



Full Length Article

Brown coal and nuclear energy deployment: Effects on fuel-mix, carbon targets, and external costs in the Czech Republic up to 2050

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ABSTRACT

In response to massive destruction of the landscape and significant air pollution due to brown coal mining and usage, in 1991 the Czech Government set territorial limits for brown coal mining in the North Bohemia coal basin (the ‘Territorial Environmental Limits’). In 2015, however, this 24-year-old prohibition was lifted at one of two open pit mines under the ban and, as a consequence, some of its reserves of brown coal may be mined in future. We use the regional technology-rich energy system optimization model, TIMES, to analyse the impacts of maintaining the ban versus three options for less environmentally stringent mining policies – the policy adopted in 2015 and two additional policy propositions which would further lift the ban at the second open pit mine, which have not been rejected by the Czech government. We evaluate the effects of these four policy options on the Czech energy system, the costs of generating energy, air quality and greenhouse gas emissions, and related external environmental and health costs up to 2050. We find that none of the three new policy variants jeopardizes achievement of the 2030 carbon reduction targets. However, the 2050 80% carbon reduction target may not be achievable in any case – the projected reductions range between 66 and 71%, and only maintaining the 1991 ban could reduce this gap, whereas the two policies under discussion would mean that reaching this target would be even more challenging. The newly adopted 2015 policy will lead to at least 709 PJ more brown coal use and up to 85 Mt more greenhouse gases emissions by 2050. The additional supply of brown coal made available by lifting the limits will exceed domestic demand. Brown coal that will be burnt in domestic power plants will lead to additional external costs due to adverse impacts on the environment and human health of up to €306 million.

1. Introduction

North Bohemia was one of the most polluted regions in Europe in the early 1990s, termed the ‘Black Triangle’, together with areas of heavy industry and coal mining in Poland and East Germany [1]. In 1991, the Government of the Czech Republic decided to restrict brown coal mining within ‘Territorial Environmental Limits’ (TEL) in the North Bohemia coal basin.¹ As a result, any expansion of brown coal mining at the Bílina pit, and any new mining in the ČSA pit were banned. Since then, a number of parties are demanding that the two brown coal pits be re-opened on the basis of social concerns: to ensure the delivery of cheap coal for domestic central heating, to boost regional employment, and to reduce energy dependency. These pressures

were to no avail, and the ban was re-confirmed by the Czech government in 2008.

Everything changed in October 2015, when the TELs were lifted. After 24 years, the Czech government re-opened the TELs issue and faced a decision over whether the brown coal mining limits should remain unchanged (TEL1), or be partially or completely lifted. In order to ensure a supply of high quality domestic brown coal, especially for Czech heating plants, the Government revoked its past binding decision about the brown coal mining TELs, and approved lifting the brown coal mining limits at the Bílina open pit (TEL2). In addition to TEL1 and TEL2 variants, the government also considered partially (TEL3) or even completely (TEL4) lifting the mining limits at the ČSA open pit. The government declared that lifting the mining limits at the ČSA pit might

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¹ Since 1991, Territorial Environmental Limits have been in place on the brown coal reserves in Northern Bohemia. The limits define the areas where open-pit mining is allowed and where it is not, and are legally binding according to Decrees No. 331 and 444 on Territorial Environmental Limits on Mining passed in 1991, and further re-confirmed by Decree 1176/2008, by the Government of the Czech Republic.

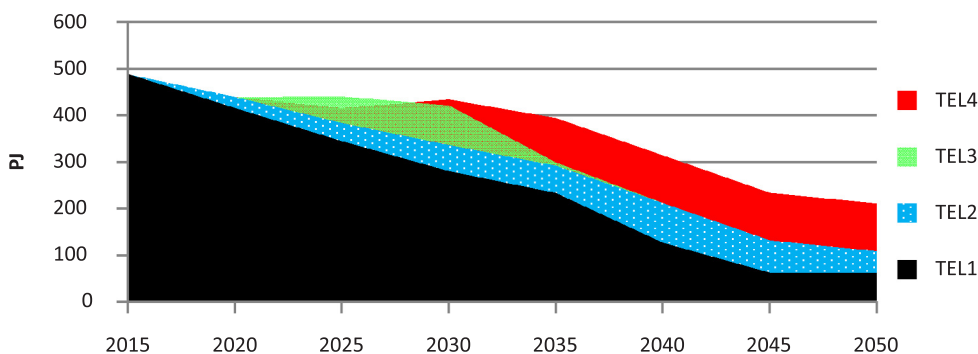


Fig. 1. Planned brown coal mining in the four Territorial Environmental Limits variants (5-year averages). Source: own compilation based on [2].

be re-considered as part of the next revision(s) of the State Energy Policy (SEP), that should be made every 3–5 years.

The government decision to lift the brown coal mining limits contrasts with current EU energy-climate policy, which calls for a reduction of greenhouse gas emissions and coal usage, and an increase in the share of renewable energy sources (RES) in final energy consumption.² Lifting the brown coal mining limits in the Bílina pit (TEL 2) may provide approximately 123 Mt (1795 PJ) of newly accessible brown coal, and further development of the ČSA pit may yield 44 Mt (745 PJ) under TEL3 or even 146 Mt (2485 PJ) under TEL4 of newly accessible brown coal over the period 2016–2050; see Fig. 1, more details in [2].

Collaterally with the decision process on the Territorial Ecological Limits, construction of new nuclear reactors is under consideration in order to combat climate change and to increase the energy security of the Czech Republic. The most recent 2015 SEP [3] assumes that one or two new nuclear reactors might be available to generate electricity by 2035, although a public tender on building two new nuclear reactors was cancelled in 2014 due to the unwillingness of the government to agree a contract for difference in power price.

This paper contributes to the current policy debate on what direction the Czech energy sector should take, and what the consequences of repealing coal brown limits or further freeing up of coal reserves may be. We focus on the impacts of the brown coal limits and nuclear policy decisions on the Czech energy system and on the possibilities of achieving carbon reduction and renewable energy targets. We assess the impacts of each of the four brown coal availability policy variants and the decision whether to build new nuclear power plants. This modelling is presented within ‘a present policy-context’, as exogenous energy demand (total electricity demand, residential coal and district heating use) is strictly reflecting the assumptions of the most recent 2015 SEP of the Czech Republic [3]. The impact of brown coal availability on the Czech energy system has already been analysed by [4] and [5]. The model of the heat and power sector applied in [4] analyses the impacts of complete lifting of the limits (TEL4) only. Máca and Melichar [6] quantified the health effects of airborne emissions induced by the three policies proposed to lift the mining limits (TEL2–TEL4), but they did not analyse the impacts on the energy system or emissions attributable to an optimized energy supply mix.

We extend the TIMES-CZ model of the overall Czech energy balance and assess the impacts of all four policy options in question in combination with three possible ways of utilising nuclear energy in the Czech Republic.

² The 20-20-20 target to be achieved at the EU level by 2020 has been updated by setting the EU commitment at 40-27-27 by 2030 [27], which was integrated into the EU 2050 Roadmap for moving to a competitive low-carbon economy [28], which requires reducing greenhouse gases emissions to 80% below the 1990 level by 2050. The 40-27-27 target specifically includes 1) reduction of the EU's GHG emissions by at least 40% relative to the 1990 level; 2) an increase in the share of renewables to at least 27% of the EU's final energy consumption; and 3) an increase in energy efficiency by at least 27%. These new 2030 EU targets will be accompanied by reforms of the EU Emissions Trading System and by a complex series of measures to achieve a competitive, affordable, secure, and sustainable energy supply for the EU [29].

Our results show the ratified lifting of the Territorial Environmental Limits (TEL2) – as agreed in 2015 – may lead to more use of brown coal between 709 PJ and 869 PJ cumulatively over the period 2015–2050 and across the entire energy system. This range depends heavily on nuclear power deployment after 2035. It will imply 65–85 more Mt greenhouse gases (GHGs) emissions over the whole period than if the TEL1 ban remained in place – in relative terms, this amount represents about 54–71% of the annual GHG emissions released in 2015. The impacts of an additional revocation of Territorial Environmental Limits under variants TEL3 and TEL4 are very small compared to the newly approved TEL2 policy, since additional available brown coal reserves would exceed the domestic demand for brown coal. None of the three new policy variants that revoke the coal mining restrictions set under TEL1 would jeopardize compliance with the EU 2030 carbon targets. However, the TEL1 policy would not achieve the Roadmap 80% target in 2050, and additional measures in both the ETS and the non-ETS sectors would be needed to achieve this target in the Czech Republic. In 2050, the TEL1 would lead to a GHGs emission level that is 68–71% lower than the 1990 reference emission level, depending on nuclear power deployment. The new coal mining policy as agreed in 2015 (TEL2) and the two alternative options (TEL3 and TEL4) – that are still under consideration by the present Czech government – would result in 63–70% reductions in 2050, compared to the 1990 level. This small difference is due to the very high 1990 base level – in absolute terms TEL1 would generate 1–8 Mt less GHGs emissions than the three alternative policies.

The lifting of the brown coal limits in itself would not have a significant impact on the deployment of renewable energy sources as they do not compete with brown coal on a levelised cost basis, but rather with more expensive and advanced technologies, including gas in particular. Newly available brown coal would affect the use of biomass only. The investment costs of newly installed electricity and heat generating technologies and fossil fuel prices are more important (they are, in fact, decisive factors), impacting the wider deployment of renewable energy more than the availability of brown coal.

Failing to achieve the EU climate-energy policy target is not the only adverse effect of this policy. The use of electricity and heat from fossil fuels is also associated with significant environmental and health damage [7]. Our model indicates that the newly implemented policy (TEL2) may result in up to €306 million of additional external costs related to adverse impacts on the environmental and human health by 2050.

The remainder of this paper is organized as follows. The next section describes the TIMES-CZ model and data sources. Section 3 introduces our key modelling assumptions, including assumptions on fuel and European Emission Allowances (EUA) prices, costs of new technologies, and the shape of nuclear power development. Section 4 summarizes the results. The last section discusses policy implications and conclusions.

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