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The environmental benefits of the implementation of first Polish nuclear power plant

Poland is nowadays undergoing the stage of reorganisation of its power sector. In order to cover new environmental policy, several renewable energy sources (i.e. wind turbines, biomass plants) have been already introduced as well as more efficient conventional technologies (using fossil fuels –coals, natural gas). Importantly, to fully adjust to strict national emission levels and simultaneously prevent blackout periods in future, the construction of first Polish nuclear power plant (NPP) is expected to be necessary. That has been confirmed in government programme and led to the undertaking the investment of 3,000 MW class power unit located on the Baltic shore.

The construction of first Polish nuclear power plant is expected to benefit the national emission market and promote low-emission economy. In Poland, where currently up to 82% of electricity is generated in coal-fired power units, the shift toward nuclear power seems to be necessary in order cover strict forthcoming pro-environmental European Union standards (i.e. with regard to the Directive 2010/75/EU) and reduce national CO₂, NO_x, SO₂, dust and Hg releases from power sector. In 2014, professional heat and power combustion units were responsible for, respectively, 51.5%, 30.0%, 47.4%, 8.8% and 54.3% of Polish releases of aforementioned pollutants. Hence, to determine the expected national emission cuts obtained by the implementation of NPP, the identification of environmental-related issues within coal-fired power plants is justified.

In this work the environmental benefits of the implementation of 3,000 MW nuclear power plants were calculated and compared in relation to coal-fired units. In order to determine the positive impact of nuclear power and to identify the quantity of avoided emissions (of carbon dioxide, sulphur oxides, mercury, dust), harmonised calculation model of coal-fired power plants were proposed and referred to nuclear unit. Importantly, the future emission standards related to the Directive 2010/75/EU were included. To compare the impact of fuel selection on the environmental issues, representative samples of different Polish solid fuels (bituminous coal, lignite, solid biomass, sewage sludge, high-calorific-refuse derived fuel) were selected and examined (proximate and ultimate analysis were conducted). Finally, annual emission savings were discussed.

Summary

A study has shown that by the replacement of coal-fired power plants by the nuclear one with the electrical capacity of 3,000 MW, about at least 22.4 TWh (up to 14% of annual Polish consumption) of electricity can be generated. Further, up to 16.4 million tonnes of lignite, 8.9 million tonnes of hard coal or 13.1 million tonnes of solid biomass can be saved. For the case of lignite, the emission, at least, of 21.29 million tonnes of CO₂ (6.9% of total annual Polish emission in 2014), 1,610 tonnes of dust (0.4%), 16,102 tonnes of NO_x (2.2%), 16,102 tonnes of SO₂ (2.0%) and 564 kg of mercury (5.9%) can be avoided. The same applies to the outlook for the rest of fuels - for selected hard coal: 17.60 million tonnes of CO₂ (5.7%), 1,357 tonnes of dust (0.4%), 13,566 tonnes of NO_x (1.9%), 13,566 tonnes of SO₂ (1.7%), 271 kg of mercury (2.9%), and for biomass - 20.04 million tonnes of CO₂ (6.5%), 1,471 tonnes of dust (0.4%), 14,712 tonnes of NO_x (2.0%), 14,712 tonnes of SO₂ (1.8%) and 294 kg of mercury (3.1%). This is confirmed by the fact that the implementation of first NPP in Poland will be beneficial from the environmental point of view.

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