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01 Introduction

INTRODUCTION

Strategically situated on the Baltic coastline at the mouth of the Vistula, Gdansk has flourished economically in past centuries thanks to its mercantile prowess. One of the largest cities in Central Europe, Gdansk has a rich history at the crossroads of important commercial and communication routes. The city was a member of the Hanseatic League and remains one of the largest Polish transport nodes of international significance today.

At the same time, the exposure to political influences that came with economic prosperity, and the city's character as a cultural melting pot, has led to Gdansk's pivotal role in many historical events of global importance. Most notably, Gdansk is where the Second World War began, but also the birthplace of the 'Solidarity' movement that played a key role in bringing an end to communist rule across Central Europe. Despite its tumultuous past, Gdansk has remained a dynamic and attractive city. Large green areas connect with beautiful beaches and ornate streets, contrasting starkly with the dramatic architecture of the city's industrial port. The city attracts millions of visitors from all over Europe each year. Gdansk's versatile, daring, and open character makes the city a perfect site for starting a new, bold endeavor: the transition from a linear to a circular economy.

The Circular Cities Program Poland

The Circular Cities Program Poland is a collaboration between Metabolic Institute and Polish Circular Hotspot, generously funded by the MAVA Foundation. In the program, Metabolic works with stakeholders in the cities of Krakow, Lublin, and Gdańsk to develop circular strategies that bring long-lasting systemic impact and ensure a sustainable future. We collaboratively expand on their existing strategies while facilitating an exchange of experiences and lessons learned in online sessions due to COVID-19 restrictions.

How to read this report

This report results from a 1-year process in collaboration with varied stakeholders from the private, public, and academic realm. It was established with valuable input and cooperation from the municipality of Gdansk. The report is meant to create a vision and operating framework for moving towards a circular economy in Gdansk, catalyzing cross-sector collaboration and innovation for a wide range of stakeholders, including citizen organizations, the private sector, and academia. The report is divided into two sections starting with an overview of insights and opportunities for the city, a vision, and a demonstration of related case studies. The second section provides a thorough background analysis, diving into four key sectors in Gdansk.





INTRODUCTION

The circular economy

In a circular economy everything we depend on for our health and wellbeing is carefully preserved. This includes preserving the value of products, but also the natural capital of the environment on which we depend. It goes beyond simply recycling, to redesigning our economic system as one that is regenerative and resilient.

The European Union has adopted the circular economy as one of its core strategies and studies suggest that adopting circular economy principles in Europe could generate a net economic benefit of €535 billion by 2030 (2). Especially in sectors prone to inefficient material usage, a shift towards a circular and material-saving economy offers significant opportunities for businesses. As an

example, the construction sector alone wastes around 15% of building materials and uses 50% more steel and concrete than necessary. Through circular initiatives in the built environment, around €195 billion and 12 million tons of steel could be saved (1).

In 2017, Poland was the third most carbon intensive carbon economy in Europe. The five main contributing sectors being power, industry, the built environment (mainly heating), agrifood and transport (2). These are predominantly fueled by coal. This comes at a cost. Poland holds 33 out of 50 cities with the highest air quality issues in the EU, according to the WHO (3). The two major sources of pollutants are motor vehicles and the burning of coal domestic solid fuel furnaces. The cost of related health impacts with 2015 figures was estimated at 16,15 billion euros (2).

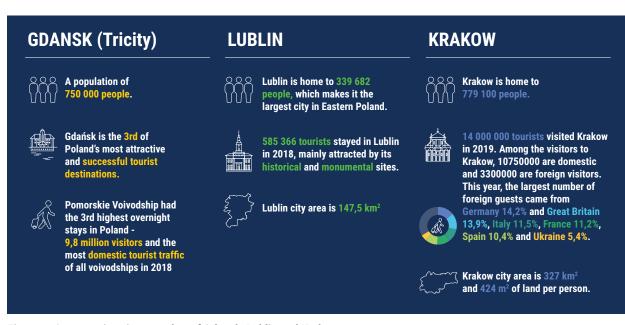


Figure 1: Comparative city snapshot of Gdansk, Lublin and Krakow.

- (1) McKinsey Centre for Business and Environment. (2015). Growth within: A circular economy vision for a competitive Europe. Retrieved from: source
- (2) McKinsey. (2019). Carbon-Neutral Poland 2050: Turning a Challenge into an opportunity. Retrieved from: source
- (3) Nabrdalik, M., Santora, M. (2018). Smothered by Smog, Polish cities rank amongst dirtiest in EU. Retrieved from: source
- (4) Ministry of Entrepreneurship and Technology (2018). Polish Circular Economy Roadmap. European Commission.
- (5) Municipality of Krakow (2018). This is where I want to live. Krakow 2030. Krakow development strategy; source



INTRODUCTION

Recent action by Poland's cities, governments, and local communities indicate that change is sought after. The acceptance of the circular economy (CE) roadmap at the national level in 2018 (4) and city development strategies (e.g. Krakow 2030) (5) emphasize readiness for a transition towards a circular economy. This transition could help tackle some of the country's greatest social and environmental challenges. It could move the current economy into a fundamentally sustainable state by becoming resource-efficient and working towards critical climate goals.

Cities can lead by example

On March 11th 2020, the European Commission adopted a new Circular Economy Action Plan (CEAP) - one of the main building blocks of the EU's Green Deal. The Plan involves a sustainable product policy framework, a reduction of waste, and interventions across key product value chains (i.e. electronics and ICT, batteries and vehicles, packaging, (micro) plastics, textiles, construction and buildings, and food, water and nutrients) (6). It is now time to accelerate and scale up across Europe.

Growing cities and consumption patterns combined with an extractive and wasteful economy create a plurality of negative environmental impacts both inside and outside of our cities. The footprint of most cities is far greater than the physical space they occupy. This brings opportunity.

Cities like Gdansk can play a leading role in accelerating a sustainable economy by leveraging their unique characteristics to propagate effective strategies, policy, and infrastructure solutions to drive implementation. By sharing best practices and broadly communicating their progress along the way, a city can act as a catalyst in driving systemic change on a regional and national level. This can facilitate the implementation of sustainability initiatives brought forward by different stakeholders.



(6) European Commission. (2020, March 25). EU Circular Economy Action Plan. EU Commission. Retrieved from: source



GDANSK DRIVING SYSTEMIC CHANGE

Human and environmental health in cities come together under the framework of the circular economy. For Gdansk, kicking-off its journey towards a sustainable future can be accelerated by building momentum amongst the city's active community of citizens, public authorities and businesses. By connecting, expanding and strengthening local circular economy initiatives in the built environment, the food sector, energy and waste systems, Gdansk can build the foundation for circular economy transition across civil society, private actors and the municipality.

The municipality has already made first strides towards a sustainable future by expressing an ambitious vision in its 2030 strategy seeking to strengthen the social, economic, and cultural potential of the city. It uses the principles of cooperation, learning, mobility and openness to action an operational program with goals for revitalization of degraded areas, optimizing energy systems and limiting consumption, protecting urban ecosystems, improving everyday mobility and upgrading the municipal waste system. Yet, formulating actionable objectives, targeting the necessary resources to make evidence-based decisions, and crafting the right policy are prerequisites to implementation.



Figure 2: Opportunities for the circular economy in Gdansk.



OUR APPROACH

Building the Gdansk of the future

The circular economy offers tangible strategies to achieve this, from developing new technologies to the evolution of new forms of collaboration and new business models. At the same time, it has excellent potential to provide new employment and skills development opportunities for the many different communities that call Gdansk their home.

Envisioning a circular Gdansk

Achieving a sustainable future requires systems transformation. Our integrated approach (figure 3) considers Gdansk's unique characteristics, strengths and challenges, and surroundings to set a bold vision for the future collaboratively.

This report presents five vision lines that can form a framework to work towards a circular economy in Gdansk. Achieving this vision in Gdansk requires a coordinated set of actions over multiple years, supported by strong leadership from and collaboration among local government, the private sector, academic institutions, and civil society. It also involves integrating the role of the city in the region.



Figure 3: Methodology.

most impact towards implementing

interventions.

In this report, we present a several case studies as inspiration on how Gdansk can embark upon the journey towards a circular city and sustainable future. These range from policy to economic and physical projects.

Building a community of practice

We conclude this report with a set operational recommendations and guidelines for building out local driving groups and empowering citizen-based stewardship towards a circular transition.



learned across the Polish network

12 Leveraging cities to drive systemic change

Cities are our future. They are the drivers of the global economy, centres of creativity, diversity, and interaction -- and they are home to the majority of the global population. Cities cover only 3% of the earth's surface, yet they consume 75% of all natural resources, making them effective places to address critical environmental and social challenges (7).

Cities and their impact on planetary health

Growing cities and our current economic system rely heavily on our planet and the natural resources it holds. Construction and consumption in cities is fueled by the extraction of virgin materials, freshwater sources, food production, and energy production. This comes at the cost of the natural systems that support our ability to live on the planet, resulting in unfavorable conditions most heavily affecting already vulnerable communities inside and outside our cities.

Loss of natural land, excessive fertilizer use and monoculture crop production, toxic mining practice, and emissions related to production and consumption are at the root of climate change resulting in increased urban flooding, rising temperatures, water scarcity, and an alarming loss of biodiversity, jeopardizing our future.

We need to reinvent cities as healthy, sustainable, and inclusive places; producers rather than simply global resource drains. We can do so by fundamentally changing how our economy works, starting with how we design and plan cities.









Figure 4: Cities as leverage points.



Integrated green spaces that facilitate:

- Biodiversity
- · Water retention
- · Community gathering

Happy and strong community with access to local goods and services and governance over their neighborhood.

A circular designed diverse built environment.

Climate resilience and clean air.

A local economy that stimulates innovation and jobs.

Circular industrial zone.

Integrated agriculture:

Local food production in peri-urban regions.



5% City

- Green
- · Carbon-neutral
- · Car free



Productive landscape mosaic:

- Agriculture
- · Nature & recreation
- Energy production

A VISION FOR THE SUSTAINABLE CITY OF THE FUTURE

To drive positive change, we must design our cities to cater to the livelihoods of urban communities, while keeping within the limits of the planet and allowing other species to flourish.

We must use our imaginations to envision an urban future in which our cities are centers of smart, circular, and local production. Urban areas are abundant with greenery and provide a home to many different species, softening the boundaries between human activity and natural areas. Resources are distributed in a just and equitable manner, allowing all communities to benefit and all needs to be met; citizens are happy and fulfilled. In this future, cities hardly draw any virgin resources from their hinterlands and create only negligible amounts of waste.

Ecosystems around cities must be structurally supported to provide habitat and ecosystem services. To preserve these areas of wild nature, cities must be designed as compact environments, while maintaining a human scale that stimulates engagement, social interaction and a sense of personal belonging.



At least 50% "Wilderness"



Figure 5: The sustainable city of the future.

HOW DO WE GET THERE?

To reach sustainability objectives, cities should be built on the foundation of resilient communities that have strong ties to their local environment, and provide a backbone of social goods and services to all citizens. The principles of the circular economy (figure 6) provide a clear framework to achieve this. Through integrating these principles into the development of the built environment, urban economies, and city governance, we can accelerate the transition.

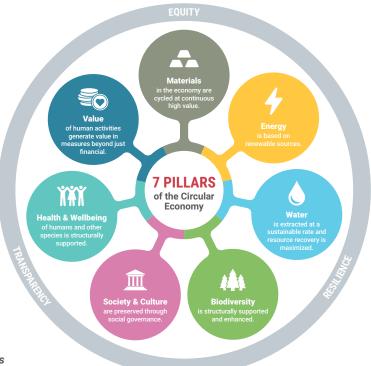


Figure 6: The Seven Pillars of the Circular Economy.

Approaching the circular economy holistically

Integrating the circular economy into the vision of a sustainable, smart and resilient city embraces more than the circular management of material and waste resources. Too often, the attempt to solve one problem in isolation from social, economic, ecological or political considerations leads to unintended and undesirable consequences in other domains of society.

To overcome the challenge of treating problems and their solutions (such as waste generation) in silos, the Seven Pillars of the Circular Economy (8) presents a framework that understands cities as complex and interconnected systems. This framework served as a guideline to co-create key indicators that the city of Gdansk should monitor to evaluate their progress towards a circular economy. The key principles of the seven pillars are described above.

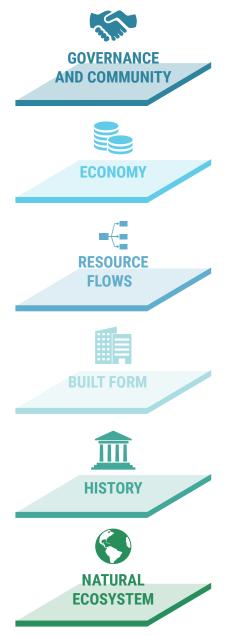
⁽⁸⁾ Metabolic. (2017). The Seven Pillars of the Circular Economy. Retrieved from: source



Main insights from current state analysis of Gdansk

GDANSK - A CITY WITH MANY LAYERS

A truly circular economy prioritizes holistic outcomes affecting the water and energy sector as well as human health, biodiversity and value beyond just financial value. A circular economy strategy should be strongly related to the local culture. Building an effective circular economy strategy requires a deep dive into the unique characteristics of the city. We investigate the many layers that make the city of Gdansk what it is today to get a thorough understanding of our starting point and identify key leverage points and transformative potential.



Gdansk possesses strong regional importance, as the capital of Pomorskie Voivodeship, and home to nearly half a million people. It is northern Poland's cultural hub, and part of a larger Metropolitan area often referred to as the Tri-City, together with Gdynia and Sopot.

Gdansk's economy developed around its prominent port. It is a major industrial center for shipyard, metallurgical and chemical plants, as well as a logistics nexus that handles fossil fuel transport. In addition, the Tri-City area is a popular tourist destination. In 2018, Gdansk attracted over 3 million visitors.

Gdansk's residents, tourists and local industry cause extensive resource flows through the city, with a total of 226 000 Mg of municipal waste and 319 000 Mg of industrial waste. The city's 10 290 GWh of energy consumption comes almost entirely from fossil fuels.

Like many cities, growing urban development and (sub) urbanization is putting pressure on creating a healthy affordable and comfortable living environment for humans and other species. Large developments occur along the waterfront, and historic districts are undergoing urban renewal efforts. The car centric and (post-)industrial makeup of the city require spatial reconfiguration to contribute towards a circular economy.

The history of Gdansk is closely tied to the Baltic Sea and Baltic countries, due to its long-held role as a major trade port of Poland. Its historic buildings and rich history will remain part of the city's transforming identity.

Positioned along the coastline of the Baltic Sea and the Vistula Delta, Gdansk relies on extensive water management systems to protect its low-lying areas against flooding. The city has relatively large amounts of green space, but green areas are pressured by continuing urbanization.

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LAYING THE FOUNDATION OF GDANSK'S FUTURE

Gdańsk is the capital of Pomorskie Voivodeship, situated at the mouth of the Vistula River on the Baltic Sea. It is home to a population of nearly half a million people, making it the largest city in northern Poland. Gdansk is also **northern Poland's cultural hub** with an extensive history of events that take place in the city to this day.

The history, culture, and economy of Gdańsk are inseparably tied to the Baltic Sea, the Baltic countries, and Hanseatic traditions. This has led to strong mercantile development, resulting in the city becoming Poland's principal seaport and one of the Baltic Sea's main international transport hubs.

Gdansk achieved its status as an important center of trade and culture in the 16th century, fueled by its diversified ethnic make-up and strategic location. This has also made the city attractive to outsiders. Under the reign of Teutonic Knights in the 14th century, Gdansk joined the Hanseatic League, a mercantile organization, which led to the development of its role as a seaport. Gdansk expanded greatly, reaching its peak during the Renaissance as the most prosperous port on the Baltic, bringing with it religious freedom and tolerance.

Key economic sectors

As a result of its prominent port, Gdansk has become a major industrial center for shipyards, metallurgical and chemical plants, and food-processing facilities as well as a logistics nexus that handles coal exports and petroleum imports, much of the latter processed at a nearby refinery. The city's coastal location has also resulted in a polycentric structure focused around three locations which evolved from a previous linear system. In the bigger spatial context, this has led to the development of the Tri-City Metropolitan Area, which also includes the cities of industrially oriented Gdynia and resort-type Sopot.

A developing city

The city of Gdansk is constantly in development, in terms of its culture, economy, and physical environment. The development of external road accessibility has resulted in suburbanization of what once was a compact city, occupying the natural areas surrounding the city. Although Gdansk is already a relatively green city, the Gdansk 2030 strategy focuses on further improving the quality of public space, and creating an attractive environment for its inhabitants both in the center and suburbs (9).

The recent trend of suburbanization has significantly increased the pressure on every element of Gdańsk's transport and road infrastructure. As people are moving to the suburbs, the Municipality of Gdańsk desires to limit traffic from private cars in the city,

despite relatively favorable infrastructural conditions. Connecting the different neighborhoods of Gdańsk and the wider tri-state area by public transportation is a major point of focus for the municipality of Gdańsk. Further expansion will limit car use while connecting suburban areas, providing inhabitants with access to public services in adjacent cities. Over the last ten years, the implementation of cycling infrastructure has increased from 81 to over 600 km of bike lanes (10).

There is strong interest from developers in buying up underdeveloped areas closer to the city center. These areas are typically poorly equipped with technical and social infrastructure causing the cost of maintenance and investments to rise substantially for inhabitants. At the same time, the city center is not an alternative since the limited availability of dwellings makes housing unaffordable. Major developments emerge on the waterfront with, as a good example, the Young City. With its revitalization of the old historic warehouses into apartments and cafe's, this development holds promise to function as an urban center for the tri-state area. However, the question remains, just like in the city center: who will be able to afford to live there?

Finally, there is the challenge of transforming the existing building stock - mainly historic housing - and its associated technical infrastructure to become more energy efficient.

⁽¹⁰⁾ Visit Gdansk. (2021). Retrieved from: source



⁽⁹⁾ Gdansk 2030 Plus Development Strategy

BUILDING ON GDANSK'S STRENGTHS



The city of Gdansk has many qualities that make it an attractive place for the principles of a circular economy to land. The following elements provide a strong basis for transitioning to a circular economy:

A city with an international character - Gdańsk has the highest success rate in applying for EU funding in Poland. The value of investments carried out since 2007 (based on EU project spending block of 2007-2013) per inhabitant was as high as PLN 20 300 (11). The city is also active in many European collaborations e.g. CIRTOINNO (Tourism and SMEs).

A young workforce - The Pomorskie Voivodeship (of which Gdansk is the largest and capital city) has a thriving academic scene with its 24 academic institutions and large populations of students (12). The average age of inhabitants of the region is 39,6 (13), the youngest in Poland, the working people covers 58,8% of the population (14).

A regional identity - The Pomorskie region, home to Sopot, Gdynia and Gdansk, provides a strong base for economic development. The municipality is working on building more of a transportation infrastructure which will stimulate the regional potential for a circular economy.

A thriving local economy - Gdansk has the largest Port economy in the Baltic. The city has experienced a steady decline in unemployment, reaching 2,3% in 2019 (15). Recently a shift has been made to the Biotechnology and ICT sector. Many residents are employed in the repair of vehicles and the construction sectors- sectors with a high potential for integrating circular economy practices.

Natural ecosystems - Most inhabitants have access to the city park within a 15-minute walk. The municipal government is furthermore improving its wastewater treatment and facilities (IWAMA) and is undertaking educational campaigns for citizens (NonHazCity) . The city has installed 13 city rain gardens to address flood vulnerability and stormwater run-off and is planning to install more. Poland announced the "My Water" program, a national initiative working to address the problem of droughts in the country. The initiative aims to install 20 000 units for retaining rain or thawing water, through individual grants. Grants can be used for the purchase of under or above ground retention tanks as well as drainage pipes (16).

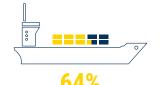
Coastal handling capacity - Gdansk's coastal location is an important asset. Gdansk's port demonstrates a diversified handling capacity and favorable infrastructural conditions. Gdansk used its mercantile strength to develop related industries, such as the logistics sector, with manufacturing and warehousing facilities linked with refineries and chemical industry. Over time, these facilities can play a relevant part in the moving, transferring and processing of materials to promote a local and regional circular economy.



/ biggest container terminal in Poland, biggest of the Baltic Sea.



million Mg increase in the volume of goods transhipment in the Port between 2009-2019.



of all maritime container



of all liquid fuels freight in Poland

- (11) Poland. (n.d.). EU Funds in Poland.
- (12) <u>Statistical Yearbook of Pomorskie Voivodship 2019</u> (str. 189)
- (13) Statistical Yearbook of Pomorskie Voivodship 2019
- (14) Gdańsk in numbers. (2019). Rynek Pracy.
- (15) Gdańsk in numbers. (2019). Rynek Pracy.
- (16) Ministry of Agriculture, Nature and Food quality. (March 2016). Rainwater retention programme for agriculture.



BUILDING ON GDANSK'S STRENGTHS



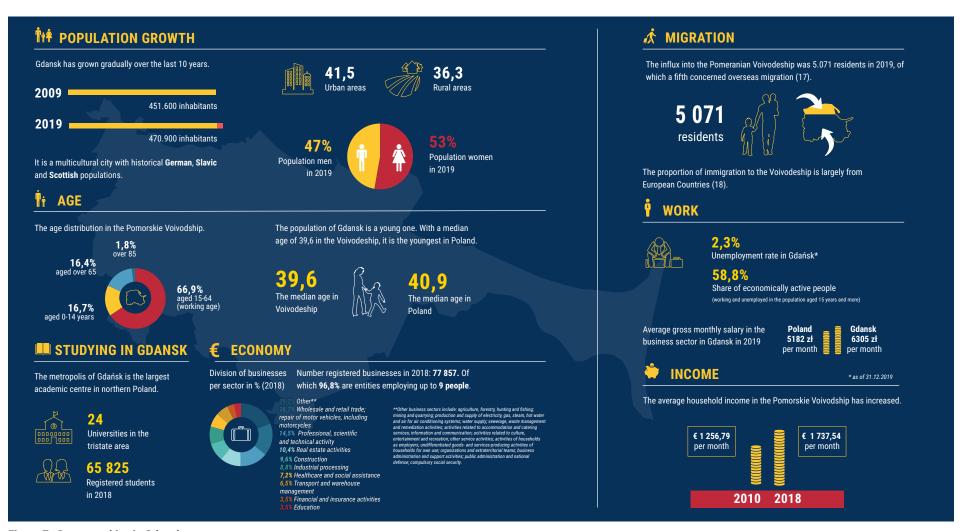


Figure 7: Demographics in Gdansk.

- (17) Statistical Yearbook of Pomorskie Voivodship 2019
- (18) emographic situation of the Pomorskie Voivodeship in 2018



OVERCOMING CHALLENGES

Although Gdansk is already on track towards a sustainable future we can identify a couple of circular opportunities that can address some of the challenges the city is facing:

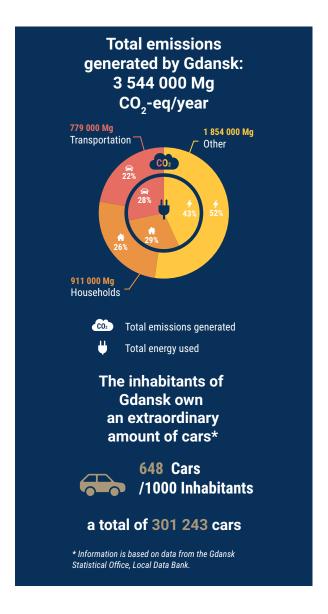
A shift to sustainable transportation - The residents of Gdansk favour personal transportation (301 243 passenger cars registered in 2019) causing daily congestion and air pollution (19). Mobility in Gdansk is responsible for 22% of all CO₂ emissions, and 28% of the total energy used.

Implementing green infrastructure- Although the city government is actively stimulating green spaces, having residents actively maintain these green spaces is challenging. New construction often involves limited (public) green space. The necessary cooperation between different municipal departments can be a barrier to implementation.

Resilience to climate change- Gdansk is located on the shores of the Baltic at the mouth of the Vistula. The natural characteristics of the city also make it prone to the extreme weather events and coastal flooding associated with climate change. Monitoring resources- There is currently limited overview of which construction and demolition waste flows are produced, and how these materials are processed. Gaining better insights in these flows can improve the reuse of local materials and lead to financial benefit and decreased resource consumption.

Urban development -The construction sector is the most material-intensive sector in Gdansk and it is booming. There is a trend of inhabitants moving to the suburbs of the city, which results in increased traffic congestion and sprawl at the cost of green space. Although the historic city center attracts many tourists, the monumental buildings are also energy-inefficient. Urbanization is putting pressure on the stock of affordable housing, making the city less accessible to lower-income communities.

Fossil-fuel heavy economy - Gdansk's economy currently centers significantly around the import, processing and export of natural resources, such as Amber, petroleum and coal. Extensive chemical processing occurs as well. These industrial activities cause relatively high CO₂ emissions and impact on natural ecosystems. The use of renewable energy, efficient technologies, and alternative, cleaner source materials can decrease the impact of these industries on the environment.



(19) Gdańsk in Numbers. (2019). Mobility and Transport.



LEVERAGING OPPORTUNITIES

Circularity is not only about increasing recycling rates, but integrating circularity across the entire value chain and economy. The highest-impact strategies reduce the amount of material throughput and waste entirely.

From waste to value- Yearly, thousands of tonnes of both municipal and industrial waste are handled at the lowest value possible: 19% of all waste in Gdansk is incinerated, and 11% of all waste is landfilled. At the same time, the capacity of the waste system is under pressure due to increasingly strict requirements on recycling and large numbers of visiting tourists. Extensive opportunity lies in the high quality processing of waste flows, both to decrease the environmental impact and to build the local economy.

Closing the water cycle- Gdansk's water system holds large potential to close cycles locally. Yearly Gdansk has rainfall of around 131 million m³, which can be captured and used for irrigation of public green spaces and surrounding agriculture. Currently 27 million m³ of fresh water is used for industrial cooling, which can potentially be substituted by sea water. Additionally, discharge water from households contains large amounts of nutrients (such as nitrogen, phosphorus and carbon) that can be recovered and used as organic fertilizers or as a source material for circular production.

The city is implementing rain gardens to harvest rain water. The total area of small retention facilities in Gdańsk is nearly

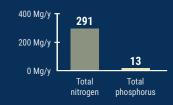


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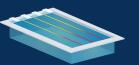
which can accommodate nearly 1,5 thousand cubic meters of water

Gdansk's discharge water carries large amounts of nutrients, which are currently not recovered.

This is a loss of valuable resources, and a potential for eutrophication (pollution) of surface waters.



Yearly, 131 million m³ of rain falls on Gdansk. This is equal to:



52 000

OLYMPIC SIZED SWIMMING POOLS

This water could be caught, stored and used for irrigation.



Currently, **27 million m³/y** of fresh water is used for industrial cooling in Gdansk, and discharged into the Baltic Sea directly after use.



This fresh water use could be substituted by sea water.





LEVERAGING OPPORTUNITIES

Circularity is not only about increasing recycling rates, but integrating circularity across the entire value chain and economy. The highest-impact strategies reduce the amount of material throughput and waste entirely.

Recovering materials from the construction sector

- The construction chain is responsible for extensive mineral extraction and carbon emissions. Concrete alone causes 152 500 Mg CO₂-eq emissions per year in Gdansk. There are currently no facilities that recycle construction waste in Gdansk. Most of the waste is recovered on site and turned into aggregate, which is a low-value method of recycling. To achieve the ambition of recycling 70% of construction and demolition waste, construction flows must be more extensively monitored.

Renewable energy- Gdansk's energy consumption of almost 10 290 GWh/year remains mostly reliant on fossil fuels. 0% of Gdansk's energy comes from renewable sources. This is far below the national target to have 21% renewable energy by 2030 in Poland. The city must divest from fossil fuel to achieve their climate goals and limit emissions. The city is in the process of building an incinerator for municipal waste. Although this will contribute to diversion from landfill and provide heating for a population, it will also create a dependency for incinerating waste that could otherwise be treated for higher value such as recycling. On the long term, Gdansk could leverage its potential for solar and wind energy production.

Valorizing organic waste- In Gdansk, around 32 000 Mg of food waste waste is generated yearly, large portions of which come from households and agricultural activities, but also from food processing in the city and from the hospitality sector. Food waste can be prevented by changes in business and consumer behavior, and by stimulating the exchange of food to assure high quality processing and use of organic materials. Unavoidable food waste can be used at high-value for the creation of products, biofuel, or compost, creating potential for circular businesses to thrive.

The municipality strives to have a minimum:



70%
recycling rate for construction and demolition (C&D) waste.

An unknown fraction of C&D waste is generated and processed on site. This makes it difficult to say whether the municipality is reaching its target.

Primary energy carrier use by Gdansk:



Gdansk uses 0% of renewable energy, while the goal of Poland is 21% renewable energy use by 2030

The concrete used in Gdansk's construction sector is responsible for a large amount of emissions:





A CITY MADE OF NEIGHBORHOODS

Achieving a sustainable future requires implementation of sustainable interventions in the built environment. It involves increasing Gdansk's self-sufficiency level, design and retrofitting buildings for energy efficiency and material recovery, implementing the infrastructure needed for repair and re-use, and facilitating new types of mobility. We will have to design our cities to integrate and support native biodiversity and create a healthy and vibrant environment for diverse socio-economic activities serving all communities. Naturally, not all parts of a city are suited to all kinds of functions.

Using neighborhood typologies

Each neighborhood can play an essential role in achieving a sustainable future based on its unique characteristics. At the same time, we will find similar neighborhoods with overlapping characteristics throughout the city: i.e. historic, monumental city centers, post-war socialist residential neighborhoods, and (post-)industrial areas. These similar characteristics come with similar suitability for sustainable interventions. For instance, we can design outer city neighborhoods to produce renewable energy by building on their post-industrial nature, proximity to natural resources, and existing infrastructure. In contrast, neighborhoods in the dense citycenter might consume more due to their higher densities and older building stock, but they are are much better suited to host campaigns for waste reduction.

Neighborhoods with overlapping characteristics can be categorized and divided over so-

called neighborhood typologies. Our unique methodology combines material flow analysis with spatial analysis to identify high opportunity resource flows and neighborhood characteristics. The resulting neighborhood typologies can help match concrete action to specific locations based on their potential for impact. Thus, some neighborhoods might be more suitable to host central city infrastructure and industrial symbioses, whereas other areas might be more appropriate for local community centers and school programs.

We identified the following neighborhood typologies in Gdansk based on characteristics such as land use, population density (20), waste streams in the area (see chapter "sectors in focus" p. 57), % of green space cover(21) as well as the available waste (water) processing infrastructure of the city. See the following page for the 9 typologies we identified for Gdansk.

⁽²¹⁾ Open Street Map. (2018). Land use (park, nature reserve, vegetated land types). Retrieved from: source



⁽²⁰⁾ Population Data per district, region Gdansk. (accessed 2020).

A CITY MADE OF NEIGHBORHOODS



Residential hubs (Brzezno, Przymorze Wielkie, Przymorze Male, Zaspa-Mlyniec, Aniolki, Piecki-Migowo, Siedlce, Wzgórze Mickiewicza, Chelm & Orunia Górna-Gdansk Poludnie)

Residential hubs are housing districts outside of the city-center with small to moderate green space and population density. Quality of and investment in infrastructure varies among these districts, and most spatial development plans here focus on improving the quality and densification policy of the housing stock (9). These neighborhoods are populated enough to create a sense of community but spacious enough to provide a pleasant environment for Gdansk's communities to flourish. Accentuating existing strong networks and initiatives as well as directing financial incentives towards developing local and community-enhancing initiatives such as community gardens, repair centers, and school programs in these neighborhoods can facilitate the transition to a circular economy. Further building out participatory budgeting can help the community have agency over the pursuit of these goals.



Consumption centers (Zaspa-Rozstaje, Wrzeszcz Dolny, Wrzeszcz Górny, Suchanino, & Śródmieście)

Consumption Centers are characterized by a high population density and a lot of traffic. We can also think of these neighborhoods as places where people come to gather, share experiences, and visit, drawn to the central location and clusters of restaurants, bars, and stores. These highconsumption activities go hand in hand with waste production. The monumental character of the city center makes it challenging to implement large scale energy-production technologies. Reducing energy use is a first step. These inner-city neighborhoods can further rely on productive neighborhoods to produce extra energy for their supplies. Consumption Centers can facilitate retailers and product banks that remarket the reused, refurbished, and recycled products and materials of Gdansk's entrepreneurs. The close proximity of restaurants and hotels creates potential in bundling the organic waste streams that can help reach the critical quantity of flow for effective composting for other purposes like a circular food hub



Waterfront industry (Nowy port, Letnica, Mlyniska & Stogi)

Gdansk's globally renowned harbour areas are home to large scale industries, processing facilities and manufacturing, situated at the coast and along the Vistula Delta. In addition to their important production and processing functions, part of these areas also hold the city's cultural and tourism attractions. Revitalization and maintenance of cultural heritage (buildings and squares) are the focus of development plans for these areas (9). Some post-shipyard areas located more closely to the center are gradually transforming into downtown residential and service functions. The heavily industrial areas provide a lot of space for experimentation with industrial symbiosis and new. circular business models. Industrial areas closer to the center and visited by more people can function as showcase space for circular hubs, to raise public awareness on the transition to a circular economy.

(9) Gdansk 2030 Plus Development Strategy



A CITY MADE OF NEIGHBORHOODS



Loop closers (Rudniki, Przeróbka & Jasien)

These peripheral neighborhoods have a productive and processing function in the urban metabolism. They host a range of city-wide infrastructures. including energy production, waste (water) processing, and large-scale manufacturing, and have mid-level population densities. Some of them also generate large amounts of industrial waste, of which a share is processed in the same area. The productive nature of these neighborhoods. combined with existing large spaces from industrial activity, can provide a platform for innovation, experimentation, and small-scale manufacturing. The municipality can test innovative concepts and living labs in these areas, which can be scaled up to the rest of the city if proven effective. These circular activities can help create jobs and redefine the neighborhood's identity.



Agricultural zones (Kokoszki, Orunia-Sw. Wojciech-Lipce, Olszynka & Wyspa Sobieszewska)

Agricultural zones are peripheral neighborhoods with extensive farming activity and low population densities. Gdansk has a substantial agricultural sector - 11.6% of the city's land use is agricultural. These neighborhoods can be crucial resource producers. Gdansk can leverage these areas to its advantage and become partly self-sufficient in food supply and create closed nutrient loops through composting. One of the largest districts in the city, Wyspa Sobieszewska, holds a large share of the agricultural land of Gdansk, and is an important recreational area of the city as well. Here, citizens visiting can reconnect with the source of their food, and be introduced to regenerative forms of farming.



Concrete jungle (Stryża & Wzgórze Mickiewicza)

Concrete jungles are peri-center residential and commercial neighborhoods with a high population density and minimal green space. Considering the intense adverse health effects caused by traffic congestion and little access to nature, creating accessible natural pocket spaces should be top priority in these areas. Ideally, many of the roads should function as green veins that allow clean air and sanctuary in the city center. Green roofs and increasing pervious surfaces would also help make the city more hospitable and resilient in the face of erratic rainfall.



Green oases (Zabianka-Wejhera-Jelitkowo, Oliwa, VII Dwór & Bretowo)

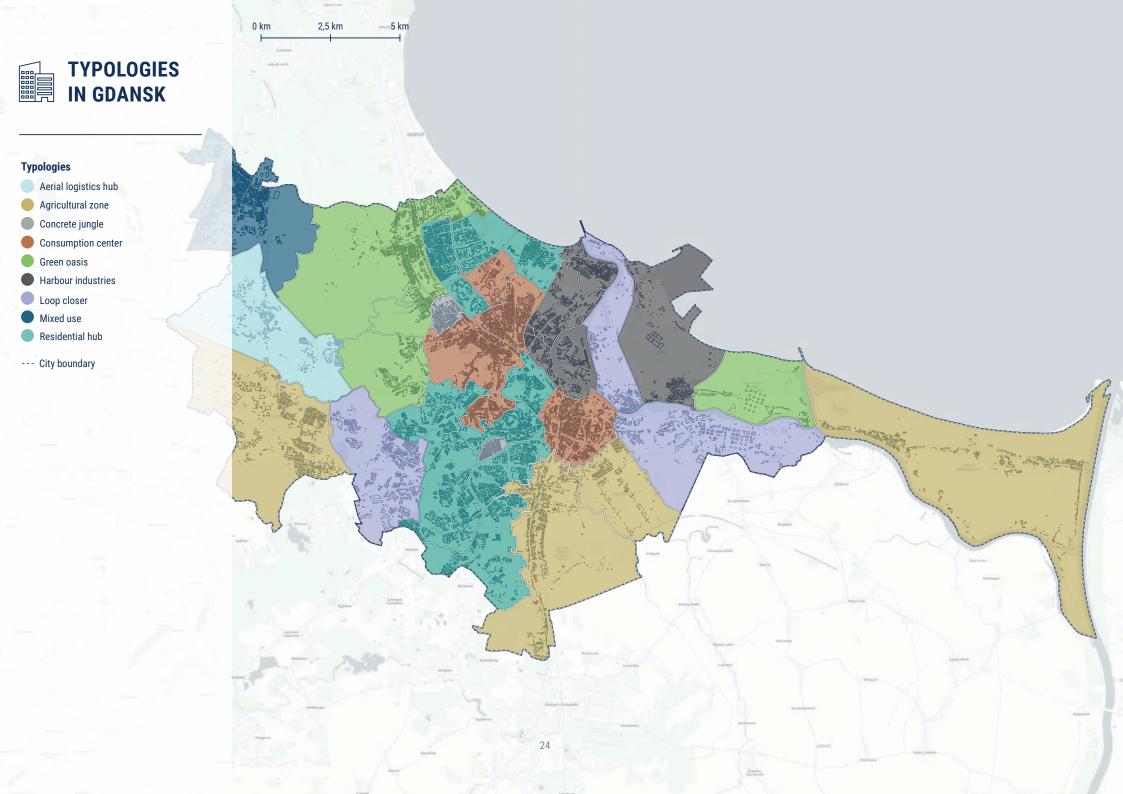
These peripheral neighborhoods, located in the West of Gdansk, offer plenty of green space and serve as ecologically rich retreats for the urban residents and as spaces for biodiversity to thrive. As the city grows, these areas should be supported and protected and serve educational and recreational purposes. Urban sprawl into these areas should be limited.

⁽²⁰⁾ Open Street Map. (2018). Land use (park, nature reserve, vegetated land types). Retrieved from: https://download.geofabrik.de/europe/poland/malopolskie.html





⁽¹⁹⁾ Population Data by District Krakow.Population density, retrieved from: https://bdl.stat.gov.pl/BDL/start





104 Towards a circular future for Gdansk

If we take high-level ideas about what a sustainable city should look like and apply circular economy principles to Gdansk, what could the city actually look like? Here we imagine some of the changes that might have taken place to achieve a fully circular local economy and sustainable future for Gdansk in 2050. We have organized the vision around thematic areas keeping in mind that the city is made of different neighborhoods that can contribute to this vision through their unique characteristics. The vision presents an imagined future meant to achieve a common dot on the horizon. It builds on the existing strategies for Gdansk and stakeholder input, and can serve as a directional framework. Achieving this possible future might seem challenging in light of current socio-political conditions. It requires a coordinated set of actions over multiple years, supported by a collaboration between local government, the private sector, academia and civil society.

This section is meant as a resource for urban changemakers. It includes some insights on how to build a community of practice, a high-level guide for starting a circular initiative as well as several case studies that provide tangible examples. We also present a set of tangible objectives and Key Performance Indicators to provide insight into how to monitor progress towards achieving a sustainable future.

A VISION FOR THE FUTURE OF GDANSK



A city with high-value use of resources

In 2050, resource flows are cycled through the city and surrounding peri-urban areas at their highest value.

- Gdansk has created a monitoring system that keeps track of household and industrial waste streams
- Repair and reuse centers that recover materials at their highest value have opened across the city
- The city's heritage manufacturing scene in the food sector, service sector and steel industry have benefited from a transition to a circular economy
- Local resource centers provide valuable materials for Gdansk's construction sector



A connected city fueled by clean energy

Locally produced energy fuels the city's clean. Smart and modern mobility system that connects the logistical hub of Gdansk to the rest of the world.

- Gdansk's revitalization zones have become inspiring use cases for energy-efficiency in the built environment
- Solar energy is now generated across the city's vast rooftops
- Waste heat from data centers and industry is providing many neighborhoods with heat
- Car-free zones are rapidly spreading throughout the city
- Alternative freight and delivery systems, such as cargo bikes, are now well-established in the city's high-density districts



A resilient city with a healthy ecosystem for all species

Ecosystems in and around Gdansk are supported to provide a safe and habitable environment that can in turn support a thriving community.

- Multi-functional green spaces that provide food, space for recreation, social gatherings and wildlife habitats have been implemented in each neighborhood
- Surrounding ecosystem services are safeguarded from urban development
- Water capture from the city's rooftops not only reduces the pressure on local wastewater infrastructure - it protects citizens against flooding events
- Integrated agricultural systems, such as aquaponics, in Gdansk's suburbs provide the city with food



A sustainable, diverse and affordable built environment

Gdansk's urban environment stimulates a symbiotic relation ship between humans and nature and leaves space for flora and fauna to thrive both inside and at the edges of the city.

- Gdansk has established a monitoring system that keeps track of all construction materials used in the city
- Using secondary construction materials has become a common practice through the consolidated efforts of architects, local designers, developers and the municipality
- Ambitious energy efficiency standards for new and existing buildings have drastically reduced energy consumption of the built environment
- A citizen participation program built out by the city now allows citizens to actively shape urban development processes



A city with a culture of academia and innovation

Gdansk is regionally and internationally known for its rich and innovative academic scene, that stimulates clean and sustainable development.

- Through industrial symbiosis scans, Gdansk enables various material and energy exchanges in surrounding industrial parks
- Circular innovation hubs are set up in Gdansk's industrial neighborhoods
- By bringing together stakeholders from public institutions, private companies and academia, Gdansk has become a hotspot for innovation in clean technologies

CREATING THE ENABLING CONDITIONS TO ACHIEVE SYSTEMIC CHANGE IN GDANSK

Throughout our research and interaction with local stakeholders, we have come across some challenges. To successfully implement the circular economy and gear towards a sustainable future, we can identify a couple of systemic actions, or general building blocks, that will help create the enabling context for the circular economy to be successful in Gdansk.

- The circular economy is a joint venture
 - Collaboration across sectors and with existing initiatives will fast track the transition. This does require good insights into existing NGOs and local initiatives and an active role from the local government to create cross-sectoral driving groups. These could be organized around sectors.
- Communicating the vision and actions Publicly communicating about the circular
 economy can be a strong tool to create
 awareness of the circular economy and the
 action agenda for Gdansk. It can also play
 a crucial role in creating a coalition around
 key strategic directions.
- An active municipality The local government plays a major part in fostering a circular city. The municipality can push the circular transition by setting out tenders to showcase new building technologies, providing subsidies for green infrastructure, and convening working groups.

- Getting better insights into waste streams
 - It is essential to develop a data collection and monitoring program that details how the city is progressing on improved resource management and inclusive economic development. This will provide as continuous feedback to improve efforts and stimulate the transition.
- Policy and legislation Changing policy can be challenging and time-sensitive since it is often informed by national or EU legislation. Organizations, academics and entrepreneurs can work with the local government to create temporary experimental zones that can help provide the space needed for innovation.

6

Identifying funding to incentivize the private sector, academia, and community organization - Understanding the funding landscape's potential at various scales (regional, national, EU) will help to mobilize budgets. The Green Deal and INTEREGG might hold potential. A scan of alread-existing subsidies and funding mechanisms that can be adjusted can also help.



HOW TO BUILD A DRIVING GROUP FOR A CIRCULAR GDANSK

Building a driving group

Once we know Gdansk's potential is to transition to become a circular city, who will translate these insights into action? The 6-step plan below shows how a driving group can translate insights and goals into action through pilot projects (inspired by DRIFT, Erasmus University Rotterdam, 2014).

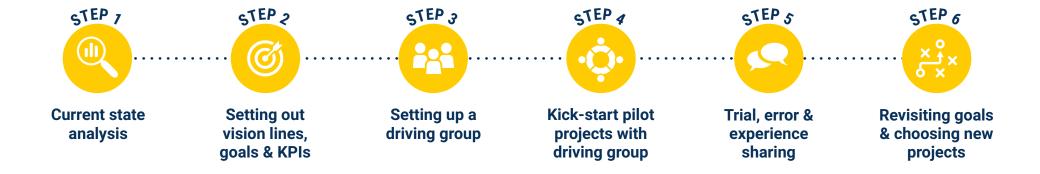
This report presents an analysis of the current state of Gdansk in its transition to a circular economy (1). It reveals the strengths and weaknesses of the city, and the challenges to overcome and opportunities to grasp. It sets out five vision lines and accompanying goals for the city to strive for, in order to become a fully circular city. It provides the city with KPIs to measure her progress towards these goals. Each vision line has the potential to be translated into tangible pilot projects. Now, who is going to decide what these projects will be, and how they will take shape?

The answer is simple: the city needs a driving group for a circular Gdansk. Once set up (3), this group will generate momentum around the concept of a circular economy and the insights into the current state, challenges and opportunities of the city. The driving group can choose and kick-start the first pilot projects (4) that challenge the status quo, and explore how i.e. sustainable business models land in Gdansk. Each member of the driving group takes ownership of parts of the pilot projects that fit them best.

These projects can be conducted on a trial and error basis and in an explorative manner, generating experienced-based knowledge, learning from each other's experimentation and sharing best practices (5). Some of these pilot projects potentially become flywheels for the transition to a circular Gdansk and will inspire other curious city stakeholders to take the circular transition further. From the lessons learned in these projects, and with the help of the

expanded network, the driving group can revisit the goals and update them where needed, and launch new projects to move towards these goals.

One of the most important strengths of the driving group is their diversity: ideally, the group represents all corners of society, or the 'triple helix' of academia, business and government. Cooperation between these different sectors has proven to accelerate innovation much faster and more thorough than when sectors operate alone. Launching the transition across sectors also creates longer lasting effects.





CASE STUDY: VERENIGING CIRCULAIR FRIESLAND

An example of a driving group accelerating the transition to a circular economy is Vereniging Circulair Friesland (Association of Circular Friesland, one of the provinces of the Netherlands). The association aims to become the most circular region in Europe by 2025.

The association was founded by a few ambitious business leaders in the province: frontrunners of the circular economy, aiming to accelerate circular business and innovation. The association is now led by 11 core members, coming from business, education and governmental bodies, each leading one theme of the transition. The VCF is thereby a triple-helix organisation at its heart. Themes include Construction, Organic materials, Water, Plastics, Education, Energy, Agrifood, and more.

The core members lead the transition together with over a 100 members (businesses, knowledge institutes, governments, NGOs and more). The association does not only share knowledge and experiences, but has a strong focus on putting things into practice: members feel closely connected by the common mission, and know how to find each other to launch project after project. A few examples:

- The National Test Centre for Plastics: A center to test and improve ways of cleaning and sorting plastics;
- The Energy Campus Leeuwarden: A crosspollination centre where businesses, government and knowledge institutes come together to facilitate the renewable energy transition;
- ROEN, the Circular Procurement Catalogue: A
 platform where producers of circular products can
 offer their goods directly to governments and other
 customers.





ANYONE CAN START A CIRCULAR INITIATIVE

The following steps will help urban changemakers in Gdansk to drive efficient implementation of impactful circular solutions. Everyone should be able to take part in implementing the circular economy. No matter if you are an experienced entrepreneur or an aspiring one. Put simply, the purpose of the following section is to support local actors in getting circular initiatives off the ground.

Shape a value proposition:

Exploring local best practice as well as circular opportunities from other cities around the world can help you to build out your own value proposition for planned or current initiatives. While a few inspirational case studies are listed in this report, they only scratch the surface of an extensive repository of circular entrepreneurship around the world. A good resource for identifying best practices is the European Circular Economy Stakeholder Platform, as well as the case study collection of the Ellen MacArthur Foundation.

Identify your local opportunities:

After scanning existing projects related to your planned circular initiative, it is time to dive deeper into the local opportunities for high-value material reuse available in your surrounding. This report serves as a great starting point to identify which waste streams may be available for feeding circular activities. You can also use the stakeholder analysis in this report to map out the key players, existing programmes as well as policies that are present in Gdansk. Identifying potential supporters or collaborators, but also key barriers, is essential to get any project off the ground.

Find local collaboration:
Use the information from

Use the information from the previous step to actively engage with the key stakeholders you have identified. If you are still uncertain where and how to find relevant stakeholders and collaborators for your idea, it is helpful to approach a local network or join a teambuilding portal to link-up with others. Good points of departure are local co-working spaces or start-up communities in your city.

Build out a business plan:

Whether you are developing a for-profit or a non-for-profit organization, building a viable business plan and value proposition is a critical step to flesh out your ideas. While traditional business model canvases work well to help you in this process, there are also a variety of adaptations available that focus on the circular economy. The Circular Design Guide, developed by the Ellen MacArthur Foundation and IDEO, provide many resources on circular business model development.

From plan to implementation:
The most challenging part of

The most challenging part of starting a circular initiative is the implementation. To find resources and financial support for your project, it is necessary to research relevant investment programs and incubation programs that can facilitate implementation at scale.



VISION: A CITY WITH HIGH-VALUE USE OF RESOURCES

Today, the Gdansk waste system has undergone an enormous metamorphosis: the opening of the incinerator in 2023 allowed for a vast diversion of waste away from landfill. Now, in 2050, incinerating waste is hardly necessary anymore. Overall, resource use has decreased dramatically and close monitoring allows for high-value cycling of all resources.

It starts at the household level- all communities within Gdansk are aware and actively participating in recovering materials and maintaining their complexity. This starts by using as little packaging as possible and limiting food waste. Every district has the necessary infrastructure needed to repair. refurbish or exchange goods before anything is disposed of. PSZOKs have been turned into repair centers and stores for secondary construction materials. In the 20s, the popularity of repair and reuse locally is scaled up to the point where most residents and initiatives participate in product lifespan extension programs. In the 30s, many companies switched to product-as-a-service models, renting products and taking them back for repair and reuse. By 2040, every major store in the city sells was second-hand products in addition to new ones. Abundant food is shared in community fridges. The organic fraction of household waste finds a new life as compost for local community gardens that deliver fresh fruits and vegetables to the community that maintains them.

The municipality has enlisted monitoring dashboards to track resource flows through the city. This is the newest addition to the Marshalls office waste monitoring system. The dashboard provides insights into not only where materials are located but also facilitates links with processing facilities and entrepreneurs. Spare compost is collected and used for food production in surrounding (peri-urban) farmland. Larger organic waste streams from food processing industries are taken up by innovative entrepreneurs to turn into new, circular products such as fruit leather and local beer breweries.

Experimentation programs for different collection methodologies have resulted in a few dynamic options tailored to different districts based on their accessibility and available materials. This allows for smart decision-making in logistics and improves efficiency.

Although hazardous waste used to be a challenge, new local economies and circular designed products have minimized this significantly.





WAYS FORWARD: A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE

Insights from workshop

A workshop with city stakeholders showed interest in piloting a physical hub that can center activities around the circular economy, for instance a repair and reuse hub. The following insights and potential steps of action were identified:

Challenges:

- · Arranging funding for a physical CE hub.
- · Finding a central, suitable location to host CE activities.
- Demonstrating the relevance of CE projects.

Opportunities:

- · Collaborating with and building upon existing zero-waste and circular initiatives.
- More focus on offering post-consumer services for the exchange of products and materials.

Potential starting points:

- 1. Osowa neighborhood, at the edge of the city, could benefit from a combination of providing social public space e.g. (library) and CE services.
- Organize repair and reuse events at different partner organizations, instead of at a fixed location. The Earthosphere ecocentre (Ziemiosfera) can potentially provide space cyclically for CE related events.
- 3. Brainstorm with circular entrepreneurs to explore potential scale-up.

Related strategies and policy documents

- Environmental Protection Program Pomeranian Voivodeship 2018-2021 (Program Ochrony Srodowiska Wojewodztwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Provincial Waste Management Plan Pomeranian Voivodeship in 2022 (Plan Gospodarki Odpadami dla Wojewodztwa Pomorskiego 2022).
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony srodowiska dla miasta Gdanska na lata 2015-2018 z perspektywa do roku 2020).

What's already happening?

- Anna Desogus is organizing the Tri-city Circular Economy Club chapter, which will be a platform for interested stakeholders to continue working together on circular ideas and models in Tri-city.
- Ziemiosfera Gdansk is an eco-center, that serves as a zero-waste store, hosts workshops about a circular economy, and a place to convene around a cup of coffee.



INSPIRATION: A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE



Repair cafe international

Repair cafe international is an organization that stimulates the creation of repair cafes in Belgium and the Netherlands, through offering interested people practical, legal, social and branding advice for starting a repair cafe. The organization also provides an overview of repair cafe locations.



Scrap Store 22@

Located in Barcelona's hub for circular initiatives, Scrap Store 22@ is a place to foster material exchanges between local businesses, designers and artists. The materials available for reuse and recycling are donated by local companies or organizations.



ReCup

Germany's reuse system for cups and take-out: The German business ReCup has successfully introduced a nation-wide deposit system for coffee cups and, most recently, aslo take-out bowls. To date, they are supported in over 5,200 cafes, restaurants and gas stations throughout the country.



InStock

The Dutch restaurant InStock uses food which would otherwise be thrown out as the base for all of their dishes, preventing food waste.





WASTE 4think

Pay-As-You-Throw (PAYT)

San Jose, a city in the US with currently around a million inhabitants, implemented a PAYT-system back in 1993. It resulted in extensive annual savings on municipal solid waste costs, and a strong increase in recycling rates.



Responsible Purchasing Promotion Scheme

Nantes, France, as part of the city's plan for public purchasing, has set 11 clear actions and targets that also include guidelines for circular procurment.







KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - A CITY WITH HIGH-VALUE USE OF RESOURCES		KPIS - A CITY WITH HIGH-VALUE USE OF RESOURCES
Gdansk reduces its municipal and industrial waste generation.	☆~◆◆☆☆☆☆ ◆◆	Mg/y of municipal waste generated per capita.
2. Gdansk terminates all use of landfills by 2040.	本46 ★童育◆◆	Mg/yof waste going to landfill annually per capita.
3. Gdansk improves its virgin resource efficiency.	☆ 4 6 本 童 育 章 ② ≦	Mg/y of virgin resources consumed by industry per zł gross metropolitan product (GMP).
 Gdansk recovers maximum value from waste streams, both industrial and municipal. 	☆ 4 6 本 前 前 章 ◆ 6 至	Average revenue/profit per tonne of recovered waste.
Gdansk empowers all citizens to reduce their resource consumption and recover resources.	☆ 46411111111111111111111111111111111111	% of the population that has access to the tools, infrastructure and knowledge needed to reduce consumption and recover material value.
Gdansk ensures that nutrients from all biotic wastes are returned to natural cycles.	A40A1M6中0至	Percentage of organic waste processed to recover nutrients and return them to soil.
7. Gdansk reduces its reliance on critical (scarce) materials.	☆ 4 6 本 童 前 電 全 ② ≦	Mg/y of critical (scarce) materials consumed by industry per zł GMP.
Gdansk improves information flows on waste production and processing between stakeholders and the City.	4 4 6 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Qualitative assessment of the quality of information flows.
Gdansk raises awareness on the importance of zero waste among citizens and tourists.	A 4 6 4 篇 简 章 ④ 至	Percentage of citizens and tourists aware of the importance of waste reduction (qualitative assessment through surveys).



VISION: A CONNECTED CITY FUELED BY CLEAN ENERGY



In 2020, Poland lagged behind on other European countries. Whereas many countries were adopting zero-emissions goals, Poland held on to its national tradition of coal. Although Gdansk, benefitting from its coastal location, suffered less from poor air quality than many other Polish cities, this didn't take away the harmful emissions resulting from fossil fuel dependency and a total lack of renewable energy.

Today, Gdansk is a proud zero-emission city, running fully on renewable energy. After starting a large sprint in 2020, the Polish national target of 21% renewable energy was easily achieved. Reducing energy use was a central focus for the city. The municipality played an exemplary role by retrofitting their own building stock and making the potential for renewable energy visible. The windy city, furthermore, leveraged its coastal location and installed wind turbines where possible. It also rolled out a large campaign including subsidies for energy efficiency measures in residential buildings and subsidies to install solar panels for private property owners and industries. Districts that are more suitable for energy production make up for districts where energy production proves to be challenging. Surplus electricity goes to the Tri-City cooperation where it is shared with other municipalities. Winters in Gdansk are cold as always but heating is now provided by a plurality of sources including rest heat of industry, surface water and data centers.

Gdansk is accessible to all its inhabitants through different modes of clean transportation. This has been fundamental in the shift towards zero emissions and improvement of air quality. Both citizens and visitors of Gdansk move comfortably through the city mostly by bike or foot for short distances. Every district has small mobility hubs that connect the surrounding natural spaces and other neighborhoods - a far more attractive and affordable option than travelling by personal car. Electric personal vehicles are still available in the suburbs and are used only for greater distances outside of the coverage of public transportation. The municipality gradually fossil fuel cars out by adopting integrated circular planning principles to design public space for people instead of cars. It is hard to believe how many parking spaces the city once held. The cities in the Tri-state area collaborate to arrange regional public transportation.

WAYS FORWARD: A CONNECTED CITY FUELED BY CLEAN ENERGY

Insights from workshop

v showed that car use is a strong aspect of culture and infrastructure in Gdansk, but that there is interest to stimulate active modes of transportation.

Challenges:

- · Too few parking spaces for the number of cars.
- New parking lots are currently under construction and will stimulate/facilitate easier car use.
- Some residents might be reluctant to decrease car infrastructure.

Opportunities:

- There is momentum around the potential of turning parking lots into green spaces;
- · Initiating car free-zones;
- · Increasing number of bike-lanes in the city.

Potential starting points:

- 1.Start with temporary green parking lots; preferably by introducing a new direct functionality, such as public seating area or a pop-up coffee corner.
- 2.Set up an initiative to create a relevant "arterial" biking lane through the city of Gdansk, that rapidly connects residents between major areas.

Existing strategies and policy documents

- Environmental Protection Program Pomeranian Voivodeship 2018-2021 (Program Ochrony Srodowiska Wojewodztwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Low Carbon Economy Plan Gdansk (Plan gospodarki niskoemisyjnej dla Gdanskiego Obszaru Metropolitalnego).
- Electromobility Development Plan (2017).

What's already happening?

- · Creation of a strategy around electric mobility.
- The Development Forum of the Gdansk Agglomeration (in Polish known as FRAG- Forum Rozwoju Agromeracji Gdanskiej) is working with residents, experts, and scholars from the Gdansk University of Technology to create a pedestrian friendly and socially inclusive design of Podwale Przedmiejskie in the historic center of Gdansk.



INSPIRATION: A CONNECTED CITY FUELED BY CLEAN ENERGY





New York City "Street Seats"

Street Seats is a program where New York organizations and businesses can apply to transform underused street areas (e.g. sidewalks and parking lots) into vibrant social spaces, between the months of March through December.





Public bikes

In the Netherlands, public bikes are available with the national public transport pass. This improves the last-mile transport and stimulates both active mobility and the use of public transport.



From parking to urban parks

<u>Dallas</u> has converted a 3-acre parking lot into a public park and gathering place in the center of the city. Similar transformations have also been completed in other cities, such as <u>Santa Monica</u>, Chicago and Washington.



Community cargo bike sharing in Budapest

<u>Cargonomia</u> was born out of the collaborations between a local bike repair shop, a bike delivery company and a farming cooperative in Budapest. Today, the initiative not only showcases local and clean food delivery, it has also become a community hub that runs repair workshops, organizes events and rents out cargo bikes.



Bike network Pesaro (Italy)- Bicipolitana

To provide a safe and continuous cycling network that connects users to the various parts of the city, the city of Pesaro created fourteen "lines" crossing the city. Among these cycling lines is a primary network that connects suburban neighborhoods with the city centre. A secondary network links the primary network with main points of interest and services in the center. A key element of the program was its branding, that represented the city lines in a similar way as a subway map, with different colours for each line. The city saw a 50% increase in cyclists in the city within two years of launching the Bicipolitana network.





KEY PERFORMANCE INDICATORS TO TRACK PROGRESS

OBJECTIVES - A CONNECTED CITY FUELED BY CLEAN ENERGY		KPIS - A CONNECTED CITY FUELED BY CLEAN ENERGY
 Gdansk maximizes local electricity production from renewable resources. 	♣ ♦ ♦ ♦ ♦ ♦ ♦	Locally generated renewable energy percentage of total energy use of Gdansk.
2. Gdansk minimizes GHG emissions.	A + 6 A A A W S A O E	$\ensuremath{Mg/y}$ of $\ensuremath{CO_2}$ equivalent GHG emissions per person / GMP.
Gdansk minimizes car use and maximizes public transport and bike use.	五 4 6 4	Percentage of total city transport use divided over car, public transport, bike and foot.
4. Gdansk improves cycling infrastructure.	五46411111111111111111111111111111111111	Length of total amount of cycling lanes in meters.
5. Gdansk maximizes energy efficiency of buildings.	A + 6 A A A W TO A O E	$\mbox{Mg/y}$ of \mbox{CO}_{2} equivalent GHG emissions of residential, commercial and public buildings .
6. Gdansk maximizes use of rest heat from industry and data centers.		Total GJ of rest geat used to heat buildings, as a percentage of total heating demand.
7. Gdansk abolishes all coal burning for the heating of homes by 2030.		Share of Coal in gross final energy cconsumption.
Gdansk improves air quality until below EU Limit Value and WHO Guideline.	五46411111111111111111111111111111111111	$\text{PM}_{2.5}$ and PM_{10} levels (in $\mu\text{g/m}^3$).



VISION: A RESILIENT CITY WITH A HEALTHY ECOSYSTEM FOR ALL SPECIES



In 2020, both the quantity and quality of green space in Gdansk was declining. Rapid urban development came at the cost of the natural ecosystem, initiating a trend of suburbanization and imperviousness. Gdansk became increasingly prone to flooding. The citizens of Gdansk were disconnected from their natural ecosystem, and littering became a significant problem inlocal forests and beaches. Although the municipality had strong goals to maintain sufficient space for biodiversity, water retention as well as spaces for gathering, implementation proved challenging.

Today, Gdansk has shifted to a new paradigm in which the economy and society are understood as subcomponents of the natural environment. The urgency of global climate change and the COVID-19 pandemic in the early 20s triggered the understanding that a separation between cities and nature was no longer viable and called for a shift towards a more resilient system of integrated green spaces that provide a regenerative environment for all species, including humans.

Nowadays, urban communities are built around the shared understanding that the health of natural systems underpins all of human wellbeing - ecosystems are supported to provide a safe and habitable environment that can in turn support a thriving community. This is reflected in circular urban design principles that promote thriving ecosystems such as healthy soils. Every district holds

a constellation of public green spaces owned and maintained by neighborhood coöperations stimulating local stewardship. These include community farms for food provision, recreation- and gathering spaces, high-quality parks in which most grass has made place for wildflowers and local native plants that support soil health and water retention.

Green, living roofs, and facades provide benefits to the health and happiness of Gdansk's community as well as an aesthetic ally pleasing cityscape. Neighborhoods are connected by green corridors and public spaces are built on roads that are now obsolete due to the shift away from the personal car. Water retaining roofs harvest sufficient rainwater, and local composting combined with nutrients that are harvested from wastewater facilities provide sufficient resources for ecosystems to thrive.

A newly found connection to the local environment has led to a shift towards a local diet away from meat and most importantly, a shift in consciousness for the inhabitants of Gdansk. Simpler living, closer to nature, and personal efforts to reduce unnecessary consumption have become the norm. This, combined with more active lifestyles and improved public healthcare, has led to declining public healthcare costs. Instead of producing for export, the farms in the city's immediate surroundsnow provide food for local processing and consumption. Local community farms include aquaponic systems to provide sufficient

local produce. Children are stimulated early on through educational programs that connect them to natural ecosystems. Field trips and visits to local community farms support their understanding of the food system, and the concept of regenerative, closed loops. The municipality of Gdansk is a steward of the peri-urban region allowing natural environments to thrive for their own intrinsic value and ensuring that the city stays compact by limiting sprawl.

The use of groundwater has been reduced drastically due to the upgrade of wastewater treatment facilities and new local water systems that enable grey water use for households. The water quality in the Baltic has dramatically improved. Conservation of Gdansk's beautiful beaches, the Baltic Sea and Vistula, and forests lie at the heart of everyone living in the city, but also to the visitors of Gdansk. The city works to ensure that visitors and newcomers to the area are informed about stewardship practices.

Although Gdansk has regulated the number of tourists visiting the city, it is still widely known as an attractive tourism destination. The municipality makes sure that all visitors coming to enjoy Gdansk's monumental cityscape and beautiful coastline comply with sustainability regulations. The city of Gdansk has built resilience by embracing its natural ecosystem and the benefits it can provide by creating the conditions for all species to thrive.

2

INSPIRATION: A RESILIENT CITY WITH A HEALTHY ECOSYSTEM FOR ALL SPECIES

Insights from workshop

Our workshop with city stakeholders showed interest in stimulating more green spaces in the city of Gdansk. Extensive piloting is already underway, specifically around the topic of nature-based solutions and rainwater retention. The following challenges and opportunities were identified in the workshop:

Challenges:

- Old monuments in the city center have restrictions for green roofs and facades.
- Local food production is still difficult due to limited funds and space.

Opportunities:

- · There is growing support for nature-based solutions.
- New developments need a larger required % of green space in their plans.
- Permeability of public spaces (parking lots and squares) can be improved.
- There lies potential in protecting the wetlands in and around Gdansk.

Potential starting points:

- 1. Work with community organizations and the municipality on the inclusion of more green space in upcoming developments.
- 2.Start a pilot campaign around creating green facades/walls. Requires allocated funding, and provision of information on techniques and types of suitable plants.

Existing strategies and policy documents

- Environmental Protection Program Pomeranian Voivodeship 2018-2021 (Program Ochrony Środowiska Województwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony środowiska dla miasta Gdanska na lata 2015-2018 z perspektywa do roku 2020).
- Gdansk Water Strategy 2018 Stage 1 (Gdanska Polityka Wodna etap 1 2018).

What's already happening?

- The **OSTAB** program is working on creating a connected network of green spaces through the city of Gdansk.
- Throughout the city, various nature-based solutions are implemented, primarily around capturing and improving the quality of rainwater.



INSPIRATION: A RESILIENT CITY WITH A HEALTHY ECOSYSTEM FOR ALL SPECIES





Hamburg's Green Roof Strategy

The city of Hamburg in Germany has implemented an incentive program that provides subsidies to homeowners who install green roofs on their buildings. Subsidies are tied to the multifunctionality and quality of the green roof, favouring to designs with higher rainwater capture or solar energy generation.



Circularity on the ground

De Ceuvel, a sustainable office park built on the site of a former shipyard in Amsterdam North, is home to 17 workspaces and a popular community cafe. It provides an example on how to transform the post-industrial area (with contaminated land) into a mixed-use residential and commercial area.



"DrainGardens" in Austria

Like many other communities in Austria, Ober-Grafendorf has experienced an increase in heavy rainfalls and flooding incidents. As a nature-based alternative to a costly expansion of sewage capacity, the town constructed various small-scale "DrainGardens" along urban streets that capture and slowly release excess rain water.



Aquaponics in Vienna

<u>Blün</u> - a Vienna-based start-up for integrated urban food production - demonstrates that fish and vegetables can be produced in a fully circular system in urban areas. Apart from reducing the amount of fertilizer and water needed, Blün also showcases circular packaging and logistics systems to deliver their goods.



Nature inclusive construction

Through integrating green space in the built environment, habitats can be created for insect and bird species in cities. Examples of nature inclusive design are bird's nests in building elements, green walls and roofs and insect hotels. In addition, greenery can contribute to water retention, decrease the urban heat island effect, improve air quality and provide a comfortable living environment.





KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - A RESILIENT CITY WITH A HEALTHY ECOSYSTEM FOR ALL SPECIES		KPIS - A RESILIENT CITY WITH A HEALTHY ECOSYSTEM FOR ALL SPECIES
1. Gdansk improves water drainage capacity of the entire city.	五~◆▲血´´´、◆◆ ◆	Water draining capacity in m³/m per neighborhood.
2. Gdansk improves rainwater capture for irrigation.	五 4 6 4 1 m 专 全 ② ≦	m³/y of rainwater captured as a share of total rain fallen in the city.
3. Gdansk reduces its flood risk.	五~◆▲ 魚 賞 賞 ◆ ◆ ● €	ha of urban land use prone to flood risk.
 Gdansk promotes green spaces for all species to thrive within all districts including space for gathering, biodiversity and water retention. 		m² of space for the natural environment to thrive/total m² of the district.
5. Gdansk protects its natural assets of beach, forest and sea.		ha of natural areas under legal environmental protection.
6. Gdansk supports programs to increase biodiversity in the Tri-City Region.	☆ 4 ○ ◆ 章 ※ ● ◆ ○ ●	% of public funding invested to increase citizen's awareness of urban nature and ecosystem services, and educate urban citizens about sustainability and the environment.
 Gdansk enhances peri-urban food production and local resource cycling. 	▲ 4 6 4 1 m 電車 ● ≦	Mg/y of food produce in peri-urban areas of Gdansk.% of organic waste generated in Gdansk that is returned to the local soil.
8. Gdansk enhances citizen's awareness of the importance of ecosystem services.	五46411111111111111111111111111111111111	% of residents in Gdansk that have knowledge on the importance of ecosystem services



A SUSTAINABLE, DIVERSE AND AFFORDABLE BUILT ENVIRONMENT



The 20's in Gdansk were characterized by suburbanization, an influx of global corporations, and increasing housing prices. The city was on a fast track to becoming unaffordable for its citizens, ultimately resulting in young inhabitants leaving the city to try their luck elsewhere. During this time, neighborhoods were designed using an abundance of concrete- hardly any building materials were reused. Construction materials ended up in incineration plants or as low-value aggregate for other uses.

This all changed when the city committed to a model of circular construction, integrating circular principles into all tendering guidelines and installing building materials hubs governed by the municipality. The city now makes use of new technologies including a monitoring system for construction materials. In the early 20s, nine areas were up for redevelopment. Of these, four were used to experiment with the use of secondary construction materials, innovative low-impact building materials, flexible zoning regulations, and new energy efficiency guidelines.

A few example buildings were selected to showcase the possibilities of constructing with secondary building materials, inducing a new trend in local design. The new monitoring system has led to Gdansk's early achievement of a 70% recycling rate of construction materials. Commitment from the

private sector to provide insights in to the materials used in construction and demolition has catalyzed collaboration within the construction sector. Nowadays architects, developers, the municipality, and future communities all work together to design the neighborhoods that they want to live in. Here, material passports made mandatory in 2025, ensure that at the end of a building's lifetime materials can be reused in new projects contributing to diversity and aesthetic value. Gdansk holds a mix of old historic buildings and modern buildings including those made of wood and energy-generating facades.

Local residents have a strong influence on the urban development process and have agency to create the environment that they want to live in. Public space is stewarded by the community to ensure the maintenance and plentiful integration of green. Diversity is promoted not only in terms of demographics by providing a plurality of housing typologies, but also by promoting mixed-use and local services that foster social cohesion. Every district has multiple community centers that provide local programming and training programs. The city built out its participatory budgeting system and has given neighborhood agency in local decisions while keeping its central role to ensure that all districts are planned to allow for different typologies complementary to the Gdansk everyone wants to live



INSPIRATION: A SUSTAINABLE, DIVERSE AND AFFORDABLE BUILT ENVIRONMENT

Insights from workshop

Our workshop with city stakeholders pointed out the large role that the municipality of Gdansk has to play in reaching this vision, through implementing more stringent guidelines for urban development, energy performance and material use.

Challenges:

- PSZOKs often lack expert knowledge.
- Circular design criteria are often not included due to fear of an invalid tender or increased costs.

Opportunities:

- Improve the functioning of PSZOKs with more expert knowledge, and more space to store and process (construction) materials.
- Include stricter top-down criteria for the inclusion of recycled, bio-based and locally sourced materials.

Potential starting points:

- 1.Start an information campaign with the municipality to promote circular construction interventions that result in cost savings over time, (such as higher insulation requirement) or that require little to no extra investment.
- 2. Distribute information on building projects that have implemented circular or sustainable criteria in the tri-city area, icon projects, to demonstrate that it can be done successfully.
- 3. Organize a roundtable discussion with local parties in the construction sector to discuss stimulating circular construction and ways to collaboratively overcome barriers.

Existing strategies and policy documents

- Municipal Revitalization Program of the City of Gdansk in the years 2017-2023 (Gminny Program Rewitalizacji Miasta Gdańska na lata 2017-2023).
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony środowiska dla miasta Gdańska na lata 2015-2018 z perspektywa do roku 2020).

What's already happening?

 The Development Forum of the Gdansk Agglomeration (in Polish know as FRAG- Forum Rozwoju Agromeracji Gdanskiej) focuses on spatial issues of re-urbanization and revitalization, with a focus on building a strong local economy.



INSPIRATION: A SUSTAINABLE, DIVERSE AND AFFORDABLE BUILT ENVIRONMENT



De Groene Grachten

De Groene Grachten is an organization in Amsterdam that was brought to life specifically to stimulate the sustainable renovation of historic buildings and monuments, such as the buildings along Amsterdam's historic canals.



Material passports

<u>Madaster</u> is an online platform that allows property data to be stored, The platform gives identity to the materials present in building, allowing for potential high value reuse. Under the EU's BAMB project a similar platform has been created, aiming to provide a onestop-shop for a circular building sector.



ReBuilding Center, Seattle

Located in Seattle, the <u>Rebuilding Center</u> is North America's largest hub for salvaged building materials. Apart from diverting building materials from landfill, the center focuses on community training in carpentry, plumbing and repair.



Circular standards

The City of Amsterdam has implemented the principles of circular tendering (i.e. the circular performance of a building project) in six circular housing projects.



Slovenia's largest wooden building

Born out of an EU-funded project, the research institute <u>InnoRenew</u> has started to build their new research building, using innovative timber construction methods. The building will function as a living lab to foster knowledge on renewable materials in construction.



De Warren- cooperative living

<u>De Warren</u> is a cooperative living and sustainable building project, initiated by 50 driven individuals in Amsterdam. Through crowdfunding, loans, private investment and some sustainability subsidies, the group is building a super sustainable apartment complex of 16-20 apartments, that will provide long-term sustainable and affordable housing to the city.



KEY INDICATORS TO MEASURE PROGRESS



OBJECTIVES - A SUSTAINABLE, DIVERSE AND ACCESSIBLE BUILT ENVIRONMENT		KPIS - A SUSTAINABLE, DIVERSE AND ACCESSIBLE BUILT ENVIRONMENT
 Gdansk includes densification and sprawl prevention requirements into its development plans. 	五464mm多变多至	Perhaps expand of newly developed areas in m²/m²
2. Gdansk facilitates increase in construction waste collection.	☆ 4 6 4 立 m 专 中 ⊙ ≦	 Mg/y of construction waste collected seperately, as a share of total construction waste.
		of PSZOK points collecting construction waste.
3. Gdansk improves reporting on construction waste production.		Mg/y of on-site construction waste generated.
4. Gdansk facilitates secondary construction material sourcing.	★ 4 4 1 111 	Mg/y of secondary construction materials used.
Gdansk sets up green public procurement policies for public space & municipal real estate.		Percentage of procurement using environmental criteria compared to total procurement of the city administration.
6. Gdansk sets quota for social housing per neighborhood.		% of m² social housing development/ all m² housing development.
 Gdansk includes citizens and community goals within its strategic development plans. 	440 A A M M & 40 E	% of community representatives included in strategic meetings for urban (district) development.
8. Gdansk ensures equitable distribution of recreational and blue-green space.		 Number of community development initiatives related to sustainability or circularity supported by Gdansk per 10 000 capita.
		 Availability and distribution of space with respect to specific individual or household socioeconomic profiles and landscape design, measured using GIS and statistical analysis.



VISION: A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION



The municipality of Gdansk, in collaboration with the Pomorskie Region, has transformed its economy. A thriving local economy that generates and preserves value through innovative solutions and new business models while providing local job security has emerged. This makes the city an attractive place for young people to start their entrepreneurial endeavors.

This new economic system is not aimed at growth. Circular business models such as product-as-a-service help to bring the city's consumption-related impacts within the boundaries of the city. In many cases, value for the community is generated independently of finance and materials. This is visible in a rich sharing economy, local direct exchanges of goods and services, a strong culture of repairing and reusing goods, and second-hand markets.

Gdansk made use of its strengths as a port city, the connection between industry and academia, developments in IT, and cooperation networks in its transition. The implementation of a designated circular hub in one of the old shipyards instigated a new culture of innovation. In the early 2020s, Gdansk tested and scaled up new circular business models in several sectors, going beyond recycling towards a broader concept of valorization of local waste streams. For example, companies in construction

transport now have a 'sharing' business model together with waste collectors, which allows them to share trucks. In this way, they limit transport in the city and share the capital costs of trucks. Another example is a company that buys discarded furniture from offices to refurbish, and to give second life in schools and cafe interiors.

Flexible municipal regulations allowed for local piloting, creating an enabling environment for testing and scaling up new solutions on a larger scale. At the same time, the municipality, in collaboration with the Pomorskie Region, stimulated the growth of regional end markets and demand for circular products and materials through procurement and other incentive frameworks. The first circular innovation hub, piloted in the 20s in the harbor area, proved successful, and more hubs have now been implemented in many of the historic industrial neighborhoods.

Gdansk has become a city where creativity and innovation starts at primary school, becomes a specialization at the largest academic center in Poland, and manifests itself through an accessible network of local entrepreneurs and circular business. Gdansk has become a city that invites young people to stay.

INSPIRATION: A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION

Insights from workshop

Various interesting and necessary trajectories were identified during our workshops with city stakeholders, involving across a wide variety of actors in the Tri-city area.

Challenges:

- People often throw away furniture close to home, in the trash, whereas these products could be input for local entrepreneurs.
- City officials could benefit from an increased understanding of the relevance and potential of the circular economy.

Opportunities:

- · Create a Zero-Waste tourism covenant.
- Initiate an Upcycle Boulevard in Letnica, with pick-up service, or dedicated pickup times.

Potential starting points:

1.Create a system that helps to collect furniture and other valuable household products by picking it up from the home. This requires a point of contact, but also a network of local entrepreneurs or organizations that can either store, process or sell the products.

Existing strategies and policy documents

Gdansk 2030 Plus Development Strategy.

What's already happening?

- Gdansk has one of the best Polish startup accelerators: Space3ac., as well as other incubators like Starter. Infrastructure for startups is another strength, centered around the Olivia Business Centre and O4 Coworking.
- The EU RUGGEDISED project, in which Gdansk will study the smart solutions installed in other lighthouse cities in view of its own future implementation.
- The UP foundation supports local development through intersectoral collaboration between businesses, NGOs and public institutions, with a strong focus on social responsibility.



INSPIRATION: A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION





Fresh venture building

Fresh is a venture building program in the Netherlands that aims to support entrepreneurs in creating new ventures that address the world's systemic challenges. The program brings together entrepreneurs and experts, and provides mentoring and financial support. Perhaps a similar program, centered around the circular economy, can be initiated in Gdansk in collaboration with incubators like Space3ac or Starter.



CIRCO Circular Economy tracks

<u>CIRCO</u> is an organization that teaches classes about the circular economy to help kickstart circular initiatives, visions, and businesses. Two thirds of attendees have been shown to actively engage in circular economy projects after attending the tracks.



Circular Built Environment (CBE) Hub

Technical University of Delft is collaborating with the Amsterdam Institute for Advanced Metropolitan Solutions (AMS) and leading partners in the construction industry through the CBE hub. The hub manifests itself as a platform through which diverse parties conduct coordinated research and do innovative projects around circular buildings.



PeelPioneers

The Dutch company <u>PeelPioneers</u> transforms orange peel waste from restaurants, hotels or supermarkets into valuable products for the food industry.



INSIGHT

The EU-funded <u>INSIGHTS</u> project works on developing a curriculum and training program for a new professional profile: the industrial symbiosis facilitator who identifies synergies between regional sectors and helps them to establish material or energy exchanges.



Kalundborg - The world's first ecoindustrial park

Established in the 1970s, Kalundborg Symbiosis is the world's first example of industrial symbiosis. Over 14 industrial partners mutually share energy, water and materials, saving over 635 000 tons of CO₂ and 24,2 million euros in economic expenses per year.





KEY INDICATORS TO MEASURE PROGRESS



OBJECTIVES - A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION		KPIS - A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION
Gdansk attracts, facilitates and upscales circular, cleantech (impact-reducing) startups.		Number of startups established in Gdansk surrounding zero waste, recycling, remanufacturing, reusing and recovery of resources, as a share of all companies.
Gdansk connects its rich academic scene with local and international businesses.		# of joint R&D programmes for universities and business.
Gdansk ensures citizens have the right type of training/experience to have meaningful circular jobs.		Number of training/experience and educational programmes related to circular/manufacturing employment.
 Gdansk leverages its history of manufacturing to enhance manufacturing employment. 	五464mmm 雪季 ① 至	Manufacturing employment as a proportion of total employment (SDGs).
Gdansk boosts circular innovation in material intensive sectors (manufacturing, logistics, transportation and waste treatment).	▲ 40411111111111111111111111111111111111	Share of Polish patents related to waste management and recycling.
Gdansk joins world leading cities in developing, testing and scaling new technologies relating to the circular economy.		Total revenue from the cleantech sector in Gdansk as a share of GMP
Gdansk supports bottom-up community initiatives on sustainability and circularity.		Number of community initiatives related to sustainability or circularity supported by Gdansk per 10 000 capita.



Background report: in-depth current state analysis

ANALYSING GDANSK'S CURRENT-STATE

The vision for Gdansk and inspirational cases laid out in the first section of this report are the result of an in-depth **current-state analysis** of different fundamental layers of Gdansk (history, built form and natural environment), as well as a deep dive in to four key sectors which have been identified as essential starting points for a circular economy in Gdansk. To understand circular opportunities in each focus sector, this deep dive consist of three essential steps.

ANALYSIS STEPS







Stakeholders and policies

In this step, the aim is to understand the policy landscape and map existing and possible stakeholders to drive the circular transition.

We identify existing policy goals relating to Gdansk's city development strategies, water-, energy-, waste policies, and relevant policies for Pomorskie Voivodeship.

To drive the transition to a circular economy, engaging with the most important stakeholders of the city is crucial. We conduct interviews with core stakeholders in the waste and utility systems, commercial, and governmental spheres as well as community organizations.

Mapping material flows

Material flow analyses are a way to represent the urban metabolism of Gdansk: they not only show how energy, materials and water are passing through the city, but also give insights into environmental impacts and opportunities for circularity.

Each of the lines represents a different resource category.

- The lines are scaled so that their thickness corresponds with the total material mass of that category, with material inputs entering on the left and waste streams exiting on the right.
- All of the flows are based on actual data collected from the municipality and other stakeholders in Gdansk. All data sources and the methodology are explained in a separate document.

Mapping opportunities

In this step we create spatial maps of circular opportunities. Different districts have different functions within a city. For the four focus areas, we identify which areas of the city hold the greatest circular economic opportunity, and where the most impact can be made.



REVISITING THE CITY: A HISTORY OF GDANSK

Describing Gdansk's past as 'eventful' is an understatement. Standing at the end of Gdansk's long wooden pier one can see two of the most important sites in 20th century history: the spit of land where World War II began, and the shipyard where the Cold War began its long and gradual final act.

Becoming a dynamic international trading hub

Gdansk achieved its status as an important center of trade and culture in the 16th century, fueled by its diverse ethnic make-up and strategic location. This has also made the city attractive to outsiders. Under the reign of Teutonic Knights in the 14th century, Gdansk joined the Hanseatic League, a mercantile organization, which led to the development of its role as a seaport. The

King of Poland regained the city 150 years later and granted local autonomy in gratitude for its loyalty.

Gdansk expanded greatly, reaching its peak during the Renaissance as the most prosperous port on the Baltic, bringing with it religious freedom and tolerance. Legions of international traders were tempted to join the local German–Polish population, adding their own cultural influences to the city's unique blend.



Figure 9: A history of Gdansk.

REVISITING THE CITY: A HISTORY OF GDANSK

A free city

Poland's partition at the end of the 18th century led to Prussian annexation of the city. Gdansk lost its primary trade routes, setting off its decline. Caught in a tug-of-war between Germany and Poland, the city once again gained independence after the German defeat in the First World War.

But this didn't last long. German military attempts to re-incorporate Gdansk marked the beginning of World War II, resulting in the city becoming a smoldering mass of rubble, heroically rebuilt in the next decades.

Yet the city's tumultuous history and impressive rebuild are not what it is primarily known for. Triggered by revolts by worker associations in the many shipyards in the 80s, Gdansk became the city where the Solidarity movement was born, forming a crack in the Soviet Bloc that gradually led to the emergence of a new political map of Europe. Gdansk became a city the world will always associate with free trade unions and the start of the downfall of the communist system (22).

The 'Young City

The rich history of Gdansk and the revolts of worker associations in the 80s have strengthened the feeling of uniqueness by the inhabitants of Gdansk (23). Today this rich history is visible throughout the city, most notably in the Main Town, which, after being destroyed in World War II, has been rebuilt to resemble historic Polish style. Although a landmark for tourists, some argue that the neighborhood is no true representation. Further development in this style is dismissed by many architects. Oliwa and Wrzeszcz, old pre-war tenement districts, however, are places seen as a representation of real Gdansk culture (24).

The old shipyard days are over and the areas are being redeveloped into a bustling new waterfront destination, the Young City. Here Gdansk's identity as the "The City of Freedom" comes back in a monument for the Fallen Shipyard Workers and the many visitors looking for a fun night on the town (25).

For a long time, the economy of Gdansk was built on its long tradition of shipbuilding. Gdansk is now center stage of urban development focused on tourism and catering to a new service-oriented industry (22).

- (22) Polanska, D. (2008). Decline and revitalization in post-communist urban context: a case of the Polish city—Gdansk. Communist and post-communist studies, 41(3), 359-374.
- (23) Tusk, D. (1996) Był sobie Gdansk. (There was a Gdansk). Gdansk: Dar Gdanska.
- (24) Bossak-Herbst, Barbara, 5. The Changing Image of Gdansk, Poland From Regained Homeland to Multicultural City in Nas, P. J. (2011). Cities full of symbols: a theory of urban space and culture (p. 303). Leiden University Press.
- (25) Scoppetta, C. (2011). The Polish seaport-city of Gdansk. A gateway for the Baltic Sea EU macro Region. Portus Plus, 2.

COMMUNITY: LIVING IN GDANSK

Who lives in Gdansk?

Quality of life in Gdansk has been on a steady upward trajectory and has seen improvements in almost every aspect since 2012, most notably in the public transportation system, quality of public space, and work, as well as a sense of security (26). This has led to an influx of new inhabitants, which is expected to grow further in the coming decade. Workforce migration will likely make up for the forecasted drop in natural growth. This in turn will further strengthen the labour market and attract new (international) businesses.

A thriving port city

Gdansk's coastal location is arguably its most important asset. The port of Gdansk demonstrates a diversified handling capacity as well as favorable navigation and infrastructural conditions, allowing it to handle the world's largest container ships. Gdansk also uses its mercantile strengths to develop other industries connected with transportation, in particular, the logistics sector, with manufacturing and warehousing facilities linked with refineries and chemical industry. There is still plenty of space for economic development in Gdansk, both in the vicinity of the port and near the Gdansk ring road, that are an attractive development factor for industrial production and logistics. Unused land from closed shipyards also provide opportunity. Gdansk's intensive road network stands out other metropolitan areas in Poland.

Working in Gdansk

Though there are bigger labour markets for an educated workforce than Gdansk (only the sixth biggest city in Poland), the Tri-city potential of Gdansk, Gdynia and Sopot is compelling for global corporations. This has led to the recent development of the city's biotechnological and ICT sectors. An increase in labour demand has in turn caused a gradual decrease in the unemployment rate, which was only 2,3% in 2019, with long-term unemployment contributing to ca. one-third of this number (27).

(26) Statistical Office in Gdansk. (2019) Demographic situation of the Pomorskie Voivodship in 2018. Retrieved from: source

(27) Wieczerzak, J. (2018). Rozmieszczenie i gęstość zaludnienia obszaru metropolitalnego Gdansk-Gdynia-Sopot. Prace i Studia Geograficzne, 63(4).





GREEN SPACE BY CITY DISTRICT (green space in m²/person)

- 0 120
- 120 500
- 500 700
- 700 1 600
- 1 600 2 370
- Rivers
- Waterways
- Beach

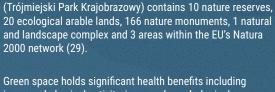
(28) Municipality of Gdansk (2015). Low carbon economy plan for Gdansk cities.
(29) Pomeranian Landscape Park Complex.
(n.d.). FORMS OF NATURE PROTECTION.
(30) Bertram, C., & Rehdanz, K. (2015). The role of urban green space for human wellbeing. Ecological Economics, 120, 139-152.
(31) Biela, I. City of Gdansk. (2018, January 1). "I couldn't do it in the countryside" - see how the last Gdansk farmers live. City of Gdansk.

(32) Nabrdalik, M. and Santora, M. (2018, April 22). Smothered by smog, Poland's cities rank among Europe's dirtiest. New York Times. (33) Wiśniewska, K., Lewandowska, A.U. & Staniszewska, M. Air quality at two stations (Gdynia and Rumia) located in the region of Gulf of Gdansk during periods of intensive smog in Poland. Air Qual Atmos Health 12, 879–890 (2019).

(34) Municipality of Gdansk (2015). <u>Low</u> carbon economy plan for Gdansk cities.

The Baltic Sea links Gdansk to the Baltic countries and Hanseatic traditions of the region. The Bay of Gdansk is home to Poland's principal seaport and one of the Baltic's main international transport hubs.

Beyond its stronghold as an economic gateway for the city, The Bay of Gdansk is home to a number of beaches which contribute to the region's tourism success.



Gdańsk is shaped by its natural location at the mouth of the

Vistula Delta - green spaces, agricultural land and nature

The region's largest green space, the Tri-city Nature Park

reserves can all be found within the city boundaries of

Gdańsk

Green space holds significant health benefits including increased physical activity, improved psychological well-being, and moderation of adverse environmental effects (noise and urban heat island effect). It furthermore promotes biodiversity in cities. Optimally, every inhabitant would have access to 36 ha within 1km of their home (30). Most neighborhoods in Gdańsk hold sufficient green space.

Urban farms dot the outskirts of the city, growing seasonal vegetables and flowers that supply local processing facilities and wholesalers (31).

Flood vulnerability affects Gdansk, being located on the outskirts of the Vistula Delta (Zulawy) with a large part of the Zulawy sitting below sea level. Land reclamation began in the 13th century, with the area relying on a series of polders, dikes, irrigation drainage and pumping stations (28).

The city has withstood catastrophic flood events every 20 years in the 20th century and every 6 years in the 21st century. Existing flood infrastructure has required significant improvements in recent years, with increasingly unstable weather a cause for concern with regard to future events.

5 km

0 km

2,5 km

Air pollution is a major problem in Poland, critically affecting the health of its inhabitants and the environment. It is the result of the country's primary extractive industry, coal. Coal combustion is not without costs - approximately 48.000 Poles are estimated to die from illnesses related to poor air quality annually (32). Though Gdansk's coastal location makes air pollution less of a concern when compared to most other cities in Poland, pollution still has considerable negative effect on the city's air quality (33).

Cold winters require extensive use of solid fuel heating devices, contributing to air pollution in the city - with almost 30 thousand homes heated by solid fuels in 2015 (15,9% of homes). While improvements have been made since 2017, the heating problem (34) and increased car traffic, a trend that is expected to continue, both pose a threat to Gdansk's air quality.

Key sectors in focus

OVERVIEW OF SECTORS AND EXPLANATION WHY THESE HAVE BEEN CHOSEN



WASTE

Why?

Waste might be the first thing that comes to mind related to the circular economy. A key element of the transition from a linear to a circular economy is to change our perception of dealing with resources as "waste". Improving the use of resources requires us to understand how the waste system currently functions. Analysis of the existing waste system provides an entrypoint to work across the entire material chain and identify up- and downstream opportunities towards a more circular system.

Gdansk's waste system is complex and characterized by extensive industrial and municipal waste flows. Lack of knowledge of hazardous waste can threaten local communities' health and well-being. Increasingly strict recycling policies put pressure on the capacity of wastehandling systems. Achieving a circular transition of Gdansk's waste system calls for a consolidated efforts from local businesses, public institutions as well as citizens.





MAPPING OPPORTUNITIES page: 63



Why?

The utility sector provides the fundamental resources (water, energy) for a wide range of processes in the city. Providing a steady and sustainable supply of these services is fundamental to a resilient and healthy urban ecosystem.

An analysis of Gdansk's municipal energy supply shows that the city's consumption of 10 290 GWh remains largely reliant on coal combustion. To date, 0% of Gdansk's energy demand comes from renewable energy. Harnessing Gdansk's potential to transition to a cleaner energy system is imperative for moving towards a flourishing, sustainable economy.



GDANSK'S WATER AND ENERGY SYSTEM page: 66 & 68

(%) MAPPING OPPORTUNITIES page: 69



CONSTRUCTION

Why?

Having a comfortable, safe and healthy living environment is a basic necessity for all. Yet, the creation of our built environment is currently associated with highly extractive material use and high associated embedded CO₂-emissions on a global scale.

In 2018, the construction sector worldwide was responsible for 39% of CO₂ emissions and an estimated 60% of the total global use of materials (35). In Poland, the situation is no different: construction makes up one of the city's largest material demands. With this in mind, we view the construction chain as an important leverage point to tackle when transitioning to a circular economy.

Sustainable materials, logistics, technologies and building techniques can contribute to a healthy environment in Gdansk, and contribute to the fight against climate change on a global level. Gdansk's efforts to revitalize degraded areas of the city provide important entry-points to test, develop and scale sustainable and circular building practices.

STAKEHOLDERS AND POLICIES page: 71

GDANSK'S CONSTRUCTION SECTOR page: 72

MAPPING OPPORTUNITIES page: 73



AGRIFOOD

Why?

Globalized and intensified agricultural practices are changing the functioning of ecosystems worldwide, resulting in widespread loss of biodiversity and affecting a wide range of ecosystem services.

As the largest metropolitan area in the Pomorskie Voivodeship, Gdansk and the tri-city area is a consumption center of large amounts of food, with an impact that stretches far and wide. Changing how and which food is consumed is therefore a crucial element of the transition to a new economy. In addition, focusing on sustainable, healthy food production can increase local resilience, decrease environmental impact, and contribute to healthy communities.

STAKEHOLDERS AND POLICIES page: 75

GDANSK'S AGRIFOOD SECTOR page: 76

MAPPING OPPORTUNITIES page: 77

58

Municipal Waste

WASTE

Kick-starting a circular transition in Gdansk begins with rethinking the city's waste system. In a circular economy, waste is considered a resource, and all resources are ideally cycled indefinitely instead of being sent to a landfill or incinerated to create energy. Closing waste cycles will not only keep resources cycling at their highest value, it is also tightly linked to clean energy systems, green spaces, and the health and wellbeing of Gdansk's citizens and environmental systems.

Still, not all waste is treated at its highest value. A significant portion of municipal waste from Gdansk is incinerated (21%). Heat recovery from waste is one of the lowest form of value creation from waste. An even lower form of waste treatment in the hierarchy of value retention is landfilling. Yearly, Gdansk still landfills 6 930 Mg of municipal waste. A higher quality resource recovery system can result in economic, social and environmental benefits for the city of Gdansk.

-\(\overline{\pi}\)- Highlighted opportunities:

- · Identifying higher value opportunities for selected waste streams to divert away from landfilling (medium-term) and incineration (longer term).
- •Monitoring and mapping recycling facilities as a basis to achieve a 50% recycling rate.
- · Further separation of residual municipal waste.

Industrial Waste

Gdansk's industry produces more waste yearly than its residents full stop, In 2018, local industry was responsible for 319 000 Mg of waste. Large portions of this industrial waste are treated at low value. Around 57 300 Mg (18%) of industrial waste is incinerated, and 52 200 Mg (16%) is landfilled. The petroleum industry around Gdansk contributes large flows of waste.

In circular industrial systems, firms and manufacturers closely collaborate to find opportunities for resource-sharing and waste reuse. Since industrial waste is often homogenous in character and available in larger quantities, the by-products of industrial processes can serve as a feedstock to create other high-value products. Yet, the lack of transparency and oversight into industrial waste treatment poses a challenge to successfully increase materials recovery.

-Ò- Highlighted opportunities:

- Improving monitoring of industrial waste.
- Identifying high-value opportunities for homogenous industrial waste that are currently landfilled or incinerated.
- Developing local infrastructure of recycling and reuse of construction materials.



STAKEHOLDERS AND POLICIES: WASTE

POLICY

- Environmental Protection Program Pomeranian Voivodeship 2018-2021
 (Program Ochrony Srodowiska Wojewodztwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Provincial Waste Management Plan Pomeranian Voivodeship in 2022 (Plan Gospodarki Odpadami dla Wojewodztwa Pomorskiego 2022)
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony srodowiska dla miasta Gdanska na lata 2015-2018 z perspektywa do roku 2020).

STAKEHOLDERS

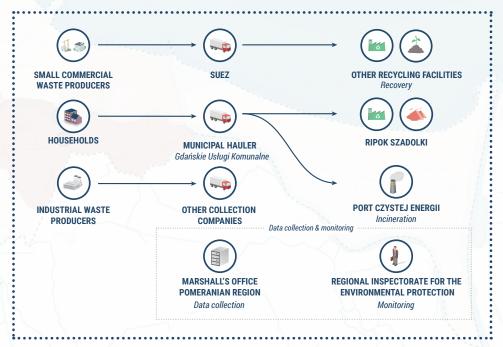
The waste system in Gdansk and other parts of Poland is comprised of the municipal and industrial waste systems. It is characterized by many different players, ranging from households and industry, private haulers such as SUEZ, the municipal waste company RIPOK Szadółki, and a plurality of waste treatment facilities. Improved reporting on waste treatment in the city will allow for a more comprehensive picture of the waste system.

Recently the city has started the construction of a waste incineration facility (the Utilization Plant on the Waste Map in this section) together with its private partners. ZU transfers hazardous waste to Port Service (private installation). The Marshall's office is responsible for data collection and there are several monitoring agencies, for example, the Regional Inspectorate for Environmental Protection monitors whether companies are complying with regulations.

KEY OBJECTIVES

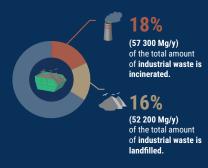
- Increase waste collection at PSZOK points, Reduce municipal waste generation,
 - · Increase no. of PSZOK points.
- Introduce repair and exchange of used items at PSZOK Points.
 - Increase the minimum recycling rate to 50% of municipal paper, metal, plastic & glass in line with EU recycling directives.

Stakeholders of the Gdansk waste system

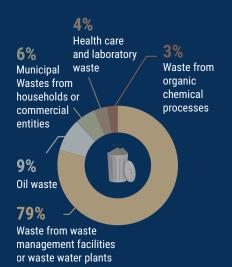


INDUSTRIAL WASTE

Large amounts of industrial waste are currently treated at low value:



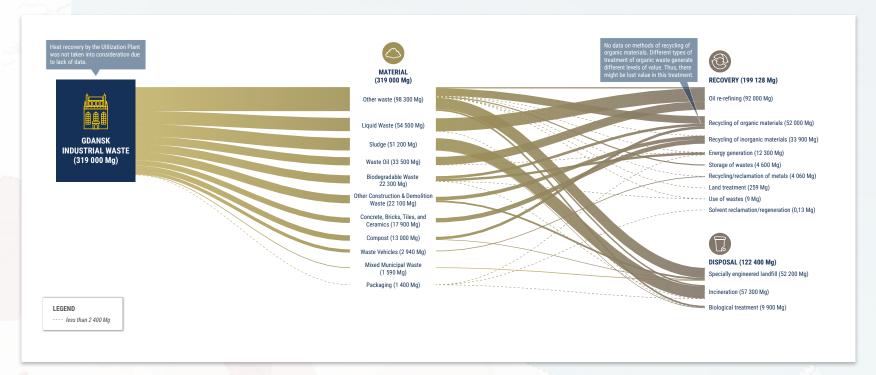
Top 5 waste types in "Other Waste" category (Total: 94 525 Mg)



4

MATERIAL FLOW ANALYSIS(a): INDUSTRIAL WASTE





Industrial waste generation

This waste category represents all waste generated by the industrial activities of Gdansk.

Collection and sorting

Industrial waste streams are more homogenous than municipal waste, and therefore do not have to be sorted as much as municipal waste. Industrial waste streams, such as waste oils and fluid waste have the potential to be refined and recycled at high value.

End of life

A large portion of industrial waste in Gdańsk is currently sent to landfill or recycled at low value: 57 300 Mg/y of industrial waste are incinerated, 52 200 Mg/y are landfilled. As compared to municipal waste, this is a very large proportion. This lays out large potential for higher value processing of industrial waste.



MUNICIPAL WASTE

The ambition of the municipality is to:



"Increase the minimum recycling rate to 50% of municipal paper, metal, plastic & glass."

The barrier here is: How do we measure this **50%** increase if we do not have a complete picture of what happens now?



Large amounts of municipal waste are currently treated at low value:



Citizens of Gdansk generate:

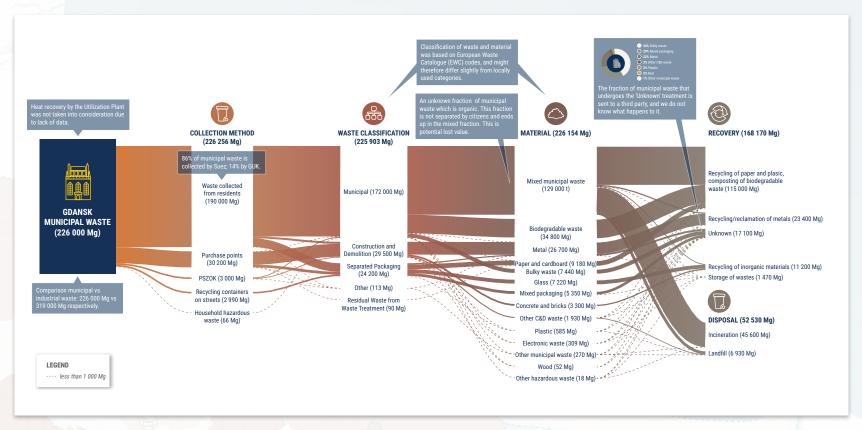




4

MATERIAL FLOW ANALYSIS(b): MUNICIPAL WASTE





Municipal waste generation

This category represents all waste generated by the households of Gdansk.

Collection & sorting

Municipal waste collection at source in Gdansk is comprised of different collection methods, including a selective municipal waste collection point (PSZOK), ambulatory collections of hazardous waste, and selective waste collection bins.

End of life

All municipal waste collected is transferred to the regional municipal waste treatment installation located in Gdansk and operated by the municipal company (Zakład Utylizacyjny Sp. z o.o. RIPOK Szadółki).



Waste generated by industries in each district

- 0 800 Mg
- 800 3 500 Mg
- 3 500 7 150 Mg
- 7 150 16 500 Mg
- 16 000 27 500 Mg
- 27 500 67 800 Mg
- 67 800 328 500 Mg

Primary waste recovery facilities (t material recovered/year)

- >1 000 100 000 Mg
 - 100 000 200 000 Mg
 - 200 000 260 000 Mg

Waste processing facilities

- Hazardous waste incineration plant
 Port Service
- Landfill
- Biological treatment of waste

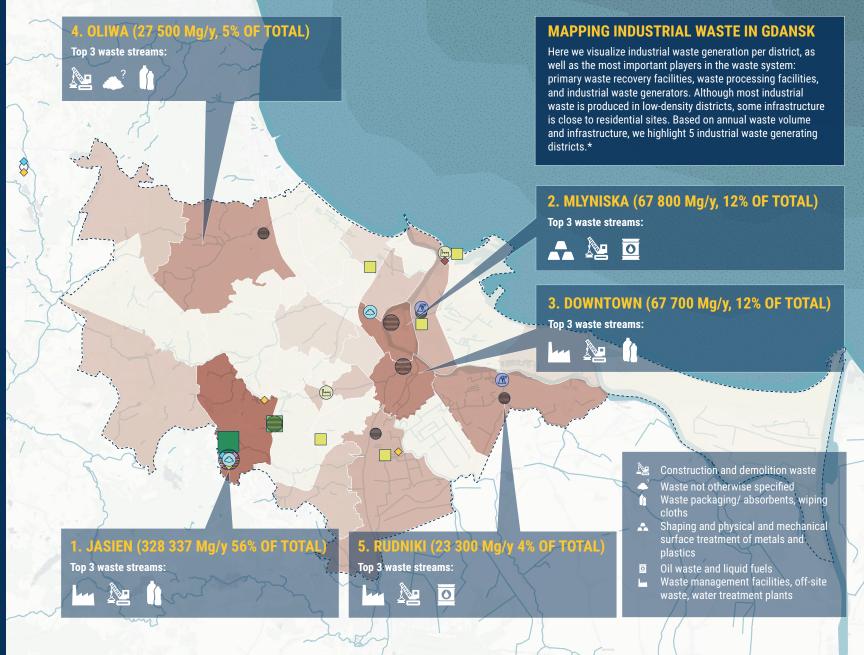
Top industries by total waste generated (2017)

- >8 000 25 000 Mg
- 25 000 119 000 Mg
 - 119 000 210 000 Mg

Municipal waste processing facilities, by collection group

- Household waste
- Selective collection point (PSZOK)
- Gniazda containers
- Hazardous waste from households





(a) Sources in table a.

*The categories we used to express the top 3 waste categories per district are based on European Waste Catalogue (EWC) codes**.

**Please note that the sum of industrial waste for this map includes exchange of waste between companies, and therefore sums up higher than the total of industrial waste in the Material Flow Analysis on p. 61 & 62.

Energy

Gdansk's energy consumption remains mostly reliant on fossil fuels, coal occupying the largest share. The bulk of the energy is consumed by the densely populated areas in the north and the centre of the city, as well as by industry and data centers*. The newly built incineration plant of Port Czystej Energii will partially contribute to the city's electricity and heat. However, there are still significant untapped opportunities available for Gdansk to transition to a completely renewable energy system, leveraging the wind and solar exposure of the city. Monumental housing provides opportunities for energy efficient renovation.

-\(\frac{1}{2}\)- Highlighted opportunities

- Leveraging the potential for renewable energy.
- Increasing energy efficiency through the renovation of the built environment.
- Using alternative sources for heating such as data centers and surface water.

Water

Despite major financial outlays in past years, Gdańsk's wastewater systems reveal a pressing need for redevelopment. The pre-treatment water system lacks capacity, resulting in the contamination of surface water, as well as the Gulf of Gdańsk, with stormwater and meltwater. Water supply and sewage treatment systems are in need of modernization due to wear and usage of potentially harmful materials. There are opportunities for nutrient recovery from waste water and the use of rain water for purposes other than drinking water. Increased stormwater management can provide a solution for urban flooding and the resulting contamination of surface water. Gdańsk is currently developing a policy for small-scale urban water retention and will continue these efforts, putting a greater emphasis onimproving the quality of rainwater.

-Ò- Highlighted opportunities

- Capturing and utilizing the rainwater that falls on the city for e.g. irrigation.
- · Using seawater as cooling water for industries.
- · Recovering nutrients from wastewater to prevent value loss.

^{*} A data centre ('centrum danych' in Polish) is a building in which an organization's shared IT operations and equipment are centralized, for the purposes of storing, processing, and disseminating data and applications. These buildings use up large amounts of electricity (up to 100 MWh/y).

STAKEHOLDERS AND POLICIES: ENERGY

POLICY

- Environmental Protection Program 2018-2021 (Program Ochrony Srodowiska Województwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Low Carbon Economy Plan Gdansk (Plan gospodarki niskoemisyjnej dla Gdanskiego Obszaru Metropolitalnego).

KEY OBJECTIVES

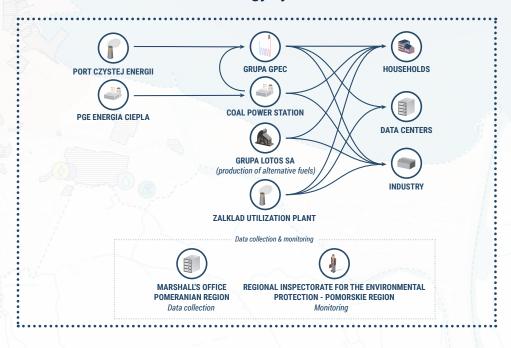
- Increase total sustainable energy production to 1 000 MW.
- Modernize heat supply sources for the city, by converting alternative fuels into ecological fuels.

STAKEHOLDERS

The most important energy providers of the city are the coal power station of PGE Energia Ciepła and Grupa LOTOS SA. The Incineration Plant, newly built by Port Czystej Energii, will provide city heating from 2023 officially. The Municipal Centralized Heating System distributes heat throughout the city. Car traffic and transportation of goods is responsible for most of the fuel use of the city. The Regional Inspectorate for Environmental Protection plays an important role in monitoring the environmental consequences of the fossil fuel use of the city.

GDANSK UTILIZATION PLANT

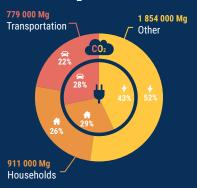
Stakeholders of the Gdansk energy system





ENERGY

Total emissions generated by Gdansk: 3 544 000 Mg CO₂-eq/year



Total emissions generated



Total energy used

Primary energy carrier use by Gdansk:



Gdansk uses 0% of renewable energy, while the goal of Poland is 21% renewable energy use by **2030**

The inhabitants of Gdansk own an extraordinary amount of cars*

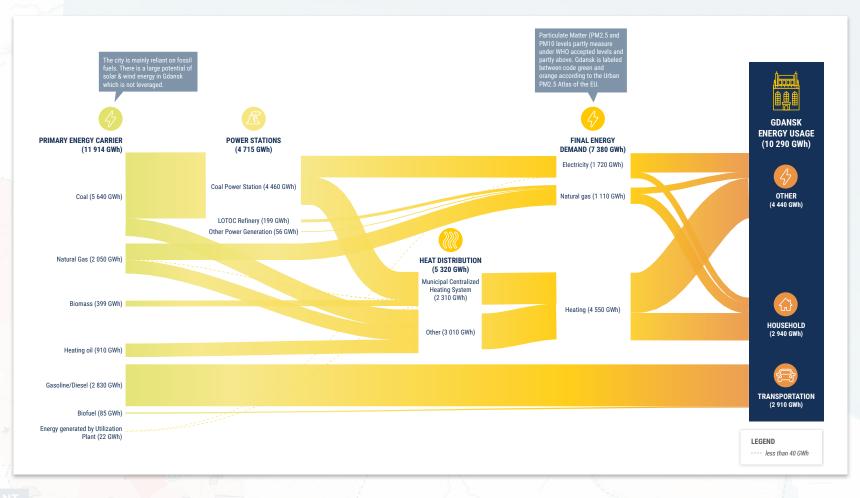


648 Cars /1000 Inhabitants

a total of 301 243 cars

MATERIAL FLOW ANALYSIS (c): ENERGY





Primary energy use

The primary energy use of the city is currently calculated on the basis of consumption as registered in 2014, extrapolated to 2018. In this way, the primary energy consumption of the city is displayed as almost entirely reliant on coal.

Conversion

66

Power stations including the coal power station convert coal into electricity and heat. Heat is mostly distributed through the Municipal Centralized Heating System and other systems. The final energy demand of Gdansk is divided over electricity, natural gas, and heating.

End use

The total energy usage of the city is divided over households, transportation and 'other', which is mainly comprised of industrial energy use.



STAKEHOLDERS AND POLICIES: WATER

POLICY

- Environmental Protection Program Pomeranian Voivodeship 2018-2021 (Program Ochrony Srodowiska Województwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony srodowiska dla miasta Gdanska na lata 2015-2018 z perspektywa do roku 2020).
- Gdansk Water Strategy 2018 Stage 1 (Gdanska Polityka Wodna etap 1 2018).

STAKEHOLDERS

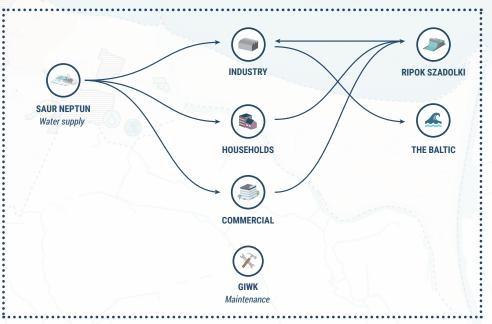
The Municipal Water Department of Gdansk is responsible for drinking water supply, stormwater management, and the sewer system. Water quality in streams of the region is monitored on a national level. Gdansk Water and Wastewater Infrastructure (GIWK) is the owner of the water supply and wastewater collection system.

Operator Saur Neptun Gdańsk S.A. is responsible for the supply of drinking water and for the discharge and treatment of urban waste water. Rainwater management and the drainage system are handled by Gdańskie Woda Sp. z o.o. Water quality in watercourses in the region is monitored at the national level. Gdansk Water Supply and Sewage Infrastructure (GIWK) is the owner of the water supply and sewage.

KEY OBJECTIVES

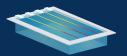
- Decrease water usage in agriculture and industry
 - Increase proportion of population using water treatment facilities.
- $\boldsymbol{\sqsubseteq}\hspace{-0.7em} \boldsymbol{\triangleright}$ Increase efficiency of pre-treatment water system,
 - · Improve flood and stormwater systems,
 - Modernize sewage and water treatment facilities.
- Sustainably manage aquatic areas with respect to natural values and flood protection.

Stakeholders of the Gdansk energy system





Yearly, 131 million m³ of rain falls on Gdansk. This is equal to:



52 000

OLYMPIC SIZED SWIMMING POOLS

This water could be caught, stored and used for irrigation.



Currently, **27 million m³/y** of fresh water is used for industrial cooling in Gdansk, and discharged into the Baltic Sea directly after use.



This fresh water use could be substituted by sea water.

The city is implementing rain gardens to harvest rain water. The total area of small retention facilities in Gdańsk is nearly

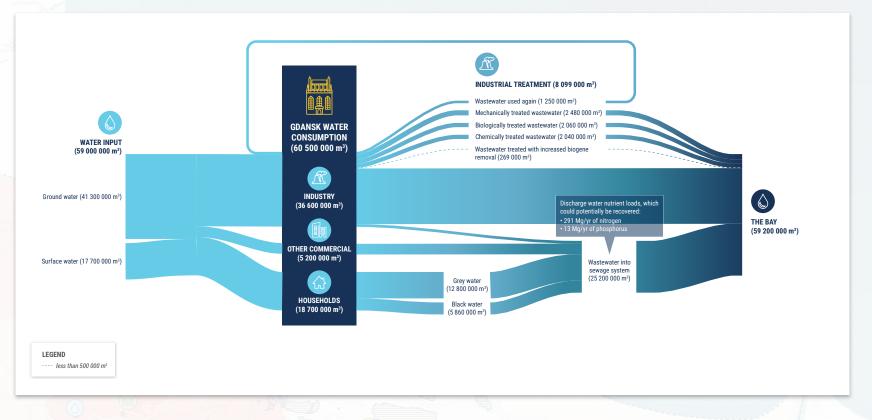


20 ha

which can accommodate nearly 1,5 thousand cubic meters of water

MATERIAL FLOW ANALYSIS (d): WATER





Sourcing

The majority of Gdansk's water is sourced from groundwater, via extraction points throughout the city. The rest is extracted from surface water.

Wastewater treatment

Household wastewater is treated by the city's wastewater treatment plant. Waste water is made up of greywater (from showers, sinks, and washing machines) and blackwater (from toilets). Industrial wastewater is treated separately and partly reused again.

Disposal

Treated wastewater (from both households and industries) is disposed of through a pipeline that pumps the treated discharge deep into the bay. Some industrial waste water is directly disposed to ground- and surface water.

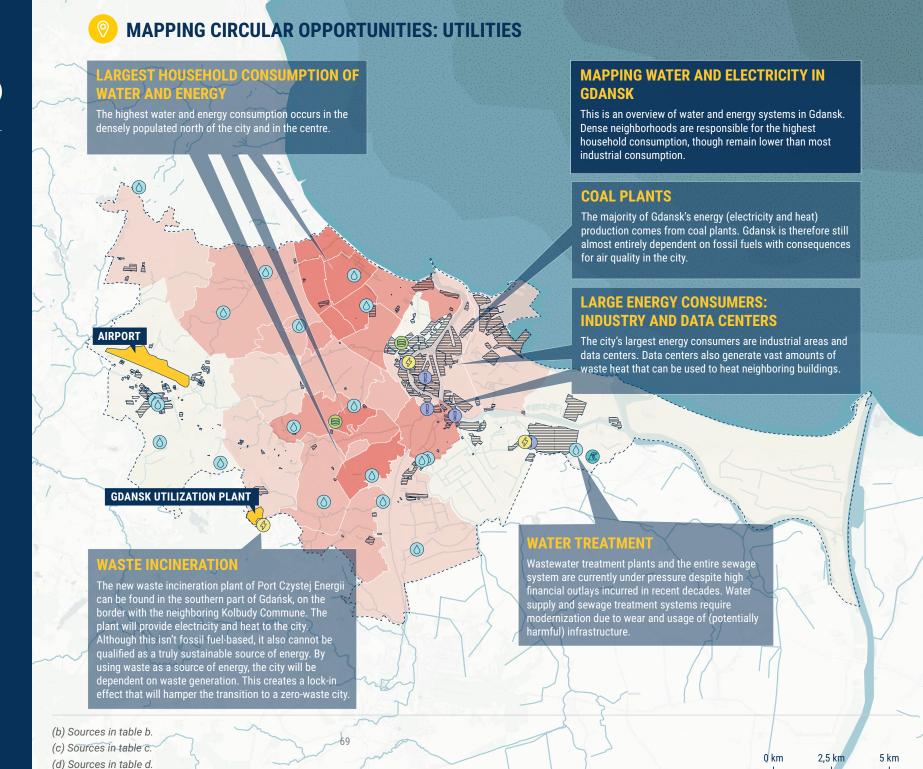
UTILITIES IN GDANSK (b,c,d)

POPULATION DENSITY BY CITY DISTRICT (persons/km²)

- 100 600
- 600 1 200
- 1 200 5 000
- 5 000 7 500
- 7 500 13 150

UTILITIES

- Large energy consumers
- Maste water treatment plants
- Energy production plants
- Water extraction sites
- Data centers
- Major industrial areas
- Selected area of interest







STAKEHOLDERS AND POLICIES: CONSTRUCTION

POLICY

KEY OBJECTIVES

- Municipal Revitalization Program of the City of Gdansk unbold 2017-2023 (Gminny Program Rewitalizacji Miasta Gdansk ana lata 2017-2023).
- Environmental Protection Program City of Gdansk 2015-2018 (Program ochrony -> Increase construction and demolition recycling rates to 70%. srodowiska dla miasta Gdanska na lata 2015-2018 z perspektywa do roku 2020).
- Revitalize nine degraded areas of the city.

STAKEHOLDERS

The construction sector in Gdańsk is booming. Walking through the city this is made visible by the many cranes and new buildings in the city scape. Most construction waste is processed onsite. A fraction of this waste, of unknown quantity, is directly used on site again (crushed and applied). This means this construction waste is downcycled.

The rest of the construction sector waste is collected by local purchasing points; this is also where the construction sector purchases materials. Some of the waste is incinerated to provide the concrete sector with energy. The final amount is landfilled at the municipal waste treatment site.

Stakeholders of the Gdansk construction sector





CONSTRUCTION

The municipality strives to have a minimum:



recycling rate for construction and demolition (C&D) waste.

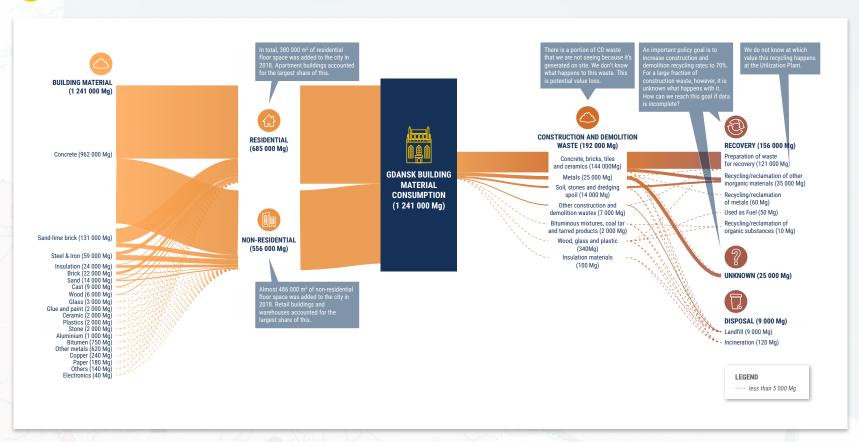
An unknown fraction of C&D waste is generated and processed on site. This makes it difficult to say whether the municipality is reaching its target.

The concrete used in **Gdansk's construction** sector is responsible for a large amount of emissions:



MATERIAL FLOW ANALYSIS (e): CONSTRUCTION





Primary material use

There are a lot of construction and renovation projects planned in Gdansk. These projects are responsible for the largest primary material demand of the city (as compared to other sectors), divided over the material categories above.

Material consumption

The total construction material consumption of Gdansk is comprised of residential and non-residential construction and renovation.

Waste composition

During demolition, as well as during construction and renovation, a lot of construction materials become available. The largest streams are concrete and metals.

Recovery

Of all C&D waste that is reported on, 81% is recovered. Yet, how it it recovered, and what material is produced by means of recovery, remains unclear. Direct reuse of building elements is preferable, and energy recovery from building materials is least preferable.



PROJECTS PERMITTED (2016 - 2020)

Construction

- Small projects (700 15 000 Mg)
- Large projects (15 000 6 290 000 Mg)

Renovation

- Small projects (1 600 17 000 Mg)
- Large projects (17 000 455 490 Mg)

Demolition

- Small projects (700 7 000 Mg)
- Large projects (7 000 30 480 Mg)

PURCHASE POINTS COLLECTING CONSTRUCTION WASTE

0 - 100 Mg

100 - 1 000 Mg

1 000 - 12 000 Mg

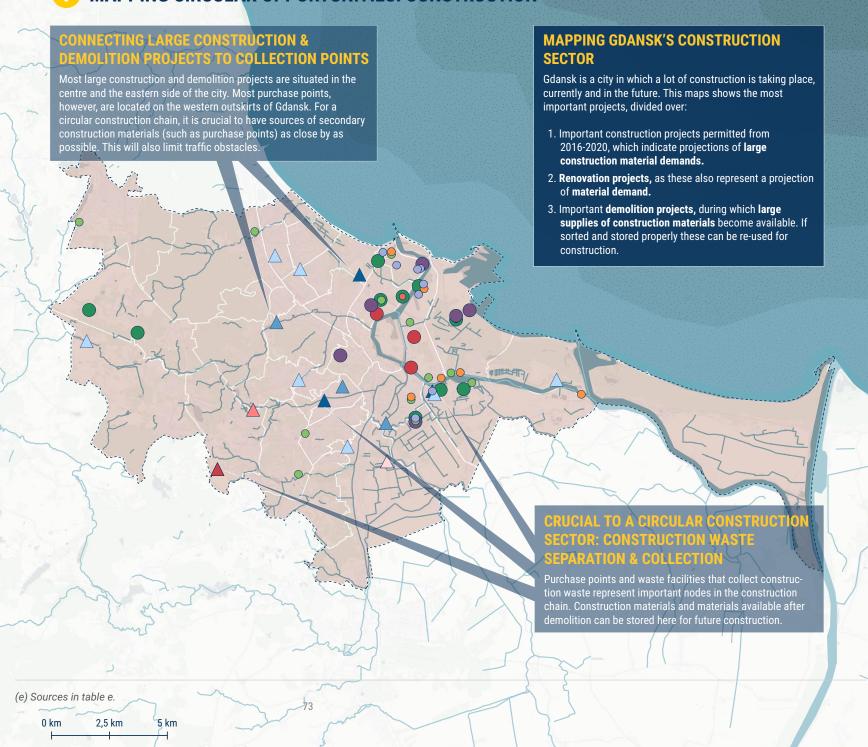
WASTE FACILITIES COLLECTING CONSTRUCTION WASTE

▲ 0 - 100 Mg

100 - 1 000 Mg

🛕 1 000 - 2 800 Mg





Hotels, restaurants, and cafes not only make up an important economic sector of Gdansk; they are also important nodes in the food system. Almost 15 000 Mg (more than 10%) of the city's food consumption occurs within hospitality. This goes hand in hand with large amounts of food waste. Gdansk, being a port city, is not a large producer of food in itself: only 63 km² of the city's land use is dedicated to agriculture. Industrial food processing in the northwest of the city, however, plays another important role in Gdansk's food system. These industries use large amounts of resources, and generate substantial amounts (almost 1 300 Mg) of organic waste.

^{\(\)} Highlighted opportunities:

- Bundling collection of food waste from hospitality clusters to recover nutrients in high value.
- Creating opportunities by composting food- and green waste locally and applying it at local green spaces.
- Growing local food for the city: expanding urban agriculture in peri-urban areas of Gdansk.



STAKEHOLDERS AND POLICIES: AGRIFOOD

POLICY

- Environmental Protection Program Pomeranian Voivodeship 2018-2021 (Program Ochrony Srodowiska Województwa Pomorskiego na lata 2018-2021 z perspektywa do roku 2025).
- Provincial Waste Management Plan for the Pomeranian Voivodeship in 2022 (Plan Gospodarki Odpadami dla Województwa Pomorskiego 2022).

KEY OBJECTIVES

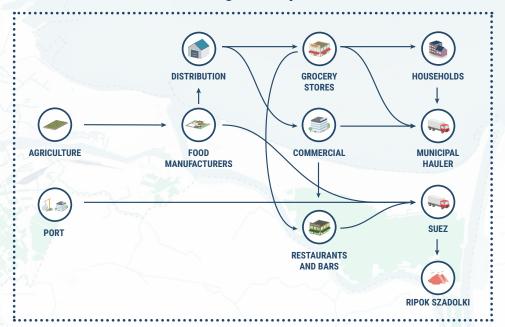
- Increase the number of the region's ecological farms to 840.
- Increase surface of recultivated land to 203 ha.
- Running effective systems for the selective collection of municipal waste, including primarily green waste and other bio-waste, manage bio-waste in home composting and feeding of animals.

STAKEHOLDERS

A relatively small share of the land around Gdansk is dedicated to agriculture (only 63 km²), mostly cultivating wheat, maize, and sugarbeet. These supply large industrial food processors include Dr Oetker, Bakery Cukierna, and Confectionery Plant Baltyk. The city holds a few urban farms that produce food and local compost for the city.

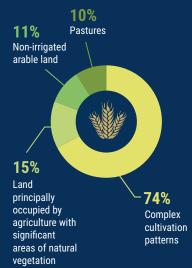
The organic portion of municipal waste is composted by the Utilization Plant. In 2016, out of almost 20 000 t wet waste, the plant produced approx. 4 500 t compost. 1 340 t went to municipal organizations, companies and residents. The rest of the compost was used to rehabilitate the landfill. In 2017, the production of compost was temporarily suspended due to on the need to expand the compost installation.

Stakeholders of the Gdansk agrifood system



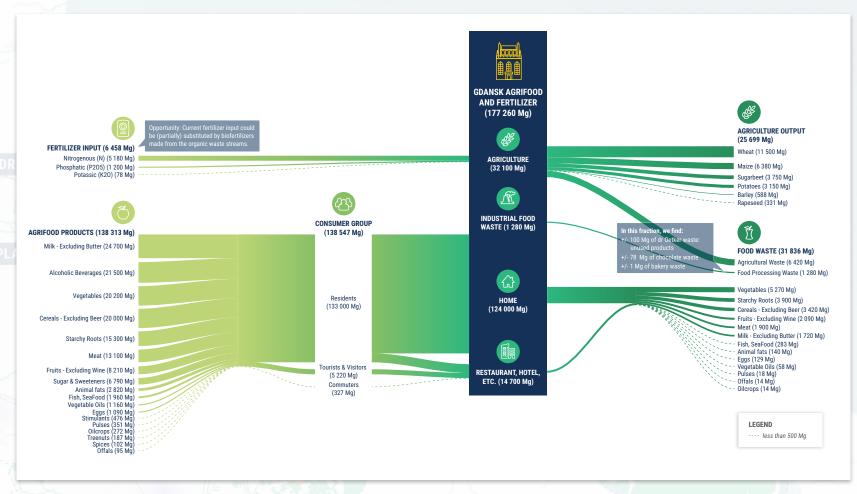


Agricultural land use (Total: 63 km²)



MATERIAL FLOW ANALYSIS (f): AGRIFOOD





Food input

On the input side of the city, we consider fertilizer used for agriculture in Gdansk, and food consumed by citizens, tourists, and visitors of, as well as commuters to, the city. The latter is based on the average diet of a Polish citizen (36).

Agrifood throughput

The total of agrifood throughput consists of input for agricultural produce, food consumed by households and by the hospitality industry.

Agrifood output

Agrifood waste is divided over agricultural waste, industrial waste, and consumption-related waste. Agricultural produce is included in the agrifood output of the city.

(f) Sources in table f.(36) FAO. 2016. Retrieved from source



- Selected food manufacturers
- Selected urban farms
- Farm land
- Cluster of hotels, restaurants, cafes, etc.
- 🗎 Railway stations
- Railway

MAPPING CIRCULAR OPPORTUNITIES: AGRIFOOD

INDUSTRIAL FOOD PROCESSORS AND MANUFACTURERS Clusters of large food processing and manufacturing companies Clusters of large food processing and manufacturing companies MAPPING GDANSK'S FOOD SYSTEM This map provides an overview of the food system of Gdansk: food production, processing, and consumption. A

BAKERY SZYDLOWSKI

Clusters of large food processing and manufacturing companies are situated along the train lines, in the city centre and in the northwest. These not only consume large amounts of raw material for production, they also generate large amounts of organic waste. Such large industrial waste streams are like goldmines for a circular economy: these highly heterogeneous streams can be turned into high-value products.

DR. DETKER

FOOD PRODUCTION IN GDANSK

products.

Farmland is shown in green, mostly covering the eastern and western outskirts of the city. Areas east of the city centre are home to some of Gdansk's urban farms. These are not only producers of local food, but also interesting areas to locally process organic waste (by means of i.e. composting).

circular food system for Gdansk involves closing loops of

organic material locally: processing food waste to become

high-quality fertilizer for farmland and urban farms, but also

using industrial food waste to manufacture high-quality new

CONFECTIONERY PLANT BALTYK

HOSPITALITY & FOOD WASTE CLUSTER

These purple areas show clusters of hotels, restaurants, and cafes. They are mainly concentrated around the railways and stations. These are spots where large amounts of food are consumed and where large amounts of food waste are generated, not only by citizens, but also by the millions of tourists Gdansk receives on a yearly basis. These clusters, therefore, are hotspots where food waste can be collected on a large scale, ready to be processed at high value.

(f) Sources in table f.

REFERENCES

- McKinsey Centre for Business and Environment. (2015). Growth within: A circular economy vision for a competitive Europe. Retrieved from: https://www.mckinsey.com/~/ media/mckinsey/business%20functions/sustainability/ our%20insights/europes%20circular%20economy%20 opportunity/growth_within.ashx
- McKinsey. (2019). Carbon-Neutral Poland 2050: Turning a Challenge into an opportunity. Retrieved from: https://www. mckinsey.com/~/media/McKinsey/Industries/Electric%20 Power%20and%20Natural%20Gas/Our%20Insights/ Carbon%20neutral%20Poland%202050%20Turning%20 a%20challenge%20into%20an%20opportunity/Carbonneutral-Poland-2050.pdf
- Nabrdalik, M., Santora, M. (2018). Smothered by Smog, Polish cities rank amongst dirtiest in EU. Retrieved from: https://www.nytimes.com/2018/04/22/world/europe/ poland-pollution.html
- Ministry of Entrepreneurship and Technology (2018).
 Polish Circular Economy Roadmap. European Commission. Retrieved from: https://ec.europa.eu/ transparency/regexpert/index.cfm?do=groupDetail. groupMeetingDoc&docid=22847
- Municipality of Krakow (2018). This is where I want to live. Krakow 2030. Krakow development strategy; Retrieved from: https://www.bip.krakow.pl/?dok_id=94892
- European Commission. (2020, March 25). EU Circular Economy Action Plan. EU Commission. Retrieved from: https://ec.europa.eu/environment/circular-economy/
- United Nations. (2017). UN Sustainable Development Goals. Retrieved from: https://www.un.org/ sustainabledevelopment/cities/
- Metabolic. (2017). The Seven Pillars of the Circular Economy. Retrieved from: https://www.metabolic.nl/news/ the-seven-pillars-of-the-circular-economy/

- 9. Gdansk 2030 Plus Development Strategy
- Visit Gdansk. (2021). https://visitgdansk.com/en/ aktualnosci/discover-gdansk-form-bicycle,a,3745
- 11.Poland. (n.d.). EU Funds in Poland. https://poland.pl/experience-poland/investments-projects/eu-funds-poland/
- 12.Statistical Yearbook of Pomorskie Voivodship 2019 (str. 189) Retrieved from: https://gdansk.stat.gov.pl/en/publications/statistical-yearbooks/statistical-yearbook-of-pomorskie-voivodship-2019,1,26.html
- 13.Statistical Yearbook of Pomorskie Voivodship 2019 Retrieved from: https://gdansk.stat.gov.pl/en/publications/ statistical-yearbooks/statistical-yearbook-of-pomorskievoivodship-2019,1,26.html
- 14.Gdańsk in numbers. (2019). Rynek Pracy. Retrieved from: https://www.gdansk.pl/gdanskwliczbach/rynek-pracy,a,108051
- 15.Gdańsk in numbers. (2019). Rynek Pracy. Retrieved from: https://www.gdansk.pl/gdanskwliczbach/rynek-pracy,a,108051
- 16.Ministry of Agriculture, Nature and Food quality. (March 2016). Rainwater retention programme for agriculture. etrieved from: https://www.agroberichtenbuitenland. nl/actueel/nieuws/2020/06/05/rainwater-retention-programme-for-agriculture
- 17. Statistical Yearbook of Pomorskie Voivodship 2019
- 18.Demographic situation of the Pomorskie Voivodeship in 2018
- 19.Gdańsk in Numbers. (2019). Mobility and Transport. Retrieved from: https://www.gdansk.pl/gdanskwliczbach/ transport,a,108052
- 20.Population Data per district, region Gdansk. (accessed 2020).
- 21. Open Street Map. (2018). Land use (park, nature reserve,

- vegetated land types). Retrieved from: https://download.geofabrik.de/europe/poland/malopolskie.html
- 22. Polanska, D. (2008). Decline and revitalization in post-communist urban context: a case of the Polish city—Gdansk. Communist and post-communist studies, 41(3), 359-374.
- 23.Tusk, D. (1996) Był sobie Gdansk. (There was a Gdansk). Gdansk: Dar Gdanska.
- 24.Bossak-Herbst, Barbara, 5. The Changing Image of Gdansk, Poland From Regained Homeland to Multicultural City in Nas, P. J. (2011). Cities full of symbols: a theory of urban space and culture (p. 303). Leiden University Press.
- 25. Scoppetta, C. (2011). The Polish seaport-city of Gdansk. A gateway for the Baltic Sea EU macro Region. Portus Plus, 2.
- 26.Statistical Office in Gdansk. (2019) Demographic situation of the Pomorskie Voivodship in 2018. https://Gdansk.stat. gov.pl/en/publications/population/demographic-situationof-the-pomorskie-voivodshipin-2018,2,2.html
- 27. Wieczerzak, J. (2018). Rozmieszczenie i gęstość zaludnienia obszaru metropolitalnego Gdansk-Gdynia-Sopot. Prace i Studia Geograficzne, 63(4).
- 28.Municipality of Gdansk (2015). Low carbon economy plan for Gdansk cities. https://www.Gdansk.pl/urzadmiejski/plan-gospodarki-niskoemisyjnej-dla-Gdanskauchwalony,a,46560
- 29.Pomeranian Landscape Park Complex. (n.d.). FORMS OF NATURE PROTECTION. https://tpkGdansk.pl/formyochrony-przyrody-3/
- 30.Bertram, C., & Rehdanz, K. (2015). The role of urban green space for human well-being. Ecological Economics, 120, 139-152.



REFERENCES

- 31.Biela, I. City of Gdansk. (2018, January 1). "I couldn't do it in the countryside" see how the last Gdansk farmers live. City of Gdansk. https://www.Gdansk.pl/wiadomosci/nie-moglbym-tego-robic-na-wsizobacz-jak-zyja-ostatni-rolnicy-w-Gdansku,a,97719
- 32.Nabrdalik, M. and Santora, M. (2018, April 22). Smothered by smog, Poland's cities rank among Europe's dirtiest. New York Times. https://www. nytimes.com/2018/04/22/world/europe/poland-pollution. Html
- 33.Wiśniewska, K., Lewandowska, A.U. & Staniszewska, M. Air quality at two stations (Gdynia and Rumia) located in the region of Gulf of Gdansk during periods of intensive smog in Poland. Air Qual Atmos Health 12, 879–890 (2019). https://doi.org/10.1007/s11869-019-00708-6
- 34.Municipality of Gdansk (2015). Low carbon economy plan for Gdansk cities. https://www.Gdansk.pl/urzad-miejski/plan-gospodarki-niskoemisyjnej-dla-Gdanska-uchwalony,a,46560
- 35.Global Status Report for Buildings and Construction 2019 Analysis IEA
- 36.FAO. 2016. Retrieved from http://www.fao.org/faostat/en/#country/173



SOURCES CHAPTER 4

Table a: Industrial Waste

Data source	Description of data used	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2017	Gdansk

Displayed Spatial Data

Data source	Description of data used	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2017	Pomorskie

Table b: Municipal Waste

Data source	Description of data used	Year	Region
Analysis of the state of municipal waste management	Report about municipal waste generation and handling in the city.	2018	Gdansk

Table c: Energy

Data source	Description of data used	Year	Region
Project of Updating the Assumptions of the Heat Supply, Electricity and Gas Fuels of the City of Gdansk	Electricity, natural gas and district heating generation and consumption in the city	2011	Gdansk
BDL - National Databank	Vehicle count	2018	Poland, Gdansk
National Energy Balance Sheets	Fuel use for transportation	2017	Poland
Greenhouse Gas (GHG) Emissions Measurement and Reporting Guidelines	GHG emission factors for different fuels	2018	Singapore
Information on social and economic situation of Gdańsk	Comparing energy consumption between 2011and 2018	2011, 2018	Gdansk

Displayed Spatial Data

Data source	Description of data used	Year	Region
Population data	Population data by district	Unknown	Gdansk
Open Street Map for lesser Poland - land use: industrial zones	Vector polygons used from displaying major industrial zones	2018	Gdansk
Open Street Map for lesser Poland - point of interest: airport	Vector polygon of the airport location	2018	Gdansk
Energy producing facilities from City Report	Point Data - address	2018	Gdansk



Table d: Water

Data source	Description of data used	Year	Region
GIWK - Gdansk Water Supply and Sewerage Infrastructure Authority	Share of groundwater vs surface water	Unknown	Gdansk
<u>BDL</u> - National Databank	Water demand, sewage treatment and discharge figures	2018	Gdansk
Waternet - Amsterdam water company	Breakdown of household gray vs black water	2016	Amsterdam

Displayed Spatial Data

Data source	Description of data used	Year	Region
Open Street Map - water wells & water towers	Vector polygons from open street map used for displaying water infrastructure	2018	Gdansk
<u>Open Street Map</u> - Water Bodies and Waterways	Vector polygons used from displaying major industrial zones	2018	Gdansk
Water intake sites	Point Data of intake sites extracted from the Waterworks Gdansk	2018	Gdansk
Wastewater treatment plants	Point Data of waste water treatment sites extracted from the Waterworks Gdansk	2018	Gdansk

Table e: Construction

Data source	Description of data used	Year	Region
BDL - National Databank	Number and floorspace of new buildings constructed in the city.	2018	Gdansk
Building composition model	A model that describes the materials used in different types of buildings based on the age, floorspace and function of the building.	2018	Netherlands
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2018	Gdansk
Analysis of the state of municipal waste management	Report about municipal waste generation and handling in the city.	2018	Gdansk

Displayed Spatial Data

Data source	Description of data used	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Point vector data - received from the Marshal Office of the Province about Construction and Demolition waste generation and handling with addresses	2017	Gdansk
Construction, Renovation, Demolition sites in Poland	Point data of major construction projects in Krakow with volume in cubic meters	2018	Gdansk



Table f: Agrifood

Data source	Description of data used	Year	Region
BDL - National Databank	Population by age and gender	2018	Gdansk
New Food Balances (FA0)	Average consumption of European countries by type of food product	2018	Poland
<u>DNFCS 2012-2016, 1-79 years</u> (RIVM)	Dutch food consumption survey by type of food product, age and gender	2016	Netherlands
Food waste accounting along global and European food supply chains: State of the art and outlook	Percentage of food waste generated by type of food.	2018	Europe
Out-of-home eating frequency, causal attribution of obesity and support to healthy eating policies from a cross-European survey	Report about how often people in different European countries eat out vs eat at home.	2014	Poland
Individual tourism	Report about the number of tourists and visitors to the city.	2018	Gdansk

Table f: Agrifood (cont.)

Data source	Description of data used	Year	Region
Commutes to work in Poland - NSP 2011 results	Data about the amount of intercity commuters	2011	Gdansk
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2018	Pomorskie
Corine Land Cover	Land use map	2018	Gdansk
Crop Yield Data (FAO)	FAO data about crop yields in different countries	2018	Poland
Food Loss and Waste in the Food Supply Chain (FAO)	Data about what proportion of agricultural production is wasted at the farm	2017	Global
BDL - National Databank	Fertilizer application rates	2018	Pomorskie

Displayed Spatial Data

Data source	Description of data used	Year	Region
Open Street Map - Points of interest: hotels, restaurants, cafes	Vector points for HORECA sites	2018	Gdansk
<u>Open Street Map</u> - Land use: farm areas	Vector polygons of farmland	2018	Gdansk
Open Street Map - railways	Line data of railway and railway stations	2018	Gdansk
Large producers of organic waste: Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	FAO data about crop yields in different countries	2018	Poland
<u>Open Street Map</u> - land use: allotment gardens	Sites where there are garden allotments in the city	2018	Gdansk

Table g: Environmental Map

Displayed Spatial Data

Data source	Description of data used	Year	Region
<u>Corine CLC</u> vegetated cover + <u>Open Street Map</u> : land use (park, nature reserve, vegetated land types)	Green Area/district	2018	Gdansk
Open street map: natural areas	City natural features such nature reserve and beach	2018	Gdansk
Open street map: water ways & water bodies	Water bodies and Water ways	2018	Gdansk



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