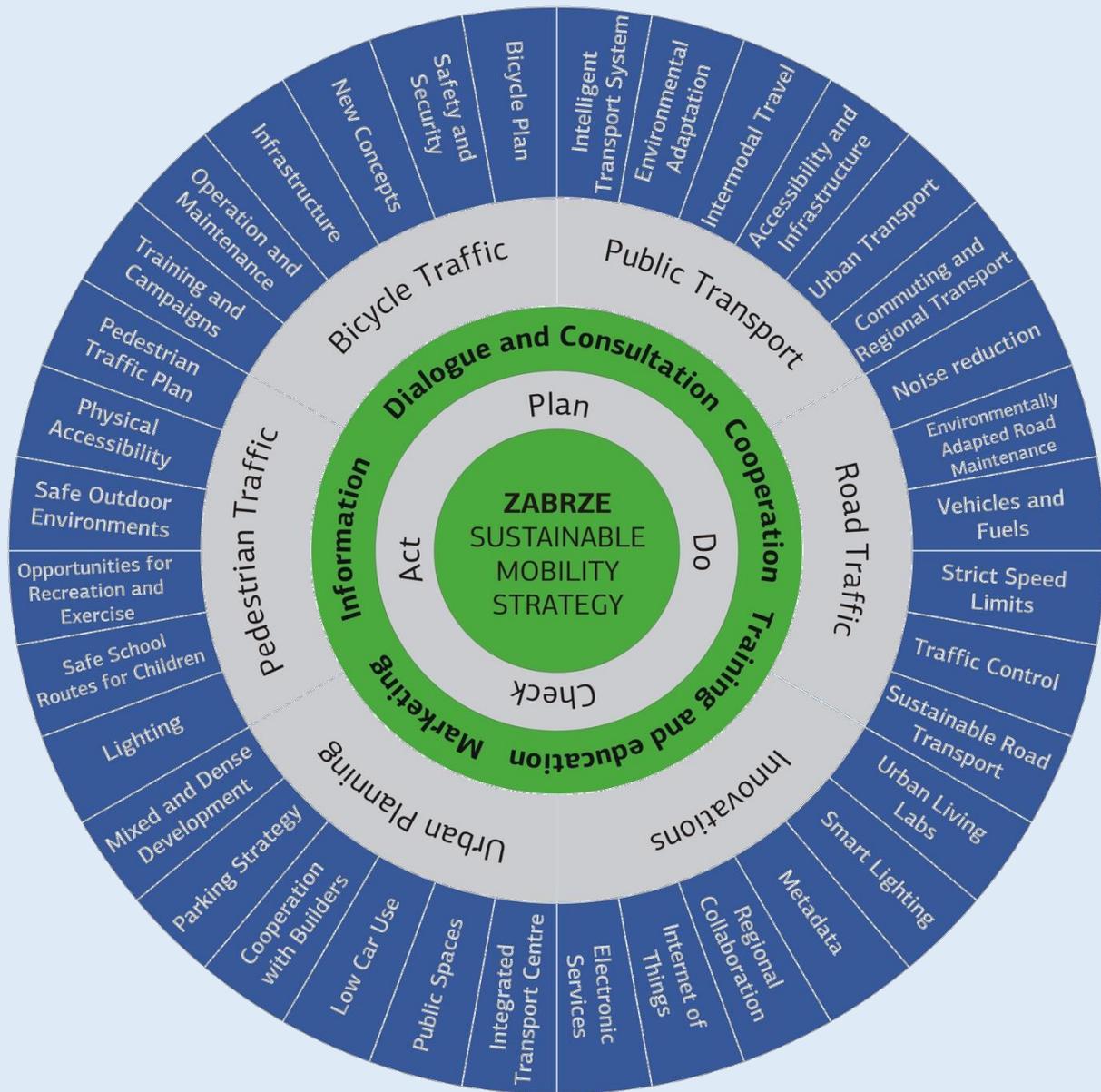


GREEN WAVE FOR ZABRZE



A SUSTAINABLE MOBILITY STRATEGY



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THE INTERNATIONAL INSTITUTE FOR
INDUSTRIAL ENVIRONMENTAL ECONOMICS

GREEN WAVE FOR ZABRZE



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A SUSTAINABLE MOBILITY STRATEGY

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ABBREVIATIONS

BRT – BUS RAPID TRANSIT

CAFÉ – CLEAN AIR FOR EUROPE

CBA – COST BENEFIT ANALYSIS

CH₄ – METHANE

CO₂ – CARBON DIOXIDE

dB – DECIBEL

DOLL – DANISH OUTDOOR LIGHTING LAB

EPOMM – EUROPEAN PLATFORM ON MOBILITY MANAGEMENT

EU – EUROPEAN UNION

EUR – EURO

GBPS – GIGABITS PER SECOND

GPS – GLOBAL POSITIONING SYSTEM

IOT – INTERNET OF THINGS

ITC – INTEGRATED TRANSPORT CENTRE

LED – LIGHT-EMITTING DIODE

LiFi – LIGHT FIDELITY

LPG – LIQUEFIED PETROLEUM GAS

LUNDAMATS – LUND ENVIRONMENTALLY ADAPTED TRANSPORT SYSTEM

IIIEE – INTERNATIONAL INSTITUTE FOR INDUSTRIAL ENVIRONMENTAL ECONOMICS

KZK GOP – THE UNION OF TRANSPORT OF THE UPPER SILESIA INDUSTRIAL REGION

NGO – NON-GOVERNMENTAL ORGANIZATION

NO_x – MONO-NITROGEN OXIDES

PDCA – PLAN-DO-CHECK-ACT

PLN – POLISH ZŁOTY

PM₁₀ – PARTICLE MATTER LESS THAN 10 MICROMETRES IN DIAMETER

PPP – PUBLIC PRIVATE PARTNERSHIP

SED – STRATEGIC ENVIRONMENTAL DEVELOPMENT

SEK – SWEDISH KRONOR

TV – TELEVISION

USD – UNITED STATES DOLLAR



ACKNOWLEDGEMENTS

We would like to express our deepest gratitude to Madam Mayor of Zabrze, Ms. Małgorzata Mańka-Szulik, for the warm welcome, great hospitality and granted access to all human resources of Zabrze Municipality.

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Dziękuję bardzo!

EXECUTIVE SUMMARY

We are a team of Environmental Management and Policy Master's students at the International Institute for Industrial Environmental Economics (IIIEE), Lund University, Sweden. As part of our Strategic Environmental Development course we were invited by Madam Mayor of Zabrze, Ms. Małgorzata Mańka-Szulik, to develop a framework for a sustainable mobility strategy for the city of Zabrze.

Zabrze is located in the heart of the Silesia region of Poland. Historically, it was built around coal mining and other related heavy industries. However today, Zabrze is pushing its transition from black to green with the aim to become an example of sustainability in the Silesia region.

In terms of transportation, the city has an extensive tram system as well as conventional city busses. In recent years there has been an effort to develop comprehensive bicycle routes and to promote biking as a sustainable and healthy mode of transport.

All aspects of transportation development in Zabrze are designed with a focus of the regional policy in mind. Recently, the Upper Silesia region adopted a common transport policy and in response to this, Zabrze is currently developing a municipal mobility strategy.

During our visit to Zabrze we met with top city officials, NGO representatives and local citizens. It was during this process that we were inspired by the Deputy Mayor Ms. Katarzyna Dzióba when she described her vision for Zabrze as: "A city where you have lots of space for walking, biking, trams, railway, clean air and happy people." We further discovered that the city possesses strong leadership with a good vision and is supported by committed human resources. Therefore, we strongly believe that, with the right tools in hand and a good strategy to follow, the city of Zabrze is well on its way towards sustainable mobility.

During our extensive preparation phase in Lund we met and interviewed representatives of Lund and Malmö municipalities, as well as various professionals and innovators from Sweden, Denmark and Germany. Based on the valuable inputs we obtained, we developed a sustainable mobility strategy framework for the city of Zabrze.

We were specifically inspired by LundaMaTs, the sustainable mobility strategy of Zabrze's sister city, Lund. We re-invented their so called strategy wheel and adapted it to the context of Zabrze.



INTRODUCTION AND BACKGROUND

Our task was to develop a framework for a sustainable mobility strategy for the sister city of Lund, the city of Zabrze in the Silesia region of Poland. The strategy is designed to include both hard and soft measures in order to take a holistic approach.

ZABRZE TODAY

Zabrze is part of an agglomeration of 14 cities that historically was built around coal mining and other related heavy industries. Zabrze has a population of 180 000. At its peak Zabrze had eleven active coalmines, today there is only one mine in operation. In order to respond to the changing realities, the city is actively pursuing new ways to attract modern business to the city by creating an economic zone and developing tourism built around their industrial heritage.



THE CENTRE OF ZABRZE

In terms of transportation, the city has an extensive tram system as well as conventional city busses. In recent years there has been an effort to develop comprehensive bike routes. The Upper Silesia region has recently adopted a common transport policy. In response to this, Zabrze is currently developing a municipal mobility strategy. All aspects of transportation development are designed with a focus of the regional policy in mind.

PREPARING FOR ZABRZE



VINGE CONSTRUCTION SITE

In preparation for our trip to Zabrze we conducted various site visits and meetings to gain an understanding of how different actors contribute in creating a sustainable mobility environment. These site visits included Kraftringen headquarters in Lund where the focus was on the transition of energy mix in the Skåne region as well as the development of the tramline in Lund and the role the energy company will play in developing the electric vehicle network expansion in the region. We also met with a representative from the energy service provider E.ON to discuss how they are

exploring new business models.

In order to consider potential innovation within mobility we visited the Danish Outdoor Lighting Lab (DOLL) where we received a first-hand exhibition of how lighting solutions can promote safety in mobility as well as reduce future energy costs. To gain insights about various biking markets around Europe we conducted an interview with a representative of the bike sharing system nextbike Germany. We also visited Fredrikssund in Denmark where they are developing a new smart city district, Vinge. The focus of our discussion was how city planners are designing and considering developments with sustainable mobility in mind. This was relevant to Zabrze as they are also developing solutions for a new city district, Nowe Miasto.



KIM BOSTRÖM, DOLL



CONCEPT OF DISTRICT IN VINGE

Furthermore, we met representatives from Malmö and Lund municipalities to specifically discuss and analyse their particular mobility strategies. We decided to create the strategy for Zabrze based on the sustainable mobility strategy of Lund, LundaMaTs. LundaMaTs is short form for Lund Environmentally Adapted Transport System in Swedish. Key factors influencing this decision are that LundaMaTs is a flexible strategy that breaks down the complexities of an integral policy, creates a manageable starting point and easily evolves over time.

SUSTAINABLE MOBILITY STRATEGY

DEFINITION

A sustainable mobility strategy can be defined as a strategic plan designed to meet the mobility needs of people and businesses without compromising other essential human or ecological requirements of today or in the future. Taking into account social, environmental and financial aspects, it aims to ensure accessibility for all citizens, improve safety and security, reduce emissions to air, noise pollution and energy consumption as well as improving the efficiency and cost-effectiveness of the transportation system [1]. All in all, it is aimed to enhance the attractiveness and quality of the local living environment.

LUNDAMaTs

In the late 1960s Lund was at a crossroads. The municipality had to choose between building a four-lane motorway right through the medieval city centre, and focusing on a sustainable development of the city's transport system. The decision fell on the second alternative and the motorway was not built. In 1998, after one year of planning, Lund introduced the first generation of LundaMaTs

[2]. LundaMaTs I, focused on the environment, suggesting 26 project proposals within the reform areas bike city, commercial transport, urban planning, environmentally adapted car traffic, and developed public transport.

LundaMaTs II, the second generation of LundaMaTs, which was adopted in 2006 had widened its focus from environmental aspects to the sustainable development of the transport system. Since then, the mobility strategy of Lund has focused on all three sustainability aspects – environmental, economic and social aspects. LundaMaTs was created by the municipality in cooperation with the consulting company, Trivector, also involving many other actors from both the municipality as well as the region. The planning process included theme groups and reference groups, seminars and discussions. The result was a broad approach aiming to make the transport system sustainable in the long



OUTDOOR ADVERTISING IN LUND

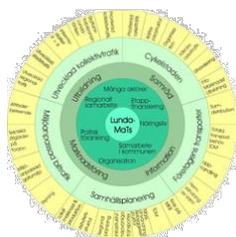
term. The vision was complemented by 18 measurable and specific targets and various performance indicators. Not only a new intrinsic reform area, pedestrian traffic, was added, but also two so called additional reform areas: management system and mobility management. The purpose of the latter two, was to facilitate and increase the efficiency of work in other parts of LundaMaTs [3].

Since the introduction of LundaMaTs II, many of the measures used in LundaMaTs I and II have been incorporated in the Municipality's ongoing work.

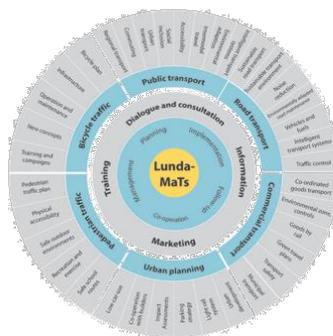
In order to address the change in conditions for traffic and urban planning in Lund, the third and current generation, LundaMaTs III, was introduced in 2014. Reform areas have been replaced with focus areas that address today's challenges of the municipality. LundaMaTs III has an even more holistic approach with a special focus on the expansion of Lund and considerations for social sustainability [4].

All versions of LundaMaTs are based on a Strategy Wheel that has evolved over time as visualised below. The wheels illustrate the vision, components for its achievement, reform or focus areas as well as specific action proposals. The measures that have been identified in the wheels include both soft as well as hard measures following the 4-steps-principle developed by the Swedish Transport Administration. Solutions are developed by; (1) influencing the need and choice of transport through soft measures, (2) improving the efficiency of the existing transport system, (3) making small, and (4) making large investments in new infrastructure projects [5]. LundaMaTs is characterised by processes of coordination, cooperation, continuous evaluation, and improvement. LundaMaTs II has succeeded to achieve 13 of its 18 targets. Of the five remaining targets, two targets are on track for achieving their objectives and three targets are not. To mention some of the successes, the use of public transport has increased by 37 % in 2013 compared to 2004. At the same time the accessibility for people with disabilities, children and elderly has been increased. Overall, the CO₂ -emissions caused by traffic in the municipality has been decreased by 14.5 % and the amount of citizens that state that their behaviour is influenced by LundaMaTs has been increased by 81 % [6].

Finally, LundaMaTs as well as the projects and activities are well known among the people that live in the city of Lund and the measures have also affected the way they travel. An evaluation showed that soft measures are of the same, or even higher, effectiveness compared to the physical hard measures [2].



LundaMaTs I
1998-2006



LundaMaTs II
2006-2013



LundaMaTs III
since 2013

STRATEGY WHEEL OF CITY OF LUND; FIGURE CREDITS: LUND MUNICIPALITY

MOBILITY MANAGEMENT

Transport-related environmental and health problems continue to be of concern for many European cities and regions and the way travel is organised, at local, national or regional level needs to be improved. The use of traditional solutions such as infrastructure improvement and regulations are not enough to cope with these problems. Mobility management addresses this need by taking an integrated approach [7]. There is more potential to influence the need for transport and mode of choice by integrating mobility management at an early stage of planning. By analysing the current and future needs of the community, city or region it allows for an easier transition to more sustainable travel.

MOBILITY MANAGEMENT

MOBILITY MANAGEMENT IS A CONCEPT TO PROMOTE SUSTAINABLE TRANSPORT AND MANAGE THE DEMAND FOR CAR USE BY CHANGING TRAVELLERS' ATTITUDES AND BEHAVIOUR. AT THE CORE OF MOBILITY MANAGEMENT ARE "SOFT" MEASURES LIKE INFORMATION AND COMMUNICATION, ORGANISING SERVICES AND COORDINATING ACTIVITIES OF DIFFERENT PARTNERS. "SOFT" MEASURES MOST OFTEN ENHANCE THE EFFECTIVENESS OF "HARD" MEASURES WITHIN URBAN TRANSPORT (E.G. NEW TRAM LINES, NEW ROADS AND NEW BIKE LANES). MOBILITY MANAGEMENT MEASURES DO NOT NECESSARILY REQUIRE LARGE FINANCIAL INVESTMENTS AND MAY HAVE A HIGH BENEFIT-COST RATIO [8].

Mobility management is therefore seen as a complementary, cost effective approach for bringing transport and mobility together in line with sustainability. It is an innovative instrument that focuses on improving organisation and information across sustainable transport modes and services [9]. Many projects have already been implemented at the EU level to form and foster mobility management techniques, expertise, and knowledge by providing guidance as well as platforms for exchange and collaboration. An example of an ongoing platform is the EPOMM (European Platform on Mobility Management). EPOMM focuses on the development and promotion of mobility management in Europe through provision of tools, resources, modal split data, and forums among others [8].

There are numerous cases in which the concept has been applied successfully in different countries within Europe. One illustration of this is in Sweden: the city of Lund, a sister city to Zabrze, has integrated mobility management as part of their strategy for sustainable transport [10]; Region Skåne uses mobility management in order to achieve its greenhouse gas reduction targets related with travel to work [11]. This has been realised through increased provision of information on travel options, and how to avoid unnecessary travels but also campaigns for telecommunications and virtual meetings in place of travelling. In Belgium, the Velo programme in Leuven, is another example where the concept was applied. In Leuven the decision was made to repair and rent out safe bikes to students who may not have enough finances to buy their own and this would lead to increased modal share of cycling through supply of safe alternatives. In 2007 alone, over 5000 bikes were rented contributing to the modal split of students [12].

Changing behaviour of people with regard to their travel choices can be challenging. For mobility management to be successful, it is important to develop a wide variety of different services that are adapted to the needs and demands of the clients. These services should include; information and advice, consulting, awareness, transport organisation and co-ordination, and sales and reservation of transport related products [7].

- *Information and advice.* This involves processing and interpreting existing information and providing of tailor-made answers to specific transport questions. It includes the provision of applications for smartphones, placement of informative signs or maps at stops and stations, and provision of trip planners or information regarding connections and transfers
- *Consulting.* This focuses more on tailoring mobility solutions for a specific site such as a household or a large company. The process includes an initial assessment, a detailed consideration of alternatives, and tailored recommendations.
- *Awareness.* This is a means of social marketing, and includes activities which increase people's consciousness regarding transportation alternatives to the passenger car. For example, offering trial passes for use of public transport targeted at specific demographics or groups known to travel frequently by passenger car. This may raise awareness in specific segments of the population.
- *Transport organisation and coordination.* This includes any activities which organise new forms of transport or coordinate existing forms to make services available in a new area or way. Examples may be constructing of a new path to a bus stop, or providing a bike rack at a site where a bike lane enters the site etc.
- *Sales and reservation of transport related products.* This includes activities for purchase and securing transport e.g. different payment options such as a monthly pass, multi-use tickets, and the ability to purchase tickets which cross geo-political boundaries, modes, and operators. It also includes the ability to depend upon the availability of transport through booking or insurance [11].

Soft measures will help to create a notion or positive reinforcement to changing behaviour. The notion for mobility management is most effective when combined with hard measures. When the supply of infrastructural development is paired well with the demand side of mobility management, a mutual enforcing loop can be created. This in turn can enhance any measures' alternative to use of passenger car and consequently a change in travel behaviours.



MALMÖ CITY CENTER

BARRIERS AND BENEFITS

BARRIERS

The transition to sustainable mobility is not an easy task that can be completed overnight. In order to successfully implement a sustainable mobility strategy, it is necessary to identify the main barriers that need to be addressed during the transition process. While in Zabrze, we were able to observe and assess three main barriers that are described below. Both, cooperation between various partners and applying a holistic approach will be important in order to address these barriers. Our strategy is therefore designed in a holistic way that is flexible while at the same time creates a working standard among various actors through the Plan-Do-Check-Act (PDCA) principle.

MIND-SET

Our time in Zabrze highlighted the affection that people possess for their cars. This is by far the greatest barrier. To overcome this barrier depends directly on efforts put into the following barriers of infrastructure and safety. Changing the choices people make requires addressing all barriers in order to provide practical and equitable alternatives. Giving people the incentive to consider alternate modes of transportation is critical in order to complete a transition to sustainable mobility.

INFRASTRUCTURE

The infrastructure should reflect the sustainable mobility mind-set. In order to reduce the use of cars in the modal split, priority needs to be provided to alternative transport options. Addressing infrastructure is primarily based on utilising hard measures, such as building new bike paths or retro-fitting existing roads. However, soft measures, such as awareness and communications campaigns, are also required in order to affect how people perceive and receive the changes. How people perceive the changes will be directly linked to safety.

SAFETY

If people do not feel safe going by bike, then they are more likely to leave their bikes at home and choose other modes of transport, instead. The feeling of safety and security is essential for all modes of transportation. Safety needs to be prioritised in order to help change the mind-set by increasing people's willingness to take other modes of transport. Safety for pedestrians and cyclist depends, in large part, on soft measure, but also directly by the approach taken towards infrastructure.

BENEFITS

The active and sustainable transportation system brings about numerous social, health, environmental and economic benefits. Highlighting these benefits can help to promote the transition to sustainable mobility.

SOCIAL BENEFITS

Social capital. Designs of pedestrian and cycling friendly neighbourhoods, can facilitate incidental contacts between neighbours and foster social capital in form of social networks, interactions, norms and trust. While promoting social norms, social capital may act as a means of preventing antisocial behaviours that can fuel feelings of insecurity [13].

Natural surveillance. Diverse land-uses within urban environments can result into increased public safety and minimise fear by creating lively streets monitored by local business proprietors and residents. Pedestrian traffic can be a means of protection against serious personal crime, which occurs when pedestrians are scarce [13].

Reduced transport poverty. Creating walkable neighbourhoods and increasing frequency of access to public transport, limits transport poverty and also prevents marginalisation of other vulnerable subgroups with restricted mobility for example older people, people with disabilities and children [14]. Lastly, is the reduction in traffic jams and parking difficulties.



AMSTERDAM; PHOTO CREDITS: TRIVECTOR

ENVIRONMENTAL BENEFITS

Despite its role in economic development, road traffic in Zabrze is characterised with growing levels of motorization. As a result, transport sector is increasingly linked to environmental problems; air quality, noise, biodiversity and land take, climate change among others. Activities of transport industry release several million tons of air emissions into the atmosphere including Nitrogen oxides (NO_x) methane (CH₄), carbon dioxide (CO₂), carbon monoxide (CO) particulate matter (PM_x), nitrous oxide (N₂O), chlorofluorocarbons (CFCs), perfluorocarbons (PFCs), silicon tetrafluoride (SF₆) heavy metals etc. which often lowers the quality of air. Some are greenhouse gases e.g. CH₄ and CO₂

which can contribute to climate change while others contribute to ozone depletion particularly NO_x. According to specialists, from Zabrze's Department of Ecology, the average daily ambient air quality for air particles (PM₁₀) is still exceeded within the city ranging between 55 µg/m³ to 125 µg/m³. The EU



CITY OF LUND

legislation on ambient air quality and cleaner air for Europe (Directive 2008/50/EC) requires that the daily concentration value (50 µg/m³) must not be exceeded more than 35 times in a calendar year. PM₁₀ is primarily caused by low-stack emissions from household heating but also from vehicles. Road traffic noise in agglomerations within Zabrze was found to be 55-65 dB and along the main built road infrastructure 65-70 dB for L_{den} (day-evening-night level) [15]. Increasing noise levels have a

negative impact on the urban environment reflected in falling land values and loss of productive land uses. Implementing the sustainable mobility strategy is one of the mediums through which the city of Zabrze will calm these environmental problems, while at the same time achieve the following:

- *Reduced toxic air, and noise pollution.* This in turn lowers the associated environmental and health problems.
- *Reduced dependence on imported non-renewable fossil fuels* and thus increasing economic but also national security.
- *Natural habitat conservation.* Fewer cars on the road decrease the demand for more roads and parking lots, allowing more land for green space.

ECONOMIC BENEFITS

The human toll for poor air quality is worse than for road traffic accidents, making it the number one environmental cause of premature death in the EU. It also impacts the quality of life due to asthma or respiratory problems.” [13].

The European Commission estimates that the effects of air and noise pollution can also result in a loss of working days as well as high health care needs for vulnerable groups like children, asthmatics and the elderly who are most affected. In order to tackle air pollution and to curtail its impacts

on human health and the environment, the EU Commission developed and implemented the Clean Air for Europe (CAFÉ) programme. The Commission also

estimates that the benefits to peoples' health from implementing the CAFÉ program is around EUR 40 billion a year, over 12 times the costs of pollution abatement, which are estimated to reach EUR 3.4 billion per year in 2030 [20]. From a country perspective, Poland is already estimated to be losing PLN 480 billion (EUR 40-120 million) in external health costs of disease and premature deaths caused by air pollution [17]. Therefore, by implementing the Strategy, the city of Zabrze will earn a wealth of economic benefits below:

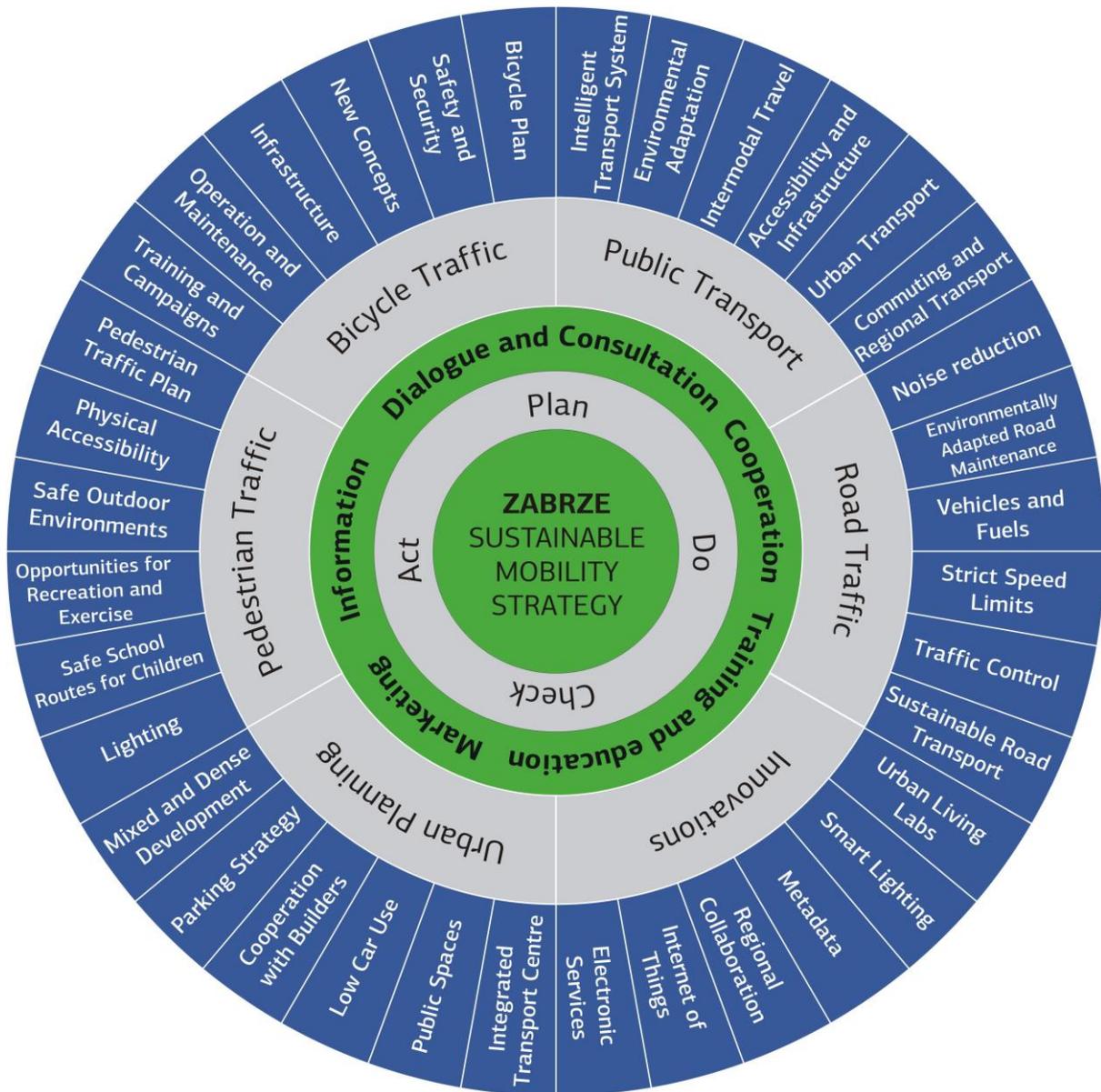
- *A reduction in the health care costs*, met both by the city and the employers.
- *A saving in tax money*, achieved from reduced roadway construction and maintenance costs.
- *Support of community based businesses*.
- *Increased work productivity* from minimising sick days.

HEALTH BENEFITS

According to the Health Effects Institute, traffic-related air pollution has been seen to contribute to morbidity and mortality through a variety of mechanisms manifest in form of respiratory, cardiovascular, reproductive and neuro-developmental effects which lower the quality of life [16]. Poland suffers from a loss of 40 000 premature deaths a year related to air pollution [17]. Other health impacts are also related to traffic noise. Noise pollution is a major environmental health problem in Europe and road traffic specifically is the most dominant source for environmental noise. In Europe as a whole, an estimation of over 125 million people are affected by noise greater than 55 dB (day-evening-night level). In addition, over the estimated 10 000 premature deaths a year, 8 900 (89 %) are attributed to road traffic noise, and almost 20 million adults are affected plus a further 8 million suffer from sleep disturbance due to environmental noise [18]. In terms of public health impact, traffic noise has been ranked second among the selected and evaluated environmental stressors. In addition, exposure to noise in Europe is increasing compared to other stressors, for example exposure to second hand smoke, dioxins and benzene, which are declining [19]. For the city of Zabrze in a local context, implementing a sustainable mobility strategy can be a means for mitigating the burden of these traffic related air and noise problems leading to healthier and happier people.

OUR STRATEGY WHEEL

The success story of LundaMaTs served as inspiration as we developed our sustainable mobility strategy framework for Zabrze.



DEVELOPING OUR STRATEGY

THE VISION

The deputy mayor Ms. Katarzyna Dzióba described her vision for the city of Zabrze as “A city where you have lots of space for walking, biking, trams, railway, clean air and happy people.” Inspired by this vision, we have developed a framework for a sustainable mobility strategy to be used by the city of Zabrze as a tool to assist completing the transition from black to green and to become a leader in sustainability in the Silesian region.

***“A city where you have lots of space
for walking, biking, trams,
railway, clean air and happy
people.”***

***- Deputy Mayor
Ms. Katarzyna Dzióba***

THE GOALS OF THE SUSTAINABLE MOBILITY STRATEGY

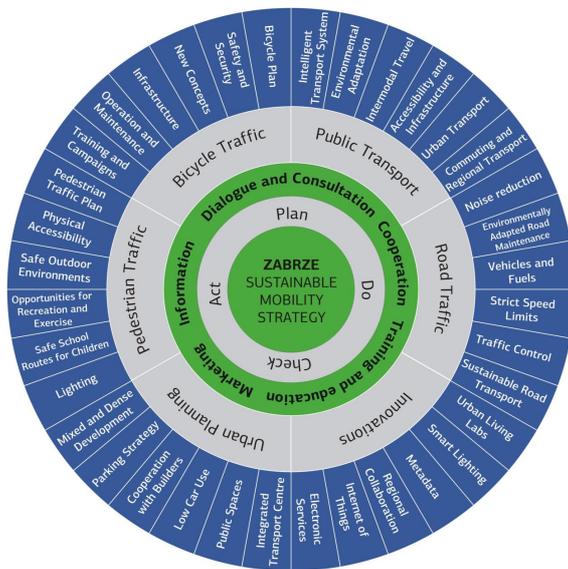
Owning a car has become an icon of social status and is often seen as most convenient mode of transport. One of the main goals of the proposed sustainable mobility strategy is therefore to reduce the motor-vehicle traffic in favour of alternative modes of transport that are more sustainable. However, this transition is not only a major goal but also the means to achieve other goals. Leaving the car at home, going to work by public transport or bike, visiting friends in the city by train and walking to the weekly market helps to improve the air quality and reduces noise pollution and emission of greenhouse gases while promoting human health. A sustainable mobility strategy can turn Zabrze into a more vivid and lively city that does not only attract more people to live in Zabrze but also more companies to settle down and invest in the city.

Integrating sustainable mobility alternatives can positively contribute to the development of the tourism built around the industrial heritage and promote the city of Zabrze as an appealing tourist attraction in the Silesian region.



LUND TRAMLINE; ILLUSTRATION CREDIT: LUND MUNICIPALITY

RE-INVENTING THE LUNDAMATS-STRATEGY WHEEL



Turning a vision into reality and achieving the goals requires, not only good management and commitment, but also concrete measures. The transition to sustainable mobility makes a structured and comprehensive approach necessary and cannot be achieved overnight. The first step is to develop a strategy that sets the framework for further work, which then needs to be followed by specific action plans and concrete measures. Using the sustainable mobility strategy of Lund as a base we developed a strategy for Zabrze that can establish a solid foundation to build upon. By re-inventing and adapting the LundaMaTs-Strategy Wheel to the context of Zabrze, the city can benefit from the lessons learned by its sister

city, Lund, and develop a successful sustainable mobility strategy that itself may serve as an example for other cities in the Silesian region.

ONE VISION, SIX REFORM AREAS, THIRTY-SIX PROJECT PROPOSALS

The proposed sustainable mobility strategy for Zabrze is a broad approach including several levels and components that all interact with each other. The strategy is summarised and presented in the strategy wheel.

- Zabrze’s vision of sustainable mobility constitutes the centre of the wheel. Everything else pivots on the vision and the formulated goals and targets.
- The first ring describes the management conditions that must exist to ensure a successful implementation of the strategy.
- The second ring presents how information and involvement should be distributed.
- The third ring contains the six intrinsic reform areas that we have identified to be most important to focus on. Within these reform areas concrete measures need to be organised.
- The fourth and final ring contains six project proposals for each reform area, 36 proposals in total. The project proposals include suggestions for concrete actions or specific focus areas. The proposals can be replaced by or complemented with other proposals. For each project proposal an action plan with specific targets and measures needs to be developed. A good starting point is to focus on one project proposal for each reform area. As those projects develop, the strategy is designed to seamlessly grow as new projects and action plans are gradually added to the process.

All components of the strategy wheel are essential and interdependent to keep the wheel rolling and to ensure its success. The six reform areas are connected to each other so that the whole context should always be kept in mind instead of



focusing completely on one separate reform area. This also emphasises the need of inter-departmental cooperation as well the use of the Plan-Do-Check-Act-management method. One good example of this interconnectivity is the parking strategy, which, as part of the Urban Planning reform area, connects to all the other areas, as will be presented below.

Even though all reform areas are connected and essential for the strategy, some are of higher priority than others. During our meetings in Zabrze, and as a result of our own observations in town, we have identified public transport as well as bicycle and road traffic as areas of high priority. We also identified urban planning as unique reform area of high importance as it is overarching and relates to all the other reform areas.

In the following, each element of the wheel will be shortly explained. Descriptions of all reform areas and project proposals are given including examples of associated projects.



THE CENTRE

The centre of the wheel is the strategy's vision and the desired result. The vision is not only the pivot of the wheel but also the heart of the strategy. Therefore, before coming to Zabrze we knew that we would need to make out the vision of Zabrze in order to build our strategy around it. With the aim to identify the vision of the city we asked the same question in every meeting:

“What is your vision regarding mobility in Zabrze?”

The answers we received revolved around increasing the modal share of bikes and public transport as well as providing the citizens with good alternatives to using their cars and that it should meet the citizens' expectations. However, we found the inspiration we were looking for in our very first meeting when the deputy mayor Ms. Katarzyna Dzióba described her vision as “A city where you have lots of space for walking, biking, trams, railway, clean air and happy people.”



LUND TRAMLINE; ILLUSTRATION CREDIT: IDA BLANK, TRIVECTOR

THE 1ST RING: PLAN-DO-CHECK-ACT

The first ring of the strategy wheel contains the conditions that must exist in order to successfully implement the sustainable mobility strategy. The iterative four-step management method of Plan-Do-Check-Act (PDCA) serves as a structured way of organising and controlling processes resulting in continuous improvement. Not only should this method be applied within each department, but also during cooperation between different departments.

The first step, *planning*, includes the establishment of objectives and targets that are measurable and consistent with the vision (e.g. to increase the length of pedestrian and cycle paths by 10 % by the year 2025). It further consists of specific action plans on how to achieve this. The second step, *doing*, is about implementing the necessary measures and projects and executing the action

plans (e.g. building a new pedestrian or cycle path). The purpose of the third step, *checking*, is to analyse the performance of the second step. The actual results are compared against the objectives and targets that have been set in the first step (e.g. calculating the length of new pedestrian and cycle paths and benchmarking this number against the set target). The final step, *acting*, restarts the loop: If the result of the third step is that the target has not been met, further actions need to be planned. However, if the target has been met, it will serve as a baseline for a new plan (e.g. the new target for pedestrian and bicycle paths could be an increase in usage of 30 % by 2035).

Following these four steps helps create transparency when managing tasks within and

between departments in regards to roles and responsibilities as well as objectives and targets. Furthermore, the circular approach of PDCA leads to continuous improvement and ensures that processes and tasks are constantly on trial in order to make sure that they are in line with the vision and overall targets. PDCA is a vital tool that facilitates successful implementation of the suggested sustainable mobility strategy.

PLAN:

- ESTABLISH MEASURABLE OBJECTIVES AND TARGETS
- DRAW UP SPECIFIC ACTION PLANS

DO:

- IMPLEMENT NECESSARY MEASURES AND PROJECTS
- EXECUTE ACTION PLANS

CHECK:

- ANALYSE RESULTS OF STEP TWO
- COMPARE RESULTS WITH OBJECTIVES AND TARGETS OF STEP ONE

ACT:

- USE STEP ONE OBJECTIVES AND TARGETS AS NEW BASELINE; OR
- TAKE ADDITIONAL ACTIONS TO MEET THE STEP ONE OBJECTIVES AND TARGETS



THE 2ND RING: DISTRIBUTION OF INFORMATION AND INVOLVEMENT

Strategy implementation is not exclusively an internal process. The municipality has to take certain measures to ensure that communication, involvement and information distribution occurs among other stakeholders including citizens and businesses. The second ring describes the key areas of information as well as involvement distribution that is required for successful implementation of mobility management.

DIALOGUE AND CONSULTATION

Building dialogue and consultation with citizens of the city is crucial in order to identify expectations and acceptance of change while pairing those with the actual needs of the transport system. It is advisable to conduct regular surveys and consultations with the public for collection of data necessary to benchmark targets and objectives, evaluate the success and to identify areas in need of improvements.

COOPERATION

Cooperation with local businesses, regional and national government and supranational bodies, such as the European Union, is another essential element of a sustainable mobility strategy. Building tangible and dynamic relationships can help to secure funding, attract knowledge, and create a favourable investment climate as well as a good public image.

TRAINING AND EDUCATION

Continuous training of municipality staff and other public bodies related to the implementation of the strategy has to be a perpetual process in order to be able to adapt to changing environments and absorb incoming knowledge. The public, and especially children, should be educated about various aspects of sustainable mobility in order to increase their awareness and acceptance for the need of changes.



BICYCLE DAY AT LUND

MARKETING

Transparent marketing campaigns are essential to present the vision of the strategy to the public and to convince the citizens on the necessity for transition. The focus here is to raise awareness and not political campaigning.

INFORMATION

Collection of information is one of the most important aspects of successful implementation of any strategy. Therefore, it is important that data on various measurements is aggregated and transparently presented to the public via an open data platform.

THE 3RD AND THE 4TH RING: REFORM AREAS AND PROJECT PROPOSALS

The third ring of the wheel consists of the six reform areas that we have identified to be most important for the city of Zabrze to focus on. In the following sections we break down the six reform areas. We demonstrate how the strategy wheel works by giving one or two examples of project proposals including both soft and hard measures.

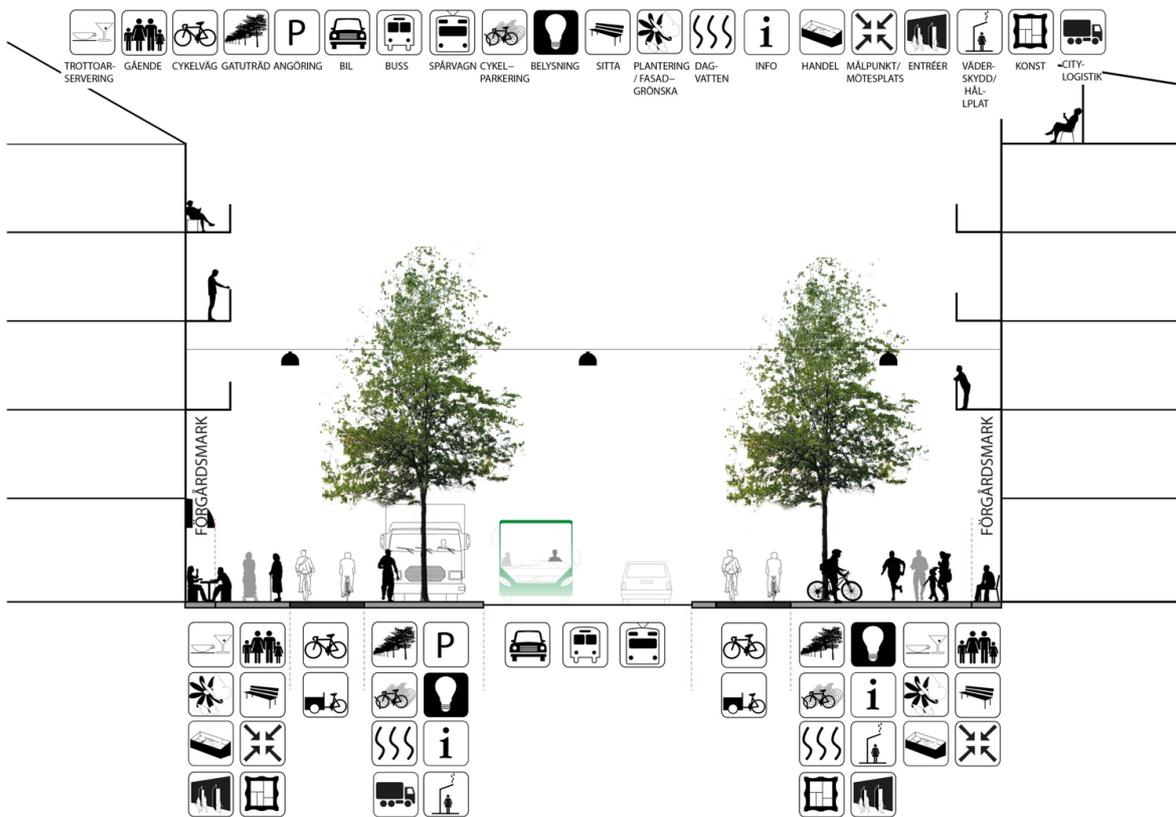
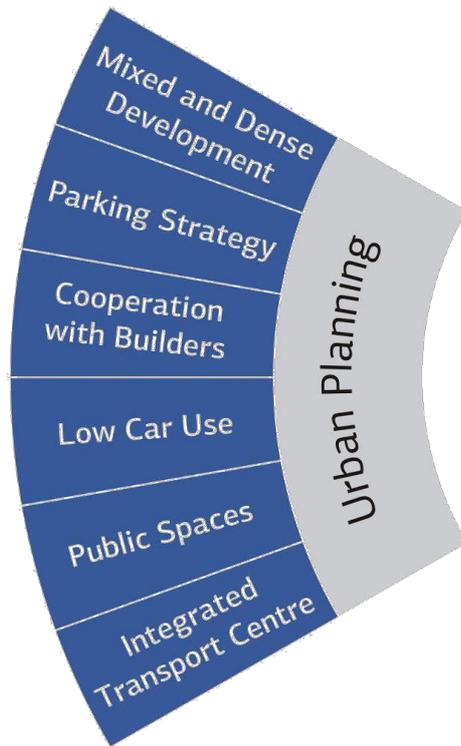


ILLUSTRATION OF MALMO TRAFFIC PLAN; ILLUSTRATION CREDITS: MALMÖ MUNICIPALITY

URBAN PLANNING



Urban Planning is crucial when it comes to the transition to sustainable mobility. It has to take an overall view of the whole city, the citizens and their needs. It also needs to consider the region and cooperation with other cities. It is a coordinated process that involves actors from different departments, other municipalities and, at the same time, the participation of the public. Urban planning deals with the long-term planning and development of land use, road and transport infrastructure. It decides where people live, work and go to school influencing where they socially interact and spend their leisure time. It has to consider the access to consumer goods and services as well as the main commuting routes. Urban planning determines the directions the city development will take and provides the basis for the more detailed city planning.

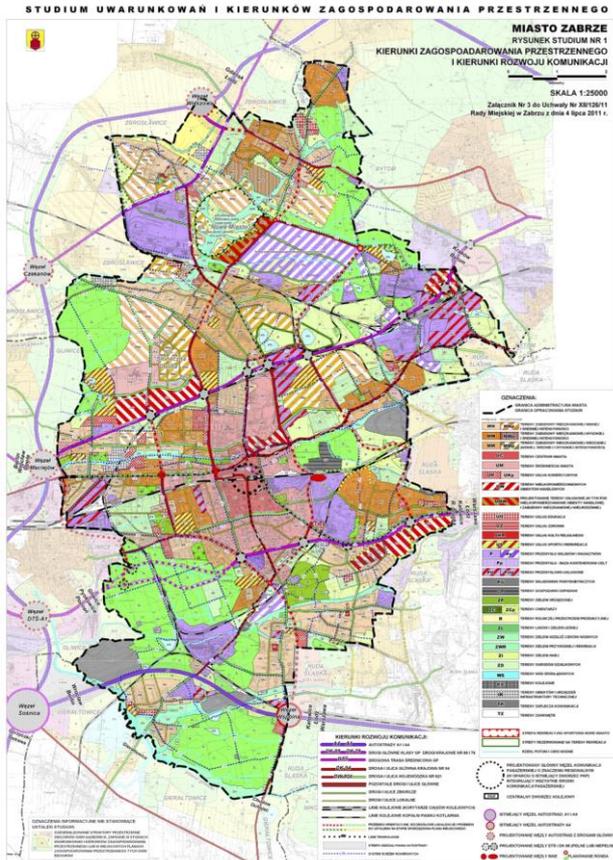
Urban planning needs to consider and weigh several development possibilities and play through their possible impacts already in the early planning stage. Possible future development needs have to be considered to avoid lock-ins and to remain flexible when it comes to further changes of the infrastructure. This includes among, other things, being prepared for a possible conversion of a bus line into a tramline by making necessary arrangements during the planning and building process; but also to plan for spaces for electric vehicle charging stations even though the electric vehicle system may not be developed, yet.



CONCEPT OF URBAN PLANNING; ILLUSTRATION CREDIT: JOHN GREENFIELD VIA FLICKR

Furthermore, urban planning needs to be coordinated with other municipalities. This includes daily commuting between cities, the localization of out-of-town shopping centres and the interaction of the public transport systems as well as the biking networks.

According to the current zoning and development plan of Zabrze, the city is planned to expand northwards. During our meetings, we have identified three major development projects that are currently ongoing, each at a different stage of progress. North of the city centre, the Katowice Special Economic Zone is developed in order to attract production companies to the city of Zabrze. The road infrastructure, including bicycle paths, has already been built and construction work is ongoing. Close by, a new city district, Nowe Miasto, is in the planning phase. It is designed to be a residential area that will attract people that will work in the Special Economic Zone. Furthermore, an integrated transport centre that combines several modes of transport is at the early planning stage and planned to be completed by 2020. The instrument of urban planning can and should be used by the city of Zabrze to promote sustainable transport, not only when planning these new development projects, but also when considering the future development and trends of the city in general.



ZONE MAP OF ZABRZE;
ILLUSTRATION CREDIT: MUNICIPALITY OF ZABRZE

Transport is one important aspect of urban planning making it necessary to integrate urban development with transport planning. It plays an important role in every municipality due to the fact that it affects everybody's everyday life all the time. Transport is needed in all aspects of life from; how we get to work or



CAPACITY OF DIFFERENT TRANSPORT MODES;
FIGURE CREDIT: TRIVECTOR

school to bringing products to the consumer, through to how we spend our leisure time. Thus, transport significantly contributes to our quality of life. However, if poorly planned, it also brings along several negative effects such as congestion, noise and air pollution. Urban planning is a tool to reduce transport requirements and to make the indispensable transport more sustainable. Urban planners need to consider the location of houses, workplaces, and businesses, as those are the factors that significantly affect the choice of transport mode. Transportation demands can be reduced and accessibility increased by planning dense cities and mixed-use areas that combine multiple functions such as residences, services, workplaces, and businesses.



While the majority of modern societies have been built around motorised traffic, sustainable mobility requires to also consider other modes of transport. Reducing motorised traffic does not only decrease the infrastructure costs, it also brings along several environmental and health benefits [21]. Shifting away from car traffic to other modes of transport allows people to use public spaces more efficiently while maintaining the same level of mobility.

Studies have shown a direct link between the choice of sustainable transport modes and the feeling of security, safety and convenience. There is greater possibility that more people opt for public transport if interchanges and stops are attractive, safe and secure during all times of the day and if busses are given better conditions such as bus-only streets. The same is true for biking and walking meaning that the share of pedestrian and cycle travel can be increased by designing more direct and aesthetically pleasing routes [21]. Well-designed cities offer favourable conditions to walk and bike and create environments in which it feels simple and obvious to travel by bus, tram or train [22].

To summarise, urban planning that it is not oriented on cars can be an effective instrument to promote walking, biking as well as public transport, especially



PATHWAY IN LUND

when planning new infrastructure. However, urban planning rarely happens on a white piece of paper, thus making it important to also consider the existing infrastructure which influences the development of the city by supporting the conventional way of thinking. Nevertheless, urban planning can be seen as an opportunity to change the conventional way of thinking and to move towards more sustainability, even when it comes to existing infrastructure. Existing roads in the city centre can be closed for car traffic allowing only public transport to pass and providing attractive bike and pedestrian paths. This can increase the attractiveness of the city centre, improve safety for bikers and pedestrians as well reduce air and noise pollution.



BICYCLE PARKING LOT NEAR LUND TRAIN STATION

Because of the importance of urban planning in the transition towards more sustainability we highlight it as one reform area that is interlinked to all the other reform areas. Urban planning is key when it comes to the attractiveness of public transport being able to create the conditions for positive development within that reform area. Planning new residential and business areas needs to go hand in hand with the planning of public transport routes and networks. Urban planning also determines road, bicycle and pedestrian traffic and the possibility to change fast and smoothly between the different modes of transport. Last but not least, urban planning can make use of innovations, for example in the form of urban living labs but also facilitate innovations by opening up possibilities for smart city solutions.

A final note is that urban planning and the consequential changes of the physical infrastructure need to be complemented by mobility management to affect human behaviour and facilitate change. At the same time, it needs to be highlighted that the link between mobility management and urban planning works in both directions meaning that mobility management also influences urban planning: By promoting car-sharing, the demand for cars can be reduced resulting in a lower need for parking.

We want to emphasise that there is a strong link between urban planning and all the other reform areas in our strategy wheel. Urban planning serves therefore as good example of how sustainable mobility is a complex and comprehensive topic that requires cooperation and coordination between different actors. The strategy wheel only starts rolling if all these areas are pulled together.

PROJECT PROPOSALS FOR URBAN PLANNING [4TH RING]

MIXED AND DENSE DEVELOPMENT

Mixed and dense development means dense construction and concentration of residential as well as commercial and service buildings. It combines multiple functions such as residences, services, workplaces, and businesses. Mixed and dense development utilises infrastructure in an efficient way, thus reducing the demand for transport as well as increasing accessibility. It is not only essential to decrease land consumption but also promotes – due to the short distances – cycling and walking as an attractive means of transport [21].



PARKING LOT IN ZABRZE

PARKING STRATEGY

The availability of parking is strongly connected to the convenience of using cars as a mode of transport. Thus, a good parking strategy can be used to give incentives to leave the car at home and instead choosing other modes of transport. Furthermore, reduced parking means more space for other modes of transport such as biking and walking or space that can be used to create attractive meeting places.

PARKING STRATEGY – SUGGESTIONS FOR ACTIONS

A GOOD PARKING STRATEGY CONSISTS OF SEVERAL COMPONENTS. IT INCLUDES ECONOMIC INCENTIVES, FOR EXAMPLE IN THE FORM OF PARKING FEES IN THE CITY CENTRE. AS LEARNED DURING ONE OF OUR MEETINGS IN ZABRZE, THIS HAS BEEN A SUCCESSFUL TOOL IN GLIWICE. IN GLIWICE, THE NUMBER OF LONG-TERM PARKED CARS COULD BE SIGNIFICANTLY DECREASED WHILE INCREASING THE NUMBER OF SHORT-TERM PARKING LOTS. OTHER ELEMENTS OF A PARKING STRATEGY ARE INFRASTRUCTURAL CHANGES, SUCH AS LIMITING THE AMOUNT OF AVAILABLE PARKING OR SWITCHING FROM AREA-INTENSIVE GROUND-PARKING IN THE CITY CENTRE TO PARK-AND-RIDE PARKING GARAGES AT THE OUTSKIRTS [21]. HOWEVER, IT NEEDS TO BE CONSIDERED THAT CITIES FACE THE CHALLENGE THAT REDUCING AVAILABLE PARKING IS OFTEN PERCEIVED BY THE PUBLIC AS A LOSS OF FLEXIBILITY OR AN INTRUSION ON THEIR LIBERTY OF CHOICE RESULTING IN A RESISTANCE TO THE CHANGE. A PARKING STRATEGY, ESPECIALLY INFRASTRUCTURAL CHANGES, SHOULD THEREFORE BE COMBINED WITH MOBILITY MANAGEMENT MEASURES AIMING TO RAISE THE AWARENESS AND ACCEPTANCE OF CAR DRIVERS AND TO PROMOTE PUBLIC TRANSPORT AS WELL AS BIKING AND WALKING. THOSE SOFT MEASURES CAN INCLUDE THE PROMOTION OF CAR-POOLING AND BIKE-SHARING. IN ADDITION, SPECIAL DAYS OF ACTIONS, SUCH AS CAR-FREE SUNDAYS, CAN BE ORGANISED ENCOURAGING CITIZENS TO LEAVE THEIR CARS AT HOME FOR ONE DAY AND USE OTHER MODES OF TRANSPORT INSTEAD. THIS SHOULD BE COMPLEMENTED BY AN AWARENESS CAMPAIGNS COMBINED WITH THE POSSIBILITY TO USE THE PUBLIC TRANSPORT FOR FREE OR AT A REDUCED COST DURING THAT DAY.

FURTHERMORE, PROMOTING THE ADVANTAGES OF THE PARKING STRATEGY CAN BE USED TO RAISE CITIZENS' AWARENESS AND ACCEPTANCE. TO MENTION ONLY ONE EXAMPLE: A SINGLE PARKING SPACE OCCUPIES ON AVERAGE 25 M² - 25 M² THAT CAN BE USED FOR OTHER PURPOSES, SUCH AS BIKE PATHS OR FOR WIDENING THE PEDESTRIAN WALKWAYS. IT CAN ALSO BE TRANSFORMED INTO GREEN AND ATTRACTIVE PLACES FOR PEOPLE TO MEET AND SOCIALLY INTERACT OR FOR NEW CONCEPTS SUCH AS URBAN GARDENING. ECONOMIC INCENTIVES, INFRASTRUCTURAL CHANGES AS WELL AS SOFT MEASURES CAN FURTHERMORE BE COMBINED WITH AN INNOVATIVE PARK-GUIDING SYSTEM THAT MONITORS THE AVAILABILITY OF PARKING AND OFFERS GUIDANCE TO THE CLOSEST PARKING LOT.

A SUCCESSFUL PARKING STRATEGY AFFECTS ALL THE REFORM AREAS, BY REDUCING CAR TRAFFIC AND CONGESTION THROUGH THE COMBINED USE OF URBAN PLANNING AND INNOVATION. AS A RESULT, IT ENHANCES PUBLIC TRANSPORT, BICYCLING AND PEDESTRIAN TRAFFIC AND THUS, FACILITATES IMPROVEMENT IN THESE THREE REFORM AREAS.

COOPERATION WITH BUILDERS

The development of land-use plans and other urban planning documents can be complemented by cooperation with building contractors providing additional opportunities to influence people's behaviour. Such an agreement could for example reduce the requirements for the development of parking lots if the building project commits to provide good bike infrastructure or car-pooling possibilities.

LOW CAR USE

To achieve a reduction of car use it is necessary to change the mind-set and the habits of Zabrze's citizens. That is a process that does not happen overnight and requires both awareness campaigns as well as infrastructural changes. Whether or not people change their transport behaviour is highly dependent on the attractiveness of the



CITY OF LUND

alternatives. It is therefore necessary to offer favourable conditions for public transport, cycling and walking. At the same time, it should be less convenient to take the car, which can be achieved by the restriction of car use in central areas or by the implementation of parking fees.

PUBLIC SPACES

Providing green public spaces where people can meet and socially interact makes a city more, vivid, lively and attractive. Designing an appealing public space is easiest when planning new infrastructure – however, existing infrastructure can be retrofitted. This can be a permanent change or a temporary “pop-up” measure. A good example for possible retrofitting is Warszawski square, in central Zabrze. Today it serves as a parking space, but could easily be transformed into a vivid market square with trees and benches.



WARSAWSKI SQUARE IN ZABRZE; PHOTO CREDIT: ZBIGNIEW RAU

INTEGRATED TRANSPORT CENTRE

An Integrated Transport Centre (ITC) connects all kinds of public transport, with a good biking and pedestrian infrastructure but also includes a well-designed solution for car traffic. This contributes to a more sustainable travel behaviour of the citizens of Zabrze, as well as commuters from the region. The ITC is another good example of how the different reform areas are connected to each other and how important it is to have the broader picture in mind.

During our stay in Zabrze, we had the possibility to gain insights into the current plans for the ITC. Based on this information, and especially the detailed discussion we had with representatives from the Investors' Service Office, we have developed the following suggestions.

PUBLIC TRANSPORT

THE ITC SHOULD ALLOW INTERCHANGES BETWEEN ALL KINDS OF PUBLIC TRANSPORT, MEANING TRAINS, TRAMS AND BUSES, INCLUDING CITY BUSES, REGIONAL BUSES AS WELL AS LONG-DISTANCE BUSES. SCHEDULES SHOULD BE DOVETAILED AS MUCH AS POSSIBLE CONSIDERING THE MAIN COMMUTING ROUTES. IT SHOULD BE CONVENIENT FOR PASSENGERS OF PUBLIC TRANSPORT TO CHANGE BETWEEN DIFFERENT MODES OF TRANSPORT WITHOUT LONG WAITING TIMES IN BETWEEN. WITH REGARD TO COMMUTING BETWEEN CITIES, IT IS NECESSARY TO CONSIDER THE WHOLE TRIP AND COOPERATE WITH OTHER CITIES IN ORDER TO ENSURE THAT PEOPLE CAN TRAVEL FROM DOOR TO DOOR COMBINING DIFFERENT TYPES OF TRANSPORT.

BIKING AND WALKING

THE ITC SHOULD FURTHER BE EASILY ACCESSIBLE FOR PEDESTRIANS AS WELL AS CYCLISTS. THIS INCLUDES A GOOD INFRASTRUCTURE OF SAFE WALKWAYS AND BIKE PATHS. THE ITC SHOULD BE PHYSICALLY ACCESSIBLE FOR EVERYONE, INCLUDING PERSONS WITH DISABILITIES, CHILDREN, ELDERLY AND OTHER PEOPLE WITH REDUCED MOBILITY. IT SHOULD ALSO OFFER SUFFICIENT SPACE FOR BIKE PARKING TO ATTRACT MORE CYCLISTS. BIKE SHARING STATIONS NEXT TO THE ITC CAN FURTHER INCREASE THE SHARE OF PEOPLE BIKING TO THE ITC. FINALLY, IN ORDER TO PROMOTE BIKING AND WALKING TO AND FROM THE ITC IT IS NECESSARY THAT THE ITC IS LOCATED WHERE PEOPLE LIVE AND WORK.

A SOLUTION FOR CAR TRAFFIC

EVEN THOUGH WE BELIEVE THAT THE SHARE OF CAR TRAFFIC IN THE MODAL SHARE SHOULD DECREASE SIGNIFICANTLY, WE DO THINK THAT THE CAR WILL REMAIN A MORE OR LESS IMPORTANT MODE OF TRANSPORT FOR SOME. PEOPLE WHO LIVE IN THE OUTSKIRTS OF THE TOWN OR IN OTHER AREAS THAT ARE POORLY COVERED BY PUBLIC TRANSPORT WILL TO SOME EXTENT STAY RELIANT ON THEIR CARS IF BIKING IS NOT AN OPTION. HOWEVER, THE AIM SHOULD BE TO REDUCE THE NUMBER OF TRIPS AND THE DISTANCE TRAVELLED BY CAR TO A MINIMUM. THIS MEANS, CONVINCING THOSE WHO ARE CURRENTLY COMMUTING BY CAR FROM ONE CITY TO ANOTHER TO ONLY USE THE CAR FOR THE FIRST PART OF THE JOURNEY AND THEN SWITCH TO PUBLIC TRANSPORT OR OTHER MODES OF TRANSPORTATION. THE ITC CAN FACILITATE THIS CHANGE IN TRAVEL BEHAVIOUR AS IT MAKES THE CHANGE BETWEEN DIFFERENT MODES OF TRANSPORT MORE CONVENIENT. HOWEVER, THE PRIOR MODE OF TRANSPORT TO AND FROM THE ITC SHOULD BE PUBLIC TRANSPORT, BIKING OR WALKING IN ORDER TO AVOID AN INCREASE IN CAR TRAFFIC AS WELL AS CONGESTION AROUND THE ITC. A GOOD PARKING STRATEGY FOR THE AREA OF THE ITC COMBINED WITH CHEAP PARK AND RIDE OPTIONS AT THE OUTSKIRTS OF THE TOWN CAN REDUCE AN INCREASE IN TRAFFIC AROUND THE CENTRE WHILE AT THE SAME TIME STAYING ATTRACTIVE FOR COMMUTERS.

ATTRACTIVENESS AND SAFETY

THE ITC SHOULD NOT ONLY SERVE THE PURPOSE OF INTERCHANGING BETWEEN DIFFERENT TYPES OF TRANSPORT, IT SHOULD ALSO BE A PLACE WHERE PEOPLE ENJOY BEING. EVERYONE SHOULD FEEL SAFE AND SECURE DURING ALL HOURS OF THE DAY; THE APPEARANCE OF THE ITC SHOULD BE APPEALING AND CLEAN; AND THE WAITING TIME SHOULD BE AS CONVENIENT AS POSSIBLE, ENSURED FOR EXAMPLE BY RAIN SHELTERS AND BENCHES. LOCATING SHOPS, CAFÉS AND OTHER SERVICES NEARBY, INCREASES THE ATTRACTIVENESS OF THE ITC AND CAN FURTHER ENHANCE THE EXPERIENCE WHILE DECREASING TRANSPORT DEMANDS.

At the current stage, the ITC is planned to be built next to the existing central train station of Zabrze. That has the advantage that the main bus stations as well as a tram station are located nearby. Furthermore, the central station is central in the city centre thus minimising the demand for transport. However, building the ITC in the old city centre will probably lead to an increase in car traffic in the city centre. This will not only cause congestion and local air and noise pollution, but also oppose the aim to improve the bicycle infrastructure in the city, which requires a reduction in car use.

We therefore suggest to move the ITC northwards and locate it near the crossing Aleja Jana Nowaka-Jeziorańskiego and Hagera. This would provide the opportunity to connect the old city centre with the new developed Katowice Special Economic Zone and the new city district Nowe Miasto. Both areas will attract a large number of people to live and work in. Considering that the southern part of Zabrze in large parts consists of green areas with low population density, we think that it would be reasonable to move the ITC northwards in the direction of where a dense city development is planned.



CONCEPT OF INTEGRATED TRANSPORT CENTRE IN ZABRZE

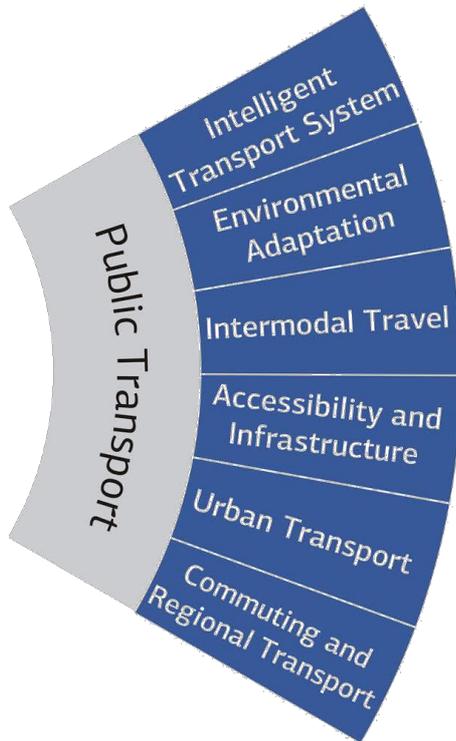
Furthermore, the suggested location is closed to commercial areas and could be easily integrated in the current transport infrastructure. The street Nowaka Jeziorańskiego DK88 is one of the main streets crossing Zabrze in east-west direction. It is easily accessible from the highways surrounding Zabrze. In line with the current modernisation and expansions plans for the streets Hagera and Nowo Hagera 1, the car traffic to the ITC could therefore be organised in a way that significantly decreases traffic in the old city

centre. The existing tram line that connects the suggested location with the city centre could be further developed in order to reduce travel time between the ITC and the old city centre.

While it would be relatively easy to move the existing main bus station northwards, it is more difficult to connect the train system with the suggested ITC. However, operational railway infrastructure is already in place. These railway tracks north of the central station lead to the international airport and are today mainly used for freight traffic. The tracks are connected to the current main passenger railway tracks in Western Zabrze and our idea, if feasible, is to reconnect them in Eastern Zabrze again. In doing that, the regional and national railway system would not be affected, as the trains would still enter and leave the city of Zabrze at the same spot, while at the same time, the central station could be moved northwards towards the suggested location of the ITC.

In conclusion, we see a high potential in the alternative location and therefore strongly recommend considering it in the planning process.

PUBLIC TRANSPORT



Public transport plays a key role in the transition to a more sustainable transport system in the city because a well-organised and developed public transport system is essential to reduce local as well as regional car travelling. The reform area of public transport therefore aims to turn the existing system of trams, busses and trains in Zabrze into a competitive alternative to cars.

As time and travel duration are important criteria for travellers, a key aspect of the competitiveness of public transport is the reduction of travel times. Especially during peak traffic times, it should be faster and more convenient to go by public transport. Among others, this can be facilitated by the prioritisation of public transport within the city's transportation infrastructure or an intelligent transport system.

At the same time, the public transport system needs to be reliable, well-functioning and, in the ideal case, supported by a real-time information system. It should be convenient to change different modes of transportation with ease of accessibility.

Furthermore, the trams, busses and trains, as well as the stops and stations should be clean and attractive. Possible measures to achieve this are rain shelters, comfortable seating capabilities and strategically located waste bins. Offering the users of public transportation free newspapers, info screens or even Wi-Fi can constitute an advantage that cars cannot compete with.

People should feel secure while waiting for or travelling by public transport during all times of the day. A well-designed lighting system at the stations as well as the possibility to talk to the driver in the case of an emergency can enhance the feeling of security making public transport more attractive.



LABELS ON THE TRAIN IN LUND

Finally, public transport can be promoted using mobility management. Test commuting is one example of how the city of Lund is promoting public transportation. This is a programme where car commuters are provided with the opportunity to test public transport for a test period of three months. The idea is that the car user commits to refrain from commuting by car and gets a free ticket to travel by public transport in return. At the end of the test period there will be car drivers that started enjoying the benefits of public transport and decide to continue this way of commuting.



PUBLIC BUS IN LUND

4TH RING: PROJECT PROPOSAL FOR PUBLIC TRANSPORT

INTELLIGENT TRANSPORT SYSTEM

An intelligent transport system makes travelling by public transport faster and more convenient. It can consist of several elements regarding both traffic design as well as user-friendliness. An example of this is an online travel planner that provides easy to understand information about travel times, routes and prices for citizens and visitors of the city. Real-time information provided via digital display boards, mobile phones as well as simple online and rapid ticket purchase methods such as e-tickets, period or prepaid transit passes help to improve the convenience. An intelligent transport system can also create a

Since the introduction of green wave, the average speed of busses in Lund increased from 18 km/h to 22 km/h [23].

green wave for busses using GPS-controlled signal prioritization. This reduces traffic jams, CO₂ emissions and ensures higher average speed of public transport.

ENVIRONMENTAL ADAPTION

Public transport in Zabrze should be aimed to be fossil fuel free. The electricity for trams and trains should come from renewable energy sources. Busses could be fuelled with biofuels produced in the biogas plant that is currently being developed in Zabrze.

INTERMODAL TRAVEL

Public transport alone cannot satisfy all transportation needs of a society. It is therefore necessary to make the change between different modes of transportation as convenient as possible. This includes local traffic such as bicycle and pedestrian traffic as well as trains and busses as part of the regional traffic system. Besides connecting several modes of transport, transport centres can also be combined with shops or services in order to provide relevant information. Currently the possibilities of intermodal travelling in Zabrze are suboptimal. We see great potential in Zabrze's plans to build an integrated transport centre that combines all modes of urban transport, meaning bus, tram, train, biking, walking and cars.



CITY OF LUND

ACCESSIBILITY AND INFRASTRUCTURE

We have identified three proposals regarding accessibility of public transport. First of all, the public transport infrastructure needs to ensure physical accessibility for all. Busses, trams, trains as well as stations should be equipped with special ramps or lifts to be accessible for people with reduced mobility, elderly and prams. The second type of accessibility in terms of public transport



PUBLIC BUS IN LUND

refers to accessibility as means of getting to several places in the city or the region. In this regard, public transport should provide the opportunity for all to access, for example, public service buildings such as libraries, agencies or health care centres. The third type of accessibility can be understood as economic accessibility and social inclusiveness. The price structure of tickets should therefore enable everyone to afford using public transport as mode of transportation while in part financing the operational costs.

URBAN TRANSPORT

Urban public transport needs to be fast and convenient in order to compete with car traffic. This can be accomplished through infrastructural changes, including separate bus lanes or optimised route design with more direct routes. In addition, technology, such as GPS-controlled signal prioritisation, can further decrease travel time. Moreover, establishing intelligent ticket systems can decrease the time for entering and exiting the bus. Finally, it might be necessary to combine these measures with restrictions for cars in order to make public transport more competitive and faster.



TWO TRAMS IN ZABRZE; PHOTO CREDIT: MAGDALENA SOSNOWSKA

COMMUTING AND REGIONAL TRANSPORT

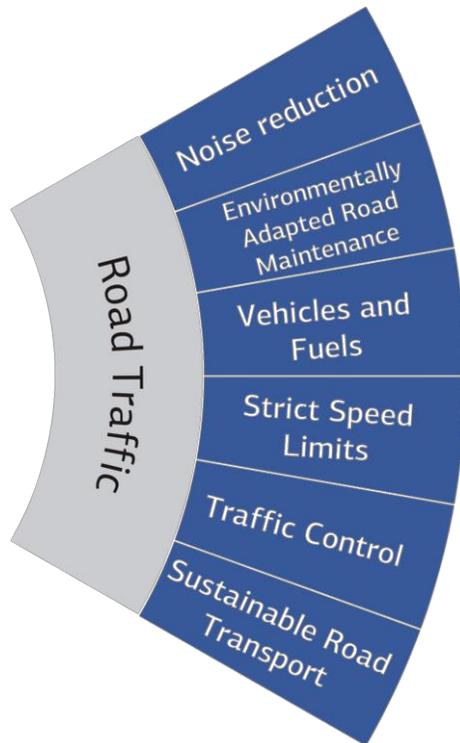
From our time in Zabrze we discovered that, most commuting happens between the cities within the Silesia region. Connecting the regional transport system with the local one is therefore crucial. The Union of Transport of the Upper Silesian Industrial Region (KZK GOP) is running the public transport system for the whole region and coordinating the regional with the local traffic. However, commuting and regional transport can still be improved by taking into account the whole trip from the starting point to the destination (door to door). Door to door considerations include not only the public transport system but also the way to the station and the way from the station to the final destination. Therefore, every city in the agglomeration should consider entire trips in order to facilitate convenient commuting from door to door.

CASE STUDY FROM MALMÖ – A BRT-SUCCESS

IN 2014 THE MUNICIPALITY OF MALMÖ INTRODUCED SWEDEN'S FIRST BUS RAPID TRANSIT (BRT) SYSTEM. THE MALMÖEXPRESS CONNECTS LARGE PARTS OF THE CITY BY UTILISING A SEPARATE BUS LANE AND PRIORITISED CROSSINGS. THE TRAVEL TIME IS FURTHER DECREASED AS PASSENGERS CAN ENTER AND EXIT THE BUS THROUGH ALL FOUR DOORS AND BUY THEIR TICKETS ELECTRONICALLY IN THE BUS WITHOUT INVOLVING THE BUS DRIVER. THE STATIONS ARE ELEVATED TO FACILITATE SMOOTH ENTERING AND EXITING, THUS ENSURING ACCESSIBILITY.

THE FLEET IS MADE UP OF 24-METER LONG BUSES THAT OFFER EXTRA LARGE CAPACITY. TO AVOID CONGESTION AND TO MAXIMISE CONVENIENCE, MORE BUSES ARE UTILISED DURING RUSH HOUR. FURTHERMORE, THE BUSES OFFER FREE WI-FI. ALL BUSES ARE SO CALLED GAS HYBRIDS THAT USE A COMBINATION OF BIOGAS AND BATTERIES RESULTING IN LESS NEGATIVE ENVIRONMENTAL IMPACTS. AS A CONSEQUENCE, LEVELS OF NITROGEN DIOXIDE ALONG THE ROUTE HAVE BEEN DECREASED BY 8 % SINCE THE INTRODUCTION OF THE MALMÖEXPRESS. BESIDES THE POSITIVE ENVIRONMENTAL EFFECTS, THE BUS HAS ALSO ATTRACTED A YEARLY INCREASING NUMBER OF PASSENGERS, ALMOST DOUBLING THE AMOUNT OF PASSENGERS DURING THE FIRST YEAR. [24-27].

ROAD TRAFFIC



Road traffic is the most common mode of transport for people in Zabrze, as owning a car has become an icon of social status. A car provides freedom to choose the route, speed and destination. In many cases it is more convenient and faster than other modes of transport. However, data provided by the Ecology Department of Zabrze shows a high correlation between air pollution and rush hour traffic indicated by PM₁₀ levels exceeding EU standards. In addition, noise maps also revealed that the level of traffic noise often exceeds the EU standards. Both, noise and air pollution can negatively affect health and result in a higher risk of premature deaths.

Heavy car traffic is a challenge for every city's mobility system. However, overreaching restriction created by local government can negatively affect people's morale and support. It needs therefore to be emphasised that project proposals for road traffic do not only include hard measures, restrictions or economic means. To ensure political acceptance, it is instead important to also use soft measures to influence people's behaviour and habits. A sustainable mobility strategy should incentivise people to choose more sustainable modes of transport by ensuring convenient and reliable public transportation, safe walking paths, and a well-developed biking infrastructure.

During the last decade, the cities of the Silesia agglomeration have been connected building a dense network of motorways. As a result, car traffic in many cases has become the most convenient mode of transportation. However, air pollution caused by heavy car traffic can have long-term negative effects on human health and the natural environment. Therefore, it is important to organise car traffic in a sustainable manner. We acknowledge that car traffic will continue being part of the modal share while stressing that the use of cars needs to be decreased significantly.

The reform area of road traffic is closely related to all other reform areas of the proposed strategy. Reduced speed limits for cars increases the safety for pedestrian and bike traffic, and increases the competitiveness of public transport. Meanwhile, project proposals of other



RETROFITTED ROAD IN MALMÖ

reform areas, such as the proposed parking strategy, also affect the reform area of road traffic. Urban planning solutions and various technological innovations may incentivise people to choose more sustainable modes of transportation.

Looking at the example of Lund, it can be observed, that, while the decision to focus on a sustainable development fell in the late 1960's, it took until 1998 to finally introduce the first version of LundaMaTs. Since then, not only the sustainable mobility strategy of Lund but also the mind-set and habits of the population have changed significantly. Therefore, it should not be expected to achieve a major shift of people's mind-set in Zabrze in a short period of time – changing people's behaviour is a long term mission that requires iterative actions and measures.



PHOTO COLLAGE OF LUND IN 1960S AND NOW; PHOTO CREDIT (UPPER LEFT AND RIGHT): LUND MUNICIPALITY

4TH RING: PROJECT PROPOSALS FOR ROAD TRAFFIC

NOISE REDUCTION

From the data provided by the Department of Ecology of Zabrze, it is evident that noise pollution is a significant problem in the city. In many areas surrounding main arteries of traffic, noise levels exceed 60 dB, thus reaching a level at which an increased risk of heart attacks occurs. A study of Danish scientists showed the correlation between traffic noise in residential areas and increased number of myocardial infarction of local population [28]. Therefore, it is important to reduce traffic flows in dense central areas, and to further develop the existing sound wall system around motorways. Another factor impacting the level of noise is the road surface. Large parts of Zabrze are paved with old bricks that cause high levels of noise when cars are passing. The example from Hamburg, Germany, shows that filling the gaps between the bricks with tar can make traffic less noisy. This reduces noise levels while preserving the old image of the town.

ENVIRONMENTALLY ADAPTED ROAD MAINTENANCE

Road maintenance is an unavoidable and highly cost intensive public service. Adapting environmentally friendly solutions cannot only reduce negative effects to the natural environment but also provide budget savings. Road maintenance intensifies during the winter, when roads are being cleaned and scraped from snow and ice, and sprayed with de-icing or anti-icing salt or chemicals. Beside

THERE ARE ALSO INNOVATIVE SOLUTIONS THAT ARE ALREADY AVAILABLE TO MAKE DE-ICING AN EFFECTIVE AND MUCH MORE EFFICIENT SERVICE. SENSORS CONNECTED TO LAMP POSTS CAN IDENTIFY CONDITIONS OF ROAD SURFACE IN REAL-TIME ALLOWING A SOFTWARE TO CALCULATE THE MOST EFFECTIVE ROUTE FOR SNOW CLEARING VEHICLES. MOREOVER, THESE VEHICLES CAN BE EQUIPPED WITH SENSORS THAT CAN PROPERLY DOSE DE-ICING CHEMICALS AND PERFECTLY ADJUST THE NOZZLES. IN DOING CHEMICALS CAN BE SAVED, WHICH REDUCES NOT ONLY THE COSTS FOR THE MUNICIPALITY BUT ALSO SAVES THE ENVIRONMENT.

the benefits of clean and safer roads, salt and other chemicals used for de-icing and anti-icing have negative effects not only on the environment but also on roads and cars by accelerating asphalt erosion and corrosion of vehicles. Therefore, when the temperature rises in spring and no frost is expected to occur before the next winter season, roads have to be cleaned and washed. Additionally, the use of more environmentally friendly chemicals should be considered.

VEHICLES AND FUELS

Diesel, petrol and biofuels differ in emission levels of CO₂, NO_x and PM. The municipality should ensure that alternative fuels to diesel and petrol are easily accessible. The currently planned biogas plant in Zabrze could become a driver to introduce biofuels to city busses. At the same time, it should be acknowledged that Poland is one of the leading markets for liquefied petroleum gas (LPG) systems in motor vehicles, which is a more environmentally friendly fuel than regular diesel or petrol.

THE ISSUE OF THE NEW TESLA MODEL 3 HAS BECOME THE SINGLE MOST SUCCESSFUL PRODUCT LAUNCH, EVER. IT HAS BEEN RESERVED BY 325 000 PEOPLE, IMPLYING FUTURE SALES OF USD 14 BILLION [29]. NEVER BEFORE HAVE SO MANY PEOPLE RESERVED A VEHICLE DURING THE FIRST WEEK OF ITS PRODUCTION. THIS MARKS THE BEGINNING OF A NEW TREND WITH REGARD TO THE FACTORS THAT INFLUENCE THE DECISION WHAT KIND OF CAR PEOPLE BUY. IN SOME PARTS OF THE UNITED STATES OF AMERICA AND NORTHERN EUROPE, HAVING A TESLA HAS ALREADY BECOME AN ICON OF SOCIAL STATUS. STEADY GROWTH OF PEOPLE'S INCOME AND THE GROWING NUMBER OF REGISTERED VEHICLES IN POLAND, SUPPOSES THAT IN THE NEAR FUTURE MORE AND MORE PEOPLE WILL AFFORD NEW CARS, INCLUDING ELECTRIC VEHICLES. ON A NATIONAL LEVEL, THE DEVELOPMENT OF THE CHARGING STATION INFRASTRUCTURE AND PROVISION OF ECONOMIC INCENTIVES COULD CHANGE THE POLISH ICON OF THE SOCIAL STATUS FROM "OWNING A CAR" TO "OWNING AN ELECTRIC VEHICLE".

HOWEVER, IT HAS TO BE RECOGNISED THAT ELECTRIC VEHICLES ARE ONLY AS ENVIRONMENTALLY FRIENDLY AS THE ENERGY MIX THAT PROVIDES THE ELECTRICITY THEY RUN ON. THE CASE OF THE FIRST TESLA IN SINGAPORE ILLUSTRATES THAT DESPITE THE FACT THAT ELECTRIC VEHICLES DO NOT EMIT CO₂, THEY USE ELECTRICITY FROM THE GRID, AND IF THAT ELECTRICITY IS PRODUCED FROM COAL OR NATURAL GAS, IT WILL CAUSE CO₂ EMISSIONS. THE TESLA MODEL S FROM THE PRESENTED SINGAPOREAN CASE USES 444 WH/KM THAT IS EQUIVALENT TO CO₂ EMISSIONS OF 222G/KM, WHICH IS THE EQUIVALENT TO THE EMISSIONS OF A LARGE SPORT UTILITY VEHICLE (SUV) OR SMALL COMMERCIAL TRUCK [30]. THEREFORE, THE DEVELOPMENT OF THE ELECTRIC VEHICLES INFRASTRUCTURE SHOULD GO IN LINE WITH AN INCREASED SHARE OF RENEWABLE ENERGY IN THE COUNTRY'S ENERGY MIX.

STRICT SPEED LIMITS

It is easily observed that many drivers in Zabrze exceed speed limits. Therefore, introducing strict speed limits and more efficient speed controls will create a safer environment for pedestrians and cyclists while reducing the number and severity of car accidents. Zabrze city can take easy-to-implement measures such as introduction of more speed bumps. Positive effects of slower traffic speeds include reduced noise levels and increased safety for cyclist and pedestrians.



SPEED BUMP IN LUND

TRAFFIC CONTROL

Traffic control is a broad concept that includes the introduction of separate lanes for selected transport or car-pooling. In some cities it includes the allowance to drive on bus lanes and priority parking for fully electric vehicles as soft measure that incentivises people to choose bus or to buy an electric vehicle. Moreover, it promotes car-pooling instead of traveling to work by car on your own.

SUSTAINABLE ROAD TRANSPORT

This project area focuses on overall reduction of emissions in the transport system. It includes the selection of materials of the road paving, speed zones, type of crossings, retrofitting of crossroads to roundabouts, and even trees and plants that increase the attractiveness and improve air quality.



RETROFITTED ROAD IN MALMÖ

PEDESTRIAN TRAFFIC



Pedestrian traffic is not only the most surface space efficient mode of transport; it does not produce any emissions while at the same time promotes human health. Nevertheless, pedestrian traffic is often underrepresented in mobility strategies. That is why we decided to emphasise the benefits of walking and to include pedestrian traffic as a separate reform area. Pedestrians on the streets and in the city centre create a lively and vivid city atmosphere that contributes to more attractiveness of the city. This in turn, promotes businesses, such as shops and cafés, to settle in the city centre. Thus, by increasing the number of pedestrians in the city centre more economic benefits can be realised through revitalisation of currently unused commercial spaces. Not least, focusing on pedestrian traffic as a sustainable means of transport will help the city of Zabrze when developing its tourism.

Creating a safe, secure and enjoyable walking environment for residents, workers and visitors is crucial when it comes to pedestrian traffic. Road safety, as one example, can be increased by speed reduction measures. The use of signalled crossings is another way of increasing the visibility of pedestrians at road curves, crossings and during the night. The sense of security does not only influence where people walk, but also during which hours of the day they feel secure and comfortable walking in the city. Furthermore, dark areas, uncut shrubbery as well as abandoned public spaces can negatively affect pedestrians' sense of security, thus discouraging walking. A well-planned lighting system that ensures that people see and can be seen is therefore essential to increase the sense of security [31]. There is also a potential for improving local neighbourhood safety when pedestrian traffic increases due to the fact that more people on the street create a natural surveillance, which also increases people's sense of security. Greening the streets, calming down traffic and allowing cafés and shops to use public spaces for outdoor seating during the warmer months can improve the attractiveness



PHOTO COLLAGE OF TUNAVÄGEN/E22, LUND;
PHOTO CREDIT: S. PETER, I. PHADTARE & P.
UDOMCHAROENCHAIKIT

of the walking environment. Innovative LED-lighting solutions can furthermore contribute to more attractiveness of pathways and positively influence the urban image.



RETROFITTED ROAD IN MALMÖ

Moreover, children should be able to move around in the city safely meaning it is necessary to consider children's needs when looking at pedestrian traffic. The same applies for elderly people for whom walking is often the most preferred and sometimes the only means of mobility. Being able to walk to the supermarket and to run an errand in the neighbourhood enables elderly to be self-sufficient ensuring their freedom of mobility. Especially because of the aging population in Zabrze, it is therefore necessary to consider accessibility aspects regarding elderly when it comes to the design of pedestrian traffic in the city. In addition, by emphasising the needs of the groups with decreased mobility will improve traffic safety at the same time.

4TH RING: PROJECT PROPOSALS FOR PEDESTRIAN TRAFFIC

PEDESTRIAN TRAFFIC PLAN

Designing a separate plan focused on pedestrian traffic is a good tool to promote walking as an important means of transport. Such a plan should include the status quo as well as the vision and the goals for pedestrian traffic in Zabrze. Further, the plan should be complemented by project proposals and action plans that aim to create an attractive walking environment raising the benefits of walking. This includes identifying possibilities of improvement for the main walking routes as well as creating a more attractive, safe and secure walking environment in general. When developing the pedestrian traffic plan, surveying citizens is a good tool to gain local knowledge about their wishes and needs. Surveys will help to identify areas of prioritisation.

PHYSICAL ACCESSIBILITY

Besides safety, security and attractiveness of the walking environment, accessibility plays an essential role within the reform area of pedestrian traffic. The city should be enjoyable for everyone, meaning that pedestrian walkways are designed in a way that also allows people with disabilities, children and elderly to easily get around and enjoy the city. Measures ensuring accessibility includes among others; extensive bevelled access points where a step would otherwise be required and adaptations for visually impaired street crossings at crossings.



PATHWAY IN LUND

SAFE OUTDOOR ENVIRONMENTS

Both, safety as well as the sense of security, are crucial elements of pedestrian traffic. Safety walks are a good tool to identify areas in the city that suffer a lack of safety or make people feel insecure. Installing smart and attractive lighting along walkways makes pedestrians more visible while creating a safer environment that delivers a sense of security. However, safety for pedestrians does not only refer to risks caused by car traffic or cyclists but also includes the risk of slip and falls. To ensure a safe outdoor environment therefore also requires removing leaves as well as snow and ice from pedestrian walkways.

OPPORTUNITIES FOR RECREATION AND EXERCISE

It should not be disregarded that pedestrian infrastructure is not only used as means of getting from point A to point B, but also for promenades, sport and other activities. By creating attractive recreation and exercise opportunities close to dwellings, the need to travel for leisure activities can be reduced. A good example is running tracks or outdoor gyms that have the positive side-effect of promoting public health.

SAFE SCHOOL ROUTES FOR CHILDREN

Considering children within the reform area of pedestrian traffic is not only essential as they form one of the most vulnerable pedestrian group, but also because the children of today are the adults of the future. It is therefore necessary to educate children as early as possible about sustainable mobility and encourage them to walk and bike or to choose public transport. Ensuring safe school routes for children includes reduced traffic speed with strict speed controls near schools as well as a design of crossings that makes sure that children are easily visible and not hidden by parked cars adjacent to the crossing. Those infrastructural measures should be complemented by soft measures such as awareness campaigns in the beginning of the school year as well as education of children in school.

LIGHTING

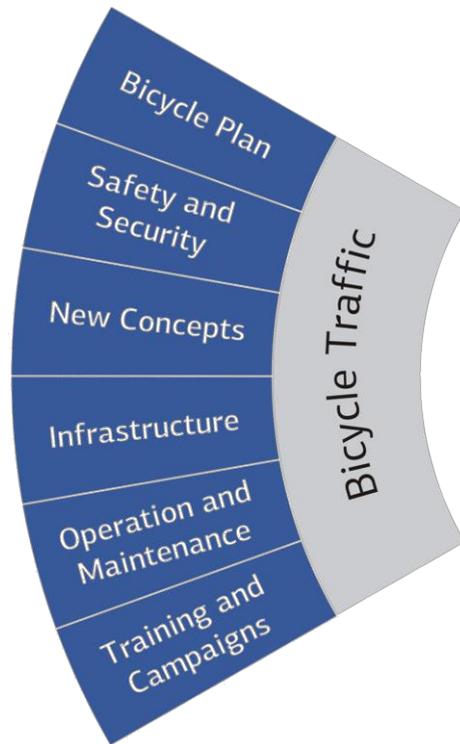
Due to its high relevance, we have chosen to highlight lighting as a separate project proposal within the reform area of pedestrian traffic. Lighting cannot only improve security and safety but also contribute to higher attractiveness of the city. It has furthermore a high potential when it comes to innovative and smart city solutions and energy cost savings.

SAFE OUTDOOR ENVIRONMENT USING LED-LIGHTING – CASE STUDY LUND

A GOOD EXAMPLE OF HOW TO CREATE A SAFE AND SECURE OUTDOOR ENVIRONMENT CAN BE FOUND IN ZABRZE'S SISTER CITY OF LUND. IN AUGUST 2015, THE MUNICIPALITY DECIDED TO INSTALL LED LIGHTING AT THE MIXED VEHICLE, CYCLE AND PEDESTRIAN UNDERPASS LOCATED WHERE THE HIGHWAY E22 CROSSES TUNAVAGEN. RETROFITTING THE UNDERPASS COST THE MUNICIPALITY OF LUND SEK 300 000 (EUR 32 175) FOR THE INFRASTRUCTURE AND ADDITIONAL SEK 150 000 (EUR 16 087) FOR THE INSTALLATION OF THE LIGHTING DESIGN.

ONE MAJOR REASON TO RETROFIT THIS UNDERPASS WITH AN LED DESIGN WAS TO ADDRESS SECURITY CONCERNS AND TO INCREASE ITS ATTRACTIVENESS. IN COOPERATION WITH A LIGHT DESIGNER A DESIGN CONSISTING OF WHITE AND BLUE LEDs FOR PEDESTRIAN AND CYCLE PATHWAYS WAS DEVELOPED AND IMPLEMENTED. WHILE THE WHITE LEDs SERVE AS INDIRECT BACKLIGHTING, THE BLUE LEDs PROVIDE INDIRECT DOWNWARD LIGHTING. AS A RESULT OF THE NEW LIGHTING DESIGN, USERS OF THE UNDERPASS ARE VISIBLE THROUGHOUT THE FIFTEEN METRE UNDERPASS, WITH FACES BEING VISIBLE AT TEN METRES. THIS INCREASES SAFETY FOR PEDESTRIANS WHILE MAKING PEOPLE FEELING MORE SECURE. AFTER OBSERVING THESE POSITIVE RESULTS AND SUBSTANTIAL IMPROVEMENTS, THE MUNICIPALITY OF LUND IS CONSIDERING TO RETROFIT OTHER PRIORITY UNDERPASSES AND TUNNELS IN THE CITY [31].

BICYCLE TRAFFIC



In terms of sustainable mobility, having a good biking system in the city is a key aspect. We recognised that the city urban planners of Zabrze have created a bicycle map that includes current and proposed bike routes. We were also informed of the fact that a bicycle strategy has been developed for the entire Upper Silesia region. With these considerations, we have incorporated a bicycle traffic reform area, into our strategy framework that is intended to transform Zabrze into a bicycle friendly city and raise the share of cycling in the city transportation modal split. In order to accomplish the goal of maximising sustainable mobility, a key aspect for Zabrze is to transform the perception of biking from a recreational activity to a means of everyday transportation.

The greatest direct benefits from increased biking are the reduction of air and noise pollution in the city. This is important for Zabrze as there is a need

to improve the air quality within the city. Data provided by Janusz Famulicki of the Ecology Department of Zabrze show a high correlation between air pollution and rush hour traffic indicated by PM₁₀ levels exceeding EU standards. In addition, noise maps also revealed that the level of traffic noise often exceeds the EU standards. Both noise and air pollution can negatively affect health and result in a higher risk of premature deaths. Choosing bikes over cars can definitely reduce these levels and help Zabrze toward meeting EU standards. Biking reduces congestion and frees up spaces along roads that may otherwise be required to accommodate parking cars. Biking is a physical activity, which

promotes health and wellness resulting in a reduction of indirect medical expenses.

The barriers for increasing biking traffic in the city are a product of causes and effects that are deeply

connected to one another. The general mind-set of people is to take their car even when it is not necessarily the best option.

This mind-set has led to a history of infrastructure development that prioritises cars. As mobility is primarily focused on cars, the infrastructure development has unintentionally compromised safety for cycling by not creating sufficient bike lanes or alternatives that allow people to bike through the city without biking among car traffic. The result of this is that cycling is viewed as an unattractive means of transportation. To be able to accomplish a shift in perception, biking needs to be safe, convenient and attractive for people of all ages.

“It takes me 15 minutes to get to work by car and 10 minutes to walk. And I take my car”.

The overarching goal of the six projects proposals under the bicycling reform area is to make cycling a more attractive mode of transport. This is not a process that will happen overnight, as changing people's mind-set and daily habits is an extremely difficult task. However, we are confident that the suggested project proposals will help Zabrze to transform into a bicycle friendly city while helping achieve the vision of sustainable mobility.



BIKE PARKING RACK IN LUND

4TH RING: PROJECT PROPOSALS FOR BICYCLE TRAFFIC

BICYCLE PLAN

In a commitment to fulfil Zabrze's vision, to be a city with lots of space for biking, Zabrze should continue to develop a bicycle plan within the city, which also complements that of the entire Silesia region agglomeration. In order to effectively reach the goals of creating a safer and more effective infrastructure a clear timeline for projects needs to be defined. Specific targets for expanding and designing a connected bicycle network should be the focus.

SAFETY AND SECURITY



BICYCLE PARKING IN MALMÖ TRAIN STATION

We observed a variety of measures that can be implemented in Zabrze that can serve to discourage car traffic while encouraging bike traffic. Creating a safe cycling environment on roads can be obtained through strict speed reductions, early starts for bikes at signalised intersections, as well as planning separate bike routes that decrease travel time. Visual cues can be provided for vehicles to slow down and stay in allocated traffic lanes. Efficient street and off-road bike path lighting increases safety while biking. In addition, setting up bike parking racks or enclosed bike garages can reduce risks for theft.

NEW CONCEPTS

An example of a new concept is public bicycle sharing schemes that are designed for short trips across the city. This allows opportunities to borrow a bike for a few minutes, a few hours, or even an entire day. Another concept can be online cycling-projects information forums. These forums allow citizens to actively track and keep up to date as well as comment on the status of biking related projects happening within the city.



BICYCLE SHARING IN LUND

INFRASTRUCTURE

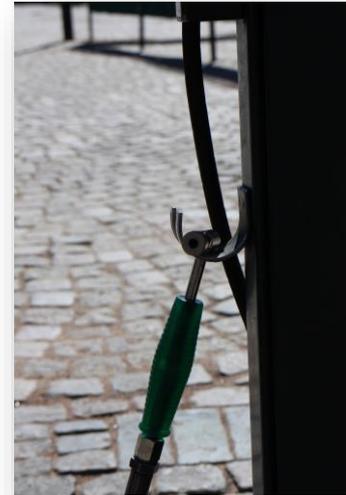
This proposal aims at creating and improving cycling infrastructure that can attract and improve people's level of cycling. Key aspects to this project proposal include considerations for providing safe routes, improvements to routes that experience increased demand and how bike paths are built, such as brick versus paved and retrofitted versus alternate parallel route.

OPERATION AND MAINTENANCE

Projects here are typically tied to infrastructure but incorporate additional aspects. Public bicycle tire pumps, maintaining traffic signs and having a preparedness plan for extreme weather are some measures to be included here.

TRAINING AND CAMPAIGNS

This project proposal is intended to create education and awareness programs for changing the behaviour and mind-set of the public towards cycling as a means of everyday transportation. The point is to highlight benefits and encourage a safe cycling environment. This creates a window for the city to work with community groups, NGOs, schools and others in order to promote bicycle safety, education and awareness.

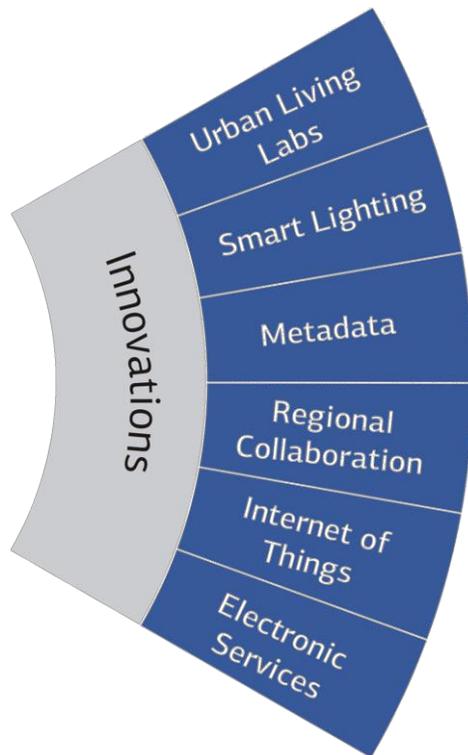


BICYCLE TIRE PUMP IN LUND

THE CASE STUDY OF NEXTBIKE BIKE SHARING IN OPOLE, POLAND

A GOOD EXAMPLE OF SUCCESSFUL BIKE SHARING IN UPPER SILESIA IS THE TOWN OF OPOLE, WHICH HAS A POPULATION OF 126 000. IN JUNE 2012 THE FIRST PHASE OF THE NEXTBIKE BIKE SHARING SYSTEM WAS INTRODUCED WITH A HANDFUL OF LOANING STATIONS AROUND THE CENTRAL STATION. THE SYSTEM IS BASED ON THE BUSINESS PHILOSOPHY THAT THE SYSTEM SHOULD PROMOTE PUBLIC TRANSPORTATION COOPERATION THROUGH THE INTERMODAL MOBILITY CHAIN AND SHOULD BE EASY, FLEXIBLE AND COST EFFECTIVE. THE SYSTEM WORKS THROUGH AN APP ON YOUR PHONE. AFTER REGISTERING AND CREATING AN ACCOUNT WITH A PLN 10 DEPOSIT THE SYSTEM IS READY TO BE USED. IT IS FREE FOR THE FIRST 20 MINUTES OR PLN 2 UP TO 60 MINUTES AND PLN 4 FOR EACH ADDITIONAL HOUR BEYOND THAT. TODAY THE SYSTEM HAS 16 STATIONS AND 164 BIKES. IN 2015, THE SYSTEM RECORDED APPROXIMATELY 70 000 LOANS, AN INCREASE OF 19 % COMPARED TO THE PREVIOUS YEAR, WITH AN INCREASE OF 36% MORE REGISTERED USERS. FROM 2012 UNTIL THE END OF 2015 THE OPOLE BIKE SHARING SYSTEM HAD BEEN UTILISED BY 15 000 USERS WITH AROUND 234 000 LOANS. NEXTBIKE POLAND REPORTED THAT IN 2015 THERE WAS A STATISTICAL NEW USER ABOUT EVERY HALF HOUR AND THE AVERAGE LOAN WAS APPROXIMATELY 22 MINUTES. IN ORDER TO PROMOTE AND INTRODUCE PEOPLE TO THE CONCEPT OF BIKE SHARING, NEXTBIKE POLAND RUNS VARIOUS CAMPAIGNS SUCH AS PICNIC BY BIKE WHERE THEY OFFER THE ENTIRE FIRST HOUR FREE OF CHARGE EVERY WEEKEND IN MAY. BIKE SHARING IS A PRO-ECOLOGICAL AND HEALTH-ORIENTED FORM OF PUBLIC TRANSPORTATION THAT INCREASES A CITY'S SUSTAINABLE MOBILITY PROFILE [32].

INNOVATIONS



Innovations have become an inseparable part of urban development. The rapid development of Information Technology provides a number of smart solutions that can be adapted to city environments to enhance people's mobility and make commuting more convenient and sustainable. The concept of "Smart city" has already become a buzzword as more and more cities around the globe experiment with different adaptations of technologies in urban environments.

Each lamppost can become a supercomputer that not only provides smart lighting, but also provides LiFi (Light Fidelity) Internet connection of more than 200 Gbps. Other solutions include the ability to capture and provide information about traffic, temperature of road surface, levels of air and noise pollution, etc. Using Internet of Things network solutions, each citizen can become a contributor to the digital proponent being able to connect to city's infrastructure via smartphone.

Innovations have multiple positive socioeconomic effects, especially by reducing bureaucracy, optimising management of city's resources, providing safety and security to people, and increasing their convenience and accessibility. Economy of scale effect of rapid technological development reduces the costs of installation making, what was once was thought of as the future, available now.

The development of the Economic Zone in the Northern part of Zabrze is a great place for experimentation with different available LED lighting and sensor solutions. Building cooperation with lighting living labs, Zabrze could not only attract investments of companies oriented in lighting technologies, but also become Poland's hub for smart lighting solutions.



LED LIGHTING IN DOLL LIVING LAB, COPENHAGEN

4TH RING: PROJECT PROPOSALS FOR INNOVATIONS

URBAN LIVING LABS

Urban living lab is a concept of an open access research cluster for scientists, innovators, businesses and start-ups. It involves multiple actors to co-create, innovate and experiment with new technologies, products and services in a real-life setting to improve urban environments.

SMART LIGHTING

Smart lighting is a technology of innovative lampposts, programmed in a way to save energy when possible. Currently the most common sodium lamps are using 100 % of energy throughout the entire period from dusk to dawn. LED lampposts can be programmed to reduce energy consumption and light emission to lower percentage during the periods of minimum traffic (e.g. from 2 am to 5 am). Moreover, LED lamps connected with motion sensors can keep reduced lighting and increase it only when it detects upcoming vehicle to provide 100 % lighting only for a fraction of time while vehicle passes by.

DOLL – A PHOTONICS GREEN LAB IN DENMARK

IT IS A NEW PLATFORM FOR DEVELOPING FUTURE LED-LIGHTING SOLUTIONS. DOLL'S AIM IS TO CREATE ENERGY EFFICIENCY AND INTELLIGENT INDOOR AND OUTDOOR LIGHTING SOLUTIONS WHILE GENERATING JOBS WITHIN THE AREA OF LIGHTING. DOLL SUPPORTS MUNICIPALITIES, REGIONS AND PRIVATE COMPANIES WITH THE DEVELOPMENT OF NEW AND IMPROVED LIGHTING SOLUTIONS. LED LIGHTING IS A PROMISING TECHNOLOGY WHICH CAN LEAD TO MAJOR COST REDUCTIONS. A CRUCIAL PART OF THIS TRANSITION FROM TRADITIONAL ILLUMINATES TO MORE SUSTAINABLE ILLUMINATES IS TO FOCUS ON QUALITY, THE END-USER, AND ENERGY EFFICIENCY. DOLL'S THREE LABORATORIES WILL TAKE PART IN ENSURING A FUTURE-PROOF TRANSITION TO NEW LIGHTING TECHNOLOGIES [33].

METADATA

Various sensors can gather terabytes of data on different measures and store them in the cloud. Aggregation and analysis allow continuous tracking of changing environment allowing effective control, efficient maintenance, and continuous improvement of city's infrastructure environment. Providing access to open data enables universities, businesses and start-ups to experiment and create solutions for more sustainable living.

SUCCESS FACTORS

Deriving from the LundaMaT's example and considering the PDCA-management method, we have identified four key success factors for Zabrze.

BENCHMARKING

Every strategy has inevitable elements such as vision, mission, goals, objectives and targets. Setting objectives and targets requires benchmarking, which can be defined as an evaluation by comparison with a standard or set value. To establish that value, some basic information has to be collected and aggregated in order to help define reasonable objectives and goals, and later to evaluate the success rate of the strategy's implementation.

COST BENEFIT ANALYSIS

BENCHMARKING ENABLES THE ABILITY TO AGGREGATE DATA ON DIFFERENT MEASURES THAT CAN EVEN BE USED FOR COST BENEFIT ANALYSIS (CBA), A TOOL USED BY DECISION MAKERS TO WEIGHT THE TOTAL COSTS AND BENEFITS OF AN ACTION OR A PROJECT. CBA IS A CONVENIENT TOOL TO JUSTIFY ENVIRONMENTAL EXPENDITURES GIVING A MONETARY VALUE FOR EXTERNAL COSTS AND NON-MONETARY BENEFITS, SUCH AS CLEANER AIR OR REDUCED NUMBER OF RESPIRATORY DISEASES.

BUSINESS MODELS

Some of the project proposals in the fourth ring of the strategy wheel are cost intensive, therefore a flexible approach to new business models is necessary.

Public Private Partnership (PPP) is a business model where a private company provides public services. This avoids up-front capital expenditure for public bodies, allocates financial, technical and operational risks to the private partner, and ensures long-term returns for private company's investments [34]. As an

example of a successful PPP-model implementation is the Sala municipality in Sweden. Sala signed a 10- year contract with Phillips Sweden for the provision of street lighting, installation and maintenance services. According to the contract, the municipality pays SEK 1.9 million (EUR 203 000) annually. This is equivalent to the amount of previous operational costs for energy consumption and maintenance. The result being that Sala now has a new LED lighting system while reducing total energy costs by 80 %. Phillips Sweden has ensured the maintenance and operation, while the return of the company's investment is ensured for the period of 10 years from green savings keeping the municipality's budget in balance [35].



LED LIGHTING IN SALA MUNICIPALITY;
PHOTO CREDIT: L. WÜNNENBERG

COOPERATION

We have identified the importance of cooperation between the municipality with businesses, regional and national governments as well as supranational bodies. However, external cooperation is not effective without existing presence of internal cooperation. Therefore, it is also important to ensure substantial cooperation within different departments and other public bodies involved in the implementation of the strategy. Here we find the fundamental reason for establishing PDCA in the first ring. It is crucial to ensure multi-level engagement of the municipality's staff, more than just organising meetings of heads of departments. It is also necessary to set up working groups composed of various levels of specialists including external consultations in the form of private or university collaboration that are all subject to clearly defined deliverables.

Most of the project proposals included to the strategy wheel require engagement of specialists from different departments of the municipality and other public institutions. For example, to elaborate parking strategy, working group should consist of representatives of planning department, strategic department, infrastructure etc.

Each multi-department working group has to have its chairperson, clear division of tasks between the specialists, agreed agenda and regular meetings. It is also important to identify benchmarks to set objectives and targets, that would ensure constant evaluation of progress. Furthermore, it is important to ensure that local community is involved in working groups either directly or as an independent observer. Local community can be involved through public hearings or by including local representatives to working groups.

TRANSPARENCY

Every person involved should understand and follow the general vision of the strategy and should have a clear understanding of roles and responsibilities. In that sense we understand transparency as clear division of tasks as well as accessibility of information, followed up by accountability. This is aided through utilising the PDCA management method.

The roles and responsibilities of every person involved in the implementation of mobility strategy is decided in the planning stage. Transparent allocation and delegation of tasks contributes to better psychological climate and to an increase of working efficiency. It is important that everyone knows what the individual responsibilities are during the *doing phase*, as well as everyone understands that their outcome will be *checked*. Moreover, the *acting phase* allows everyone to contribute with his or her ideas for the improvement. Regularly scheduled meetings need to be scheduled where everyone is heard and understands that there are clear deliverable dates.

CONCLUSIONS

Zabrze possesses strong leadership with a will to create a good vision toward sustainable mobility. Our strategy gives Zabrze the advantage of benefitting from lessons learned by their sister city, Lund. Building and executing a strategy requires investments in human resources and time to benchmark and compare by utilising the PDCA method is a critical success factor. There are several very large projects that directly address mobility currently in the planning phases. One project is the IKEA centre, but more directly in terms of mobility is the Integrated Transport Centre. After discussion and further analysis, we strongly recommend investigating possibilities to locate the ITC to the potential northern option. These projects will shape the direction that Zabrze will take for decades to come in terms, of not only mobility but, sustainability. Is sustainability the driver for what we do? Is there another option? With the right tools in hand of; a clear vision, a manageable strategy using PDCA, we believe that Zabrze will further enhance its transition from black to green and become a leader in sustainable mobility in the Silesia region.





SED TEAM ZABRZE

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TEAM ZABRZE

THE IIIEE ADVANCES KNOWLEDGE ON HOW TO CATALYSE THE TRANSITION TO LOW-CARBON AND RESOURCE EFFICIENT ECONOMIES. THE MISSION OF THE IIIEE IS TO PROMOTE SUSTAINABLE SOLUTIONS PURSUED BY PUBLIC AUTHORITIES AND BUSINESSES – INTERNATIONALLY, NATIONALLY AND LOCALLY. IT IS DONE THROUGH ASSESSING GOVERNANCE AND MANAGEMENT PROCESSES, EVALUATING POLICY INSTRUMENTS AND BUSINESS MODELS, AND EXPLORING VISIONS AND SCENARIOS FOR SUSTAINABLE FUTURES [36].

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REFERENCES

- [1] Wefering, F. et al. (2014). Guidelines. Developing and Implementing a Sustainable Urban Mobility Plan. Retrieved from http://www.eltis.org/sites/eltis/files/sump_guidelines_en.pdf
- [2] Ljungberg, C. (n.d.). Bridging the gap – the use of methods from research results for implementation of Sustainable Urban Transport Plans – with the example from Lund. Sweden. Retrieved from <http://www.vtpi.org/lund.pdf>
- [3] Lund Municipality, Trivector AB (2007). LundaMaTs II – Strategy for a sustainable transport system for Lund 2030. Retrieved from http://www.lund.se/Global/Sidans%20katalog-pdf/lundamats2_lager_CN2_B_eng_orig.pdf?epslanguage=sv
- [4] Lund Municipality (in press). LUNDAMATS III – Strategy for a sustainable transport system in Lund Municipality.
- [5] Swedish Transport Administration, Swedish Association of Local Authorities and Regions (2014). Strategic Choice of Measures, A new step for planning of transportation solutions, Handbook. Retrieved from <https://online4.ineko.se/trafikverket/Product/Detail/43742>
- [6] Lund Municipality (2014). LundaMaTs II – Verksamhet & Resultat. Retrieved from http://www.lund.se/Global/Förvaltningar/Tekniska%20förvaltningen/Gatu-och%20trafikkontoret/LundaMats/Rapporter/LundaMaTs_II_rapport_2013.pdf
- [7] MOST (2003). Mobility Management Strategies for the Next Decades: Final Report D9. European Commission: Contract No. 1999-RD. 11129.
- [8] EPOMM (2015). Mobility Management. Retrieved from <http://www.epomm.eu/index.php?id=2590>
- [9] EPOMM (2013). Mobility Management: The smart way to sustainable mobility in European countries, regions and cities. Retrieved from: http://www.epomm.eu/docs/file/epomm_book_2013_web.pdf
- [10] Lund Municipality (2014). LundaMats - hållbara resor och transporter. Retrieved from <http://www.lund.se/Medborgare/Trafik--infrastruktur/LundaMats---hallbara-transporter/>
- [11] Barford, A. (2015). Missed Connections: Mobility Management and the Swedish Public Transport Administration. IIIIEE Theses 2015:20, Lund University.
- [12] Vandikkele, J. (2008). Bike service for students 'Velo' (city of Leuven, Belgium). Retrieved from http://www.epomm.eu/old_website/study_sheet.phtml?sprache=en&study_id=1879
- [13] Giles-Corti et al. (2010). The co-benefits for health of investing in active transportation. New South Wales Public Health Bulletin, 21(5-6), 122-127.



[14] Currie et al. (2009). Investigating links between transport disadvantage, social exclusion and well-being in Melbourne – Preliminary results. *Transport Policy* 2009 16(3): 97–105.

[15] Zabrze Municipality (n.d.). Portal Mapy Akustycznej. Retrieved from: <http://www.pma.um.zabrze.pl/MapPortal/>

[16] de Nazelle et al. (2011). Improving health through policies that promote active travel: A review of evidence to support integrated health impact assessment. *Environment International*, 37(4), 766 - 777.

[17] Health and Environmental Alliance (2015). EU takes Poland to court over air quality. Retrieved from: <http://env-health.org/news/latest-news/article/eu-takes-poland-to-court-over-air>

[18] EEA (2014). Noise in Europe 2014. Retrieved from: <http://www.eea.europa.eu/publications/noise-in-europe-2014>

[19] European Commission (2015). The Environmental Noise Directive at a turning point. Retrieved from: http://www.euronoise2015.eu/workshop/workshop_437.pdf

[20] European Commission (2013). Environment: New policy package to clean up Europe's air. Retrieved from: http://europa.eu/rapid/press-release_IP-13-1274_en.htm

[21] City of Lund (2007). Urban Planning for Reduced Car Use – Short version. Retrieved from <http://www.lund.se/Global/Förvaltningar/Stadsbyggnadskontoret/PDF-filer/bilsnål%20samhällsplanering/Kortversion%20Handbok%20eng%20lägupplöst.pdf>

[22] Lund Municipality, Trivector AB (2007). LundaMaTs II – Strategy for a sustainable transport system for Lund 2030. Retrieved from http://www.lund.se/Global/Sidans%20katalog-pdf/lundamats2_lager_CN2_B_eng_orig.pdf?epslanguage=sv

[23] Lund Municipality (2009). LundaMaTs II: Background and Results. http://www.lund.se/Global/Förvaltningar/Tekniska%20förvaltningen/Gatu-och%20trafikkontoret/LundaMats/Rapporter/LundaMaTs%20II_rapport%202008_ENGELSKA.pdf

[24] City of Malmö (n.d.). Mer om MalmöExpressen. Retrieved from <http://malmo.se/Stadsplanering--trafik/Trafik--hallbart-resande/Nar-du-aker-kollektivt/MalmoExpressen/Mer-om-MalmoExpressen.html>

[25] City of Malmö (n.d.). MalmöExpressen – nytt busskoncept i Malmö. Retrieved from <http://malmo.se/Stadsplanering--trafik/Trafik--hallbart-resande/Nar-du-aker-kollektivt/MalmoExpressen.html>

[26] City of Malmö (2015, September 22). Luften bättre på Amiralsgatan tack vare Malmöexpressen – Pressmeddelande. Retrieved

from <http://www.mynewsdesk.com/se/malmo/pressreleases/luften-baettre-paa-amiralsgatan-tack-vare-malmoexpressen-1222150>

[27] ULO (2015, September). Dramatisk resandeökning på Sveriges ende BRT-linje. Bussmagasinet. Retrieved from <http://www.bussmagasinet.se/2015/09/dramatisk-resandeokning-pa-sveriges-enda-brt-linje/>

[28] Sørensen, M., Andersen Z. J., Nordsborg R. B. et al. (2012). Road Traffic Noise and Incident Myocardial Infraction: A Prospective Cohort Study. *PLoS ONE* 7(6).

[29] Sile A. W., (2016, March 8). Tesla Model S Owner Protests Singapore's Carbon Emissions Surcharge. CNBC. Retrieved on 27 April, 2016 from: <http://www.cnbc.com/2016/03/08/tesla-model-s-owner-protests-singapores-carbon-emissions-surcharge.html>

[30] The Tesla Team (2016, April 7). The Week that Electric Vehicles Went Mainstream. The Blog of Tesla Motors. Retrieved from: <https://www.teslamotors.com/blog/the-week-electric-vehicles-went-mainstream>

[31] Peter, S., Phadtare, I., Udomcharoenchaikit, P. (2015). Beyond Tunnel Vision: Revitalising Pedestrian Tunnels Through LEDs. LED's Light the Future: Showcasing Models of Innovative Lighting Solutions (Lund: IIIIEE), 12-19.

[32] Nextbike Polska (n.d.). O Opole Bike. Retrieved from <https://nextbike.pl/miasta/opole-bike/o-opole-bike/>

[33] Doll GreenLab (n.d.). Retrieved from: <http://www.lightinglab.dk/>

[34] Barlow, J., Roehrich, J., Wright, S. (2013). Europe Sees Mixed Results from Public-Private Partnerships for Building and Managing Health Care Facilities and Services. *Health Aff (Milwood)* 32 (1), 146-154.

[35] Mistic, M., Wuennenberg L. (2015). Business Models for Smart Street Lighting Systems: Log-In Opportunities and Lock-in Risks. LED's Light the Future: Showcasing Models of Innovative Lighting Solutions (Lund: IIIIEE), 3-11.

[36] IIIIEE (2016). About the IIIIEE: Advancing Sustainable Solutions. Retrieved from: <http://www.iiiiee.lu.se/about-the-iiiiee-0>

