Sci Eng Ethics (2018) 24:1801–1807
https://doi.org/10.1007/s11948-017-9982-3

OPINION

Central Europe: Ethical Overlaps of Environmental and Economic Interests in Coming Years

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Received: 29 August 2017 / Accepted: 19 September 2017 / Published online: 25 October 2017

Abstract Despite the size and thanks to the rich brown coal reserves, the Czech Republic is one of the leading energy producers in Europe, and the 7th biggest exporter of electricity in the world. However, following the climate change mitigation, the novel energy policy that enhances the reduction of coal mining is about to be implemented. A preliminary material flow analysis of the Czech energy sector was carried out. The data obtained confirmed that this government act would result in a dramatic reduction of revenues from electricity sales. Conversely, increased costs would be necessary in order to modernize nuclear power plants and promote the production of renewable energy. In addition, the economic analysis revealed that the act might be prejudicial to economic relations in Central and Western-European countries as some of them are significantly dependent on the electricity imported from the Czech Republic. Disputes between engineers and politicians were highlighted. The aforementioned interrelations were subsequently analyzed and a conclusion was made stating that global interests should have the highest moral priority.

Keywords Energy policy · Moral responsibility · Material flow analysis · Economics

Introduction

The low costs of feedstock and labour in the Czech Republic in recent decades has been beneficial for local oligopolies active in energy business (Frantál and Nováková 2014). Thanks to the huge reserves of mostly lower quality brown coal,

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loyal political support and rising demand for electricity in the neighbouring countries, the Czech Republic has gradually become the world's 7th largest exporter of electricity in the world (Bhattacharya et al. 2016). However, following the Paris Climate Agreement, the newly created government has given up the revenues obtained for the benefit of the environment and updated the energy policy in the sense of reducing the use of fossil fuels (Maroušek et al. 2015a). According to this government act, the percentage of electricity produced from brown coal should decrease to approximately 15% by 2040. This loss should be little by little compensated by the higher production of nuclear energy (Černoch and Zapletalová 2015) and renewables (Maroušek et al. 2017). Initially, this act was perceived positively both from a technical and ethical point of view. Nevertheless, as the implementation of the government act begins, unwanted and unforseen effects appear.

As regards the proposed expanded use of nuclear energy, the local energy conglomerates start to make their investments contingent on long-term guaranteed purchase prices of electricity, which is hardly morally acceptable for a significant percentage of citizens (Mardoyan and Braun 2015). In terms of renewables, local public opinion is seriously concerned (Jehličková and Morris 2007) by the negative impacts (both economic and environmental) of non-ethical financial support (Hašková 2017) that has been invested in the previous decades (Maroušek 2013a). The biggest criticism is related to the over-subsidized use of solar panels (donations equivalent to national defence costs), which took up much arable land and burdened the national budget (Smrčka 2011). However, there was a less visible, yet morally even worse, intensive subsidy for biogas plants which were stimulated through financial support (Vokoun 2016a, b) to process purpose-grown biomass instead of biowaste (Maroušek 2013b). The unprecedented expansion of maize monocultures that were intensively agro-chemically treated resulted in a plethora of negative effects in terms of soil (Kolář et al. 2008) and groundwater degradation (Maroušek et al. 2015b).

To give a broader view to the matter, most of the areas in the Czech Republic where the limestone reserves, which are nowadays necessary for the process of desulphurization (reduction of sulfur-based flue gases resulting from the combustion of coal) are located, have been declared protected natural areas by the Czech government (Koptíková et al. 2010). In addition, the impacts of the novel energy policy towards the countries in the region have been underestimated, which arouses other kinds of moral and economic dilemmas (Maroušek 2014).

A hypothesis was stated whether and how the implementation of the current form of the Czech energy policy will affect the Central-European region and the surrounding countries from the point of ethical behaviour towards the neighbouring countries and the world as a whole.

Methods and Data

The newest data available (United Nations Statistic Division; Eurostat; Statistic Office and Energy Regulatory Office of the Czech Republic) concerning the material flow analysis of the whole Central-European energy sector (economic activity NACE 35) and its feedstock were used to predict the model for the forthcoming years (until 2040) in response to the Novel energy policy of the Czech Republic. Following the statistics of the previous decade, the electricity production in the Czech Republic has long been maintained somewhere around 90 TWh per year, of which almost 25 TWh (approximately one quarter or one-fifth) was exported. Most electricity was exported to Austria, followed by other Central and Western-European countries, in particular Slovakia, Germany and Poland. Czech electricity, however, is exported through the electricity transmission systems of these states, most often to the Balkan countries (Burgholzer and Auer 2016). The background of the environmental concern is that about 45 TWh per year (approximately one half in the long term) of the electricity produced in the Czech Republic is generated in coal-fired power plants. Worse still, for electricity generation, low quality and outdated technologies are mostly used (Průša et al. 2013). The boundaries for the analysis of the material flow in the Czech Republic public energy sector were set according to the method presented by Brunner and Rechberger (2004), which includes (1) power plants, (2) combined power plants and heating plants and (3) district heating plants that are currently connected to the public grid. The necessary coal quantities were predicted based on the government act. The necessary limestone quantity to achieve at least 80% desulphurization of flue gases was calculated via stoichiometry (Ca present in limestone/S in coal = 1.2) with regard to the qualitative indicators of local feedstock (Valle-Zermeño et al. 2015). Emissions of SO_2, PM_{10} (particulate matter under 10 μm), NO_x, CO and VOC were predicted according to Maroušek et al. (2016), using data from the European Coal Combustion Products Association in compliance with the models presented by Wright et al. (2011) and converted into CO_2 and SO_2 equivalents (Maroušek and Kwan 2013).

Results

The resulting prediction models are shown in Fig. 1. The mathematical–statistical projection reveals that when the new energy policy of the Czech Republic enters into force the amount of mined coal, or the amount of electricity generated by coal combustion will result in the reduction of the amount of electricity exportable from the Czech Republic. It can be expected that this decline will decelerate in the coming years due to prospective investments into upgrading the energy industry. However, as already pointed out in the "Introduction" section, this issue is associated with a high risk. New blocks of nuclear power plants will be soon put into operation and the amount of electricity intended for export will slowly reach the previous values within a time frame of 10 years. It can be also noted that in the

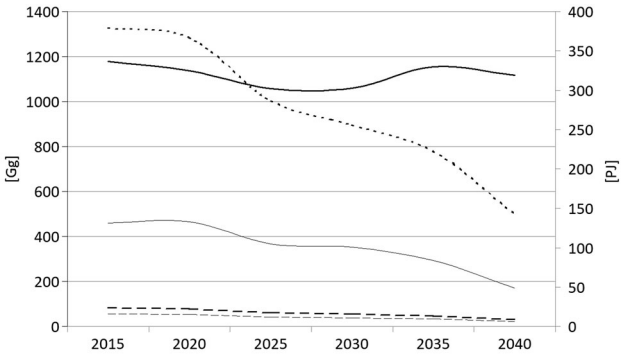

Fig. 1 Prediction based on the basis of legislative changes in the Czech Republic. The thick line indicates electricity generation [PJ]; the thin line predicts the proportion of electricity from generated from coal [PJ]; the dots show the amount of limestone available [gG]; the thick dashed line shows the expected quantity of SO_2 [Gg] and the thin dashed line shows the expected quantity of NO_x [Gg]

Czech Republic, the discussed decline will not cause a shortage in electricity locally. However, the decrease in the exportable amount of electricity will be so large that it might cause difficulties in the neighbouring states of Central Europe. The analysis also highlighted a potential looming problem with limestone, which may no longer be available at a time shorter than a decade. However, there will be a compensation in that there will be a gradual decline in production of nitrogen and sulphur oxides, which is definitely related to the decrease in the production of electricity from coal.

Discussion

There have been repeated indications that the Central-European energy sector is unsustainable in the long run (Van Wees et al. 2002). Public policies concerning renewables were many times suspected of incoherence and lack of vision for future development (Marques and Fuinhas 2012; Maroušek et al. 2012). Cansino et al. (2011) warned that if the situation is not managed properly (and by competent engineers, not by politicians), there could be a significant waste of resources and possible blackouts will not be prevented.

The results showed in Fig. 1 indicate that Central Europe and neighbouring countries will be soon thrown into a complicated intertwining of business and ethical relations that are the subject of physical laws and the global effort to mitigate climate changes. As the results suggest (see the thick line in Fig. 1), the sharp decrease in the electricity exported from the Czech Republic that run through the Central and Western-European countries to appear in a critical situation. However, Austria, for instance (a long-term business partner to the Czech Republic; over 4% of the Czech export goes to Austria and over 3% of Austrian export goes to the Czech Republic) has no coal reserves, and is still highly dependent (dependency decreased from 70 to 60% in the last decade) on the import of electricity from the

Czech Republic and Germany (Swider et al. 2008). Nevertheless, the electricity imported from Germany would hardly fully compensate the shortage in the electricity imported from the Czech Republic, given that the electricity consumption in Germany has been continuously growing; therefore electricity has to be imported also from the Czech Republic (Würzburg et al. 2013). The situation in other Central European countries is analogous and other societal and moral impacts arise because of a domino effect (Gass et al. 2013) in the case of a blackout (Maroušek et al. 2012).

The issue of limestone deposits is also alarming (see Fig. 1). Following basic moral principles, coal consumption should be limited according to the available amount of limestone, as combustion of low-quality coal represents an environmental hazard without it (Maroušek et al. 2014). The lack of limestone can be solved by the following alternatives. The first one consists in stopping the combustion of coal as soon as the Czech Republic runs out of limestone reserves. However, such a solution would mean that the Czech Republic would not be able to get any electricity to the market. In addition, this could lead to an electricity shortage in the Czech Republic itself and pull in the neighbouring countries with a domino effect, as already stated. In terms of the second solution, the areas where the remaining limestone deposits are located will no longer be considered protected natural areas. However, such a solution is not ethical either, as the Czech Republic has already been severely disturbed by mining, industry, transport corridors and human settlements (Frélichová et al. 2014). The third option could be the import of limestone in the Czech Republic. Besides the case that it is financially unfeasible (Novák et al. 2016), such a solution is not environmentally friendly either, provided that this practice would result in intensive international transport of bulky and heavy feedstock (most probably from Polish limestone deposits hundreds of kilometres away).

In connection with the above, the flue gas prediction is easily understandable. The data obtained indicated that both nitrogen and sulphur oxides would decrease (see the thick and thin dashed lines in Fig. 1). This is advantageous, since the coal mined in the Czech Republic is mostly of low quality, producing large amounts of hazardous flue gases (Rieder et al. 2007) when combusted. The energy efficiency of electricity generated from coal ranges between 37 and 43% (Zhao et al. 2015). However, in the Czech Republic the efficiency is at the lower end of the range (Kopáček and Veselý 2005; Vokoun et al. 2015). There is an analogous situation with the release of CO_2 equivalents. 245 gigagrams (hereinafter as Gg) of CO_2 equivalent is released for 1 PJ of coal-fired electricity generated in the UK (Odeh and Cockerill 2008); however, it is over 300 Gg of CO_2 equivalent in the Czech Republic. Nevertheless, these figures can be considered relatively low compared to e.g. Turkey whose energy industry behaves unethically (with the efficiency of coal-fired electricity generation of 23–27%), as it uses only a minimum amount of limestone, which results in a 50% higher production of CO_2 and SO_2 equivalents (Atilgan and Azapagic 2016). Regardless the current controversial rhetoric, the lowest amounts of CO_2 and SO_2 equivalents are reported from the USA, which is achieved by a high limestone consumption (which has grown by 150% since the twentieth century; Spath et al. 1999).

Conclusion

In the past two decades, the Czech Republic has created unusually favourable business conditions for energy conglomerates. The resulting oligopolies realised that this environment with no functional limitations is time-limited and therefore focused on short-term profit over environmental impacts. The current legislative restrictions following the climate change mitigation might have unprecedented implications; Central and Western Europe will have to face the challenge of sustaining the stability of the power grid. The tangled web of national economic interests, laws, mutual ethical relations and global responsibility for the future state of the climate arises to be resolved. The greatest moral hazard, however, is that technical engineers do not point out adequately that the main responsibility for the current state of the art lies with incompetent politicians.

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