1. Entity posing the challenge

- **AGALEUS, INDUMETAL RECYCLING, ZABALGARBI**

2. Challenge statemento

Optimisation of inbound logistics to improve waste reception at 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:

The efficiency of waste treatment plants is clearly affected by the logistical flows of waste entering the facilities.

These inbound logistics are particularly complex as treatment plants receive a wide variety of waste and products to be treated, which in turn come from a diverse range of customers with different needs.

Waste can enter the plant from the company's own vehicles as well as external vehicles, which can be directly from customers or from specialist transport companies. In turn, these vehicles can come from multiple locations, resulting in a complex logistical scenario of waster entering the plant and being unloaded at the waste weighbridge. The vehicles also have to pass through a weighbridge when entering and exiting the facilities, which is sometimes shared with other companies. This further complicates the efficient organisation between the plant and the transporters.

A further obstacle to overcome is the lack of a precise plan regarding customers' waste transport needs. Arrivals at the plant are not monitored as only partial information (in the case of company transport or third party transport companies that provide notifications) or incomplete information is available (third party transport without notification).

Another relevant area that affects the reception of waste at the plant is sampling for subsequent laboratory analysis, as in some cases the waste is only accepted by the plant if it has already been previously validated. This sampling is often carried out semi-manually, which, together with the lack of automated systems to send operational orders in the plant (work flow software), condition the communication flows and therefore the plant unloading times.

Automating such processes would have a direct impact in terms of time, and would directly improve the overall efficiency of the plant.

2. Main impacts

Bottlenecks in unloading waste at the weighbridge, mainly due to the lack of planning between the agents involved and asynchronous plant input flows. This causes difficulties in predicting unloading times, which in turn slows down laboratory, analysis, and subsequent waste treatment activities.

This could be solved by establishing a technological platform that could automatically channel, integrate, and schedule all the information relating to possible waste input flows, in a context dominated by the uncertainties surrounding the material to be treated and its input. Such a platform could solve the problem of when the load will arrive, but also of the type of waste, and the way in which it has been brought in.

The application of Artificial Intelligence technologies would also be considered, which could use historical data to predict:

- The qualities of the material to be received, as well as specific unloading requirements. Other external factors could also be taken into account.
- The predicted waste inputs based on dates and times, as well as other external factors affecting waste generation (e.g. holidays, weather, etc.) could also be taken into account.

The waste reception process would also be streamlined by including work flow software to ensure waste input registration and traceability is guaranteed (sampling, laboratory analysis, plant entry order, etc.).

3. Main questions to be solved

- Would it be possible to monitor customers' waste transport requirements? Would it be possible to establish a system to schedule the total amount of waste entering the plant?
- Would it be possible to design a system to communicate work orders and authorisations internally, facilitating waste unloading activities? At the same time would it be possible to integrate the records from different areas such as the laboratory, weighbridge etc. into a single unified platform?
- Would it be possible to have a system to predict waste entries to the plant despite having a limited percentage of scheduled deliveries?
- Would it be possible to characterise the waste (know its properties) upon arrival at the weighbridge?

- Would it be possible to predict unloading times based on the characterisation of the transported waste?
- Would it be possible to store information on each input, thus allowing traceability?

4. Expected technological solutions

The technological solutions expected to address the above challenges are:

- Software for fleet management, Track & Trace, or logistics traceability.
- Work flow Software.
- Business Intelligence solutions.
- Weighing and measuring solutions.
- Predictive models to estimate incoming waste flows from customers to predict delivery peaks and possible external factors.
- Technologies to ensure waste electrical and electronic equipment traceability.