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EVALUATION OF DEVELOPMENT DIRECTIONS OF LOW-CARBON ECONOMY IN THE NOWY TARG COMMUNE

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Abstract

The article presents an analysis of pro-ecological activities undertaken by the Commune Council of Nowy Targ in order to reduce low emission, and consequently to introduce a broadly understood low-carbon economy in this area. The commune aims at abandoning fossil fuels in favor of cleaner and safer methods of obtaining energy, which is to contribute to the reduction of PM10 and PM2.5 particulate matter emissions. In the nationwide arena, the commune was awarded in activities leading to the liquidation of low-emission as part of the competition for communes with a population up to 50,000 inhabitants and taking the second place in Poland in the *„Gmina z Misją"* ranking. The town of Nowy Targ was also the laureate of the fourth edition of the „#ekoLIDERZY2017 of the Małopolska Province" contest organized by the Provincial Fund for Environmental Protection and Water Management in Krakow (WFOŚiGW) and won the prize of PLN 20,000 in the category of „#ekoPRZEDSIĘWZIĘCIE" in the field of air protection and investments contributing to energy savings. In the commune, interventional and preventive inspections are carried out on an ongoing basis. In January 2017, the mayor appointed an advisory team for the analysis of the degree of implementation of actions in the field of air protection in the area of Nowy Targ.

Keywords: low-emission, pollution, PM10 particulate matter, SO_2, air quality, low-carbon economy

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INTRODUCTION

Currently, the low-emission threat in Polish cities/towns is very high and concerns almost every city/town in the Małopolska region. House heating furnaces and local coal-fired boiler rooms where low-grade coal or its derivatives are burned are the main source of low emission (Sztuka 2017). The problem of air quality in our country, especially violations of the permissible concentration standards of individual toxicants, was noticed by the European Union, which is associated with the risk of serious economic consequences for non-compliance with the EU law in this area (Budnikowski 2000). So far the measures implemented to improve air quality in Poland have not produced the expected results. Immediate elimination of all low power heating devices which utilize solid fuels is out of the question. The implementation process of modern heating systems, including, inter alia, massive use of gas heating and the use of system heat is long-term, and their application to the conditions of households and industry in Poland will last at least a dozen or so years (Stelmach *et al.* 2017).

Improving air quality is a systemic and economic problem. Individual communes in Poland, among which the Nowy Targ commune is an expressive example, have undertaken intensive actions aimed at solving the low-emission problem. These local governments develop numerous low-emission reduction programs aimed not only at environmental education and at identifying the needs and expectations of residents, but also at obtaining financial support for households in costs incurred as part of thermo-modernization or replacement of boilers (Dzikuć 2017).

Considering the reasons for low-emission, it should be noted that they often result from purely economic reasons. The current financial situation of a large number of households means that they often have insufficiently insulated buildings, use low-grade coal in boiler rooms and drive cars that do not meet current ecological standards (Dzikuć 2017).

Among all listed air toxicants, the highest concentrations of PM10 and PM2.5 particulate matter are of the utmost peril (Sadowski *et al.* 2017). Particulates are pollutants coming from both anthropogenic and natural sources. Fine particulates can be transported over long distances and pollute the air in regions distant from emission sources. Emission changes do not always translate into changes in particulate matter concentrations in the air, inter alia, due to the diversity of emitters and their variable activity, mechanisms of creating secondary particulate matter and transboundary transport, as well as due to the phenomenon of recurrent floating of particulate matter that previously settled on a surface (Degórska 2016). Low-emission concerns especially urban areas with dense and low-rise housing, where most houses are heated in the autumn and winter season mainly with low-quality solid fuel in the old type of household furnaces (Sad-

owski *et al.* 2017). This problem was noticed by Gryboś and Tomaszek (1997), who pointed out that the city with its buildings, squares and dense network of asphalt streets was a powerful solar heat accumulator in the lower troposphere. Cities as complex spatial and functional systems are characterized by an extremely high degree of nature transformation and high intensity of development, which creates a specific, almost completely anthropogenic living environment of their inhabitants (Paryska and Mierzejewska 2009).

Sustainable development of a country requires emphasis on a harmonious combination of economic growth with the requirements of environmental protection. This will be one of the main development tasks for Poland in the next decade. Preservation of natural resources in no worse condition and increasing their durability as well as quality cannot be treated as a barrier to development. This is a prerequisite for further improvement of the quality of life, implementation of human access rights to the environment in good condition. In the past 20 years, significant successes in environmental protection have been observed. They consist in reducing pollutants discharged into surface water and air, overcoming the problem of industrial waste management, limiting the impact of persistent organic substances, eliminating threats to the biotic and abiotic environment from the industry. The quality of air in urban areas and the consequences of the so-called low emission from households and transportation (National Development Strategy 2020) remains a key problem.

MATERIAL AND METHODS

The following study evaluated pro-ecological activities in the Nowy Targ commune in the area of air quality protection against the effects of low emission. In March 2016, at the initiative of the Mayor of Nowy Targ, a container measuring station was installed to constantly examine the quality of atmospheric air in the town. The measurement results were systematically recorded by the Provincial Inspectorate for Environmental Protection in Krakow (WIOŚ). The analyzed data of average monthly concentrations for PM10 particulate matter for the period 2016-2018 came from reports submitted to the Krakow WIOŚ. Data regarding the number of days with exceedances of 24-hour permissible concentrations of PM10 particulate matter for 2014 were obtained from the Air Protection Program *„Małopolska in a healthy atmosphere"* for the Małopolska Province.

CHARACTERISTICS OF THE RESEARCH AREA

The Nowy Targ commune is one of the communes with the highest indicators of low-emission pollution in the Małopolska Province. Research conducted

by the Provincial Inspectorate for Environmental Protection in Krakow showed that in the town of Nowy Targ, the average daily PM10 particulate matter concentration exceeded the value of 50 µg/m^3 during 41 days in 2014. The Nowy Targ commune is characterized by considerable population (Table 1) and favorable geographical location in the Orawsko-Nowotarska Basin at the intersection of important transportation routes between Krakow and Zakopane (Low Emission Reduction Program 2015).

Table 1. The number of inhabitants in the Nowy Targ commune and the town of Nowy Targ

Rural commune/Town	2016	2017
Town of Nowy Targ	33412	33361
Nowy Targ rural commune	23779	23905

Source: *Author's own elaboration based on data from the Local Data Bank*

In economic terms, the commune is an important trade center with Slovakia. The leather industry plays a significant role in it. Shoe companies, inter alia, Wojas and Demar have their factories. On a smaller scale, numerous sheepskin companies producing sheepskin coats and other leather products operate in the area of the town of Nowy Targ (Low Emission Reduction Program 2015).

The share of renewable fuels in total fuel consumption for heating purposes in the Nowy Targ commune is relatively low and amounts to around 4%. The majority of households (as many as 88%) use simultaneously wood biomass with fossil fuel for house heating. The percentage share of households burning only fossil fuels amounts to only 8%. Hard coal is the fossil fuel which is predominantly (35%) utilized. The exploitation of heating oil (1%) and natural gas (0.4%) is negligible (Low Emission Economy Plan 2015).

RESULTS AND DISCUSSION

By virtue of the Resolution of the Commune Council of November 24, 2015, the Low-carbon Economy Plan for the Nowy Targ Commune was approved, and pursuant to the Resolution of the Nowy Targ Town Council of April 20, 2015, the Low Emission Reduction Program was adopted for the Nowy Targ Commune for 2014-2023. The main objective of the Low-Carbon Economy Plan is to reduce energy and greenhouse gases in the area of the Nowy Targ commune and to implement corrective actions aimed at reducing energy consumption and greenhouse gas emission. The program also assumes improvement of air quality and living comfort of residents in areas where permissible levels of substances in the air in particular particulates, sulfur dioxide and nitrogen oxides are exceeded.

Highly ineffective boilers with very high emissivity, as well as poor quality fuels available on the market and inadequate combustion in boilers are the problem of low-emission in the town of Nowy Targ. In addition to low-emission sources related to fuel combustion in the municipal and housing sector, the following sources also exist in the Nowy Targ commune: (Strategy for the development of the town of 2012):

- point emission sources, which are associated with the combustion of fuels in boilers and furnaces as well as the technology employed in a given plant (emission from chimneys much higher than in the case of low emission),
- linear sources related to transportation (road, rail, river),
- sources of unorganized emission, e.g. open coal depots and other bulk material.

The increase in CO_2 emission in 2007-2015 in the Nowy Targ commune was the result of a significant rise in the share of emission from fuel consumption in transportation. The number of cars registered in the commune increased by 25% in this period (Low Emission Economy Plan 2015).

In October 2016, the town of Nowy Targ established cooperation and signed a favorable agreement with the Central Mining Institute in Katowice in the use of a mobile platform for measuring selected low emission parameters via innovative drones. The research carried out in the town allowed for the initial identification of specific sources of pollutants. In their information and education activities, a letter from the Mayor concerning the Resolution No XXXII/452/17 of the Regional Assembly of the Małopolska Region regarding the introduction of restrictions and prohibitions on installations in which fuel combustion takes place in the territory of the Małopolska Province was sent to the inhabitants of Nowy Targ in August and September 2017.

Thanks to the decision of the Mayor, a container measuring station was installed in March 2016 to constantly examine the quality of atmospheric air in the town of Nowy Targ. The data is systematically read by the Provincial Inspectorate for Environmental Protection in Krakow. The values of mean PM10 particulate matter concentration in 2016 at the monitoring station showed the exceedance of PM10 particulate matter in November and December. In December, the value of 104 $\mu g \cdot m^{-3}$ which exceeded twice the permissible level was noted (Table 2). Permissible level of SO_2 is 20 $\mu g \cdot m^{-3}$, and Permissible level of PM10 40 $\mu g/m^{-3}$. In the months from January to March, the commune did not have air quality monitoring stations. In 2016, mean monthly SO_2 concentrations were exceeded, in the same period as PM, and in November they amounted to 28.4 $\mu g \cdot m^{-3}$ whereas in December to 27.8 $\mu g \cdot m^{-3}$.

In 2017, the values of mean PM10 particulate matter concentration at the monitoring station exceeded the level of PM10 particulate matter from January to

March and from November to December. In January, a record value of 155 $\mu g \cdot m^{-3}$, which exceeded almost four times the permissible level (Table 2), was recorded. In 2017, mean monthly SO_2 concentrations exceeded standards only in January 45.1 $\mu g \cdot m^{-3}$ and in February 34.7 $\mu g \cdot m^{-3}$.

In 2018, the concentration values of mean PM10 particulate matter at the monitoring station exceeded its level in the months from January to March. In February, the value of 96 $\mu g \cdot m^{-3}$, which exceeded twice the permissible level (Table 2), was recorded. In 2018, the mean monthly SO_2 concentrations exceeded standards in the same months as PM10 and reached the value of 24.4 $\mu g \cdot m^{-3}$ in January and in February 25.6 $\mu g \cdot m^{-3}$.

Table 2. The value of mean concentrations for PM10 particulate matter and SO_2 concentration

Year				2016								
Month	-	-	-	04/16	05/16	06/16	07/16	08/16	09/16	10/16	11/16	12/16
SO_2	-	-	-	8.1	5.7	4.3	3.9	4.8	6.6	13.2	**28.4**	**27.8**
PM10	-	-	-	32	20	16	13	18	28	33	**57**	**104**
Year						2017						
Month	01/17	02/17	03/17	04/17	05/17	06/17	07/17	08/17	09/17	10/17	11/17	12/17
SO_2	**45.1**	**34.7**	17.5	11.3	6.5	4.1	3.8	5.1	4.8	5.0	16.5	19.7
PM10	**155**	**99**	**56**	32	23	17	15	20	20	29	**65**	**60**
Year						2018						
Month	01/18	02/18	03/18	04/18	05/18	06/18	07/18	-	-	-	-	-
SO_2	**24.4**	**25.6**	**20.1**	6.6	5.3	4.7	6.7	-	-	-	-	-
PM10	**80**	**96**	**88**	37	24	19	18	-	-	-	-	-

Source: *data obtained from http://monitoring.krakow.pios.gov.pl/dane-pomiarowe*

According to the Air Protection Program for the Małopolska Province, the mean daily concentration of PM10 particulate matter may exceed the value of 50 $\mu g \cdot m^{-3}$ only 35 days a year. In 2014, these concentrations were exceeded for as many as 41 days at the measuring station in Nowy Targ. Connection of the building to the heating network is connected with the investment in the network, and hence with the requirement to obtain declarations of the owners' will to build in the network along their real estate and the consent of the housing community to connect the building to the network, as well as to make a room available for the heat substation (Petryk 2017). Despite these adversities, in 2010-2017 MPEC Nowy Targ (Municipal Thermal Energy Enterprise) connected 14 new heat consumers, modernizing and signing connection contracts with newly built multi-family buildings. The company conducts systematic talks with the Provin-

cial Fund for Environmental Protection regarding the launch of the co-financing program for the development of the heating network in the town. Currently, the company's actions are focused on the use of geothermal energy. In 2016, Geotermia Nowotarska was established, whose task is to supply geothermal energy to the town of Nowy Targ.

Systematic intervention and preventive inspections are carried out on the territory of the commune. Only in 2016, 101 real estate controls were conducted whereas in 2018, 115 controls took place. In 2017, by the decision of the District Court in Nowy Targ, after sampling and analysis of ash samples from furnaces located in the town, fines were imposed on residents of the premises where waste was incinerated. A contract with the Central Measurement and Testing Laboratory from Jastrzębie Zdrój for examination of furnace wastes as part of conducting control activities carried out by employees of the Commune Office in the town of Nowy Targ was the result of these actions.

The local government implemented a number of specific actions to improve air quality (Table 3). These efforts were noticed in the nationwide arena. In *Gmina z misją* ranking, the Nowy Targ commune took the second place in Poland (in the category of communes with a population up to 50,000 inhabitants). The commune was also the laureate of the fourth edition of the *"#ekoLIDERZY2017*" contest organized by the Provincial Fund for Environmental Protection and Water Management in Krakow (WFOŚiGW) and won a prize of PLN 20,000 in the category of "#ekoPRZEDSIĘWZIĘCIE" in the field of air protection and investments contributing to energy savings. In January 2017, the Mayor appointed an advisory team for the analysis of the implementation of actions in the field of air protection in the town of Nowy Targ, whose main aim is to develop new directions of actions for the future, and to verify previously undertaken actions.

Table 3. Actions in the Nowy Targ commune for clean air in the years 2016-2017

Year	Type of action	The final effect of the action
February 2016	Meeting with the Master Chimney Sweep on the effects of combustion of poor quality solid fuels in buildings	Employees of the Department of Municipal Management and Environmental Protection perform control of boiler rooms located in the administrative boundaries of the town of Nowy Targ
2017	Distributing questionnaires on the inventory of heating residential buildings in Nowy Targ	Supplementing the inventory base of buildings in the area of the town as part of the LIFE project

Year	Type of action	The final effect of the action
2017	Poster action "*Smog albo zdrowie" (Smog or health)* displayed throughout the city	Presentation of the impact of air pollution on the human body as well as information about the possibility of obtaining funding to replace the old heating source with the new ecological one
	The Nowy Targ commune in cooperation with the Nowotarski Smog Alert created an educational and information leaflet on the problem of air pollution	The leaflet in question contains contact details for the Office's employees dealing with bailouts for replacing old furnaces. The aforementioned leaflet was sent out with utility bills to all residents.
	As part of the „LIFE" program, the Nowy Targ commune borrowed a thermal camera from the Marshal's Office of the Małopolska Province for the period of one month	Free thermovision analyses of buildings located in the area of the town
	Meeting of the eco-consultant of the Nowy Targ commune with local installers and entrepreneurs as part of ecological education	Forwarding information on the co-financing procedure of the PONE (Low Emission Reduction Programme) programs implemented, RPOWM (Regional Operational Program of the Małopolska Province) 2014-2020
	At the initiative of the Mayor, an educational and ecological campaign was organized as part of which the "*Autobus energetyczny* "(Energy Bus), being a mobile educational and information center, arrived.	Raising public awareness of climate change and air protection
	22nd Edition of the Podhale Construction, Installation, and Design Fair under the slogan „*Walczymy o czyste powietrze Podhala" (We fight for the clean air of Podhale)*	Presentation of the c.h. boiler range, fireplaces, heating and ventilation installations
	at the initiative of the Mayor and the Energy Efficiency Development Forum, educational workshops for teachers and doctors led by dr hab. eng. Artur Badyda, Associate Professor at the Warsaw University of Technology were organized in the Office	Training of teachers and doctors influencing the formation of environmental awareness of residents (training materials, scenarios for conducting educational classes/lectures)
	Free training at the initiative of the Mayor and the Frank Bold Foundation	The training conducted, by a legal advisor, on the rights and duties of the commune and its residents in the field of combating air pollution conducted by a legal advisor

Year	Type of action	The final effect of the action
2017	Free training at the initiative of the Mayor and the editorial board of GlobeEnergia, the Association of Communes and Poviats of Małopolska and „Energetyczny obywatel" (Energy Citizen)	Presentation of renewable energy sources, their financing, and the possibility of producing own energy
	„Dzień bez samochodu" (Car-free Day) action as part of the European Week of Sustainable Development	Promotion of ecological forms of mobility

Source: Author's own elaboration based on data obtained from the Mayor of the Town of Nowy Targ in the public information mode (correspondence dated 23 October 2017)

Due to the large interest in financial aid for actions aimed at reducing low emission in the town of Nowy Targ, especially before the heating seasons, the town grants bailouts to the applicants (Table 4). In 2006-2009, the Nowy Targ commune granted 105 bailouts from the Municipal Environmental Protection and Water Management Fund (GFOŚiGW) with a total value of PLN 219,000.

Table 4. The balance of expenditure of GFOŚiGW for actions aimed at reducing low emission in the town of Nowy Targ in the period from June 2006 to the end of 2009

Year	Number of bailouts	Type of heating medium installed	Type of building	Costs in PLN incurred for bailouts
since June 2006	36	eco-pea coal, gas, oil, solar collector	residential, commerce	72,500
2007	24	eco-pea coal, gas	residential, commerce	51,500
2008	24	eco-pea coal, gas	residential, commerce	49,000
2009	21	biomass, eco-pea coal, gas	residential, commerce	46,000
Total	105	Total		PLN 219,000

Source: Author's own elaboration based on data obtained from the Mayor of the Town of Nowy Targ in the public information mode (correspondence dated 23 October 2017)

By the virtue of the resolution of the Commune No XXIV/193/2012 regarding the granting of the targeted bailout from the budget funds of the town of Nowy Targ since 2012, a support program financed also from the town budget for tasks related to the reduction of low emission was implemented. In 2012-2015, the total amount of bailouts granted came to PLN 91,719.30 and was distributed among 25 applicants (Table 5).

Table 5. The balance of expenditure from the budget of the Nowy Targ commune between November 2012 and December 2015

Year	Number of bailouts	Type of heating medium installed	Type of building	Costs in PLN incurred for bailouts
since Novemnber 2012	3	gas	residential	10,347.97
2013	10	gas	residential	38,167.27
2014	4	gas	commerce	14,741.30
2015	8	gas	residential	28,462.76
Total	25	Total		PLN 91,719. 30

Source: Author's own elaboration based on data obtained from the Mayor of the Town of Nowy Targ in the public information mode (correspondence dated 23 October 2017)

Bearing in mind the advisability of implementing tasks for environmental protection, the commune authorities systematically submit applications for financial support to the WFOŚiGW in Kraków (Table 6).

Table 6. Acquired funds for clean air in 2016-2017

Year	Type of action	The final effect of the action
2015	Signing a contract with the WFOŚiGW for replacing central heating boilers as part of the adopted PONE (Low Emission Reduction Programme) in the town of Nowy Targ. Financing for replacing old central heating boilers utilizing solid fuels with gas, eco-pea coal of 5th efficiency class over 87% and biomass boilers	Co-financing covered a total of 170 residential buildings. Residents obtained co-financing in the amount of 85% of eligible costs. Funds raised from the fund PLN 110750.00, the town donated PLN 771,255.00 from its own budget.
August 2017	Pursuant to the Resolution No. 1392/17, the Board of the Małopolska Province, the Nowy Targ commune received subsidies in the maximum amount of PLN 1749529.00.	Co-financing for replacement of central heating boilers in the years 2014-2020 in individual households (biomass – 75 items, gas fuels – 50 items)
September 2017	Pursuant to the Resolution No. 1533/17, the Board of the Małopolska Province, the Nowy Targ commune received subsidies in the maximum amount of PLN 759, 735.14.	Co-financing for replacement of central heating boilers in the years 2014-2020 in individual households (solid fuels – 100 items)

Source: Author's own elaboration based on data obtained from the Mayor of the Town of Nowy Targ in the public information mode (correspondence dated 23 October 2017)

The town signed a cooperation agreement for air quality with the Polskie Górnictwo i Gazownictwo Obrót detaliczny S.A company. It also cooperates with the Polish Chamber of Ecology and the Platform of Producers of Solid Fuels Heating Devices as part of which in 2015 the town of Nowy Targ received a certificate for supporting modern and ecological heating solutions in the city.

CONCLUSIONS

The research results obtained allowed to put forward the following conclusions:

- The problem with maintaining air quality in the commune concerns sulfur dioxide, PM10 suspended particulate matter and benzo[e]pyrene. Low emission is generated mainly by the combustion of fuels in the municipal and household sector as well as by the unorganized emission from open coal depots and other bulk material.
- The Low Emission Reduction Program for the Nowy Targ commune for the years 2014-2023 is consistent with the Resolution No. XLII 662/13 of the Małopolska Regional Assembly of 30 September 2013 regarding the Air Protection Program for the Małopolska Province.
- The local government intensifies systematic cooperation with external parties in the field of low-carbon economy development
- For activities aimed at eliminating low-emission, the Nowy Targ commune has been awarded numerous times.
- The commune systematically modernizes and develops the infrastructure of the municipal heating network.
- The share of funds from WIOŚ obtained by the Nowy Targ commune is systematically growing.
- The local government runs social campaigns for the formation of pro-ecological attitudes of the commune's inhabitants.

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