City for People • Socially Equitable • Economically Prosperous • Climate Smart • Respecting the Local Environment

Smart Zabrze

Building on a Mine of Opportunities

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THE INTERNATIONAL INSTITUTE FOR INDUSTRIAL ENVIRONMENTAL ECONOMICS

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Building on a Mine of Opportunities

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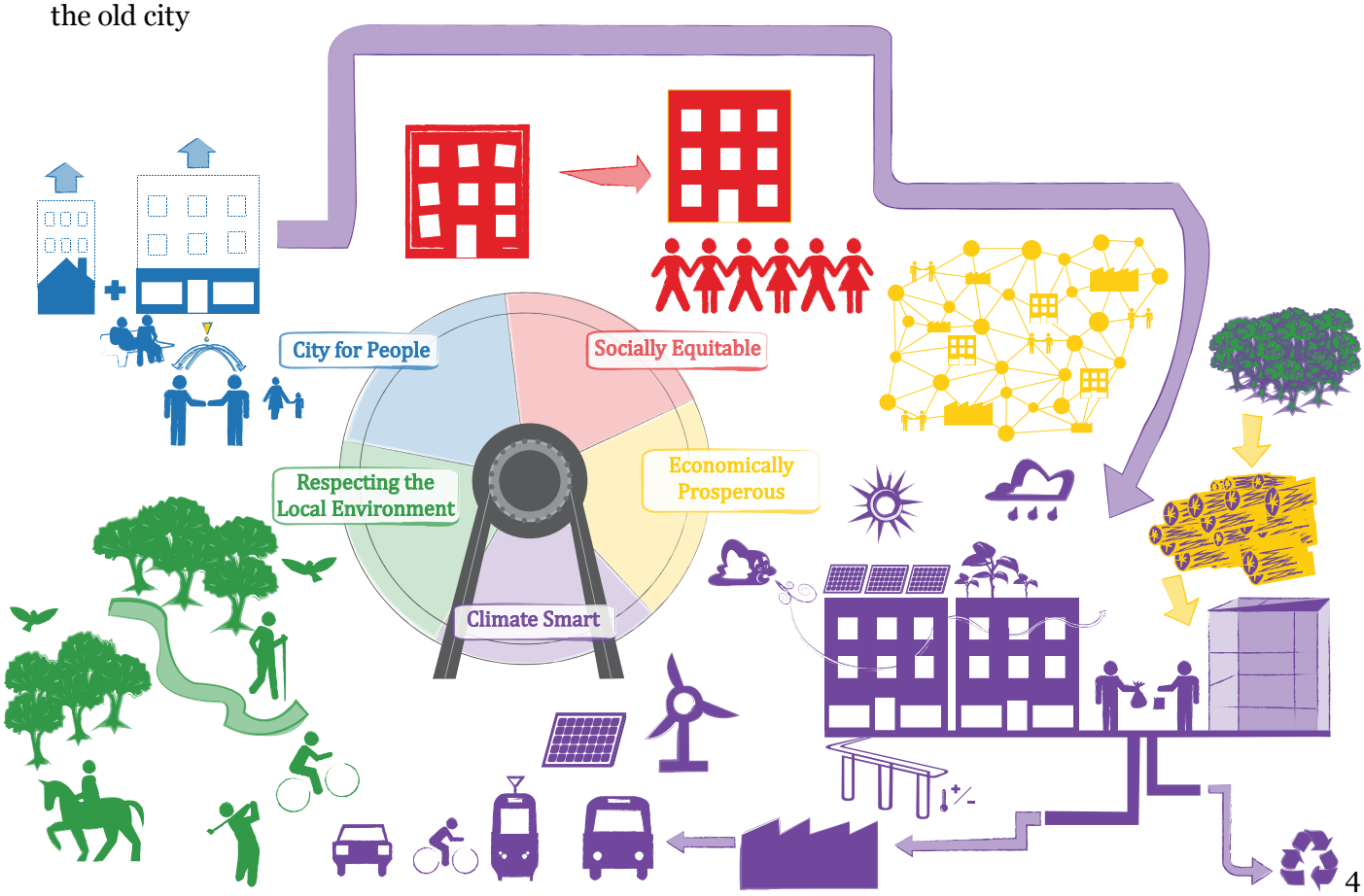
To our fellow B-19-ers: Thanks for your feedback, and we will be #keepingyouupdated!

Executive Summary

As a group of Environmental Management and Policy students of the International Institute for Industrial Environmental Economics (IIIEE), we were invited by the Mayor of Zabrze, Małgorzata Mańka-Szulik, to consult the city on the development of a new city district, Nowe Miasto. Nowe Miasto will be locate in a ca. 250ha large investment area which today mostly consists of agricultural land and wetland vegetation. It is located between the Northern parts of the city of Zabrze, the village Rokitnica, industrial zones as well as forests in the west and east. It is 7km north of the old city center and is a very quiet and peaceful place.
Zabrze is on the verge of a transition from a Polish mining and industrial centre to a metropolitan hub. It is an attractive location for both tourists and a dynamic population. Due to the dedication of the city's mayor, Małgorzata Mańka-Szulik, and a progressive administration the city is expertly combining progress and innovation on the one hand, and heritage and environmental sustainability on the other.

We see that Zabrze is well on its way to become the vibrant, sustainable city it is aiming to be. Still, there are several steps necessary to become a place that draws attention across Poland and internationally. Based on the first-hand-experiences we collected in Sweden and Denmark, as well as from other cases around the world and the research we carried out on site in Zabrze, we developed three major recommendations:

- Preserve and enhance the area's value: Create a green network
- Become the region's sustainability forerunner: Build a smart pilot community
- Build on existing potential: Foster the transition to sustainability in the old city



Preserve and Enhance the Area's Value: Create a Green Network

The creation of a protected green area across the central part of Nowe Miasto, couched in a larger green network running from the South-West part to the North-East will protect the creek and provide access to, and connect, the surrounding nature.

- Enhance both the area's recreational value and local biodiversity.
- Increase in property values in the area due.
- Create a green brand and identify for Zabrze, making it a visible example both nationally and internationally.
- Increased tourism revenue due to tours of the project and the recreational opportunities.
- Improve the general aesthetic value of the city.
- Promotion of healthy lifestyles by encouraging people to walk, hike, bike or simply spend time out in the fresh air.

The golf course that the municipality wishes to build on the investment area might put stress on the local ecosystem. It will be crucial to carefully integrate it in into the existing vegetation by following several environmental principles, such as changing the landscape as little as possible, use native species and local resources and others. If these principles are successfully implemented, the Nowe Miasto golf club might become the first certified eco-friendly golf club in Poland, attracting many visitors.

Become the Region's Sustainability Rorerunner: Build a Smart Pilot Community

Zabrze has the opportunity to make the new community of Nowe Miasto a pilot project for sustainable urban planning by creating a carbon smart neighbourhood which respects the local environment. Infrastructure development such as roads and housing should be carried out in an environmentally sensitive way. It should be a priority to avoid an extensive growth of the residential area into the green space and preserve the existing nature.

We envision Nowe Miasto to be a showcase of an energy-self-sufficient city, w of energy efficient integrated building design, renewable energy supply, smart transportation solutions and much more. Implementing these ideas will involve a close dialogue with the investors and developers to push beyond national regulations and yield benefits of the first-mover-advantage with regards to funding from the national and European level.

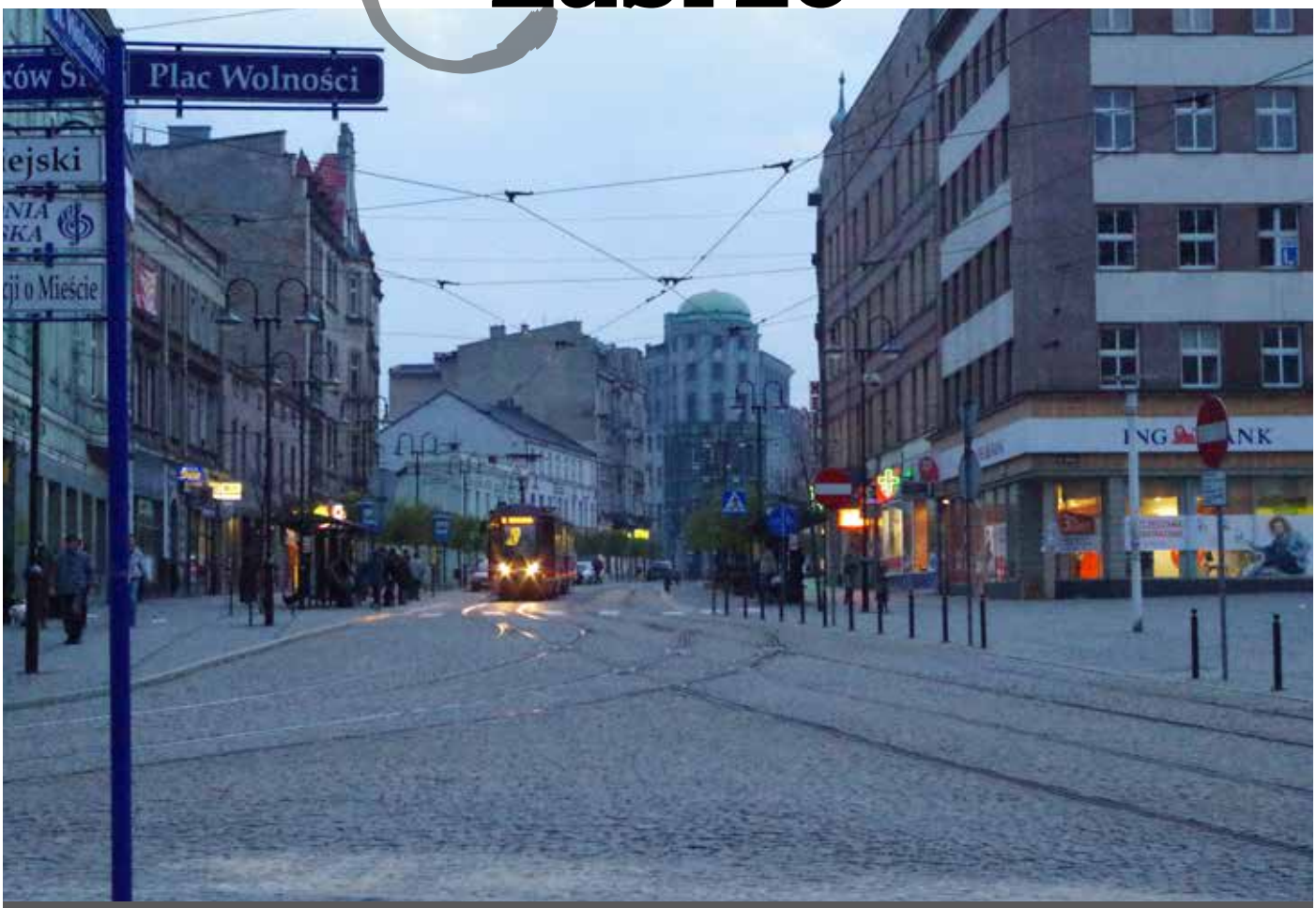
Building a new community with a vibrant city life from scratch is always a challenge, but also a great opportunity. By carefully designing Nowe Miasto, the city has the chance to do the right thing from the beginning and avoid a lock-in into unsustainable technologies and habits. It should be the city's aim to invite new residents to easily make sustainable choices in their daily lives.

Build on Existing Potential: Foster the Transition to Sustainability in the Old City

If designed carefully Nowe Miasto will be the lighthouse project in Southern Poland showcasing a modern, sustainable community. However, the efforts put into this new part of the city should not divert attention from the old centre. Zabrze has been constantly investing in the maintenance and modernisation of its cultural and industrial heritage. We strongly encourage the municipality to build on this potential and to further foster a transition to a vibrant, sustainable community within the old boundaries of the city.

Therefore, we developed recommendations in three fields of sustainable urban planning: increase the old city's walkability, accelerate the refurbishment of the existing building stock and foster local value creation. A general guiding principle on the development of new residential areas should be to limit urban sprawl and improving the quality of life in the old parts of the city, always with the aim to create a lively, walkable and healthy community which respects the local environment.

Zabrze



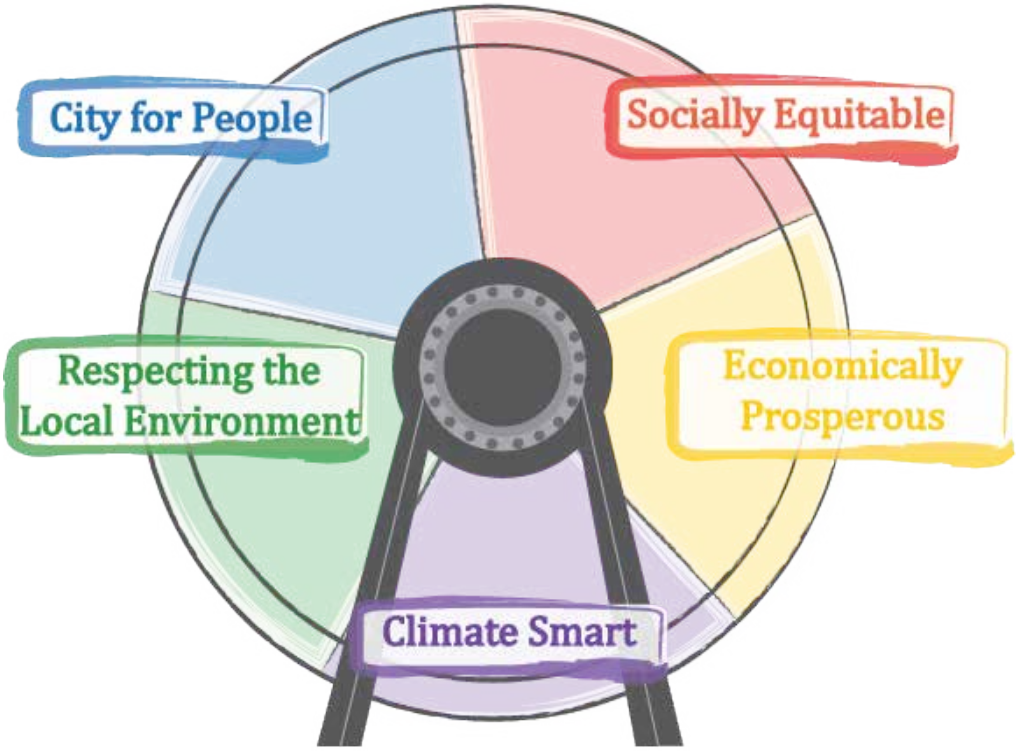
Zabrze is in a fascinating situation: a city on the verge of a transition from a Polish mining and industrial centre to a modern and sustainable hub, offering an attractive location for both the city's residents and tourists. Mayor Małgorzata Mańka-Szulik and her dedicated administration are leading the city through a transition, which combines progress and innovation while remembering the city's industrial heritage. We see that Zabrze is well on its way on its transition to become the vibrant, sustainable city it is aiming to be. There are still several steps that need to be taken to become a place that draws attention across Poland and internationally.

Embedded in Zabrze's and Lund's City partnership we are more than happy to consult the city of Zabrze on the development of Nowe Miasto, the new city to become a pioneer in sustainability. Nowe Miasto is a ca. 250ha large plot of mostly agricultural land 7km north of the old city center, which the municipality of Zabrze decided to develop into a new part of the city. It is located between Zabrze, the village Rokitnica, industrial zones as well as forests in the west and east. Extended forest areas are adjacent in the east and west. Today, it mostly consists of agricultural land and wetland vegetation. It also contains a small stream, which adds aesthetic value to the area.

In this report we introduce the reader to value-based planning. Based on this, we present the vision for a truly sustainable development of the Nowe Miasto investment area. In addition to this we propose the city to become a part of the Reference Framework on European Sustainable Cities (RFSC). It is an online toolkit designed to help cities integrate sustainable development into their planning.

The three pillars are 1) the creation of a green network along the creek, 2) building a pilot communiwty, a showcase of sustainable urban planning and 3) a golf course which respects the local environment. As the development of Nowe Miasto will be an integral part of Zabrze's overall transition towards sustainability, we decided to expand our scope beyond the investment area itself and added further recommendations for the old city.

Value Based Planning



This report is based on the principle of value based planning, as applied successfully by Malmö. This approach identifies the key values of a development area and sets a framework to help planners implement these values as they realize their vision. As important values are maintained more easily, the process remains flexible to allow for new adjustments and developments in the future [1]. Starting from a strong vision of Zabrze as the most sustainable city in Poland, we propose six values that should be the cornerstones in the urban planning process and help to translate the vision into practice.

City for People

People go where people are. Walkable cities tend to have a vibrant city life. The key is providing access to attractive public space, where people meet, innovate, and relax. The aim is to create a magnetic city, which increases the quality of life for the old residents and attracts new ones.

Socially Equitable

A healthy community does not leave anyone out, but works to raise the tide of all the people. A plan that provides affordable housing as well as job opportunities is essential to a cohesive community.

Economically Prosperous

Prosperity based on smaller, interconnected but flexible entities and a focus on clean technology and innovation trigger the transition to a resilient economy.

Climate Smart

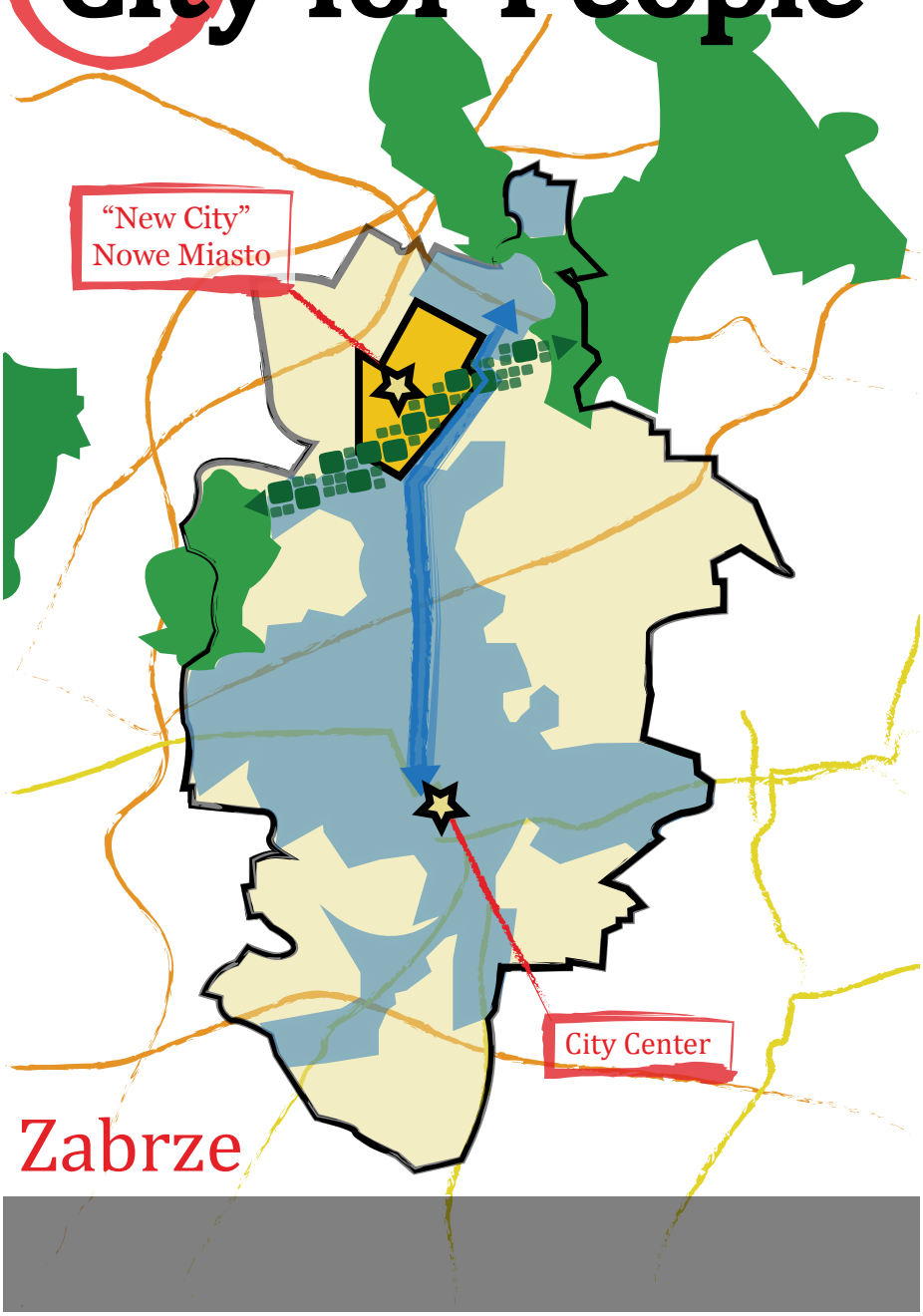
Climate change must be addressed at all levels through mitigation efforts as well as adaptation planning. Zabrze has an opportunity to show the world how to leapfrog old technologies by creating a smart community in Nowe Miasto, combining new solutions with highly energy efficient buildings and renewable energy sources.

Respecting the Local Environment

Green space is a valuable asset for both the health and wellness of people and also for preserving local biodiversity. This adds to the resilience of a community and is important for education and recreation of youth and adults alike.

Nowe Miasto

City for People



Nowe Miasto is an attractive place for a residential development due to its access to nature and a its character as a calm and quiet place. Nowe Miasto can be a groundbreaking lighthouse project -- a livable, socially integrative, climate smart city, which respects the local environment. Experience tells us that in urban development environmental and economic sustainability do not conflict with each other. Projects from Sweden have shown that ambitious sustainability goals helped to attract investors and progressive project developers. This will set Zabrze apart as a city setting the example for how Polish cities can change to meet climate and environmental targets.

Jan Gehl, a renound architect, has five planning principles:

"good architecture is between life and form"
-- Jan Gehl

1.

Locate the city's functions (schools, grocery stores, churches, etc.) strategically to shorten the distances between them and create lively spaces where people can easily meet.

2.

Create a versatile city through the integration of various functions such as arts, business development, and community development projects to create a more cohesive community and provide a feeling of security in individual city districts.

3.

Design city space so it is inviting and safe for pedestrian and bicycling traffic.

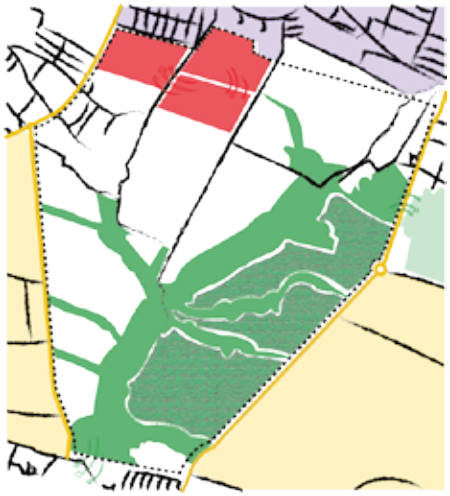
4.

Integrate buildings and city space to draw the life inside the buildings outside into green spaces and other public spaces.

5.

Reinforce public spaces so people want to stay longer, which will create lively spaces where people want to be [2].

Step-wise Development into Nowe Miasto



Step-wise development into Nowe Miasto

Green space surrounding urban areas is a highly valuable resource. From an environmental perspective, the first priority should be to preserve these areas and improve their quality. In urban planning, the development of a green field should be pursued if alternative options, such as the densification of existing urban space or brownfield development, are not available or have proven to be unfeasible. Therefore, we recommend to follow a step-wise-approach and to start with a sensitive residential development in the Northern part of the Nowe Miasto investment area.

This way the new community can be easily connected to the existing infrastructure of Rokitnika. Furthermore, the Northern part provides enough space for residential growth as it is demanded. Rather than building many one-family houses, we recommend designing a dense settlement of urban villas. This approach of building attractive multi-family apartment buildings has proven to create an attractive, vibrant city in the Western Harbour project in Malmö.

Urban densification reduces the need for transportation and costly infrastructure investments and contributes to the major goal of leaving the character of the open green space intact, which makes the area unique. Building modern, multi-family apartment buildings is also in line with Zabrze's need to provide attractive places for a growing middle-class.

Creating a Vibrant City Life

The basic prerequisite for a city to work is creating an place for people. To create a vibrant and sustainable community from scratch is always a major challenge, and will require collaborative planning and a step-wise approach. Our ideas for a livable and sustainable Nowe Miasto draws upon the influential work of the Danish architect Jan Gehl as well as experiences gained in urban development projects in Lund and Malmö.

To create a socially and environmentally sustainable design for Nowe Miasto the city should encourage an outdoor city life and a pedestrian culture. This includes offering highly attractive public space, such as parks and little squares with small shops and gastronomy as well as short distances between vital city functions. Mixed-use areas that have shopping areas with services and shops located on the ground floor of residential and office buildings create a warm and inviting atmosphere. Providing an interesting 'edge' between buildings and streets is vital to make walking an interesting experience. A sociological study in Copenhagen has shown that city life is seven times greater in front of interactive, open facades than in front of passive facades. Concentrating a major part of commercial activity in a mall will draw city life away from the street and foster individual motorised transport modes. The mixing of functions is commonly applied to increase the livability of new city districts.

Planning these spaces from the beginning is important to prevent a lock-in into unsustainable lifestyles. Built infrastructure shapes human behaviour in many ways. One obvious example is how existing infrastructure influences our choice between different transport modes.

If public transport is fast, cheap and reliable, we might prefer it over car usage on our way to work. If vital city functions such as schools, kindergartens and grocery shops are located within a reasonable walking distance from our homes, we might even consider car ownership as irrelevant. These choices have a major impact on our environmental footprint. Not using a car for one week saves as much energy as exchanging all lighting to highly efficient light bulbs in one year.

Unfortunately, the rise of the car in the 1960s as a privileged transport caused urban planning to revolve around car-based cities. This paradigm is still influential today. In older cities, housing was located around vital functions and public space, such as the market place. On the contrary, new cities are often characterised by long distances and the strict separation of residential, commercial and recreational zones. In addition, modernist cities often lose part of their attractiveness due to a lack of architectural diversity and a concentration of social interactions in large shopping malls, drawing people away from public city space. The prevalence of this type of planning is particularly visible in American suburbs. The American architect James Howard Kuenstler has developed a sharp critiques of this in his book “Geography of nowhere”, arguing that the car-based infrastructure has not only caused a lock-in into unsustainable, but also unhealthy and socially isolated lifestyles. The distant location of Nowe Miasto from the old city center will demand substantial efforts to create a city for people, which is not car dependent.

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Source: Malmö stad

Integrate Gardens for Food and Health

Small garden plots have become embodied into Polish culture as a quiet place that provides privacy to people living in large apartment blocks. Newer architectural designs can provide the desired privacy as well as creating inviting green spaces that are integrated into housing and retail areas. Malmö has experienced crime-free zones around its community gardens as well as beautification of apartment buildings.

Malmö has experienced crime-free zones around its community gardens as well as beautification of apartment buildings

Today, every new apartment in Malmö's Western Harbour district has a garden box. Traditionally privacy was provided by a family garden or allotment garden, which is protected under law as a "public utility" to provide a place for people to rest, recreate, and provide other social needs such as gardening [3]. This culture has sustained over the years and should be a central part of planning for Nowe Miasto. Research on allotments in Warsaw indicated that these spaces did in fact supply many benefits to the community including "climate improvement, active recreation, meeting place, landmarks… environmental protection, social needs, and economy" [3].

Urban gardens can become a part of the waste management system. We have a great resource of rich nutrients in our cities (food waste, yard waste, and household waste water). These can be reused to go into growing food instead of becoming a problem waste stream [4].

Green Network

The creation of a protected green area across the central part of the Nowe Miasto will provide access to and connect the surrounding nature. Couched in a larger green network this will enhance both the area's recreational value and local biodiversity.

The creation of a green network presents Zabrze with the opportunity to expand its already existing industrial heritage tourism concept, as successfully combined in the formerly heavily industrialized Ruhr area in Western Germany. Zabrze would thus become the green heart of the Silesian Metropolis.

Creation of green networks has been a widely practiced planning technique since the renowned German planner Schmidt recommended the integration of a network of green spaces to separate developments in the early 1900s¬ [5]. Protecting green spaces has been long recognized to promote the health of the people living near nature as well as providing economic and social benefits.

Economic benefits of a green network include an increase in property values in the area around it [6]. There will be opportunities for employment through the maintenance of green spaces as well as other recreational and cultural areas [8]. Furthermore, a network of this kind could support branding and identity creation, which increases visibility of Zabrze nationally and internationally.

Socially and culturally the benefits for Zabrze could include increased tourism revenue as well as general aesthetic value of the city; it would also promote healthy lifestyle by encouraging to walk, hike, bike or simply spend time out in the fresh air. The existing horse-riding activities could be embedded in a comprehensive sports concept. Other recreational activities could promoted such as and barbeques, or cultural events and art exhibitions. It could also aid local knowledge creation and education by making school excursions possible.

The green network would have a great positive impact on the environment; it would help water retention and provide space for storm water management as well as providing air quality improvements. Importantly, it would preserve and even enhance the existing biodiversity.

Cooperative Planning

Cooperative Planning will help maximize the benefits of a green network through planning coordination among the park department, tourism industry, spatial planners, and nongovernmental organizations, and citizens in Zabrze [7]. This can help create a useable space that is in demand from both the people in the city and tourists. Planning for maintenance in the beginning can help reduce the cost later. Monitoring programs can be used to determine the level of use, human impact on the habitat corridor, and other key issues identified by planning members. Opportunities for the area to be covered under Natura2000 may exist, but if not the area will still be a multifunctional habitat network [5]. The green network would link recreation opportunities, enhance biodiversity, used for stormwater management and flood prevention, and improve water quality [8].

Industrial Tourism and Nature in the Ruhr

Essen, Zabrze's partner city, lies in the Ruhr Metropolis just as Zabrze is located in Silesian Metropolis. Both have a similar industrial heritage and have and do face similar challenges. At the same time they were both given amazing opportunities: industrial heritage tourism. The Ruhr Metropolis has paired tourism concept with a rich network of nature and landscape art.

In Emscher, the river was degraded to a sewer at the beginning of the 20th century. The restoration of the river began in the 1990s. It gradually created the new Emscher Valley. This extensive leisure and recreational area is criss-crossed by kilometres of paths, picnic sites and playgrounds.

Source: Metropole Ruhr Leitbild

Also, in the area wastelands have attracted new natural growth. In the Emscher Landscape Park transport routes from industry have been transformed into cycle and hiking parks, which lead to many beautiful spots such as gardens, parks, and where tourists as well as locals can admire plants and animals that have adapted to difficult conditions. Green oases were created around the former collieries, like for example on the World Heritage Site Zollverein in Essen.

There are many remnants of the mining era in the Emscher Landscape Park, which now serve as excursion destinations. The many spoil tips in the Park are now great for mountain biking or hiking. Also, art object are presented on the tips, with the famous ""Bramme für das Ruhrgebiet" by Richard Serra on the Schurenbach tip in Essen [9].

Small creeks are often straightened to provide quick drainage off of agricultural land. Creating curves in a creek slows water down after heavy rainfall and protects from flooding downstream. It is also good to create habitat and to retain water upstream.

Stormwater Management

The Mikulczycki creek has been straightened and flooding problems on the south end of the property have been identified. This can be eased through intelligent water management on the property including a creek restoration and constructed wetlands or retention ponds. Creating curves in a creek slows water down after heavy rainfall and protects from flooding downstream. By holding rainwater in the green network and allowing it to slowly flow downstream the southern flooding problems will be eased. Restored wetland areas are also well known for being important places for habitat, and will be rich with songbirds and attractive during all seasons.

Source: Malmö stad

Green areas serve many purposes, but holding storm water after heavy rain storms can protect local property from flooding damage. When the area is dry it can be used for recreation and habitat for plants and animals.

Smart Transportation

Zabrze has the opportunity to leapfrog over the mistakes many cities have made when developing new city districts that are heavily dependent on car transportation. Many of those cities, for instance Copenhagen and Lund, realise the benefits of sustainable transport and have modified their streets in an effort to make them more bicycle and pedestrian friendly. It will be of major importance to establish a convenient public transport connection between Nowe Miasto and the old city centre right from the beginning of the development. Cities have seen economic benefits in improving public transport connections between city districts. For instance, Portland, USA's newly improved public transport line resulted in 3.5 billion US dollar new economic development around the route that connects the centre to the surrounding areas [10].

Possible Challenges

Radical development will always meet some opposition. Designing an environmentally friendly transportation system for Nowe Miasto with a clear focus on sustainability will therefore be a challenge. Public transport (PT) is a cornerstone of environmentally friendly transportation development, but in the new, eastern EU Member States, public transport is under considerable pressure. These states are seeing a decrease in passenger numbers and reduced transport supply [11]. Customer required modernisation as well as increased customer convenience make the shift towards an actual alternative to the private car very complicated. However, this situation is normal and other countries have experienced similar reaction when moving from the car-dominated lifestyle to other means of mobility.

Experience Going Car-Free: Lund and Copenhagen

In countries like Sweden and Denmark a shift to pedestrian friendly transportation has also been met with opposition. Lilla Fiskaregatans is one of Lund´s major shopping streets and until the 1970s the street was open for car traffic. When the street was turned into a pedestrian street it was met with opposition from local business in the beginning. Now, Lilla Fiskagergatan is one of the busiest streets in Lund with thriving business and real estate prices along the street are amongst the highest in Lund [12]. Another street, the famous Strøget in Copenhagen was also closed for car traffic in the 1970s. Local businesses spoke against it and argued that it would scare away customers but the opposite happened and Strøget is now booming with pedestrian life and business [2].

Source: Lund stad

Solving the Challenges

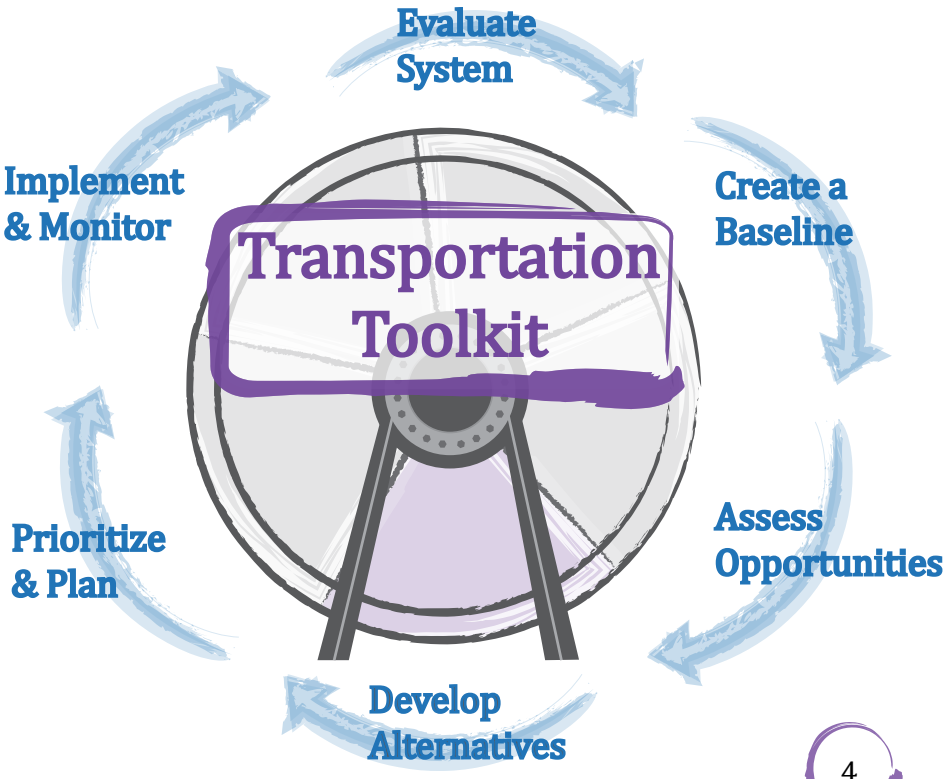
A priority in the strategic planning for the transportation system and infrastructure in Nowe Miasto should be to have a clear framework: the Transport Toolkit. Developed by the Low Emission Development Strategies Global Partnership (LEDS GP) Transport Working Group, together with the United Nations Environment Programme the toolkit was introduced in April 2014. It is designed to give urban planners and policy makers the capacity to implement a variation of smart climate transport initiatives. The Transport Toolkit includes multiple web-based tools to help city authorities through the process and it also includes guidebooks, academic articles, case studies, best practices, videos, PowerPoints, databases, and scenario calculators. It consists of six key activities authorities have to take to develop a strategy around the transportation sector (For more information on LEDS Toolkit [13]).

A priority in the strategic planning for the transportation system and infrastructure in Nowe Miasto should be to have a clear framework: the Transport Toolkit.

Cooperation with stakeholders should also be a priority. Zabrze has an opportunity that local governments sometimes do not use and have not seized when renovating and designing city districts. To capture all possible benefits the city can emphasise cooperation, awareness, and involvement of all relevant stakeholders. For instance, Lund, Sweden has received EU awards for sustainable transport policy. A key part of their strategy was to include stakeholders and include business needs and interests when designing transport policy [14].

Polish Examples of Climate Smart Transportation Programs: Gdynia and Wroclaw

Campaigns outlining the benefits of public transport have also proved beneficial to raise positive awareness and results. For instance, a campaign among new employees in Gdynia that encouraged them to change their travel behaviour resulted in a 12% decrease of car driving and a 10% increase in other transport modes [15]. Other strategies have also received positive acceptance in Poland. Wroclaw in Poland has been trying to establish public transport as a powerful and attractive alternative to the car by emphasising regional cooperation with neighbour municipalities and the Polish State Railways [11]. With strong will of parties involved, Wraclow has been able to improve the attractiveness of public transport to its citizens by e.g. offering a “joint ticket” applicable to various public transport modes. This has also lead to increased networking of public transport providers in the region and increased knowledge building in the sector [11].



1.

Evaluate System

Evaluate the status of the current transportation network/ infrastructure.

2.

Create a Baseline

Establish a baseline measurement of existing transportation system to be able to compare future development against.

3.

Assess Opportunities

Assess transport development opportunities that enables increasing transport demand to be met with reduced environmental impact.

4.

Develop Alternatives

After consideration of feasible opportunities, establish short- and long-term transport system objectives to match to the already identified low emission transport development opportunities. From there, assess the alternative transport development scenarios for possible implementation.

5.

Prioritize and Plan

Prioritize the scenarios and adopt an environmentally friendly transport development plan.

6.

Implement and Monitor

Start the implementation action plan that outlines a timetable, roles and responsibilities, available budget, performance metrics, partnership activities, and a plan for continuous monitoring and refinement.

Sustainable Ways of Getting Around

Cities aiming for a smart profile should focus their planning around modern, sustainable transportation systems. This creates a unique opportunity for Zabrze to join other cities worldwide that have ambitious and sustainable transportation goals. Instead of investing in a car-oriented infrastructure Zabrze can lead by example in Poland with its new city´s smart sustainable transportation system. This will raise positive attention and will attract young people and businesses to the area, since studies have shown that areas that are designed for pedestrian traffic are popular in demand as a housing option amongst young people as well as different types of retailers [16].

Make Transportation Accessible and Save Valuable City Space

Transit oriented development (TOD) is a concept framed around city development that aims for mixed-income, moderate to high urban density, where buildings are located within an easy walk of a transit stop and functional areas. The development is based on a functional mix of residential, shopping, and employment opportunities designed for pedestrians without excluding the car. TOD design and orientation aim to encourage transit use. With TOD in mind Zabrze´s Nowe Miasto can be transformed into a smart transport city area where citizens can conveniently access different functional areas like schools, grocery stores and health service. However, if land used for development is allocated without thinking of connectivity separations of functions increase, resulting in increased travel needs and therefore reinforcing the growth of car traffic.

Furthermore, infrastructure for cars takes up large amounts of space. For instance, car-driven infrastructure takes about ten times more space than infrastructure for busses, trains or bicycles [17]. In areas that are well connected the need for parking spaces is reduced. A lower rate of parking space areas will therefore reduce the cost of development, which is an economically positive side effect. Next sections will discuss various means of public transport, point out successful case studies and touch upon how Zabrze can adopt these smart transport modes.

Cycling

Bicycle traffic, along with pedestrian traffic, impacts the environment less than any other form of transportation. However, creating appealing sustainable transport solutions is a major challenge, particularly as a pedestrian and bicycling culture cannot be anticipated from the new residents. The aim should be to build a city, which actively invites people to walk, use the bike or public transport. Offering the option of safe bicycle lanes along all roads can encourage citizens to switch from cars to bicycles as the main transport mode.

Offering the option of safe and well-connected bicycle lanes along roads can encourage citizens to switch from cars to bicycles as the main transport mode. Additionally, key facilities are needed to support bicycles: bicycle stands, stationary bicycle air pumps, secure bike paths, and special bicycle traffic lights at street crossings [18]. Reducing the need for cars and roads and placing more emphasis on bicycle infrastructure reduces resource use (in the form of gasoline, asphalt-roads and land space) and increases citizens' safety.

Many cities have introduced bike sharing systems. This allows residents and visitors to be even more flexible in choosing a sustainable transport mode. Particularly, for the transportation of groceries or heavy items a sharing system for cargo bikes might be an interesting option.

Bicycle Friendly Cities: Lund and Søndeborg

Many cities have successfully implemented bicycle friendly transport infrastructure. Two of those cities are Lund and Søndeborg. Many see Lund as an attractive city to live in and in fact housing prices in Lund are amongst the highest in Sweden. According to Lund's city planners the public transportation friendly infrastructure plays a role in that [19]. Lund has set ambitious goals to encourage bicycle use amongst its citizens, aiming for at least 1/3 of the residents travelling by bicycles [20]. The convenient bicycle infrastructure has resulted in a 7% increase in bicycle traffic and a 4% reduction in car traffic during the same time period [20].

Sønderborg is another ambitious city when it comes to bicycles. Bicycle traffic consists of 12% of all traffic in the city where 52% of that bicycle traffic is commuting [21]. With other municipalities in Syddanmarks (Region of Southern Denmark) with higher share of bicycle traffic than Sønderborg, the city is allocating more budget for building bicycle paths, renovating old ones and funding campaigns to raise bicycle-use awareness amongst its residents. With its bicycle friendly transport policy Sønderborg has set the goal to be the region's top bicycle city by 2028 [21].

Public Transport

The Silesian trams running through Zabrze are a heritage of old times. City authorities want to preserve them and they even see them as a public transport option to the planned Nowe Miasto district. The trams provide residents of Zabrze with an alternative to the private car and therefore can be seen as a viable option in Zabrze´s quest towards a climate smart transportation system. However, since the current tram system (infrastructure as well as trams) has not been updated to meet requirements of a modern, efficient transport mode, city authorities should improve the tram system, if they want the trams to be a real alternative.

Recommendations

- improve entrance areas, e.g. having boarding platforms level with the tram floor,
- update the ticket system
- increase the tram speed
- smooth out the tramline route to make the ride more comfortable

Another good public transport mode is the bus. Compared to cities that are dominated by cars, cities with well designed bus systems have much less congestion, lower CO_2 and pollutant emissions and offer better mobility for all social and economical classes [22]. With an operating biogas plant at Zabrze´s waste water treatment plant [23] and further development of biogas production in the city, city buses and the city car fleet can be fuelled with biogas instead of gasoline since gas-powered buses have much lower emissions of local air pollutants and CO_2 than comparable diesel buses. Lund has seen the benefits of running its city buses on biogas made from organic waste generated from the city´s residents. Biogas is CO_2 neutral and running the fleet on biogas would therefore help Zabrze achieving its climate smart profile by further minimising health and environmental hazards resulting from vehicle emissions.

Car-sharing in Malmō

A smart way to have fewer cars on the streets, reduce pollution, and limit space needed for parking lots is to set up a car-sharing system. Car-sharing stations where residents can access a car by booking it online are located at several places in Malmö. These stations are run by Sunfleet, a private car-sharing company. Car-sharing has grown considerably in the city for the past few years [28] and during the development of the Western Harbour district, a residential area called Fullriggaren was the first area in Malmö were all residents are members of a car-sharing scheme free of charge [30]. In the attempt to reduce the amount of parking space, the city's authorities had a successful dialogue with constructers, resulting in the constructers paying for the car-sharing membership for residents for the first five years. This was a strategy to reduce car-use in the area and the contractors developed this plan to receive the permit to build in the area [29].

Buses

One way to run an effective city bus system is to establish a bus rapid transit system (BRT). A BRT system usually has specialized design, services, and infrastructure to prevent the typical causes of delay. Often described as a "surface subway", BRT aims to combine the capacity and speed of light rail or metro with the flexibility, lower cost, and simplicity of a bus system [24]. To be considered BRT, buses should operate for a significant part of their journey within a fully dedicated right of way, in order to avoid traffic congestion.

Characteristics of a BRT System

- Use of a dedicated lane in the centre of the road to avoid typical curb-side traffic delays
- Establish off-board fare collection stations to reduce delay related to paying the driver when boarding
- Create boarding platforms, which are level with the bus floor for quicker boarding
- Priority for BRT buses at intersections to avoid intersection signal delay

BRT systems have increased transit ridership and attractiveness within urban corridors and they have the ability to offer high quality public transit service with limited infrastructure [26]. BRT systems usually do not match the carrying capacity of metros, but cities can build a number of BRT-lines at the same cost as one rail line. BRT systems can also be built incrementally and offer more flexibility in terms of routes modification than rail systems [22].

MalmöExpressen

Source: Malmö stad

City authorities in Malmö are known for innovative approaches to environmental challenges and the ability to be forerunners in sustainability issues. The city is now taking the concept of BRT to a new level introducing the world's first gas hybrid "superbus" called MalmöExpressen (fuelled with a combination of biogas and rechargeable batteries recharged during braking) [26]. The superbus will be 24 meters long and will run on a specially built bus lane stretching 8.3 km. from the Western Harbour district through Malmö´s centre connecting all major parts of the city [27].

With the Nowe Miasto area approximately 7 km away from Zabrze´s most dense area a bus system running on local biogas from organic waste from Zabrze´s residents could be an ideal option. Cooperation with the local Solaris bus company on developing and establishing a superbus BRT system in Zabrze could play as a smart showcase example for Poland.

Gothenburg´s Biogas Fleet

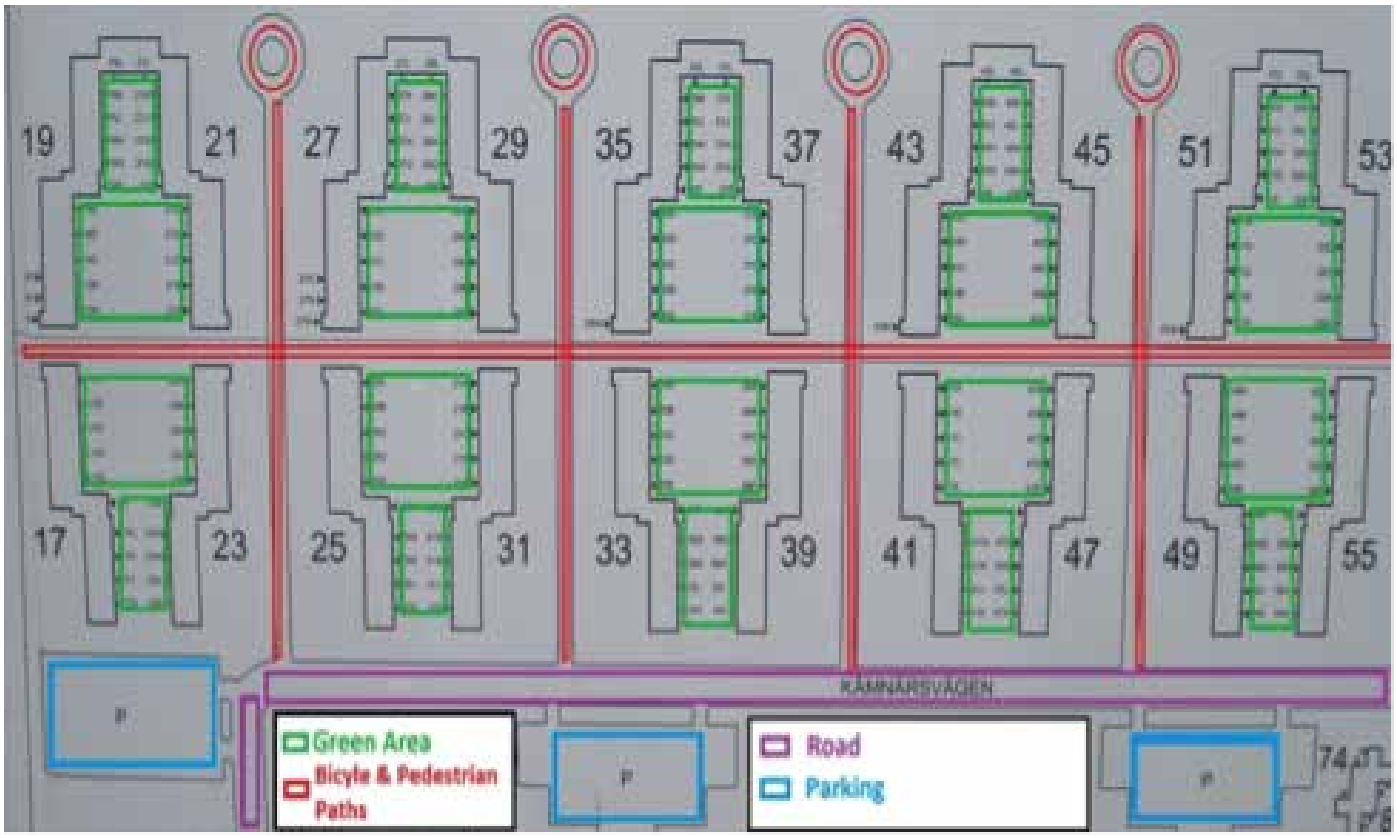
Gothenburg council in Sweden has the aim to have 95% of its car fleet to run on biogas or natural gas by 2015 [30]. Currently the percentage is 94% [31]. In 2005 the proportion of "environmental cars" in the fleet was 50% so in few years the proportion of cars running on bio- or natural gas has nearly doubled [32]. At the same time as more of the vehicles are fuelled with gas, number of vehicles in the fleet has also gone down from 2,400 vehicles in 2005 to 2,150 vehicles in 2012. This success was due to: parking privileges for "environmental cars", car-sharing, travel policies that favour digital meetings as an alternative to travelling, and an integrated transport management system that is run in close collaboration with six different municipal companies and administrations in Gothenburg. The integrated transport management system includes purchasing, administration, and usage of the vehicles [30]. Zabrze can adopt these measures when designing its sustainable transport system.

Zabrze can also follow Gothenburg´s approach when replacing old vehicles of its fleet. Gothenburg´s car fleet is replaced by 700 vehicles each year and the city´s priority is to purchase clean fuel cars [30]. With great opportunities in biogas production, and a need to regularly replace city cars, Zabrze can gradually implement biogas fuelled cars into its car fleet.

biogaz
energia z odpadów

Pedestrian & Bicycle Friendly Neighbourhoods

As mentioned earlier in this report cities should be designed for people rather than cars. That of course means that residential areas should be designed in a way that residents can move freely and safely around without roads cutting of important routes to necessary functional areas like schools, health service, and grocery stores. Kämnärsrätten residential area in Lund is an ideal example of a neighbourhood designed with pedestrian mobility in mind. It is closed off for car traffic and parking space is a short walk from the buildings. There are plenty of green areas and bicycle/pedestrian paths connecting the neighbourhood to functional areas, Kämnärsrätten has all the elements of a "city" designed for people.



Source: Lund stad

Less is Better: Avoid Additional Roads

A road going through Nowe Miasto could challenge goals for sustainable transportation and maintaining a quiet and private green place for people to live. The road going through the area will harm the tranquility and higher property values of the area. The planned road meant to connect the new Special Economic Zone (SEZ) east of Nowe Miasto with the Highway in the north as inking Karola Goduli in the East of Nowe Miasto to the B78 northwest is problematic. Interviews with city officials clarified that the road is meant to provide good access to the highway, and create an eastern north-south tangent for Zabrze. However, the road was planned before there was good access to the B88 crossing Zabrze north of the centre, and without taking into account the natural value and of the Nowe Miasto area.

Now the situation has changed: the B88 is accessible nearby the southeast corner of the SEZ, creating quick access to the highway A1: to both highway entrances in the northeast and the southwest. Therefore, the potential time saving gained through the planned road – of ca. 5-7 minutes to either of these points – is now offset, as the route via the B88 directly leads there. The original reason for the construction of this road seems to be diminished under today's conditions. On the other hand, the planned road would dramatically impact the area of Nowe Miasto and also cross Ofia Katynia, one of the most important north-south connections of the northern city centres and already now under heavy pressure during peak hours.

Cutting across Nowe Miasto, the new road would:

- Dramatically damage the rare ecosystem around the creek
- Create a barrier for people and animals, thereby significantly reducing the recreational & ecological value
- Create significant noise pollution in this last quiet part of the entire region (see noise map) as heavy trucks would drive across the center of the Nowe Miasto area, over one of the highest points of the area
- Create visual disturbance in this otherwise "untouched" area

A bottleneck on Ofiar Katynia could be created (eastern tangent of Nowe Miasto), which could harm the interconnection of the northern communities with Zabrze centre. Therefore, we strongly recommend not building the road across Nowe Miasto investment area. Instead, the southeastern connection to the B88 should be expanded. This also gives the opportunity to connect the existing cargo rail yard at the B88 southeast of the SEZ. Transferring cargo to rail offers additional and more environmentally friendly capacity for the companies of the SEZ and could take pressure off the roads

Noise Map of Zabrze

Source: City of Zabrze

Golf Course

Building a socially integrated, financially successful, and sustainable golf course is a large undertaking. Building a golf course on the Nowe Miasto will create challenges with regards to all three pillars of sustainability.

Enhancing Social Value

The golf course will cover a significant part of the green field, and golf can be a very exclusive sport. Accessibility should be ensured for all inhabitants and visitors of Nowe Miasto for at least some parts of the course. The social exclusiveness of golf can be addressed by the creation non-for-profit organization or charity (like for example Charity Golf für Bildung in Berlin, Germany), which would generate funds for promotion of golf amongst those who would not be ordinarily capable of actively participating in this sport. Such a place could employ volunteers and create a space where young people from local communities could learn how to play golf at reduced prices or for free.

Another way to increase the social value of the golf course would be to have information signs placed next to tee signs that identify local flora and fauna. Thus, golfers, both young children as well as older players could learn more about their natural surroundings.

One more idea is to build a multifunctional golf course, which on certain safe areas of the course allows for other activities such as an archery range, playground or a cyclo-cross track. Also by opening the clubhouse for other sport clubs, conferences or indoor activities, the building, which would otherwise be empty large part of the year, can be utilised in a better way [33]. More functional variety will therefore mean more people using the area all year round and thus there will be a better chance to create higher revenues [34].

Economic Challenge

Internationally many, if not most, golf courses struggle with profitability due to their capital intensive nature. In fact, all seventeen 18-hole golf courses which were built in Poland since the 1990s are in the red. Running costs, such as the maintenance of the greenfield, the procurement of fertilizer and water for irrigation, as well as the replacement of equipment commonly exceed the incoming money flow. For the development of the golf course in Zabrze it should be assessed carefully if there is sufficient demand for golfing in the region to make the desired golf course a business case. One way to increase the changes of the course's viability is to apply the principles of sustainable golf course design, which is discussed in the following sections.

Sustainable Design

Often environmental impacts of golf courses are not kept in mind during the design stage of a golf course the course can have serious ecological impacts [35]. However, by conducting a Strategic Environmental Impact Assessment (SEA) for the golf course, golf architects can prioritise how to design the course in the most sustainable way. By reducing inputs, using existing contours and vegetation and keeping the design of the golf course simple yet attractive, earthmoving, irrigation and planting will be minimised leading to lower costs. Also the maintenance of the course can be kept down and the natural surroundings of the course will be left untouched. By following the suggestions the course will be environmentally friendly and can strive to achieve a green-label making it a more attractive course to visitors and professional golfers.

Basic principles of Sustainable Golf Course Design

- As little landscape change as possible - the bigger the change, the bigger negative environmental impact it will have and more maintenance is required [36].
- Use native vegetation as much as possible in landscape design, e.g. planting drought resistant plants from Zabrze botanical garden.
- Use organic fertilizers and pesticides.
- Use local material for necessary landscape inputs, e.g. sand, rocks, etc.
- Use/purchase recycled/natural golf course equipment (plastic and wood), e.g. benches, bins, flags and tee signs.
- Use natural water systems as much as possible (gravity and topography) to reduce energy and construction input. Piping, culverting and canalising the water flows can degrade natural water ecosystems [37].

Size and Location of Course

An 18 hole golf course covers on average 65-70 hectares, but this amount of land is not needed to create a good course that is environmentally friendly. This can be done on 40-60 hectare of land. An excellent example of an innovative, low maintenance golf course built for affordable price on such a small area of land is the Geyser Golf Club in Iceland [36]. The nine hole course is built on an 18 hectare site without compromising the beautiful natural landscape.

Looking at the Nowe Miasto area, the planned Nowe Miasto Golf Club can be located east of the Mikulczycki stream and designed in harmony with the beautiful landscape thus avoiding unnecessary environmentally degrading landscape changes that would be inevitable if the course would be built across the stream. Another important argument for placing the golf course on the east side of the stream is that the natural beauty of the area will be preserved. If the golf course would be built on both sides of the stream, the green network connecting the Nowe Miasto area with other green areas would be cut off by the course. Building a golf course on the existing wetland around the creek might also be technically unfeasible without major landscape changes. Finally, by using less area for the golf course, land could be used for other activities attracting non-golfers to the area as well, and thus further enhancing the social value of the Nowe Miasto area. These activities could be hiking, horse riding, and mountain biking. One idea could be to build an environmentally friendly playground. At the Western Harbour area in Malmö an ecological playground was built on one of the green areas attracting children of all ages. Most of the material used for the construction is recycled and can be used again if the playground needs to be demolished in the future [38].

Water System Design

Golf course water system design and management is complex but at the same time a very important aspect of the course´s sustainable profile. These are basic principles that should be of high priority when the course will be constructed and later managed [38]:

- Stormwater storage can be located at the site for irrigation and used as a feature as well;
- The same goes here as for other course design and that is to keep the designed turf grass area as small as possible thus reducing the need of irrigation;
- Choosing water efficient, disease, stress and drought tolerant turf grass will further reduce the need for irrigation, fertilizer and pesticide use. This will reduce possible risks to water quality as well as soil and air quality;
- Use gravity to reduce the use of energy needed for irrigation. By placing water tanks and reservoirs at locations where gravity instead of energy can move the water, energy costs used to power irrigation can be reduced by almost 50 %;
- Water quality can be protected by designing rough grass soakaways as well as turf grass bio-filters along turf grass areas. Topography should also be used to direct water into natural ditches thus reducing construction of pipelines and other manmade runoff design.

General Maintenance of the Course

All golf courses need fertiliser and pesticides. Adding chemical fertilizers and pesticides to the soil can cause many environmental problems but the main concerns are leaching and runoff of chemicals to the soil and nearby water streams [39]. Chemical products can also cause health problems. Golf course superintendents have for instance been found to have higher risk for many types of cancer [40]. By using organic fertilizers and organic pesticides and applying it with great care the impacts on the environment can be reduced as well as hazardous health effects can be prevented. One option of a fertiliser that could be applied on the course is biofertiliser from the planned biogas station in Zabrze. Careful application (prevent overuse) of organic fertilizers can also reduce the need for mowing the course, which leads to savings in fuel use.

Fairway and Tee design

Fairway and tee areas should be designed to be as simple as possible, to reduce maintenance. Avoiding elevation and associated steep contours that are hard to mow is therefore suggested [41]. These areas should be designed in harmony with the natural landscape.

Rough

Out of play areas can often be left unmaintained, therefore reducing the maintenance costs of the course. This may require weed control and planting new species (e.g. found in the botanical garden) however it can at the same time increase biodiversity and further increase the beautiful landscape [36].

Bunker design

Bunkers need a lot of maintenance if they are to be an attractive part of the course. Therefore if a golf course is to be designed in a sustainable way, numbers and size of bunkers should be kept at a minimum. The sand in the bunkers should come from a local area since importing sand for the bunkers is not sustainable (sand needs to be added regularly to the bunkers) [36].

Green design

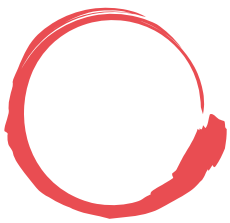
Man made large greens are unsustainable since greens need constant maintenance with lawn mowers and fertilizers. Having the greens small instead of large reduces the impact of these artificial features. It also increases the chance that the golfer enjoys the existing natural site features (which are closer to his vision if the greens are small) rather than standing on a large man made green that disconnects him from the actual nature of the site. Also, keeping the contours of the green not steep will make maintenance more sustainable since steep contours can be hard to mow (more fuel use) and retain grass on (more fertiliser use) [42].

Equipment/Accessories

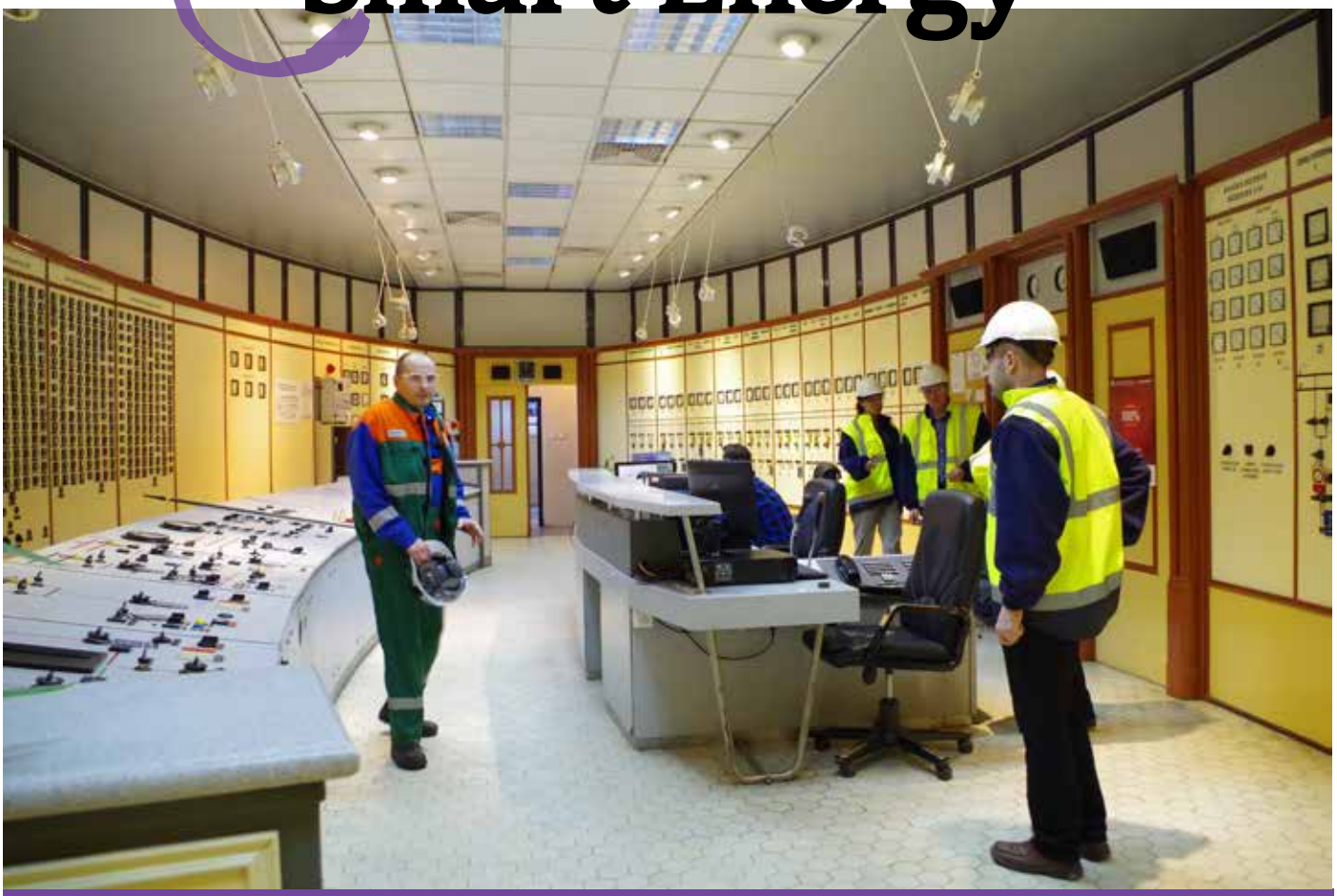
Make sure that all accessories of the course, e.g. benches, course poles/ fence and tee signs, garbage bins and flag poles are made from environmentally friendly material. For instance benches and poles /fence can be made from wood and garbage bins, tee signs and flag poles from recycled plastic.

Green Certification

If the three pillars of sustainability are used as focus areas in the design of the golf course, the Nowe Miasto golf club can be the first certified eco-friendly golf club in Poland. Poland´s best known golf course, Modry Las, located in northwestern Poland, is now striving for a greener image by building eco-friendly show homes at the course area [43]. Nowe Miasto can take a step further and be a showcase for how to build an entire golf resort in a sustainable and eco-friendly way.



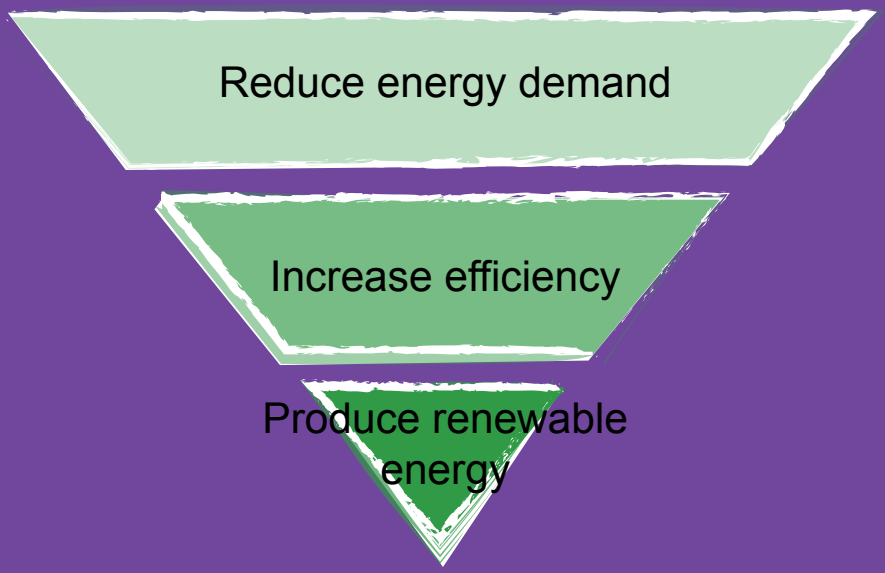
Smart Energy



The community of Nowe Miasto could become a demonstration site of a cutting-edge smart energy system, based on a mix of renewable energy sources, highly energy efficient buildings, and a smart grid, which interacts with aware consumers in households and offices. The energy system should be built on the following principles:

- reduce energy demand wherever feasible
- increase efficiency
- use renewable energy for the remaining demand

Following the principles of the Energy Triangle we envision Nowe Miasto to be self-sufficient over large parts of the year. This will increase the pilot project profile of the community and reduce its vulnerability to rising energy prices.



Renewable Electricity Supply for Nowe Miasto

Ideally, Nowe Miasto will be supplied with electricity from local renewable energy sources. As renewable sources highly fluctuate in their electricity generation it is important to rely on a mix of different energy carriers as well as storage or back-up capacity. The sources that seem most applicable in Zabrze are biomass, solar, and wind. In general, wind and solar energy have proven to complement each other relatively well. Windy weather is often combined with less sunshine and the other way around.

Poland also has a great potential for biomass, which could replace coal and gas as a reliable and always available energy carrier. One option for Nowe Miasto is to use small combined heat and power plants running on wood chips. In Germany, these micro-power plants have been successfully installed multi-appartment buildings [44]. The economic feasibility for these projects will depend on the development of fuel costs as well as the support schemes defined in the new Renewable Energy Act on the national level.

The sources that seem most applicable in Zabrze are biomass, solar, and wind.

Small-scale photovoltaic (PV) systems, which are integrated into the building design, can reduce a four-persons-households' electricity purchase from the grid by 30% [45]. If the PV is connected to a battery another 30% of electricity consumption can be covered over the year [45]. The exact energy yield depends on the local conditions and varies between 100 and 180 kWh per m^2 of photovoltaic panels [45]. However, Zabrze is in a relatively good position for solar radiation with an average annual sum of 120 kWh per m^2 [46].

Small rooftop installations are already an attractive investment today, as the Polish PV market is reaching grid parity, which means that the costs of generated electricity at the household level, is less than or equal to the price of purchasing power from the electricity grid [48]. This is due to the steep price decrease of solar rooftop installations, which has fallen by 67% between 2006 and 2013 [45].

Even though PV panels can cover a substantial amount of the community's electricity consumption, it will not suffice to make it self-sufficient.
We recommend the municipality to consider opening tendering process for a lighthouse wind energy project, close to the electric power transformation station North-West of Nowe Miasto. Although this idea comes up against political challenges, similar barriers have been addressed in many places across Europe. Wind is suggested for Zabrze due to the city's good wind conditions of 5.88 m/s at an altitude of 60m and 6.94 m/s at 120m [48]. Under moderate assumptions, one smaller wind mill of 2000 kilowatt performance, would yield approximately 3.5 million kWh electricity per year, equalling the electricity consumption of 1,000 inhabitants [49]. New wind turbines already achieve a performance of 5 MW on land, yielding energy from stronger winds in higher altitudes. The wind park could be integrated into the city's tourism concept by offering tours to the top of the windmills, offering Zabrze's visitors a great insight into new technological development and a scenic view over the region.

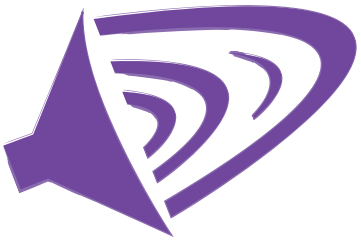
Even though PV panels can cover a substantial amount of the community's electricity consumption, it will not suffice to make it self-sufficient.

Wind Energy: Reaching New Heights

What about...

Noise

Noise pollution is dependent on the type of wind turbines, as well as the size of the wind farm and its location. Five normally operating wind turbines close to the power transformation station would approximately create emissions of 45 dB(A) at a distance of 600m in the closest settlements [52]. This is a lower noise level than in almost all existing residential areas of Zabrze [53].



Landscape

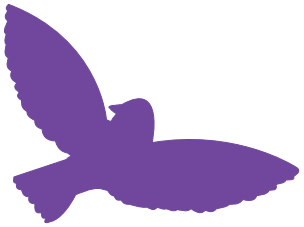
Beauty always lies in the eye of the beholder. Locating a handful of wind mills close to the electric power transformation station North-West of Nowe Miasto, where electricity lines dominate the landscape's character, would not disturb the view of Zabrze's residents.

Costs

Wind onshore is nowadays the cheapest source of renewable electricity, with average electricity generation costs of 6 cents per kilowatt hour [50].

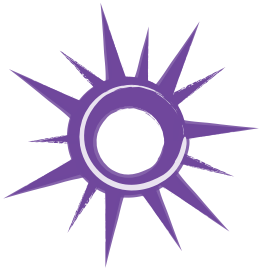
Birds

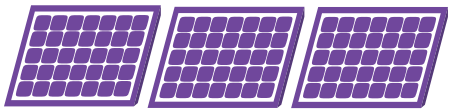
Wind power is much less of a threat to birds than usually assumed. For example, all wind turbines in the United States kill 400,000 birds each year, while cars and trucks kill 100 million birds and cats kill another 100 million. Most bird deaths can be attributed to outdated designs of wind mills and the location of wind turbines in birds' migration corridors. New designs reduce the blade rotation speed and therefore decrease the hazard for birds[51].



Renewable Sources for Heating

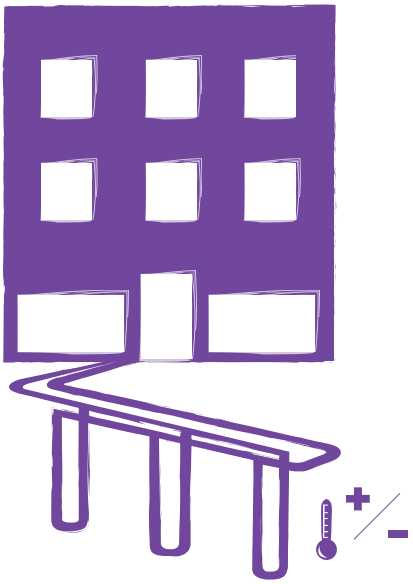
Solar Thermal Energy





Active solar heating systems, in the form of solar collectors, provide buildings with hot water for heating, as well as showering and other purposes. Solar collectors yield between 270 to 500 kWh per m², depending on the local conditions. Each square meter of solar collectors, replaces roughly the consumption of 40l of oil used in a conventional boiler heating system. The share of a building's total energy consumption that can be provided by solar heating systems is strongly determined by the buildings' insulation. Pilot projects have achieved a solar coverage for heating of 70% and more [45].

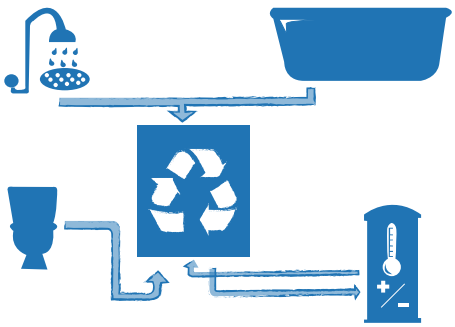
Geothermal Energy for District Heating



If it is economically feasible to connect Nowe Miasto to the district heating network will depend on a number of different factors. The current district heating in Zabrze is provided by the combined heat and power plant (CPH) Zabrze, operating predominantly on coal and around 10% biomass [54]. Assuming that the most modern energy efficiency technologies will be applied, the energy demand might be low enough to solely rely on less infrastructure intensive alternatives, such as locally installed heat pumps alongside solar collectors or micro-combined heat and power plants running on biomass.

We also see potential in geothermal heat as a source for heating residential areas. The Upper Silesian region has a number of abandoned coal mines with former mining infrastructure deep into the ground that could potentially be reused for geothermal heat when filled with water. Some of the coal mines, such as the Guido mine in Zabrze, require constant draining from inflowing water and have high related maintenance costs. Reusing the mines for the extraction of low-temperature geothermal heat could serve as an additional source for the local district heating network. This is already successfully applied in Glasgow, Scotland [55].

Use of Excess Heat of Grey Water / Wastewater



Another innovative solution for heating is to extract heat from the residential wastewater and use the cool refuse water for cooling purposes. Successful examples of this energy synergy can be found at innovative communities such as Stockholm's ecocity (Hammarby Sjöstad). Reusing the excess heat present in household wastewater (from showering, washing machine, dishwasher) by employing heat pumps, reduces the demand for energy and allows for a decentralised, independent system.

Two systems are envisioned:

1. Heat extraction from high-temperature wastewater in the residential building: Connecting the heated water to a heat pump that upgrades the heat to a point where it can be reused within the building;
2. Heat extraction from low-temperature wastewater in the local wastewater infrastructure: Here the excess heat of collected wastewater is upgraded with heat pumps and fed into the local district heating network

Integrated Building Design

The design of new buildings in Nowe Miasto will play a major role in determining the carbon footprint of the community. Currently, buildings account for 40% of the total energy consumption in Europe. It is therefore of central importance for a sustainable society to decisively target energy efficiency of buildings - in heating and electricity consumption, but also inherent energy content of the building materials. Therefore, energy efficiency in building is an explicit priority of the EU and member states are required to define minimum energy performance requirements. Poland has implemented the EU directives among others through the Law on Energy Efficiency of 2011 and the second National Action Plan [56]. Like the average of European countries, in Poland around 70% of the energy consumption of households falls on space heating. With rising wealth this fraction has been slightly decreasing over the last two decades, as electricity consumption has increased. However, the overall consumption of energy for heating has decreased only marginally: from 17 koe/m2 (koe=kilo of oil equivalent) to 15koe/m2 – thereby missing the goal of the Polish building standard of only 10 koe/m2 [56]. This shows that much more can and should be done to improve building energy efficiency in Poland. Zabrze can take the lead here by creating Nowe Miasto as a showcase of highly energy efficient buildings.

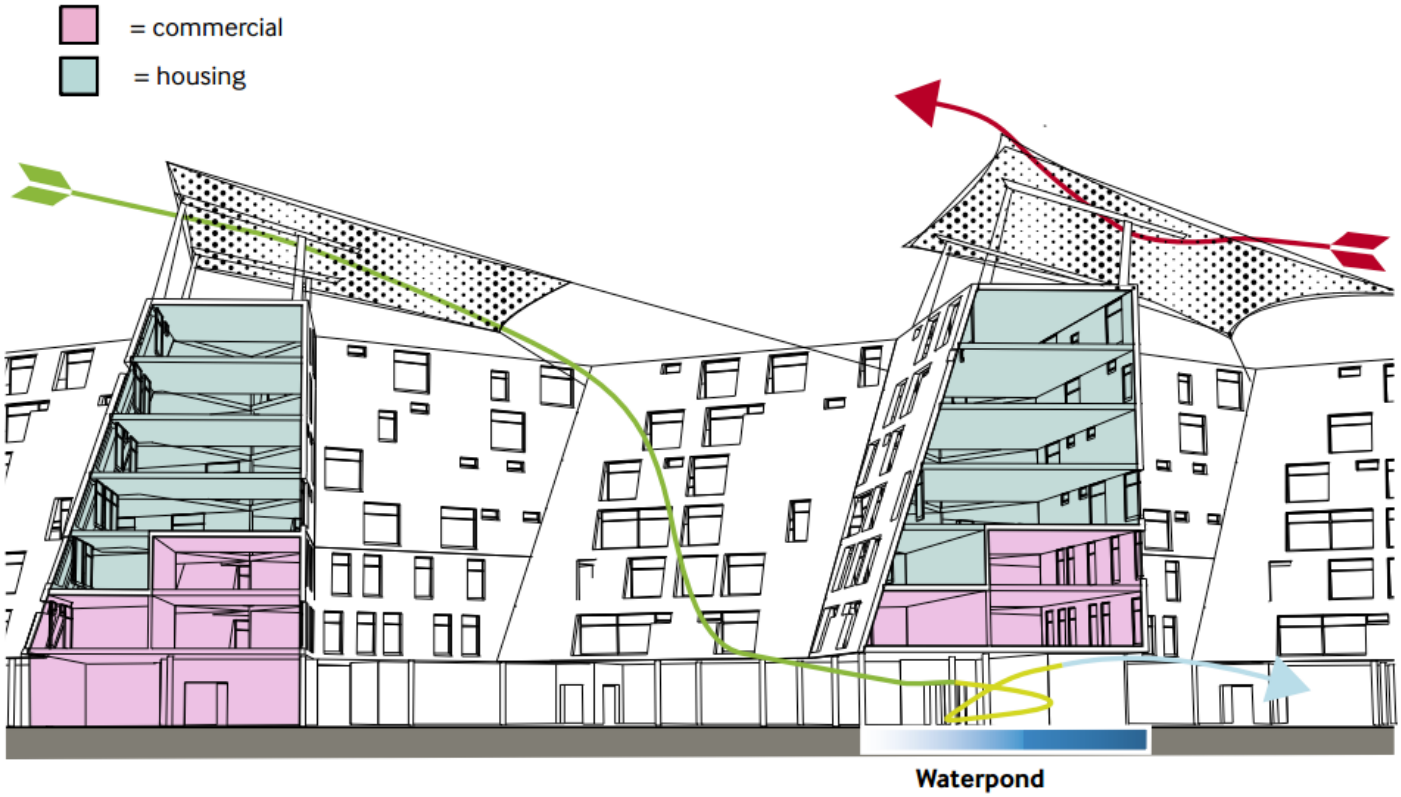
The energy-efficient housing programme offers grants of PLN 50,000 (EUR 12 500) to people who build new or renovate their old homes and whose retrofitted houses use no more than 15 kWh/m² annually from external sources of heating and electricity. Homes which use no more than 40 kWh/m² annually will receive PLN 30,000 (EUR 7,500). --IEA

As emphasized in the 2010 EC Directive on the energy performance of buildings, an energy efficiency evaluation of buildings should include not only thermal characteristics but also larger electric and electrical installations and the use of renewable resources. Moreover, the use of passive heating and cooling elements, shading, indoor air-quality, adequate natural light and design of the building should be considered [57]. In other words, the trend in the EU goes towards integrated building design. Importantly, by the end of 2020 all new buildings in the EU are required to be "nearly zero energy buildings" – buildings of very high energy performance and covering its energy requirements mostly from local renewable sources. The public sector is required to reach the same level two years earlier and support the development of such buildings through national and local plans – as implemented in the Polish Law on Energy Efficiency [58].

In order to reach ambitious goals, Zabrze can make use of the Polish energy-efficient housing programme, which offers grants. Two important grants for Zabrze are:

- PLN 50,000 (EUR 12,500) for newly built or retrofitted/ renovated homes using no more than 15 kWh/m² annually from external sources of heating and electricity
- PLN 30,000 (EUR 7,500) for homes using no more than 40 kWh/m² per year [59]

In summary, energy efficiency in buildings is of high importance and will be increasingly legally required. To show Zabrze's commitment to create a lighthouse project for a sustainable smart city, Zabrze should lead the way by pre-empting the regulation and use its developments as showcase for zero energy or better even energy positive buildings.



During the hot season, prevailing S.W wind is allowed to pass through the block thereby reducing the need for airconditioning. The effect is enhanced by passing over water surfaces.

During the cold season, prevailing N.E wind is deflected from the built structure, reducing the need for heating.

Source: Lund stad

Integrated Building Design for Nowe Miasto

Besides choosing the right building materials, applying an integrated building design is of great importance to maximize the benefits of low-energy buildings, as it can dramatically improve a building's performance in terms of energy use, and impacts on environmental and human health. Integrated building design makes use of natural principles allowing for passive heating, cooling and ventilation, as well as natural lighting. To do so, buildings are constructed according to the local climate. For example, taking into account seasonal variations, by making maximum use of orientation towards the sun, heating and lighting requirements can be met passively. Likewise, observing the main wind direction, good ventilation and cooling can be improved. Trees and other vegetation can be a barrier to cold winds and provide shade in the summer. They also help reduce and control rainwater runoff. The size and quality of windows, as well as the thermal insulation of the building can then be adapted to the requirements of the building. To cover the remaining need for heating, cooling, and lighting active systems are scaled accordingly. As presented above, local renewable energies, particularly solar PV and solar heating, should be added to cover the energy requirements of these systems. The roof should be designed to accommodate these systems easily and effectively. Lastly, smart metering and the connection to a (local or larger) smart grid offers further potential to minimize energy costs and improve the integration of electricity from various energy sources into the system [66, 67].

Natural Materials are Good for People

In conventional buildings, 80-90% of the energy use – and therefore significant costs – can be associated after construction. In more energy efficient buildings however the energy embedded in the building materials - the energy used to produce the materials - may account for up to 46% of the energy footprint. Other environmental impacts may also be significant, such as water and resource use, pollution during production, and toxicity of materials when the building is demolished. Therefore, a life-cycle perspective in evaluating performance and costs of materials should be taken, since materials which are cheap to buy and install may cause significant costs in maintenance or disposal - not to mention may have substantial environmental impacts as well [61]. For example, conventional insulation materials such as styrofoam take a lot of energy to produce, while renewable materials like sheep wool or compressed straw require very little energy. This means by using natural materials builders can reduce the total climate impact potential up to 98% compared to conventional insulation [61].

Using natural materials has the potential to significantly reduce the environmental impacts from a life-cycle perspective.

Using natural materials has the potential to significantly reduce the environmental impacts from a life-cycle perspective. Examples are fiber boards made from kenaf, wooden beam structures instead of steel concrete or natural clay bricks and shingles instead of conventional bricks. While steel reinforced concrete emits large amounts of CO_2 during its production, wooden constructions may even have a positive carbon balance (absorbing more CO_2 than emitting for its production) if the timber is re-used after its useful lifetime in a building. One good example of attractive, highly energy efficient wooden architecture is the German town Bad Aibling. Also attempting to minimize its environmental footprint and be socially inclusive, this model neighborhood could be a good example for Zabrze to take inspiration from.

City of Wood: Bad Aibling, Germany

Situated on an old military base in Southern Germany, the "City of Wood" in Bad Aibling can be seen as a lighthouse project in many ways. It blends technological showcases of sustainable building with socially integrated living, local job creation, aesthetics, and design. It is home to Germany's largest wooden high-rise building, and aims to be entirely energy autonomous through renewable energy sources. First, new houses are built as multi-dwelling homes with four (up to eight) floors. Detached villas are integrated with the existing, retrofitted buildings. Both are designed for very high energy efficiency, aesthetic value and superior indoor climate. They all use wood as a main building resource. It has the advantages of offering high material performance and versatility while being a renewable resource with low and in some cases a positive carbon balance. The economic feasibility is proven by the fact that many of the dwellings are dedicated to social housing and public institutions like the local school. The houses are integrated with a mix of renewable energies (solar PV, biomass heating, geothermal energy). The area is so successful in part because experimentation is part of the concept, and because it has addressed all the pillars of sustainability it is socially inclusive, economically prosperous, environmentally sensitive and climate smart [62].

Natural materials have low levels of toxic contents and can contribute to a healthier indoor climate, improving the quality of life for residents. At the same time, the performance of such natural materials is similar to conventional materials if applied correctly, and may offer unique design opportunities [60]. The possibility to source such natural products locally and the need for different skills can contribute to local expertise building and economic development. Finally, as the markets for production, distribution and application of such materials is so far underdeveloped, there is great potential for creating local expertise for this market niche – thereby improving the local economy and forming the base for special expertise which can be exported. We therefore highly recommend taking the opportunity of the Nowe Miasto development to build modern, well-designed buildings using natural materials.

Straw Bales for Insulation

One alternative to conventional insulation materials are straw bale walls. Straw as insulation material has numerous advantages, such as good insulating properties (R-value of 7 m2 *K/W – compared for example to an R-value of 5 for expanded Polystyrene, a typical insulation material [63]), negative net climate impact, a healthy microclimate, and very low prices. Contrary to public opinion, fire resistance of straw bale walls is very high.

Since straw is a renewable surplus product of agriculture it can be sourced cheaply and locally. Construction may be done using specialized methods applied by experts, or by means of traditional low-tech methods involving the local community. Thus, building with straw could be used to both to create rare expertise locally (to be exported elsewhere) and to foster a sense of community [64].

Straw has been used as building material for centuries and has proven durable, with some original houses of the first U.S. Nebraskan settlers still in good condition after over 100 years. Recent experiences from Denmark and the Baltic States Estonia, Latvia, and Lithuania have been positive. In a 2006 project in Estonia, modern cottages were built using wooden structures and straw bale construction. The straw bale insulation cost less than 1/10 of comparable rockwool insulation. Including stand-alone wind power generation the total costs were only 10,000 EEK/m² (~2,500PLN / 650EUR) [65]. Given the clear advantages of the material and positive experiences the number of constructions using the material is increasing, but there is not yet an industry – a market opportunity for early movers which Zabrze could make use of.

Governing Sustainable Building Through Frameworks

Building sustainably can be enhanced by applying a framework that helps to coordinate and check that developers are implementing the desired ambition level, e.g. with regards to energy efficiency. An example of how such a framework is the Swedish “Miljöbyggprogram SYD” (eco-building program in Southern Sweden) [60].

“Miljöbyggprogram SYD” is directed at contractors (not applied to private house builders) and sets requirements for constructors of new buildings as well as retrofit projects. The framework has been developed within a collaboration of the University of Lund, the municipalities of Lund and Malmö. The framework focuses on five core areas describing the quality of the building within its direct environment. These areas are: energy, protection from humidity, in-house climate, urban biodiversity, in-house acoustic and traffic noise. The five core areas can be evaluated to three different levels; A “Best”, B “Very good”, C “Good”. New building projects shall at least reach level C when finished.

According to the “Miljöbyggprogram SYD”, the following steps are performed when carrying out a new building project or retrofit project:

- agreement on the ambition level in the core areas after finalized project,
- consecutive examination of compliance with determined characteristics after the building is finished (‘result protocol’)
- a final follow up of compliance two years after the building has been constructed.

The choice of the ambition level is determined through a dialogue between the contractor and the municipality. However, the pursued levels within the core areas are pre-set. After the definition of the ambition levels, the constructor formally applies for the construction of a building or buildings at the municipality. In the application the contractor presents the features and specific details that will allow the project to be compliant with the ambition levels agreed on beforehand. In the case that the contractor does not comply with the committed agreements, the municipality is enabled to disqualify the contractor for future projects in the municipality [60].

Energy Performance Contracting: A Means to Align Incentives for Energy Efficient Buildings

One issue with highly energy efficient buildings is that for the optimal design, many people – owners, developers, architects, designers and engineering firms – need to work closely together. This may mean higher efforts for some of these, but traditional contracts are not designed to reward such efforts. In normal building development, architects, designers & engineering firms (A/E) are usually paid a flat fee or a percentage of the construction costs, discouraging them from spending effort on long-term efficient and innovative design. Likewise, Investors and developers rarely have a financial incentive to pursue high efficiency buildings [68].

Energy performance contracting (EPC) intends to solve this. By designing contracts in a way that developers and A/E firms get paid through long-term cost savings, EPC ensures additional cross-disciplinal efforts to maximize energy efficiency. In other words, the goal of EPC is that the more energy efficient and cheap a building is during its lifetime, the higher the pay-off for developers and A/E firms. Incentives are therefore aligned across all actors involved in a retrofitting or new building project: Everybody is interested in making the building as efficient as possible.

the goal of energy performance contracting is that the more energy efficient and cheap a building is during its lifetime, the higher the pay-off for developers and A/E firms.

Usually EPC are applied in retrofitting, but the Rocky Mountain Institute (RMI) provides models for new buildings. In practice this means:

- Before planning, agree on a baseline of how resource efficient the building should be and how high the compensation of each actor will be for reaching this benchmark.
- Simulate the building design using computer modeling to estimate how much energy and resources the building will use; Elements of the model should be lighting, water heating and space conditioning.
- After finishing the building, conduct measurement & verification (M&V) for a period of time to verify the accurateness of the model; if needed the target performance may be adjusted.
- M&V also supports building operation for maximum utility and is done by a third-party actor acceptable to all contracting parties.

Any EPC contains (at least) 4 elements:

- A clearly stated target or performance goal.
- A method to evaluate performance during the design process.
- A protocol for measuring performance after the building is constructed, commissioned and occupied.
- A/E compensation (or design/build fee) that is partly contingent upon meeting the performance goal.

The RMI document “Energy Performance Contracting for New Buildings” (2004) contains step-by-step instructions how to establish a specific EPC, and important example contract sections [68].

Source: Malmö stad

Green Roofs

We envision the Nowe Miasto Pilot Neighborhood to have green roofs. Besides adding aesthetic value to the neighborhood and standing out as visual examples of the smart sustainable approach the new development takes, they have many advantages [69]:

- Retention of rainwater: 70-90% in summer and 25-40% in winter. This decreases peak runoff and delays the total volume of water flowing and can reduce flooding.
- Filter and clean the water, and depending on what material is used heavy metals can be captured – protecting local streams and lakes.
- Improve local air quality by capturing dust, particles, and other pollutants through the porous surface and biological systems in the plants.
- Cool on hot days and insulate on cold days. Plants capture UV, which would be converted into heat on a normal roof; the evaporation adds cooling effect. The layer of growing material and plants provides insulation during the cold winter months.

Temperature Differences

Temperature under roof membrane at mean temperature 18.4 °	
Normal Roof	Green Roof
32°C	17.1°C
Temperature under roof membrane at mean temperature 0°C	
Normal Roof	Green Roof
0.2°C	4.7°C

Source: Nottingham Trent University; see [69].

Green roofs reduce the need for cooling in summer by up to 75%, and the need for
heating in winter. Therefore, a good addition to passive houses and integrated
building design [69]. In addition to these benefits green roofs fit together well with solar PV. They can improve solar PV performance by 1-10% [70].

Green roofs also add high quality space in the urban environment. This space can be used for community green spaces, or urban gardening. Green roofs are an excellent opportunity to make the neighborhood interesting, accessible, and stand out from regular developments. One innovative idea will be implemented at the Berlin Holzmarkt - connecting green roofs of the buildings to create a “mountain path” across them, which can be a magnet for visitors both local and external [71]. At the University of Warsaw green roofs have become recreational public spaces. Atop the library building a combination of extensive green areas with elements of architecture, art, beautiful parks and even ponds, this publicly accessible green space has become a magnet for tourists and locals alike. It impressively shows how green roofs can be designed to be economically, socially and environmentally beneficial [72].

Moreover, green roofs contribute to local job creation in fields like manufacturing, plant
growth, design, installation, and maintenance, and can improve the durability of flat roofs significantly. This adds to the benefits that offset the initial higher price. Last but not least, green roofs can have a positive impact also for the local environment, offering nesting places for birds and places for insects and local plant species [73].

The arguments for green roofs are clear. Additional costs are partly or directly offset by increased durability and improved PV performance, and there are many social benefits that make investments into green roofs very worthwhile. The Polish association for green roofs (www.psdz.pl) has considerable experience with green roofs and surely can be of help. Creating green roofs would add to the image of the strong commitment of Zabrze to become the “green heart of Silesia”.

Source: Malmö stad

Smart Water and Waste

Beside the accommodating function of cities, the provision of sanitation services, the establishment and application of sound waste management of municipal waste and use of district heating are important pillars to ensure a healthy environment for citizens and the natural environment.

Waste

Issues regarding waste, the EU Directive on the Landfill of Waste (Accession 2003) as well as the Act of 1 July 2011 on the Amendment to the Act on Maintaining Cleanliness and Order in Municipalities assigned the responsibility for pushing forward and establishing adequate waste management at the local level. Despite all efforts, Poland continues to use landfills and many municipalities lack modern infrastructure (especially in rural areas) that treat the collected waste. This is amplified by a poor separation of waste at the source and in material recovery and recycling. Surveys show that waste dumping -- at inadequate sites or to neighbour's containers -- is an issue that needs to be addressed.

Source: Malmö stad, Western Harbour Guide

New targets are from the Polish Act on Maintaining Cleanliness and Order in Municipalities, which came into force in 2012. It introduced new recycling and recovery targets for paper, glass, metal and plastic as well as for biodegradable waste. Respectively, a recycling target of 14% is strived for in the year 2014 (with increasing recycling rates up to 50% in the year 2020) and less than 35% of the total mass of biodegradable waste generated compared to the reference year 1995.

Waste management in the new development area can be inspired from the model of bo01 in Malmö. A smart waste management system in the new development will facilitate and enhance waste segregation while simultaneously prepare for further reuse and recycling of the waste fractions.

1. Food to biogas
Grinding, suction, and transport of food waste from private households to an underground tank located at the new community (bo01) is then collected and used for biogas. This is an example of a comprehensive waste-to-energy system.
2. Waste recycling
Outside of the houses, waste collectors are placed in very close proximity to the houses and segregate waste into the fractions combustible waste (plastic), recyclable fractions (glass, aluminium), paper,

as well as hazardous substances (batteries, electronics etc.) and residual fractions. All fractions are separately sucked into a vacuumed underground system, not allowing any waste odour to be released into the environment.

The simplicity of this system for the user allows the inhabitants to support the local waste management while the automated underground waste infrastructure decreases the need for waste trucks frequently entering the area. The waste infrastructure should be designed in a way that ensures safety for the inhabitants and the local natural environment.

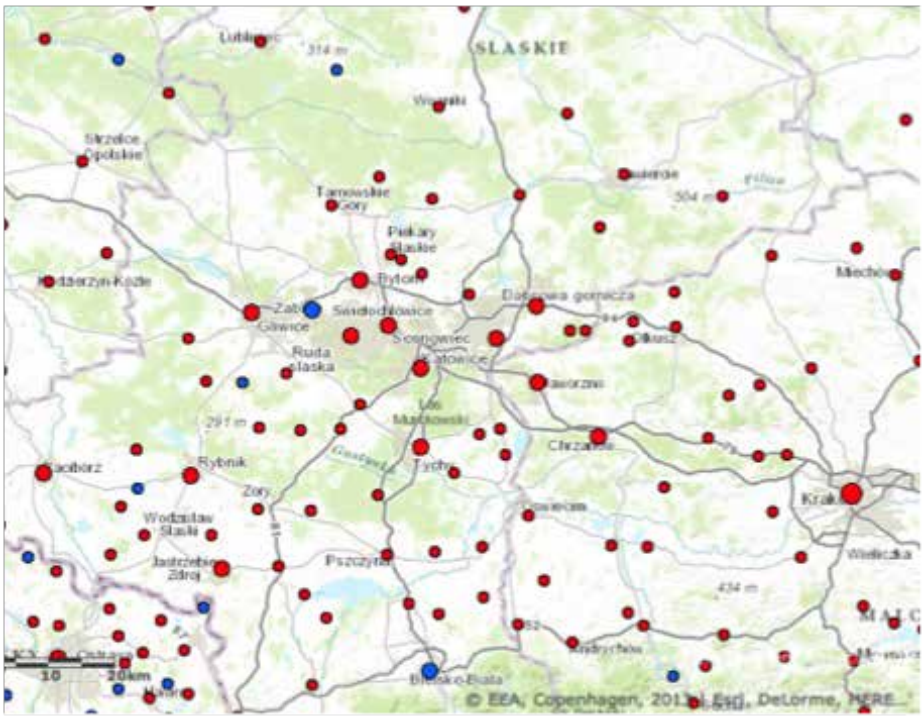
Recommendations

To achieve such a system in Nowe Miasto the city should:

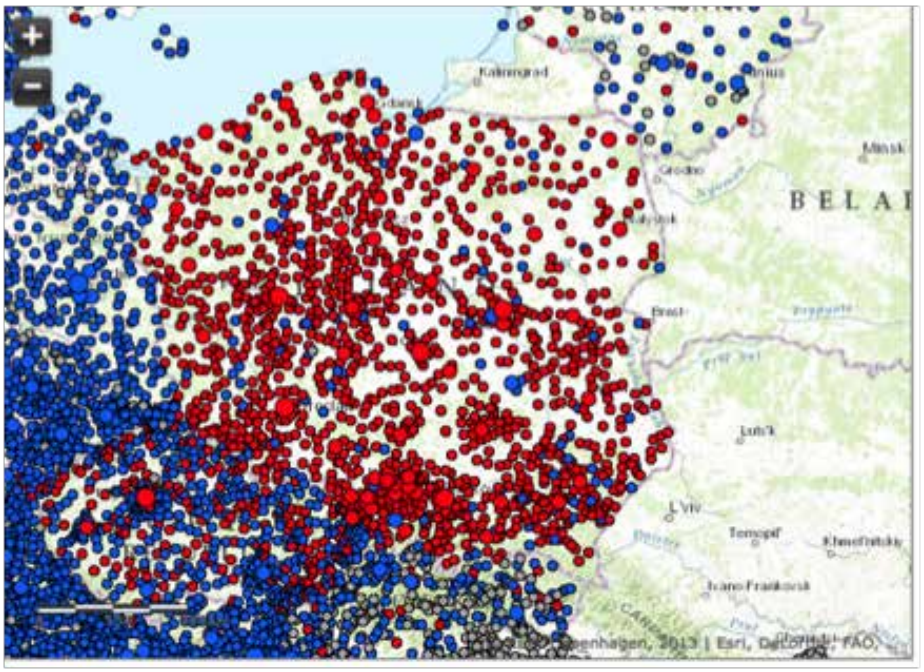
- Increase the support of the population by providing access to waste infrastructure (access to waste collection, recycling facilities etc.), design incentives for residents to separate waste fractions and by that decrease socially unaccepted waste dumping and decrease cleaning costs for the municipality.
- Build confidence in the waste management system of the local government
- Install an underground vacuum waste system that takes up different waste fractions (combustibles, biodegradables, recyclable waste fractions).
- Increase the municipal waste processing capacity, that is, mechanical, biological and thermal waste treatment (includes a feasibility study of a combined thermal waste treatment and district heating facility).
- Evaluate the hybrid financing model for local waste management, that is a combination of public-private-partnerships with EU funding.
- Continue with the investigations of the feasibility of a biogas system based on the recommendations from the report "Energy from Waste. A pilot Biogas System in Zabrze" by the IIIEE, 2013.

Wastewater

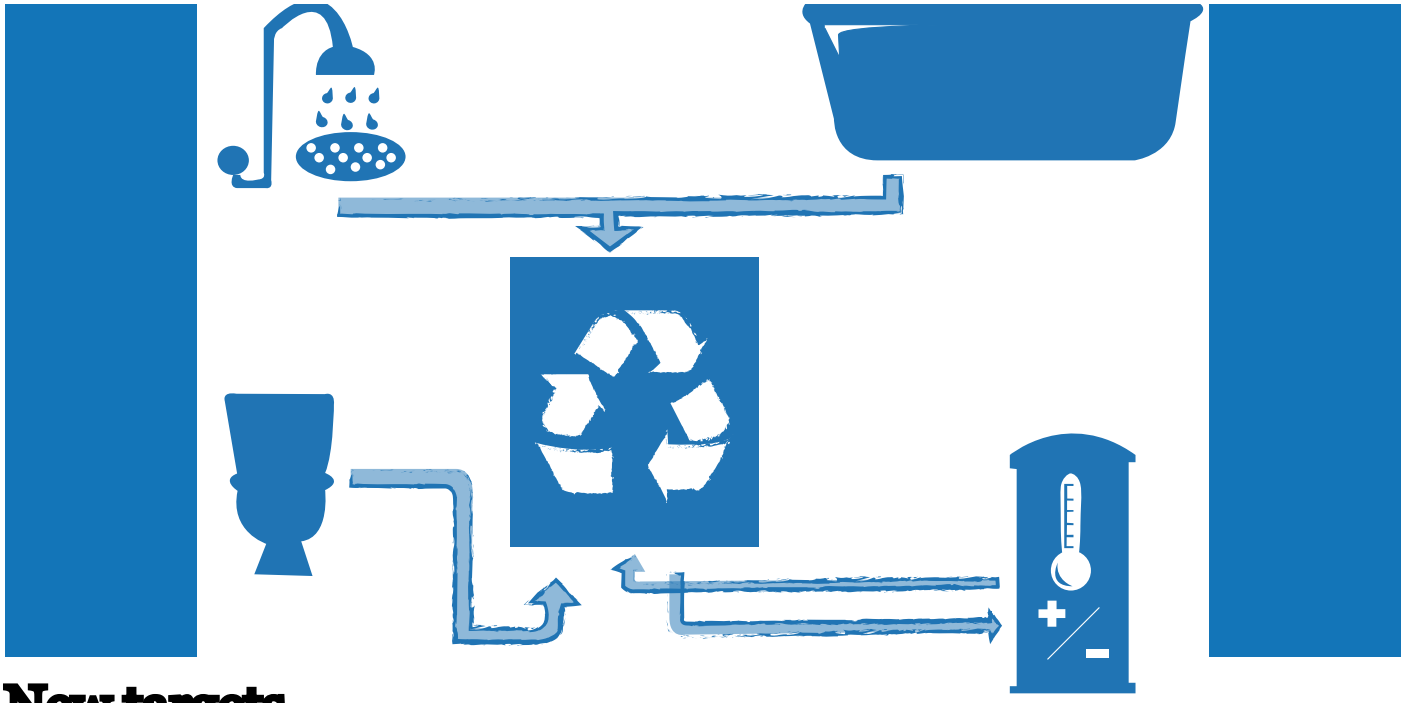
Regarding the management of wastewater, Zabrze has a regionally outstanding performance and compliance with the European Wastewater Treatment Directive (Art. 3,4 and 5). Zabrze has installed a new sewage system (sanitary and rainwater), modernized the existing sewage system, and constructed a new water supply system.



Map of wastewater treatment plants in Silesia, Poland. The blue dots indicate compliance with the Urban Wastewater Treatment Directive.



Poland and its state of wastewater management: red dots indicating a general non-compliance with the Urban Wastewater Treatment Directive.



New targets

Sustainable water management starts at the consumption of water. Conscious use of water is important for a sustainable future of Zabrze. Monitoring the amount of water consumed by residents allows for setting targets to lower the amount of fresh water used at the source (at residential houses for example). Reduced fresh water consumption generates less wastewater and hence decreases the need to treat wastewater, resulting in a lower effort for the local wastewater treatment plant. Intelligent financial models ensure that a reduced wastewater load is not jeopardizing the profits of the private wastewater treatment plant. The goal for all stakeholders (residents, municipality, wastewater treatment facility, drinking water supplier) should be to decrease the amount of water used.

Today many chemicals are used, which have different physical and chemical attributes that put a burden for on local water resources, and natural processes do not breakdown some of these chemicals. Wastewater treatment facilities need to adapt to the new requirements these pollutants pose. A helpful source for current developments and technologies to clean wastewater from pollutants can be found on the website of the European Commission on the Water Framework Directive.

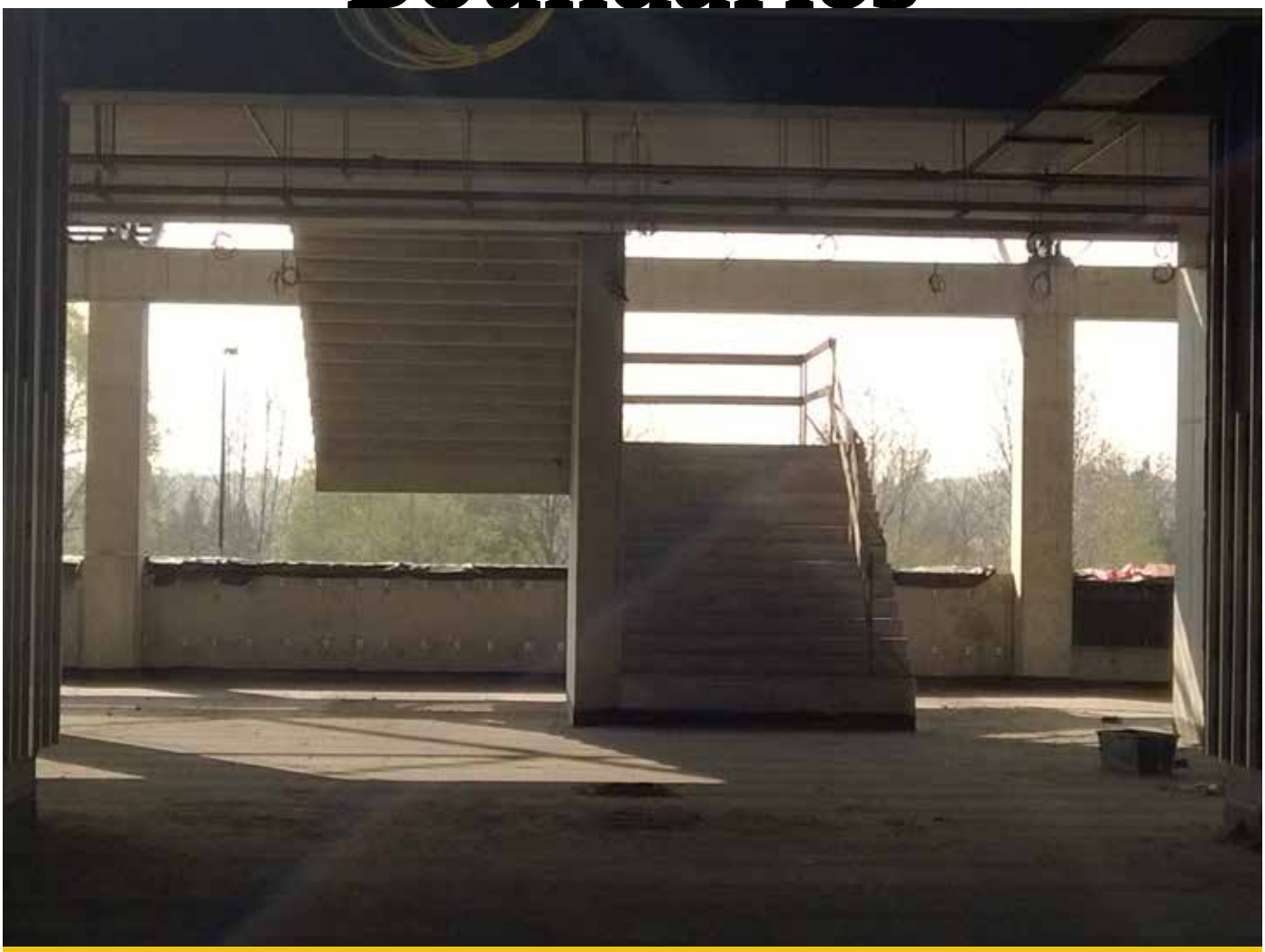
Grey water and rainwater constitute an option for a smart Zabrze, by making best use of present resources and conserving valuable fresh water sources. Fresh water of drinkable quality applied in toilets or garden irrigation degrades the value of the resource where water of lower quality would suffice.

Recommendations

Decrease the use of fresh water (drinking water quality) and promote the use of grey water and rainwater for non-drinking water functions (toilets, garden irrigation, etc.);
Continue to improve wastewater treatment for chemicals of concern. In order to advance the wastewater treatment, look into the issue of micro-pollutants such as endocrine disruptors, and stay up to date with amendments made to the water framework directive.

City Center

New City in Old Boundaries



If designed carefully Nowe Miasto will be the lighthouse project in Southern Poland showcasing a modern, sustainable community. However, the efforts put into this new part of the city should not divert attention from the old centre. Zabrze has been constantly investing in the maintenance and modernisation of its cultural and industrial heritage. We strongly encourage the municipality to build on this potential and to further foster a transition to a vibrant, sustainable community within the old boundaries of the city.

Guiding principles should be to limit urban sprawl and instead work on densification and improving the quality of life in the old city centre, always with the aim to create a lively, walkable and healthy community, which respects the local environment.

Zabrze is on a good track with its plentiful green spaces and its extensive renaturalisation programme of brown fields along the river side. We also saw a vibrant outdoor city life in Zabrze's neighbourhoods. Areas of improvement that we identified are particularly the inner city's walkability as well as the refurbishment of the existing building stock. The following sections summarize our ideas on these issues. We would also like to present two interesting cases from Malmö and Newcastle in Australia, where efforts to revitalize local value creation have made more resilient and robust local economies.

Inviting People to Walk and Cycle

To have a smart sustainable image a city must prioritize reducing its environmental impact from mobility. The principles for sustainable transportation outlined for Nowe Miasto are also applicable to the old city.

City authorities have already closed off the old city centre for car traffic, only allowing trams running through Wolnosci Street, thus making it more pedestrian friendly. But with the construction of the Platan Mall, the city centre has been "shifting" towards that area. The accessibility of Platan´s surroundings for non-car users could benefit significantly from a few improvements:

- Build bicycle paths along the Mikulczycka road (no. 921) and setting up traffic lights north of the mall, where the Hutniczy Park is located would make it easier for pedestrians and cyclists getting to Platan.
- Install traffic lights to connect the path running through Hutniczy Park to the mall. Currently, the path ends on the east part of the road with no secure option of crossing the street, entering the Nowe Miasto neighborhood on the west.
- Establish parking fees for the city center to discourage extensive car usage and invite people to walk, bike, or take public transport. The income raised could be used to cross-subsidize sustainable transport infrastructure, such as bicycle paths.

Freiburg's Vauban District

The Vauban Sustainable Urban District is an ecological restoration process of the old military barracks in Freiburg, Germany. The project has been in existence for 17 years now, and keeps being a showcase for a sustainable urban district, where social cohesion and cooperatives have been constructed alongside the reinvention of the space. The Vauban experience has showed the potential for social inclusion of a diverse set of residents. This is in part accomplished through an extremely diverse range of housing. Alongside private enterprises, many cooperative groups have emerged (since 2006, 52 new groups have emerged making a total of 92). These groups are often managed through participatory processes, allowing low-income families to participate. The Genova Cooperative created by Forum Vauban in 1997 is a self-managed rental cooperative. Its buildings, which contain 36 to 40 apartments are mainly occupied by young people, elderly, and people on low income. In each phase of design of the buildings interested people take part, and special places have been designed for meetings. Aspects such as the looks of the facades, orientation, common areas, as well as the scale of the development are decided collectively. Apart from design and construction, the cooperative is also responsible for collectively owned properties, for example a hostel and the laundrette. Importantly, women play a strong role in the processes within the many social and community initiatives. Since 1997 there is a women's committee, which takes interest in many different undertakings of the District, bringing the often silenced opinions of women forth [76].

Refurbishment of Existing Buildings

The existing building stock of Zabrze offers substantial potential for energy efficiency improvements (retrofitting). Given the current low standard of insulation, such measures can be very cost-effective. The municipality has recently started a subsidy scheme to accelerate the refurbishment. This is particularly important for high-rise buildings where socially equitable solutions have to be found to ensure current residents are not displaced. One such approach has been successfully implemented by architects Druot, Lacaton, and Vassal in Paris: structurally independent winter gardens with highly insulating glass surfaces were added to the existing buildings, adding attractive living space. Thermal efficiency was improved by 50% without increasing the price per square meter. The residents – most from low-income background – were consulted throughout the process and none had to move due to the refurbishment [74]. This example shows that cost-effective, socially equitable refurbishment is possible and can add to the quality of life in existing buildings.

The old buildings of Zabrze – predominantly brick buildings often with elaborate wall decorations – present a different challenge altogether; here, a sensitive approach should be taken, balancing energy efficiency and preserving the beauty of the buildings. Highly insulating windows, roof and floor insulations and intra-wall insulations could be options to be explored.

Source: Refurbishment Druot Lacaton Vasalle

Rich Local Culture in Vacant Spaces

In order to attract a young, culturally interested audience and support community spirit, Zabrze can make use of its vacant buildings and areas by following the model of Renew Australia. Renew Australia is an independent body which guarantees short-term and cheap leases of private and public space to entrepreneurs and artists. These gain an opportunity to try out creative actions with very low costs, while the owners retain the option to end the lease with short notice. Vacant spaces are used, their value increased and cultural, entrepreneurial local culture is fostered. The approach created over 70 new businesses within a year in the small town Newcastle, Australia and is now copied internationally [77].

Social Inclusion in Latvia

Besides good technical execution it is equally important to engage with the people living in the building to be renovated. One example from Latvia shows that by incorporating the residents in the discussion of whether and how to refurbish, what measures to take, and what aspects to keep in mind while doing so, the rate of refurbishments was increased significantly. By appointing one resident to be a spokesperson and interacting closely with all locals behavioural barriers were overcome and an improvement was experienced through the renovating process [75]. It is important to get to know the people, build trust, and provide ongoing support. Such an approach is suggested in Zabrze to further improve the involvement of its residents to educate them on the benefits of refurbishment and low-energy buildings and consequently both increase the speed of refurbishment and promote more sustainable live styles.

Local Value Creation

Source: City of Zabrze

For becoming a sustainability forerunner among Polish municipalities it will be vital to attract businesses, which engage with sustainability. The aim should be to not only be a consumer of technological and knowledge-based sustainable solutions, but also a producer. The city of Malmö has gone through an impressive transition from an industrial city to a sustainability knowledge centre in less than three decades. The factors that have contributed to Malmö's successful economic transition are presented in detail.

Malmö and Zabrze share similar challenges and opportunities. The two cities have a comparable population size, are located in very densely populated regions, come from an industrial background, and benefit from recent infrastructure development projects. Like Zabrze, Malmö has shown very strong leadership and the political willingness to enter the transition to a sustainable city. Malmö's economy was traditionally based on the shipbuilding and construction industry. When the shipbuilding industry ceased in the 1980s/1990s Malmö lost 27,000 jobs and 35,000 inhabitants, leaving the city in a deep economic crisis and in need of a new identity [78]. Today, Malmö has a bigger workforce than ever before and a forerunner in sustainable urban city planning. It accomplished this through fostering growth of new economic sectors. These sectors are: cleantech, digital media, life sciences, logistics, and tourism. Recently, the OECD ranked Malmö as the world's fourth most inventive city [79]. This tremendous economic transition occurred in a relatively short period of time because of the city's strong leadership and vision, connecting Malmö to Copenhagen and mainland Europe, and attracting new business and entrepreneurs to help recover the economy.

Strong Leadership & Strong Vision

Under Malmö's Mayor Ilmar Reepalu the city developed a vision of becoming an environmental leader. This required nothing less than shifting the economy from heavy industry to a center of culture and knowledge. Several groundbreaking decisions were taken, such as the transition to 100% renewable energy as well as the development of new eco-communities in former industrial areas.

Source: Malmö stad

The Western Harbour district is now an internationally known showcase of sustainable urban planning and Masthusen will be the first certified BREEAM community outside the UK. BREEAM is a worldwide leading design and assessment method for sustainable buildings [80].
Another important step undertaken under Mayor Ilmar Reepalu was the foundation of Malmö University, which opened in 1998. The university life attracted a young and creative labour force.

Connecting Malmö

New infrastructure projects, particularly the construction of the Öresund Bridge, fostered an economic integration with Copenhagen and the mainland of the European Union. Today, fast regional trains provide Malmö with access to an international airport in less than half an hour. Since then many companies strategically moved their headquarters to Malmö. The region's attractiveness will further increase when the Fehmarn Belt Tunnel between Denmark and Germany will be constructed by 2021.

Attracting New Businesses

Every day eight businesses start operations in Malmö [79]. The municipality strongly supports start-ups working on sustainable solutions through the Malmö CleanTech City. The core idea was to develop a green cluster, by establishing cooperation between companies, academia, and the municipality. Malmö CleanTech City provides free office spaces for

small companies and connects business ideas with the needs in the city. By facilitating networking opportunities and “TestBeds” companies are supported in bringing innovative products on the market [81].

Lessons for Zabrze from Malmö

To become a sustainability forerunner among Polish municipalities it will be vital to attract businesses which engage with sustainability. Zabrze should aim not only to be a consumer of technological and knowledge-based sustainable solutions, but also a producer of these solutions. The showcase of Malmö underlines the importance of local knowledge creation for local value creation. With the existing Institute of Environmental Engineering of the Polish Academy of Sciences, Zabrze has a great potential to build on. The recent foundation of the incubator, Zabrzańskie Centrum Innowacji with its focus on supporting start-ups in the field of IT and renewable energy is a further step in this direction.

Taking Zabrzańskie Centrum Innowacji Further

Research has shown that innovations develop to a large extent in regions, or knowledge clusters. This is because even in a digital world, direct social interaction between creative individuals is crucial for the development and dissemination of innovations [82]. Therefore, the Zabrzańskie Centrum Innowacji could yield even higher benefits, if integrated into a regional CleanTech development concept. With the recently founded CleanTech cluster in Krakow and the Energy Efficiency Foundation in Katowice the region of Southern Poland has a great potential to become the CleanTech forerunner nationally and internationally. Today Poland is the OECD country with the smallest public fund for innovations [82]. Combining forces in the region is a strategy to lobby for more support from the national level.

Reference Framework on European Sustainable Cities

To support cities like Zabrze in their efforts to become more sustainable, there are many tools and methods that could be applied. The Reference Framework on European Sustainable Cities (RFSC), is a joint initiative of the Member states of the European Union (EU), the European Commission and European organizations of local governments, and is available to Zabrze free of charge [83]. It also opens the doors to cooperation with the EU as identified in an interview with Ms Axelle Griffon (February 2014) representing the RFSC. She suggested that there would be money offered by the EU for sustainable action plans, which will be available in the near future. It has been hinted that cities using the tool might have more chances to receive the funding as they are already committed to sustainable urban development.

The RFSC is an online toolkit designed to help cities integrate sustainable development into their planning. It does this by providing the tools and support cities need to integrate sustainable principles into their policies and programs.

Strategy

A city can create a strategy for e.g. sustainable development, playground etc.

Check for an integrated approach

A city can assess the importance of the project characteristics (Low-Medium-High). This section does not explain how to do/conduct a project, but gives an overview (plus/minus) of that particular undertaking.

Build a monitoring strategy

A city can choose indicators (also benchmarks) by themselves from a large database (developed based on other 200 frameworks), or can add its own, that it considers the most important. The tool provides an excel sheet to fill.

Source: Lund stad

Zabrze could use RFSC as they work to develop new sustainable ideas and projects and to monitor progress of projects already in action. Once signed in, the toolkit will allow Zabrze to create a profile (including its size and other characteristics). Zabrze can then match/network with other comparable cities. The tool also allows for networking by finding other cities that use the same toolkit for similar projects. Notably, profile and network participation are complementary to the tools that are the focal point of the framework.

As the tool does not apply "one-fits-all" approach, Zabrze could decide on its own what are the themes, targets, and timeframes it wants to use. Also, the toolkit is not intended for ranking cities, but rather gives methodology in achieving a particular goal. Additionally, it should facilitate better communication within a city, including different departments of a municipality by engaging each in the design process, as well as between cities, associations etc. Similarly, better results are to be expected from a specific project by using the toolkit's integrated approach, tools for monitoring, and to build capacity.

Lastly, a city can affiliate its account with for example a university. Meaning, that if Zabrze were to create a profile and affiliate the IIIEE Team Zabrze with it, the Team would be able to help out with the process. It could also be used for future SED projects, and long-term cooperation with the IIIEE.

Meet the Project Team

From left to right: (Front row) Nathalie Becker, Mallory Anderson, Sarah Kloke (Bottom row) Tilmann Vahle, Steinar Kaldal, Patrycja Długosz

Mallory Anderson

United States of America
Has an academic background in Environmental Studies.

Nathalie Becker

Germany
Has an educational background in Life Sciences.

Patrycja Długosz

Poland
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Sarah Kloke

Germany
Education: Political Sciences

Steinar Kaldal

Iceland
Education: Political Sciences

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Germany
Education: Environmental Studies and International Politics

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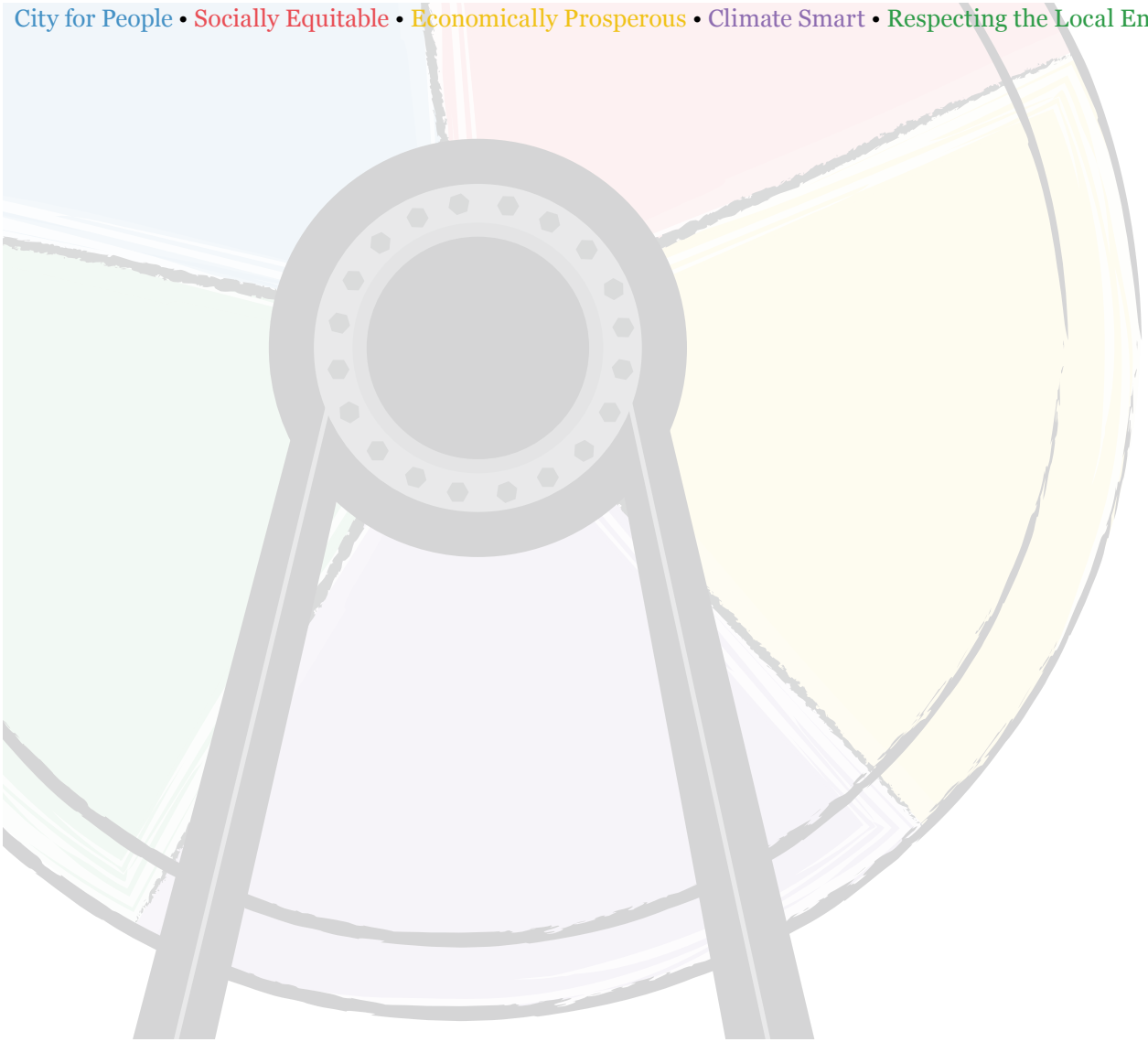

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