Curitiba challenge brief
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### Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIF</td>
<td>Activity, share, intensity and fuel</td>
</tr>
<tr>
<td>BRT</td>
<td>Bus Rapid Transit</td>
</tr>
<tr>
<td>CNG</td>
<td>Compressed natural gas</td>
</tr>
<tr>
<td>COFOM</td>
<td>Comitê de Fomento (Development Committee)</td>
</tr>
<tr>
<td>Copel</td>
<td>Companhia Paranaense de Energia Elétrica (Paraná Electric Power Company)</td>
</tr>
<tr>
<td>ETS</td>
<td>Effluent treatment stations</td>
</tr>
<tr>
<td>FIEP</td>
<td>Federação das Indústrias do Paraná (Federation of Industries in the state of Paraná)</td>
</tr>
<tr>
<td>FJP</td>
<td>Fundação João Pinheiro (João Pinheiro Foundation)</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GPC</td>
<td>Global Protocol for Community Scale Greenhouse Gas Emission Inventories</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse gas</td>
</tr>
<tr>
<td>GVA</td>
<td>Gross value added</td>
</tr>
<tr>
<td>HDI</td>
<td>Human Development Index</td>
</tr>
<tr>
<td>HDU</td>
<td>Human development Unit</td>
</tr>
<tr>
<td>IBGE</td>
<td>Instituto Brasileiro de Geografia e Estatística (Brazilian Institution of Geography and Statistics)</td>
</tr>
<tr>
<td>ICMS</td>
<td>Imposto sobre Circulação de Mercadorias e Serviços (Tax on Circulation of Goods and Services)</td>
</tr>
<tr>
<td>INEP</td>
<td>Instituto Nacional de Estudos e Pesquisas (National Institute for Educational Studies and Research)</td>
</tr>
<tr>
<td>IPEA</td>
<td>Instituto de Pesquisa Econômica Aplicada (Institute for Applied Economic Research)</td>
</tr>
<tr>
<td>IPPUC</td>
<td>Instituto de Pesquisa e Planejamento Urbano de Curitiba (Institute for Research and Urban Planning of Curitiba)</td>
</tr>
<tr>
<td>ISS</td>
<td>Imposto sobre Serviços (Tax on Services)</td>
</tr>
<tr>
<td>MEC</td>
<td>Ministerio da Educação (Ministry of Education)</td>
</tr>
<tr>
<td>MS/CNES</td>
<td>Ministério da Saúde/Cadastro Nacional de Estabelecimentos de Saúde (Ministry of Health/National Database of Healthcare Facilities)</td>
</tr>
<tr>
<td>MWh</td>
<td>Megawatt hour</td>
</tr>
<tr>
<td>PlanClima</td>
<td>Municipal Plan for Mitigation and Adaptation to Climate Change</td>
</tr>
<tr>
<td>PMCMV</td>
<td>Programa Minha Casa Minha Vida (My House, My Life Programme)</td>
</tr>
<tr>
<td>PUC-PR</td>
<td>Pontifícia Universidade Católica do Paraná (Pontifical Catholic University of Paraná)</td>
</tr>
<tr>
<td>RAIS</td>
<td>Relação Anual de Informações Sociais (Annual Social Information List data set)</td>
</tr>
<tr>
<td>RIT</td>
<td>Rede Integrada de Transporte (Integrated Transport Network)</td>
</tr>
<tr>
<td>SESA</td>
<td>Secretaria de Estado da Saúde do Espírito Santo (Espírito Santo State Department of Health)</td>
</tr>
<tr>
<td>UTFPR</td>
<td>Universidade Federal do Paraná (Federal University of Paraná)</td>
</tr>
<tr>
<td>UTFPR</td>
<td>Universidade Tecnológica do Paraná (Technological Federal University of Paraná)</td>
</tr>
<tr>
<td>VAB</td>
<td>Gross Value Added (GVA)</td>
</tr>
</tbody>
</table>
Foreword

Transformation: an open and continuous process

The global agenda around climate change calls for urgent and concrete actions. And it is in cities that solutions for urban, environmental and social requalification are born, as they are needed to stop global warming.

This moment calls for idea-sharing and for more attitude. This is a call, a summons. We have obligations to preserve life - ours, those of our fellow humans and all species that inhabit Earth.

Having people as a measure of public actions is, for our city, a fundamental principle of planning.

Curitiba was chosen by the United Nations as a model city for the celebrations of World Habitat Day in 1995, the same year our city hosted the preparatory event for the United Nations Conference on Human Settlements. The following year, in Istanbul, Curitiba actively took part in the presentation of best practices in favour of urban and human sustainability.

Today, among Brazil’s state capitals, Curitiba has advanced most in achieving the United Nations Sustainable Development Goals and in reaching the precepts of the 2030 Agenda with the Climate Change Adaptation and Mitigation Plan (PlanClima).

The Smart Climate Cities Challenge represents another significant step in the continuous advances towards sustainability. The aim is to transform two important areas of the city into zero carbon gas (CO₂) emission models.

The Pinhão Valley Innovation Ecosystem is emblematic in this process, as it was the address of the first industrial district in Curitiba. From the first factories of the past to the technological revolution, we have walked with the certainty that it is possible to develop sustainably in all areas. And, from the perspective of the challenge of inclusion, integration and emancipation, Vila Torres – a formerly occupied area, today has also merged in the area covered by Pinhão Valley.

It is worth mentioning some successful examples that favour a more sustainable daily life in the big city, such as the BRTs of the public transport system, the Lighthouses of Knowledge and Innovation, the Cajuru FabLab, the production of healthy food at the Urban Farm and in urban vegetable gardens, the Zero Waste Programme of the Municipal Market, and the selective collection of the “Garbage that is not garbage” programme.

Encouraged by our latest award – the Latam Smart City Awards 2021, we are now targeting the Caximba Solar Pyramid, another major project in Curitiba to tackle climate change, which translates into a pyramid-shaped Photovoltaic Generation Unit with solar panels. Clean energy for the smart city!

Transformation is an open and ongoing process. The challenge is launched, and Curitiba is always willing to innovate and contribute to building a better and fairer world for everyone.

Rafael Greca,
Mayor of Curitiba
1. Introduction
1.1 About the City of Curitiba

Curitiba is capital of the southern Brazilian state of Paraná. It is Brazil’s eighth most populous city. Built largely on flat terrain, the city has a humid subtropical highland climate with mild temperatures throughout the year. Curitiba is often known and awarded for its urban planning system and environmental awareness. In recent years, Curitiba has been also acknowledged for its initiatives to becoming a smart city. General information about city aspects can be found in the table below.

<table>
<thead>
<tr>
<th>Territory</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>935 metres</td>
</tr>
<tr>
<td>Estimated Population, IBGE, 2020</td>
<td>1,948,626 inhabitants</td>
</tr>
<tr>
<td>Installation Date</td>
<td>29 Mar. 1693 (Birthday)</td>
</tr>
<tr>
<td>Number of Voters, TSE, 2020</td>
<td>1,349,888 voters</td>
</tr>
<tr>
<td>Latitude</td>
<td>S 25º25’02”’</td>
</tr>
<tr>
<td>Geometric Growth Rate, IBGE, 2010</td>
<td>1%</td>
</tr>
<tr>
<td>Longitude</td>
<td>W 49º16’07”’</td>
</tr>
<tr>
<td>Elderly Index, IBGE, 2010</td>
<td>8%</td>
</tr>
<tr>
<td>Territorial area</td>
<td>435 km²</td>
</tr>
<tr>
<td>Dependency Ratio, IBGE, 2010</td>
<td>38%</td>
</tr>
<tr>
<td>Demographic Density, IPARDES, 2020</td>
<td>4,481 inhab/km²</td>
</tr>
<tr>
<td>Sex Ratio, IBGE, 2010</td>
<td>0.91 men/women</td>
</tr>
<tr>
<td>Degree of Urbanization, IBGE, 2010</td>
<td>100%</td>
</tr>
<tr>
<td>Aging Rate, IBGE/IPARDES, 2010</td>
<td>38 elderly/100 young people</td>
</tr>
<tr>
<td>Human Development Index - HDI, UNDP/IPEA/IFP, 2010</td>
<td>0.823 HDI-M</td>
</tr>
<tr>
<td>Education</td>
<td>Health</td>
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<tr>
<td>----------------------------------------</td>
<td>---------------------------------</td>
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<tr>
<td>Nursery Enrollment</td>
<td>Health Facilities</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td>MS/CNES, 2020</td>
</tr>
<tr>
<td>32 150 students</td>
<td>6 432</td>
</tr>
<tr>
<td>Preschool Enrollment</td>
<td>Hospital Beds</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td>MS/CNES, 2020</td>
</tr>
<tr>
<td>33 480 students</td>
<td>5 978</td>
</tr>
<tr>
<td>Elementary School Enrollments</td>
<td>Fertility Rate</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td>UNDP/IPEA/FJP, 2010</td>
</tr>
<tr>
<td>214 346 students</td>
<td>1.58 children/woman</td>
</tr>
<tr>
<td>Average Years of Study</td>
<td>Gross Birth Rate</td>
</tr>
<tr>
<td>IBGE, 2019</td>
<td>IBGE/SESA, 2019</td>
</tr>
<tr>
<td>11.8 years</td>
<td>11.07 per thousand inhabitants</td>
</tr>
<tr>
<td>Basic Education Development Index</td>
<td>Mortality Rate</td>
</tr>
<tr>
<td>- Ideb</td>
<td>IBGE/SESA, 2019</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td>5.75 per thousand inhabitants</td>
</tr>
<tr>
<td>High School Enrollments</td>
<td>Households</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td></td>
</tr>
<tr>
<td>71 179 students</td>
<td></td>
</tr>
<tr>
<td>Enrollments in Professional Education</td>
<td>Permanent Private Households</td>
</tr>
<tr>
<td>MEC/INEP, 2020</td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>34 665 students</td>
<td>576 190</td>
</tr>
<tr>
<td>Enrollments in Higher Education (in</td>
<td>Households with Piped Water</td>
</tr>
<tr>
<td>person)</td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>MEC/INEP, 2019</td>
<td>575 598</td>
</tr>
<tr>
<td>Water and Energy Consumption</td>
<td>Households with Bathroom or</td>
</tr>
<tr>
<td></td>
<td>Toilet</td>
</tr>
<tr>
<td></td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>110 864 499 m³</td>
<td>575 630</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>Households with Collected</td>
</tr>
<tr>
<td>Sanepar, 2019</td>
<td>Garbage</td>
</tr>
<tr>
<td></td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>4 590 728 MWh</td>
<td>575 635</td>
</tr>
<tr>
<td>Electric Power Consumption</td>
<td>Households with Electric Energy</td>
</tr>
<tr>
<td>Copel, 2019</td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td></td>
<td>576 057</td>
</tr>
<tr>
<td>Economy</td>
<td></td>
</tr>
<tr>
<td>Establishments</td>
<td>Jobs</td>
</tr>
<tr>
<td>ME/Work (RAIS), 2019</td>
<td>ME/Work (RAIS), 2019</td>
</tr>
<tr>
<td>59 110</td>
<td>918 227</td>
</tr>
<tr>
<td>Establishments in Characteristic</td>
<td>Working Age Population</td>
</tr>
<tr>
<td>Tourism Activities</td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>ME/Work (RAIS), 2019</td>
<td>1 531 838 people</td>
</tr>
<tr>
<td>10 130</td>
<td></td>
</tr>
<tr>
<td>Economically Active Population</td>
<td>Occupied Population</td>
</tr>
<tr>
<td>IBGE, 2010</td>
<td>IBGE, 2010</td>
</tr>
<tr>
<td>995 543 people</td>
<td>947 195 people</td>
</tr>
<tr>
<td>Occupation Rate</td>
<td></td>
</tr>
<tr>
<td>IBGE, 2010</td>
<td></td>
</tr>
<tr>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>GDP per capita</td>
<td>Gross Domestic Product - GDP</td>
</tr>
<tr>
<td>IBGE/Ipardes, 2018</td>
<td>IBGE/Ipardes, 2018</td>
</tr>
<tr>
<td>R$45 458</td>
<td>R$87.2 billion</td>
</tr>
<tr>
<td>VAB Agriculture and Livestock</td>
<td>Gross Added Value - GVA</td>
</tr>
<tr>
<td>IBGE/Ipardes, 2018</td>
<td>IBGE/Ipardes, 2018</td>
</tr>
<tr>
<td>R$12.8 million</td>
<td>R$72.0 billion</td>
</tr>
<tr>
<td>VAB Trade and Services</td>
<td>GVA Industry</td>
</tr>
<tr>
<td>IBGE/Ipardes, 2018</td>
<td>IBGE/Ipardes, 2018</td>
</tr>
<tr>
<td>R$50.3 billion</td>
<td>R$12.8 billion</td>
</tr>
<tr>
<td>Municipal Expenses</td>
<td>Municipal Revenues</td>
</tr>
<tr>
<td>PMC, 2020</td>
<td>PMC, 2020</td>
</tr>
<tr>
<td>R$9.2 billion</td>
<td>R$9.3 billion</td>
</tr>
<tr>
<td>Municipal Expenses</td>
<td>ICMS</td>
</tr>
<tr>
<td>PMC, 2020</td>
<td>PMC, 2020</td>
</tr>
<tr>
<td>R$9.2 billion</td>
<td>R$10.0 billion</td>
</tr>
</tbody>
</table>
1.2 Curitiba’s climate challenge

The average temperature in Curitiba is now 1.2ºC higher than six decades ago. The rainfall pattern has changed: strong and intense storms are more common; and there are periods of drought, as experienced in the last two years. In both cases, the population is impacted, either by inconveniences resulting from floods, the scarcity of water, or thermal discomfort.

As a counter measure, Curitiba has been progressively strengthening its environmental policy and advancing initiatives to face climate change at the local level. The establishment of the Climate Change Strategy of Curitiba provides for medium - and long- term actions for technical and scientific foundations for the proposal of the Municipal Plan for Mitigation and Adaptation to Climate Change. The steps defined for the Municipal Climate Change Strategy were as follows:

1. Preparation of an Inventory of Absorption Sources (sinks) of the Municipality (carbon stock in green areas).
2. Preparation of an Inventory of the Municipality’s Greenhouse Gas Emission Sources.
3. Preparation of an environmental and socioeconomic vulnerability study.
4. Elaboration of the Municipal Plan for Mitigation and Adaptation to Climate Change.

Based on the GHG emission sources inventory, in carrying out a study of vulnerabilities and risk analysis, scenarios for emission reductions in the city were modeled. Subsequently, the Municipal Plan for Mitigation and Adaptation to Climate Change, PlanClima, was published.

Acutely aware of the urgency to fight climate change, Curitiba has embarked on firm measures to confront the phenomenon. Among these already implemented are Hortas Urbanas (urban farms); the encouragement for innovation and the creative economy, such as the innovation ecosystem Vale do Pinhão, and the environmental education grid within the Linhas do Conhecimento (Knowledge Lines) programme. Actions that contemplate the use of renewable energy also received special attention. For instance, the city has decided to invest in energy saving technologies, through the government programme Curitiba Mais Energia (Curitiba More Energy). This programme provides for the use of solar lighting in the city’s public spaces, such as bus terminals and the former deactivated landfill.
2. The challenge: Creating zero-carbon neighbourhoods in Curitiba
2.1 Towards zero carbon neighbourhoods

The city of Curitiba has the ambition to be carbon neutral by the year 2050. The planning to reach this goal started with the PlanClima development, which provides the basis for implementation of climate actions. One way to seek carbon neutrality is to establish zero carbon areas in the city. The challenge is to find innovative and integrated business models, services and technologies for the occupation of multiple urban functions, such as mobility, energy consumption and waste management. Support for this is envisaged through governance and from business, investors, academics, and the public.

The zero carbon areas are in line with the principles of the city’s Urban Development Policy, established in the Revision of Master Plan Law of Curitiba (Law 14.771/2015). Additionally, the city aims to facilitate movement through an integrated network of roads, a high-quality integrated public transport system, favouring public over private transport, creation of cycling lanes, streets exclusively for pedestrians; and other forms of non-motorized modes of travel.

New technologies, strategies and business models will contribute to reducing greenhouse gas emissions while promoting social well-being. For this, specific axes were identified where proposals for neutrality of emissions should be directed, namely: towards mobility, the stationary use of energy, and waste management. Curitiba’s ambition is to achieve carbon neutrality through a systemic and integrated approach to these sectors, in order to establish a circular, low-carbon economy. By developing low-carbon models integrated into the existing urban fabric, and sufficiently robust to promote sustainable development, Curitiba will once again lead the drive for sustainability in Brazil.

Within the forecasted revision of the Curitiba of the Revised Master Plan and as a result of the contents of PlanClima, the search for carbon neutral zones or neighbourhoods remain one of the city's long-term planning goals. Curitiba has 75 neighbourhoods with different physical territorial characteristics, inhomogeneous population density, and varied local economies. Therefore, the proposal to achieve carbon neutrality by region should take this diversity into account.
2.2 The challenge to overcome

For the Climate Smart Cities Challenge, Curitiba City Hall and the Institute for Research and Urban Planning of Curitiba (Instituto de Pesquisa e Planejamento Urbano de Curitiba – IPPUC), who chairs the program, have selected two regions in the city, Vale do Pinhão and Vila Torres, which, despite being close to each other, have distinct characteristics. Successful proposals will respond to the following sectors of energy, mobility, and waste emission reduction, in a way that supports the overall aspiration for integrated, zero-carbon, equitable development.

**Energy**

The nation’s current (2021) installed electricity power generation is 174,883.1 MW. Of this, 58.34 per cent comes from hydroelectricity, 25 per cent from thermoelectric sources, and 10 per cent from wind power. Photovoltaic energy represents 1.87 per cent of the total energy generated.

Since 2019, Brazil has been facing a serious water crisis, considered the worst in 91 years. Reservoirs in the south-east and Midwest regions account for 70 per cent of the nation’s energy consumed, but are operating at 19.59 per cent of capacity as at September 2021.² Similarly at the Itaipu plant in the state of Paraná, 8 of the plant’s 20 turbines are shut down, leading to the lowest production since 1994.

As a result, the cost of energy has risen considerably in recent years. In 2021, the cost of residential energy increased by 8.97 per cent. On an individual scale, the search for other energy sources is limited due to the cost of new technologies, a fact backed by a survey carried out with the local community.

Given this perspective, and considering the situation may persist for years according to scenarios modeled by the Environmental and Socioeconomic Vulnerability Study of the city, Curitiba seeks innovative and affordable solutions for the generation of sustainable energy. It should be considered, on one hand, that one of the pilot areas, Vila Torres, is a vulnerable community, where the construction pattern of houses makes it difficult to install individual sources of sustainable energy generation. On the other hand there is Vale do Pinhão, founded in the 19th Century and largely made up of factories, which is now ripe for urban renewal.

**Mobility**

The Revision of Curitiba’s Master Plan 2015 reinforces the mixed-use occupation at the development axes, promotes mixed-uses throughout the city, and prioritizes public transport and active mobility. Thus, the plan seeks to decongest the central region and enhance dynamic neighbourhoods. In this way, through local services and businesses, Curitiba aims to reduce vehicular traffic in the city, thereby reducing emissions.

The city’s origin-destination survey, from 2016, shows that most trips in Vila Torres are made on foot (56.3 per cent) or by bus (21.9 per cent). Travel by car correspond to only 14.8 per cent. Contrastingly, in Vale do Pinhão 55.1 per cent of the trips are by private vehicles, 20.6 per cent by bus and 16.8 per cent on foot. The entire region is served by public transport.

Considering Commuter travel profiles, Curitiba seeks solutions to be tested in the two target areas, in which the commuter movement and the distribution of loads and provision of local services produce low emission and accessible cost for the neighbourhood scale (“the last mile”).

**Waste**

In the year 2020 Curitiba generated a total of 1,800 tons of urban solid waste per day. Of 100% of the waste collected, approximately 20% is recyclable and the remaining 80% is sent for disposal in a landfill, according to information extracted from PlanClima, in 2016.
Therefore, there is huge potential for reuse of the waste sent to landfills, considering its composition: 40 per cent is organic waste; 12 per cent plastics; 4 per cent each of paper and of metal, and 20 per cent others. That is to say a great amount of the waste generated in the city does not yet have economic use, or opportunities for fitting into production chains so that they could be used within the Ecocidadão Programme and by recyclers in general. There is a range of used products, such as electronic waste, that could be valued if inserted in recycling chains.

Many families, especially in Vila Torres, depend on recycling materials for their income, a situation that has been worsened by the Coronavirus pandemic and unemployment. In addition, there are only few initiatives for composting organic waste due to the lack of guidance and community infrastructure. According to the survey of the public, commerce and industry, they would prefer financial incentives in order to engage in composting. However, new possibilities for the economic use of waste could contribute to improving earnings for families.

Therefore, Curitiba seeks innovative solutions in Vale do Pinhão and Vila Torre for a more effective segregation of urban solid waste and greater use of recyclable waste by communities. This would reduce the amount of waste sent to landfills. Considering the profile of the generated waste and PlanClima emission reduction scenarios, the target for recycling by 2030 is another 30 per cent to the current 20 per cent of waste generated in the two neighbourhoods.

It is understood that the solutions could be anchored in approaches such as optimization and diversification of recycling materials; income generation; promotion of local sustainable business and green jobs; reuse of the organic parcel of waste; and strategies for a circular economy.

2.3 Ingredients to solve the challenge

Curitiba has a long history linked to successful projects in urban planning, environmental conservation, urban solid waste management and public transport. However, in view of the challenges posed in this programme, the solutions must be innovative and not focus on the existing programmes in Curitiba. Among the variables needed to solve the proposed challenges, the most significant are as follows:

**Financing:** the search for partnerships for continued financing for testing, development and implementation, since the municipality is subject to the Fiscal Responsibility Law and the Bidding Law, which establishes a rigorous and bureaucratic process for the investment of its resources.

**Technological Infrastructure:** If technological proposals based on access to social networks, broad and fast Internet access are presented, the specific infrastructure for this operation, especially in the pilot areas, must be evaluated and possibly adapted.

**Institutional Arrangements:** Institutional arrangements that need to be formatted (that is, agreements, contracts, partnerships for proposals, such as donations or the purchase of equipment), need to be studied in advance.

**Engagement of actors in the demonstration areas:** The development of proposals shall be participative and must clearly state the benefits to the population. The solutions must be developed taking into consideration the needs of the community and aspects such as affordability, long-term feasibility and socio-environmental impact. These and the effective engagement of stakeholders would be needed in order to guarantee the success of proposals.
3. Carbon emissions characteristics
### 3.1 Total emissions in the city

Curitiba started accounting for its GHG emissions in 2011. Since then, it has prepared four greenhouse gas emission inventories, namely:

- 1st Inventory: Base year 2008; Realization 2011
- 2nd Inventory: Base year 2012; Realization 2015.
- 3rd Inventory: Base Year 2013; Realization 2015.
- 4th Inventory: Base year 2016; Implementation 2019

Although the inventories present different methodologies that makes temporal comparison difficult, it appears that the city’s greatest contributions are linked to the transport sector (see figure 1).

**Figure 1: GHG emissions profile of the inventories**

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (TCO2eq)</th>
<th>Sector</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>3.52 million</td>
<td>86%</td>
<td>Energy 94%</td>
</tr>
<tr>
<td>2012</td>
<td>3.67 million</td>
<td>75%</td>
<td>Transport 83%</td>
</tr>
<tr>
<td>2013</td>
<td>4.13 million</td>
<td>72%</td>
<td>Transport 84%</td>
</tr>
<tr>
<td>2016</td>
<td>3.51 million</td>
<td>66.6%</td>
<td>Transport 99.8%</td>
</tr>
</tbody>
</table>

GHG Emissions Profile from Curitiba’s Inventories.
Total emissions reported in the 4th inventory amounted to 3,505,046 tons of carbon dioxide equivalent (CO₂) distributed as a percentage as shown in figure 2.

**Figure 2: Total GHG emissions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>10.8%</td>
</tr>
<tr>
<td>Stationary energy</td>
<td>22.6%</td>
</tr>
<tr>
<td>Residuous</td>
<td>66.6%</td>
</tr>
</tbody>
</table>

### 3.2 Drivers of emissions and demand

Emissions from Curitiba are directly related to the city’s economic profile. In recent years the city has expanded to the most peripheral portions of its territory, thereby pushing demand for more transport and energy.

According to the emission trends identified in the base year 2016, the business-as-usual scenario considers maintenance of the city’s status quo, considering the population, economic and sector energy intensity growth projections.

The upper line of the graph in red represents the Trend Scenario (without mitigation) and shows the upward trajectory of emissions resulting from population and economic growth, without considering any climate reduction action (see figure 3). In this scenario, it is estimated that in 2030 total emissions will be 4,834,507 tCO₂, and in 2050 it will reach 6,855,886 tCO₂. Projections show that emissions will nearly double by 2050 compared with 2016.

**Figure 3: GHG emissions trends of Curitiba**

Emissions trajectory in Curitiba for the trend, planned, ambitious and extended scenarios.
3.3 Drivers and demand per sector

Transport
In Curitiba, private cars, buses, taxis, trucks, motorcycles and other modes of land transport are the main means of circulation for residents. Fossil fuels used in land transport are gasoline, diesel and natural gas for vehicles (compressed natural gas), in addition to ethanol, which is classified as a biofuel.

It is also noteworthy that the fractions of biodiesel mixed with diesel and ethanol mixed with gasoline are considered, as required under Brazilian law. Regarding electric vehicles, despite the prospect of growth in the sector in the Brazilian scenario, the presence of these vehicles in the city is negligible.

Curitiba has a high rate of motorization (0.81), which corresponds to approximately 4 vehicles for every 5 inhabitants. Throughout the 2010s, the city’s population grew 10.43 per cent, from 1,764,541 inhabitants to 1,948,626. The number of vehicles registered in the municipality, in turn, increased 18.78 per cent, from 1,232,991 to 1,464,535.

When comparing the surveys carried out for the City Mobility Plan (2008) and the Origin and Destination Survey of Curitiba (2016), it is observed that the modals that suffered the most changes related to travel by cars. These movements increased from 22 per cent in 2008 to 45.80 per cent in 2016. Travel by bus decreased from 45 per cent in 2008 to 21.01 per cent in 2016. These changes are evident from the increase in the number of vehicles on public roads, as well as by the drop in the number of passengers on public transport.

Table 2 demonstrates the city’s modal distribution characteristics, with the respective average travel distances, based on the Origin Destination Survey (2016). In addition to the predominance of the individual modal already explained, a quarter of the trips (25.4 per cent) are carried out through active mobility (on foot or bicycle), corresponding to distances of up to 3.09 km (on bicycle).

Table 2: Curitiba’s modal distribution feature

<table>
<thead>
<tr>
<th>Modal</th>
<th>Percentage of displacement</th>
<th>Average distance (km)</th>
<th>Average travel time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>23.3%</td>
<td>1.75</td>
<td>16.35</td>
</tr>
<tr>
<td>Bike</td>
<td>2.1%</td>
<td>3.09</td>
<td>21.07</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>2.7%</td>
<td>7.55</td>
<td>24.70</td>
</tr>
<tr>
<td>Car</td>
<td>45.8%</td>
<td>5.48</td>
<td>22.57</td>
</tr>
<tr>
<td>Bus</td>
<td>21.2%</td>
<td>9.51</td>
<td>46.47</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.5%</td>
<td>4.12</td>
<td>23.45</td>
</tr>
<tr>
<td>School bus</td>
<td>4.1%</td>
<td>3.65</td>
<td>29.99</td>
</tr>
<tr>
<td>Others</td>
<td>0.5%</td>
<td>5.67</td>
<td>25.97</td>
</tr>
</tbody>
</table>

Source: IPPUC – Survey Origin-Destination, 2016-2017
The demand for public transport in Curitiba is 1,365,615 passengers per day. They ride on the Integrated Transport Network (RIT) buses along 81 kilometres of exclusive channels, serving 21 Integration Terminals, 331 stations and 254 bus lines, which together cover 300,773 km daily (URBS, 2019).

The total fleet of public transport in Curitiba is 1,601 vehicles; the operating fleet comprises 1,229 units, fully characterized by the modal on tires. Of this total, 62 use low-carbon emission technology, 26 bi-articulated buses, and 6 articulated buses run on B100 biodiesel – soy oil and 30 hybrid buses. These have two motors that run in parallel: a diesel engine and an electric one. The rest of the fleet uses diesel fuel.

As a result of the COVID-19 pandemic, there has been a greater drop in the number of public transport users, representing a loss of around 47%, comparing all passengers transported in year 2020 to year 2019. Currently, RIT carries around 710,589 passengers on a business day. Preliminary studies project that when the pandemic is over, or sufficiently contained, the break-even point in transported passengers should be 75 per cent of the 2019 demand.

The total emission of the transport sector was 2,334,605 tons of CO₂. Figure 4 shows the contribution of GHG emissions from fuels used in this sector.

**Figure 4: Transport sector emissions**
Energy use of buildings
The data on buildings and households in Curitiba refer to the last survey of the census on these elements, which was carried out in 2010. As for the type of private household in the city, the census showed that 399,038 (73.19 per cent) were houses, 152,947 (26.56 per cent) were apartments and 1,475 (0.26 per cent) were tenements.

Information on the target areas of the challenge are presented in chapter 4.

As for greenhouse gas emissions from the stationary energy sector, two sources are the main generators are i) consumption of electrical energy by buildings; and ii) the consumption of fossil fuels for heating and cooking, electricity generation (generators) in residential, commercial and institutional buildings, industries, public lighting and rural properties. The sector also accounts for emission losses that occur along the natural gas distribution network.

Regarding the use of fossil fuels, Curitiba considered the fuel sales within the city limits. These include the use of natural gas, liquefied petroleum gas, diesel, and to a lesser extent the use of biomass in power generation. The total emissions of the stationary energy sector were 791,928 tons of CO$_2$. Figure 5 shows the distribution of these emissions in relation to electricity consumption, fuel combustion and fugitive emissions.

Figure 5: Emissions from energy use of buildings
The share of emissions from the stationary energy sector in relation to the subsectors is presented in figure 6.

**Figure 6: Share of emissions from the stationary energy sector**

![Pie chart showing the share of emissions from the stationary energy sector](image)

- 39.2% Residential buildings
- 4.6% Institutional buildings
- 31.0% Commercial buildings
- 24.8% Construction and Manufacture industries
- 0.1% Agriculture, forestry and fishing activities
- 0.3% Fugitive emissions

Figure 7 shows the distribution of total emissions for each subsector as a function of electricity consumption in buildings and fuel combustion.

**Figure 7: Total emissions for each subsector**

![Bar chart showing the distribution of total emissions](image)

- Residential buildings
- Commercial buildings
- Institutional buildings
- Construction and Manufacture industries
- Agriculture, forestry and fishing activities
- Combustible residual oil
- Diesel
- Liquefied Petroleum Gas
- Natural Gas
- Electricity consumption
Despite the consumption of electric energy contributing the largest portion of the total emissions of the stationary energy sector, each subsector has a specific profile. While institutional buildings represent almost 90 per cent of emissions resulting from electricity consumption, in residential and commercial buildings the consumption of liquefied petroleum gas is quite expressive. In the agriculture subsector, despite representing 0.1 per cent of the sector’s emissions, the use of diesel is the largest contributor to these emissions.

**Waste management**

The collection of urban solid waste in Curitiba is outsourced to a private company following an international bidding process. The company contracted is required to provide cleaning services in general (manual and mechanical sweeping, washing of public spaces and roads, etc.), collection and transportation of organic waste to a landfill. The city also has recyclable waste, debris and plant material collection services that are disposed of in an appropriate place.

When all the waste generated for 2020 in Curitiba is added together, an average of 1,800 tons per day is sent to the landfill and an average of 1,400 tons per month of recyclables is collected.

For the final disposal, Curitiba is part of a consortium with 23 other municipalities called Conresol. The landfill used by the consortium is in the neighboring city of Fazenda Rio Grande.

With regard to greenhouse gas emissions, the waste sector contemplated the emissions generated in the final disposal of urban solid waste in landfills, the incineration of waste from the municipality’s health services, and the treatment of domestic effluents. The sanitation concessionaire that serves Curitiba and other municipalities in the metropolitan region treats domestic effluents in the city’s five treatment stations. The total emission of the waste sector resulted in 378,512 tons of CO₂. Figure 8 shows the distribution of emissions from this sector.

**Figure 8: Distribution of emissions from the waste sector**
3.4 Emissions per neighbourhood

The survey of emissions from Curitiba has always been focused on the urban scale and on the entire city. The city’s latest GHG inventory resulted in a total 3,505,046 tons of CO₂ equivalent. Considering the intensity units, the following indicators are obtained:

<table>
<thead>
<tr>
<th>Description</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions of GHG per capita</td>
<td>1.85t CO₂/hab</td>
</tr>
<tr>
<td>Emissions of GHG per Gross Domestic Product (GDP)</td>
<td>41.8t CO₂/R$1,000,000,00</td>
</tr>
<tr>
<td>Emissions of GHG per unit of area</td>
<td>8.057t CO₂/km²</td>
</tr>
</tbody>
</table>

Since the city’s neighbourhoods have different social and economic characteristics, carrying out specific surveys for each region of the city is challenging.

In order to carry out inventories at neighbourhood scales, some information on consumption and services from providers in the city could be disaggregated, such as information on water consumption, waste water generation, and energy consumption.

Curitiba carried out its origin-destination survey in 2016 and 2017. The results of this survey can be divided into areas of analysis. Estimates of GHG emission generation can be made based on the displacements and modes indicated. The specific estimate for mobility on a smaller scale will require the adoption of ASIF (activity, share, intensity, and fuel) models for its composition, all specified in the Global Protocol for Community Scale Methodology. The city’s emission inventory was carried out based on the top-down method, or fuel sales.

3.5 The PlanClima

Curitiba developed its Climate Change Mitigation and Adaptation Plan – PlanClima to bolster the city’s carbon neutral trajectory. The multidisciplinary elaboration process was started in 2018. This came after the city of Curitiba signed a letter of commitment to abide by Deadline 2020, a pledge by the C40 Network of Large Cities to engage vigorously in climate action.

PlanClima seeks to promote strategies, integration of multisectoral and cross-cutting actions, aiming to reduce greenhouse gas emissions and increase the city’s capacity to adapt to climate risks. In its planning effort, PlanClima also focuses on the groups most vulnerable to these risks.

There are 20 prioritized actions to achieve the goals of reducing emissions and building resilience in relation to climate change. These priorities are divided into five strategic sectors: environmental and urban quality; energy efficiency; solid waste and effluents; sustainable urban mobility; and urban hypervisor and innovation.

Currently, PlanClima is being revised to detail each of the 20 priority actions. The Plan’s governance structure is also being defined in order to engage the involvement of public authorities, productive sectors, and the society.
Five strategic sectors

In addition to considering the key components of the Climate Action Planning proposed for Curitiba—which are carbon neutrality; resilience to climate risks; climate governance and collaboration; and inclusive climate action — PlanClima structures its actions into five main work streams, known as Strategic Sectors, emphasizing the areas in which Curitiba must focus to fight climate change (see figure 9).

Figure 9: Curitiba’s strategic sectors to fight climate change

GOVERNANCE AND MONITORING

URBAN AND ENVIRONMENTAL QUALITY
Maintenance of ecosystemic services and promotion of environmental services in the city, distributing equitably the City’s inclusive wealth

ENERGY EFFICIENCY
Incentives to renewable energy, building efficiency

SOLID WASTE AND EFFLUENTS
City’s solid and liquid waste management, fostering the sensible production and consumption, continuous improvement in the collection, treatment and disposal of generated solid waste

SUSTAINABLE URBAN MOBILITY
Promotion of urban mobility services in Curitiba with higher attractiveness to public transport, energy efficiency, and reduction of individual vehicles circulation

URBAN HYPERSICOR AND INNOVATION
Stablishment of the data management culture to administrate services at real time, plan long term policies and innovation incentives.
3.4 Mitigation and adaptation goals

In addition to its primary goal of carbon neutrality by the year 2050, PlanClima has developed a trajectory with mitigation and adaptation to climate change goals. The main ones are presented here.

**Mitigation goals:**

**Energy**
- 40 per cent of buildings with photovoltaic modules
- 100 per cent of renewed buildings with high energy efficiency standards
- 100 per cent of new buildings with high-energy efficiency standards

**Waste:**
- 10 per cent of waste sent to landfill

**Transport:**
- 85 per cent of movements by public transport and active mobility
- 100 per cent of passenger vehicles working on renewable or clean energy

**Adaptation goals:**

**Inundation - macro drainage**
- Increase the rainfall distributed retention volume throughout the rivers of the main hydrographic basins, prioritizing nature-based solutions

**Flooding - microdrainage**
- Increase reservation volume with reservation tanks distributed in the city
- Improve the system for maintenance, cleaning and clearance of a rainfall collection network
- Increase permeability in the city

**Heatwaves**
- Increase the reservation capacity for drinking water collection
- Increase and requalify urban green areas, from forests to tree-lined roads
- Reduce water losses in the city’s water supply system
Introduction The challenge Carbon emissions characteristics City resources and investment plans Creating a conducive environment for innovation Studies, research and data The neighbourhood approach to the challenge
4. The neighbourhood approach to the challenge
In this chapter, the main characteristics of the two target areas for the challenge are presented: Vale do Pinhão and Vila Torres. Territorial, environmental, economic and social characteristics and data are given to highlight the differences and complementary opportunities between the areas. A technical volume is available with detailed information.

4.1 Location of the areas

The locations of the target areas are shown in figure 10. Vale do Pinhão was demarcated, corresponding to that of the mixed-use zone, ZUM-VP, with specific parameters of land use and occupation (Law 15.511/2019). Vila Torres is a spontaneous occupation area, which was regularized in the 1990’s. Since Vila Torres and Vale do Pinhão are located close to each other, an influence area was also delimited to characterize some aspects that will be presented below.

Figure 10: Target areas
4.2 Understanding the historical context of the areas

For a better understanding of the dynamics of the two target areas, a brief history of the occupation and transformation of the areas over time is presented.

**About Vale do Pinhão**

The process of urbanization of the space where the Rebouças neighbourhood is currently located began in the 1880s, and is connected to the building of the railroad linking Curitiba to the port municipality of Paranaguá.

The transport facilities resulting from the proximity to the train station attracted several industries to the neighbourhood at the beginning of the 20th century. Through this process, this space became the city’s industrial sector, a characteristic that remained for several decades and was formalized by Alfred Agache’s Urban Plan in 1943.

The relationship with industrialization in the development process of the Rebouças neighbourhood also influenced the characteristics of its occupation. As evidenced by the Bulletin of Casa Romário Martins (2000), at the beginning of the 20th century, the neighbourhood was composed of a popular class engaged in “urban professions”, working as railway employees or in the traditional centre.

The industrialization process that marked the Rebouças neighbourhood in the 19th and 20th centuries left its constructive characteristic, which marks the neighbourhood’s landscape to the present day.

**About Vila Torres**

Vila Torres, called Vila Pinto until 1995, is in the Regional da Matriz, covering the Jardim Botânico and Prado Velho districts, 2.5 km from the city centre. The spontaneous occupation of the area along the banks of the River Belém began in the 1970s.

Villa Torres comprised 199,400 square metres of homes without title deeds. The municipality had to buy private land to regularize the situation. So, in 1989 COHAB2 put order to the city’s anarchic landownership by approving a plan to allot land and issuing public deeds of purchase and sale.

In 2011, Vila Torres was included in the Urbanization, Regularization and Integration of Precarious Settlements Programme. The programme aims to identify precarious settlements, unhealthy conditions, unsafe housing and provide improvements. The programme also looks to improve urban infrastructure and resettle people in units of the Minha Casa Minha Vida Programme - PMCMV and Social Work. In the last 20 years, Vila Torres has received major investments and infrastructure works. City Hall has requalified Avenida das Torres, thereby providing easy access to the city.

4.3 Land use characterization

Vale do Pinhão is a zone established under the Land Use Law for the city, and it allows for a mix of residential, business and commercial uses. The city also greatly favours the establishment of startup companies and technological business. On the other hand, Vila Torres is a small portion of a mixed-use zone, comprising mainly residential use and small business (see figure 11).
Vale do Pinhão is an area of the city which has been occupied since the 1800s, so it is very urban and not many of its natural aspects remain. A small part of its natural forest cover can be found on private properties and parts of the rivers that run through the area are still visible. There is a good network of streets, with trees and small public squares in the area.

Vila Torres is partially bounded by the Belém River, one of the main rivers in Curitiba and some 17 km long. As Vila Torres is a small area of high-density population, there is little natural forest cover or a good street network. Figure 12 shows the hydrography and green areas in the area.

4.5 Social aspects - profile of the communities

The characterization of the social and economic challenges in the area of influence, as well as the details of the Vale do Pinhão and Vila Torres sections, were broken down into the following items: i) community profile; ii) equity challenges; iii) education and youth; and iv) economy.

Figure below shows the density in the influence area. Even though Curitiba’s population a growth grew from 2010 to 2020, there was a population decrease in all the influence area, as can be seen in detail in Table 3.
Figure 14: Demographic density by census sector (inhabitants/hectare) - 2010

Elaboration: IPPUC – Monitoring.
Table 3: Area, population and demographic density in the area of influence, Vale do Pinhão, Vila Torres e Curitiba – 2010 and 2020.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vale do Pinhão</td>
<td>57.34</td>
<td>1 415</td>
<td>24.68</td>
<td>1 204</td>
<td>20.99</td>
</tr>
<tr>
<td>Vila Torres</td>
<td>24.63</td>
<td>4 166</td>
<td>169.12</td>
<td>3 987</td>
<td>161.86</td>
</tr>
<tr>
<td>Influence Area</td>
<td>414.10</td>
<td>11 408</td>
<td>27.55</td>
<td>10 476</td>
<td>25.30</td>
</tr>
<tr>
<td>Curitiba</td>
<td>43 484.13</td>
<td>1 751 907</td>
<td>40.29</td>
<td>1 948 626</td>
<td>44.81</td>
</tr>
</tbody>
</table>

Elaboration: IPPUC – Monitoring and database.

4.6 Social aspects - equity issues

In 2010, Curitiba’s average per capita income was almost twice the national average. When analyzing the intra-urban context, however, it is possible to identify a series of contrasts. While in the same year the adjacent neighbourhoods of Alto da Rua XV, Cristo Rei, and Jardim Botânico HDU had an average per capita income of just over R$ 3,000.00, in Vila das Torres the average was less than R$ 450.00 (see figure 14). Corroborating this result, in 2010 Vila das Torres had a significantly higher proportion of extremely poor [1], poor [2] and vulnerable to poverty [3], compared with other territories in the intervention area and also to the municipal average.

Another relevant aspect is the type of employment in each area, as demonstrated in Table 4.

Figure 14: Household income for Vila das Torres and Vale do Pinhão
The neighbourhood could be characterized by the high rate of crime against sexual dignity (138 occurrences/100,000 inhabitants in 2018, the fourth worst result in the municipality); drug trafficking (1,619 occurrences/100,000 inhabitants in 2018, the worst result); and domestic violence (1,500 notifications/100,000 inhabitants in 2018, the second worst result in Curitiba).
4.7 Social aspects - youth and education

Considering the aspects related to education, it is possible to note once again the greater social vulnerability of Vila das Torres, which showed a lower frequency of children, adolescents and young people at school. As a result, while in these two Human Development Units (HDUs) the expected time of study for the age group of 18 years reaches almost 13 years, for Vila das Torres the value is less than nine years, below the national and municipal average. However, perhaps the indicator with the most contrasting results is the illiteracy rate of the population aged 15 and over. While for Vila das Torres this indicator exceeds 10 per cent, in the second territory with the worst result, Prado Velho and Rebouças, the result does not reach 2.5%.

*Figure 16: Illiteracy rate for Vila das Torres and surroundings*
Regarding child labour, while the municipal average in 2010 was just under 6 per cent of incidence, in Vila das Torres it was almost 10 per cent. Likewise, the proportion of mothers aged up to 17 years was higher in Vila das Torres, although for this indicator the Human Development Unit for Prado Velho and Rebouças was even more startling. An indicator of vulnerability to which 15 to 24-year-olds in territories of the area of influence are subjected is the percentage of them out-of-school, out-of-work, and exposed to poverty. Once again, almost 10 per cent of those in Vila das Torres are in these conditions. Contrastingly, other territories in the area of influence did not reach 2.5 per cent.

### 4.8 Social Aspects – Waste and recycling collectors

Vila Torres, Vale do Pinhão and their surroundings have scheduled collection of organic waste that varies between nighttime, daytime and between weekdays and weekend, depending on to demand. Vila Torres has a more frequent collection schedule, called Programa Tudo Limpo (the Clean all Programme). The collection of organic and recyclable waste is divided in sectors. As regards organic waste, an average of 814 tons is collected each month in the sectors involving Vale do Pinhão and Vila Torres and sent to a landfill. On average 28 tons of waste is collected and recycled. Regarding Programa Tudo Limpo, an average of 42 tons per month of waste is collected and sent to a landfill.

In addition to formal waste collection, there are social and environmental programmes, such as Câmbio Verde (Green Exchange, in English). This is a programme for the benefit of vulnerable populations whose communities lack adequate urban infrastructure. The alleyways and streets in some such areas, though, are too narrow for the entry of garbage collection trucks. In such cases, residents take their recyclable materials to a central, accessible point for collection.

The programme consists of a local policy to fight hunger. This policy covers aspects of education, household waste, income generation, ecological preservation, and encouragement for the organization of horticultural producers. Some direct outcomes of the programme’s activities have been the supply of food harvest surpluses to markets in the Metropolitan Region of Curitiba, better food quality for the low-income population, as well as the cleaning and preservation of the environment. Approximately 8,000 people are served by this programme, and the monthly values for this exchange are 250 tons of recyclable waste per 65 tons of vegetable foods.

There are two Câmbio Verde exchange points of the programme in the Vila Torres, with biweekly frequency. The quantities and data regarding the time period from January to July 2021 is presented in the table 3.

<table>
<thead>
<tr>
<th>Table 3: Location of Câmbio Verde Exchange points in Vila Torres</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of Cambio Verde Programme</strong></td>
</tr>
<tr>
<td>Vila Torres Aquilino</td>
</tr>
<tr>
<td>Vila Torres Baltazar</td>
</tr>
</tbody>
</table>

The Ecocidadão Programme is aimed at recycling waste in partnership with informal collectors. This City Hall programme began in December 2007 by the partnership agreement between the Municipality of Curitiba with Associação Aliança Empreendedora, AVINA Foundation and the National Movement of Waste Pickers. Later, this partnership was formalized between the Municipality of Curitiba and the Pro-Cidadania Institute of Curitiba, the IPCC.
Cooperatives are remunerated by the Municipality for the volume of material they recycle and by the selling of these recycled materials to private companies. The Municipal Environment Secretariat allocates a minimum of 10 tons of recyclable materials from the official collection to each unit. Additionally, waste is collected by each cooperative all over the city.

The Ecocidadão Programme runs recycling parks, which are spaces endowed with physical, administrative and management infrastructure for receiving, sorting and selling the material collected by waste pickers.

Vila Torres has four units of the Ecocidadão Programme, which processes an average 28.75 tons per month each.

Regarding the recyclable collectors, it is important to point out the way in which collectors carry out the recyclable materials.
There are two types or recyclable collectors, one of which consists of private vehicle owners. Individuals in this category carry their recyclables in carts attached to their vehicles. Most collectors though, which form the other group, hand pull their carts (see Figure 17) along roads. Such methods increase the risk of road accidents; endangers the cart operators, who must also contend with the weather and hazardous working conditions.

4.9 Economic Aspects

Regarding the challenges for the economy, attention should also be paid to the distribution of activities and occupation of individuals by sector of the economy. In 2019, most businesses in Curitiba accounted for 34 per cent of the service sector. Likewise, for the influence and for Vale do Pinhão, services represented 36 per cent and 35 per cent of activities, respectively. That is so, where it is possible to identify that most service establishments were related to accommodation and food (18 per cent); administrative activities (18 per cent); and professional, scientific and technical activities (16 per cent).

In Vila Torres, only 17 per cent of the establishments were classified as services. In this territory, most records fall under autonomous activities, such as waiters, parcel deliveries, taxi drivers, bricklayers, manicurists and pedicurists. Consequently, the other segments were less representative, with the exception of industries and activities related to water, sewage, electricity, and gas. It is also worth mentioning industrial activities, since most corresponded to activities related to civil construction.

Figure 18: Commercial Permits in Vila Torres and Vale do Pinhão.
When analyzing the occupation of the residents in each of the areas of influence, it is possible to observe that in the HDU Rebouças, which represents the largest territorial extension of the Pinhão Valley, the representation of employees in the service segment is 62 per cent compared with the municipal average of 54 per cent and the national average of 44 per cent. On the other hand, in Vila das Torres, the highlight is the percentage of employees in civil construction and in sectors of public utility industrial services, such as waste management services, water, electricity and gas.

4.10 Neighbourhood perceptions about mobility, energy and waste

Thirty-two residents from Vale do Pinhão and 48 from Vila Torres were interviewed on their perceptions about where they live and their habits. For Vila Torres, 70 per cent of the residents said they were receiving up to 1 minimum wage of monthly household income (approximately US$250). Another 54 per cent said they used the bus as their main mode of travel. As for Vale do Pinhão, 56 per cent of respondents reported a monthly household income of up to 3 minimum wages (approximately US$700). Also, 72 per cent of respondents from Vale Torres used the private car as their main means of transport. Most respondents, that is 70 per cent, claimed that the current R$4.50 (US$0.81) bus fare was the reason for not using public transport more often.
All respondents currently use electricity supplied by Copel (Companhia Paranaense de Energia Elétrica). Most respondents identified cost as a major factor driving them to opt for a more sustainable energy source. For cooking, 93.8 percent of respondents identified cooking gas as their energy source.

All respondents said they used Curitiba's solid waste collection service as the main way to dispose of waste. More respondents, that is 56.4 per cent, said they would opt for composting if they had adequate guidance or if there was an option for community composting (41 per cent).

Thirty-two people who work in commerce and industry in Vale do Pinhão and 44 in Vila Torres were interviewed on their perceptions about where they live and about their habits. Regarding Vila Torres, 74 per cent of residents characterized their company as small. For 29 per cent, the bus was the main means of transport to work and 20 per cent used other forms.

As for Vale do Pinhão, 62.5 per cent of respondents characterize their company as medium-sized. The same percentage said they used the company’s own fleet for their activities. Concerning energy, 40 per cent believed that the cost of alternative fuel would be a barrier to more sustainable transport, and the same percentage held that they would adopt a less polluting alternative if offered financial incentives.

All respondents currently use electricity supplied by Copel. Most respondents (65.8%) said the cheaper cost of using sustainable energy would drive them to that source rather than conventional one. Furthermore, 47.4 per cent said they would be willing to adopt a more sustainable energy system if the generation of this energy were communal.

Almost none of the companies in Vila Torres (97.7 per cent) had air conditioning in their establishment, while in Vale do Pinhão 53 per cent said they had between 1 and 3 units installed on site.

It was also observed that 92.1 per cent of those interviewed said they used Curitiba's solid waste collection service as their main form of garbage disposal. Among respondents, 23.7 per cent said they would opt for composting if they had adequate guidance, or 22.4 per cent said if a discount on the municipal waste collection fee was offered. The results of this research can be found in its entirety in the technical volume.
4.11 Sources of information for residents

In the city's 10 regional administrations, residents of Curitiba have access to information on municipal services, works and equipment via the social media communication tool WhatsApp, based on their registration with the NAR (Regional Administration Centres) of the Municipal Secretariat for Social Communication.

In Vale do Pinhão, communication has been reinforced since the community's objective is to enhance the innovation environment through entrepreneurship, creative economy, and technology. In order that this programme impact the greatest number of people, several communication channels were developed (see table 4).

Table 4: Communication channels for Vale do Pinhão

<table>
<thead>
<tr>
<th>Vale do Pinhão: <a href="http://www.valedopiniao.com.br">www.valedopiniao.com.br</a></th>
<th>Community: comunidade. valedopiniao.com.br</th>
</tr>
</thead>
<tbody>
<tr>
<td>valedopinhaoprefeitura</td>
<td>agencia.curitiba</td>
</tr>
<tr>
<td>Vale do Pinhão</td>
<td>@empreendedora_curitibana</td>
</tr>
<tr>
<td>@valedopiniao_curitiba</td>
<td>+55(41)32137514</td>
</tr>
</tbody>
</table>

4.12 Impacts of inaction on residents

For the preparation and definition of the scope of PlanClima's actions, emission scenarios were carried out taking into account the demographic and economic variables of the city (presented in section 3.2), and the assessment of climate vulnerabilities and risks.

It is important to emphasize the concept of risk so that the results are correctly interpreted. Risk is defined as the materiality of the occurrence of dangerous events or trends (threats). That is to say a region with a high probability of occurrence of a threat (such as mud slides, flooding or heat waves) to which it is vulnerable and exposed (has many material assets and people) run a high degree of associated risk.

As a result of this evaluation, the following stand out:
- The future trend of an increase in the average temperature of Curitiba
- The non-existence of a specific trend towards an increase or decrease in the annual volume of rain over the next decades, but the data indicate that the city may have some years with rain well above the average, with several consecutive days of precipitation
- The strong drought trend
- The maximum rainfall in a day, since almost every year the city could expect at least one episode of very heavy rain
- The greater probability of occurrence of extreme storm events in the future, with the potential to cause flooding and flooding; on the other hand, consecutive days without rain would also be frequent and the city may experience long periods of drought, with effects on the water supply
5. City resources and investment plans
Over the last 4 years Curitiba has invested around 3.1 per cent of its total expenses annually. Investments have ranged from US$41 million to US$68.5 million per year. The 2022–2025 Pluriannual Plan foresees investments of US$466 million, of which climate finance will command the largest share.

Some US$29.5 million in investments are planned for the period 2022 to 2025 in the Matriz Regional Administration, where the two intervention areas are located. These are interventions in road infrastructure, construction, rehabilitation and adaptation in food supply facilities; implementation and revitalization of leisure areas; renovation and expansion of sports, leisure, tourism and security facilities, with emphasis on the implementation of the new Natural History Museum.

The Sustainable Mobility Programme is based on restructuring an integrated metropolitan system that reaffirms mobility as an important asset of the territory and awakens a new culture. The design of this system includes a set of elements that comprise services, infrastructure, new technologies and governance arrangements that need to act in synergy to ensure sustainability and accessibility and offer residents the best experiences.

Recently, in partnership with the World Resource Institute, Brazil, the municipality designed a strategic map for the Sustainable Mobility Programme. Its objective is to redesign the logic of urban mobility service systems in Curitiba and the metropolitan region to generate greater attractiveness and energy efficiency, and thus reduce the number of individual vehicles on the roads and of GHG emissions in line with PlanClima.

Two of the main routes of the existing public transport network, the East–West Express Line (BRT) and the Inter 2 Direct Line, will be the initial milestones of the expected transformation to mobility. They will have significant intervention with the reform and modernization of terminals; the construction of new stations, which will be wider, more comfortable, intermodal, self-sustaining and connected in a micro smart grid system. Dedicated overtaking lanes, revitalization of gender-sensitive sidewalks and landscaping, and fleet renewal with the adoption of electric buses, complete the planned interventions. These two lines, prior to the Covid-19 pandemic, were responsible for carrying 291,000 passengers per business day, meaning about 27 per cent of commuters in the structural transport system in Curitiba.
The resources for the implementation of civil works for the Inter 2 and BRT East-West projects are secured with a US$227.15 million loan from the Inter-American Development Bank and the New Development Bank. Curitiba was recently selected as one of the 20 deep dive cities of the TUMI E-Bus Mission, which aims to establish a broad coalition of public and private sector organizations to achieve a transition to electric buses and replicate this in at least 100 cities by the end of 2022. A model for the deployment of these buses to the Inter 2 and BRT East-West routes is under way. From this experience, city transport officials will have a solid basis to find the best way to continue the decarbonization of the fleet in the next transport concession that starts at the end of 2025, thereby well on the way to operating a 100 per cent zero emission fleet in 2050.

In accordance with the strategy of promoting active mobility, there is the Caminhar Melhor Project which provides for new sidewalks along roads in the central region and neighbourhood centres with large pedestrian flows. The network of cycle lanes is also to be expanded. The first stage of this project allows for 29.4 kilometres of cycling lanes and 21.5 kilometres of new sidewalks citywide. There is a plan to invest another US$8 million to US$10 million to these projects in 2022 and 2023.

The municipality is drawing up terms for the accreditation of specialized and qualified companies so that it could sign a cooperation agreement for the building, operation and maintenance of a bicycle rental and storage system in Curitiba. This would enable the intermodality provided for in both projects. One of the minimum requirements for the provision of this service is to locate the cycle docking stations strategically, close to places with high cycling demand, so they dovetail with public transport nodes (buses, stations and terminals. As a desirable requirement, it is expected that for now at least 10 per cent of the bicycles would be electric, but they would be increased with demand. Investments of this nature form part of Curitiba's drive to achieve energy efficiency in view of climate change and for innovation.

The Curitiba Mais Energia Programme includes the photovoltaic generation plant at Palácio 29 de Março, in operation since 5 June 2019, financed with resources from Copel’s Energy Efficiency Programme, and supervised by the National Electric Energy Agency.

Curitiba is rated CAPAG B (Payment capacity rate B), according to an assessment by the National Treasury Secretariat (STN - https://www.tesourotransparente.gov.br/temas/estados-e-municipios/capacidade-de-pagamento-capag). The percentage of expenses with personnel, according to the Fiscal Responsibility Law (LRF), is at 42.25 per cent below the limit. The ratio of Curitiba’s gross consolidated debt to net current revenue (Indebtedness - DC) is 19.09 per cent (DC < 60 per cent), giving the city a grade A rating. Likewise, the relationship between the city’s financial obligations and available cash also achieved grade A with 3.37 per cent. The only indicator in which Curitiba received a B rating was in the relation between current expenses and adjusted current income (Current Savings - PC), with a result of 90.98 per cent (PC = or > 90 per cent and < 95 per cent). This result is due to the COVID-19 pandemic, as the municipality increased its current health spending to support the most vulnerable population. Despite this result, these indicators portray that Curitiba is financially solvent. The city has readily usable resources that are not earmarked for needs to meet short-term financial obligations. Moreover, the city’s savings are in good shape and able to cover investments, amortize the debt, meet current expenses, including interest payments. Curitiba had a CAPAG A rating, prior to the pandemic.
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6. Creating a conducive environment for innovation
In Brazil, Federal Law No. 10,973/2004, which provides for incentives for innovation, scientific and technological research in the productive environment, and other measures, was amended by Federal Law No. 13.243/2016. This amendment provides for incentives for scientific development, research, scientific and technological training and innovation. It also amends Law No. 10973 of 2 December, 2004.

The city has a long history of fostering innovation. Since the 20th century, Curitiba has sought to produce spaces favourable to innovation, such as construction of the first Brazilian Software Park (Complementary Law nº 22/1998).

**Curitiba Technopark**

The Municipal Programme established by Complementary Law No. 64/2007 supports development of technology-based companies, science and technology institutions. The programme, run by the Curitiba Development Agency of, grants tax incentives for such firms and promotes the sharing of knowledge and innovation in strategic high-tech sectors in the municipality.

By virtue of this law, the municipality allows the concession of a differentiated taxation regime for tax on goods and services (Imposto sobre Serviços, or ISS), lowering the rate from 5 per cent to 2 per cent during the company's participation in the programme.

The company that meets the legal requirements gains COFOM approval for its technological innovation research and development project (PPI) can expect the incentive.

The beneficiary company is committed to developing the agreed innovation by investing at least the difference in the ISS rate, adhering to project’s goals and inputs plan. In addition, COFOM’s is required to conduct annual performance monitoring of companies participating in the programme. This seeks to verify the aggregate performance as well as the achievement of economic and technological performance results of the enterprise. At the end of the incentive period, companies are expected to submit a detailed report on the innovation development process, indicating the achievement or non-compliance with the target plan.

As the incentive’s closing date approaches, the company may present a new proposal for its renewal, via a new innovation project. The new period, if approved, starts right after the end of the previous project.

Information and documents can be accessed and are available at [http://www.agenciacuritiba.com.br/incentivos/tecnoparque/](http://www.agenciacuritiba.com.br/incentivos/tecnoparque/)

**Vale do Pinhão**

Decree 857 of 25 April 2017 establishes that innovation, understood as an important instrument for undertaking regional development, has been the cervical spine of specific public policies to promote ecosystems based on innovation. Innovation is not a dispersed phenomenon because the geographic concentration and proximity of actors facilitate the exchange of information and the sharing of knowledge. Its territorial distribution is not random either, but is the result of such public policies and private actions of a local networking, favourable to the innovative environment.

Silicon Valley in the United States and similar technology parks elsewhere have been adopted as reference models for establishing innovative habitats and ecosystems in Curitiba. The Vale do Pinhão project associates the urban requalification of old industrial districts, in the Rebouças district of Curitiba, aiming to promote the innovation ecosystem, encompassing new concepts, trends, and policies in line with the municipality’s objective of making Curitiba a smart city.

Under the aegis of Vale do Pinhão, companies of all sizes in Curitiba, including startups, can gain advantages and benefits, such as the connection between actors and cutting-edge professional qualification.

Further information is available at [http://www.valedopiniao.com.br/](http://www.valedopiniao.com.br/)
Innovation Engineering / Escher Mill
Decree No. 885/2017 creates the Engenho da Inovação (Innovation Mill), granting permission for the use of the municipal structure itself by Curitiba Development Agency and the Cultural Foundation of Curitiba, establishing that the Mill will function as an environment for the development of the innovation ecosystem, which will be able to encompass the dissemination of technologies, subject to legal requirements.

Municipal Innovation Law
Law No. 15,324/2018 seeks to strengthen innovation as a pathway of the city’s transformation by providing incentives for the productive sector environment. The aim is to develop the municipality’s entrepreneurship and innovation ecosystem, and a Municipal Science, Technology and Innovation Council. The law benefits a set of productive sectors that include the entrepreneurship ecosystem, arrangements that promote innovation, business incubators, scientific institutions, independent inventors, technology centres, and startups. The law also authorizes the municipality to make use of instruments to encourage innovation, such as economic subsidy, financing, technological bonuses, tax incentives and the use of investment and participation funds. The law also provides for the creation of the Municipal Innovation Fund for projects aimed at building the city’s innovation ecosystem and the creation of the Municipal Science, Technology and Innovation Council.

Vale do Pinhão Innovation Fund
Article 2 of Paraná’s Innovation Law No. 15,324/18, provides for the menopause creation of a Municipal Innovation Fund to foster development of Curitiba’s entrepreneurship and innovation ecosystem. When established, the fund is to support financing instruments to encourage the construction of specialized and cooperative innovation environments and to its own innovation in companies.

With the publication of Law No. 15,536/19, the Vale do Pinhão Innovation Fund, - INOVA VP, was established. This is public fund for projects that include in their activities research and development of innovative solutions to the daily challenges city residents face.

The Curitiba Development Agency, pursuant to the caput of article 3d, is responsible for technical management of the fund that will be constituted as a Budget Unit of the Municipal Secretariat of Finance. Also, the Management Committee appointed by decree is responsible for defining public policies for the investment of resources.
6.2 Law and policies

At the federal level, the Statute of Cities Law No. 10.257/2001 and the Statute of the Metropolis Law No. 13.089/2015 establish the principles and guidelines for which all of Brazil’s cities must base their development plans. The Municipal Master Plan establishes principles, guidelines, plans, and programmes that regulate Curitiba’s development and how innovations should take place driven by municipalities, the public, and the private sector.

Some of these guidelines included in the Urban Development Policy of the Municipality, that in Article 14, establishes the full development of the social functions of the city and urban property, by promoting social development, integration and cooperation with the federal, state and municipal governments of the Metropolitan Region of Curitiba. The guideline also aims to reduce social, economic and environmental impacts in risk areas and increase the metropolis’ resilience to severe weather events resulting from climate change;

Another guideline is article 17, in which the urban structuring policy has the general objective of guiding, ordering and disciplining the city’s development. These are to be done through regulatory instruments that define the spatial distribution of activities, the density and configuration of the urban landscape with regard to building and the subdivision of the land, seeking a balance between natural and built aspects.

In article 39, the Municipal Urban Mobility Policy is committed to facilitating the circulation of people and goods in the city. The general guidelines of the Municipal Environmental Policy within article 62 are aimed at the gradual reduction of pollutants released into the air, soil, subsoil and water. The guidelines are also meant to encourage the generation and use of clean energy from non-polluting and sustainable energy matrices, and encourage the distributed generation of electricity from renewable sources or qualified cogeneration.

Article 66 requires the municipality to establish the Climate Change Mitigation and Adaptation Plan, whose objective is to take measures aimed at the gradual reduction of greenhouse gas emissions in the city.
6.3 Land and permits procedures

Curitiba’s Master Plan of 1965 has been revised by Law No. 14,771/2015. Its article 13 concerns urban development policies, including the balance between the natural and the built environment, reduction of socioeconomic vulnerabilities and those of the environment. It also calls for the promotion of smart city concepts in municipal urban planning.

To ensure that the premises of the Master Plan are implemented, the city relies on the definitions of Law No. 15.511/2019 on Land Zoning, Use and Occupation, bringing organization and control to the city’s occupation process.

At the same hierarchical level, the city Law No. 15.582/2021 deals with the Municipal Policy for the Protection, Conservation and Recovery of the Environment, establishes procedures for the management of solid waste, conservation of biodiversity and of water resources, protection of flora, the mitigation and adaptation to climate change, among others.

This set of municipal legislation requires every citizen, company or government agency that wishes to build in the city to follow a procedure to obtain a specific construction permit. They must go through the environmental licensing regime, with the establishment of mitigating and compensatory measures. Regulation at this level also applies to those wishing to develop commercial activities or the production of goods. They need a Location and Operation Permit that also goes through the environmental licensing process, whether simplified or complete, with the establishment of standards and norms of the operation.

6.4 Monitoring frameworks

The system of monitoring and social control of urban policy currently adopted by the municipality is consolidated from the application of the following work steps:

1. Definition of indicators through the method of evaluative questions – (divergent phase).
2. Alignment of selected indicators with reference documents and charters to which the municipality is a signatory, such as National, State and Municipal Plans; Sustainable Cities Programme (Brazilian Civil Society Organization); and the United Nations Sustainable Development Goals.
3. Validation of the selected indicators through a matrix of the relevance variable, consistency, feasibility, malleability, scope, and accessibility (convergent phase).
4) Feeding the indicators and evaluating the results through the following types of analysis: a) historical or evaluation of the municipality’s performance over time; b) multicentric or comparison of municipal performance with other analysis references, such as hub municipalities in metropolitan regions with similar physical, demographic and geopolitical characteristics; and c) intra-urban or evaluation of the spatial distribution of public policies.
5. Democratic presentation and validation by a collegiate composed of representatives from different segments of society.

In addition to allowing the monitoring of the municipality’s evolution in relation to the guidelines provided for in the Master Plan and the commitments signed, the proposed monitoring has served as a subsidy for the review of plans originating from the Master Plan and as a model for monitoring the results of several other plans, programmes and projects with themes related to urban policy. More specifically, the definition of the information to be included in this challenge brief, as well as the method for analyzing the results, went through some of the steps listed, making the necessary adaptations.
6.5 Communication

Over the past four years, the Curitiba has invested heavily in innovative and intelligent communication platforms. The object of this measure is to get closer to and respond to the population it serves. The city authority’s main channel of communication with residents is the City Hall website: www.curitiba.pr.gov.br. It provides information about the city administration, municipal programmes, projects and works in progress, and regionalized information. It also directs the public to various services. However, to be close to all audiences, the city operates on a variety of social media communication platforms (see figure 19).

Figure 19: Social networks used by the city of Curitiba

Another traditional contact channel between City Hall and residents is the telephone helpline 156. Residents’ requests, complaints or praise for services rendered can be channeled through this facility. The city also uses this line to conduct surveys on public satisfaction with services or their interests.
6.6 Experimentation environments and test beds

Regarding innovation assets, those within the scope of this project are listed along with a few more, given the relevance of their actions in the areas they represent (see table 5). Also highlighted are institutions that work in innovative social entrepreneurship with an important role in Vila Torres.

Table 5: Innovation assets, institutions

<table>
<thead>
<tr>
<th>Promotion and Development Agencies</th>
<th>Research and Innovation Centres</th>
<th>Accelerators and Incubators</th>
<th>Co-working</th>
<th>Universities</th>
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<tbody>
<tr>
<td><strong>Agência Curitiba de Desenvolvimento e Inovação S/A</strong> (Curitiba Agency for Development and Innovation S/A)</td>
<td>Instituto Senai de Inovação em Eletroquímica (Senai Institute of Innovation in Electrochemistry)</td>
<td>Aceleradora Senai (Senai Accelerator)</td>
<td>Worktiba Barigui e Worktiba Cine Passeio (Public coworking created by the City Hall of Curitiba, IMAP and the Curitiba Agency)</td>
<td>UFPR - Universidade Federal do Paraná (Federal University of Paraná)</td>
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<tr>
<td><strong>Agência Paraná de Desenvolvimento</strong> (Paraná Development Agency)</td>
<td>Instituto Senai de Tecnologia Meio Ambiente e Química</td>
<td>Aceleradora Sistema FIEP - Federação das Indústrias do Paraná (Federation of Industries in the state of Paraná)</td>
<td>Aldeia</td>
<td>UTFPR - Universidade Federal Tecnológica do Paraná (Federal Technological University of Paraná)</td>
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<tr>
<td><strong>Fundação Araucária</strong> (Araucaria Foundation)</td>
<td>Inovação at Universidade Federal do Paraná (Innovation at Federal University of Paraná)</td>
<td>HOTMILK (Entrepreneurship and Innovation)</td>
<td>Biosfera (Mentoring and technology infrastructure)</td>
<td>IFPR - Instituto Federal do Paraná (Federal Institute of Paraná)</td>
</tr>
<tr>
<td><strong>Code for Curitiba</strong></td>
<td>UT-UTFPR Incubadora de Inovações da Universidade Tecnológica do Paraná (Innovation Incubator of the Technological University of Paraná)</td>
<td>Nex Coworking</td>
<td>PUC-PR Pontifícia Universidade Católica do Paraná (Pontifical Catholic University of Paraná)</td>
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<td><strong>Associação das Empresas Brasileiras de Tecnologia da Informação</strong> (Association of Brazilian Information Technology Companies)</td>
<td>Incubadora Tecnológica do Tecpar (Intec) (Tecpar’s Technological Incubator (Intec))</td>
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<tr>
<td><strong>Curitiba Angels</strong></td>
<td>Aceleradora ISAE Business (ISAE Business Accelerator)</td>
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<tr>
<td><strong>SEBRAE/PR</strong></td>
<td>Unidade Distrito Spark CWB (Spark CWB District Unit)</td>
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</table>
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7.

Studies, research and data
A Demand Assessment for Inclusive Climate Action was carried out in 2020 by WayCarbon, a South American consultancy firm specializing in climate change and sustainability issues. The assessment was provided with the technical help of the C40 Group to the City of Curitiba under the Climate Action Planning Programme.

An Environmental and Socioeconomic Vulnerability Assessment for the Municipality of Curitiba was made by SNC-Lavalin Projetos LTDA in partnership with IPPUC.

The Climate Risk Assessment of the City of Curitiba, part of Grupo C40’s Technical Assistance Programme, was prepared by iCare & Consult, 2020.

An Online Consultation Report was the result of a consultation for a qualitative assessment of the population’s profile in relation to the climate change theme categorized by gender, age, education level, and neighbourhood of residence.

The 2016 Base Year GHG Emissions Inventory contains the city’s updated emissions profile. The inventory also establishes the baseline against which ambitious and extended emission scenarios can be compared with trends and planned scenarios.
A better quality of life for all in an urbanizing world