WP3

Survey of industrial symbiosis in Pomeranian Region, Poland

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Content

1. Introduction

Aim of the European project "UBIS - Urban Baltic Industrial Symbiosis" (INTERREG South-Baltic Programme) is to use biogenic resources as well as waste and residues sustainable in industrial symbiosis and to reduce emissions at the same time. Even if a lot has already been achieved in this area, there are still many unused material flows and there are possibilities to use them even more efficiently. In the project existing collaborations will be investigated as well as new ones identified and evaluated. The regional surveys will enable to use learnings and tools from UBIS project to stimulate further investments in industrial symbiosis with the goal to identify new urban industrial symbiosis opportunities.

2. Investigated area/region/community - Pomeranian Region, Poland

The investigated area is the Pomeranian Region or Voivodeship in north-central Poland on the shore of the Baltic Sea. The Voivodeship has an area of 18 310.34 km². With around 2 319 700 inhabitants [4] the population density is 127/km^2. The Pomeranian Voivodeship has 16 counties (powiat) of which four are cities. It has 123 communes (gmina), 42 towns and 2861 rural localities [1]. The capital of the Pomeranian Voivodeship is Gdańsk and forms with the
cities Gdynia, Sopot the metropolitan area Tricity, which is a very important transport junction (principal seaport of Poland) and the largest academic and scientific centre of the Northern Poland, as well as the main cultural centre.
The unemployment rate is continuously decreasing from 9.3% (in 2010) [5] to currently 5.5% [4], whereat the unemployment rate with 5,3% and 6,6% is lower in urban areas than in rural areas, respectively [5]. Especially the unemployment rate in Gdańsk is below 4% (currently 3%), which means that state of full employment is achieved [6].

In the Pomeranian Region are established two Special Economic Zones (SEZ): Pomeranian Special Economic Zone (PSEZ) and Słupsk Special Economic Zone (SSEZ). The special Economic Zones stretch across other Voivodeships and are sectioned in subzones. In the Pomeranian Voivodeship the PSEZ covers areas of Gdańsk, Tczew, Starogard Gdański, Malbork, Sztum and Kwidzyn. The SSEZ consists of 18 subzones of which 9 are in the Pomeranian Voivodeship, e.g. around Słupsk, Lębork, Ustka, Czarne or Debrzno. The objectives of the Special Economic Zones are to facilitate the cooperation between enterprises, institutions and local authorities, to accelerate the economic growth of the region and to promote job creation. The subzones are industrial areas located close to: other industrial and technological parks, major transportation links (motorway, sea/river/airports, railway) and other key infrastructure (electricity, gas, water, telecommunication). Additionally, the investors gain several privileges like tax exemptions, support during and after the investment implementation, assistance in finding skilled labour force.

Figure 1: Pomeranian Voivodeship [8]

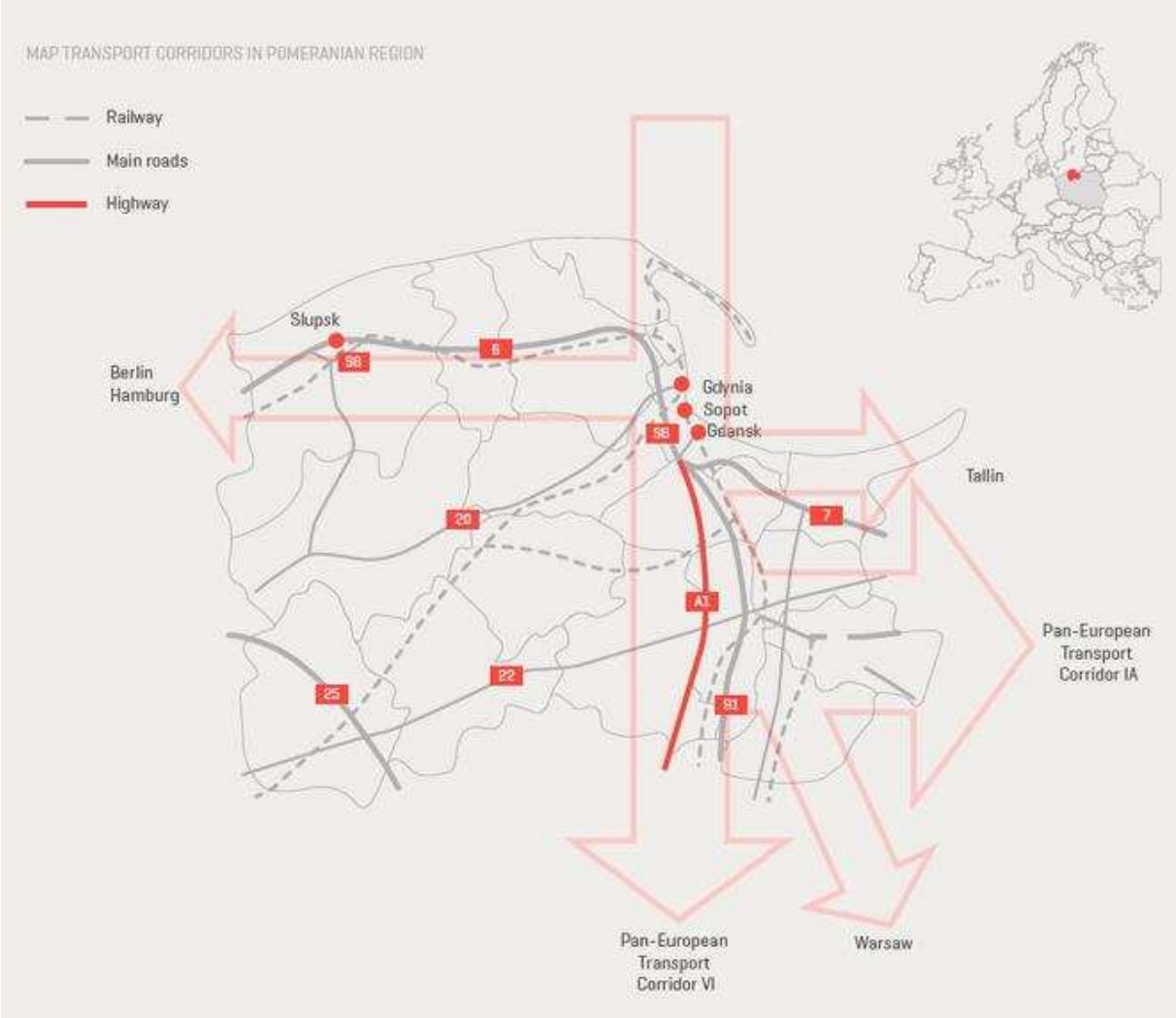


Figure 2: Map of transport corridors in Pomeranian Voivodeship [18]

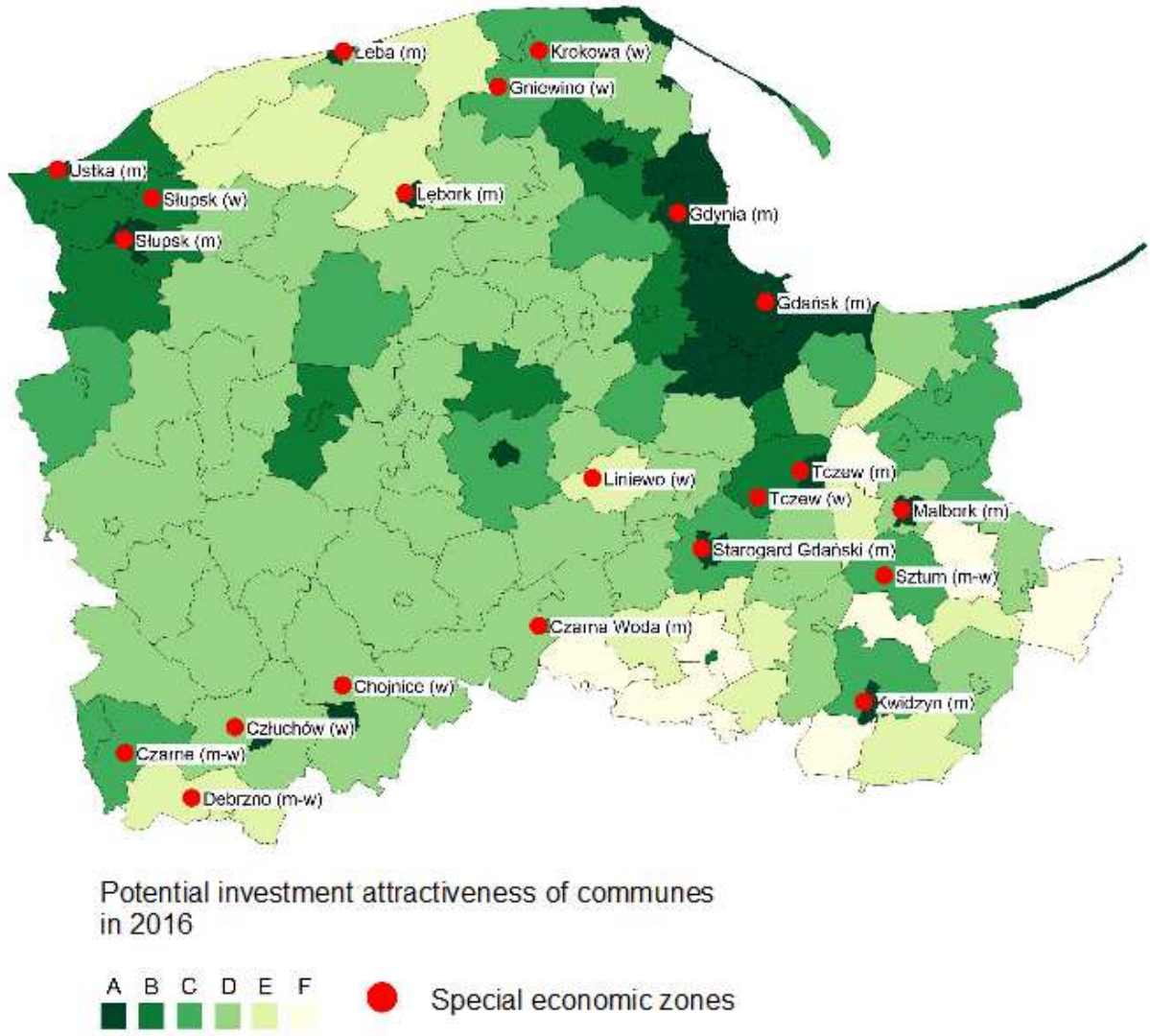


Figure 3: Investment and special economic zones of Pomeranian Voivodeship [20]

The structure of economic entities of the Pomeranian Voivodeship in 2016 was as following [9]. The majority of economic entities are commercial companies and companies with limited liability.

Table 1: Structure of economic entities in the Pomeranian Voivodeship

Entity	**Total**	**Belonging to industrial sector**
state owned enterprises	3	2
cooperatives	1042	113
commercial companies	32610	5956
Commercial and stock companies	870	-
Commercial companies - with limited liability	27955	-
Civil companies	17762	-

The polish definition of economic sectors is given in the Polish Classification of Activities (Polska Klasyfikacja Działalności) PKD-2007. Due to the available data given by the Central Statistical Office of Poland [9] the presented data can differ from the common definition of primary, secondary, tertiary sectors or also deviations comparing different data sets can occur. According to the PKD-2007 also quaternary and quinary can be distinguished. In 2016 in the agricultural, industrial and service sector were 62 (±18%), 322 (±5.4%) and 599 (±3.8%) thousand persons employed [11], respectively, whereas the values in brackets is the coefficient of variation. According to the main statistical office, 986(±0.8%) thousand persons were employed 2016 in total in the Pomeranian Voivodeship [11]. In comparison to Poland the high share of service sector is unique. The industrial sector subdivides as following [20]: 15% food industry, 10% production of electronic and optical devices, 7% production of metal goods, 5% supply of electricity/gas/water, 5% production of rubber and plastic goods and 2% manufacturing of chemical products.

3. List of industries at the site

The summary of most important and largest industries in the Pomeranian Voivodeship is given in the following table:

Table 2: Main industries of the Pomeranian Region

Corporation name	Location	Kind of activity
Drutex S.A.	Bytów	production of doors and PVC windows
Saur Neptun Gdańsk	Gdansk	Water treatment
Energa Gdańsk Power Generator	Gdańsk	energy supplier
Gdańsk Repair Yard	Gdańsk	repair shipyard
Grupa LOTOS	Gdańsk	exploitation of oil and gas, production and distribution of petroleum products
Elnord	Gdańsk	energy supplier
GZNF „Fosfory”	Gdańsk	fertilizer production
GPEC	Gdańsk	district heating, energy
Dr. Oetker	Gdańsk	food and beverage
Remontowa Holding SA	Gdańsk	shipyard industry
DCT Gdańsk	Gdańsk	Maritime, container facility

Corporation name	Location	Kind of activity
Mostostal Pomorze SA	Gdańsk	Construction and manufacturing of large steel structures
Gdynia Stocznia	Gdynia	shipyard
Rolls-Royce Poland Spółka z.o.o	Gdynia	Maritime Production, Service
Philips Consumer Electronics	Kwidzyn	electronic
International Paper Kwidzyn	Kwidzyn	paper products
Jabil Circuit Polska	Kwidzyn	electronic
Jabil Assembly Polska	Kwidzyn	electronic
Lacroix Electronics	Kwidzyn	Electronics manufacturing
Alteams	Lębork	Manufacturing cast aluminium products
Lubiana	Łubiana	chinaware manufacturer
Smurfit Kappa	Pruszcz Gdanski	paper packaging
Prime Food	Przechlewo	food and beverage
Curver Poland Sp. z o.o.	Słupsk	plastic products
Polpharma	Starogard Gdański	pharmaceutics

Corporation name	Location	Kind of activity
Destylarnia Sobieski	Starogard Gdański	distillery
Flextronics International Poland sp. z o.o.	Tczew	electronics
Eaton	Tczew	Automotive, electronics
PGE Capital Group	HQ Warsaw	Energy

4. Main material and energy streams of the industries/plants/facilities

Electrical power

It can be seen that the installed power of power stations is continuously increasing in the Voivodeship [12]. The total electric energy usage in 2016 was 7891 GWh [16]. In reverence to the statistically confidential information, no data is delivered by the Statistical Office about the kind of power station. Nevertheless, from previous years it is known that more than 50% of electricity is generated from fossil fuels, namely hard and brown coal. Only for 2016, it is revealed that 372.2 MW of installed power are from hydro or other non-conventional power stations having more than 0.5 MW. The Energy Regulatory Office reports 754.468 MW of installed renewable energy sources [14]. The Energa Group [12], which is after PGE, Tauron and Enea the biggest energy company in Poland generats 38% of electricity by renewable energy sources and has in the Pomeranian Voivodeship installed 1.63 MW solar power, 33.418 MW small hydro power and 24 MW wind power.

Table 3: Installed power of power stations in the Pomeranian Voivodeship [12]

Year	**Total [MW]**
2010	1379.9
2011	1422.7
2012	1509.4
2013	1633.5
2014	1684.5
2015	1768.8
2016	1931.4

The highest electrical energy consumption can be found in the entities of industry and construction. Industry and construction comprise the sectors C to F according to the PKD-2007, which are: C) industrial processing; D) production and supply of electricity, gas, steam, hot water and air for air conditioning systems; E) water supply, sewerage, waste management and activities related to reclamation; F) construction.

Table 4: Electric energy consumption of Pomeranian Voivodeship in 2016 [16]

Business activities	**[GWh]**
Own consumption of professional power plants and combined heat and power plants (together with heating boilers professional power industry)	252
Own consumption of professional heating plants	16
Mining and quarrying	23
Industry and construction	2881
Water supply & waste management	161
Transportation	407
Agriculture (only consumption for	101

Business activities	**[GWh]**
production purposes, without consumption in farmers' households)	
Households (together with farmers' households)	1749
Other recipients	2303

Table 5: Renewable Energy Sources of Pomeranian Voivodeship [14]

Kind of energy source	**No. of installations**	**Power [MW]**
Biogas from sewage treatment plant	5	5.297
Landfill biogas	6	5.359
Agricultural biogas power station	9	12.159
Fired agricultural, forest, garden biomass	1	1.4
Mixed Biomass	1	0.95
Photovoltaic power stations	18	2.437
Wind onshore	57	692.915
Hydro up to 0.3 MW	75	5.542
Hydro up to 1 MW	15	8.286
Hydro up to 5 MW	6	15.323
Hydro up to 10 MW	1	4.8
Co-fired (fossil fuel & biomass)	1	n/a

Heat

In 2016 the approximated amount of installed heat power in the Pomeranian Voivodeship was 3.68 GW, which was determined by voluntary information of 26 enterprises [15]. The heat grid (excluding internal heat grids of industrial installations) exhibits a length of around 1543 km [15]. The total heat consumption in 2016 was 38162 TJ [16], excluding heat used in mining, water/waste treatment and air conditioning sector. The highest heat consumption is recorded for the industry and construction sector with 24004 TJ, whereat they satisfy their need to 95% by own production. The second largest heat consumer with 11106 TJ are households. Depending on the infrastructure, the heat comes either from district heating or by burning of fossil fuels. Households consumed in 2016 [16]: 426 thous. tonne or 19.5% of hard coal, 7987 TJ or 23.2% natural gas, 29 thous. tonne or 43.9% liquified gas for stationary use, and 5 thous. tonne or 12.2% light heating oil.

Table 6: Heat consumption of Pomeranian Voivodeship in 2016 [16]

Sector	**[TJ]**
Industry and construction (own production)	24004 (22819)
Transport	218
Households	11106
Other recipients	2834

Investigating the heat market of the Three-City (Gdańsk, Gdynia, Sopot), we can observe still potential for the development of the district heating. In the Table below are provided data of the largest companies in Gdańsk and their heat generation and consumption.

The total annual residential and service sector heat demand in buildings for the Three-City is given with 16.2 PJ/a [22]. The total excess heat volumes are 22 PJ/a, where 50% come from thermal power and the remaining 50% from industry [22].

Table 7: Summary of heat sources of the largest industrial enterprises in Gdańsk [7]

Company	Provided by district heating [MW]	Installed capacity [MW]	Fuel
Gdańska Stocznia "Remontowa", ul. Na Ostrowiu 1	18		
Stocznia Gdańsk SA, ul. Na Ostrowiu 15/20	6,5	2	oil, natural gas
SPIE Elbud Gdańsk SA, ul. Marynarki Polskiej 87	6		
Zarząd Morskiego Portu Gdańsk SA, ul. Zamknięta 18	3,75	5,97	natural gas, oil
Centrum Techniki Okrętowej SA ul. Wały Piastowskie 1	2,2		
SAUR NEPTUN Gdańsk SA, ul. Wałowa 46	1,56	6,745	biogas, oil
Centrum Techniki Okrętowej SA, ul. Szczecińska 65	1,052		
Centrum Techniki Okrętowej SA,Al. Rzeczypospolitej 8	0,82		
Polski Rejestr Statków SA, ul. Hallera 126		0,53	natural gas
PolbrukSA,ul. Nowy Świat 16c		0,136	natural gas
Spółdzielnia Mleczarska Polmlek-Maćkowy,ul. Bartnicza 1		13	coal
GZNF FOSFORY SA, ul. Kujawska 2		9,992	process heat, oil
Pomorskie Przedsiębiorstwo Mechaniczno-Torowe, ul.		3,135	oil

Company	Provided by district heating [MW]	Installed capacity [MW]	Fuel
Sandomierska 17			
Dr Oetker Polska , ul. Adm. Dickmana 14/15		1,16	natural gas
Grupa Lotos SA, ul. Elbląska 135		464	natural gas, light oil
Lotos Petrobaltic SA, ul. Stary Dwór 9		1,9	natural gas
LPP SA, ul. Łąkowa 39/44		0,7	natural gas
Zakład Utylizacyjny Sp. z o.o., ul. Jabłoniowa 55		2,986	biogas, oil

Water

The total water withdrawal of the region in 2016 was 224.4 hm^3 and the total water consumption was 202.3 hm^3, whereat 93.6 hm^3 were used for industrial needs [19]. The total amount of discharged industrial and municipal wastewater into surface waters or into the ground were 166.6 hm^3, of which 35.8 hm^3 were cooling water [19]. 130.8 hm^3 of wastewater required treatment, where the treatment rate accounts with 99.9% [19]. 70.2 hm^3 of this wastewaters required increased biogen removal [19].

Other materials

Excluding municipal wastes, the generation and accumulation of wastes in 2016 for the Pomeranian Voivodeship is shown in the following Table [19]. 82% of the 2092.4 thous. tonnes of waste were recovered. The amount of disposed waste was 260 thous. tonnes (equalling 12.4%), of which 9.5% were incinerated and 59.4% were landfilled. The amount of transferred to other recipients and temporary stored wastes was 45.6 and 69.2 thous tonnes, respectively.

Table 8: Generated and accumulated wastes in 2016 of Pomeranian Voivodeship

Type	**Generated [thous. tonnes]**	**Accumulated on landfills (heaps, tailing ponds) [thous. tonnes]**
Total	2092.4	3888.3
Washing and cleaning minerals	27.8	-
Fly ash and slag from wet waste disposal furnace	74.5	3779.2
Soil and stones	715.1	0.0
Coal fly ash	84.5	-
Mixtures of fly ash and solid waste from calcium desulfurization methods of exhaust gases	6.1	-
Other	1184.4	109.1

5. Mapping of industries/plants/facilities

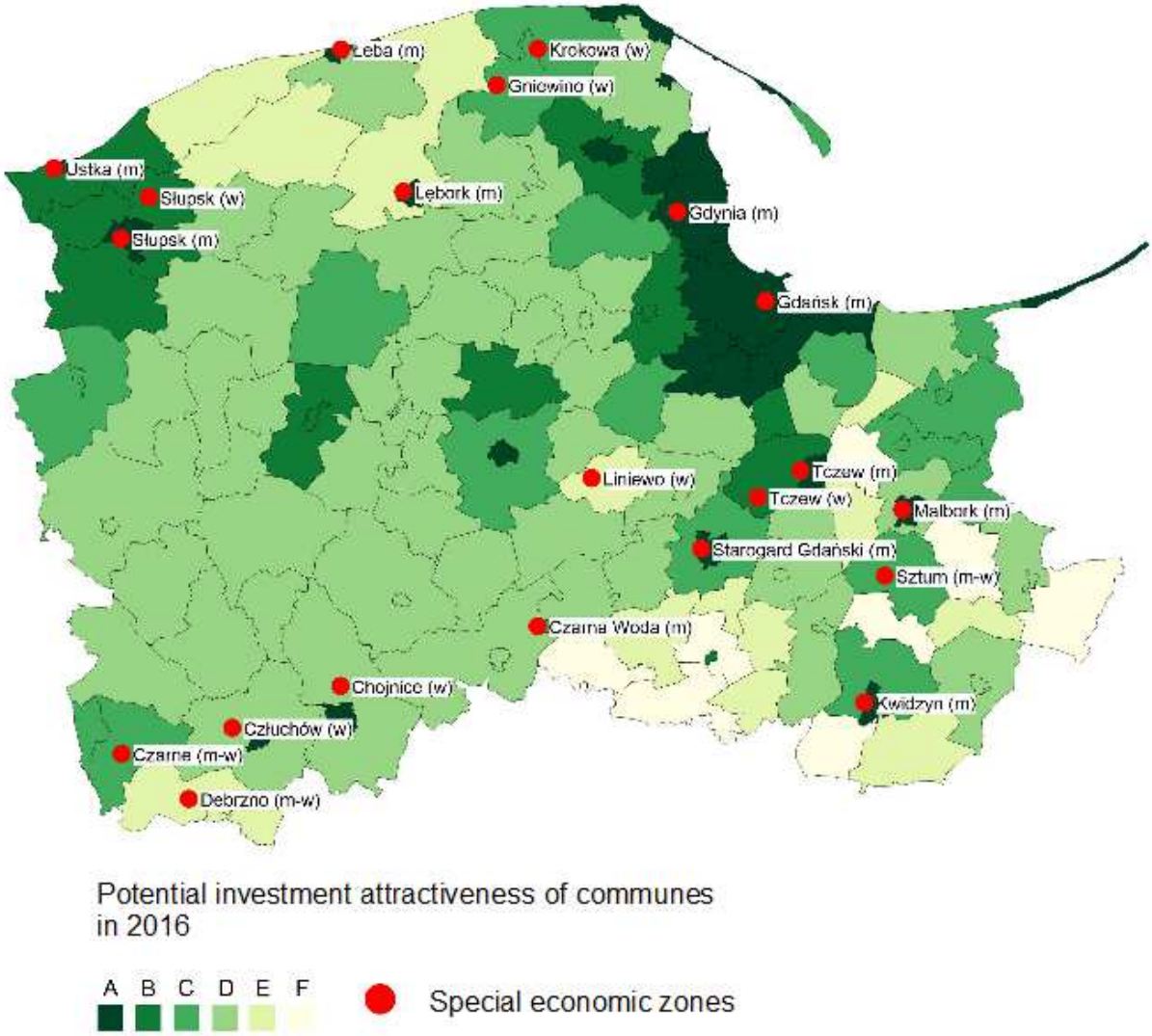
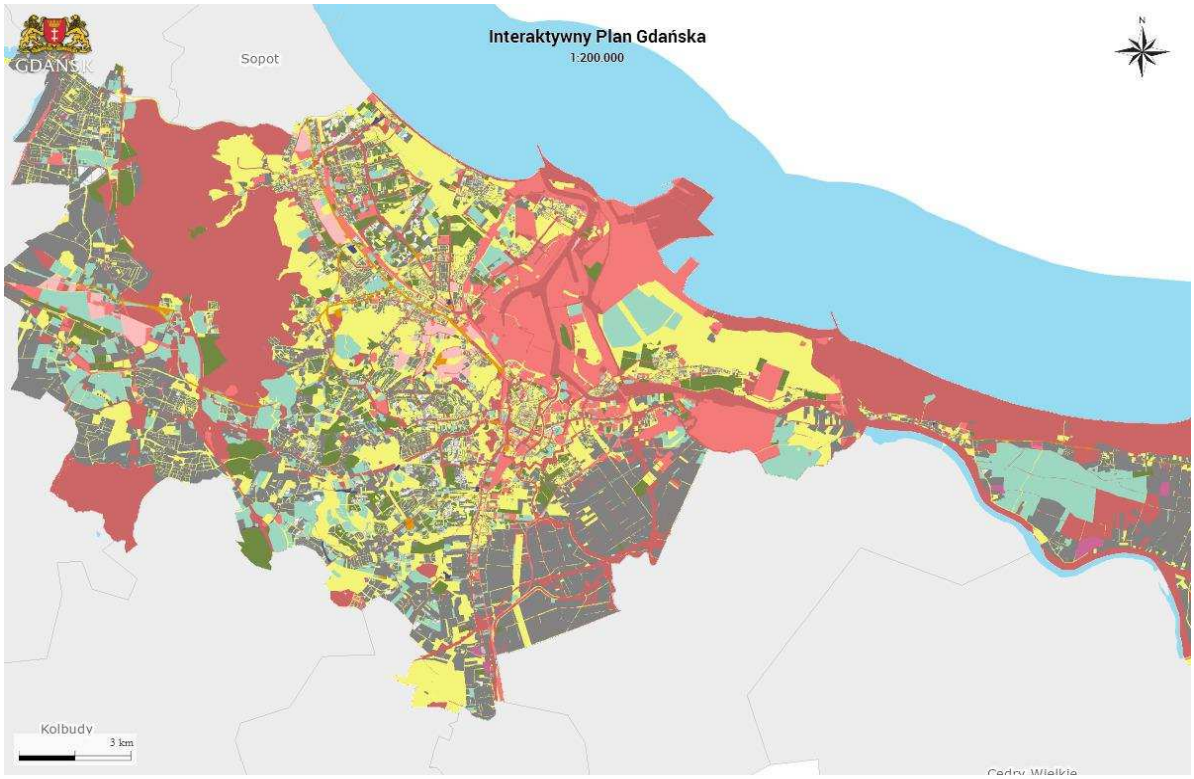


Figure 3: Investment and special economic zones of Pomeranian Voivodeship [20]

Important industrial parks and areas of the Pomeranian Voivodeship are summarised in the Figure of special economic zones.

In the following are presented the land ownership situation of Gdańsk and locations of the largest or most important entities in Gdańsk.



- Individuals in co-ownership with legal entities
- State Treasury, if not in coincidence with perpetual usufruct
- Voivodeships, if they exist in coincidence with perpetual users
- Churches and religious associations
- State Treasury, if it exists in coincidence with perpetual usufruct
- Property of natural persons
- Districts and unions of counties, if they do not coincide with perpetual users
- Single State Treasury companies, state-owned enterprises and other state-owned legal entities
- Single-member companies of local self-government units and other legal entities, whose founding bodies are self-governing bodies
- Commercial law companies and other registration bodies
- Communes and inter-municipal unions, if they do not coincide with perpetual usufruct
- Voivodships, if they do not coincide with perpetual users
- Building Societies
- Municipalities and inter-municipal associations, if they exist in coincidence with perpetual users

Figure 4: Land ownership map of Gdańsk [17]

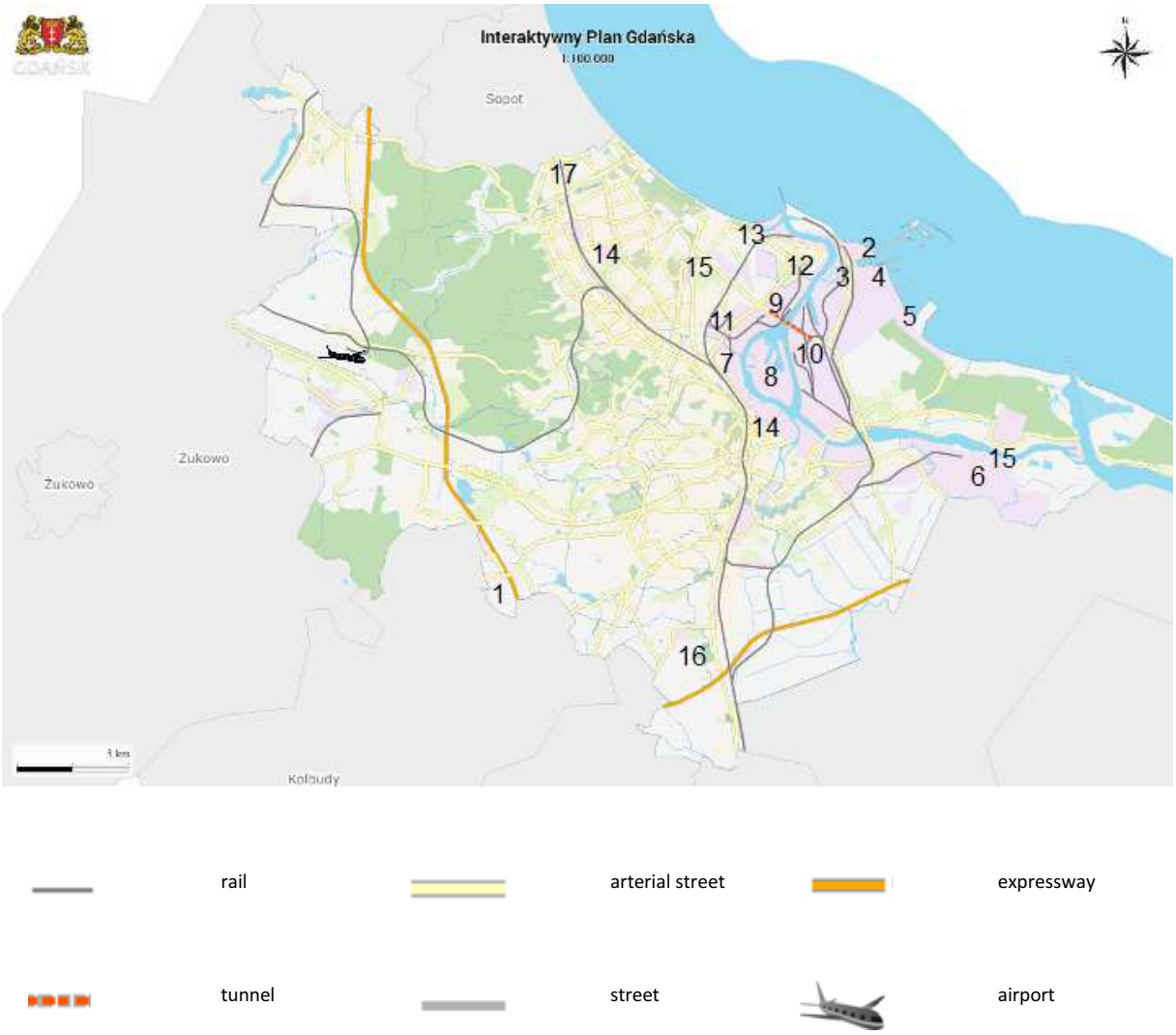


Figure 5: Infrastructure and main companies of Gdańsk based on [17]: : 1) Zakład Utylizacyjny Sp. z o.o. w Gdańsku , 2) Naftoport Sp. z o.o., 3) Siarkopol Gdańsk S.A., 4) Gaspol S.A., 5) DCT Gdańsk S.A, 6) Grupa LOTOS S.A., 7) Gdańska Stocznia Remontowa, 8) Stocznia Gdańsk S.A., 9) MOSTOSTAL POMORZE S.A., 10) Fosfory Sp. z o.o., 11) SPIE Elbud Gdańsk SA, 12) Zarząd Morskiego Portu Gdańsk SA, 13) Cargofruit Sp. z o.o., 14) Centrum Techniki Okrętowej SA, 15) Sewage Treatment Plant, 16) Spółdzielnia Mleczarska Polmlek-Maćkowy, 17) Dr Oetker Polska

6. Possible synergies

The highest potential for the implementation of Industrial Symbiosis, due to the presence of large industrial complexes have Gdańsk, Tczew, Starogard Gdańsk and Kwidzyn. However, also the sides of the special economic zones are predestined for the implementation of industrial symbiosis. The current survey on industrial symbiosis in the Pomeranian voivodeship reveals that the highest potential of industrial symbiosis are in the field of heat exchange, since over 95% of consumped heat in the industry comes from own production. However, the study also is limited by the data, which is available, e.g. it is known that 35.8 hm^3 cooling water are discharged with no information on the discharged heat. Furthermore, no information can be found of released heat by air cooling. Nevertheless, also other possibilities of industrial symbiosis exist, e.g. lowering industrial water consumption.

In the following, one possibility for industrial symbiosis in Starogard Gdański is described (see Figure below). A summary of the location and stakeholders is given in the Table below. In all three entities organic waste streams occur, which can be used for the anaerobic digestion. Fertilizer can be extracted from the digestate and remains can be used as fuel in the heat and power plant. Incineration of the remains generates heat, which can be used by the co-located industry and for district heating. Currently, a concept for the development of the district heating network is elaborated [21]. Biogas can be electrified, whereas fly ash and gypsum can be used for the production of construction materials.

Table 9: Preposition of industrial symbiosis in Starogard Gdańsk

	Polpharma	ZUOK Stary Las	STAR-WIK
Basic information of the entities	- among the top 20 generic drug manufacturer in the world - 600 products	- Municipal wate management facility of Starogard Gdański - 45'000 Mg/year - 190'000 residents	- Urban waste water treatment plant - 16 000 m^3/d - max. 19 000 m^3/d
Promissing streams for symbiosis	- Solvents, waste water (ammonia), waste heat	- Processing of organic fraction (1000 Mg/year) - Decrease of landfilling	- Currently no digester
Current applied technologies	- Incineration plant, WWT plant - 300 TJ heat (steam and hot water) from EC Starogard Sp. z o.o. CHP	- Sorting, composting	- Mechanical-biological treatment (phosphorous removal, nitrification, denitrification)
Proposal	Sewage sludge + Organic fraction + Sewage sludge => Anaerobic digestion		

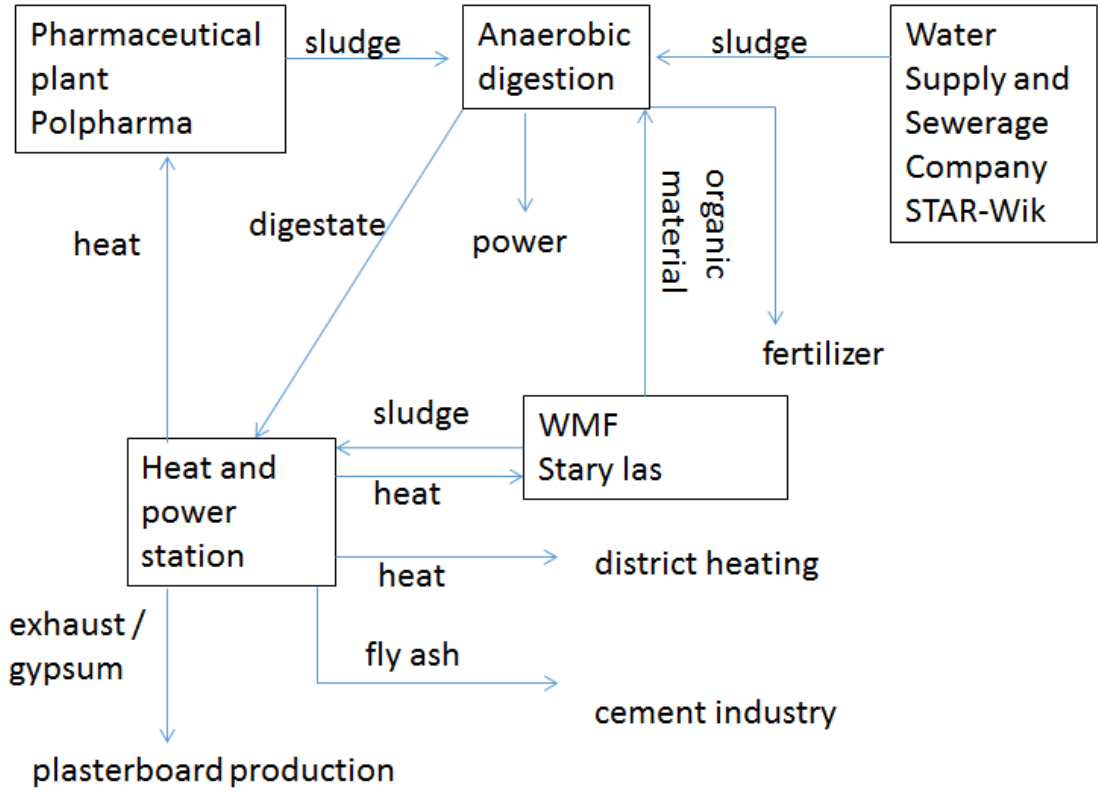


Figure 6: Flow diagram of material and heat streams of industrial symbiosis in Starogard Gdańsk (WMF: Waste management facility)

7. Disclaimer

The contents of this survey is/are the sole responsibility of the author[s] and can in no way be taken to reflect the views of the European Union, the Managing Authority or the Joint Secretariat of the Interreg South Baltic Programme 2014-2020.

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