

# Recycl3R

## Recycling waste items via Open Data and semantics

Recycl3R is a tool that supports and engages citizens in the task of recycling their waste items by providing direct access to residue information and waste disposal locations.

### Recycl3R solution

Waste production is still a pending issue in our society. Europe generates large amounts and types of waste. It is estimated that Europe produces annually over 250 million tons of household waste and more than 850 million of industrial waste.

Poor waste management contributes to climate change and air pollution, and directly affects many ecosystems and species. But waste is not only an environmental problem, it is also an economic loss. Labour and the other inputs (land, energy, etc.) used in its extraction, production, dissemination and consumption phases are also lost when the 'leftovers' are discarded. Moreover, waste management costs money; creating an infrastructure for collecting, sorting and recycling is costly.

In order to face this problem, governments are promoting the use of recycling as a way to reuse materials, minimize the impact in the natural environment, generate revenue and create jobs.

In Europe, the shift in waste management is closely linked to EU waste legislation, but EU countries can adopt different approaches to waste management. Within the EU, we can find huge differences among different member countries. The information about what types of waste items are collected and how it is done depends on the legislation of every single country, and it can change depending on the local community inside one country.

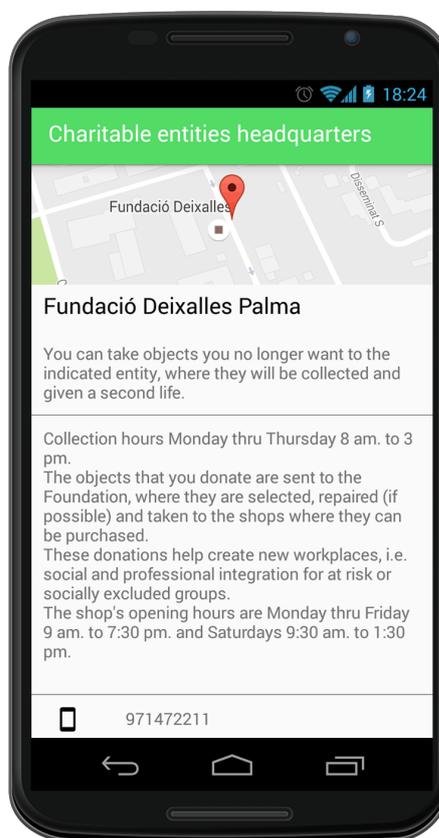
Due to the large amount of materials and components available in nowadays products, users willing to recycle often lack information about how and where to dispose the generated residues once the products have been consumed. Users might find this information on public Web sites, but they usually require a lot of time to find it and understand how waste management works in their local community. Additionally, it can imply a change in their mind and not finalizing the waste disposal.

**Recycl3R tries to solve this problem by enabling direct and quick access to information in order to promote consumer recycling in cities.**

Recycl3R is an application that relies on a custom search engine, which users can query for an item and immediately retrieve the category of the residue (e.g. plastics, toxic, textile, etc.). In addition, the application provides the user with a list of places nearby her location where she could dispose the residue. By giving citizens direct access to waste disposal information, Recycl3R saves their time and encourage them to recycle.

Recycl3R consumes a custom service created especially for the previous purpose. As already mentioned, the service provides two kinds of information. On the first hand, giving a text description of the residue (e.g. "plastic toy") it shows the category of the residue or waste fraction. This information helps the user identify the kind of residue that she is handling. Many users do not know this information or they have a wrong consideration. On the second hand, once the fraction is known, the user can retrieve a list of nearby locations plus details about how to dispose the residue. This is extremely useful for users willing to recycle. It can also be seen as a way of avoiding the "laziness factor" suffered by many users who do not recycle just because they don't know the places where to bring their waste.

**The most significant aspect of Recycl3R is the way the data about residues and disposal locations have been combined and presented to the user by means of a search engine, which drastically facilitates its consumption.**



More information about the Recycl3R mobile app can be found here: <http://www.6020peaks.com/recycl3r/>

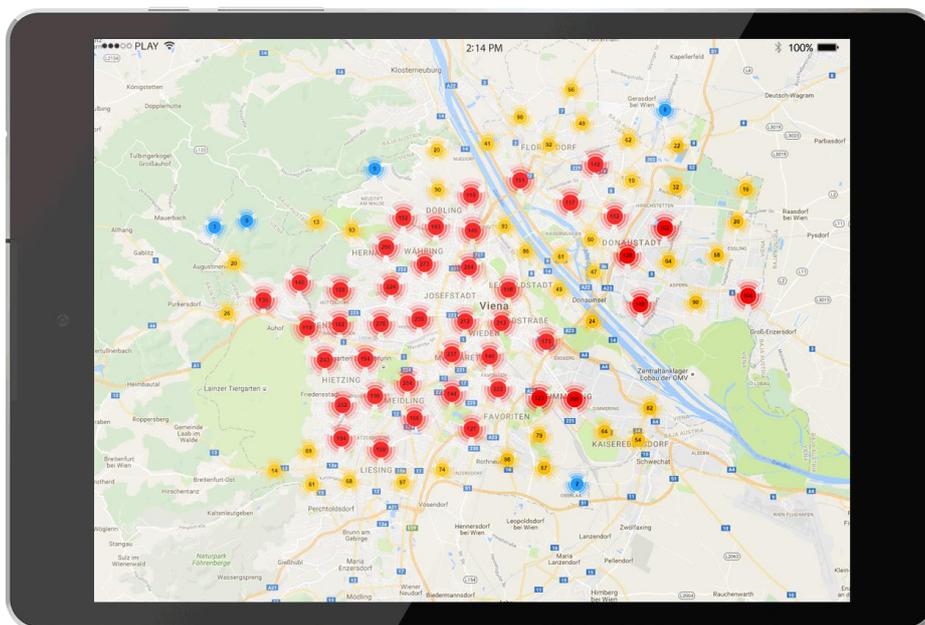
An Android version of the Recycl3R mobile app is available here: <https://play.google.com/store/apps/details?id=com.sixtytwentypeaks.recycl3r>

## Open Data

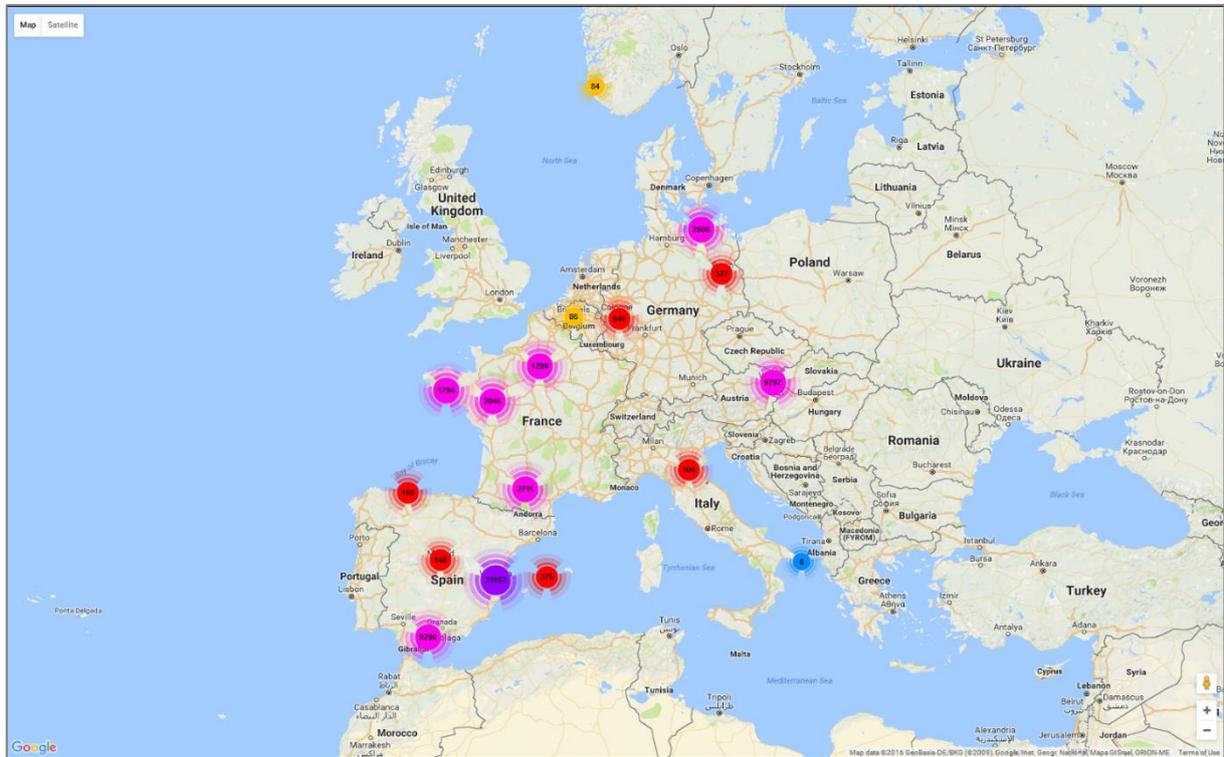
In the last few years many municipalities and governmental organizations have invested into publishing their internal data to the public under the paradigm of Open Data. There are many types of data (like spatial and financial data) that those organizations have in their possession and could be useful for the citizens or businesses to have access to. In the Open Government Data space there are examples of very well documented and presented datasets and others that do not facilitate enough the usage of the data.

During our research for datasets, we faced many challenges as the datasets that we wanted to consume refer to spatial data, which is a type of data that can be designed and published in many different ways. There are differences in many dimensions, i.e., the geographical system that is used, the unit used to describe the containers, the language, etc. In principle, we standardized all the dimensions to the common model.

Expanding the coverage to all the EU countries was a very challenging part of the initiative, as we had to find the Open Data platforms of the countries and search for the dataset that covers the requirements of the Recycl3r. A lot of countries have only a very basic platform with only a few datasets, without any data about recycling. Other datasets were very hard to import and consume as they were published in very specific spatial data formats.



We have prepared a demo to showcase the various collection points that we have already integrated, which can be accessed under the link <http://recycl3r.com/demo/eldc/>.



The demo collection contains 67.740 POIs of 16 waste categories for 23 European cities.

- AT: Wien - 9.787 POIs (Organic waste, Plastics – Light packaging, Paper and cardboard, Glass, Scrap metal).
- BE: Brussels - 86 POIs (Glass).
- DE: Bonn - 646 POIs (Paper and cardboard, Glass, Small appliances, Textile and footwear).
- DE: Charlottenburg/Wilmersdorf - 327 POIs (Green glass, White glass, Brown glass, Colour glass).
- DE: Rockstock - 2.806 POIs (Paper and cardboard, Glass, Regular waste, Textile and footwear).
- ES: Barcelona - 250 POIs (Cooking oil, Batteries and accumulators).
- ES: Gijón - 169 POIs (Batteries and accumulators, Textile and footwear).
- ES: Madrid - 148 POIs (Textile and footwear).
- ES: Málaga - 9.290 POIs (Plastics – Light packaging, Paper and cardboard, Glass, Regular waste).
- ES: Manlleu - 686 POIs (Organic waste, Plastics – Light packaging, Glass, Regular waste, Batteries and accumulators, Textile and footwear).
- ES: Marratxí - 375 POIs (Plastics – Light packaging, Paper and cardboard, Glass, Textile and footwear).

- ES: Santa Cruz de Tenerife - 4.898 POIs (Plastics – Light packaging, Paper and cardboard, Glass, Regular waste, Electrical and electronic devices).
- ES: Valencia - 30.912 POIs (Regular waste, Cooking oil, Batteries and accumulators).
- FR: Angers Loire - 2.039 POIs (Plastics – Light packaging, Glass, Regular waste, Textile and footwear).
- FR: Lorient - 1.794 POIs (Paper and cardboard, Glass, Textile and footwear).
- FR: Montpellier - 1.743 POIs (Plastics – Light packaging, Paper and cardboard, Glass, Regular waste, Textile and footwear).
- FR: Paris - 1.134 POIs (Glass, Textile and footwear).
- FR: Saint Malo - 7 POIs (Textile and footwear).
- FR: Toulouse - 282 POIs (Textile and footwear).
- FR: Versailles - 165 POIs (Batteries and accumulators, Textile and footwear).
- IT: Bologna - 104 POIs (Glass, Diapers and sanitary napkins).
- IT: Lecce - 8 POIs (Diapers and sanitary napkins).
- NO: Stavanger - 74 POIs (Plastics – Light packaging, Textile and footwear).

## Data challenges

Integrating Open Data and also proprietary data from many sources introduces a big challenge to address, i.e. standardizing the data with the location points to a common canonical model. In this respect, we have employed the use of vocabularies to map the input data to a common model. The underlying data of Recycl3r is stored as JSON documents inside a NoSQL database, following mainly the schema provided by schema.org for places (<http://schema.org/Place>). The data is described using JSON-LD annotations in the JSON objects.

In summary the main data challenges that need to be addressed within the scope of this project can be summarized as follows:

- Decide about a common schema for homogenizing the information of the disposal Points of Interest (POIs).
- How to handle different languages for giving the information.
- Identify data stores containing open data about recycling POIs and integrate them in the system.
- Residues are categorized in different fractions (e.g. glass, paper, metal, plastic, hazardous, mixed, etc.). Usually this categorization changes from a country to another. There are more than 120 different types of fractions collected nowadays in Europe.

## Final notes

At the time of the submission, we are working on extending the search engine to work with the European common model that we have developed. This will make all the new POIs that we have integrated fully visible from the Recycl3R app.

## Team

This is the team behind the Open Data Initiative moved by recycl3R:

- Dipl.-Ing. Ioannis Stavrakantonakis is a Ph.D. candidate at the University of Innsbruck. He originally hails from Crete in Greece and lives in Berlin since 2014. Apart from his research interests, he has a few years of experience as a Software Engineer in the industry and always looking forward in investing his time in ideas that have a positive impact to our daily lives.
- Dr. Antonio J. Roa-Valverde is a passionate software engineer born in Spain, but living in Austria since 2010. He enjoys creating useful software solutions for helping people. In his free time, Antonio loves sports and the breathtaking life in the mountains.
- Mag. Ivan Gonzalez is a lawyer born in Mallorca, that lives and works in Innsbruck (Austria) since 2013. His main focus is on environmental regulations and consultancy. He loves skiing and enjoying the sun with his family.
- Mag. Thomas Sjödin Dahl is a developer born in Norway, with swedish nationality, that lives in Spain since 1979. His first contact with programming languages was in 1989 when his parents gave him the Commodore Amiga 500. Started learning HTML in high school 1994 and has been making websites since 2000. Obsessed with coding and his viking roots, loves listening to music.