Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 16 (2016) 587 – 597

Transportation Research Procedia

www.elsevier.com/locate/procedia

2nd International Conference "Green Cities - Green Logistics for Greener Cities", 2-3 March 2016, Szczecin, Poland

Energy efficiency in the context of low-stack emissions reduction on the example of the city of Czestochowa

Marcin Zawada[a], Marta Starostka-Patyk[a]*

[a]*Czestochowa University of Technology, Dabrowskiego 69, Czestochowa 42-201, Poland*

Abstract

Energy efficiency is the base of the European energy policy and it is also one of the main "Europe 2020" strategy objectives. It includes a target of reducing primary energy consumption by 20% by 2020. Due to the fact that emissions related to energy account for nearly 80% of total greenhouse gas emissions, efficient use of energy can significantly contribute to achieving the goal of a low emission economy and fighting the climate changes.

According to the European Environment Agency report from 2013, Poland was among the European countries with the most polluted air, with the largest share of low-stack emissions in polluted air, mostly with toxic dust.

The city of Czestochowa undertakes a number of activities in the field of energy efficiency and reduction of energy use to counteract negative impacts on the environment. Implications of the actions taken contribute to reducing greenhouse gas emissions with the aim to protect the climate as well as to support the national commitments implementation to reduce greenhouse gas emissions, improve energy efficiency and increase the share of renewable energy sources in the national energy balance.

The purpose of this article is to characterise the actions taken by the city of Czestochowa to increase energy efficiency and reduce greenhouse gas emissions in the period of 2008 -2014, and also to evaluate tangible benefits of these actions.

Peer-review under responsibility of the organizing committee of Green Cities 2016.

Keywords: Energy; energy efficiency; low emission, low-stack emissions; emissions reduction; Czestochowa city;

* Corresponding author. Marta Starostka-Patyk, Tel.: +48-34-3250-330; fax: +48-34-3613-876.
E-mail address: marta.s.patyk@gmail.com

Peer-review under responsibility of the organizing committee of Green Cities 2016.
doi:10.1016/j.trpro.2016.11.055

1. Introduction

According to the European Environmental Agency report of 2013 (Report, 2013), Poland was among the European countries with the most polluted air. The list of the top 10 metropolises included as many as six Polish cities such as: Gliwice, Katowice, Krakow, Nowy Sacz, Sosnowiec and Zabrze. In these cities the largest share of air pollution is caused by low-stack emissions, and above all toxic dust.

Low-stack emissions concept is conventionally defined as emission of pollutants released into the air by emitters (chimneys) up to 40 meters high. Thus, responsibility for low-stack emissions is attributed to transportation, local boilers burning solid fuels and heavy fuel oil, supplying heat to municipal buildings, utilities, service companies, small businesses and individual house hearths burning fossil fuels, especially coal and biomass (Kubica 2013).

Considering the domestic structure of sources of gaseous and particulate pollutants while developing collective air quality assessments, in Poland pollutants are generally divided into the following groups:

- basic pollution: sulphur dioxide, nitrogen dioxide and dust, formed mainly during combustion of fuels in energy production processes and widespread throughout the country;
- specific pollution from various processes used in industrial plants;
- pollutants emitted from mobile sources, mainly from motor vehicles;
- secondary pollution often arising at a considerable distance from emission sources as a result of the reaction and the changes taking place in a polluted atmosphere, for example: oxidizing agents (photochemical oxidants), such as ozone, or leading to acidification of the environment, such as sulphates and nitrates.

Individual households are the most responsible for the air poisoning and smog formation. The reason lies mainly in inefficient house heating, using outdated technologies, poor quality fuel combustion and waste that emit particularly toxic compounds into the air (Voytenko et al., 2015). Pollution emitted from house chimneys can be divided into two types - toxic gases and toxic dust. Toxic gases originate primarily from combustion of coal and poor quality gas. These gases have a very irritating effect on the respiratory system. In contrast, dust is made up by tiny particles which comprise, inter alia, heavy metals such as mercury, cadmium or lead. They cause mechanical irritation of the upper and lower respiratory tract, facilitating the process of infecting organism by bacteria and viruses (Holman et al. 2015).

Plans of low emission economy being introduced in many municipalities have, among the others, to contribute to achieving objectives set out in the EU climate-energy package by 2020, i.e.:

- reducing the greenhouse gas emissions;
- increasing the share of energy from renewable sources;
- reduction of final energy consumption, which should be achieved by improving energy efficiency,
- and improving air quality within the municipalities.

2. The state of air pollution

Every country, including Poland, is obliged under the EMEP (European Monitoring Environmental Program) to take an annual inventory of emissions such as CO, SO_2, TSP, PM2.5 and PM10, heavy metals (As, Cd , Cr, Cu, Hg, Ni, Pb, Se, Zn), dioxins (PCDDs / PCDFs) and a total of 4 PAH (benzo (a) pyrene, benzo (b) fluoranthene, benzo (b) fluoranthene, indeno (1,2 3-cd) pyrene). Poland is in the group of the EU countries with the largest emissions of these pollutants (Table 1).

From 1990 to 2013, the EU-28 recorded reductions in emissions of all air pollutants considered in this article. The biggest fall was reported for sulphur oxides (SOx) which between 1990 and 2013 decreased by 86.7 %, followed by non-methane volatile organic compounds (NMVOCs) which declined by nearly 60 %. Nitrous oxides (NOx) stood at 53.5 % of their 1990 levels (a decrease of roughly 46.5 %); while the smallest decrease was reported for ammonia (NH_3), emissions which fell only by 27 % by 2013 (Air Pollution 2015).

In 2013, the emissions of ammonia (NH_3) in the EU-28 stood at 3 847 870 tonnes, NMVOCs at 7 004 930 tonnes, nitrogen oxides (NOx) at 8 176 454 tonnes and sulphur oxides (SOx) at 3 429 764 tonnes (see Table 1). The biggest emitters of ammonia in 2013 in the EU-28 were France with 18.7 % of the EU total, followed by Germany with 17.4 %