009, especially due to the rising importance of manufacturing.

The sectoral development is more varied.

Energy intensity in industry follows a downward path. However, industry restructuring masks the fact that there were relatively modest energy efficiency gains. Improvements during the 1990s were due to progress within the sector, while after 2004 energy intensity declined rather due to restructuring from more to less energy intensive industrial sectors, e.g. to the automotive sector. Such sectoral restructuring should be followed in detail to distinguish drivers

for sustainable energy intensity reduction and to guard competitiveness of the economy.

The power sector in the Czech Republic covers one of the largest shares in gross energy consumption of EU countries and continues to grow. This result is partly due to considerable inefficiencies in the transformation process (explained also by the large reliance of the country's energy mix on solid fuels). The evolution of the power sector in the country is relevant not only in the context of energy efficiency targets, but also in terms of energy security and the investment climate in the power sector.

In transport, energy intensity has been increasing since 2002. This evolution has been mainly driven by the increase in road transport, especially in the freight segment, which is supported by the high share of transit freight. However, it is recognized that passenger traffic has also an important impact on transport energy intensity.

Despite its potential in terms of energy efficiency gains, the residential sector was not covered in detail in this analysis and remains an interesting avenue for further inquiry.

References

ACER/CEER (2015), "Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2014", November 2015.

Communication "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", COM(2015)80

Enerdata (2012), "Definition of Energy Efficiency Indicators in Odyssee data base"

European Commission (2013), "Market Functioning in Network Industries – Electronic Communications, Energy and Transport", Occasional Papers 129, February 2013

European Commission (2014a), "Member State's Energy Dependence: An Indicator-Based Assessment", Occasional Papers 196, June 2014

European Commission (2014b), "Electricity Tariff Deficit: Temporary or Permanent Problem in the EU?", Economic Papers 534, October 2014

Czech Ministry of Industry and Trade (2014), "National energy Efficiency Action Plan of the Czech Republic", October 2014

[1]This translates to an absolute level of final energy consumption of 25.3 Mtoe in 2020.The primary energy consumption target for 2020 is 39.6Mtoe.

[2] The slow decline of energy intensity in the Czech Republic can be observed also on data available for the 1990s – while in 1995 the Czech Republic ranked 20th out of all 28 EU Member States, in 2013 the rank worsened to 26th place.

[3]The energy component of the retail price is not regulated while other components (taxes, levies, network charges) are as is common in network industries. In 2014, regulated electricity end-user prices for households existed in 14 Member States and in 9 Member States for non-household consumers. Several countries also have regulated gas retail prices (14 member States for household and 10 Member States for non-household consumers). However, the existing price regulations can take different forms: they can be integral (i.e. cover the whole electricity price) or cover a part of electricity price, corresponding to some cost elements. Moreover, all Member States apply regulations of energy transport and distribution costs, charged by transmission and distribution system operators which are natural monopolies. (for further read see European Commission, 2013, European Commission, 2014b and ACER/CEER, 2015).

[4]Although admittedly both measures are different (e.g. energy intensity based on GVA excludes residential sector which plays an important role in energy consumption), they follow a similar trend, especially since 2000

[5]The match of energy consumption and value added is problematic because of the different scope of the two statistics. Sectors in energy statistics are based on NACE Rev2 but some are aggregated to 1 digit level and others go to detailed level of 4 digit code. In this analysis we use a simplified approach and work only with the commonly used NACE Rev2 64 branches of GVA, i.e. we add up GVA based on 64 branches to cover as similar as possible size of the sectors reported in the energy statistics breakdown.

[6] An interaction effect captures the dynamic component of restructuring. If it is positive, it signals that energy intensity is rising in subsectors that are expanding, and/or it is falling in shrinking sectors, i.e. the two effects complement each other.

[7] This holds also for residential sector but its energy intensity cannot be calculated in the same way as it is not included in gross value added classification and as such is omitted from this analysis. Services, on the other hand, have very small energy intensity.

[8]Industry includes mining and quarrying, construction and manufacturing with the exception of Manufacture of coke and refined petroleum products(C19) and Repair and installation of machinery and equipment (C33).

[9]Energy sector includes information on transformation loss (transformation input – output, i.e. the difference between how much energy is used by the industry in the transformation process in order to create energy usable by final consumers and the amount of this energy put back into grid), transfers (exchanges, transfers, returns), its consumption and distribution losses.

[10]Energy consumption of transport does not fully correspond to the value added in transport and storage branches of the economy. This is because energy consumption of transport covers all fuels used in transport activities irrespective of the economic sector in which the activity occurs. Transport and storage (Nace Rev2 branch H) covers only about 60% of all transport activities (Enerdata, 2012), i.e. it is only related to transport companies. Nevertheless, energy intensity expressed as ratio of energy consumption to value added still gives an indication about the trend, albeit one has to interpret the numbers (in particular the levels) cautiously.

[11] COM(2015)80

EUROPEAN ECONOMY ECONOMIC BRIEFS

European Economy Economic Briefs can be accessed and downloaded free of charge from the following address:
http://ec.europa.eu/economy_finance/publications/eeeb/index_en.htm

Titles published before July 2015 can be accessed and downloaded free of charge from:

- http://ec.europa.eu/economy_finance/publications/economic_briefs/index_en.htm
  (ECFIN Economic Briefs)
- http://ec.europa.eu/economy_finance/publications/country_focus/index_en.htm
  (ECFIN Country Focus)

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
  via EU Bookshop (http://bookshop.europa.eu);

- more than one copy or posters/maps:
  - from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  - from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
  - by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

KC-BE-16-007-EN-N

Publications Office