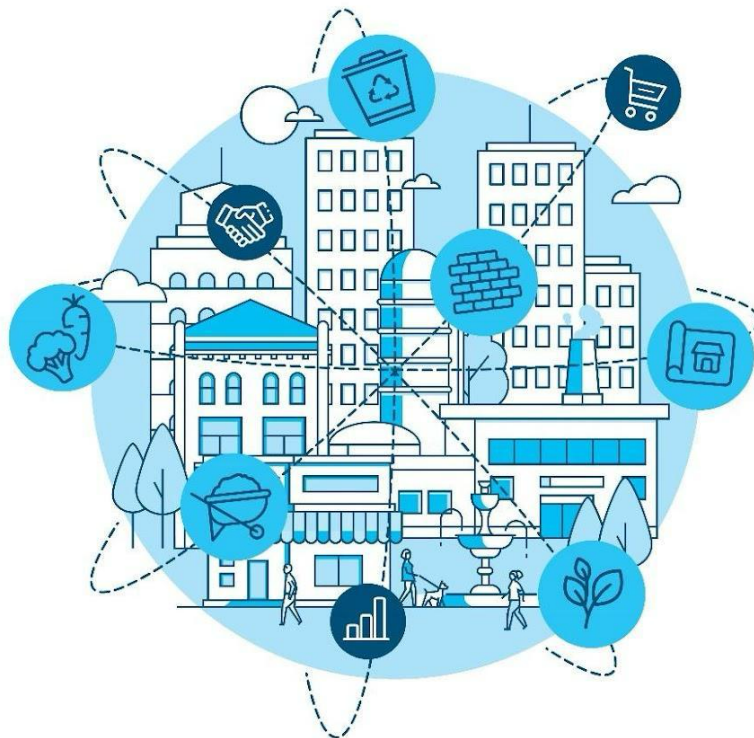# OMSW flow optimisation tool

User's Manual

Municipality of Seville

Citizen's platform

Visit the platform here ([OMSW flow optimisation tool](#))

When the users enter the OMSW platform, they will encounter the navigation panel with the text inputs for the user's district, zip code and the different type of municipal collected waste. Below the navigation panel, the user will select in the map the origin point (location) to find the closer organic bin. Additionally, detailed information about the other bins and different type of collected waste will be shown for the selected district. Two buttons are found at the bottom of the form: one that submits the form (the one labelled "Search") and the other one to reset all the text boxes.

Once the citizen fills in every input and hits the "Search" button, a column with the results will appear between the original form and the map. In this section, the citizen will see the information of each type of municipal collected waste in the selected district. Also, the citizen will se information about the three closer organic bins from the selected location, as well as information on annually waste collected both in total amount and per waste types (Fig. 2).
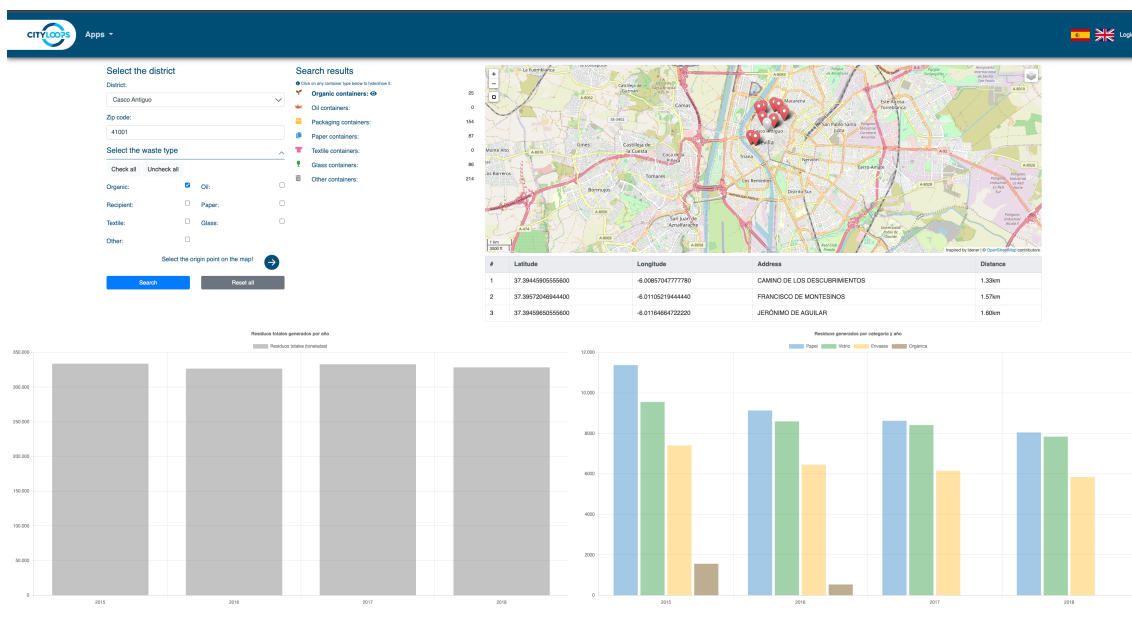
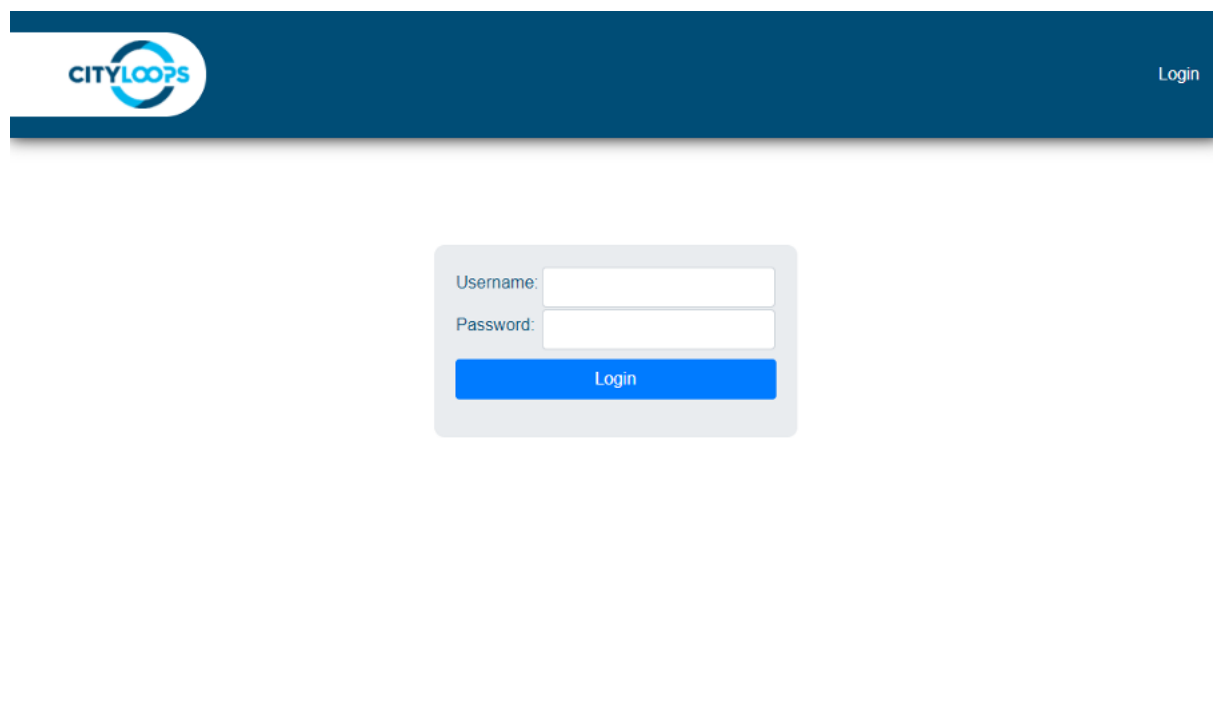**Functionalities of OW platform for citizens**

- Forms for query: The citizen will provide data about its location. The OW CityLoops platform for citizens will show the closer OW route and the location of OW bins.

- Dropdown list: The citizen could select a district. The OW CityLoops platform for citizens will show the OW route (if exist) or the closer OW route and the location of OW bins.
- Map showing OW routes implemented: A widget with a map (using OpenStreet Maps) will be presented to the citizens showing current OW routes and location of OW bins, and after the results of the query or the selection of the dropdown list, the closer one will be highlighted.
- Dashboard showing the current data on OW waste collection: The dashboard will show the data on the amount and quality of collected OW and the timestamp of the presented data.
- Control panel: A set of buttons will be included in the application to clean the forms, do the query and export information. Logos of the involved partners (Emasesa, Lipasam, Municipality of Sevilla, CityLoops project) will be included providing additional information.

Manager platform

The manager platform has several pages to perform actions related to the management of the application and its resources.

To access the manager platform, the user must click the "Login" link at the top right corner of the page. This will lead them to the login page, in which they can enter their username and password to access the manager platform.
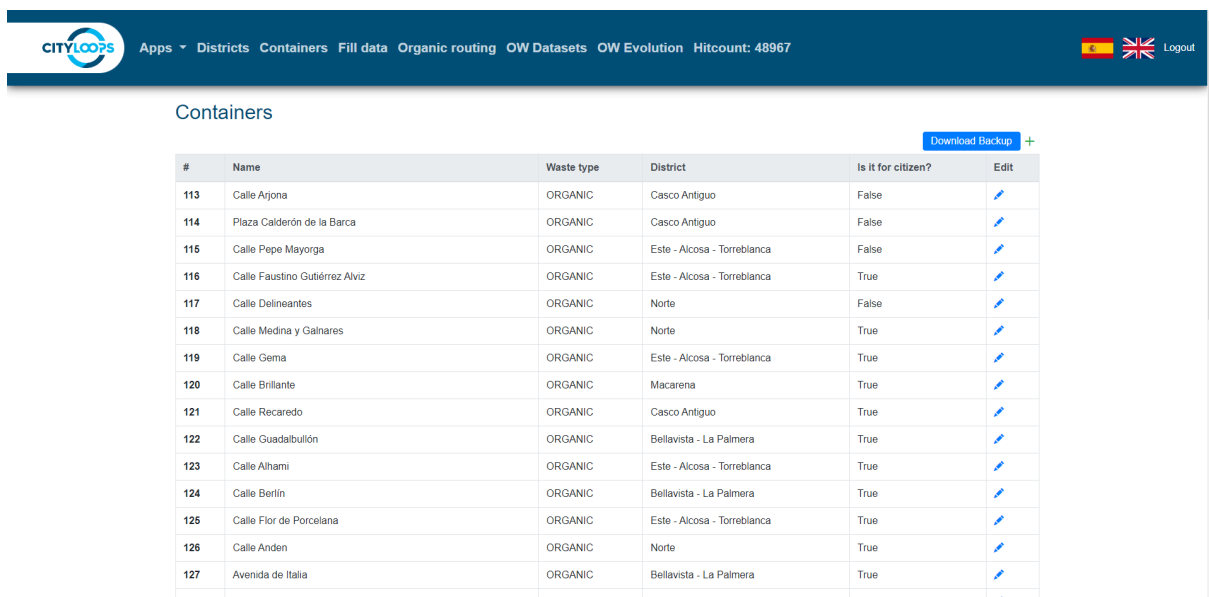

Once the user has logged in to the application, they will be able to access the pages to manage the entities of the application (containers, clean points, and districts). Each of the buttons located at the top bar of the page regarding these entities leads to the list of said entity. Through this list, the user can see the different attributes of each entity created. They can also create a

new entity by clicking on the + sign located at the top right of the table, or edit any of the already created ones, by clicking the pencil icon at the end of each row.

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The user can also download a backup of the containers saved in the database clicking the "Download backup" button located on the top-right corner of the container list table.

When entering the page to create a new entity, the user will be supplied with two ways to create a new entity: to create it manually entering the data in several inputs or uploading a file that contains the pertaining data. Note that the file uploaded must be in the correct format and contain the needed data to create a new entity.
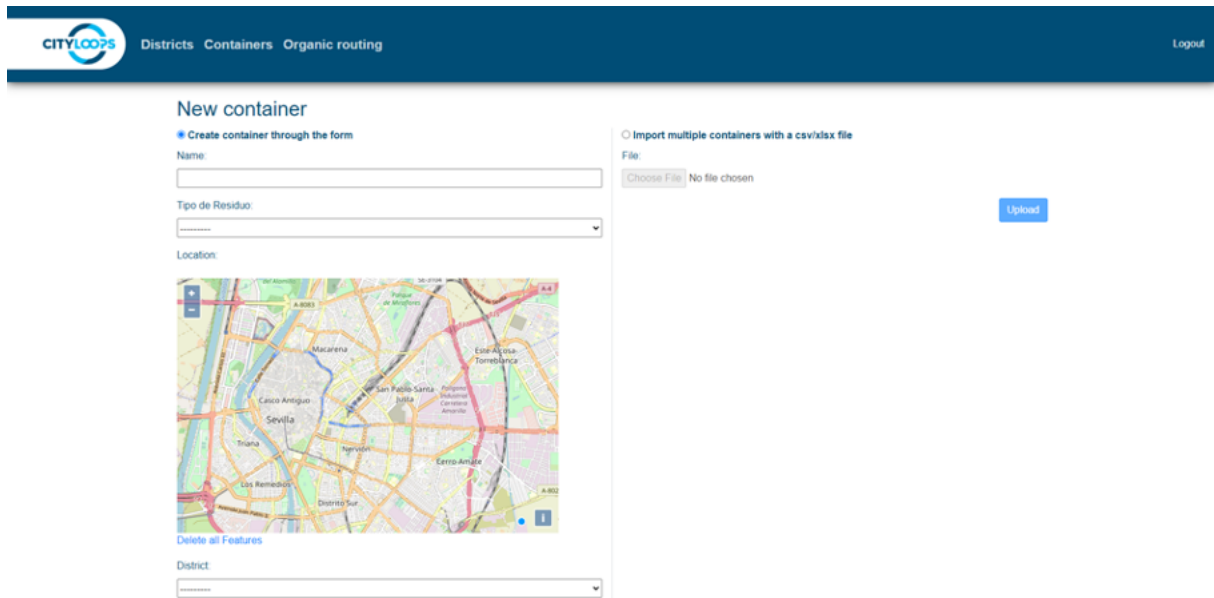
Apart from managing the different entities of the application, the user can access the organic routing page, where they can optimise the waste collection route.

On this page, the user can select the containers they want to include in the route by selecting the corresponding checkboxes. At the right of the container list, there is a map showing every container location. Whenever the user selects a container, the corresponding marker in the map will change from blue to red, indicating that that container will be included in the route.
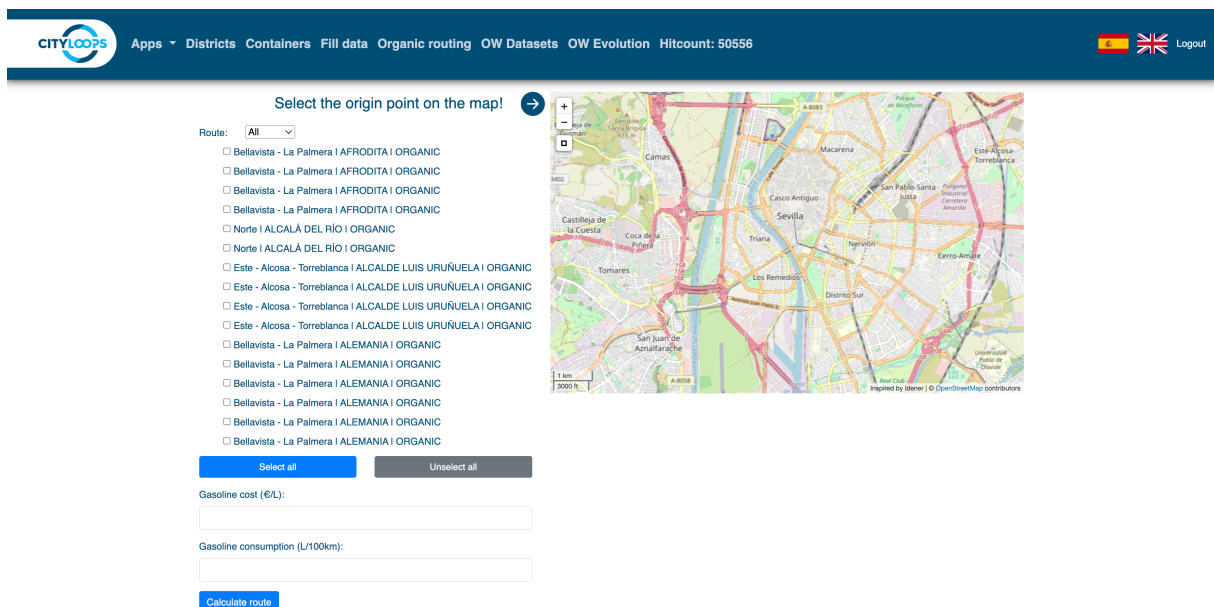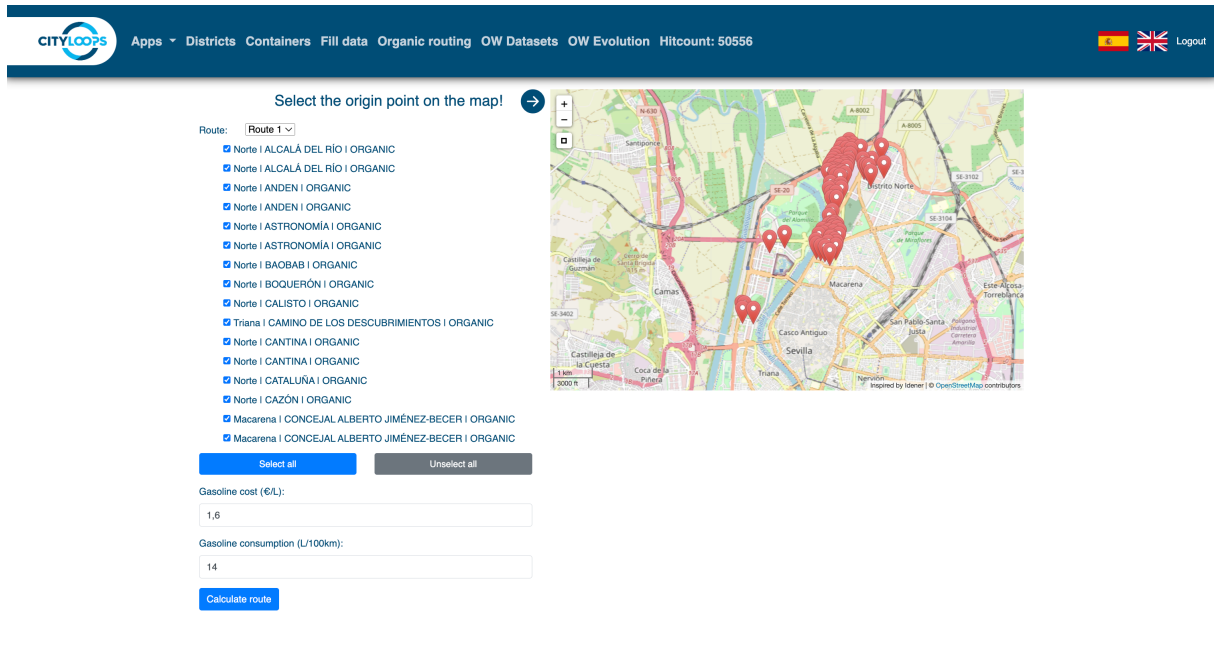
The manager platform has several pages to perform actions related to the management of the application and its resources.
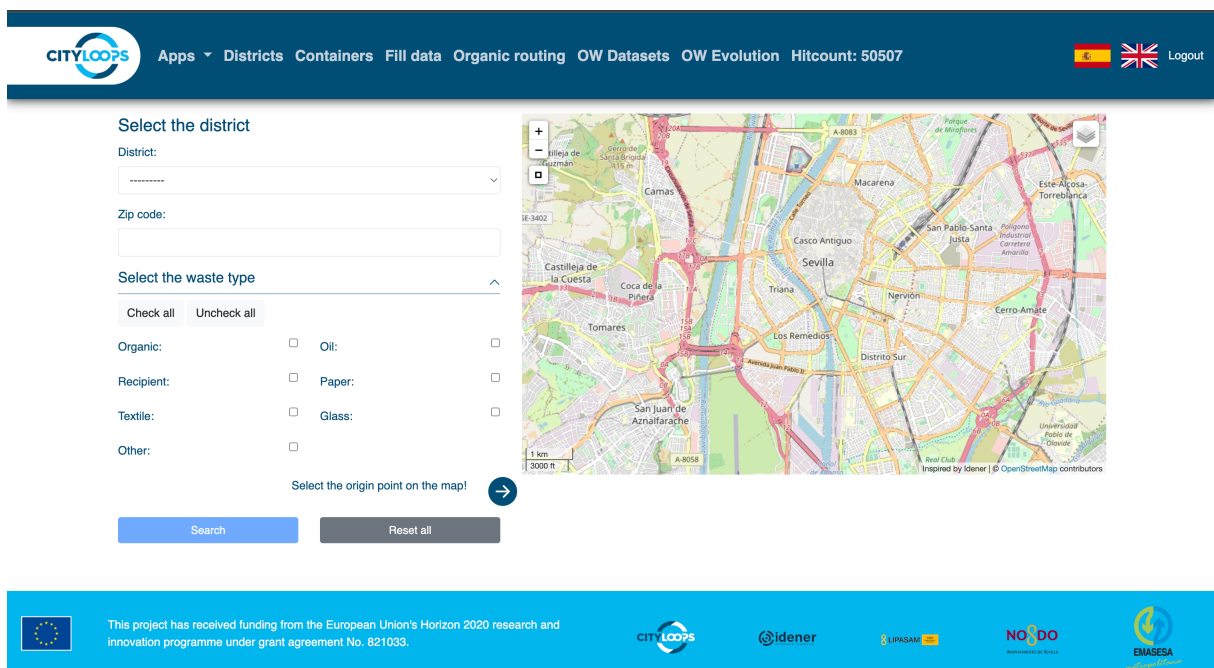
The Manager platform for Seville´s organic waste (OW) collection has two main goals: the identification and selection of potential districts to implement new OW collection routes; and the optimisation of both location of bins and routes. The software tool for managers combine data regarding economic, social, and demographic with waste data on current waste collection routes. This way, the tool is used as a helping decision-making process on the identification of those districts to implement the new OW collection, optimal location of new OW bins, optimal design of new OW collection routes, and optimisation of current OW collection routes.

When the Managers enter the platform to study potential districts to implement new OW collection routes, they will enter in the OW evolution panel. In this panel, manager will use the updated dataset in order to study and compare the different districts of the city with those that already include organic waste collection. This way, the IT tool identify and classify the city districts according to similarity degree with the districts with separate organic waste collection. In the navigation panel, managers should select the dataset, number of clusters in which they want to classify the city districts and the district with separate organic waste collection implemented to compare the rest of the city districts.

Once the manager fills in every input and hits the "Search" button, a graphic with the results will appear with a score of the districts to order them from the most potential one to implement a new organic collection route to the less potential one. In this section, the manager will see the information of different indicators used in the machine learning analysis (Fig. 4).
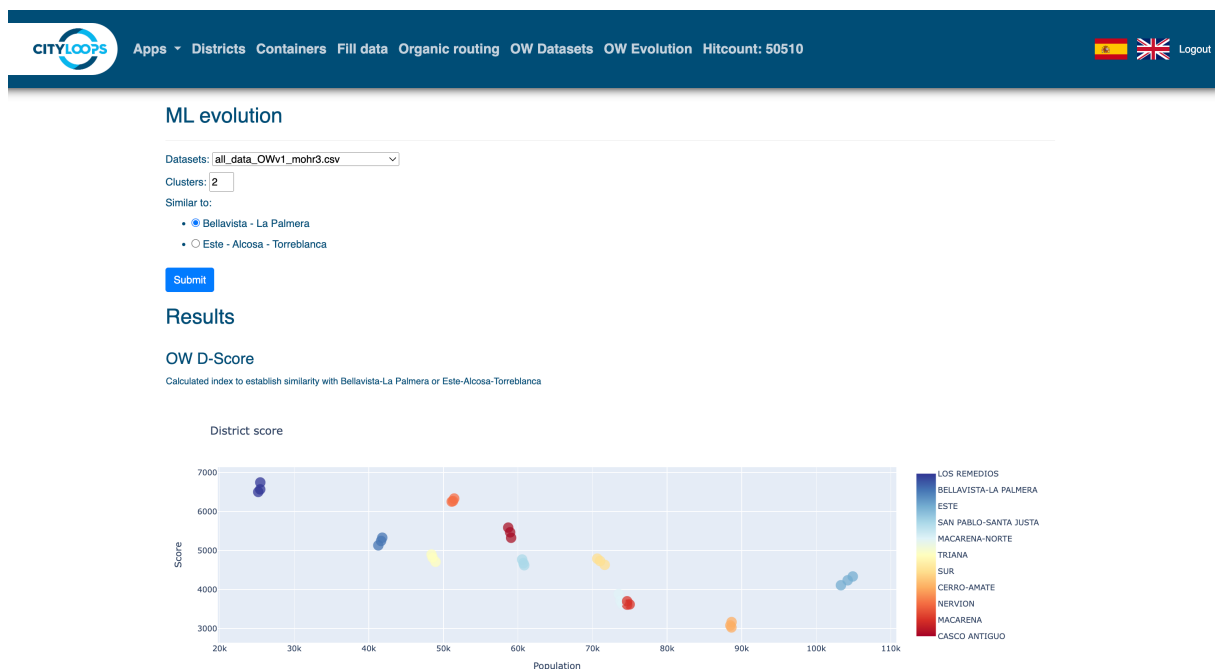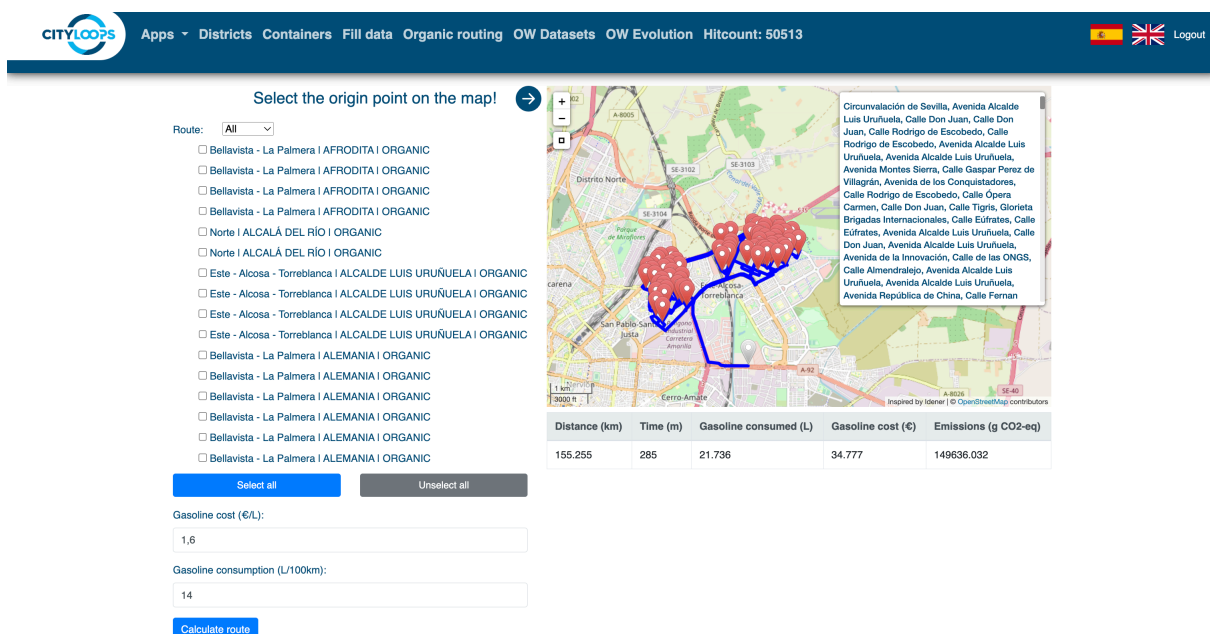
Different simulations have been made by Lipasam's managers who keep increasing the dataset with internal data on socio-economical and environmental data of the districts. Below is another example of the ML analysis (a previous one is shown in Fig. 4). The analysis of the organic waste collection has as a reference one of the routes implemented previously in the CityLoops project implementation. Then, a dataset with demographic data and environmental information on municipal waste collection is used to determine the similarity degree between the districts of the city. This way, the ML analysis gives a score of the different districts of the city to prioritise the implementation in those districts with higher similarity with the districts that have already the separate organic waste collection implemented. According to the results showed in the different scenarios set by manager, the ML analysis set the district "Los Remedios" as the good one to implement a new route for the separate organic waste collection.

Managers can select the reference of the analysis as well as the number of clusters to be considered in the ML analysis. Therefore, the ML analysis is highly resilient to the personal experience of managers and the update of the dataset. Results will definitely help in the decision-making process to take the advance of this information and prioritise the

implementation of new routes according to the observed success in the districts with the previous routes. Finally, a sound experience of the managers and workers improves the accuracy of the tool. An interdisciplinary work group is required in other to determine a good dataset with the critical data to evaluate the success of the waste collection performance.

When the Managers enter the platform to study optimization of the route collections, they will enter in the Organic routing panel. In this panel, manager will encounter the navigation panel with all the implemented organic containers. They can select each organic route separately in the dropdown menu above the containers and then select all containers of the route at the same time or select the required ones for the study manually. The selected containers will appear in the map at the right of the panel. Then, the manager has to indicate the fuel cost for the route in euros per litre and consumption indicator in litres per 100 kilometers. Finally, manager has to select the start point of the route in the map.

Once the manager fills in every input and hits the "Calculate route" button, the optimal route will be shown in the map with detailed indicating. Also, information of the total distante, estimated time of route, fuel consumption, fuel cost, and CO_2 equivalent emissions will be shown in a table below the map.

Filled bins data analysis functionality.

Lipasam implemented some filling sensors in some of their bins in order to go a step beyong the optimisation on their collection routes. So, a new functionality has been developed in the IT tool to monitor and predict the frecuency of collection of bins accroding to the filling data colleted by the sensors. This way, the IT tool could also help in the decion making process to manage the frecuency of collection of the routes. This functionallty show estimations of the bin's fillings based on the historic data collected by each sensor and show the percentage of fill. Lipasam can take the advantage of this information to determine the collection frecuency

of the bins considering that a bin is collected (optimally) in the 80% of fill. The IT tool predicts three different collection frecuencies i.e., every 3 days, every 2 days or daily according to the evolution of the filling precentages collected in the dataset (Fig.7).

CITYLOOPS   Apps ▾ Districts Containers Fill data Organic routing OW Datasets OW Evolution Hitcount: 50555   Logout

Fill data

Upload data

Stand	Street	Type	Lat	Lon	Average	Collection frequency	Feb. 13, 2023	Feb. 14, 2023	Feb. 15, 2023	Feb. 16, 2023	Feb. 17, 2023	Feb. 18, 2023	Feb. 19, 2023	Feb. 20, 2023	Feb. 21, 2023	Feb. 22, 2023	Feb. 23, 2023	Feb. 24, 2023	Feb. 25, 2023	Feb. 26, 2023	Feb. 27, 2023	Feb. 28, 2023	M 1, 2...
16	avenida séneca	organic waste	None	None	14.79	Every 3 days	15%	15%	15%	15%	14%	12%	15%	15%	15%	15%	15%	15%	15%	15%	14%	10%	1...
17	calle jándalo	organic waste	None	None	15.46	Every 3 days	14%	14%	17%	17%	17%	17%	17%	17%	9%	17%	17%	14%	14%	14%	14%	14%	14
18	ildefonso marañón lavín	organic waste	None	None	13.71	Every 3 days	15%	13%	12%	11%	9%	9%	14%	14%	15%	14%	15%	14%	15%	15%	14%	14%	1...
19	república de china	organic waste	None	None	12.57	Every 3 days	15%	15%	15%	14%	13%	13%	13%	13%	13%	13%	13%	8%	14%	12%	6%	14%	8
20	fernando corral corachán	organic waste	None	None	7.82	Every 3 days	13%	13%	13%	14%	0%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	0%	0
1900830	calle juan bautista muñoz	glass	None	None	27.32	Every 2 days	70%	79%	10%	15%	16%	15%	18%	21%	21%	21%	19%	32%	28%	19%	32%	34%	3...
1903060	calle charles darwin	glass	None	None	17.07	Every 3 days	18%	23%	16%	16%	19%	22%	22%	23%	17%	8%	20%	13%	13%	17%	17%	19%	2...
1903281	calle juan bautista muñoz	glass	None	None	1.07	Every 3 days	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0
1903700	calle américo vespucio	glass	None	None	14.86	Every 3 days	16%	12%	13%	17%	16%	14%	8%	11%	11%	11%	6%	17%	16%	17%	16%	12%	1...
1903910	camino de los descubrimientos	glass	None	None	30.07	Every 2 days	29%	29%	32%	36%	36%	36%	32%	36%	36%	25%	29%	29%	27%	29%	28%	29%	3...
1904356	calle albert einstein	glass	None	None	45.36	Every 2 days	40%	38%	47%	47%	47%	47%	47%	47%	47%	39%	41%	41%	42%	45%	44%	46%	4...
1905613	calle francisco de montesinos	glass	None	None	36.43	Daily	96%	95%	95%	3%	13%	21%	17%	23%	10%	15%	26%	23%	17%	9%	13%	38%	3...
1905680	calle inca garcilaso	glass	None	None	28.57	Every 2 days	17%	16%	19%	10%	18%	33%	35%	44%	31%	29%	29%	36%	38%	39%	46%	48%	5...
1905710	camino de los descubrimientos	glass	None	None	11.25	Every 3 days	12%	1%	10%	7%	10%	6%	7%	0%	0%	5%	7%	9%	6%	22%	12%	10%	2...
1906440	calle josé de gálvez	glass	None	None	32.43	Every 2 days	68%	68%	68%	9%	14%	12%	14%	19%	22%	20%	18%	19%	26%	32%	32%	57%	4...
1906550	alvaro alonso barba	glass	None	None	13.75	Every 3 days	12%	15%	14%	14%	14%	14%	14%	14%	14%	8%	13%	13%	13%	15%	15%	17%	1...
1906820	calle matemáticos rey pastor y castro	glass	None	None	19.07	Every 3 days	15%	16%	16%	23%	21%	21%	21%	21%	21%	21%	21%	19%	21%	21%	21%	19%	1...

Lessons learned

- Having historic socio economic data as well as enviromental data is important in order to reach to more accurate results.
- The collaboration of partners is crucial for data collection, since there is not always relevant data, at the necessary scale, in open data platforms, the aforementioned collaboration is necessary.
- The tool and the data analysis methodology need to be adapted to the available data, which should help to cover any data gaps.
- The optimisation of route collection waste reduces the cost of collection as well as the environmental impact.
- The implementation of new routes could be priorized according to the classification made by the ML functionality of the tool.
- The sensoring of the filling of bins could be implemented in the tool to predict the frecuency of collection contributing to the optimization of the collection routes.
- The visualisation of the information regarding the waste collection of the city as well as the reduction of emissions with the implementation of the organic waste collection improve the commitment of citizens and the IT tools could increase the dissemination of these information.

Functionalities of OW platform for managers.

- District representation of Seville Data: The city of Seville will be divided into a discrete representation of districts and overlapped over a real map of the city, including streets´ direction for the road traffic.
- Data request of each district: Each district will be represented by different social and economic aspects, Lipasam´s infrastructure and the waste generation and collection will be described (i.e., amounts, types of waste, quality, involved equipment, etc.).
- Evolution of the waste collection: Data about the evolution of the waste collection systems, both quantitative and qualitative, will be represented in a time-lapse showing in the last frame the success estimation of the OW collection in the districts in which it is not already implemented, regarding both quantitative and qualitative data according to the data provided by the manager through the platform.
- Optimisation of new OW collection routes: Using the data provided by the managers and the results from the resolution of the Travelling Salesman Problem, the platform will present the optimised OW collection route in compliance with the LIPASAM criteria.
- Optimisation implemented OW collection routes: Using the data provided by the managers and the results from the resolution of the Travelling Salesman Problem, the platform will present the optimised OW collection route in compliance with the LIPASAM criteria.
- Location of new OW bins: Using the data provided by the managers and the results from the optimisation of the OW collection routes, the platform will present the location where the new OW bins could be placed in the new OW collection route in compliance with the LIPASAM criteria.

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and organic waste (OW), where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and OW, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.