ACLIMA CHALLENGE 2

1. Entity posing the challenge

- **AGALEUS, INDUMETAL RECYCLING, ZABALGARBI**

2. Challenge statement

Optimisation of the internal operability of waste treatment plants

3. General context

Aclima is a pioneering cluster founded in 1995 and a benchmark in the Basque environmental sector. It represents companies, public entities, agents of the Basque Science, Technology, and Innovation Network, associations, and university training centres related to the waste, soil, integral water cycle, climate change, biodiversity and ecosystem value chains. The main objective of the cluster is to support companies in the sector to improve their competitiveness by identifying and characterising new business opportunities, innovation, and international positioning, always based on cooperation.

Aclima's current 2019- 2022 strategic plan has 3 strategic areas: climate change, environmental quality, and the circular economy as the driving forces behind the activities promoted by the cluster and 5 areas of opportunity. This includes the Basque Environment 4.0 initiative, one of the lines of action with which it aims to support the integration of 4.0 technologies in the Basque environmental sector value chains, either by developing new advanced products and services, or by facilitating process improvement.

In this context, being able to take advantage of the opportunities that the Industry 4.0 approach poses for the sector is crucial. It is also a strategic commitment of the Basque institutions in which the Eco-industry sector plays an active role as a key agent in the twin (green and digital) transition promoted by the European Green New Deal. The application of 4.0 technologies is already making it possible to generate new value proposals and it is expected to play a key role in strengthening the technological and business capacities of the Basque environmental sector as a whole. With this vision, Aclima has recently formed the Waste 4.0 working group. This group is made up of waste managers who have industrial plants and are interested in tackling the challenge of Industry 4.0 collaboratively and with a value chain approach. With this precedent, the BIND 4.0 SME Connection programme presents itself as an excellent opportunity to address this challenge in a collaborative format of open innovation with Start-ups.

In this context, and in order to better understand the challenges that will be set out below, it is essential to emphasise that companies posing the challenge belong to the integrated waste management value chain. This value chain is made up of a large number of operators that offer all kinds of environmental solutions for Minimisation, Reuse, Recycling, Management, Energy Recovery and final waste disposal activities. It is also important to note that these companies have extensive experience ranging from logistics services to recycling processes at their treatment plants. While it is true that there is a considerable difference in the production processes of the companies posing the challenge, it should be noted that they also share certain similarities in the internal operations of their treatment plants, regardless of the waste treated. This implies that they share common industrial processes such as waste weighbridges, storage, laboratory testing, etc.

Some challenges have been detected after identifying these common processes and with the desire and spirit to continuously improve the sector and the cluster itself, as well as in a bid to improve sustainability. Resolving these challenges is intended to increase efficiency and the levels of digitalisation of the companies defining the challenges.

4. The Challenge

1. Description of the challenge:

Due to the heterogeneity of the waste received at treatment plants, which in turn come from a wide variety of customers and whose composition (both physical and chemical) can differ radically, a relevant aspect is to optimise internal operations to maximise plant treatment capacity.

A number of internal processes (intra-plant logistics) have been identified as having scope for optimisation:

- **Storage**

Correct waste storage is a critical process for the efficiency of the different industrial treatment processes carried out in the plants.

The first of the critical aspects for correct storage is to identify the waste as it arrives at the plant. This task often consists of a visual inspection and sampling, although it can be automated using material identification technologies.

In some cases, in-plant treatment processes are almost automatic, which means that there is little time between the arrival of the waste and the start of the treatment process. In this case, it would be very useful to have computer vision technologies that help to recognise the material (for example, in the case of municipal waste, the type of material, associations with specific treatment values, identifying unsuitable materials) and the “apparent density” of the waste deposited in the silo. In many cases this affects the decision-making process surrounding the waste treatment, and therefore the productivity of the plant process.

A second key aspect is related to the location of this waste (inputs and outputs), bearing in mind that physical limitations both in terms of space (storage, plant, land, etc.) and shape (pit, silo, deposit, etc.) can generate potential problems in business operations (e.g. in planning purchases, production, sales, etc.).

- **Raw waste selection and traceability of results**

Another relevant treatment plant operation aspect is the ability to ensure the traceability of the waste. That is, the capability to link waste input processes with the final results of the treatment process (which also refers to waste minimisation, reuse, recycling, management, energy recovery and final disposal). Maintaining this traceability would enable plants to analyse production trends based on historical inputs. Depending on the type of process at each treatment plant, a relevant decision may be to select which type of waste is sent to treatment at any given time (e.g. in waste-to-energy recovery).

It is important to consider these aspects, as well as waste characterisation and storage, and aspects related to the situation of the raw material market itself (e.g. sales price of raw ferrous materials) to correctly make such decisions.

Therefore, an investment to improve decision-making based on the waste to be treated at any given time would have an impact on each plant's profit.

2. Main impacts

In this sense, while companies have control over the amount of waste entering the plants and can make advanced calculations and production estimates based on these quantities, traceability can often be lost once the waste has been sorted in its corresponding subgroups. Therefore its origin, provenance, and above all the specific characteristics/properties of the different customer products can be lost.

This poses a two-fold challenge:

Firstly, **storage space must be optimised while possibly improving the visual and physical traceability of the waste stored/deposited at the plant.**

Secondly, the **plant's productivity and efficiency is to be improved through better decision-making regarding which industrial process the waste will be subjected to.**

3. Main questions to be solved

- Would it be possible to select a waste location based on forecasts of new waste inputs or based on how the waste is expected to be used?
- Would it be possible to characterise existing waste in different storage spaces and formats?
- Would it be possible to make waste sorting decisions using computer vision technologies?

- Would it be possible to maintain the traceability of waste from the moment it enters the plant until the end of its passage through the treatment process?

4. Expected technological solutions

The technological solutions expected to address the above challenges are:

- Storage decision-making (machine learning)
- Computer vision
- Predictive models to plan work at the plant and anticipate space availability.
- Manufacturing control software (*plant automation system, as well as plant management and traceability*) - Digital Twin of the plant.