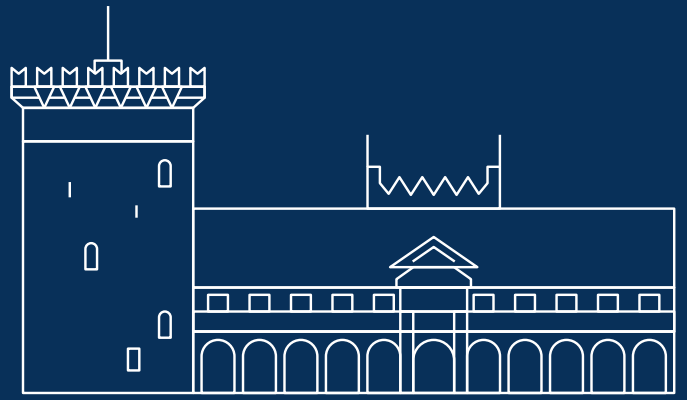
CIRCULAR CITIES PROGRAM
Poland: Lublin

A circular economy strategy for Lublin

MARCH, 2021

TABLE OF CONTENTS



01 Introduction

INTRODUCTION

Lublin is the largest and most dynamically developing city in the east of Poland (1). Bordering the European Union, it is the administrative, economic, and cultural center of the Lublin Province. The city promotes a high quality of life, a thriving academic scene, and a focus on developing democratic capital and participatory governance. Lublin's cityscape boasts both monumental architecture and natural landscapes. The city is divided by the river Bystrzyca, its Eastern banks holding valleys and gorges, and the western half atop a plateau.

Lublin is committed to creating a healthy and sustainable future as the municipal government developes its strategy for 2030. The strategy involves a strong focus on co-creation with Lublin's inhabitants - a unique opportunity to integrate the principles of the circular economy. This vision document and roadmap provide strategic goals and projects that can help land the circular economy in the city.

The Circular Cities Program Poland

The Circular Cities Program Poland is a collaboration between Metabolic Institute and Polish Circular Hotspot, generously funded by the MAVA Foundation. In the program, the cities of Krakow, Lublin, and Gdańsk develop circular strategies that bring long-lasting systemic impact and ensure a sustainable future. We collaboratively expand on their existing strategies while actively exchanging experiences and lessons learned across the Polish network.

How to read this report

This report results from a 1-year process in collaboration with the municipality of Lublin and other stakeholders from the private, public, and academic realm. The report is meant to 1) provide input into the 2030 strategic development of the City of Lublin and 2) to serve as a toolkit that catalyzes cross-sector collaboration and innovation for a wide range of stakeholders, including citizen organizations, the private sector, and academia. Thus, creating the conditions needed to land the circular economy in Lublin. The report is divided into two sections starting with an overview of insights and opportunities for the city, a vision, and strategic toolbox. The second section provides a thorough background analysis, diving into four key sectors in Lublin.

The circular economy

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

(1) Lublin City (N.d.). Lublin Special Economic Zone. Invest in Lublin.

INTRODUCTION

The European Union has adopted the circular economy as one of its core strategies and studies suggest that adopting circular economy principles in Europe could generate a net economic benefit of €535 billion by 2030 (2). Especially in sectors prone to inefficient material usage, a shift towards a circular and material-saving economy offers significant opportunities for businesses. As an example, the construction sector alone wastes around 15% of building materials and uses 50% more steel and concrete than necessary. Through circular initiatives in the built environment, around €195 billion and 12 million Mg of steel could be saved (3).

On March 11th 2020, the European Commission adopted a new Circular Economy Action Plan (CEAP) - one of the main building blocks of the EU's Green Deal. The Plan involves a sustainable product policy framework, a reduction of waste, and interventions across key product value chains (i.e. electronics and ICT, batteries and vehicles, packaging, (micro) plastics, textiles, construction and buildings, and food, water and nutrients) (4). It is now time to accelerate and scale up across Europe.

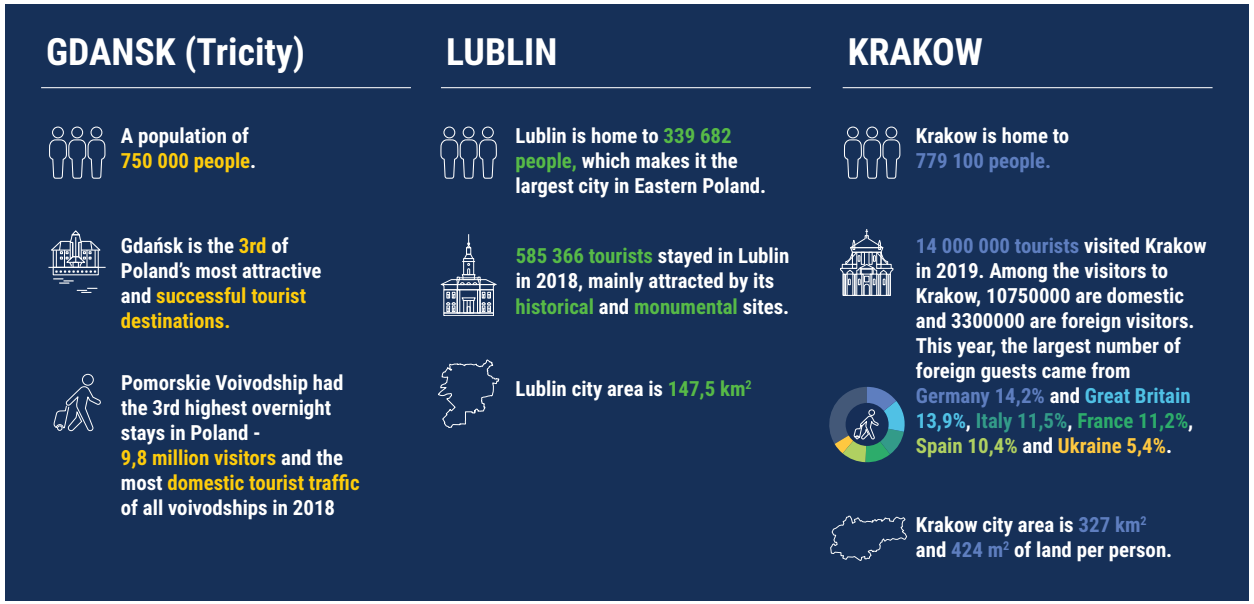


Figure 1: Comparative city snapshot of Gdansk, Lublin and Kraków, the three cities participating in the Circular Cities Program.

Cities can lead by example

Cities are our future. They are the drivers of the global economy, centres of creativity, diversity, and interaction -- and they are home to the majority of the global population. Growing cities and consumption patterns combined with an extractive and wasteful economy create a plurality of negative environmental impacts both inside and outside of our cities. The footprint of most cities is far greater than the physical space they occupy. Cities cover only 3% of the earth's surface, yet they consume 75% of all natural resources, making them effective places to address critical environmental and social challenges (5).

(2) Material Economics (2020). The Circular Economy and COVID-19 Recovery. Retrieved from: source

(3) McKinsey Centre for Business and Environment. (2015). Growth within: A circular economy vision for a competitive Europe. Retrieved from: source

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

(5) United Nations. (2017). UN Sustainable Development Goals. Retrieved from: source

LUBLIN DRIVING SYSTEMIC CHANGE

In 2017, Poland was the third most carbon intensive economy in Europe. The five main contributing sectors being power, industry, the built environment (mainly heating), agrifood and transport (6). These are predominantly fueled by coal which comes at a cost. Poland is home to 33 out of 50 cities with the highest air quality issues in the EU, according to the WHO (7). The two major sources of pollutants are motor vehicles and the burning of coal in domestic solid fuel furnaces. The cost of related health impacts with 2015 figures was estimated at 16.15 billion euros (6).

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

Figure 2: Methodology.

Co-creating the Lublin of the future

Lublin is currently guided by its 2013-2020 strategy (8), focused on four main development areas: openness, friendliness, entrepreneurship, and academics. Each of these themes provides a strong base for working towards circular development, locally and regionally. The municipality is currently developing the new Strategy of Lublin 2030 through a two-year participatory process, including Lublin's residents in the journey towards an inclusive, resilient, and healthy future for all. Sustainable development means regional integration by further strengthening regional ties and creating the Lublin Metropolitan Area. Indeed, a crucial external function of Lublin is to represent the interests of the region. This means facilitating access to culture and science, markets, and new technologies and creating a platform for economic and social exchange that provides unique opportunities.

(6) McKinsey. (2019). Carbon-Neutral Poland 2050: Turning a Challenge into an opportunity. Retrieved from: source
(7) Nabrdalik, M., Santora, M. (2018). Smothered by Smog, Polish cities rank amongst dirtiest in EU. Retrieved from: source
(8) Lublin City Council. (2013). Lublin Development Strategy 2013-2020.

LUBLIN DRIVING SYSTEMIC CHANGE

The city has set an ambitious direction. Yet, formulating actionable objectives, targeting the necessary resources to make evidence-based decisions, and crafting the right policy are prerequisites to implementation. The circular economy offers tangible strategies to achieve this, from developing new technologies to the evolution of new forms of collaboration and new business models. At the same time, it has excellent potential to provide new employment and skills development opportunities for the many different communities that call Lublin their home.

A Strategy Toolkit to drive systems transformation

Achieving a sustainable future requires systems transformation. Our integrated approach (figure 2) considers Lublin's unique characteristics, strengths and challenges, and surroundings to set a bold vision for the future collaboratively.

Achieving this vision in Lublin requires a coordinated set of actions over multiple years, supported by strong leadership from local government, the private sector, academic institutions, and civil society. It also involves integrating the role of the city in the region. In this report, we present a Strategy Toolkit holding strategic and operational objectives that can help achieve a circular economy and sustainable future, but also strategic projects and examples. These range from policy to economic and physical projects. The toolkit can serve as a strategic input to integrate circular economy principles into the development strategy for Lublin 2030. The proposed strategic projects leverage Lublin's existing participation processes and help shape cross-sectoral driving groups. They will also create public awareness and build capacity through piloting circular innovations. This Strategic Toolkit can lay the foundation for larger-scale innovation needed to achieve long-term sustainability.

Accelerating implementation

Partnerships with local organizations and on-the ground stakeholder engagement play a crucial role in developing a vision, strategies and selecting practical actions. To facilitate implementation we provide examples from cities all over the world. This can provide input for the strategy but will also provide a handle for the private sector, academia and citizen organizations to drive change. We also suggest where to implement certain solutions. Each neighborhood can play a different role in achieving citywide goals. Bringing citywide analysis to the more granular neighborhood-scale gives insight on where actions can be most effective and thus provide a potential starting point to achieve objectives.

02 Leveraging cities to drive systemic change

Cities are our future. They are the drivers of the global economy, centres of creativity, diversity, and interaction - and they are home to the majority of the global population. Cities cover only 3% of the earth's surface, yet they consume 75% of all natural resources, making them effective places to address critical environmental and social challenges (5).

---

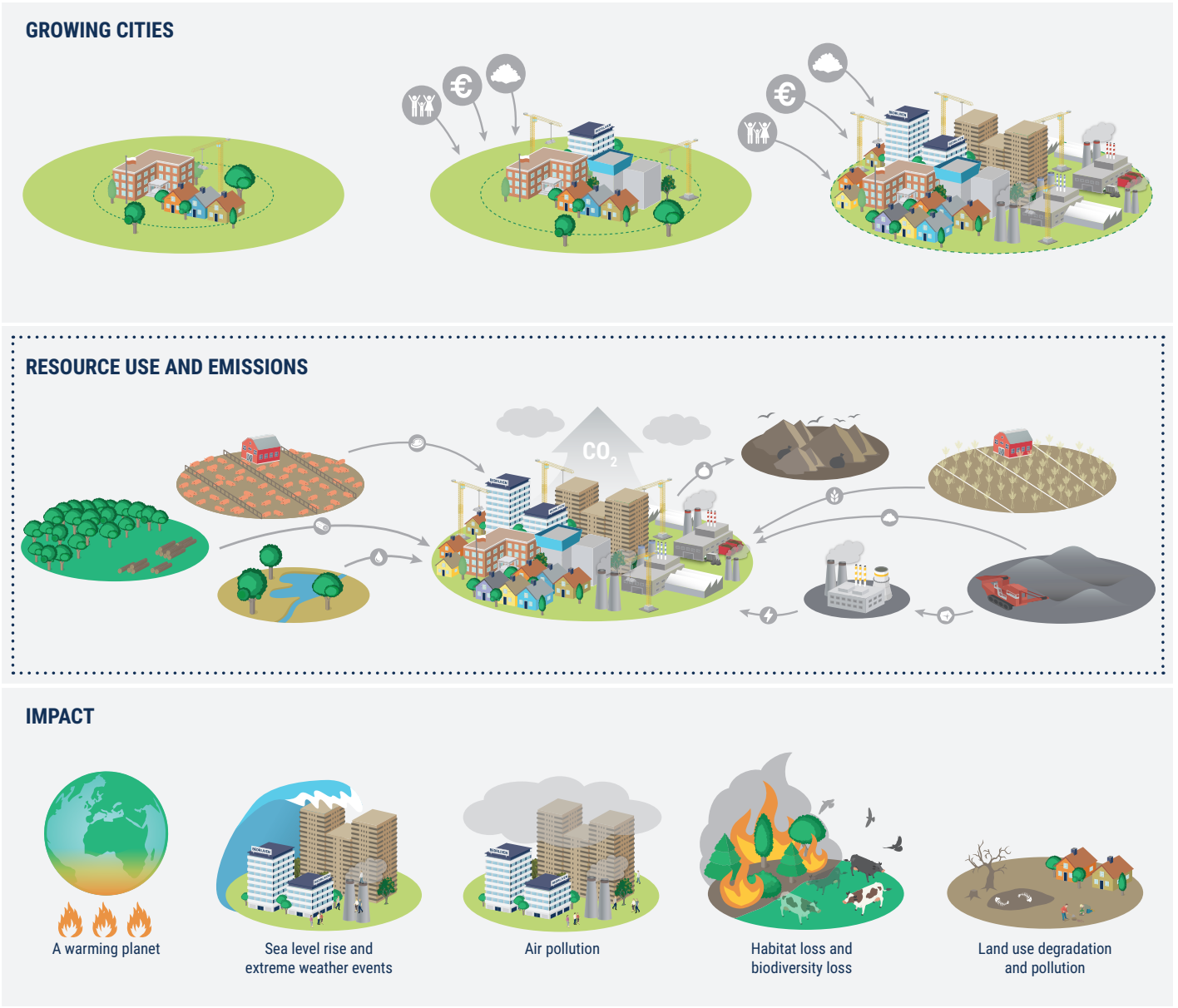
(5) United Nations. (2017). UN Sustainable Development Goals. Retrieved from: source.

Cities and their impact on planetary health

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

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

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



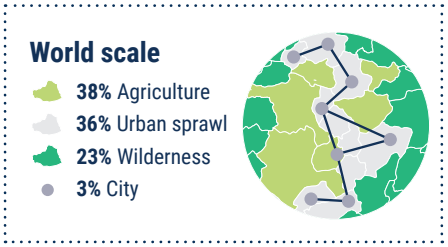
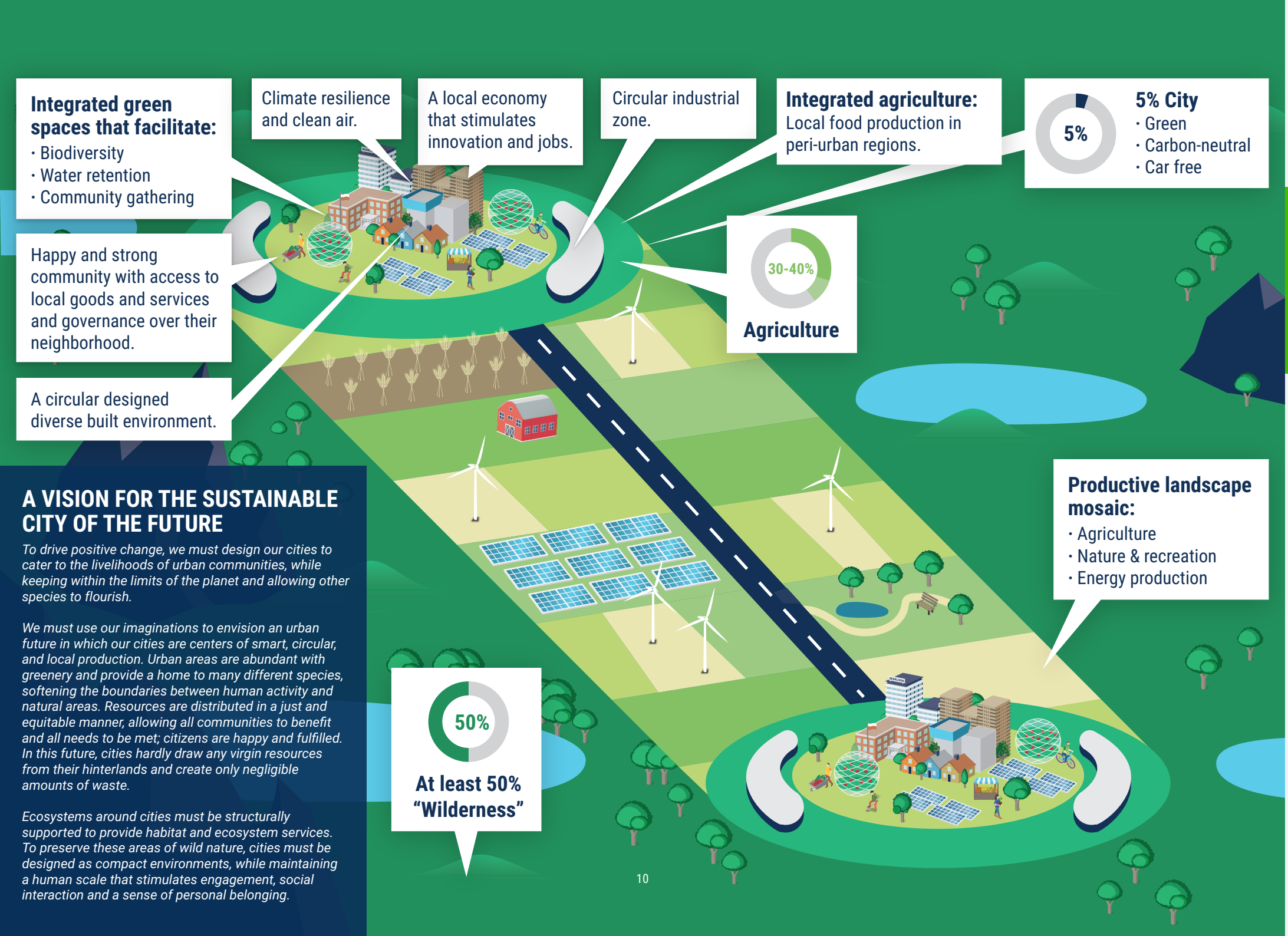


Figure 3: Cities as leverage points.



A VISION FOR THE SUSTAINABLE CITY OF THE FUTURE

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

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

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

HOW DO WE GET THERE?

To reach sustainability objectives, cities should be built on the foundation of resilient communities that have strong ties to their local environment, and provide a backbone of social goods and services to all citizens. The principles of the circular economy (figure 5) provide a clear framework to achieve this. Through integrating these principles into the development of the built environment, urban economies, and city governance, we can accelerate the transition.

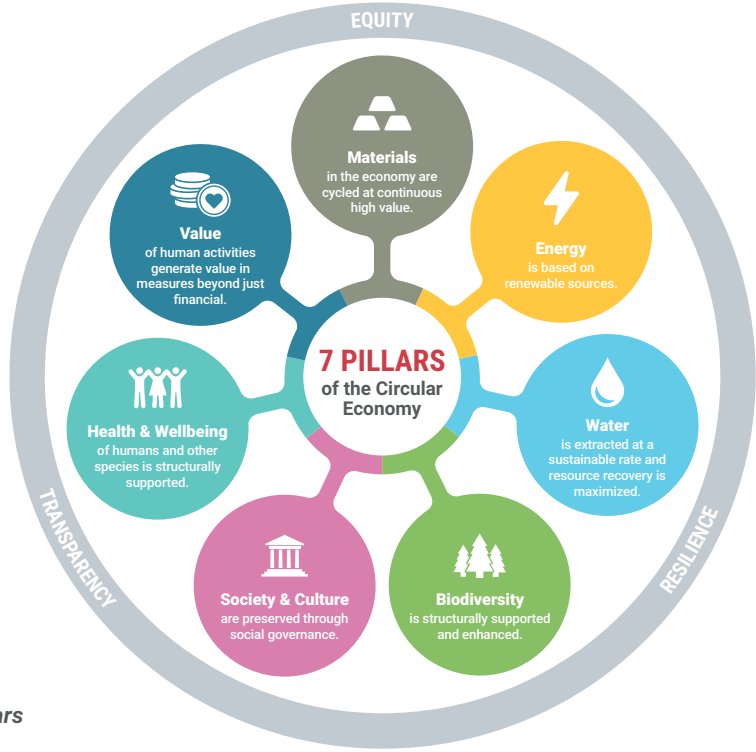


Figure 5: The Seven Pillars of the Circular Economy.

Approaching the circular economy holistically

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

To overcome the challenge of treating problems and their solutions (such as waste generation) in silos, the Seven Pillars of the Circular Economy (9) presents a framework that understands cities as complex and interconnected systems. This framework served as a guideline to co-create key indicators that the city of Krakow should monitor to evaluate their progress towards a circular economy. The key principles of the seven pillars are described above.

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

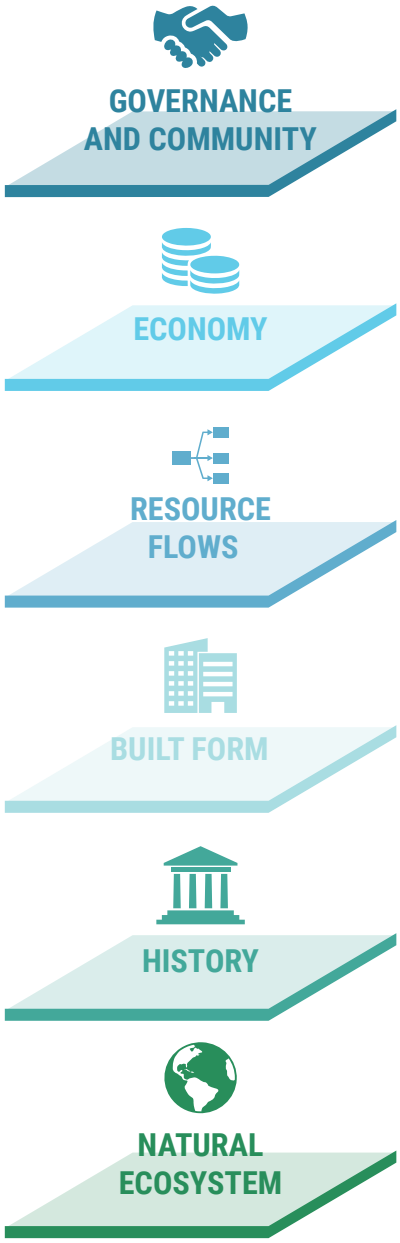
03 Current state analysis of Lublin - Key insights

As capital of the Lublin Province, Lublin is one of the larger cities of Lesser Poland, after Kraków, and is noted for its high standard of living and extensive green spaces. Although its population has shown a slight decrease over the last years, the city has a relatively highly educated workforce that attracts a knowledge economy. In addition, the city has developed into an attractive location for foreign investment.

LUBLIN - A CITY WITH MANY LAYERS

A strategy should be strongly related to the local culture. It requires a deep dive into the city's unique characteristics.

A thorough understanding of Lublin's urban systems, including its communities, existing initiatives and businesses, natural location and urban plan, and economic and material flow, will help identify key leverage points and transformative potential, gaining a thorough understanding of our starting point.



Lublin's municipality intends to catalyze the development of the entire region, giving sustainability a central place in their 2030 strategy.

More on page 69

A significant number of people in Lublin are highly educated (25%). The city, however, continues to yield a relatively low GDP and low levels of investment, despite its setup of a special economic zone that provides favourable investment conditions. In its 2030 strategy, the municipality aims to further harness the potential of its rich academic scene and educated population.

More on page 15

Lublin's agri-food sector and residential consumption produce a lot of waste yearly. Food production is responsible for 4650 Mg of waste, of which 35% is sent to landfills. Lublin's residents, tourists, and commuters produce around 13 000 Mg of food waste a year. There is value in retaining these valuable resources.

More on page 73

The city plans to revitalize central neighborhoods to maintain its younger population, and attract new residents and tourists to a vibrant city center. Developing new connections to the rest of the region and country can play a key role. Suburbanization threatens the surrounding wilderness.

More on page 21

The city has a beautiful historical center. Before the Second World War it was the Jewish cultural and religious heart of Poland, which significantly influenced the city's social fabric and its architecture. Two of the ten oldest universities are in Lublin. In the 1960s and 1970s, expanding research centers were the center of critical thinking and brought to life the spirit of resistance. Lublin is the largest academic center in eastern Poland.

More on page 66

Lublin's great strength is its natural assets with little pollution. A combination of forested land, rivers, and waterways provides Lublin with a landscaped setting that frames the inner city with nature reserves, parks, and reservoirs. Ensuring the protection of the natural environment is imperative for the future.

More on page 68

LAYING THE FOUNDATION OF LUBLIN'S FUTURE

Lublin is the largest academic, economic, and administrative center on the eastern side of the Vistula. Since its founding in the 14th century, the city has developed into a versatile economic center in a strategic location. A thriving natural environment, the relatively small amount of waste produced in the city, and the relatively good air quality are some of Lublin's most important assets. A recent analysis by PWC, awarded 98,2/100 quality of life points to Lublin (10). Lublin also joined the group of cities with the Smart City certificate in 2019, and it has a well- developed citizens participation budget, focusing on nature protection and greenery in the city.

Lublin is the largest academic center in Eastern Poland, recognized across the country for its scientific and academic research (11). A thriving scene with a variety of emerging fields, excellent academic staff, and multiple activities to support student wellbeing makes the city a reservoir of well-qualified human resources for local businesses. The city's academic roots are represented clearly in its economic sector's makeup, with 53,4% of employed persons working in the knowledge economy including finance, technical services, education, and administration (12).

The major industries in the city are the automotive and machine industry as well as **food processing, printing, metal manufacturing, production of building materials, and leather production (11).**

The Lublin Development Strategy for 2013-20 focused partly on **accelerating entrepreneurship** in the city. Lublin intends steer its economic development mainly in the directions of **biotechnology, pharmaceutics, and food processing**. The city's agricultural surroundings are an excellent resource base, mainly for plant production. Biotechnology, biochemical, genetic and microbiological knowledge combined with the city's academic potential can serve as input for local industrial development. Another essential economic element of the city's policy is to support cluster and network initiatives such as connecting universities with industry and social sphere.

The city is well connected. Several modern road and rail connections linking the city with other parts of Poland and the Lublin Airport, opened in 2012, provide quick access to the most important cities and transport hubs in Europe. Situated at one of the most well-connected locations of the city, Lublin has implemented a Special Economic Zone, one of the most attractive forms of investor support, which is meant to facilitate dynamic investments and to put Lublin back on the economic map of Poland and Europe.

Lublin experienced a steady rise in population until 1999. Since then, the population has been declining. Although the population is slightly declining, there is still plenty of construction happening as 2 889 dwellings were built in 2018: a 65% increase from 2010 construction levels (12). Through the construction of public services and renovation of historic buildings, Lublin has been improving its spatial image over the last years (8).

The city's existing **cultural and social potential** has yet to translate into economic activity. The GDP of the greater Lublin Province is low in comparison to the rest of EU, with GDP per employee only 54% of the European average. Although emerging, the city's success in attracting large investors is still relatively low. Currently, according to a PWC Report on Polish Metropoles, the Lublin agglomeration attracts nearly 80% fewer foreign investors than the average in other Polish metropolitan areas (10).

Lublin has implemented a **Special Economic Zone (SEZ)**, one of the most attractive forms of investor support (1). The investment in it involves the development of a comprehensively prepared area and obtaining significant tax benefits. An additional advantage is the excellent location of the plots near the express road and the Lublin airport. The development of infrastructure and the creation of favourable business conditions gave it position on the economic map of Poland and Europe. A large portion of the city's surface area is now occupied by spatial development plans - over 20% higher than the average of other metropolitan areas.

(10) PricewaterhouseCoopers (2019). Report on Polish Metropolises.
(11) Lublin City Council (N.d.). About the City. Lublin in Numbers.
(12) Polish Statistical Office. (2020). Lubelskie Voivodeship. Subregions, Powiats, Gminas 2019 source

BUILDING ON LUBLIN'S STRENGTHS

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

A foundation of knowledge - Lublin has a rich academic scene: Students make up 18% of the total population. Lublin can leverage and increase its strong academic base to further stimulate a culture of knowledge and innovation, by connecting universities and business. To keep advanced business services interested in Lublin's labor market, Lublin can strengthen the international competitiveness of the city's resources (e.g. science and didactic centers, available local data, research and laboratory infrastructure, strong public institutions) by putting the circular economy high on the agenda.

Emphasis on renewable transport - The city of Lublin is already investing in green transport, which can only benefit their good quality transport infrastructure. Currently, Lublin's transport is dominated by cars (577 cars/ 1000 people) compared to public transport (1 bus/ 1000 people) (13). Lublin's forecast for 2050 mentions planned railway repairs, and improvement of ring roads and a new road to Warsaw, many of which have already been executed by 2020. Improving public transport access and integrating circular development criteria will further stimulate the transition towards a clean mobility system. This will also prove beneficial to Lublin's air quality, where one of the main factors of pollution is traffic congestion.

Resource recovery - Compared to other EU countries, Lublin generates a small amount of municipal waste (only 357 kg a year compared to 487 kg EU resident average).

Active municipal government - The Municipal Revitalization Program 2017-2023 aims to revitalize the degraded inner urban areas within Lublin. There are extensive spatial development plans (covering over 20% of the city), including neighborhoods Stare Miasto, Śródmieście, and Podzamcze i Czwartek. Lublin also assigned a Special Economic Zone. The goal of this zone, well-situated in south-eastern Lublin, is to attract external investment by promoting favourable business conditions for the city.

Strong focus on food production - Lublin and the surrounding regions have extensive farmlands that produce around 23 000 Mg of food annually, as well as a strong focus on food processing in industry. Lublin's agricultural sector can provide a strong resource base that can connect with academia (biotechnology, biochemistry, engineering) for resource-efficient innovation. Waste products from these agricultural activities could produce enough compost to replace all fertilizer needed in the Lublin region.

Strong citizen participation - Lublin has a relatively strongly developed citizen's participation budget, especially around the management of green space in the city. In 2021, 12 150 000 pln (2 740 000 euros) are available for the city's participation budget.

Gateway to the East - Close to Belarus and Ukraine, Lublin is a potential centre for collaboration with Eastern Europe. In addition, Lublin Airport connects the city at a national and international level. Lublin has a high in- and outflux of foreign workforce, which provides opportunities for strategic cooperation and job creation.

Attractive natural landscapes and ecosystems - The city has good water quality, and 75% of Lublin's aquatic ecosystems are in good condition. It also has a good amount of green space: around 11,1% of the area of the city is covered in forest, totaling up to 1700 hectares of forested land within city boundaries. However, this green space is disproportionately relegated to the outer edge of the city.

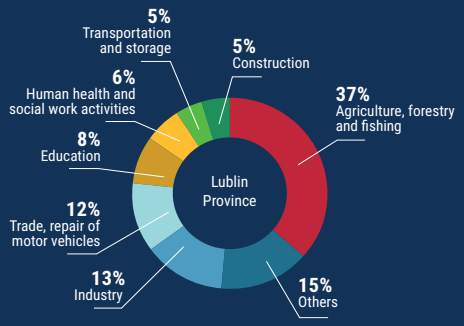
The Special Economic Zone - Lublin is home to a Special Economic Zone (SEZ) that is currently almost completely developed. A total of 68 investors have started their development plans in the area. A total of 55 companies have completed their planned projects, employing a total of 4 301 people. The value of the projects completed so far exceeds PLN 1 820 million. This large business conglomerate can serve as a catalyst for the circular economy.

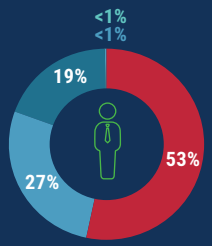
(13) Lublin city (2020). Getting Around the City. Retrieved from: source

BUILDING ON LUBLIN'S STRENGTHS

ECONOMY

EMPLOYMENT





Employed: 126 000 people (37,1% of population), of which:

- Finance/Real Estate, Professional/Science/ Technical Activities, Public Admin, Social Services.
- Retail, Repair, Transport, Accommodation, and Information/Communication.
- Mining, Utilities, Waste Management, and Construction.
- Activities, Public Admin, Social Services
- Agriculture, forestry and fishing.

1,8 billion **2010**

2,6 billion **2018**

Sold production value - Industrial activities* in the Province have increased 49% from 2010-2018.

**Value of products sold, paid work & services rendered in Mining, Manufacturing, & Utility supply.*

EDUCATION

9
Universities

60 988
Students

25%
of residents have higher university education

53,4%
of Lublin's inhabitants is employed in finance/ professional, science & technical services

INCOME

€ 916
Average monthly wage per month in Lublin Province

€ 1 058
Average monthly wage per month in Lublin City Powiat

€ 1 086
National Polish average wage per month

GDP per employee was 54% of the EU average (3)

Lublin Province GDP made up 4% of the Polish National GDP in 2017. The GDP per capita is the lowest in Poland among Provinces.

FOOD PRODUCTION

Lublin has an annual food production of approx.
23 Kton

WASTE

The inhabitants of Lublin generate, on average, **27%** less waste than other EU citizens.

Figure 6: The employment, education, labor and income in Lublin.

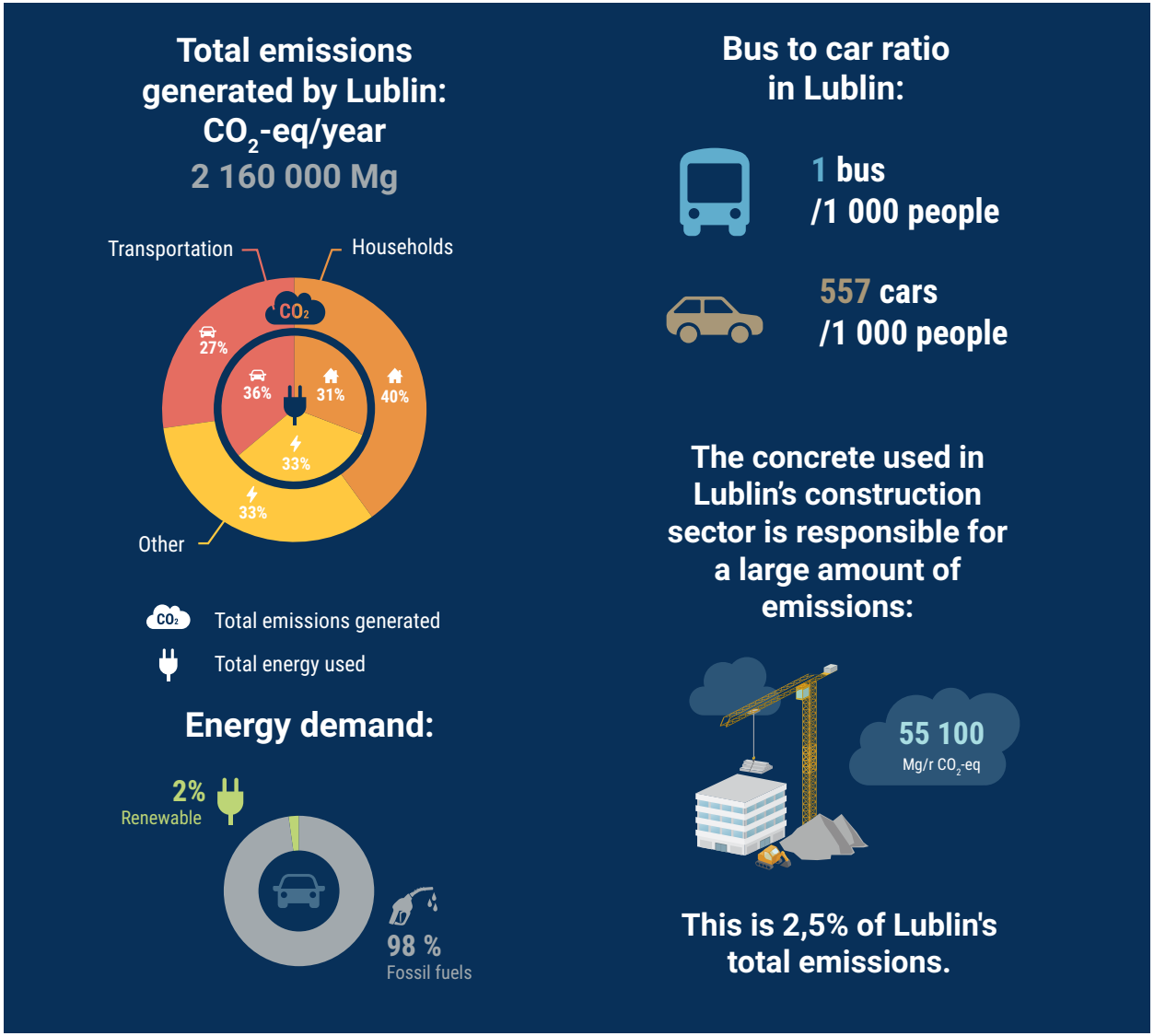
OVERCOMING CHALLENGES

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

Maintaining an innovative workforce
Lublin is experiencing a decreasing and aging population, and the average Lublin salary is only 54% of the EU average. The city has relatively low investments from outside. Students express that limited career opportunities are a reason for them to move (14). The circular economy is expected to create 700 000 jobs until 2030 (15), and can also drive innovation and improve local career opportunities in Lublin. Connections between educational institutions and local businesses can foster job creation.

Emissions and air quality
Lublin's energy production is still heavily reliant on coal. Only 2% of Lublin's energy demand is supplied by renewables.The city is responsible for a total of 2 160 000 Mg of CO_2 -eq emissions. A significant portion (2,5%) of these emissions come from concrete use. In order to compensate for the emissions resulting from the annual consumption of concrete in Lublin, the city would have to plant approximately 2,3 million trees.

Urbanization
Lublin has little green space protection measures in place, which means that its natural and agricultural areas are potentially threatened by urban sprawl.



(14) Municipality of Lublin. (2018). Foresight Lublin 2050.
(15) Cambridge econometric, Trinomics, ICF. (2018). Retrieved from: source.

OVERCOMING CHALLENGES

Consumer behaviour
To move towards a circular economy, residents need to be familiarized with more circular behaviour (e.g. sorting waste or repairing products). In addition, they can have a large influence on decreasing the impact of consumer goods by buying according to the “food miles” rule. This requires a change in both infrastructure, information and mentality.

A shift to sustainable transportation
Residents of Lublin make extensive use of personal transportation. Lublin counts over 196 000 passenger cars, or 577 cars per 1 000 people. This causes daily congestion, air pollution and extensive CO_2-emissions. Continuing the exploration of clean forms of urban mobility, such as public transport and bikes, can improve both the living environment and climate impact of the city.

Waste infrastructure
The infrastructure to repair and reuse materials on the neighborhood scale is not yet accessible to all residents. Stakeholders voice that infrastructure for repair and composting are missing. PSZOKs have potential, but these are currently still limited by regulations. Increased reporting on and monitoring of the origin of waste, e.g. from construction sites, could help identify high value flows which can be valorized.

Reporting
Although national law demands municipal waste to be separated into separate streams, there is limited information available on the end of life for both municipal and industrial waste. Improved monitoring of waste handling at treatment facilities can give detailed insights into process and progress towards achieving the target of 50% recycling rate by 2030.

OPPORTUNITIES FOR THE CIRCULAR ECONOMY

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

Reducing resource use
The majority of food waste comes from households. The total amount of food waste generated by Lublin's inhabitants could feed around 15 000 people, equal to 1 in 25 inhabitants of Lublin. Households also consume a significant share of the energy of the city. This occurs mainly in the densely populated west of the city and in the northeast (Kalinowszczyzna). Renovation for energy efficiency can play a large role in decreasing energy demand.

Recovering resources at high value
Close to 40% of the city's industrial waste is landfilled or incinerated a the cement plant in Chelm, two of the lowest forms of value creation from waste. Although waste volumes are lower than in other Polish cities, there is still a lot of value to be regained here. The large flows of homogenous industrial waste provide opportunities for circular economic activity. Increasing separation rates and creating larger streams of reusable mono-streams can improve value creation from Lublin's waste streams.

Value in construction waste
In 2018, 98% of this waste was reported to have been 'recycled or prepared for re-use and recovery'. However, this does not guarantee that this waste is treated at the highest value possible, so there is potential value loss here. Decreasing virgin resource use in construction and increasing the use of biobased and secondary material from local demolition can help decrease impact. As part of the Municipal Revitalization Program 2017-2023 (16), Lublin is revitalizing six areas of the city, and has many construction projects towards the outer edge of the city. Yearly, 455 000 Mg of construction materials are used for new developments and renovation, and 45 000 Mg of demolition waste is produced- that could potentially provide around 10% of materials for new construction in the city.

The PSZOK point in Lublin collects construction and demolition waste. Yearly, this amounts to:

593 500
Mg of concrete waste and concrete debris

360 700
Mg of mixed construction and demolition waste

In 2018, 98% of this waste was reported to have been 'recycled or prepared for re-use and recovery'. However, this does not guarantee that this waste is treated at the highest value possible, so there is potential value loss here.

Yearly, Lublin's inhabitants, tourists and commuters generate 13 458 Mg of food waste.

This is equal to:

35,4 mln
PIZZAS

OPPORTUNITIES FOR THE CIRCULAR ECONOMY

Value in organic waste
Organic waste can be reused at a high value relatively easily on a local scale relatively easily. It is worth experimenting with new collection methods by clustering restaurants and their food waste in the city center. For example, if all organic waste in the city was composted, this could replace all fertilizer needed in the Lublin region. Organic waste streams from food processing industry could potentially serve as material input for innovative local entrepreneurship. Organic waste from local businesses that can no longer be used as food can potentially be composted locally, or used a source of heat and biogas.

Value in wastewater
Lublin's water system holds large potential to contribute to a circular system. Each year around 78 million m³ of rainwater falls on Lublin, which could be caught and used for irrigation, industrial cooling or household functions (e.g. water for laundry or toilets). In addition, Lublin's discharge water contains large amounts of nutrients that can recovered to replace synthetic fertilizers on Lublin's agricultural lands.

Renewable energy
Lublin's energy consumption of 5 500 GWh/year remains mostly reliant on fossil fuels, with coal and natural gas providing the largest share (only 2% comes from renewables, including biobased sources). However, Poland's goal is to have 21% renewable energy share by 2030. There is a big transition needed to reach this goal. A large part of Lublin's solar energy potential goes unleveraged. In the future, the city can potentially invest in, stimulate and use energy from regional wind turbines, tapping into the extensive energy potential of wind to power the city. A diversified source of renewable energy is needed to provide a sufficiently large, constant flow of clean energy to the city.

Using existing infrastructure
Households receive 78% of their energy in the form of heat through a district heating system powered mainly by natural gas and coal. Sustainable alternative heat sources fed into the grid could include industrial residual heat or heat from surface water. PSZOK points and purchasing points can play a major role in providing space to store and treat these secondary building materials, reducing use of virgin materials and transportation.

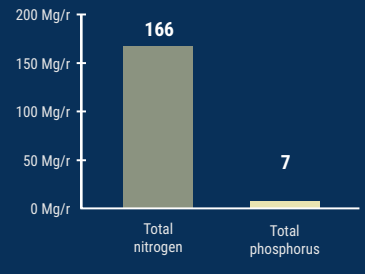
All agricultural waste would produce enough compost to replace all fertilizer needed in the Lublin region.

5 900 Mg = 890 Mg

AGRICULTURAL WASTE — COMPOST

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

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



A CITY MADE OF NEIGHBORHOODS

Establishing a sustainable future in Lublin will require transformation of in the built environment. It will require the city to increase its level of self-sufficiency, design and retrofit buildings for energy efficiency and material recovery, implement the infrastructure needed for repair and re-use as well as facilitating new types of mobility. We will have to design our cities to integrate and support native biodiversity, and create a healthy and vibrant environment for diverse socio-economic activities serving communities and the city as a whole. Naturally, not all parts of a city are suited to all kinds of functions.

Each neighborhood can play an essential role in achieving a sustainable future based on their unique characteristics. Outer city neighborhoods can be designed to produce excess renewable energy serving the entire city as production centers building on their post-industrial nature, proximity to natural resources and existing infrastructure. Neighborhoods in the dense city-center might consume more due to their higher densities and older building stock, but their inner-city location might continue to provide many of the cultural and commercial functions that are essential to any city.

Adding a spatial component to the material flow analysis allows us to go to a more granular level (See map p. 23). Some neighbourhoods might be more suitable to host central city infrastructure and industrial symbioses, whereas other neighborhoods might be more appropriate for local community centers and school programs.

A city of neighborhoods

Lublin's most densely populated neighbourhoods sit to the south-west (śródmieście) and north-east (Bazylianówka) of the city centre, with the student population concentrated around a cluster of the largest universities, east of the city centre in Rury and Wieniawa. The inner city is characterised by higher rates of unemployment, use of social services, and socio-economic disadvantage in comparison to the suburbs, and is the target of the Municipal Revitalization program. This program seeks to renovate older buildings, stimulate economic development and attract businesses to the inner city in an effort to reverse suburbanisation trends within Lublin.

NEIGHBOURHOOD TYPOLOGIES

Residential hub (Dziesiąta & Slawinek)

Residential neighborhoods are housing districts outside of the city-center with small to moderate green space and population density. These neighborhoods are populated enough to create a sense of community but spacious enough to provide a pleasant environment for Lublin's communities to flourish. Accentuating existing strong networks and initiatives as well as directing financial incentives towards developing local and community-enhancing initiatives such as community gardens, repair centers, and school programs in these neighborhoods can facilitate the transition to a circular economy. Further building out participatory budgeting can help the community have agency over the pursuit of these goals.

Consumption center (Stare Miasto & Srodmiescie)

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

Productive centers (Wrotków & Tatary)

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

Agricultural zones (Głusk & Węglin-południe)

Agricultural zones are peripheral neighborhoods with extensive farming activity and relatively low population densities. It includes neighborhoods such as Głusk, Ponikwoda and Węglin-południe, that have a combination of dense residential areas, surrounded by extensive agricultural production. Lublin is a city with a particularly large agricultural sector - 19.1% of the city's land use is agricultural. These neighborhoods can be crucial resource producers. Lublin can leverage these areas to its advantage and become partly self-sufficient in food supply and create closed nutrient loops through composting.

Green oasis (Abramowice & Zemborzyce)

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

Concrete jungle (Bronowice & Za Cukrownią)

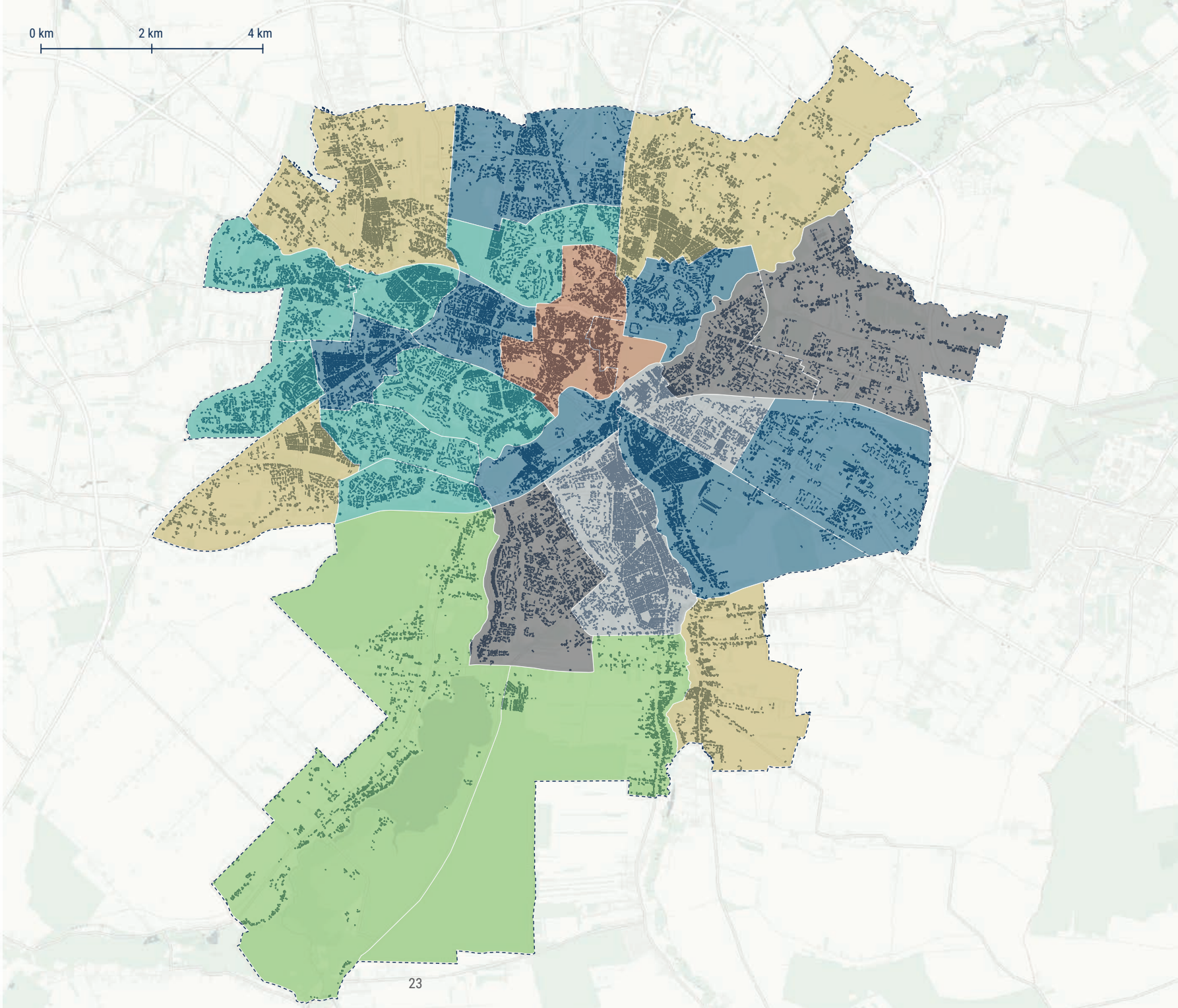
Concrete jungles are peri-center residential and commercial neighborhoods with a high population density and low green space. Considering the intense adverse health effects caused by traffic congestion and little access to nature, creating accessible natural pocket spaces should be top priority in these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

TYPOLOGIES IN LUBLIN

Typologies

- Agricultural zone
- Consumption center
- Green oasis
- Residential hub
- Conrete jungle
- Productive center
- Mixed use

--- City boundary



04 Towards a sustainable future in Lublin

If we take high-level ideas about what a sustainable city should look like and apply circular economy principles to Lublin, what would the city actually look like? Here we imagine some of the changes that might have taken place to achieve a fully circular local economy and sustainable future for Lublin in 2050. We have organized the vision around four thematic areas keeping in mind that the city is made of different neighborhoods that can contribute to this vision through their unique characteristics. The vision builds on the strategic direction formulated in Lublin's Development Strategy 2013-2020, the insights from the Lublin 2050 forecast, as well as on input from stakeholders and the municipality.

A VISION FOR THE FUTURE OF LUBLIN

A city where resources cycle at their highest value

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

- Lublin reduces the amount of waste sent to landfill and incineration through stringent reuse and recycling regulations.
- A smart data collection system of waste allows Lublin to monitor and share information with the public and entrepreneurs.
- The city's energy demands are met with renewable energy and districts are heated with waste heat from industry and data centers.
- Excess waste flows are used by local residents and entrepreneurs for new innovatiion, clean materials and products.

The smart, fossil-free, connected gateway to the east

Locally produced energy fuels a clean and modern mobility system that connects the city to the rest of the world.

- Modernization and retrofitting of buildings to ensure maximum energy efficiency.
- Introduction of emission-free mobility and transport systems.
- Creation of clean sources of heating energy in the city.
- Establishment of pilot energy efficiency projects in neighborhoods as part of regeneration programs, starting with the Old Town and Śródmieście.
- Establishing intelligent logistics systems throughout Lublin, optimizing mobility flows, and allowing goods to be transported through the city almost imperceptibly.

A city of resilient communities and sustainable urban development

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

- Lublin has a strong sense of obligation to protect city forests, rivers and lakes.
- Buildings in Lublin are made of sustainable materials.
- The voice of the citizens is the deciding factor in allocating and caring for green space in each neighborhood.
- Lublin provides a safe and friendly environment for all residents and visitors, including the academic community, eastern neighbors, and diverse groups of residents and tourists, while ensuring broad cooperation and civic participation.

A city with a culture of academia and innovation

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

- Lublin is a recognized academic center, known for its innovations stimulating the development of a healthy and happy environment.
- Extensive organic flows have allowed the city to become a leading academic center in the development of new sustainable biotechnology, pharmacy and food processing.
- Several living labs provide space for experimentation, collaborative learning, and collaboration among scientists and entrepreneurs.
- Lublin educates its residents on the topics of circularity and sustainable development.

CREATING THE ENABLING CONDITIONS TO ACHIEVE SYSTEMIC CHANGE IN LUBLIN

Lublin is in the process of creating a development strategy for 2030 as well as developing a regional strategy for the Lublin Province. Through our research, we have come across some systemic barriers to implementing the circular economy in Lublin. To gear towards a sustainable future, we can identify a couple of systemic actions that will help create the enabling context for the circular economy to be successful in Lublin. In addition to these points, the roadmap provides further inspiration on stimulating overarching systemic change.

Social & Cultural

Stakeholders indicate that there are barriers in getting the public involved as well as in creating a collaborative approach both within the municipal government and between different stakeholders.

- Communication of the vision and objectives - Publicly communicating about the circular economy can be a strong tool to create awareness of the circular economy. It can also play a crucial role in creating a coalition around key strategic directions.
- Building capacity - A common understanding of the circular economy will help align strategic goals across departments. A circular economy officer can help facilitate this within the municipal government.
- The circular economy is a joint venture - collaboration across sectors and with existing initiatives will fast track the transition. This does require good insights into existing NGOs and local initiatives and an active role from the local government to create cross-sectoral driving groups. These could be organized around high-potential sectors.

Political and Legal

Stakeholders indicate that there are many policies and regulations in place that make it difficult to implement circular innovation. Furthermore, many waste streams are currently underreported.

- Existing regulations - Changing policy can be challenging and time-sensitive since it is often informed by national or EU legislation. Creating temporary experimental zones can help provide the space needed for innovation.
- Getting better insights into waste streams - To underpin the other actions presented in this roadmap, it is essential to develop a data collection and monitoring program that details how the city is progressing on improved resource management and inclusive economic development.
- Adopting circular objectives and a monitoring framework- Adopting objectives and selecting KPIs to allow for a baseline assessment and monitoring framework to measure progress towards achieving the vision.
- Create cross-departmental collaboration - Achieving the vision involves the waste department, but also energy and construction, amongst others. It also requires integrating the actions and goals with already-existing agendas.

CREATING THE ENABLING CONDITIONS TO ACHIEVE SYSTEMIC CHANGE IN LUBLIN

A vision

To move towards a more sustainable, resilient, healthy and happy city, we must dare to envision a bold future. Therefore, this report presents four vision lines that provide an image of what Lublin could look like as a sustainable city in the future. The municipality has already started a bold project in this respect, the Lublin Forecast 2050. The document outlines different trends and uses these to envision different possible futures for the municipality.

Although we have based the vision on insights from interviews with different stakeholders, the vision lines presented in this report are less grounded in current trends, but focus more on what Lublin **could look like**. We sketch a common future based on our highest hopes for a happy and sustainable city and use that to get aligned on the future we must collaboratively create.

The vision lines are rooted in ***stubborn optimism***, a term regularly used by Christiana Figueres, former Executive Secretary of the United Nations framework Convention on Climate Change. The concept of stubborn optimism is rooted in the notion that to reach our goals; we must be optimistic about the outcome of our work and **bring optimism as an input to any challenge**. These vision lines bring this stubborn optimism to life, by challenging how we see Lublin now and in the future and sketching a hopeful future.

Economic and Financial

Access to EU funding and investment is seen as a prerequisite to implementing innovation.

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

Physical and Technological

Landing innovation in space is seen as challenging due to limited area available for innovative projects. Several factors stimulate a built environment that sparks innovation:

- An active municipality - The local government can take an active stance through providing tenders that can showcase new building technologies, subsidies for green roofs, and hosting participation meetings for selected driving groups. A procurement strategy can also drive innovation.
- A neighborhood approach- Making neighborhood development plans can help identify a suitable location for implementation and community organizations. It can also tap into existing participatory governance programs.
- Physical infrastructure: Utilizing existing infrastructure can help fast track certain innovation. The EIB program to utilize district heating for new sources of heating is an example.

CREATING THE ENABLING CONDITIONS TO ACHIEVE SYSTEMIC CHANGE IN LUBLIN

A strategic toolkit: 25 circular projects

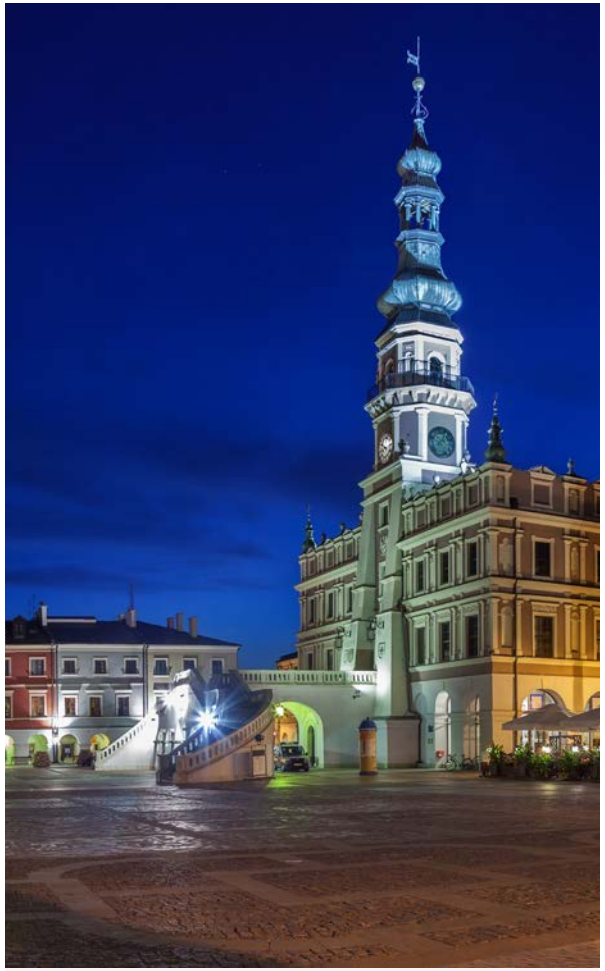
This section presents a selection of high value strategies, selected based on research, stakeholder engagement and identified leverage points combined with concrete projects and examples. **These projects are not all-encompassing, as they are meant as a starting point to achieving the vision and creating systemic change. A concrete set of projects can help drive the collaboration needed to shape a circular culture in Lublin that can catalyze innovation and ultimately transform the local economy into a circular state.** They will also drive implementation. Of course, the presented strategic directions are initial recommendations that will need further revision and vetting. As such, this strategy should not be seen as a static document but as a starting point for a more defined roadmap, or potentially as inspiration for the creation of the Lublin Strategy 2030. Ultimately there are longer term objectives including diverting away from coal, landfill and incineration. To achieve these goals will also require bold legislation and policy as well as addressing larger infrastructures.

A roadmap

The accompanying roadmap makes these actions practical and suggests how to place them in time. As these will begin to be uncovered and specific circular business cases for the city are defined, detailed action plans will need to be drafted each year. Building circular driving groups here is crucial.

Monitoring progress

The vision imagined illustrates how Lublin could develop as it progresses towards a sustainable future. Setting concrete objectives helps make the transitions tangible and measurable. We propose a set of objectives for each vision line and the Key Performance Criteria to monitor them. We use the Framework for the Seven Pillars (p. 11) to illustrate a holistic approach.



05 25 strategic projects to kickstart a circular economy in Lublin

So far, we have done an analysis of Lublin's current state. In this chapter we propose bold actions and measurable objectives to stimulate circular development in the city. Achieving this vision in Lublin requires a coordinated set of actions over multiple years, supported by strong leadership from local government and an increasingly strong collaboration with the private sector, academia and civil society. This toolkit provides strategic direction and programs organized by the vision statements. A table with objectives and Key Performance Indicators gives insight into how to monitor progress. The strategic projects were selected based on stakeholder workshops, surveys and interviews.

Of course, these strategic directions and programs are initial recommendations that will need further revision and vetting. As such, this strategy should not be seen as a static document. Ultimately there are longer-term objectives, including diverting away from fossil fuel, landfill, and incineration. To achieve these goals will also require bold legislation and policy as well as addressing larger infrastructures. Lublin's development strategy for 2030 can address these. These can be formulated in Lublin's development strategy for 2030.

25 STRATEGIC PROJECTS TO KICKSTART THE CIRCULAR ECONOMY IN LUBLIN

A city where resources cycle at their highest value

- P1 Pilot zero waste schools and public institutions
- P2 Develop procurement criteria for municipal government purchasing
- P3 City-wide reuse system for to-go waste
- P4 Pilot neighbourhood repair and reuse hub
- P5 Cross-sectoral accelerator program for circular product development from organic waste streams
- P6 Implement a 'pay as you throw' structure in industry and enterprises

The smart, fossil-free, connected gateway to the east

- P7 Energy efficiency standards in tendering guidelines for all new construction
- P8 Create a covenant with local businesses on the production and use of local renewable energy
- P9 Create Lublin Smart City Dashboard (energy, resources, water, transport)
- P10 Pilot neighbourhood repair and reuse hub
- P11 Establish car-free zones across the city

A city of resilient communities and sustainable urban development

- P12 Pilot bio-based construction of public buildings
- P13 Material passports for new development
- P14 Require all new buildings to be built according to circular standards
- P15 Build out integrated green network along Bystrzyca river
- P16 Include requirements for (public) green space in development guidelines
- P17 Further build out Citizen Participation Budget around greening the city

A city with a culture of academia and innovation

- P18 Building an inter-university MOOC platform for circular innovation
- P19 Improve primary and secondary school curriculum on sustainability and circular economy
- P20 Circular economy training for city officials
- P21 Lublin Universities establish 'green building lab'
- P22 Lublin Circular Food Hub
- P23 Create a "Circular Special Economic Zones" steering group of city officials, area management, and current businesses in the zone
- P24 Set circular criteria for new businesses in the SEZ
- P25 Establish R&D program between university, agrifood sector & food processing industries

ENVISIONING A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE

Today Lublin is proud to call itself a virtually zero waste city that creates wealth and well-being for all while contributing to a healthy functioning environment. Resource loops are closed on different scales and this is visible while walking through the city. Lublin residents bring their electronics to **repair shops**, a variety of collection vehicles collect **high quality material streams**, local composting is used for Lublin's green spaces, and the use of **low-impact, sustainable materials** such as timber and reused construction materials is reflected in the built environment.

At the start of the 2020's, Lublin already had a relatively low material footprint, with an average waste production per resident well-below the EU-average. Recycling rates were already relatively high, yet the 20's brought **increasingly strict recycling policies.** In the 20s, Lublin was only at the start of developing into the circular city it is now. Since then, enormous potential has been unlocked by ensuring that local resources are recycled at high quality. Every district has the necessary infrastructure needed to repair, refurbish or exchange goods before anything is disposed of. PSZOKs have been turned into repair centers and stores for secondary construction materials.

The shift to a circular economy, and the use of locally available materials such as high quality organic waste flows, created a new, thriving economy for Lublin, where the long-aspired **attractive business environment** for national and international investors finally manifested. A combination of investing in its strong knowledge sector and improving the efficiency of recycling, allowed Lublin to **decouple inhabitants' well-being from material consumption**. This resulted in a surge in quality of life, while decreasing the use of primary materials.

In the early 2020's most municipal waste was still incinerated to provide energy at the cement plant in Chelm. A first step towards a new system was to increase sorting rates and get both businesses and households to participate. Strict recycling policies and a city-initiated campaign focused on the potential of the circular economy achieved great results. Residents took the time to sort waste streams, which allowed waste processors to recycle at high value. However, the local workshops that were created in various neighborhoods allowed residents to repair and refurbish their products, reducing the materials that ended up in the waste management system.

To kick-start the high value use of the extensive industrial organic waste flows in Lublin, **a small-scale innovation** project was created between Lublin municipality, the biotechnology students at Lublin's universities, and several local entrepreneurs. In this innovation project, high quality bio-materials were created out of the potato factory's waste flows, that amounted to 2 620 Mg annually at the time. The success of this **innovative bio-refinery project** resulted in a strong network of collaboration between the local universities, entrepreneurs and the municipality around the circular economy. Nowadays, this network still sprouts countless initiatives in the city using materials that were once seen as waste, but that are now exchanged smartly between entrepreneurs **via a convenient IT tool that tracks resource flows through the city**. A large success included a field lab course about the circular economy in Lublin's high schools, where students were taught about the opportunities for creating value out of local resources. These students directly learned from all the circular initiatives that the city has on offer.

Lublin has taken **an active role in the region** and has led by example through knowledge exchange with the Province, which has emerged as a tight knit circular region. By the 2040's, the innovations of Lublin's strong academic center were starting to manifest in the surrounding region, turning the whole area into a resilient, **local economy,** with global attention for its innovative character and thriving food economy.

To further stimulate the transition to a circular economy, Lublin built one of the most **extensive waste monitoring** systems in the country throughout the early 2030's. Building upon its growing specialization in IT, information on the composition, quantity and flows of waste streams in the city was collected. By **making data publicly available** to all local entrepreneurs, as well as the academic centers, Lublin quickly started to distinguish itself nationally and soon internationally as a city of sustainable innovation and bio-technologies. By 2040, the city's materials for the built environment were almost all **sourced locally and sustainably**. The city made extensive use of mineral recycling, innovative biomaterials, and local resources such as local sustainable wood, and bio-concrete from the Chelm concrete plant.

A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE

The vision

Lublin strives to achieve a circular and zero waste urban metabolism. By 2050, the city aims to reduce their municipal waste generation by 90%. Of the remaining waste, less than 5% should be incinerated. Instead of losing materials to landfill and incineration, Lublin aims to recover non-biotic materials at their highest value, and ensure that nutrients from bio-materials are returned to nature. Construction materials should be sourced from demolished buildings, facilitated through the city's efficient collection and reporting system on construction waste. To achieve this vision, Lublin needs to engage the public and private sector, as well as citizens through awareness raising and capacity building.

Strategic direction

1. Setting the right example: Zero waste public institutions and schools.
2. Invest in infrastructure and logistics that enable zero-waste and circular materials management.
3. Stimulate collaboration with the private sector to utilize industrial waste for circular projects.

Existing strategies and policy documents

- Regional Innovation Strategy for the Lublin Province 2020.
- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).
- **Krajowy program zapobiegania powstawaniu odpadow** (Polish National Waste Prevention Programme).
- **Analiza stanu gospodarki odpadami komunalnymi miasta Lublin za rok 2018** (Analysis of the state of the economy municipal waste from the city Lublin for 2018).

Strategic Projects

- **P1** Pilot zero waste schools and public institutions.
- **P2** Develop procurement criteria for municipal government purchasing.
- **P3** City-wide reuse system for to-go products.
- **P4** Pilot neighbourhood repair and reuse hub.
- **P5** Cross-sectoral accelerator program for circular product development from organic waste streams.
- **P6** Implement a 'pay as you throw' structure in industry and enterprises.

LEGEND

- Policy
- Economy
- Collaboration
- Physical implementation

SETTING THE RIGHT EXAMPLE: ZERO WASTE PUBLIC INSTITUTIONS AND SCHOOLS (1/2)

Key Strategic Projects

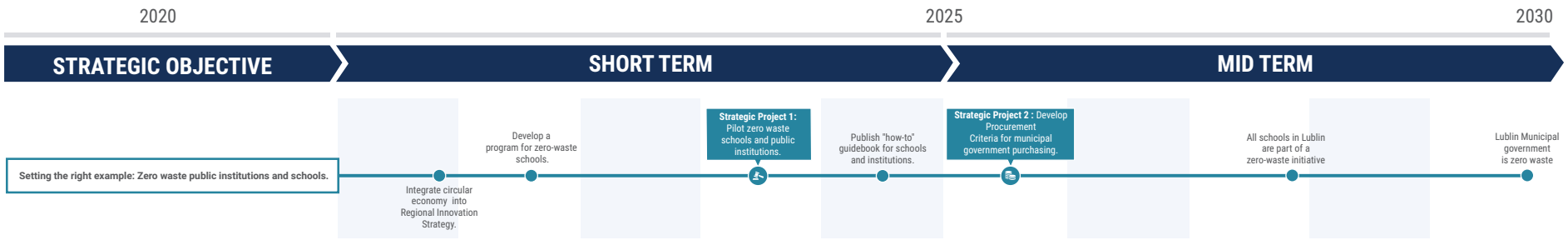
P1 Zero-waste public institutions and schools

Public institutions can set the right example and create awareness by committing to zero waste. Local schools and public institutions commit to becoming zero-waste facilities by diverting all of their waste streams from landfill and engaging in recycling, reuse or composting. School programs can be piloted with 2-3 schools and if successful can be scaled up.

- **Impacts:** Reducing waste, setting awareness for zero waste.
- **Who is needed?** Municipal governments, local schools, public institutions.
- **Key building blocks**: Building capacity.

Where to look for inspiration?

Going zero waste: *Schools in Palo Alto pledge to eliminate all waste from their systems (going further than reducing, reusing and recycling) by designing products to eliminate waste and building community collaboration.*



SETTING THE RIGHT EXAMPLE: ZERO WASTE PUBLIC INSTITUTIONS AND SCHOOLS (2/2)

Key Strategic Projects

P2 Develop procurement criteria for municipal government purchasing

Circular public procurement refers to an approach by which public authorities purchase goods and services that contribute to the implementation of a circular economy by closing material loops, energy loops, or reduced life-cycle impacts.

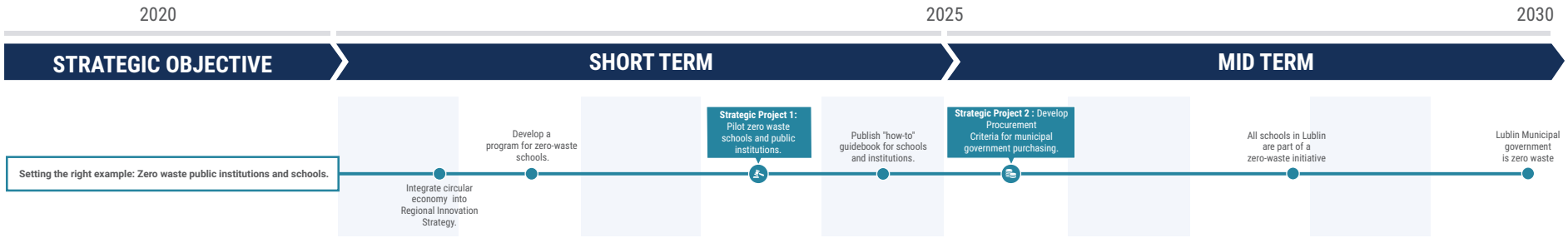
Lublin's Regional Innovation Strategy Lublin Province 2020 already expressed plans to implement sustainable procurement models as an innovative policy instrument. A pilot program to test innovative public procurement models is currently underway. Thus, Lublin is uniquely positioned to include circular criteria into their existing programs.

- **Impacts:** Supporting circular markets.
- **Who is needed?** Municipal governments, public institutions.
- **Key building blocks**: Building capacity & active goverment.

Where to look for inspiration?

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

More information:
EU Brochure on Circular Procurement



INVEST IN INFRASTRUCTURE AND LOGISTICS THAT ENABLE ZERO-WASTE AND CIRCULAR MATERIALS MANAGEMENT (1/2)

Key Strategic Projects

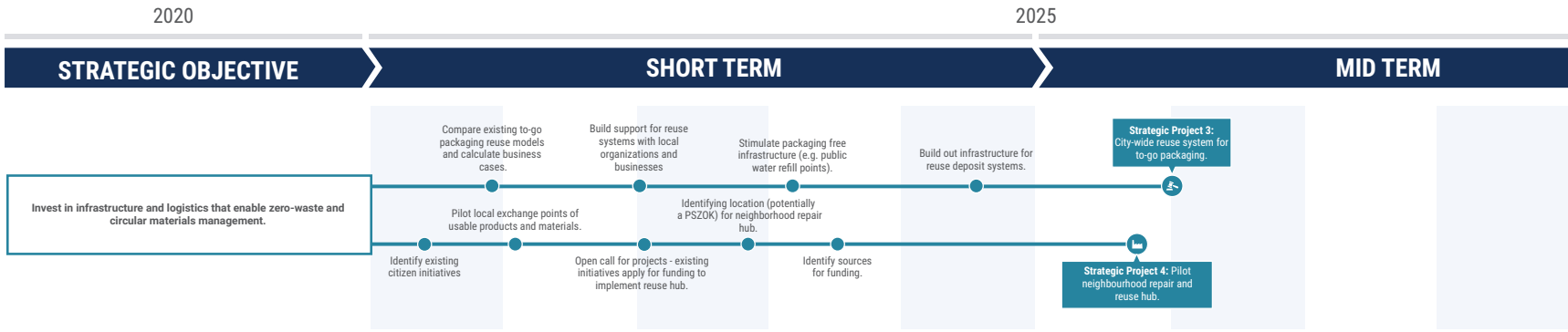
P3 City-wide reuse system for to-go packaging

Single-use cups and take-out packaging are a financial and ecological burden to municipal waste management. By bringing together large actors in the hospitality sector in Lubin, the municipality can start to build out a city-wide reuse system for disposable to-go packaging.

- **Impacts:** Reducing waste.
- **Who is needed?** Municipal governments, large actors in hospitality.
- **Key building blocks:** City-wide collaboration between cafes, restaurants and hotels.

Where to look for inspiration?

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



INVEST IN INFRASTRUCTURE AND LOGISTICS THAT ENABLE ZERO-WASTE AND CIRCULAR MATERIALS MANAGEMENT (2/2)

Key Strategic Projects

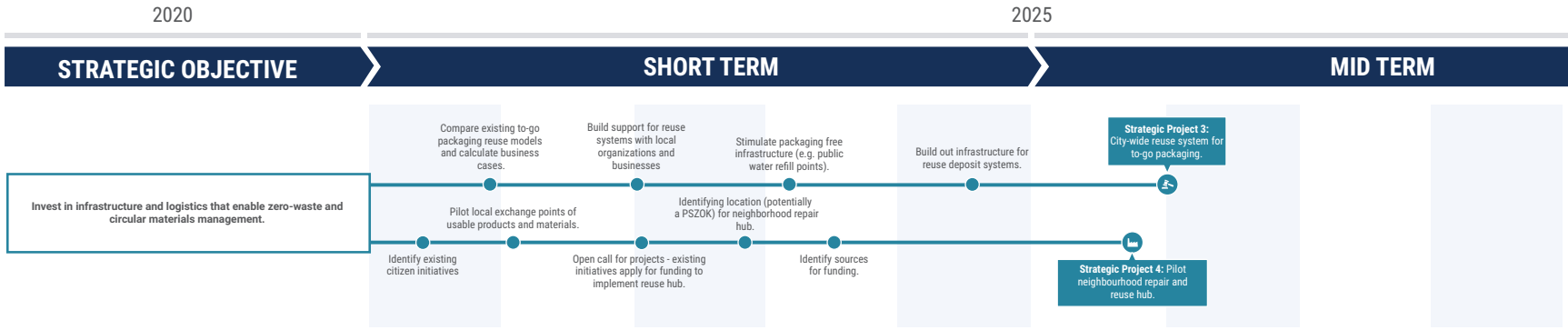
P4 Pilot neighbourhood repair and reuse hubs

Neighborhood reuse and repair hubs are a critical part of public infrastructure to enable urban circular economies. They provide citizens with the skills and tools to keep products in use longer, reducing the burden on waste management systems and saving valuable resources for the production of new consumer goods. Lublin can support the creation of these hubs by making local spaces available and providing financial and technical support for initiatives interested in creating local hubs.

- **Impacts:** Creating a culture of reuse rather than disposal.
- **Who is needed?** Existing community initiatives.
- **Key building blocks:** Funding, municipal communication channels.

Where to look for inspiration?

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



STIMULATE COLLABORATION WITH THE PRIVATE SECTOR TO UTILIZE INDUSTRIAL WASTE FOR CIRCULAR PROJECTS

Key Strategic Projects

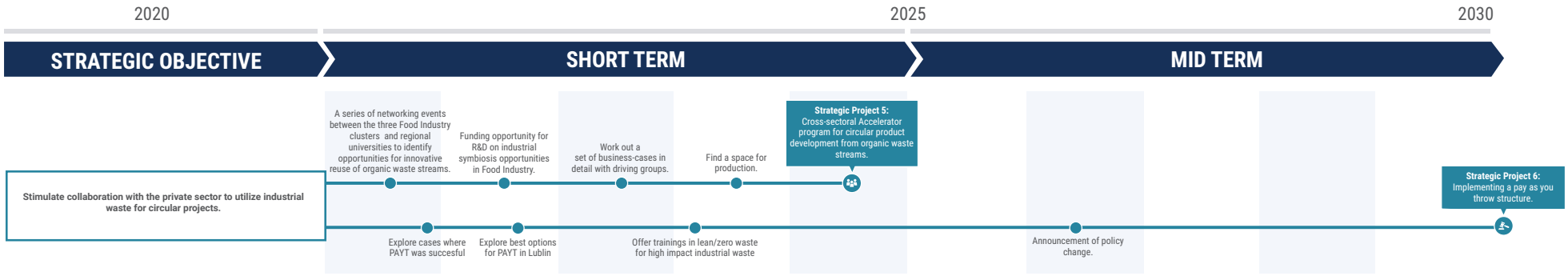
P5 Cross-sectoral acceleration program for circular product development from organic waste streams

Lublin's strong strategic focus on smart innovation in the bio-economy can be leveraged to add value to under-utilized waste streams from regional food industries. Through a targeted program that matches the three regional Food Industry Cluster Initiatives with students from business and agricultural programs, the municipality can accelerate circular products from organic processing waste.

- **Impacts:** Reducing industrial waste.
- **Who is needed?** Lublin Cluster of Food Industry, universities.
- **Key building blocks:** Collaborative events/ spaces between businesses and academia.

Where to look for inspiration?

PeelPioneers: *The Dutch company Peelpioneers transforms orange peel waste from restaurants, hotels or supermarkets into valuable products for the food industry.*



STIMULATE COLLABORATION WITH THE PRIVATE SECTOR TO UTILIZE INDUSTRIAL WASTE FOR CIRCULAR PROJECTS

Key Strategic Projects

P6 Implementing a 'pay as you throw' structure in industry and enterprises

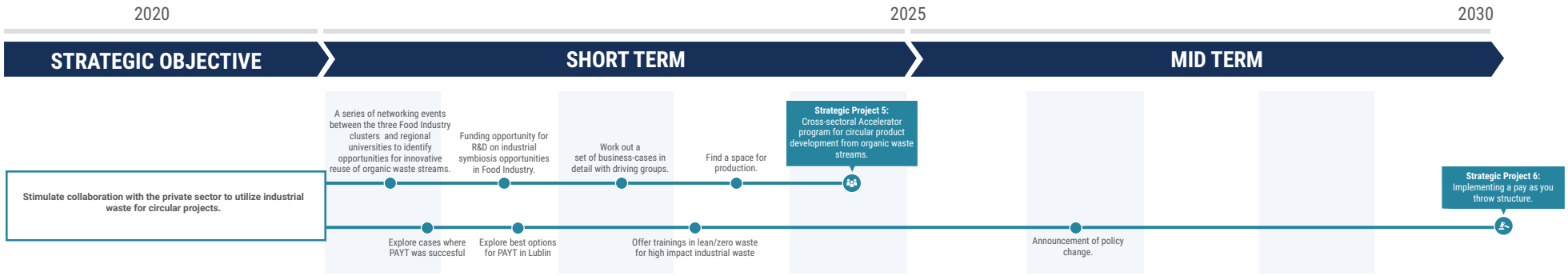
Systems "pay for as much as you throw" (ang. Pay-as-you-throw) can effectively encourage waste reduction in industry and enterprises. However, it will be necessary to closely monitor these systems to prevent illegal dumping of waste. It will also require training for the private sector on how to reduce waste and adopt sustainable resource management.

- **Impacts:** Reducing industrial waste and consumption.
- **Who is needed?** Municipal government; food-industry.
- **Key building blocks:** Measuring and monitoring, creating cross-sector collaboration & building capacity.

Where to look for inspiration?

Pay-As-You-Throw (PAYT):

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



KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE		KPIS - A CITY WHERE RESOURCES CYCLE AT THEIR HIGHEST VALUE
1. Lublin reduces its municipal waste generation.		Mg/y of municipal waste generated per capita.
2. Lublin recovers maximum value from waste streams, both industrial and municipal.		Average profit per tonne of recovered waste.
3. Lublin maintains material quality (complexity) of non-biotic resources.		Percentage of non-biotic resources recycled at the same level of quality (complexity).
4. Lublin ensures that nutrients from all biotic wastes are returned to natural cycles.		Percentage of organic waste processed to recover nutrients.
5. Lublin limits incineration of waste to >5% by 2050.		Mg/y of waste being incinerated annually per capita.
6. Lublin raises awareness on the importance of zero waste among citizens and tourists.		Percentage of citizens and tourists aware of the importance of waste reduction (qualitative assessment through surveys).
7. Lublin facilitates increase in construction waste collection.		Mg/y of construction waste collected separately, as a share of total construction waste.
8. Lublin improves reporting on construction waste.		% of on-site construction waste reported on.
9. Lublin facilitates secondary construction material sourcing.		# of PSZOK points collecting construction waste.
10. Lublin sets up green public procurement policies for public space & municipal real estate.		• % of procurement using environmental criteria compared to total procurement of the city administration; • Mg/y of secondary construction materials used in public procurement.

ENVISIONING A SMART, FOSSIL-FREE, CONNECTED GATEWAY TO THE EAST

Lublin as 'Lublin Smart City', a name that is carried with pride. Neighboring countries including Belarus and Ukraine consider Lublin as the **'cleantech gateway to the East'**, an inspiring city that has taken the lead as a fossil-free city. Modern, transparent solar panels cover the roofs of all houses constructed since the 2020s, and even some buildings in the historical center generate their own electricity. Wind turbines, spinning in the region around Lublin, supply the rest of Lublin's electricity demand, and residual heat from industry and data centers feeds directly into the upgraded district heating system, warming neighboring houses.

Thanks to the **emission-free mobility and transport systems,** and clean heating system of the city, Lublin's air quality now ranks among the highest of European cities. Lublin's shift to an almost entirely **service- and knowledge-based economy** has replaced polluting industry. Lublin's citizens move freely throughout the city by bike, foot or the **hypermodern public transport system,** which carries passengers anywhere in the Lublin Metropolitan Area.

In 2020, Poland lagged behind other European countries. Whereas many countries were adopting zero-emission goals, Poland held on to its national tradition of coal, resulting in extensive carbon emissions and poor air quality across many regions. Lublin's share of renewable energy use was also only 2% of their total energy demand. This changed in the early 20's, as Lublin adopted an **integral approach to transition away from fossil fuels**. A loan from the European Investment Bank (EIB) helped heat distributor LPEC to significantly improve the city's heat network, providing heat for around 75% of the city's population by the mid 20's. By the early 30's, all households in Lublin were heated by clean energy sources. In addition, all **public buildings and knowledge institutions were retrofitted to the highest energy efficiency level;** a strong example of what is possible. As part of the revitalization program, Stare Miasto and Śródmieście were the first neighborhoods to be retrofitted to the highest energy performance. Proof of concept led the city to adopt **strict energy criteria in zoning regulations and tendering** processes of public land.

This reduction in energy consumption went hand-in-hand with **renewable energy production**. The city started small, mapping the potential of solar panels in the city, as well as heat resulting from industrial activities, which was not yet used for heating Lublin's households. A plurality of clean energy production became visible throughout Lublin. As the city's electric mobility network expanded, public and public-private investments into renewable energy sources became widely popular. After the region passed new regulations that allowed easier placement of wind turbines, share of renewable energy rose even more.

Not only did buildings become more energy-efficient and powered by renewable energy, so did the mobility system. The city's revitalization zones played an important role in this, as they were turned into **car-free, green oases**. It was astonishing to see how much space opened up once cars were no longer allowed in the city center, making way for Lublin's residents to walk and cycle, and for other forms of clean transportation. The city went from around 0,94 km of cycling lanes per 10 000 residents in 2020, to 4 km of cycling lanes per 10 000 residents in the late 20's.Today, the cycling infrastructure provides a network of green highways that allow easy navigation to all of Lublin's neighborhoods, as well as the natural areas bordering the city.

Alongside the cycling system, Lublin initiated a **radical modernization of its public transport system** throughout the 20's and 30's. Its electrified bus fleet transports residents conveniently through the city, easily hopping on and off to travel between Lublin's neighborhoods. The city's public transport system is closely connected to the city's regional and international transportation hubs, such as Lublin's air- & drone-port, and the high speed railway that has passed through the region since the early 30's. Nowadays, traffic jams are a thing of the past. Lublin's transport system is supported by **smart technologies that optimize mobility flows** over space and time, and smart logistics systems allow for goods to be transported through the city almost without notice.

THE SMART, FOSSIL-FREE, CONNECTED GATEWAY TO THE EAST

The vision

Lublin aims to establish a local, renewable and efficient energy system by leveraging the potential of solar and wind power. Buildings require little energy for heating due to the city's efforts in energy retrofitting and stringent regulations for new development. By 2030, the city aims to entirely abolish coal burning for heating homes. Instead, Lublin works towards smart district heating infrastructure that reuses residual heat from industry and data centers. Lublin also strives to decarbonize its mobility system by shifting towards public transport and a well-established cycling network.

Strategic directions

1. Stimulating energy efficiency in the built environment.
2. Lublin Smart City dashboard for a community-focused smart city.
3. Smart and clean mobility.

Existing strategies and policy documents

- **Plan Gospodarki Niskoemisyjnej dla Miasta Lublin 2015** (Low Carbon Economy Plan for Lublin 2015).
- **Strategia rozwoju Lublina na lata 2013-2020** (Lublin Development Strategy 2013-2020).
- **Załozenia do Planu Zaopatrzenia w Ciepło, Energie Elektryczna i Paliwa Gazowedla Miasta Lublin na lata 2019-2033** (Assumptions for the Supply Plan Heat Electricity and Gas Fuels for the city of Lublin for years 2019-2033).

Strategic Projects

- **P7** Energy efficiency standards in tendering guidelines for all new construction
- **P8** Create a covenant with local businesses on the production and use of local renewable energy
- **P9** Create Lublin Smart City Dashboard (energy, resources, water, transport)
- **P10** Build out multi-modal mobility systems
- **P11** Establish car-free zones across the city

LEGEND

- Policy
- Economy
- Collaboration
- Physical implementation

STIMULATING ENERGY EFFICIENCY IN THE BUILT ENVIRONMENT (1/2)

Key Strategic Projects

P7 Energy efficiency standards in tendering guidelines for all new construction

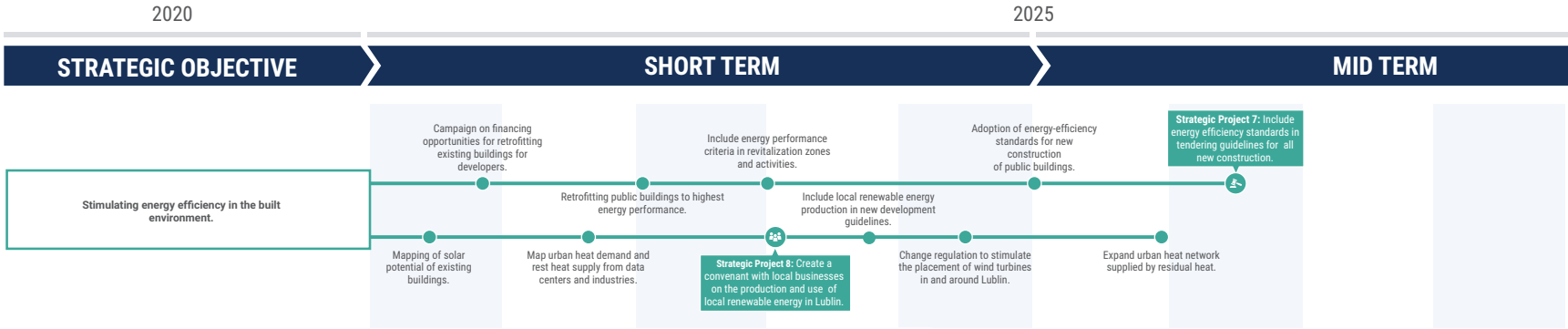
As a region with many new construction projects around the city's edges, Lublin has a strategic opportunity to reduce the demand for electricity and heating of future buildings. Setting ambitious guidelines for energy efficiency in the new built environment is critical to reducing the city's dependence on fossil fuels.

- **Impacts:** Electricity cost savings, CO_2 savings.
- **Who is needed?** Planning and zoning departments, contractors, homeowners.
- **Key building blocks:** Building capacity.

.

Where to look for inspiration?

Low-energy building on city-owned land: *The German mid-sized city of Münster has established guidelines that all new buildings on city-owned land follow the thermal performance requirements known as "Niedrig Energy Haus" (Low energy house). These standards exceed nation regulations by 30%. As a result of this project, homeowners saved almost 1 million euros in energy costs and 3 400 tons of carbon emissions per year.*



STIMULATING ENERGY EFFICIENCY IN THE BUILT ENVIRONMENT (2/2)

Key Strategic Projects

P8 Create a covenant that aligns local businesses on the production and use of local renewable energy

The transition to a low-carbon energy supply is one of Lublin's strategic areas for future smart specialization. Local businesses and industry play an important role in increasing renewable energy generation and simultaneously purchasing energy from renewable sources. A city-wide agreement between businesses can help channel mutual action between Lublin's public and private sector to move away from fossil energy sources.

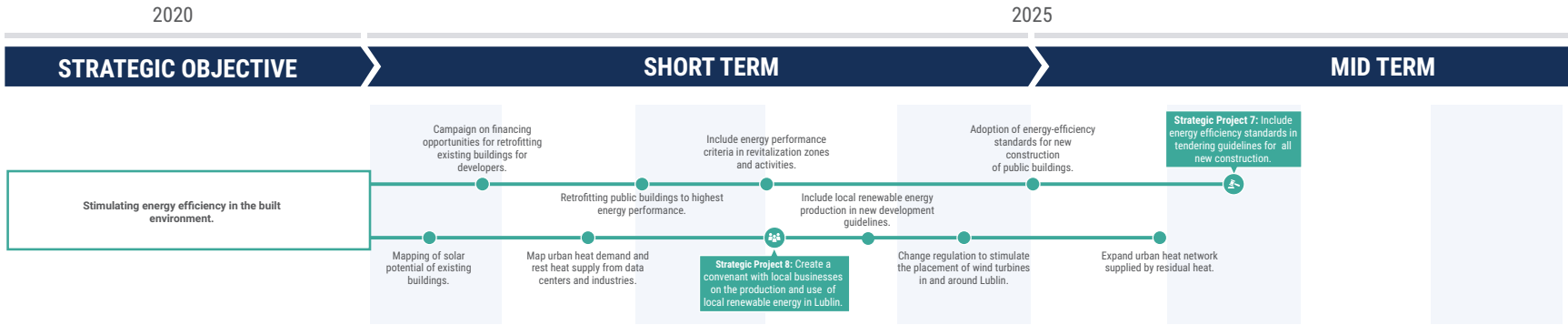
- **Impacts:** CO_2 savings.
- **Who is needed?** Business owners, investors, municipality.
- **Key building blocks:** Cross-sector collaboration; building collaboration.

.

Where to look for inspiration?

Joint investment Cooperative in Belgium.

COOPEM was founded in 2017 in the town of Mouscron in Belgium, as a joint initiative between citizens, the municipality, businesses and investors in solar energy. The goal was to promote local PV installation through collective action. Businesses agreed to contribute a part of the installation costs and paid the remaining costs from their electricity savings.



ESTABLISHING A LUBLIN SMART CITY DASHBOARD FOR A COMMUNITY-FOCUSED SMART CITY

Key Strategic Projects

P9 Create Lublin Smart City Dashboard (energy, resources, water, transport)

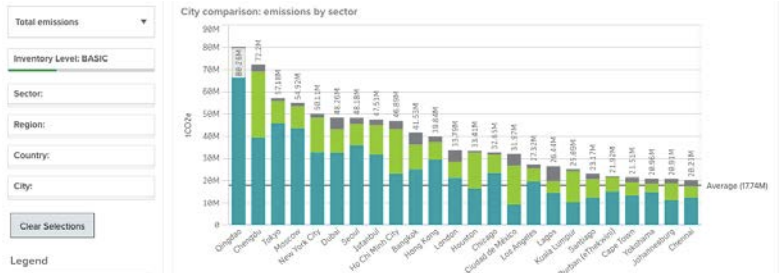
Key to more sustainable resource use is monitoring flows of energy, water, materials and transport through the city. In line with Lublin's strategy to become a smart city, this data can be made public in an online dashboard. Throughout the city, stakeholders can use insights to adopt measures for more sustainable resource use.

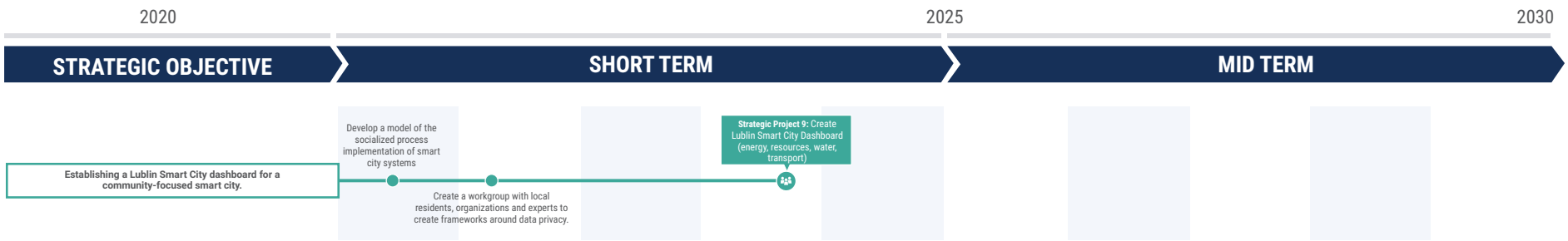
- **Impacts:** Mapping resource flows through the city forms a baseline measurement of Lublin's resource use; an indispensable measuring point to see if the city is progressing towards its sustainability goals.
- **Who is needed?** The municipality, utilities companies, public transport companies, data analysts.
- **Key building blocks:** Getting insights into impacts and waste streams.

Where to look for inspiration?

C40 greenhouse gas emissions interactive dashboard

This dashboard provides insights into historical greenhouse gas emissions (GHG) data for C40 cities, reported in line with the Global Protocol for Community-scale GHG Emission Inventories (GPC). Consistent with IPCC guidelines, it allows for credible comparison and aggregation of emissions data across timescales and geographies.





ACCELERATING THE DEVELOPMENT OF SMART AND CLEAN MOBILITY IN LUBLIN

Key Strategic Projects

P10 Build out multi-modal mobility systems
Investments into clean mobility systems are needed to offer comfortable, safe and affordable alternatives to car ownership. Increasing the municipal budget for biking infrastructure and providing subsidies for e.g. cargo bike purchases for businesses and citizens are good first steps towards a clean and smart mobility system.

- **Impacts:** reduced air pollution, CO_2 savings.
- **Who is needed?** Investment and development department, department of Strategy and Entrepreneurship.
- **Key building blocks:** Funding ; a neighborhood approach.

P11 Establish car-free zones across the city
Local air pollution and congestion pose a burden on the physical and mental health of city residents. By piloting car-free zones on selected streets, university campuses and eventually across the entire city center, Lublin can create a more liveable and healthy urban environment.

- **Impacts:** Reduced air pollution, reduced noise pollution, CO_2 savings.
- **Who is needed?** Investment and development department, department of Strategy and Entrepreneurship.
- **Key building blocks:** Internal capacity; resident co-creation session; information campaign.

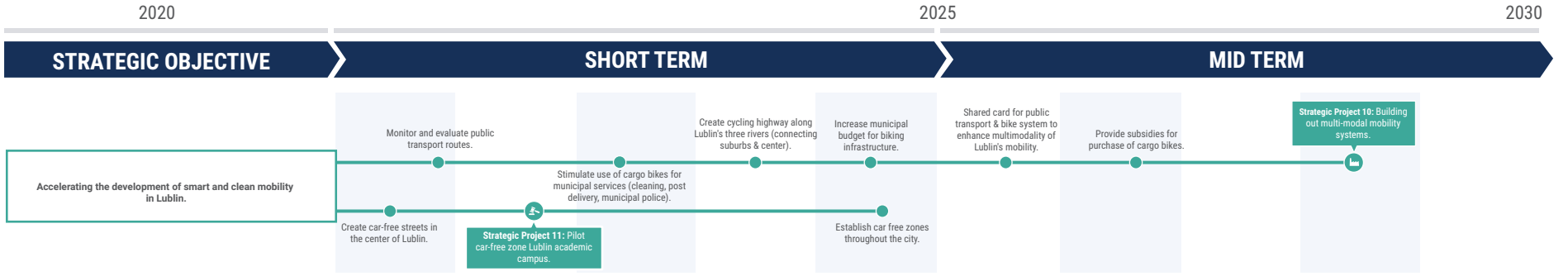
Where to look for inspiration?

Car-free zones in Barcelona
Barcelona's city council has declared to tackle urban air pollution by converting 21 streets into parks and public squares over the coming 10 years. A priority for their ambitious plan is the streets surrounding Barcelona's medieval center, where population density and pollution are very high.

CIVITAS: Cleaner and better transport in cities:
CIVITAS, a network of European cities, demonstrates over 800 solutions in 80 Living Labs across Europe. A tool inventory and a learning center help other cities to overcome their local mobility challenges.

CIVITAS 2020 Cleaner and better transport in cities

THE CIVITAS INITIATIVE IS CO-FINANCED BY THE EUROPEAN UNION



KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - LUBLIN: THE SMART, FOSSIL-FREE, CONNECTED GATEWAY TO THE EAST	KPIS - LUBLIN: THE SMART, FOSSIL-FREE, CONNECTED GATEWAY TO THE EAST
1. Lublin minimizes its total urban energy.	kWh/y energy use per capita.
2. Lublin maximizes local electricity production from renewable resources.	Locally generated renewable energy percentage of total energy use of Lublin.
3. Lublin minimizes consumption based-GHG emissions.	Mg/y of CO_2 equivalent consumption-based GHG emissions per person / GMP.
4. Lublin minimizes car use and maximizes public transport and bike use.	% of total city transport use divided over car, public transport, bike and foot.
5. Lublin improves cycling infrastructure.	Length of all city cycling lanes in meters.
6. Lublin maximizes energy efficiency of buildings.	Mg/y of CO_2 equivalent GHG emissions of residential, commercial and public buildings.
7. Lublin maximizes use of residual heat from industry and data centers.	Total GJ of rest heat used to heat buildings, as a percentage of total heating demand.
8. Lublin abolishes all coal burning for the heating of homes by 2030.	% of house heating demand generated by coal burning.

ENVISIONING A CITY OF RESILIENT COMMUNITIES AND SUSTAINABLE URBAN DEVELOPMENT

In 2050, Lublin has become a shining example of how cities provide **sustainable, inclusive habitats for all species and for a diversity of communities**. It is now one of the healthiest areas with the least pollution in Poland. In the 20s, Lublin rolled out its development strategy which was founded on the principles of openness, friendliness, entrepreneurship and academic spirit, which among other initiatives promoted a low pollution-economy. This not only helped to drastically improve the air quality in the city, but quickly started an ambitious scheme to put human and ecological wellness at the heart of the city's development strategy.

During the 20's Lublin executed extensive spatial development plans - over 20% higher than the average for other metropolitan areas. This threatened the natural environment surrounding the city, which had been in good condition compared to the rest of the country. The municipality knew that to **maximize the protection of the environment**, they needed to get everyone on board. In the 20s, campaigns for residents and tourists raised awareness of the protection of Lublin's forests, rivers and lakes and awakened a public sense of duty towards **protecting the 1 700 hectares of forested land in Lublin city**, and ultimately achieving city forest coverage of 11,1%.

In 2040, the first natural reserve outside of Lubin was granted its own rights.

The implementation of the new park with integrated natural design, right on the Bystrzyca River, evolved into a city landmark - a showcase on how to integrate nature into the city and connect Lublin's citizens with their natural surroundings without having to leave the city. The park also kickstarted the city's **Internet of Things for Lublin's green spaces**, which continuously monitors the soil's demand for nutrients and water. This system, which allowed caretakers to keep Lublin's trees, shrubs and grasses healthy and green, was rolled out throughout the entire urban ecosystem throughout the 20s. The increased quality of Lublin's vegetation immediately helped diminish the Urban Heat Island effect, providing the city with necessary shade.

Citizen awareness campaigns led to a public push for planning regulation changes, based on **providing sufficient green space in newly developed areas.** These regulations guaranteed the interconnection of forests and parks, and limited of spatial development and suburbanization on the outskirts of the city. In the 30s, all Lublin's vegetation and water was connected, which caused a wide range of flora and fauna to return to the ecosystem, and biodiversity rose to levels that had last been observed in the 1970s.

To protect the city from increasing extreme weather events, its **flood resiliency was improved.** Lublin always valued public participation and gave residents agency in creating their own innovative, water-permeable surfaces for better drainage capacity in their districts through co-financed programs.

Lublin's citizens and municipality see local debates and consultations as a core component of driving ownership of decisions for the residents. Participatory budgeting has become an even more important component of Lublin's decision making strategy. Now, for instance, the citizens' vote is the decisive factor for the assignment and caretaking of green space per neighborhood. The **increased sense of autonomy and quality of life among citizens** resulted in a welcoming and friendly city for all, with flourishing diverse communities and neighbourhoods. Welcoming attitudes also came naturally from the diverse student population in the city, concentrated mostly in the Rury and Wieniawa neighbourhoods.

A CITY OF RESILIENT COMMUNITIES AND SUSTAINABLE URBAN DEVELOPMENT

Social participation also accelerated the drive to establish the circular economy from the bottom-up. Leveraging existing local experience and tapping into their agricultural tradition and social capital, in the 30s, Lublin became nationally and internationally known as the Eastern European **epicentre of circular innovation in biotechnology.** The municipality continuously facilitated an innovation relationship between the city's universities and local businesses, which fostered a solid foundation for circular businesses.

Instead of producing for export, Lublin's farms now provide **food for local processing and consumption.** Local community farms include aquaponic systems to provide sufficient local produce. Lublin has become a city where **creativity and innovation start at primary school.** Children are stimulated early on with educational programs that connect them to natural ecosystems. Field trips foster an understanding of the food by highlighting how food loops can be closed at the local, and community farm levels. From a young age, children and teenagers learn in school how to cooperate with a diverse range of people, how to use their creative potential, and how to develop their emotional intelligence. They grow into **conscious citizens** that connect with the environment and with people around them.

A CITY OF RESILIENT COMMUNITIES AND SUSTAINABLE URBAN DEVELOPMENT

The vision

Lublin is moving towards sustainable and circular development, which increases the prosperity of its inhabitants and ensures healthy urban ecosystems. The protection of natural areas both inside and around the city is important for everyone who lives and works and visits Lublin. The city aims to maintain and protect its natural assets through protective measures and with the development of green areas and networks throughout the city. Citizens will be encouraged to participate in the city's greening process by voting on a participation budget and interacting with innovative green pilot projects throughout the city. The city aims to integrate circular principles into their new construction. The city aims to facilitate diverse affordable neighborhoods that have accessible facilities and public space for everyone.

Strategic directions

1. Implementing circular principles in construction and revitalization projects.
2. Protecting high-quality natural environment.
3. Accessible green space for and by inhabitants.

Existing strategies and policy documents

- **Program Rewitalizacji dla Lublina na lata 2017- 2023** (Revitalization Program of the City of Lublin in the years 2017-2023).
- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).

Strategic Projects

- **P12** Pilot bio-based construction of a public building.
- **P13** Material passports for new development.
- **P14** Require all new buildings to be built according to circular standards.
- **P15** Build out integrated green network along Bystrzyca river.
- **P16** Include requirements for (public) green space in development guidelines.
- **P17** Further build out Citizen Participation Budget around greening the city.

LEGEND

- Policy
- Economy
- Collaboration
- Physical implementation

IMPLEMENTING CIRCULAR PRINCIPLES IN CONSTRUCTION AND REVITALIZATION PROJECTS (1/2)

Key Strategic Projects

P12 Pilot bio-based construction of public buildings

The transition to sustainable building includes a transition to biobased construction materials. In order to provide a showcase, the municipality can pilot a public building (mostly) built with biobased materials.

- **Impacts:** The first step towards the use of renewable building materials in Lublin.
- **Who is needed?** The municipality, an architect, developer and construction contractor.
- **Key building blocks:** A selected public building, budget and capacity from the municipality.

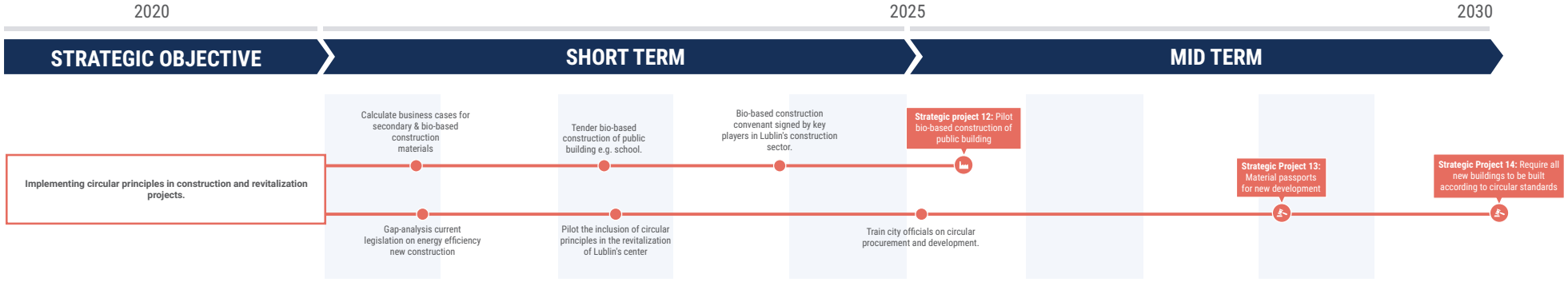
P13 Material Passports

Requiring passports for new construction will help to monitor the flow of construction materials over time. It will enable future builders to have reliable information about potential materials that can be recovered during demolition and will stimulate design for disassembly.

- **Impacts:** Ensuring high-value recycling in the future.
- **Who is needed?** Central government and developers.
- **Key building blocks**: Insight into material flows and driving innovation.

Material Passports

Madaster is an online platform that allows property data to be stored, identifying materials present in building, and thus allowing for potential high-value reuse. Under the EU's BAMB project a similar platform has been created, with the aim of providing a one-stop-shop for a circular building sector.



IMPLEMENTING CIRCULAR PRINCIPLES IN CONSTRUCTION AND REVITALIZATION PROJECTS (2/2)

Key Strategic Projects

P14 Require all new buildings to be built according to circular standards

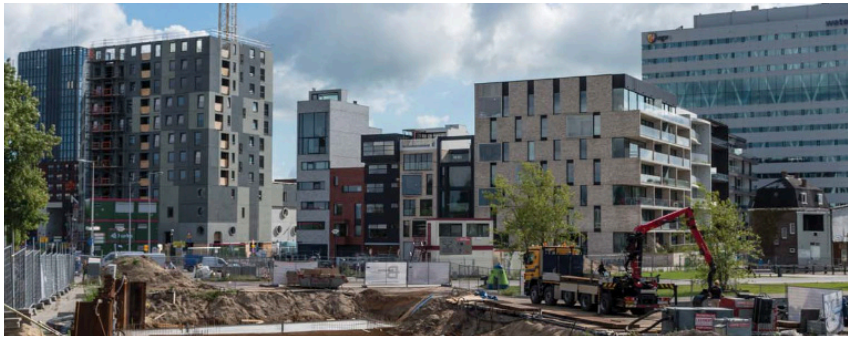
The municipality of Lublin can impose circular standards for all new construction (including material passports, energy efficiency standards and targets for secondary material use).

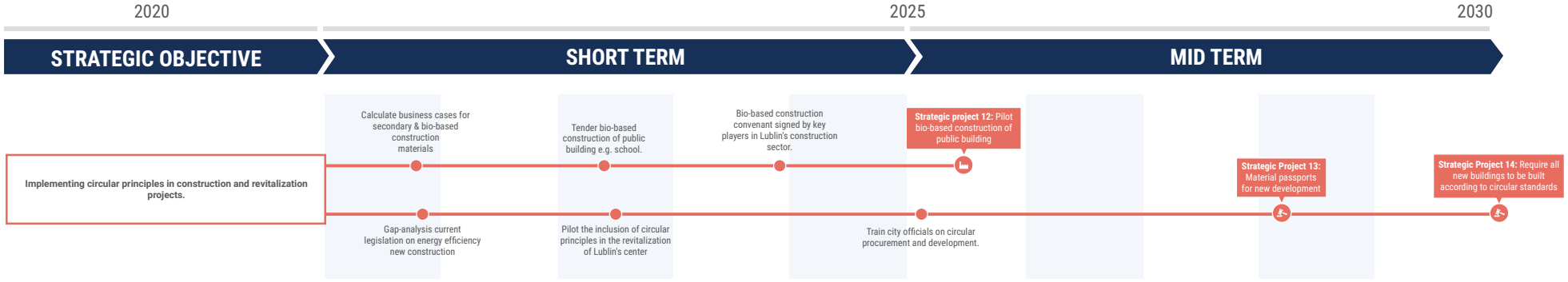
- **Impacts:** Reduce emissions and waste from building activities.
- **Who is needed?** Municipal government, central government and all actors from the construction sector.
- **Key building blocks:** Implementing physical interventions & an active government.

Where to look for inspiration?

Circular standards

The city of Amsterdam has applied the principles of circular tendering (i.e. the circular performance of a building project) to six circular housing projects.





PROTECTING HIGH-QUALITY NATURAL ENVIRONMENT

Key Strategic Projects

P15 Build out integrated green network along Bystrzyca river

Develop a new park along Bystrzyca river, that can serve as an accessible piece of nature in the city-center, within a larger integrated green network that extends along Lublin's rivers. Additionally, connected green spaces can benefit the city's flora, fauna, and human health.

- **Impacts:** Preserving local biodiversity.
- **Who is needed?** Municipal government; central government.
- **Key building blocks:** Flexible zoning; subsidies from central government (ministry of the environment?

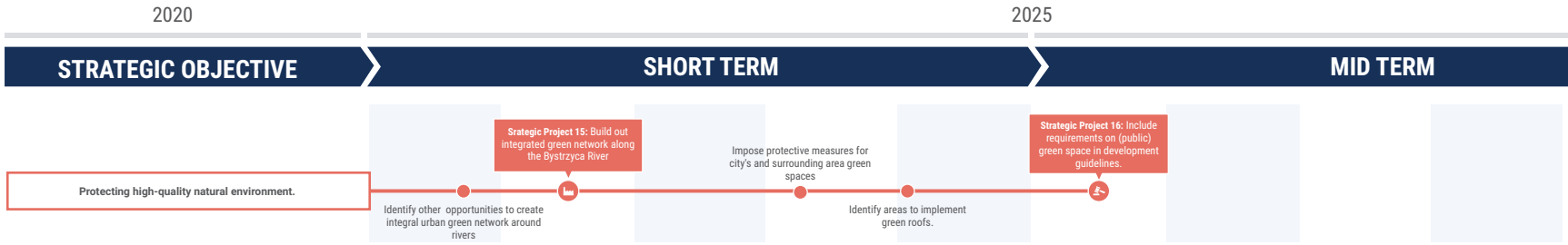
P16 Include requirements for (public) green space in development guidelines
By creating conservation measures to protect the city's existing green space (such as by-laws protecting the city's natural and agricultural land from development) and proactively developing green spaces (such as turning car parks and brownfield into natural areas), the city prioritises the health of all its inhabitants.

- **Impacts:** Protecting health of inhabitants and ensuring access to green space.
- **Who is needed?** Municipal government.
- **Key building blocks:** Zoning that protects green space, restrictions to urban development.

Where to look for inspiration?

***A Green Network for the Glasgow City Region**: The Glasgow City Region' Green Network is a prime example of a strategic and multifunctional green infrastructure project, linking existing green spaces across eight regional territories. Amongst others, plans will lead to over 3 500 ha of new parkland on derelict land and over 1 000 km new paths for public recreation*

*Link to the **Blueprint***



ACCESSIBLE GREEN SPACE FOR AND BY INHABITANTS

Key Strategic Projects

P17 Further build out Citizen Participation Budget around greening the city

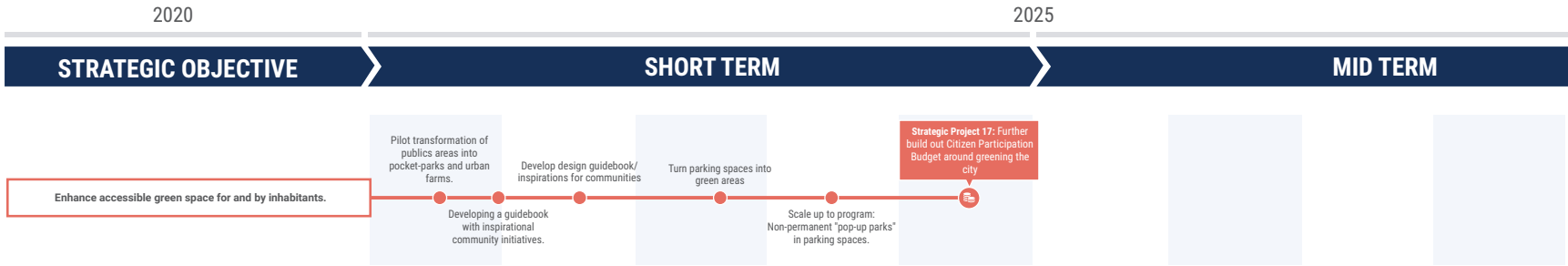
Create a budget that citizens can vote on directly, allocating funds to projects that will create more green and natural spaces within the city.

- **Impacts:** Create knowledge, awareness and engagement among citizens.
- **Who is needed?** Municipal government, citizen participation.
- **Key building blocks:** Funds for budget.

Gdzie szukać inspiracji?

Green pilot projects

In 2017, the city of Melbourne in Australia rolled out the green your laneway pilot project, where the city piloted vertical gardens, tree planting, pocket parks and food planter boxes to green the city's extensive laneway network.



KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - A CITY OF RESILIENT COMMUNITIES AND SUSTAINABLE URBAN DEVELOPMENT	KPIS - A CITY OF RESILIENT COMMUNITIES AND SUSTAINABLE URBAN DEVELOPMENT
1. Lublin improves water drainage capacity and rainwater capture throughout the entire city.	• Water draining capacity in m³/m per neighborhood. • % of permeable surface per neighborhood; • m³/y of rainwater captured and stored for use as a share of total rain fallen in the city.
2. Lublin supports programs to increase biodiversity in the region.	# of programs instigated to promote biodiversity.
3. Lublin enhances peri-urban food production and local resource cycling.	• Mg/y of organic waste composted locally. • Mg/y of food produced in peri-urban areas of Lublin.
4. Lublin enhances citizen awareness of the importance of ecosystem services.	% of public funding invested to increase citizen's awareness of urban nature and ecosystem services, and educate urban citizens about sustainability and the environment.
5. Lublin includes densification and sprawl prevention requirements into its development plans.	Density (i.e. measured by FSI) of newly developed areas in m²/m².
6. Lublin ensures equitable distribution of recreational and blue-green space.	Availability and distribution of space with respect to specific individual or household socioeconomic profiles and landscape design, measured using GIS and statistical analysis.
7. Lublin sets quota for social housing per neighborhood.	% of social housing per neighborhood.
8. Lublin includes citizens and community goals within its strategic development plans.	% of community representatives included in strategic meetings for urban (district) development.

ENVISIONING A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION

In 2050, Lublin is an established academic hub, **known for its innovation that stimulates healthy and happy environments**. Children are educated about sustainable development from an early age, and have the city as a physical living lab to learn from. The knowledge of Lublin's academic centers flows directly into the **strong networks of entrepreneurial SME's,** which in turn provide the academic centers and their diverse students with practical experience and implementation, allowing ideas to turn into practice.

Lublin's status as an academic city has long been an important part of its identity and an important opportunity for development. In 2020. Lublin had 9 universities (5 public and 4 private) and approximately 18% of the city's total population consisted of students. Despite its impressive academic position, at the turn of the century, the city was having a hard time attracting big investors from outside. However, in the 20s, Lublin was increasingly able to further establish its strength as the largest academic centre in Eastern Poland. Through a strong **collaboration project between the municipality, the knowledge institutions and a range of experts** in the early 20's, the city assured that the educational programs of Lublin aligned more closely with both the job market and the city's aspirations to **specialize in the field of IT, biotechnologies, and pharmaceuticals**, among others. In addition, Lublin implemented a Special Economic Zone (SEZ), one of the most attractive forms of investor support. To guide the development of the investment zone, a panel of local academics, citizens and entrepreneurs was created. Nowadays, the SEZ has turned into a **flourishing and innovative district that combines international knowledge and innovation with Lublin's academic and entrepreneurial excellence**, while contributing to the local economy of the city.

Lublin is also strategically positioned as the **'gateway to the east'** with proximity to the Ukranian and Belarusian borders. Lublin's inclusive, open and innovative environment further positioned the city as a strategic point and crucial connection hub between eastern Europe and the European Union. Through the 20's and 30's, the city played a growing role as an administrative and economic centre for Europe in relation to eastern Europe. It did so by improving its east-west connection infrastructure and **opening the city to talent from its Eastern neighbours** with its prestigious universities, and a variety of conferences designed to solidify these alliances.

Building upon the city's extensive organic flows, the city became a leading academic hub in the development of new sustainable biotechnologies, pharmaceuticals, and food processing. The agricultural surroundings of the city proved both an excellent resource base for supplying organic materials, as well as **a testing site for testing newly developed technologies**. This resulted in a culture of **"learning in the city".**

Nowadays, Lublin's innovative practices still benefit the city and its residents every day. Culture and science flow from the academic centers to the entrepreneurs and residents through strong networks of collaboration and physical living labs. Visitors from the region and beyond visit the city to witness and learn from its innovative science and technologies, and its rich culture of economic and social exchange.

A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION

The vision

Lublin leverages its advanced academic environment and business potential to become a leading city for circular innovation. To do this, it prioritizes education and communication of circular economy topics and technologies for all citizens. The city is becoming a key player in developing, testing and scaling new technologies related to the circular economy and fosters laboratory environments where students and entrepreneurs can experiment and test circular innovations in sectors such as the built environment and food manufacturing.

Strategic directions

1. Deepening Lublin's awareness and knowledge of the circular economy.
2. Building spaces for cross-sectoral innovation and awareness.
3. Leveraging the Special Economic Zone for circular development.
4. Creating a Circular Biotech R&D track.

Existing strategies and policy documents

- **Regional Innovation Strategy for the Lublin Province 2020.**
- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).

Strategic Projects

P18 Building an inter-university MOOC platform for circular innovation.

P19 Improve primary and secondary school curriculum on sustainability and circular economy.

P20 Circular economy training for city officials.

P21 Lublin Universities establish 'green building lab'.

P22 Lublin Circular Food Hub.

P23 Create a "Circular SEZ" steering group of city officials, area management, and current businesses in the zone.

P24 Set circular criteria for new businesses in the SEZ.

P25 Establish R&D program between university, agrifood sector & food processing industries.

LEGEND

- Policy
- Economy
- Collaboration
- Physical implementation

DEEPENING LUBLIN'S AWARENESS AND KNOWLEDGE OF THE CIRCULAR ECONOMY (1/3)

Key Strategic Projects

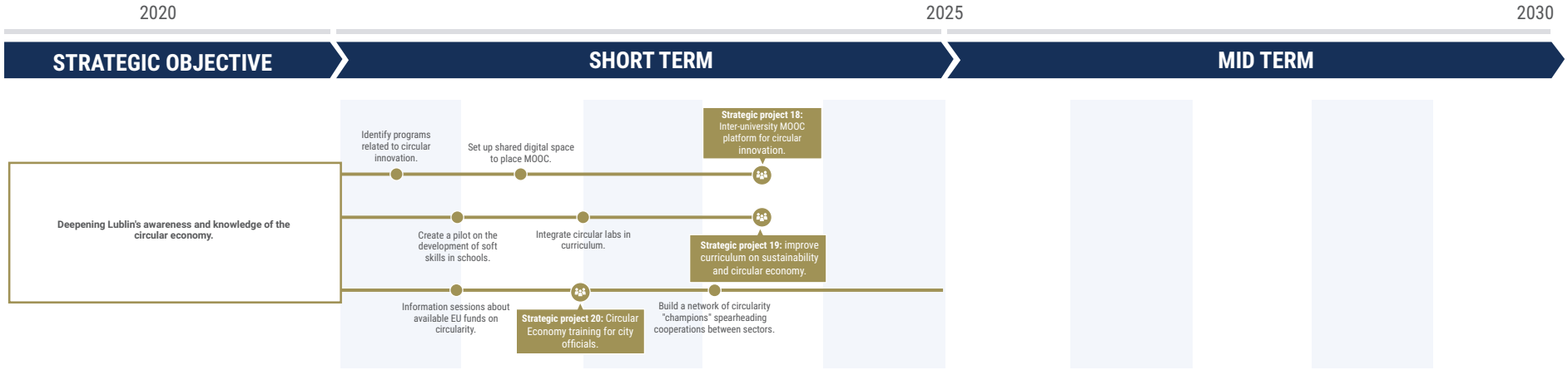
P18 Building an inter-university MOOC platform for circular innovation

Using expertise and research capabilities, the municipality and universities can team up to develop a platform where universities can identify and share strategic programs related to circular innovation.

- **Impacts:** Develop focus on collaborations between universities and city officials on the subject of the circular economy.
- **Who is needed?** Municipality, universities.
- **Key building blocks:** Funding to develop platform, willing participation from key partners.

Where to look for inspiration?

INSIGHTS- Creating a training program for Industrial Symbiosis Facilitators: *The currently running EU-funded INSIGHTS project works on developing a curriculum and training program for a new professional profile: The industrial symbiosis facilitator who identifies synergies between regional sectors and helps them establishing material or energy exchanges.*



DEEPENING LUBLIN'S AWARENESS AND KNOWLEDGE OF THE CIRCULAR ECONOMY (2/3)

Key Strategic Projects

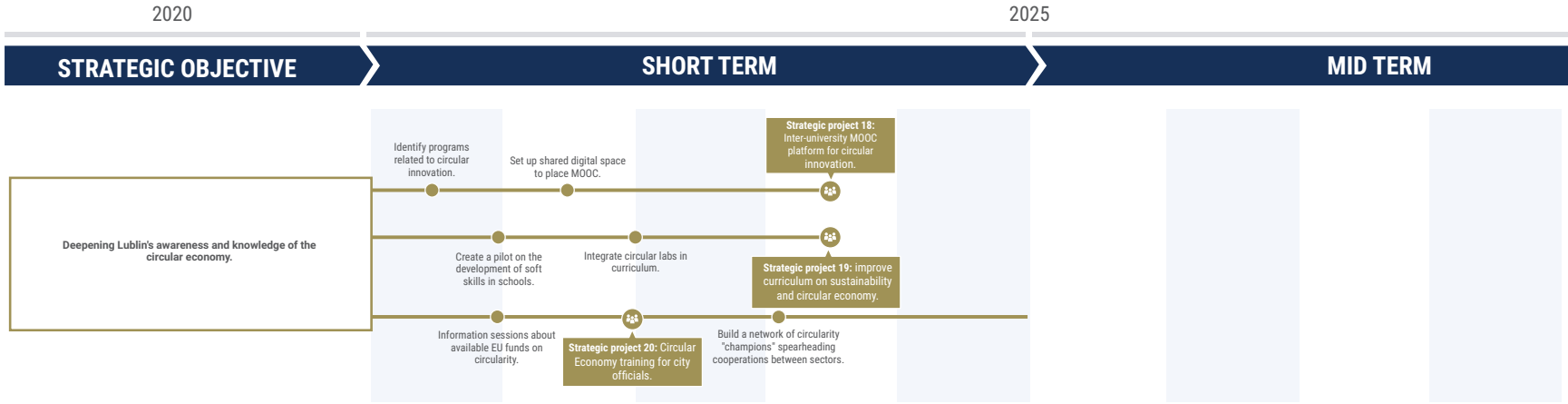
P19 Improve primary and secondary school curriculum on sustainability and circular economy

Stimulate an interest for the circular economy in Lublin by integrating principles of circularity in school curricula, creating a new generation of leaders and innovators in the circular economy and sustainability sector.

- **Impacts:** Stimulation of interest and innovation in the circular economy.
- **Who is needed?** Education ministry, experts on CE (to develop curriculum), collaboration of schools, municipality to develop circular labs in the city.
- **Key building blocks:** High-level collaboration to implement this curriculum on the national and regional level.

Where to look for inspiration?

Teaching materials for schools: *The Finnish Innovation Fund Sitra has co-created educational materials for primary, secondary and vocational schools to teach students the principles of the circular economy. Their curriculum was already piloted with over 70 000 students between 2018 and 2019.*



DEEPENING LUBLIN'S AWARENESS AND KNOWLEDGE OF THE CIRCULAR ECONOMY (3/3)

Key Strategic Projects

P20 Circular economy training for city officials

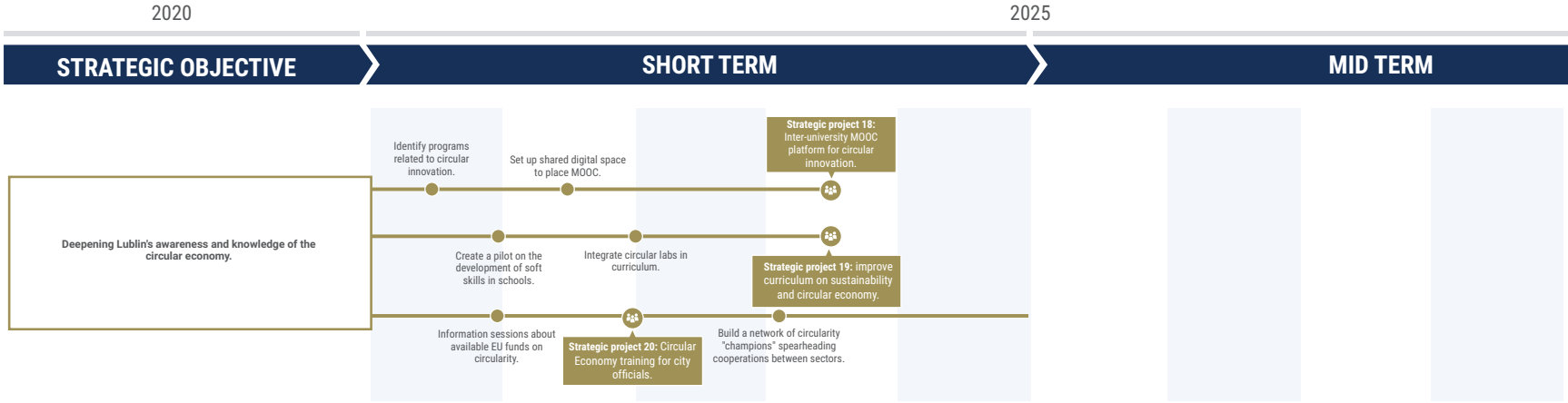
Circular economy training to support city officials in assimilating key circular economy principles, as well as integration of knowledge between departments. This can be facilitated by one of Lublin's universities or by an external consulting company.

- **Impacts:** Creating a circular-minded public service and alignment across departments can help accelerate bringing ideas into policy.
- **Who is needed?** Municipal government, CE experts (academia).
- **Key building blocks:** Funding for education, willingness to participate.

Where to look for inspiration?

CIRCO Circular Economy tracks

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



BUILDING SPACES FOR CROSS-SECTORAL INNOVATION AND AWARENESS

Key Strategic Projects

P21 Lublin universities establish 'green building lab'

Facilitated by the municipal government, local universities work in collaboration with stakeholders from the construction industry to showcase innovative and sustainable building methods and materials.

- **Impacts:** Space for innovation and potential to create greener building practices.
- **Who is needed?** Municipality, local universities, building industry.
- **Key building blocks:** Suitable locations and physical space, funding means.

P22 Lublin Circular Food Hub

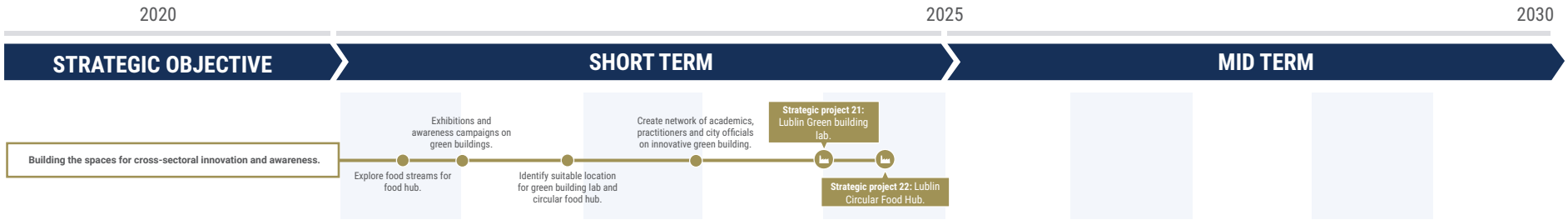
Creating a food hub in which local restaurants and entrepreneurs can turn food waste into value-added products, such as sauces, soups or pickled products. This can also contribute to Lublin moving towards sustainable tourism.

- **Impacts:** Creating value from food-waste and spreading awareness
- **Who is needed?** Local restaurants, entrepreneurs, municipal government.
- **Key building blocks:** Location to establish the food hub, collaboration between actors in the food industry.

Where to look for inspiration?

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

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



LEVERAGING THE SPECIAL ECONOMIC ZONE FOR CIRCULAR DEVELOPMENT (1/2)

Key Strategic Projects

P23 Create a "Circular SEZ" steering group of the SEZ management, city officials, area management, and current businesses in the zone

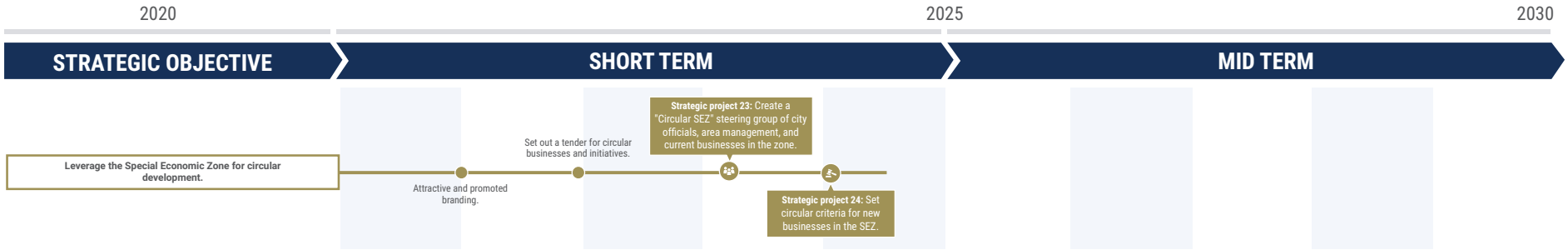
Lublin's Special Economic Zone (SEZ) and its favourable business conditions can be leveraged to accelerate the transition to a circular economy in Lublin. A first step in this process would be to form a steering group to guide businesses in the SEZ towards i.e. circular business models, industrial symbiosis and shared facilities. This group should be formed by city officials, area developers & managers, and established businesses to cooperatively set criteria for the SEZ (see P24).

- **Impacts:** Creating a circular-minded steering group and alignment across parties can help accelerate bringing circular practices into businesses.
- **Who is needed?** SEZ management, city officials, area management, and current businesses.
- **Key building blocks:** One of the parties involved taking the initiative to set up the steering group, likely the SEZ management.

Where to look for inspiration?

Circular area development by Schiphol Area Development Company

Schiphol Area Development Company (SADC) develops high quality, accessible, (inter)nationally competitive business locations on the WESTAS logistics corridor in Amsterdam. SADC develops circular principles for everyday business practices aimed at preserving existing value and creating further value.



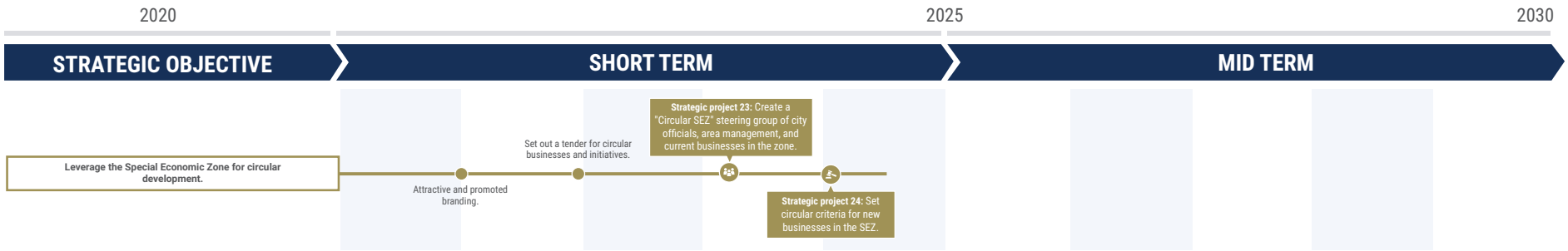
LEVERAGING THE SPECIAL ECONOMIC ZONE FOR CIRCULAR DEVELOPMENT (2/2)

Key Strategic Projects

P24 Set circular criteria for new businesses in the SEZ

The Circular SEZ steering group can, together, set criteria for circular practices for businesses in the SEZ. These criteria will form a framework for businesses already established in the SEZ to adopt more resource-efficient, climate neutral, and sustainable practices. In addition, these criteria are meant for the SEZ to select potential businesses interested to establish in the SEZ.

- **Impacts:** Established businesses in the SEZ adopting more sustainable practices, and new potential businesses being selected based on their sustainable performances.
- **Who is needed?** The Circular SEZ steering group (P23), businesses established in the SEZ, future potential businesses in the SEZ.
- **Key building blocks:** The formation of and cooperation within the Circular SEZ steering group.



CREATING A CIRCULAR BIOTECH R&D TRACK

Key Strategic Projects

P25 Establish R&D program between university, agrifood sector & food processing industries

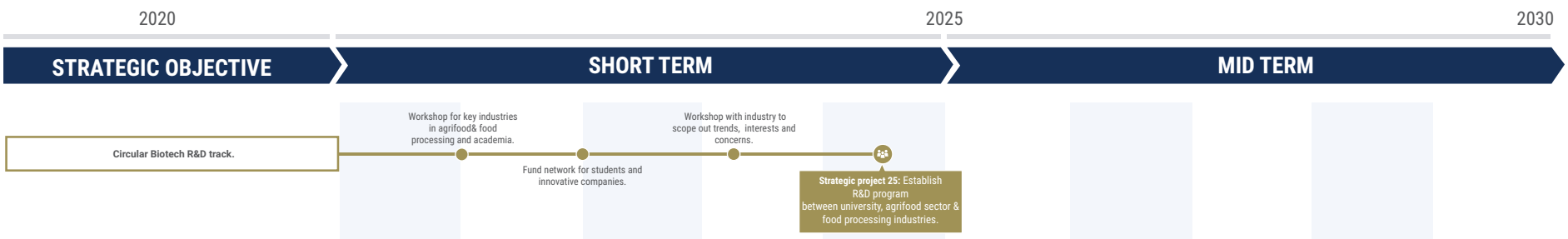
To leverage the potential of universities and industries, the municipality could develop workshops whereby key sectors in agri-food and processing, as well as relevant departments of universities, can meet, exchange and innovate with regards to new trends, interests, and concerns facing these industries. This could also potentially develop employment links for students in these fields.

- **Impacts:** Leverage shared interests and knowledge to develop and make the agri-food and processing sectorsmore sustainable. Keep students in Lublin.
- **Who is needed?** Municipality, universities, related industries.
- **Key building blocks:** Funds to develop workshops, networks and platforms to connect.

Where to look for inspiration?

Agrofood Robotics

Wageningen University in the Netherlands has kickstarted Agrofood Robotics, where engineers, researchers and industrial partners work together to innovate and find practical solutions in robotics for the agrifood sector.



KEY INDICATORS TO MEASURE PROGRESS

OBJECTIVES - A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION	KPIS - A CITY WITH A CULTURE OF ACADEMIA AND INNOVATION
1. Lublin attracts, facilitates and upscales circular, cleantech (impact-reducing) startups.	Number of startups established in Lublin focused on zero waste, recycling, remanufacturing, reusing and recovery of resources, as a share of all companies.
2. Lublin connects its rich academic scene with local and international businesses.	# of joint R&D programmes for universities and business.
3. Lublin boosts circular innovation in material intensive sectors (manufacturing, logistics, transportation and waste treatment).	% of Polish patents related to waste management and recycling.
4. Lublin joins world-leading cities in developing, testing and scaling new technologies relating to the circular economy.	Total revenue from the cleantech sector in Lublin as a share of a share of GMP (Gross Metropolitan Product).
5. Lublin supports bottom-up community initiatives on sustainability and circularity, with particular emphasis on biotechnology, biochemistry, genetics and microbiology.	Number of community initiatives related to sustainability or circularity supported by Lublin per 10 000 capita.

Background report: In-depth current state analysis

REVISITING THE CITY: A HISTORY OF LUBLIN

Lublin 's founding

Lublin is one of the oldest urban settlements in Poland, but it wasn't until the 14th century that this defensive settlement evolved into an increasingly important industrial and commercial center. From the 14th century, the city had the privilege of organizing fairs and became the main center of Poland's trade with Lithuania. In the 15th and16th century, the city flourished thanks to the exchange of goods with neighboring countries. Two great trade routes ran through the city: from the west to Ruthenia, from the east to Silesia and Greater Poland. In the 16th and 17th century the Jewish community developed in Lublin, which obtained many royal privileges for the city. Already in the 16th century, the city was struck by fires, burning many historic buildings down, the city was further destroyed as a result of the Northern war about a century later. This brought the city into economic decline, causing its fairs to fail (17).

Industry and prosperity

After the Northern war, a period of large urban expansion took place. At the end of the 18th century, as a result of the partition of Poland, Lublin found itself part of Austria and was the second largest city after Kraków in that region.

Industrial developments surged, and the first railway line was built, connecting Lublin to Warsaw and Kovel. After Poland regained independence, Lublin thrived as new industries and its first university emerged. Local craftsmanship and manufacturing benefited from a still recovering heavy- and food industry, in particular the leather, clothing, metal, and construction sectors. (17)

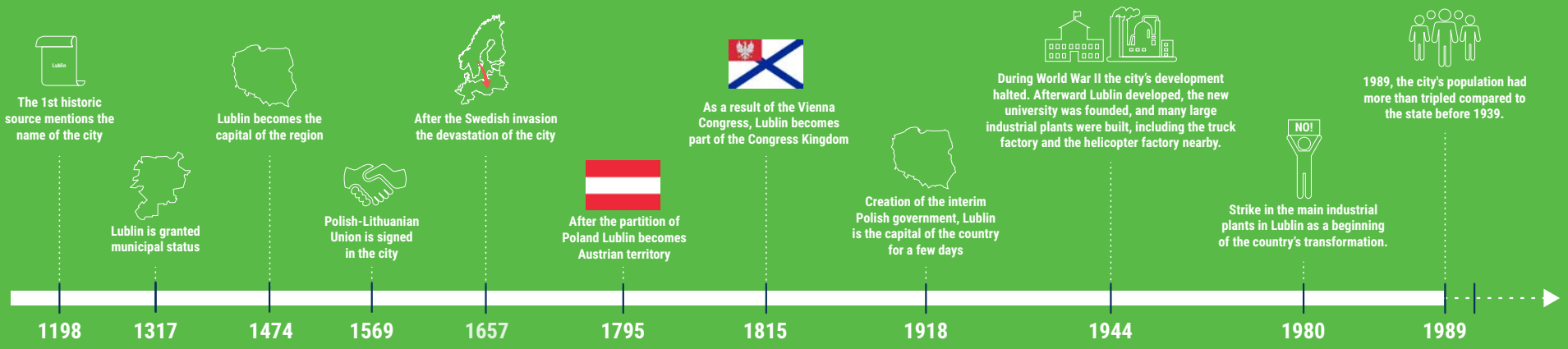


Figure 7: A history of Lublin

(17) Lublin City Council. (N.d). History. About the City.

REVISITING THE CITY: A HISTORY OF LUBLIN

Urban development

The long-awaited independence of the Temporary People's Government of the Republic of Poland, led by Ignacy Daszyński, was formed in Lublin. During this time, the city was equipped with the necessary municipal infrastructure. A thriving Lublin was hit hard in September 1939 when Germany attacked Poland. The city was bombed, destroying its built environment and using existing landmarks as offices or settlements for the German administration. Reconstruction after World War II laid the foundation for the position Lublin holds today.

During the period of Polish People's Republic (Polska Rzeczpospolita Ludowa/PRL) Lublin managed 45% of Poland's automobile production. Prestigious housing complexes are the remainders of Lublin as a socialist industrial city. In the 1960s and 1970s, Lublin's flourishing university landscape provided a hub of critical thinking as well as catholic consciousness and nourished the spirit of resistance. This manifested in Lublin's strike movement in the 1980s (18).

A catalyst for transition

Starting at the State Aviation Works in Świdnik, a city located on the outskirts of Lublin, on July 8th in 1980, workers instigated a series of strikes, demanding better wages and lower-priced food. Lublin July involved 50 000 local workers from more than 150 companies. These strikes marked the beginning of important socio-political changes in Poland, including the establishment of Solidarity Democratization of the country, a precursor to a wave of protests later referred to as the August 1980 strikes (19).

Lublin's many different historic phases have left their footprint, and history is still present in the city center. Nowadays, Lublin is a growing city seen as an attractive investment for foreign investors due to its strategic location and its versatile industrial legacy.

---

(18) The Smellscapes of Lublin. (2020). Lublin in the 20th Century - a short outline.

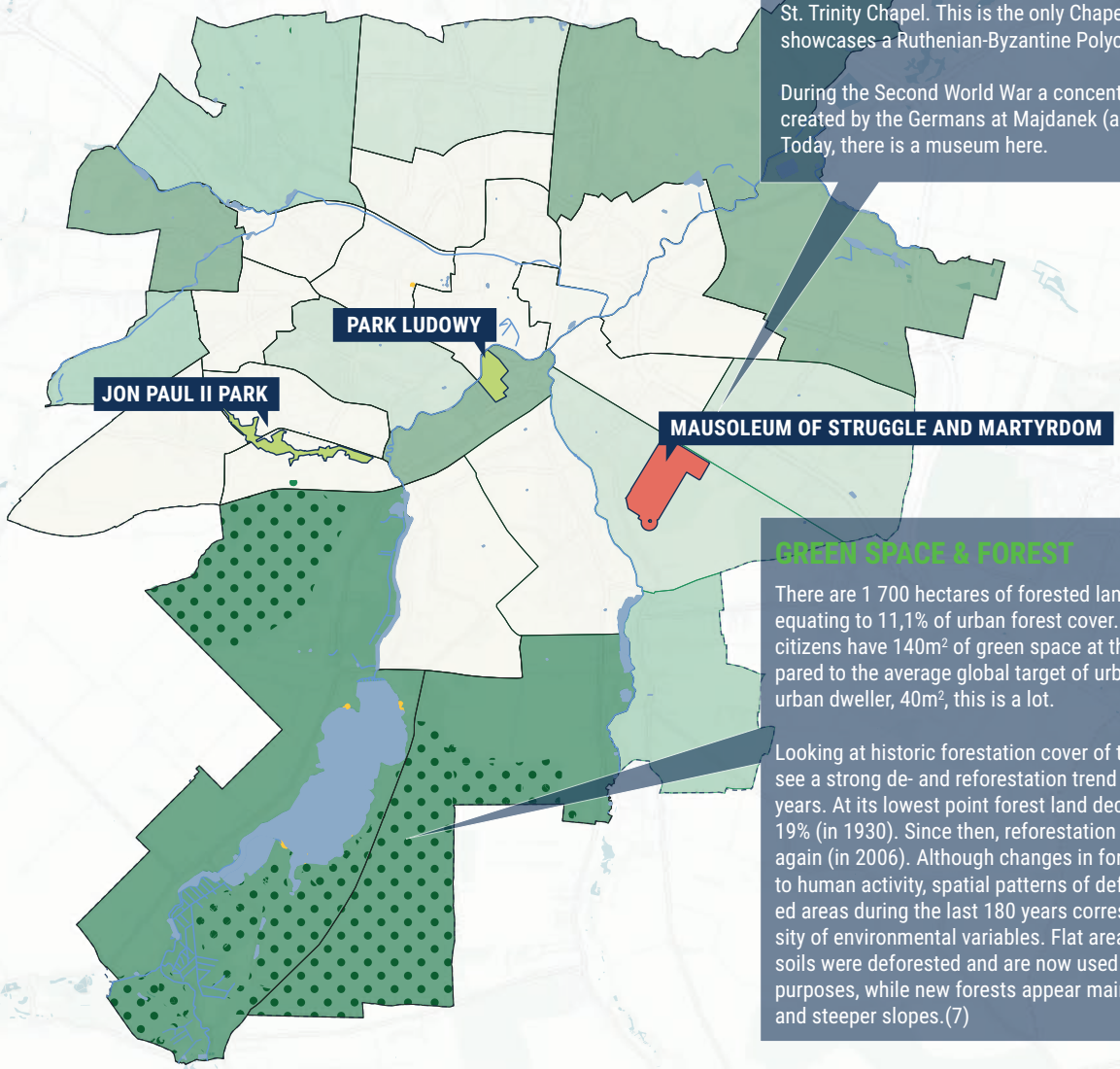
SOCIAL AND NATURAL ECOLOGY IN LUBLIN

GREEN SPACE BY CITY DISTRICT
(green space in m^2/person)

- 0 - 55
- 55 - 100
- 100 - 180
- 180 - 570
- 570 - 5 100

- Water
- Waterways

- Beaches
- Forest
- City boundary



HISTORICAL SITES

Lublin is an industrial and academic city, rich in numerous architectural monuments dating back to its origins (the Middle Ages) and the Renaissance. The most valuable monuments include the town hall from the beginning of the 15th century, the Krakowska and Grodzka gates - the remains of the former city walls and Renaissance tenement houses. Towering over the city one can see the Royal Castle with the St. Trinity Chapel. This is the only Chapel in Poland which showcases a Ruthenian-Byzantine Polychrome (wall-painting).

During the Second World War a concentration camp was created by the Germans at Majdanek (a district of Lublin). Today, there is a museum here.

GREEN SPACE & FOREST

There are 1 700 hectares of forested land in Lublin city, equating to 11,1% of urban forest cover. On average, Lublin citizens have 140m^2 of green space at their disposal. Compared to the average global target of urban green space per urban dweller, 40m^2, this is a lot.

Looking at historic forestation cover of the province we can see a strong de- and reforestation trend over the last 180 years. At its lowest point forest land decreased from 30% to 19% (in 1930). Since then, reforestation has gone up to 23% again (in 2006). Although changes in forest cover are related to human activity, spatial patterns of deforested and reforested areas during the last 180 years corresponded to the diversity of environmental variables. Flat areas covered by fertile soils were deforested and are now used for agricultural purposes, while new forests appear mainly within sandy soils and steeper slopes.(7)

6 Lublin City Council (N.d.). About the City. Lublin in Numbers.
7 Zgłobicki, W., Gawrysiak, L., Baran-Zgłobicka, B. et al. Long-term forest cover changes, within an agricultural region, in relation to environmental variables, Lublin Province, Eastern Poland. Environ Earth Sci 75, 1373 (2016).

COMMUNITY: LIVING IN LUBLIN

Who lives in Lublin?

Lublin saw a steady rise in population until 1999. In 1999, the population of Lublin was estimated at 359,154, the highest in the city's history. Since then, the population has been declining. Still, construction in Lublin is continuing. Lublin is home to 9 universities (5 public and 4 private), and boasts a population of 60 988 students - approximately 18% of the city's total population. Lublin is the largest academic centre in Eastern Poland and is a centre for scientific and academic research recognised across Poland (11).

A city of neighborhoods

Lublin's most densely populated neighbourhoods sit to the south-west (śródmieście) and north-east (Bazylianówka) of the city centre, with the student population concentrated around a cluster of the largest universities, east of the city centre in Rury and Wieniawa. The inner city is characterised by higher rates of unemployment, use of social services, and socio-economic disadvantage in comparison to the suburbs, and is the target of the Municipal Revitalization program. This program seeks to renovate older buildings, stimulate economic development and attract businesses to the inner city in an effort to reverse suburbanisation trends within Lublin.

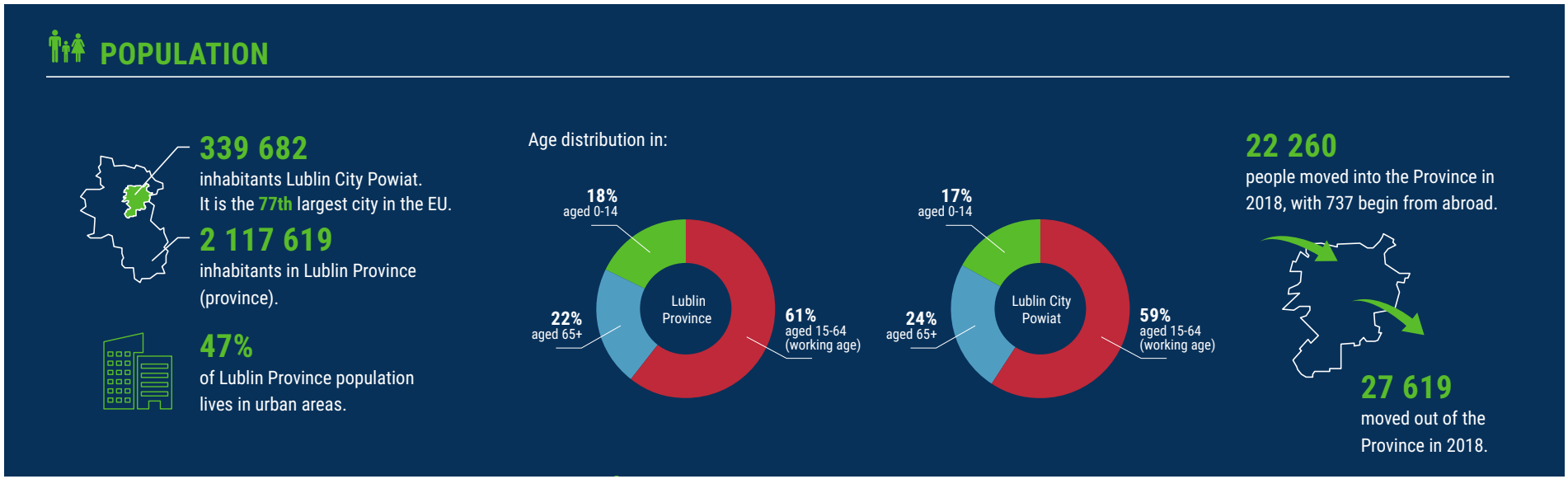


Figure 8: Demographics in Lublin.

(11) Lublin City Council (N.d.). About the City. Lublin in Numbers.

COMMUNITY: LIVING IN LUBLIN

Lublin's strengths: A livable city

The good condition of the natural environment, the relatively small amount of waste produced in the city, and the relatively good air quality, are some of Lublin 's most important assets. A recent analysis by PWC awarded 98,2/100 quality of life points to Lublin. Lublin also joined the group of cities with a Smart City certificate in 2019 and it has a well-developed citizens participation budget, focusing on nature protection and greening the city. According to the city's Strategy (8), sustainability is one of the characteristics of Lublin thanks to the green transport, investments in zero-emission public transport fleets, city bike systems, electric scooters and car-sharing.

Lublin is one of the cultural centres of Poland, with high expenditure on culture and the protection of national heritage. A lot of theatre festivals are organized by both local authorities and the academic community. One of the most important elements of the city's cultural map is the Modern Centre for the Meeting of Cultures - a space where cultural and entertainment events take place. Not only thanks to that, but the good quality of life in Lublin is also linked to a sense of security among residents, mainly due to the low crime rate, which is two-fold lower than in other cities in Poland (12).

A connected city

The infrastructure of Lublin is going to be one of its advantages. Several modern road and rail connections linking the city with other parts of Poland and the Lublin Airport, opened in 2012, provide quick access to the most important cities and transport hubs of Europe. The international and domestic airport is located in the city, the newly modernised railway from Warsaw is planned to be opened in 2020, and the S-17 route to Warsaw by the end of 2019. Moreover, among Polish cities, Lublin is at the forefront in terms of length and quality of cycling infrastructure (11).

A developing city

Although the population is slightly declining, there is still plenty of construction happening as 2,889 dwellings were built in 2018, equating to a 65% increase on 2010 (12).The development of infrastructure and the creation of favourable business conditions have given Lublin its position on the economic map of Poland and Europe. It boasts one of the most favourable investment dynamics in the country, with the Special Economic Zone being one of the most attractive forms of investor support (1). Investment in this zone involves the development of a comprehensively prepared area and comes with significant tax benefits. An additional advantage is the excellent location of the plots near the express road and the Lublin airport.

(11) Lublin City Council (N.d.). About the City. Lublin in Numbers.

(12) Polish Statistical Office. (2020). Lubelskie Voivodeship. Subregions, Powiats, Gminas 2019 source.

ANALYSING LUBLIN'S CURRENT-STATE

ANALYSIS STEPS

Stakeholders and policies

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

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

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

Mapping material flows

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

Each of the lines represents a different resource category.

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

Mapping Opportunities

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

Insights deep dive: Lublin's sectors in focus

The sources of this chapter are indicated by letters (a-e), and listed in data tables at the end of the document.

OVERVIEW OF SECTORS AND WHY THESE HAVE BEEN CHOSEN

WASTE

Why?

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

STAKEHOLDERS AND POLICIES
page: 75

LUBLIN'S WASTE SYSTEM
page: 76 & 77

MAPPING OPPORTUNITIES
page: 78

UTILITIES

Why?

Utilities such as energy and water are basic necessities for a wide range of processes in the city. Providing a steady and sustainable supply of these services is fundamental to a resilient and healthy urban ecosystem.

An analysis of Lublin's municipal energy supply shows that the city's consumption of almost 5 500 GWh/year remains largely reliant on coal combustion.

To date, only 0,06% of Lublin's energy demand comes from renewable sources (2% when including biofuels). Harnessing Lublin's potential to transition to a cleaner energy system is imperative for moving towards a flourishing, sustainable economy.

STAKEHOLDERS AND POLICIES
page: 80 & 82

LUBLIN'S WATER AND ENERGY SYSTEM
page: 81 & 83

MAPPING OPPORTUNITIES
page: 84

CONSTRUCTION

Why?

Having a comfortable, safe and healthy living environment is a basic necessity for all. Yet, the creation of our built environment is currently associated with highly extractive material use and high associated embedded CO_2-emissions on a global scale.

Sustainable materials, logistics, technologies and building techniques can contribute to a healthy environment in Lublin, and contribute to the fight against climate change on a global level. Lublin's revitalization projects across six areas in the city provide important entry-points to test, develop and scale sustainable and circular building practices.

STAKEHOLDERS AND POLICIES
page: 86

LUBLIN'S CONSTRUCTION SECTOR
page: 87

MAPPING OPPORTUNITIES
page: 88

AGRIFOOD

Why?

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

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

STAKEHOLDERS AND POLICIES
page: 90

LUBLIN'S AGRIFOOD SECTOR
page: 91

MAPPING OPPORTUNITIES
page: 92

Municipal Waste

Compared to other EU citizens, Lublin's inhabitants generate small amounts of municipal waste: only 357 kg a year (487 kg per European resident), summing to a total of 130 360 Mg a year. The amount of industrial waste generated in Lublin (not counting treated municipal waste) is significantly more: 157 500 Mg.This amount however is also relatively small compared to some more heavily industrialized cities in Poland. National recycling policies are becoming increasingly strict, and Lublin is actively encouraging its inhabitants to cooperate to reach these goals. Residents separate waste into five streams, and a Selective Municipal Waste Collection Point was created in the city (PSZOK), to which residents can bring certain types of waste free of charge.

Still, not all waste is treated at its highest value. A large part of municipal waste from Lublin is burned in the cement plant in Chełm to turn into alternative fuel. Heat recovery from waste is one of the lowest forms of value creation from waste. An even lower form of waste treatment in the hierarchy of value retention is landfilling. Yearly, Lublin still landfills 1 241 Mg of municipal waste).

Highlighted opportunities:

- Closer monitoring of recycling activities to obtain an overview of high value waste streams and information on their treatment.
- Using the traditional approach of respecting and repairing goods, encouraging communities to repair and reuse, including programming, by making local spaces available.

Industrial Waste

Despite its small industrial base, Lublin's industry still generates more waste than the city's private households. In 2018, local industry was responsible for 157 500 Mg of waste. While data on recycling and recovery practices is often missing, it is evident that a large proportion of industrial waste streams are sent directly to landfills or recovered at their lowest possible value. The construction industry and food industry are two of the largest waste generators, providing crucial entry points to transition Lublin's industrial ecosystem towards a more circular state.

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

Highlighted opportunities:

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

WASTE SECTOR: KEY PLAYERS AND POLICY

POLICY

- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).
- **Krajowy program zapobiegania powstawaniu odpadow** (Polish National Waste Prevention Programme).
- **Analiza stanu gospodarki odpadami komunalnymi miasta Lublin za rok 2018** (Analysis of the state of the economy municipal waste from the city Lublin for 2018).

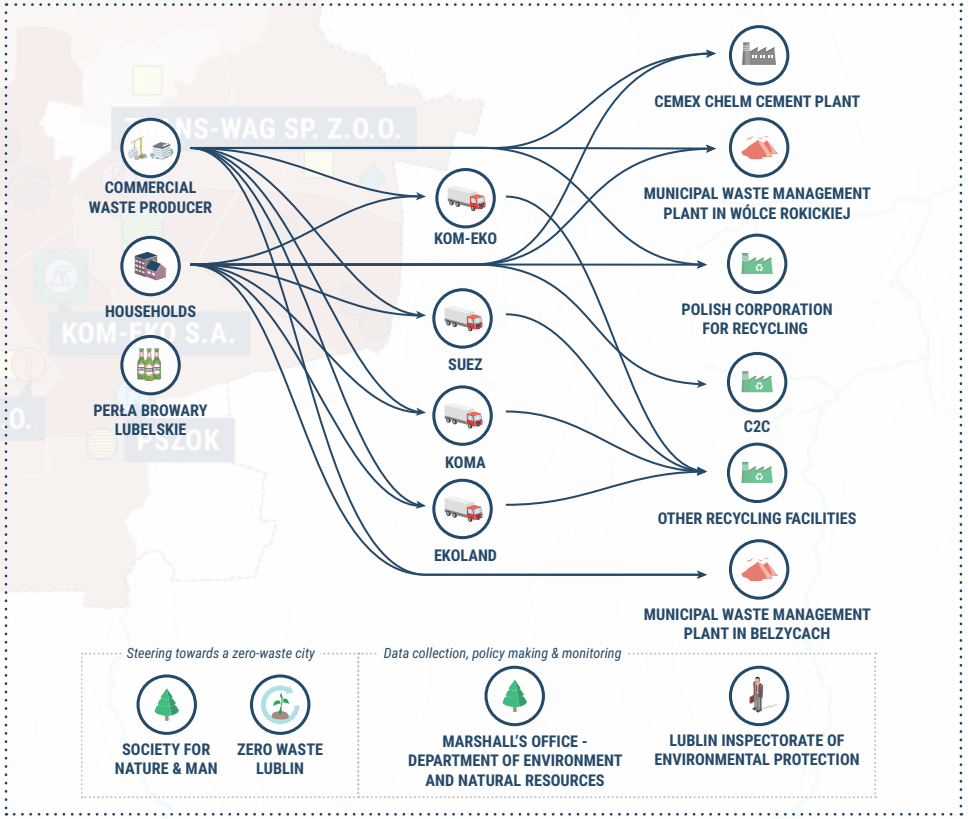
KEY OBJECTIVES

- **Development** of a green waste management system, **expansion** of existing waste facilities (dump).
- **Ban** on biodegradable waste collected separately.
- **Ban** on combustible waste with > 5 % Total Organic Carbon, >8% Loss on Ignition, and a Calorific value > 6MJ/kg.
- From 2012 **Division** of the city of Lublin into sectors to organize collection of municipal waste from property owners.

STAKEHOLDERS

In Lublin, municipal waste from inhabited real estate is collected and managed by Kom-Eko S.A., SUEZ Wschód Sp. z o.o., KOMA Lublin Sp. z o.o. and Ekoland sp.z o.o. each of these companies collects the following waste: paper and cardboard, glass, metals and plastics, BIO waste, mixed waste, green waste, construction and demolition waste (free 1m³ per household) and furniture and other bulky waste.

In single-family farms there are 6 fractions - green waste. In addition, the following types of waste are subject to separate collection in places indicated by the city: expired drugs, expired chemicals, waste batteries and spent accumulators, waste electrical and electronic equipment, worn tires. zero waste Lublin is an NGO that advocates the reduction of consumption and sets up initiatives to transition to a no-waste city. Examples of circular use of materials in the city are C2C (manufacturers of bioplastics) and the Perla brewery, which uses their rest products as feed for livestock. The Marshall's office is (partly) responsible for data collection.



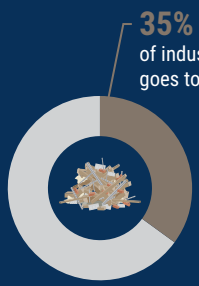
INDUSTRIAL WASTE

The total of industrial waste is almost double the amount of municipal waste generated in Lublin.

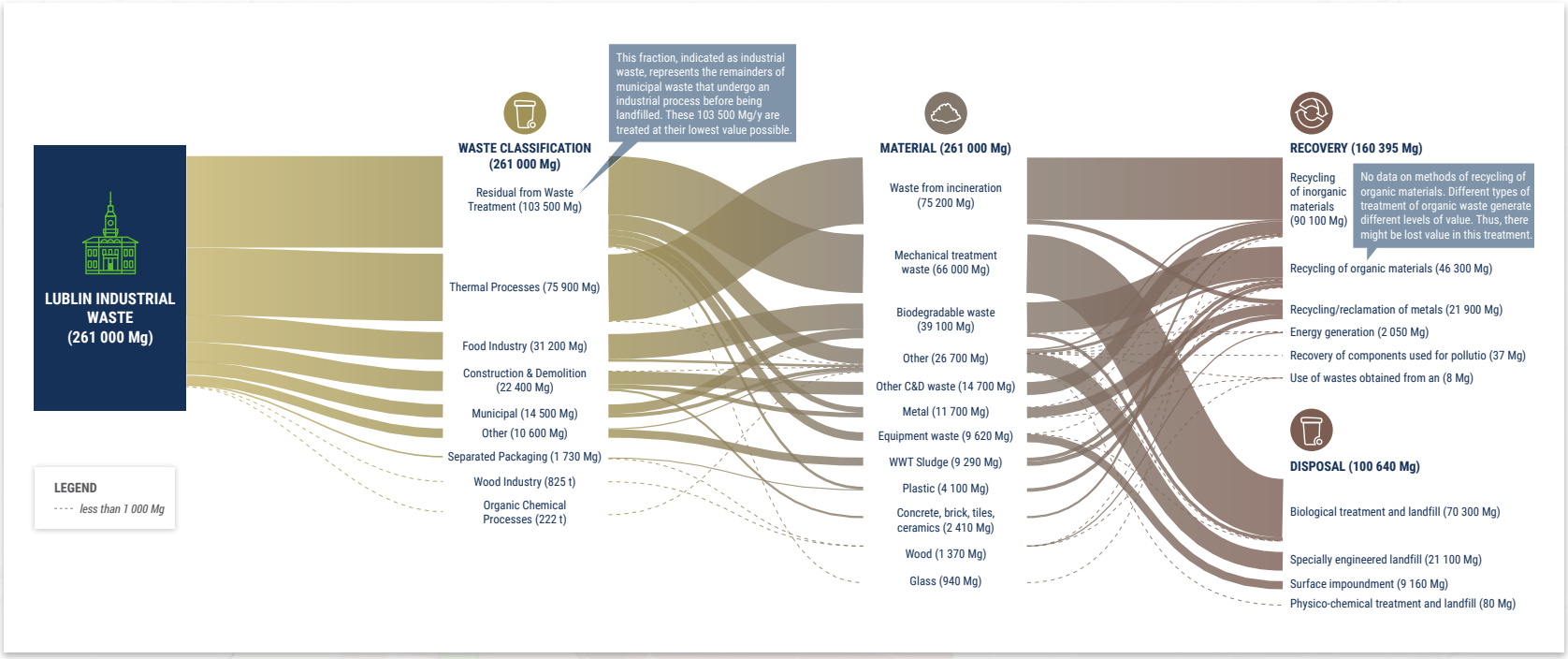
261 000
Mg/y industrial waste

130 630
Mg/y municipal waste

91 400 Mg of the total amount of industrial waste goes to landfills.



MATERIAL FLOW ANALYSIS (a2)



Industrial waste generation

This waste category represents all waste generated by the industrial activities of Lublin. A large fraction that is reported as industrial waste (indicated as 'residual from waste treatment') is composed of remainders of municipal waste that undergo an industrial process before being landfilled. Without this latter category, Lubin's industrial waste would only be 157 500 Mg/y. This relatively small amount of industrial waste is due to the fact that Lublin does not have a lot of industry.

Collection and sorting

Industrial waste streams are more homogenous than municipal waste, and therefore do not have to be sorted as much as municipal waste before treatment. Industrial waste streams, such as wood, metals, and waste from industrial food processing, can be reused or recycled at very high value.

End of life

A large portion of industrial waste in Lublin is currently sent to landfill (35%). This is an enormous yearly loss of value. For a few categories of industrial waste treatment named 'recycling', it is unknown which recycling methods are used, or which products are the output of these processes, and in what quantities. This lays out large potential for higher value processing of industrial waste.

(a2) Sources in table a2.

MUNICIPAL WASTE

Citizens of Lublin are obliged to separate their waste into 5 streams:

Other separated waste categories:

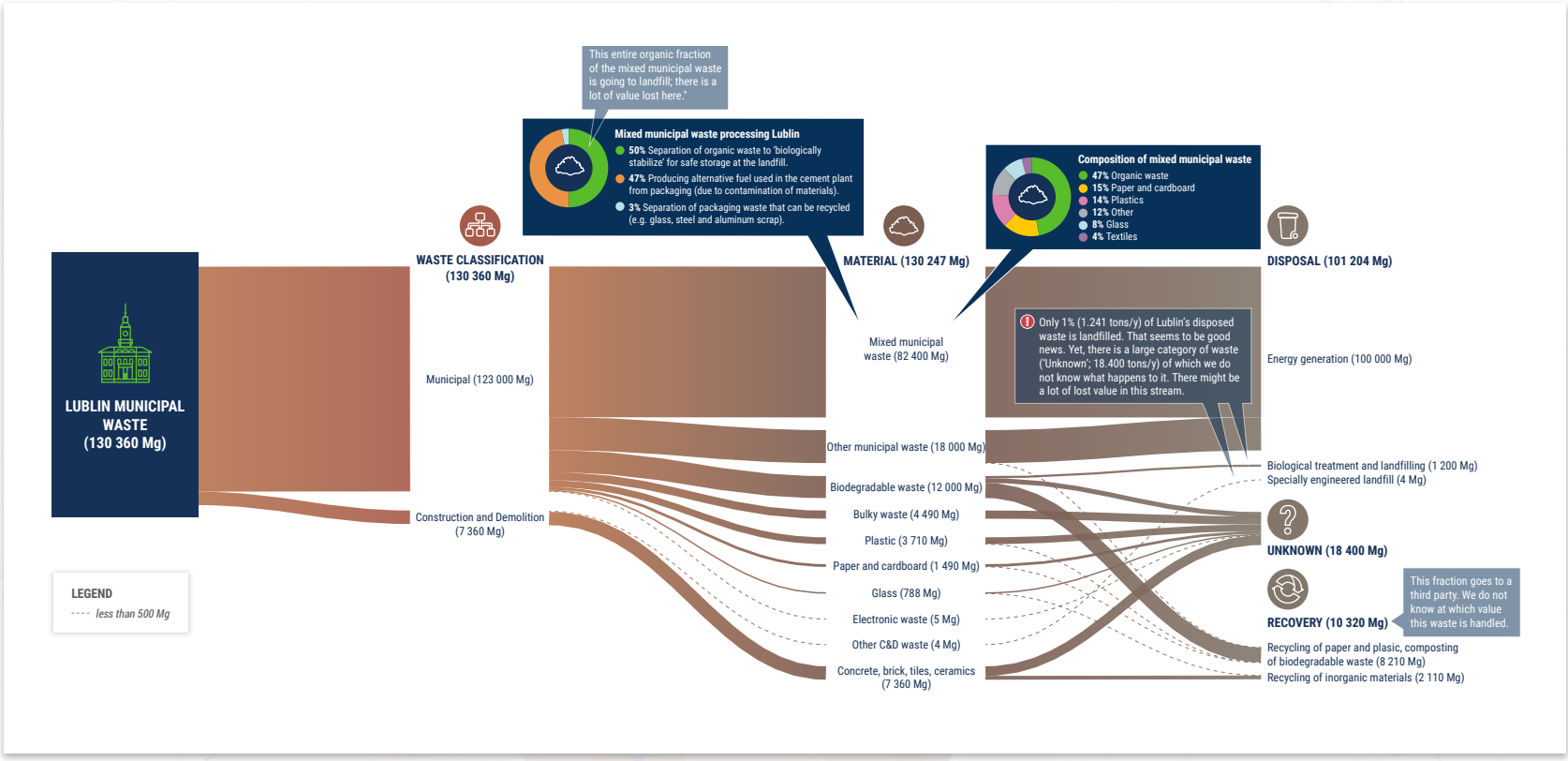
- Green waste.
- Construction and renovation waste.
- Expired medicines.
- Expired chemicals.
- Used batteries and accumulators.
- Waste electrical and electronic equipment, fluorescent lamps and waste energy-saving light bulbs.
- Used tires - cyclical actions and permanent collection points.
- Furniture and other bulky waste.

Lublin vs EU waste generation:

People in Lublin on average generate **27% less** waste than their fellow EU citizens

14% of waste unmonitored ?

MATERIAL FLOW ANALYSIS (b2)



Municipal waste generation

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

Collection & sorting

Municipal waste is collected through different collection methods, including selective municipal waste collection points and at the PSZOK facility, ambulatory collections of hazardous waste (i.e. by KOM-EKO) selective waste collection containers (managed by SUEZ, among others), containers of the Polish Corporation for Recycling for electrical waste, and collection bins on site (i.e. on construction sites).

End of life

Separated streams are processed by designated recyclers. Bio waste is composted. The Polish Corporation for Recycling processes hazardous and electronic waste. All mixed municipal waste from Lublin is processed in MBP installations either in ZZO KOM-EKO in Lublin, in ZZO Wólka Rokicka or in other plants with the status 'municipal installation'.

(b2) Sources in table b2.

WASTE IN LUBLIN (a1)

Waste generated by industries by city district

- 0 - 50 Mg
- 50 - 500 Mg
- 500 - 2 500 Mg
- 2 500 - 20 000 Mg
- 20 000 - 140 000 Mg

Primary waste recovery facilities (t material recovered/year)

- >1 000 - 10 000 Mg
- 10 000 - 100 000 Mg
- 100 000 - 121 000 Mg

Waste disposal facilities

- Physico-chemical treatment of waste
- Landfill
- Biological treatment of waste
- Surface impoundment
- Selective Collection Point (PSZOK)
- Battery Collection Point
- Hazardous Waste Collection Assembly Point

Top industries by total waste generated (2017)

- >5 000 - 20 000 Mg
- 20 000 - 60 000 Mg
- 60 000 - 140 000 Mg

Municipal waste processing facilities (>2 000 - 88 000 Mg collected 2018)

City boundary

MATERIAL FLOW ANALYSIS: WASTE

MUNICIPAL WASTE MANAGEMENT PLANT IN WÓLCE ROKICKIEJ

2. ZA CUKROWNIA: 42 897 Mg/Y (16%)

Top 3 waste streams:

I. Waste management facilities, off-site waste, water treatment plants
II. Construction and demolition waste
III. Agriculture, forestry, food processes

3. SRODMIESCIE: 27 888 Mg/Y (11%)

Top 3 waste streams:

I. Construction and demolition waste
II. Waste packaging, absorbants, wiping cloths,
III. Agriculture, forestry, food processes

4. SLAWINEK: 27 833 Mg/Y (11%)

Top 3 waste streams:

I. Waste management facilities, off-site waste, water treatment plants
II. Construction and demolition waste
III. Agriculture, forestry, food processes

INDUSTRIAL WASTE IN LUBLIN*

Here we visualize industrial waste generation per district, as well as the most important players in the waste system: waste disposal facilities, waste recovery facilities, and industries generating waste. Most industrial waste is produced in districts with low population density. Based on annual waste volume and infrastructure, we highlight 6 industrial waste generating districts.

"The total of industrial waste generated per district is tied to a self-reported address. The reported address might be an alternative company site (e.g. corporate office) rather than the industrial facility generating the waste, which possibly confounds the data.

TRANS-WAG SP. Z.O.O.

KOM-EKO S.A.

SUEZ WSCHOD SP. Z.O.O.

PSZOK

6. FELIN: 21 967 Mg/Y (8%)

Top 3 waste streams:

I. Construction and demolition waste
II.Shaping and physical and mechanical surface treatment of metals and plastics
III. Human or animal healthcare or related

MUNICIPAL WASTE MANAGEMENT PLANT IN BEŁŻYCACH

1. DZIESIĄTA: 139 034 Mg/Y (53%)

Top 3 waste streams:

I.Waste management facilities, off-site waste, water treatment plants
II. Construction and demolition waste
III. Waste packaging, absorbants, wiping cloths

5. BRONOWICE: 26 227 Mg/Y (10%)

Top 3 waste streams:

I. Waste management facilities, off-site waste, water treatment plants
II. Waste not otherwise specified
III. Thermal processesa

(a1) Sources in table a1.

0 km 2,5 km 5 km

Energy

Lublin's energy consumption of almost 3 500 GWh/year remains mostly reliant on fossil fuels, mainly coal and natural gas. The bulk of the energy is consumed by the densely populated areas in the west and the center of the city, as well as by industry and commercial buildings. Much energy potential of the carbon-based energy sources is wasted in the conversion to electricity and heat. However, making these plants more efficient alone won't drive Lublin's sustainability transition. There are many untapped opportunities in the adoption of renewable energy systems, starting with leveraging the solar exposure of the city. Commercial and industrial buildings provide large opportunities for energy-efficient renovation. Wind is not an option in Lublin due to the legislation around space.

Highlighted opportunities:

- Reduce energy use by including energy efficiency guidelines in zoning regulations.
- Promote renewable energy in the city's revitalization zones. To protect the cultural heritage of the city, clean energy production in the city center might be limited. The less dense neighborhoods at the edges of the city might have to compensate for the lack of clean energy production in the dense city center.
- Assessing the potential of industry and data centers as alternative heat sources for municipal heat systems.

Water

The Lublin Province stands out in Poland for its limited amounts of surface water and relatively large resources of good quality groundwater. These groundwater levels have been built up over decades of rainwater seeping through the limestone undergrounds (which purifies the water and adds minerals). Due to increased urbanization in the Lublin region, infiltration of precipitation has decreased and surface water run-off has increased, causing water to 'leave' the region via the river. This might create problems for future groundwater levels causing 'depressions' in water levels and water quality. The quality of the surface and groundwater is shaped by human activity. The conflicts which arise in regards to water demands of municipal, industrial, mining, agricultural, and environmental protection purposes require carefully weighed decisions.

Highlighted opportunities:

- Improving water drainage capacity and rainwater capture of the entire city.
- Closing water cycles locally to diminish groundwater uptake.
- Recovering nutrients from wastewater to prevent value loss.

ENERGY SECTOR: KEY PLAYERS AND POLICY

POLICY

- **Plan Gospodarki Niskoemisyjnej dla Miasta Lublin 2015** (Low Carbon Economy Plan for Lublin 2015).
- **Strategia rozwoju Lublina na lata 2013-2020** (Lublin Development Strategy 2013-2020).
- **Założenia do Planu Zaopatrzenia w Ciepło, Energie Elektryczna i Paliwa Gazowe dla Miasta Lublin na lata 2019-2033** (Assumptions for the Supply Plan Heat, Electricity and Gas Fuels for the city of Lublin for years 2019-2033).

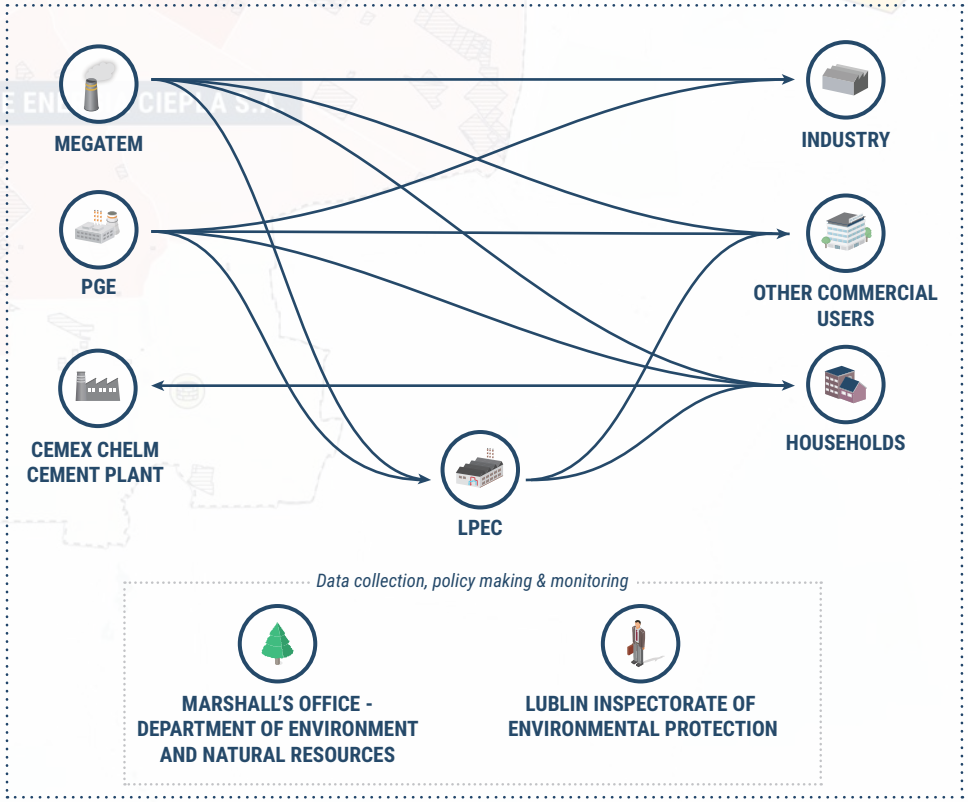
KEY OBJECTIVES

- **Decrease** energy use by 9,7% from 2008 levels, **increase** sustainable energy consumption to 17,8%.
- **Modernize** the load point of the city's heat and lighting system, **decrease** CO_2 emission by 23% from 2008 levels.
- **Utilize** electricity and heat generated by renewable energy installations, **use of** waste heat from industrial processes.

STAKEHOLDERS

Currently, the majority of all energy consumed in Lublin is generated by Megatem and PGE. Two heat and power plants which transform coal into both electricity and heat. The heat is generated in the cogeneration process, in the production of energy "waste" hot water is produced which is sold to LPEC. A large part of municipal waste from Lublin is utilized in the cement plant in Chełm, where the waste is burned as an alternative fuel.

The District Heating Network distributes heat throughout the city. The majority of this energy is used by residential functions in the city.

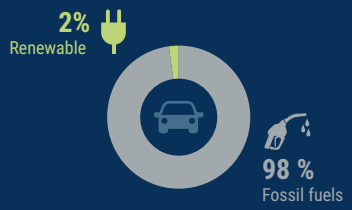


ENERGY

Bus to car ratio in Lublin:

1 bus /1 000 people

557 cars /1 000 people



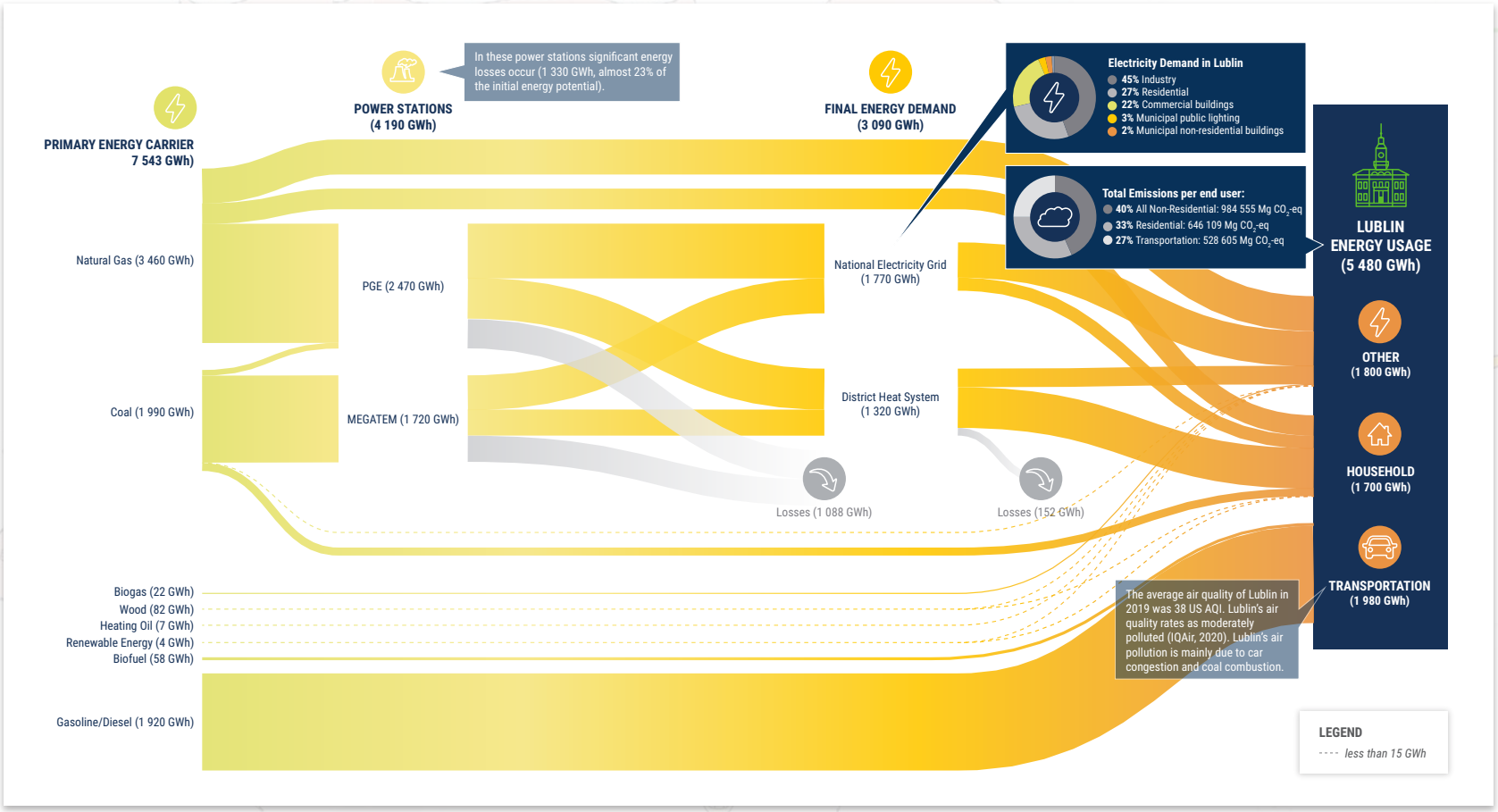
Energy priorities for the city of Lublin*:

- Improving **energy efficiency** in buildings.
- Developing sustainable multimodal **urban mobility** and low-carbon transport.
- Development of **thermal energy** heating systems.
- **Production and distribution** of energy from renewable energy sources.
- Increasing **energy efficiency** in enterprises and administration
- Information, **education** and supplementary activities.

**according to the "Low-emission Economy Plan for the city of Lublin (PGN)*

MATERIAL FLOW ANALYSIS (c2)

CEMEX CHELM CEMENT PLANT



Primary energy use

The primary energy use of the city is currently calculated on the basis of consumption as registered in 2018. We can see that there are three main energy sources (coal and gas for building energy demand, and gasoline/diesel for transport). Of all energy consumption only 2% comes from renewable sources (including biobased fuels).

Conversion

Power stations including the coal power station convert coal into electricity and heat. Heat is mostly distributed through the District Heating System. In these power stations significant energy losses occur (1 330 GWh, almost 23% of the initial energy potential). The final energy demand of Lublin is divided between electricity, natural gas, and heating (gasoline and diesel for transport).

End use

The total energy usage of the city is divided between households, transportation and 'other', which is mainly comprised of industrial energy use. Here we can see that industrial and commercial energy use is responsible for 51% of all energy (not including transportation) and households are responsible for 49%.

(c2) Sources in table c2.

WATER SECTOR: KEY PLAYERS AND POLICY

POLICY

- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).
- **V aktualizacja KPOSK (AKPOSK 2017)** (National program for municipal wastewater treatment).

KEY OBJECTIVES

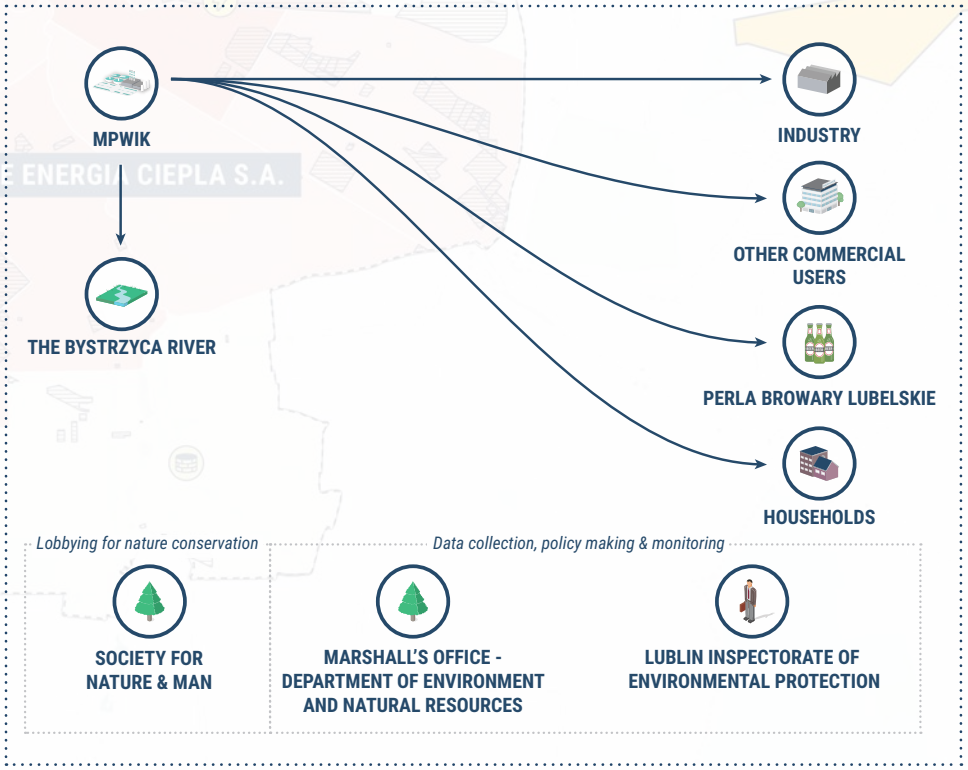
- **Protection** of surface waters by modernization of rainwater drainage system.
- **Enlargement** and modernization of the water supply network, connecting new households to the network.
- **Modernization** of sewage network and **investment** into treatment plants.

STAKEHOLDERS

The water system in Lublin is managed by MPWiK and provides the drinking water for all Lublin residents and industries. Currently the all of the water used in the city is obtained from a group of drilled wells spread throughout the south, south-east and north-west of the city. After consumption by households **(61%)**, industry **(15%)** and other commercial uses **(24%)** the water is processed by the MPWiK water purification plants in the (north)-east of the city.

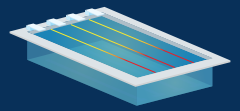
The water consumption in Lublin was at its highest point around 200 but has since decreased due to better water management and the departure of some industrial players which were large consumers of drinking water.

One of the most interesting industrial companies which consumes water is **the brewery.**



WATER

Yearly, 78 million m³ of rain falls on Lublin. This is equal to:

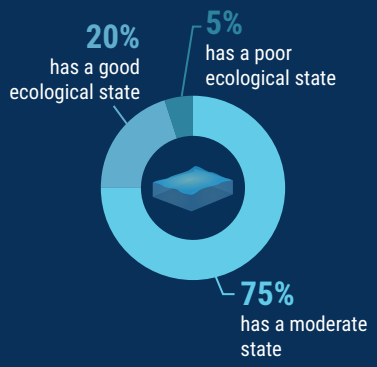


31 500

OLYMPIC SIZED SWIMMING POOLS

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

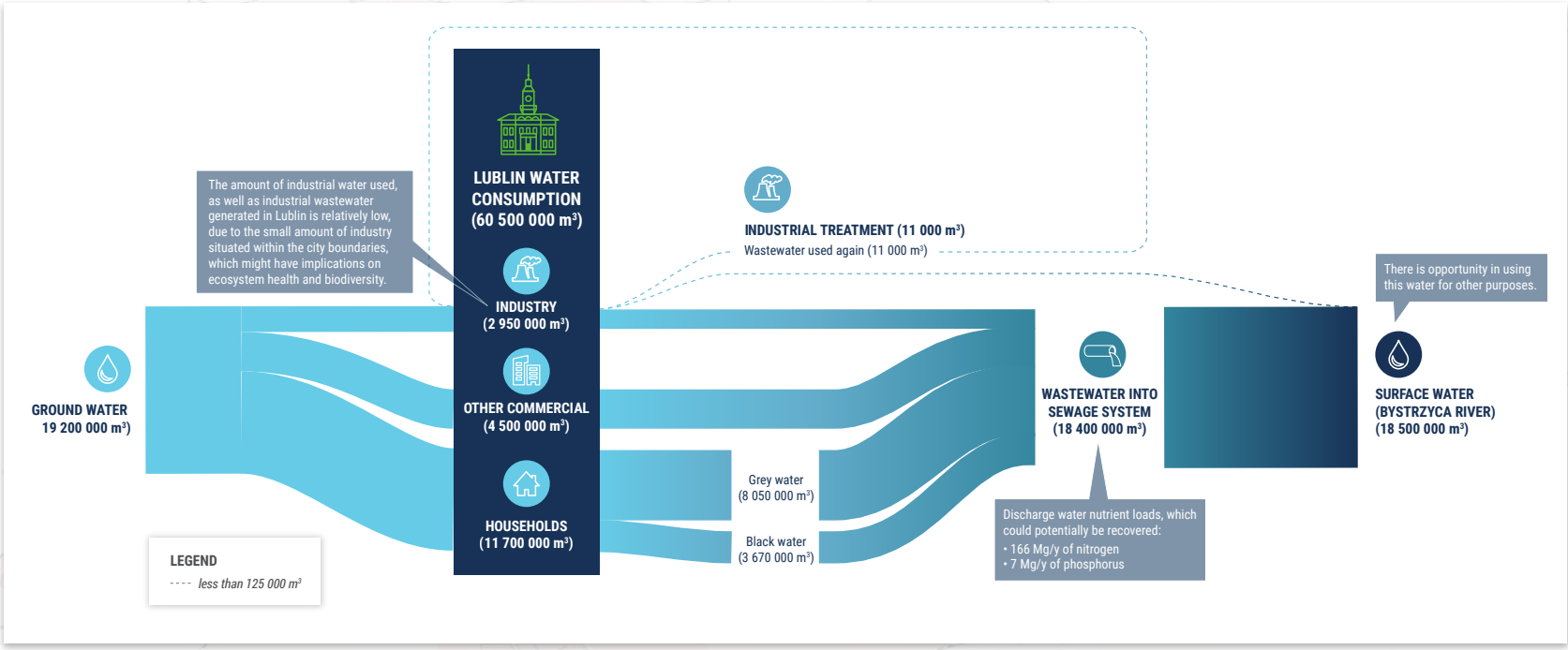
The ecological state of the rivers and surface waters in the Lublin District*:



**As researched by the Lublin Inspectorate of Environmental Protection.*

MATERIAL FLOW ANALYSIS (d2)

CEMEX CHELM CEMENT PLANT



Sourcing

All of Lublin's water is sourced from groundwater resources of the Bystrzyca river basin, via drilled wells throughout the city and its outskirts. Larger wells are located in the South, South-East and North-West of the city.

Wastewater treatment

Household and industrial sewage in Lublin is transported through a system of channels and is treated by the Main Wastewater treatment plant located in the East of Lublin. To enhance the quality of the surface water the sewage system plant has been modernized of over the past several years, causing a reduction ratio of basic pollution indicators by 97,1%. Still some improvements might be needed as researched by the Inspectorate of Environmental Protection in Lublin.

Disposal

After being treated the (waste)water is being released into the Bystrzyca river. Some of the industrial wastewater is directly disposed into the waterways. Rainwater runoff is directly disposed into the river via a separate drainage system.

(d2) Sources in table d2.

UTILITIES IN LUBLIN (c1,d1)

POPULATION DENSITY BY CITY DISTRICT (persons/km²)

- 115 - 1 000
- 1 000 - 2 500
- 2 500 - 5 000
- 5 000 - 8 000
- 8 000 - 11 300

UTILITIES

- City energy facilities
- Data centres
- Water treatment plants
- Water tower
- Water wells

- Major industrial areas
- Airport
- City boundary

WATER TREATMENT & EXTRACTION

There are two water treatment plants in the North-East of Lublin which purify the water using both mechanical and biological cleaning methods. Among these treatment plants is the "Hajdów" sewage treatment plant, that treats domestic and industrial sewage from the Lublin agglomeration at a daily average of around 120 000 m³/day. Through a continuous process of modernization over the last years, the plant is now able to reduce the basic pollution indicators by around 97,1% on average, while producing biogas in the fermentation proces. In addition, the plant has constructed a solar farm of 5 hectares, that is planned to produce around 2 000 MWh anually. After cleaning, the water is released into the river, exiting the city. There is an opportunity to repurpose this treated water.

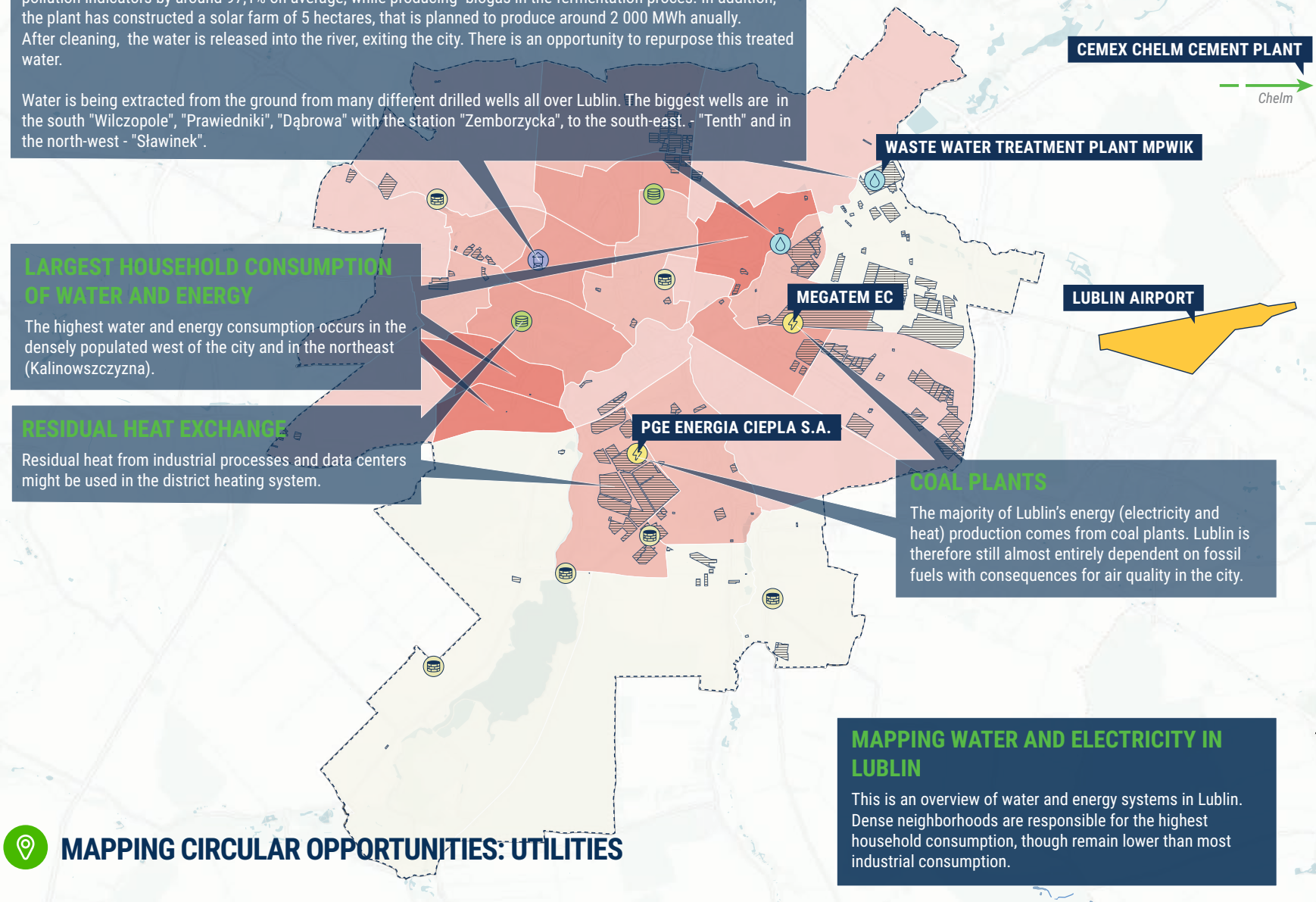
Water is being extracted from the ground from many different drilled wells all over Lublin. The biggest wells are in the south "Wilczopole", "Prawiedniki", "Dąbrowa" with the station "Zemborzycka", to the south-east. - "Tenth" and in the north-west - "Sławinek".

LARGEST HOUSEHOLD CONSUMPTION OF WATER AND ENERGY

The highest water and energy consumption occurs in the densely populated west of the city and in the northeast (Kalinowszczyzna).

RESIDUAL HEAT EXCHANGE

Residual heat from industrial processes and data centers might be used in the district heating system.



COAL PLANTS

The majority of Lublin's energy (electricity and heat) production comes from coal plants. Lublin is therefore still almost entirely dependent on fossil fuels with consequences for air quality in the city.

MAPPING WATER AND ELECTRICITY IN LUBLIN

This is an overview of water and energy systems in Lublin. Dense neighborhoods are responsible for the highest household consumption, though remain lower than most industrial consumption.

MAPPING CIRCULAR OPPORTUNITIES: UTILITIES

(c1, d1) Sources in table c1 and table d1.

0 km 2,5 km 5 km

CONSTRUCTION

In 2018, the construction sector worldwide was responsible for 39% of CO_2 emissions and an estimated 60% of the total global use of materials (21). In Poland, the situation is no different: construction makes up one of the city's largest material demands. With this in mind, we view the construction chain as an important leverage point to tackle when transitioning to a circular economy.

Despite the decline in population numbers, Lublin is building.

A total of 280 460 m² of building (floor) space was added in 2018 alone, using 455 000 Mg of construction materials. Demolition freed up 45 000 Mg of building materials, as registered yet in reality, this is likely to be much higher since unregistered demolition materials are currently excluded. To achieve a circular construction chain, keeping account of all construction waste (including waste generated and processed on-site), sorting properly, and reusing materials at their highest possible value are crucial. The municipal government aims to improve its connectivity by making the entire city more accessible by developing roads and public transport.

Highlighted opportunities:

- Increased monitoring of building material flows on construction sites to identify available secondary materials.
- Using PSZOK points as hubs for circular construction, i.e. by collecting and selling secondary construction materials. Start with the construction waste generated in zones that are currently being revitalized, such as Stare Miasto, that has both construction and demolition projects planned.
- Implementing tendering guidelines for building materials in line with circular concepts for use in the construction of new buildings.
- Use of public buildings as a showcase for a sustainable construction sector, especially in areas subject to revitalization.

(21) Global Status Report for Buildings and Construction 2019 – Analysis - IEA

CONSTRUCTION SECTOR: KEY PLAYERS AND POLICY

POLICY

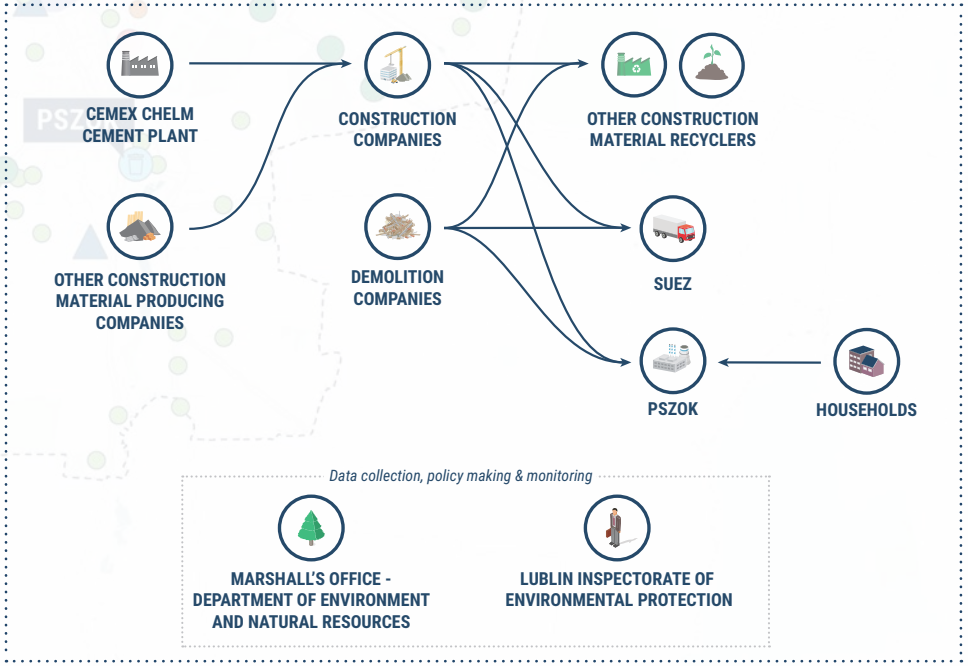
- **Program Rewitalizacji dla Lublina na lata 2017- 2023** (Revitalization Program of the City of Lublin in the years 2017-2023).
- **Analiza stanu gospodarki odpadami komunalnymi miasta Lublin za rok 2018** (Analysis of the state of the economy municipal waste from the city Lublin for 2018).
- **Ustawa z dnia 14 grudnia 2012 r. o odpadach** (Act on Waste 2012)
- **Ustawa z dnia 13 września 1996 r. o utrzymaniu czystości i porządku w gminach.** (Act on maintaining cleanliness and order in municipalities of 13 September 1996 as amended).
- **Prawo zamówień publicznych 2013** (2013 Public Procurement Law).

KEY OBJECTIVES

- **Revitalization** of degraded areas (59 individual projects in revitalization programme, 5 areas in the strategy).
- **Increasing** the quantity selective municipal waste collection points (PSZOK).
- By 2020, preparation for re-use, recycling and other forms of recovery of construction and demolition materials should achieve the level of **at least 70% by weight.**
- **Mandatory separate collection of construction and demolition waste** that is part of municipal waste.
- Public entities shall use criteria of reuse or preparing for reuse of waste in **public procurement,** provided that it is possible.

STAKEHOLDERS

Despite the decline in population in Lublin, the construction sector is booming. The private sector has a relatively strong role in the construction sector. On one hand this allows for quick mobilization around the circular economy, but this can also be a barrier to the transparent exchange of data. A proportion (unknown quantity) of construction waste is processed onsite; downcycled materials are then used there as well. The rest of the construction waste is collected at the PSZOK point.



CONSTRUCTION

The PSZOK point in Lublin collects construction and demolition waste. Yearly, this amounts to:

593 500

Mg of concrete waste and concrete debris

360 700

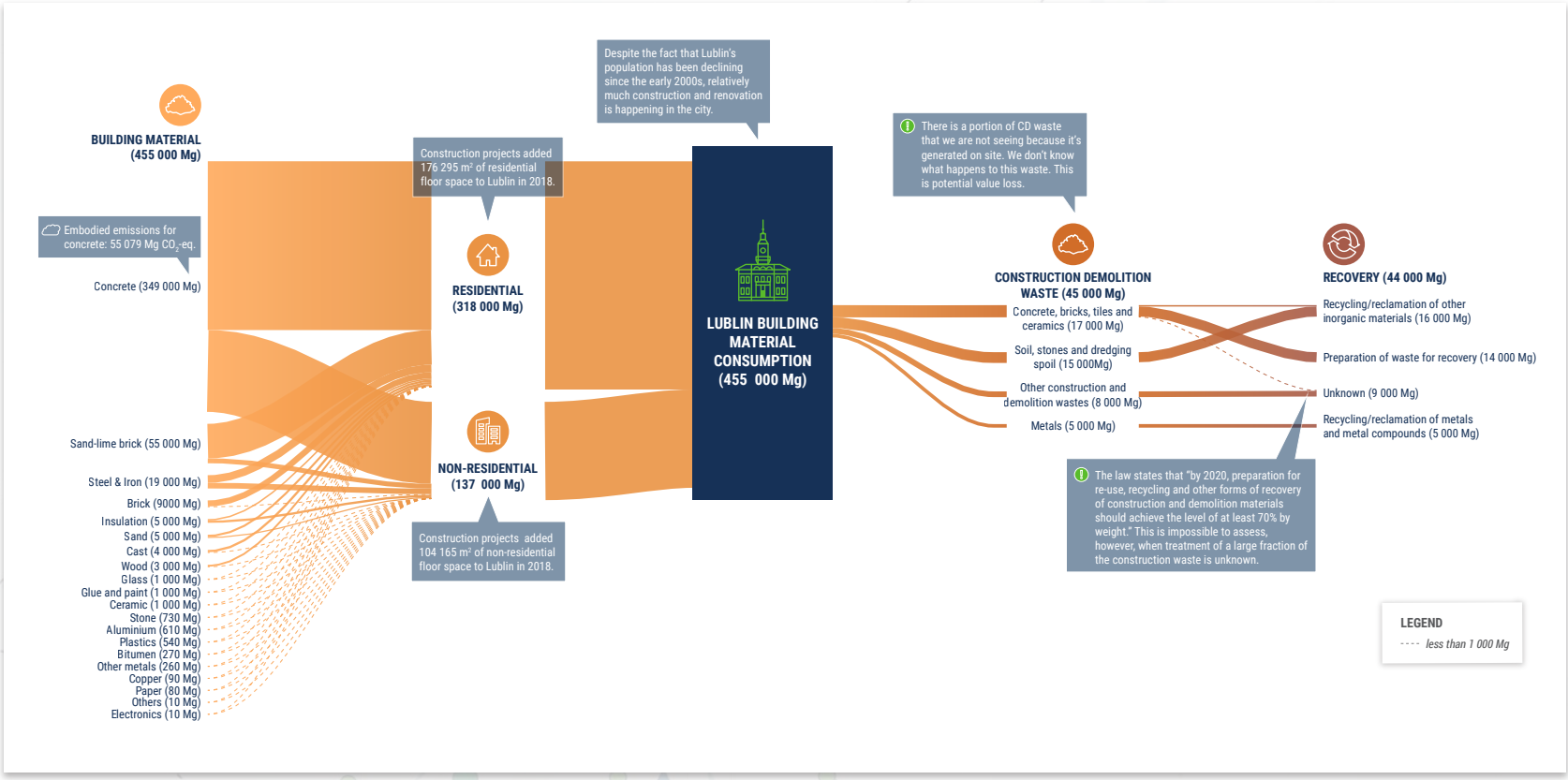
Mg of mixed construction and demolition waste

In 2018, 98% of this waste was reported to have been 'recycled or prepared for re-use and recovery'. However, this does not guarantee that this waste is treated at the highest value possible, so there is potential value loss here.

In their Municipal Revitalization Program 2017-2023, the municipality of Lublin has agreed to revitalize six areas of the city:

1. Stare Miasto
2. Śródmieście
3. Podzamcze i Czwartek
4. Rejon ul. Kalinowszczyzna
5. Rejon Dworca PKP
6. Rejon ul. Kunickiego

MATERIAL FLOW ANALYSIS (e2)



Primary material use

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

Material consumption

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

Waste composition

During demolition, as well as during construction and renovation, a lot of construction materials become available, which can be used as secondary construction materials.

Recovery

Around 98% of construction waste is reported to be recovered, yet it is not registered if this is at high value. There is also a large proportion of 'unknown' waste treatment. Direct reuse of building elements is preferable, and energy recovery from building materials is least preferable.

(e2) Sources in table e2.

CONSTRUCTION IN LUBLIN (e1)

PROJECTS PERMITTED IN 2018:

Constuction sites

- Small projects (100 - 10 000 m³)
- Large projects (10 000 - 122 000 m³)

Demolition sites

- Small projects (10 - 100 m³)
- Large projects (100 - 550 m³)

WASTE FACILITIES, RECOVERING CONSTRUCTION WASTE:

(by construction waste collected in 2018):

- 0 - 2 500 Mg
- 2 500 - 6 000 Mg
- 6 000 - 9 200 Mg

WASTE FACILITIES, COLLECTING CONSTRUCTION WASTE:

- Selective Collection Point (PSZOK)

- Revitalization zone
- City boundary

MAPPING CIRCULAR OPPORTUNITIES: CONSTRUCTION

MAPPING LUBLIN'S CONSTRUCTION SECTOR

Lots of construction is taking place in Lublin. This map shows the most important projects, divided over:

1. Important **construction projects** permitted from 2016-2020, which indicate projections of **large construction material demands.**
2. Important **demolition projects**, during which **large supplies of construction materials** become available. If sorted and stored properly these can be re-used for construction.

CONNECTING LARGE CONSTRUCTION & DEMOLITION PROJECTS TO COLLECTION POINTS

Construction projects are planned to take place all over the city. Two large demolition projects will take place in the center. For a circular construction chain, it is important to think of demolition as 'supply' of materials, and of construction as 'demand'. Supplying construction projects with secondary construction materials is essential for a circular transition. it is crucial to have sources of secondary construction materials (such as purchase points) as close by as possible. This will also limit traffic obstacles.

PSZOK

REVITALIZATION ZONES

Under the city's Municipal Revitalization Program 2017-2023, degraded inner urban areas within Lublin undergo revitalisation carried out through individual projects at various scales. Lublin contains 5 areas selected for the strategy based on a number of social indicators - unemployment, access to services/utilities, property ownership rates, and use of social assistance services per capita. The program seeks to transform the inner city by renovating degraded buildings, stimulating investment through new construction projects, and counteracting undesirable planning outcomes such as urban blight and suburbanization.

CRUCIAL TO A CIRCULAR CONSTRUCTION SECTOR: CONSTRUCTION WASTE SEPARATION & COLLECTION

Waste facilities that collect construction waste represent important nodes in the construction chain. Construction materials and materials available after demolition can be stored here for future construction. The PSZOK is an important collection point in this regard.

(e1) Sources in table e1.

0 km 2,5 km 5 km

The agrifood sector is an important part of Lublin's economy, not only from a production point of view (23 000 Mg annual food production) but also from the perspective of food processing (including beer brewing, processing of potatoes and pasta). Both of these functions produce a lot of organic waste: in fact it accounts for 43% of all food waste produced. The rest of food Lublin's waste, around 13 000 Mg a year, is produced by citizens, tourists, and commuters. If all agricultural waste was composted, all fertilizer input currently used for agriculture could be substituted.

The total amount of food waste generated by Lublin's inhabitants, tourists and visitors could feed around 15 000 people, or 1 in 25 inhabitants in Lublin. Initiatives like zero waste Lublin and the food banks play an important role in food waste prevention and giving a new purpose to discarded food. Additionally, local food is produced by means of peri-urban agricultural activity but is threatened due to limited measures to protect this green space. Conserving all green space in Lublin could have the double-positive effect of increasing resident wellbeing and maintaining local food production for the city and region.

Lublin aspires to become more attractive to tourists. The city does not have a large hospitality sector yet but is aiming to expand to attract more visitors. This aspired expansion could provide a good opportunity to develop zero-waste restaurants that serve local produce, catalyzing eco-tourism of the Lublin Province.

Highlighted opportunities:

- Lublin enhances peri-urban food production and local resource cycling.
- Creating opportunities for composting in local green spaces.
- Increasing Lublin's food self-sufficiency by integrating surrounding farmlands more closely with local food consumption.

AGRIFOOD SECTOR: KEY PLAYERS AND POLICY

POLICY

- **Strategia rozwoju Lublina na lata 2013-2020** (Development Strategy for Lublin 2013-2020).
- **Revitalization Program of the City of Lublin in the years 2017-2023** (Program Rewitalizacji dla Lublina na lata 2017- 2023).
- **Krajowy program zapobiegania powstawaniu odpadow** (Polish National Waste Prevention Programme).

KEY OBJECTIVES

- **Minimize** damage to green areas & landscape devastation in infrastructure projects.
- **Evaluate** resources, features and conditions of urban nature, and direct further development of the urban natural system.
- Urban farm development as part of **revitalization** of Rusalka Park.
- Ban on combustible waste with > 5 % Total Organic Carbon, >8% Loss on Ignition, and a Calorific value > 6MJ/kg.

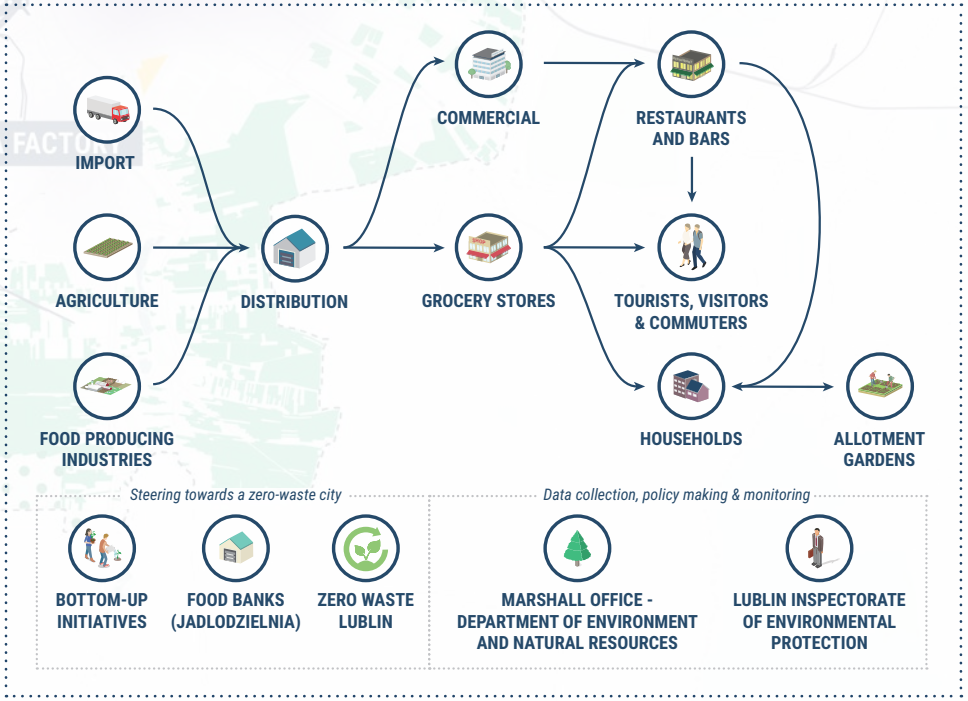
STAKEHOLDERS

The agrifood sector is very present within Lublin not only from a production point of view (23 000 Mg annual food production) but also a lot of food processing (brewery, food processing of potatoes, pasta etc.). Both of these functions produce a lot of agricultural waste which is 43% of all food waste produced.

Smaller scale initiatives which deal with food which could play an essential role in closing local loops and preventing (food)waste. Examples of these are Zero waste Lublin, a platform which hosts informal meetings where people can learn about zero waste solutions and how to implement them into their own life. Also allotments, where people grow their own food, are part of Polish cultural history and are located throughout the city.

Initiatives which help with the prevention of food waste (such as a food banks (Jadłodzielnia) could also offer solutions to both prevent food from being thrown away whilst helping those in need.

Investigating long term partnerships between these big industrial parties (exchange of compost and waste flows) and between industrial parties and smaller initiatives (left-over produce and food from households to food banks) might be a good first step to close food loops on a city scale.



AGRIFOOD

Lublin's most important organic waste producers:

Zaklady Przemyslu Ziemniaczanego LUBLIN
2 620 Mg/y

LUBELLA FOOD Sp. z o.o. S. k. LUBLIN
862 Mg/y

PERLA BROWARY LUBELSKIE S.A.
577 Mg/y

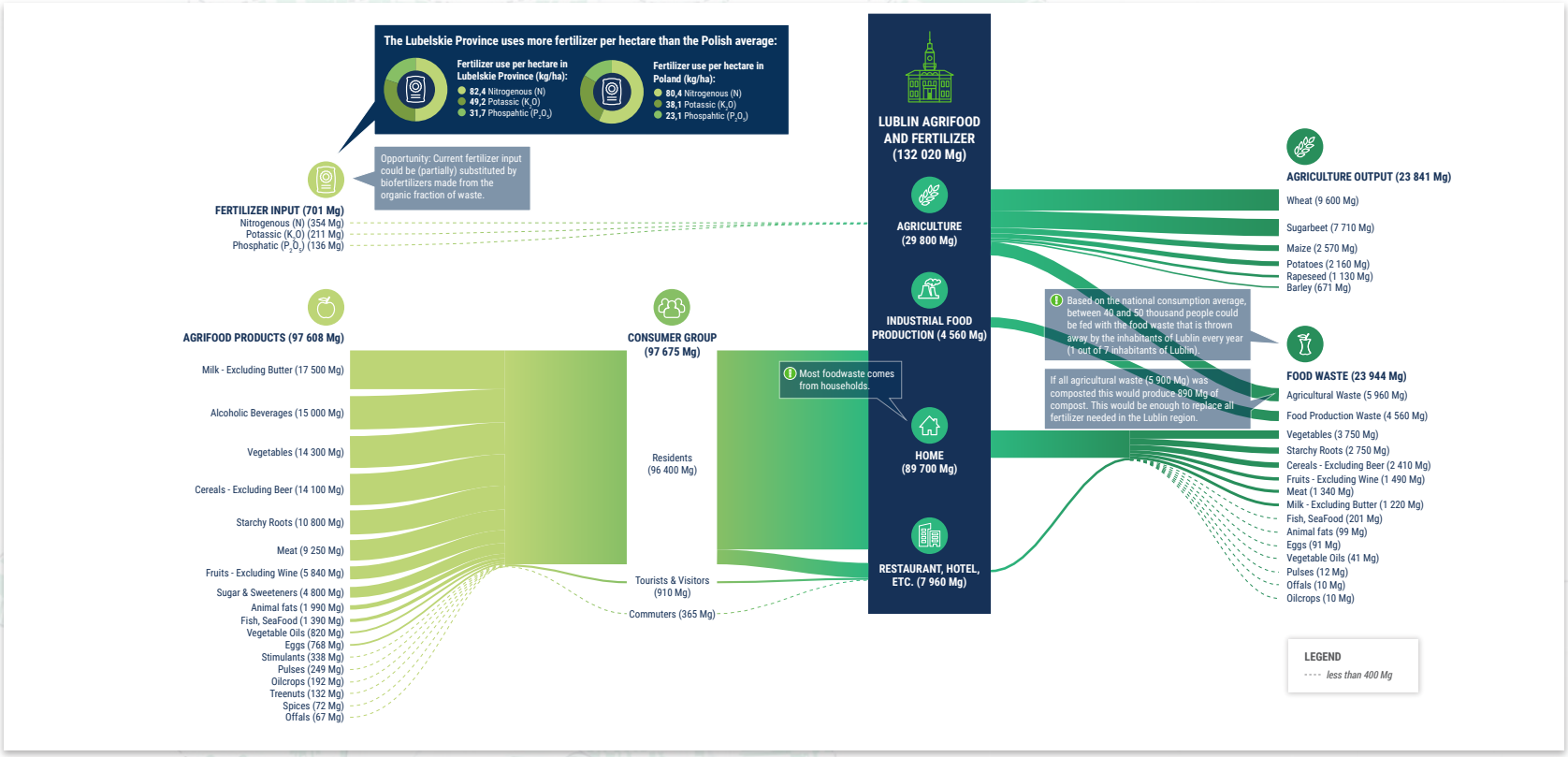
AGRAM Spolka Akcyjna
504 Mg/y

Yearly, Lublin's inhabitants, tourists and commuters generate 13 458 Mg of food waste.

This is equal to:

35,4 mln
PIZZAS

MATERIAL FLOW ANALYSIS (f2)



Food input

On the input side of the city, we consider fertilizer used for agriculture in Lublin, and food consumed by citizens, tourists, and visitors of, as well as commuters to, the city. The latter is based on the average diet of a Polish citizen (22). The fertilizer input could potentially be replaced with composted agricultural waste.

Agrifood throughput

The total of agrifood throughput consists of input for agricultural produce, food consumed by households and by the hospitality industry. Over 98,7% of all food is consumed by the inhabitants of Lublin. 91,8% of all food is consumed in the home. Only 1,3% of all food is consumed by people from outside of Lublin. This makes the household an interesting leverage point for the reduction of food waste in Lublin.

Agrifood output

Agrifood waste is divided over agricultural waste, industrial waste, and consumption related waste. Agricultural produce is included in the agrifood output of the city. A total of 13 400 Mg of food is wasted by households and hospitality industry. This is 13% of the overall agrifood input. By tackling this waste Lublin can:

- Support the fight against climate change (food waste alone generates about 8% of Global Greenhouse Gas Emissions)
- Save nutritious food for redistribution to those in need, helping to eradicate hunger and malnutrition (some 43 million people in the EU cannot afford a quality meal every second day)

(f2) Sources in table f2.
(22) FAO. 2016. Selected Indicators- Poland.

AGRIFOOD IN LUBLIN (f1)

SELECTED FOOD MANUFACTURERS (SORTED BY ORGANIC WASTE GENERATED ANNUALLY):

- 0 - 580 Mg
- 580 - 900 Mg
- 900 - 2 600 Mg

- Farm land
- Forest
- Cluster of hotels, restaurants, cafes, etc.
- Selected allotments gardens

- Railway stations
- Railway
- City boundary

(f1) Sources in table f1.

INDUSTRIAL FOOD PROCESSORS AND MANUFACTURERS

The city has several large food processing locations. These sites generate extensive flows of organic waste, that are often relatively homogenous in their composition. These waste flows can serve as a valuable resource for circular entrepreneurship focused on the high quality processing of organic materials.

ALLOTMENT GARDENS

Allotments are an important part of Polish history and reflect a history of social stability that spans the political and economic transformations of the 19th, 20th, and earliest 21st centuries. They are rooted in Poland's agrarian past and efforts to move rural labor into urban settings without infrastructure to meet their basic needs. Poland's allotment garden arrangement provides an important, though fraught, model for food security and urban open space policy. In the current climate, a lot of allotment gardens are under pressure as their prime locations are interesting for urban development.

HOSPITALITY & FOOD WASTE CLUSTERS

These purple areas show clusters of hotels, restaurants, and cafes mainly concentrated in the (historic) city center of Lublin. These are spots where large amounts of food are consumed and where large amounts of food waste are generated, not only by citizens but also by the thousands of tourists Lublin receives yearly. These clusters provide opportunities to collect waste on a large scale, ready to be processed at a high value.

BREWERY

FROZEN VEGETABLE FACTORY

POTATO FACTORY

PASTA FACTORY

FOOD PRODUCTION IN LUBLIN

Farmland is mostly present on the outskirts of Lublin. These are not only producers of local food, but also interesting areas to find opportunities to apply locally processed organic waste (by means of i.e. composting).

MAPPING LUBLIN'S FOOD SYSTEM

This map provides an overview of the food system of Lubiln: food production, processing, and consumption. A circular food system for Lublin involves closing loops of organic material locally: processing food waste to become high-quality fertilizer for farmland and urban farms, but also using Industrial food to manufacture high-quality new products.

MAPPING CIRCULAR OPPORTUNITIES: AGRIFOOD

0 km 2,5 km 5 km

REFERENCES

1. Lublin City (N.d.). Lublin Special Economic Zone. Invest in Lublin. https://www.invest-in-lublin.com/about-lublin
2. Material Economics (2020). The Circular Economy and COVID-19 Recovery. Retrieved from: https://materialeconomics.com/publications/publication/circular-recovery
3. McKinsey Centre for Business and Environment. (2015). Growth within: A circular economy vision for a competitive Europe. Retrieved from: https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/europes%20circular%20economy%20opportunity/growth_within.ashx
4. European Commission. (2020, March 25). EU Circular Economy Action Plan. EU Commision. Retrieved from: https://ec.europa.eu/environment/circular-economy/
5. United Nations. (2017). UN Sustainable Development Goals. Retrieved from: https://www.un.org/sustainabledevelopment/cities/
6. McKinsey. (2019). Carbon-Neutral Poland 2050: Turning a Challenge into an opportunity. Retrieved from: https://www.mckinsey.com/~/media/McKinsey/Industries/Electric%20Power%20and%20Natural%20Gas/Our%20Insights/Carbon%20neutral%20Poland%202050%20Turning%20a%20challenge%20into%20an%20opportunity/Carbon-neutral-Poland-2050.pdf
7. Nabrdalik, M., Santora, M. (2018). Smothered by Smog, Polish cities rank amongst dirtiest in EU. Retrieved from: https://www.nytimes.com/2018/04/22/world/europe/poland-pollution.html
8. Lublin City Council. (2013). Lublin Development Strategy 2013-2020. https://lublin.eu/gfx/lublin/userfiles/_public/pliki_do_pobrania/strategia_rozwoju_lublina_na_lat/lublin_development_strategy_2013-2020.pdf
9. Metabolic. (2017). The Seven Pillars of the Circular Economy. Retrieved from: https://www.metabolic.nl/news/the-seven-pillars-of-the-circular-economy/
10. PricewaterhouseCooper (2019). Report on Polish Metropolises. https://www.pwc.pl/pl/pdf/raport-o-metropoliach-lublin-2019-pwc.pdf
11. Lublin City Council (N.d.). About the City. Lublin in Numbers. https://lublin.eu/en/lublin/about-the-city/lublin-in-numbers/
12. Polish Statistical Office. (2020). Lubelskie Voivodeship. Subregions, Powiats, Gminas 2019 https://lublin.stat.gov.pl/en/publications/statistical-yearbook/lubelskie-voivodshipsubregions-powiats-gminas-2019,2,16.html
13. Lublin city (2020). Getting Around the City. Retrieved from: https://lublin.eu/en/travel-information/getting-around-the-city/
14. Municipality of Lublin. (2018). Foresight Lublin 2050. Retrieved from: https://www.miasta2050.pl/lublin2050
15. Cambridge econometric, Trinomics, ICF. (2018). Retrieved from: https://trinomics.eu/project/the-effect-of-the-circular-economy-on-employment-in-europe/
16. Municipality of Lublin. (2017). Municipal Revitalization Program 2017-2023 Retrieved from: https://lublin.eu/lublin/przestrzen-miejska/rewitalizacja/
17. Lublin City Council. (N.d). History. About the City. https://lublin.eu/en/lublin/about-the-city/history/
18. The Smellscapes of Lublin. (2020). Lublin in the 20th Century - a short outline. http://lublinsmellscapes.eu/lublin/
19. Wikipedia. (N.d). History of Solidarity. https://nl.qwe.wiki/wiki/History_of_Solidarity
20. Zgłobicki, W., Gawrysiak, L., Baran-Zgłobicka, B. et al. Long-term forest cover changes, within an agricultural region, in relation to environmental variables, Lubelskie Province, Eastern Poland. Environ Earth Sci 75, 1373 (2016). https://doi.org/10.1007/s12665-016-6195-z
21. Global Status Report for Buildings and Construction 2019 – Analysis - IEA
22. FAO. 2016. Selected Indicators- Poland. Retrieved from http://www.fao.org/faostat/en/#country/173

SOURCES CHAPTER 4

Table a: Industrial Waste

Table a1: Displayed Spatial Data

Data source	Description of data used	Data Type	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling. Addresses of Industrial waste sites (generators recoverers, disposal sites), geocoded to display on map 1. Waste by district scaled from lowest to highest total waste generation 2. Top ~5 waste generators	Point	2018	Lublin

Table a2: Industrial waste Material Flow Analysis

Data source	Description of data used	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2018	Lublin

Table b: Municipal Waste

Data source	Description of data used	Data type	Year	Region
Municipal Waste Report 2018 (2 korekta rocznego sprawozdania PML za 2018 r.)	Report about municipal waste generation and handling in the city. Disposal, Recovery, Incineration, facilities extracted and geocoded	Point	2018	Lublin
Lublin.eu PSZOK points	Official website of Lublin's PSZOKcollection points. Address geocoded and displayed on map	Point		Lublin
Battery collection point	Trans-Wag Sp. z o.o.battery collection point for Lublin. Address geocoded and displayed on map	Point		Lublin
Hazardous Waste collection point	Official Website of the SUEZ Wschód Sp. z.o.o Hazardous waste collection pointin Lublin Address geocoded and displayed on map	Point		Lublin
CORINE Land Cover - Copernicus Land Monitoring Service Corine CLC: Dump Sites	Landfill sites identified by Corinne LC data extracted and used to display on map.	Raster	2018	Lublin

Table b2: Municipal Waste Material Flow Analysis

Data source	Description of data used	Year	Region
Municipal Waste Report 2018 (2 korekta rocznego sprawozdania PML za 2018 r.)	Report about municipal waste generation and handling in the city.	2018	Lublin

Table c: Energy

Table c1: Displayed Spatial Data

Data source	Description of data used	Data type	Year	Region
Assumptions For The Supply Plan Heat, Electricity And Gas Fuels For The City Of Lublin For Years 2019-2033	3 energy facilities from the city displayed on map	Point	2017	Lublin
Bip.lublin.eu	Population/by district	Point	2018	Lublin
Google Maps: Data Centers	Extracted addresses for data centers	Point	2018	Lublin
CORINE Land Cover - Copernicus Land Monitoring Service Corine CLC: Airport	Extracted location for Lublin Airport	Point	2018	Lublin
Open street map (OSM):points of interest	Industrial sites: Maps polygons of the industrial buildings and sites within the city	Shapefile	2018	Lublin

Table c2: Energy material flow analysis

Data source	Description of data used	Year	Region
Assumptions For The Supply Plan Heat, Electricity And Gas Fuels For The City Of Lublin For Years 2019-2033	Electricity, natural gas and district heating generation and consumption in the city	2017	Lublin
BDL - National Databank	Vehicle count	2018	Poland, Lublin
National Energy Balance Sheets	Fuel use for transportation	2017	Poland
Greenhouse Gas (GHG) Emissions Measurement and Reporting Guidelines	GHG emission factors for different fuels	2018	Singapore

Table d: Water

Table d1: Displayed Spatial Data

Data source	Description of data used	Data type	Year	Region
Open street map (OSM):- water wells & water towers	Vector polygons from open street map used for displaying water infrastructure	Shapefile	2018	Lublin
Open street map (OSM): waterways & water bodies	Vector polygons used for displaying water bodies	Shapefile	2018	Lublin
Water intake sites	Point Data of intake sites extracted from MPWIK lublin	Point	2018	Lublin
Wastewater treatment plants	Point Data of waste water treatment sites extracted from the MPWIK lublin	Point	2018	Lublin

Table d2: Water Material Flow Analysis

Data source	Description of data used	Year	Region
MPWiK - Municipal Water and Sewerage Company	Share of groundwater vs surface water	Unknown	Lublin
BDL - National Databank	Water demand, sewage treatment and discharge figures	2018	Lublin
Waternet - Amsterdam water company	Breakdown of household gray vs black water	2016	Amsterdam

Table e: Construction

Table e1: Displayed Spatial Data

Data source	Description of data used	Data type	Year	Region
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling. Addresses for construction & demolition extracted and geocoded	Point	2018	Lublin
Municipal Waste Report 2018 (2 korekta rocznego sprawozdania PML za 2018 r.)	Report about municipal waste generation and handling in the city. Addresses for locating treatment construction waste purchase points extracted and geocoded	Point	2018	Lublin

Table e2: Construction material flow analysis

Data source	Description of data used	Year	Region
BDL - National Databank	Number and floorspace of new buildings constructed in the city.	2018	Lublin
Building composition model	A model that describes the materials used in different types of buildings based on the age, floorspace and function of the building.	2018	Netherlands
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2018	Lublin
Municipal Waste Report 2018 (2 korekta rocznego sprawozdania PML za 2018 r.)	Report about municipal waste generation and handling in the city.	2018	Lublin

Table f: AgriFood

Table f1: Displayed Spatial Data

Data source	Description of data used	Data type	Year	Region
Open Street Map - Points of interest: hotels, restaurants, cafes	Vector points for HORECA sites	Shapefile	2018	Lublin
Open Street Map - Land use: farm areas	Vector polygons of farmland	Shapefile	2018	Lublin
Open Street Map - railways	Line data of railway and railway stations	Shapefile	2018	Lublin
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling. Used to display food manufacturers	Point	2018	Lublin
Open Street Map - land use: allotment gardens	Sites where there are garden allotments in the city	Shapefile	2018	Lublin
Open Street Map - land use: nature reserve	Lublin's nature reserve (south end)	Shapefile	2018	Lublin

Table f2: AgriFood material flow analysis

Data source	Description of data used	Year	Region
BDL - National Databank	Population by age and gender	2018	Lublin
New Food Balances (FAO)	Average consumption of European countries by type of food product	2018	Poland
NFCS 2012-2016, 1-79 years (RIVM)	Dutch food consumption survey by type of food product, age and gender	2016	Netherlands
Food waste accounting along global and European food supply chains: State of the art and outlook	Percentage of food waste generated by type of food.	2018	Poland
Out-of-home eating frequency, causal attribution of obesity and support to healthy eating policies from a cross-European survey	Report about how often people in different European countries eat out vs eat at home.	2014	Poland
Communication with Lublin contacts	Number of tourists in the city.	2018	Lublin
Commutes to work in Poland - NSP 2011 results	Data about the amount of intercity commuters	2011	Lublin
Provincial Waste System (Wojewódzkiego Systemu Odpadowego)	Data received from the Marshal Office of the Province about waste generation and handling.	2018	Lublin
Corine Land Cover	Land use map	2018	Lublin
Crop Yield Data (FAO)	FAO data about crop yields in different countries	2018	Poland
Food Loss and Waste in the Food Supply Chain (FAO)	Data about what proportion of agricultural production is wasted at the farm	2017	Global
BDL - National Databank	Fertilizer application rates	2018	Lublin

COLOFON

Metabolic Institute

PROGRAM LEAD

Tamara Streefland

PROGRAM COORDINATION

Olga Bednarz

Izabela Fortuniak

CONSULTANTS

Daniel Bieckmann

Lotje Hogerzeil

Frenzi Ritter

Arjang Tajbakhsh

Martin Tauber

Joey Hodde

Charlotte Le Vay

GRAPHIC DESIGN

Asia Jackowska

Marta Sierra Garcia

Sunniva Unneland

Innowo

PROGRAM LEAD

Agnieszka Sznyk

RESEARCHERS

Hubert Bukowski

Marcelina Rosińska

LOCAL CONTRIBUTORS

Municipality of Lublin

GENEROUSLY FUNDED BY

The Mava Foundation

METABOLIC INSTITUTE

Lublin MIASTO INSPIRACJI

INNOWO