Description of the Challenge

The challenge put forward by the Port Authority of Bilbao is titled: ***"What is the best way to prevent diffuse particles from solid bulk cargoes stored in the open air on a dock from dispersing towards the space of neighbouring businesses?"***

This challenge addresses the needs described below:

Background

The Port of Bilbao has several docks dedicated to the storage, loading and unloading of solid bulk cargoes that in 2020 represented 12.4% of the total traffic managed by the Port, and which are managed by several concessionaire companies (see attached file with the types of bulk and Ton). These bulk cargoes are mostly stored in piles and in the open air. This means that weather conditions such as wind, or the loading and unloading movements themselves create a diffusion of particles that, depending on the dispersibility of the material, can cause significant negative effects on neighbouring businesses.

In addition ,these aspects of the port operation entail the following costs for the Port Authority of Bilbao, and for the port as a whole[1]:

- Operation costs: the presence of dust deposited on roads, rainwater drainage networks, distribution networks or the seabed of the port involve a significant increase in maintenance costs for the Port Authority.
- Emergency or incident costs: the environmental aspects linked to the handling of bulk cargoes can lead to emergencies or legal non-conformities that can affect the operational performance of the port or have unforeseen remediation costs that affect the economic efficiency of the activity.
- Opportunity costs: cross-contamination between goods or interference with other activities that require high levels of environmental quality can cause a loss of service quality that could prevent the development of other business opportunities.
- Reputation costs: an inadequate environmental performance can compromise the image and reputation of the port, creating a lack of trust among different social agents, which can have negative effects on both the normal development of port operations and on the development of possible activities on the port infrastructure, with the resulting economic cost for the Port Authority.

The Port Authority of Bilbao has assessed the following possible solutions:

- Mobile panels
- Covering piles with tarpaulins
- Conveyor belt with fairing and wetting
- Water spray

The measures included in the Guide on good practices regarding the handling and storage of solid bulk cargo have also been assessed, but they have not solved the challenge put forward by the Port of Bilbao. The solution that is sought should be an alternative to these measures.

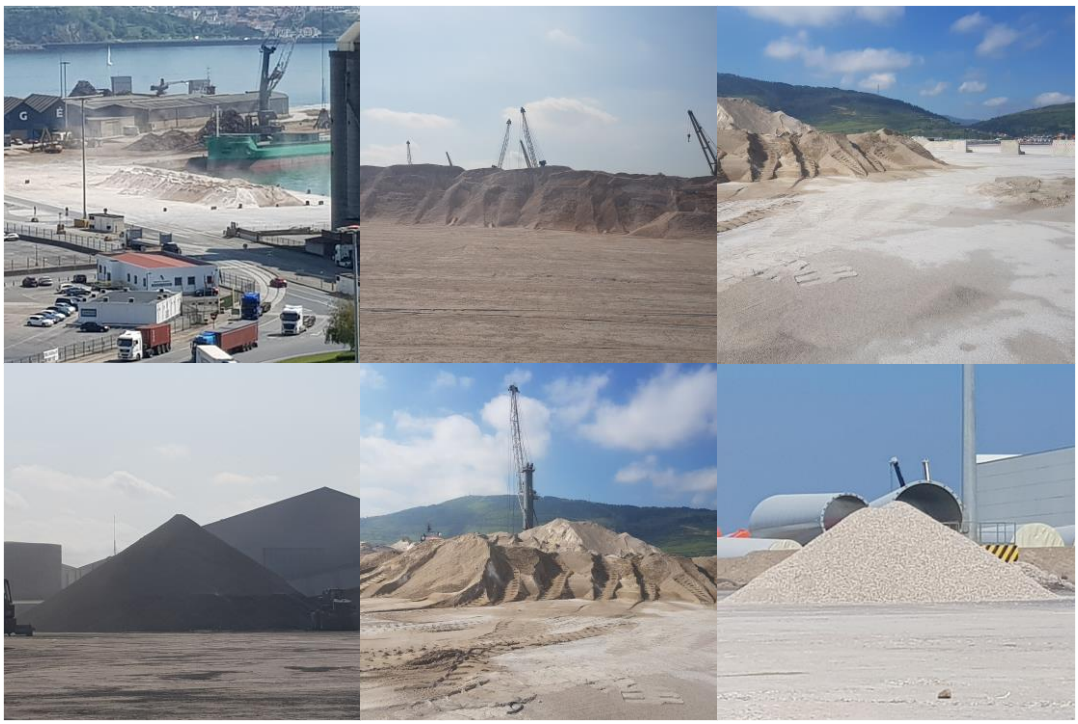
[1] Guide on good practices regarding the handling and storage of solid bulk cargo

There are several reasons why these solutions have not prospered, which range from the responsibility for the implementation of the solution to the economic/operative feasibility of the same. Firstly, the concessionaire companies that store and handle the solid bulk cargoes are responsible for implementing the measures to minimise the disruption on their surroundings derived from their activity. On the other hand, the most effective applicable measures today require a significant investment and are large-scale projects that are difficult to implement. Lastly, the eventual measures to be applied must interfere or disrupt as little as possible on the storage, loading and unloading operations of solid bulk cargoes, as this has a significant impact on the costs for the companies that work with them.

Additional information:

For further information, a series of illustrative photographs and videos are included below showing the arrangement of the solid bulk cargoes in the open air, the loading and unloading processes of these bulk cargoes, and the deterioration caused to the neighbouring plots and equipment.

- Video 1: open-air stocking of bulk cargo process
- Video 2: lorry loading process
- Video 3: view of the port and the stocking of bulk cargo during bad weather.



Source: Port Authority of Bilbao; examples of bulk cargo stored in piles in the open air.

Source: Port Authority of Bilbao; examples of bulk loading and unloading.

Source: Port authority of Bilbao; examples of deteriorated surfaces and equipment.

Interested parties

The main stakeholders involved in this challenge, and which therefore represent all of the interested parties to be taken into account when presenting the solution, are:

- The Port Authority of Bilbao, a public entity that manages the Port of Bilbao, its infrastructures and services, as well as the owner and concessionaire of the spaces. It is also tasked with guaranteeing the good relationships of the port community.
- The concessionaire companies, solid bulk cargo terminals, are the companies that manage the traffic of these bulk cargoes, and are in charge of its storage, loading and unloading.
- The concessionaire companies in the spaces neighbouring the piles of solid bulk cargoes are companies from different sectors that may be affected in some cases by damage caused by the finished parts stored in the open air, risks to the health of their workers due to dirt in their facilities or deterioration of the building.

- Lorries that transit close to the piles (this is a factor that can cause the resuspension of already precipitated particles. This is something to bear in mind, but to a lesser extent, as it can be solved/minimised with regular and adequate cleaning of the dock).
- Neighbouring municipalities of the port (although the satisfaction surveys usually mention the dust, etc. there are no complaints with regards to the quality of the air outside the port facility itself. Nor by Town Councils or other types of bodies).
- Workers' cars that are parked in areas near to the piles of solid bulk cargo (they suffer damage and sustain cleaning costs).

Needs

These particle emissions derived from the handling and storage of material transported in bulk can translate into significant environmental impacts on the social, natural and economic surroundings[1].

Table 1 Significant impacts on the surroundings caused by emissions of diffuse particles

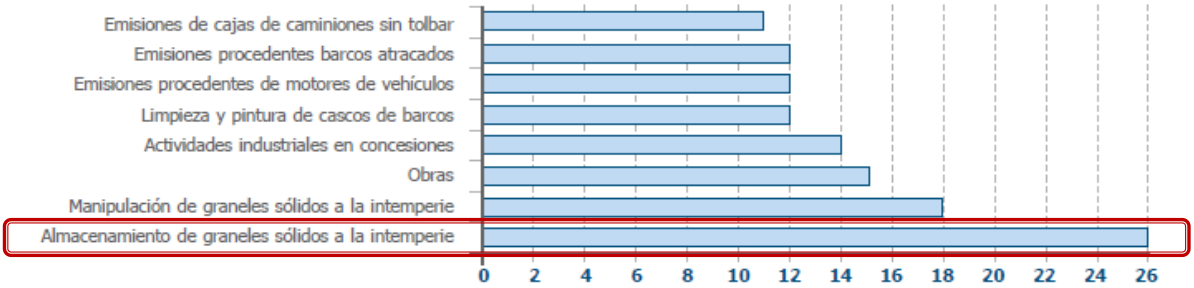
ENVIRONMENTAL IMPACTS	
Air quality	• Increased level of suspended particles
Water quality	• Contamination of sediments • Eutrophication
SOCIAL IMPACTS	
Job Security	• Inhalation of particles • Reduction of visibility
Industrial safety	• Risk of fire • Reduction of visibility
Food safety	• Increased population of birds
ECONOMIC IMPACTS	
Maintenance costs	• Increased cleaning costs • Premature deterioration of machinery • Loss of depth in docks • Deterioration of drains and inspection hatches
Deterioration of the service provided	• Cross-contamination with other goods • Interference with other productive activities of the port • Loss of goods

Source: Guide on good practices regarding the handling and storage of solid bulk cargo

In fact, as can be seen in the sustainability report prepared by the Port Authorities during 2012[2], twenty-six of the twenty-eight Port Authorities considered the handling and storage of solid bulk cargoes in the open air as the primary cause of emissions to the atmosphere in ports, while sixteen Port Authorities classify it as the second cause of the deterioration of the quality of the water and sediments[¡Error! Marcador no definido.].

[2] Sustainability report of the port system of general interest. Year 2012

Graph 1 Main sources of emissions in ports. Number of Port Authorities that consider them to be significant.



Source: Guide on good practices regarding the handling and storage of solid bulk cargo; Evolution of the traffic of bulk cargoes over another type of presentation of the goods

Of the externalities described, the Port Authority of Bilbao prioritises responding to the needs related to the deterioration of the service provided; i.e.: cross-contamination with other goods, interference with other productive activities of the port and loss of goods. It considers it necessary to prevent interferences with the activities of neighbouring plots, both those related to productive processes and the products stored on said plots. Bearing this in mind, the Port Authority of Bilbao defines two critical points of action:

- During the stocking in the open air of materials because, if they spend days on the dock without any protection, episodes of wind cause their uncontrolled dispersion, creating an impact on the surroundings.
- During the specific moments when handling bulk cargoes. Both from the lorry to the dock, and from the dock to the hold of the vessel.

Likewise, below is a list of the specific needs of several of the companies located in the Port of Bilbao that are affected by this problem:

- The company Haizea Wind is dedicated to the manufacture of foundations and offshore and onshore wind turbines, and its plant is located on dock AZ2. These are parts with a considerable size (100 m) which, once manufactured, are stored on the dock in the open air. The presence of solid bulk cargoes stored in the open air on that same dock means that with gusts of wind these materials are projected against the factory and the parts stored outside are damaged. This means that these parts may require additional maintenance or lose part of their warranty (25 years), with the high cost that this involves.
- The company Lointek, located on AZ1 is dedicated to the manufacture of large parts (industrial boilers, reactors, modular systems, etc.) of up to 2000 Tn and 150 m in length in some cases. The main gate of this company faces the dock, and at a short distance opposite it are the solid bulk cargoes operated by another company, stored in the open air. Given the size of its parts, on many occasions they must work with the gate open. There conduits, electrical systems and their production process in general are significantly affected by the dust and sand, as the projections of sand also attack the parts they produce. On the other hand, workers' vehicles are damaged and their health is put at risk. All this has forced them to increase expenditure to clean and maintain their production process, as well as on vehicles.

- CSP Iberian is the main container terminal in the Port of Bilbao. It is located on dock A1. There are solid bulk cargoes stored on the neighbouring dock, and when a S-SE wind blows, a cloud of dust impacts workers' vehicles and the main building of CSP Iberian. The damage described involve increased costs for the maintenance of the building, and for cleaning both corporate and workers' vehicles.
- The company Chronimet is dedicated to the import and export of scrap and metals. It is located on AZ-1 and its plot is enclosed around its perimeter with a fence several metres high. Its plot is not enclosed from above, as it stores scrap that surpasses the height of the fence and needs manoeuvrability for the cranes, etc. It is also located very close to where sand is stored on AZ1. The problems they have described to us refer to damage to vehicles and facilities. It should be noted that when there are episodes of strong wind, they have had to stop working as the conditions caused by the clouds of sand are not admissible and put the health of its workers at risk.

The Port Authority of Bilbao, proactive in the search for solutions for the problems of its surroundings, seeks to respond to these needs with the aim of fostering an atmosphere of harmonious relations and optimising the allocation of spaces to businesses that initially are incompatible. For this purpose, it needs to guarantee the solution to these problems in the short term and offer the main stakeholders involved a viable solution.

Objectives

As a guideline, the following table includes the functional needs required, classified as a requirement or weighted according to their level of importance, with 3 being the lowest level and 9 the highest:

Variable	Functional need	Weight
1- The solution contains the particles	1.1- On windy days	Requirement
	1.2- During loading and unloading	Requirement
2- The solution is applied to:	2.1 Loading	6
	2.2- Stocking	Requirement
	2.3 Unloading	6
3- The solution is not fixed to one location	3.1- It can be taken to different spaces	3
	3.2- Easy to transport	3
	3.3- Lightweight	3
	3.4- Easy assembly/disassembly	3
4- The solution is fixed to one location	4.1- It does not alter the existing infrastructure	6
	4.2- It does not occupy excessive space	6
	4.3- It does not alter loading and unloading operations	6
5- The solution is financially viable	5.1- The solution can be offered by the Port Authority as a service in the form of a concession/lease	6
	5.2- The manufacture of the solution has an affordable value	Requirement
	5.3- The solution is scalable to other ports with the same problem	9
	6.1- Long-lasting durability	9

6- The solution is environmentally sustainable	6.2- The material is not easily deteriorated by wind	Requirement
	6.3- The material is not easily deteriorated by rain	Requirement
	6.4- Manufactured with recycled materials	6
	6.5- After its use the material can be recycled/re-used	9
	6.6- It meets the strictest environmental regulations	9
	6.7- The material will resist adverse weather conditions	Requirement
7- Execution period	7.1- Less than 12 months	9
8- The solution is accepted by the port community	8.1- Its use is easy to explain	9
	8.2- It is easy to use	9

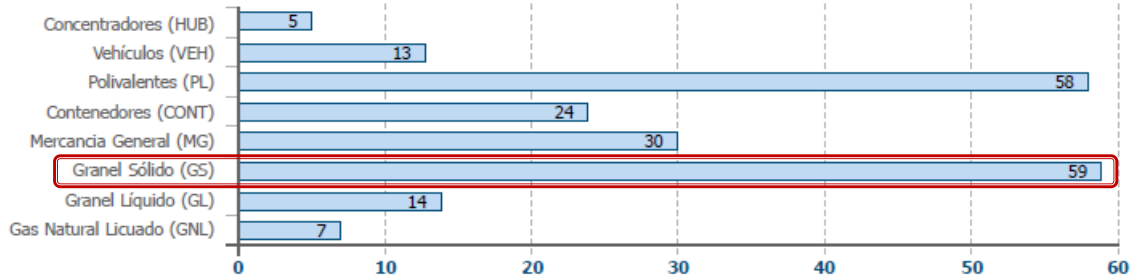
Scope

Although in the content of the document it has been considered appropriate to describe the full scope of the current challenge posed by diffuse particles from solid bulk cargoes stored in the open air on port docks, the **scope** to be covered via this challenge **is defined** as the **development of a first proof of concept**. Solutions will be accepted that are at least at level TRL 3 (Analytical and experimental critical function and/or characteristic proof-of concept) although a higher score will be given to solutions that approach TRL 6 (System demonstration in a relevant environment) and which after the tests carried out at the Port can reach TRL 7 (Prototype demonstration in operational environment) or higher.

By means of the pilot project developed between the winning company and the Port Authority of Bilbao, **the viability of the proposed solution shall be validated in a real environment and with real users**. This validation, resulting from the collaboration for the design of a solution between user entities and the winning company, will also **offer** the latter **the possibility of solving a problem that is present in many of the ports that work with solid bulk cargoes in the different maritime-port façades at both national and worldwide level**.

According to the Guide on good practices regarding the handling and storage of solid bulk cargo, during the year 2012 the port system had 59 terminals dedicated to the movement of solid bulk cargoes, which represents 28% of the total of operative terminals. To the activity of these terminals we must add the operations carried out in multipurpose terminals, usually carried out with non-specialised loading/unloading.

Graph 2 Number of terminals in the port system by types of traffic in 2012



Source: Guide on good practices regarding the handling and storage of solid bulk cargo; Number of terminals in the port system by types of traffic

In the year 2012 these installations moved a total of 89 million tonnes of bulk goods, which represents 20% of the goods traffic through ports. In general, the materials moved are coal, minerals, agri-food products, fertilisers, construction products and chemical products.

Therefore, the traffic of solid bulk cargoes represents a significant amount of activity, due to the level of activity carried out in ports, due to the resources necessary to cope with the traffic, and due to its impact on a variety of productive sectors.

This challenge is, therefore, an interesting market access opportunity not only represented by the Port Authority of Bilbao, but declared by 93% of Port Authorities at national level which consider the handling and storage of solid bulk cargoes in the open air as the primary course of emissions to the atmosphere in ports, with its corresponding environmental, social and economic impacts.

Example: use case

During the export process, the materials arrive at the port by lorry. Once the lorry reaches the concession where the goods are to be stored until they are loaded onto the vessel, there can be two situations:

1. The concessionaire company does not have a warehouse: in this case, the lorry directly unloads the solid bulk onto the dock. After all the material has been unloaded by the arriving lorries, the stevedoring companies use excavators or similar machines to push the materials into piles that can be of different heights, often surpassing a height of 12 metres.

   Once the bulk carrier is prepared, a crane equipped with a clamshell bucket or grappler (the grappler is used for scrap) the material is collected from the dock and deposited in the vessel's hold.

   Throughout this process, several sources of emission are created. The first is when the lorry deposits the material on the dock and the second is when the material is removed from the dock and deposited in the hold. However, this material stored in the open air is a constant source of emission, particularly when there is strong wind, which happens regularly.

2. The concessionaire company has a warehouse to store the solid bulk cargo: In this case, the lorry usually unloads the material outside the warehouse, and it is later brought into it by

pushing it with an excavator or similar machinery. The material is stored inside the warehouse.

When the material is later going to be exported, it is loaded inside the warehouse by an excavator and deposited in a lorry that awaits outside. The lorry travels to the dock where it tips the material that is later loaded by a crane equipped with a clamshell bucket to be deposited in the vessel's hold. In this type of operation the sources of emission are at the entrance of the warehouse, the dock where the material is unloaded from the lorry onto the dock, and while loading the bulk carrier.

In import processes, when the load arrives to the port in the bulk carrier, the sources of emission are repeated, but in the reverse order.

It is also important to note that there are companies that work with solid bulk cargoes that do not have an impact on their surroundings, as in addition to having the material stored in warehouses, they have conveyor belts with fairing and other direct loading/unloading systems to the bulk carrier (e.g. the Cleveland system).

Source: Port Authority of Bilbao; location of the docks and the neighbouring plots affected

Annexes: list of solid bulk cargoes (by typology) and amounts stored during 2019-2020

Type Container (SOLID BULK CARGO), Period (Monthly: January 2020/December 2020)						
January 2020/ December 2020 Departure	2019 LOADING Total Weight (Tns) - Previous year	2019 UNLOADING Total Weight (Tns) - Previous year	2019 Total Total Weight (Tns) - Previous year	2020 LOADING Total Weight (Tns)	2020 UNLOADING Total Weight (Tns)	2020 Total Total Weight (Tns)
SOY BEANS		1.035.900	**1.035.900**		962.383	**962.383**
LIMESTONE	720.706		**720.706**	615.568		**615.568**
NON-CALCINED PETROLEUM COKE	591.338		**591.338**	576.231		**576.231**
SULPHATES AND ALUMS	541.736		**541.736**	359.026		**359.026**
FERROUS SCRAP	50.646	363.853	**414.499**	57.297	199.143	**256.441**
CEMENTS AND CLINKER, BULK	338.910	16	**338.926**	212.768		**212.768**
CEMENTS AND CLINKER, BULK	320.843		**320.843**	193.142		**193.142**
CARBONATES		66.300	**66.300**		99.600	**99.600**
COAL		67.102	**67.102**		60.126	**60.126**
CAST IRON IN INGOTS		130.484	**130.484**		54.540	**54.540**
DOLOMITE				38.159		**38.159**
PRESS CAKES AND WASTE (OTHERS)		66.411	**66.411**		37.992	**37.992**
BENTONITE		74.278	**74.278**		36.195	**36.195**
MINERAL COAL (BITUMINOUS COAL), BRIQUETTE		52.104	**52.104**		30.150	**30.150**
SULPHUR	35.665		**35.665**	29.948		**29.948**
PRESS CAKES AND SOY WASTE	6.078	18.627	**24.705**		25.349	**25.349**
FERROUS ALLOYS		14.020	**14.020**	2.002	13.660	**15.662**
NATURAL AND CALCINED GYPSUM	30.896		**30.896**	13.937		**13.937**
WHEAT AND MESLIN		71.806	**71.806**		9.641	**9.641**
NATURAL IRON MINERAL		5.250	**5.250**		8.322	**8.322**
NATURAL CALCIUM PHOSPHATES		21.372	**21.372**		7.058	**7.058**
ZINC MINERALS	6.338		**6.338**	5.905		**5.905**
AMMONIUM SULPHATE					4.824	**4.824**
NITROGEN FERTILISERS					4.619	**4.619**
NITROGEN FERTILISERS, PHOSPHORUS, POTASIUM		16.127	**16.127**		3.519	**3.519**
SALT AND PURE SODIUM CHLORIDE					2.000	**2.000**
LEUCITE, FLUORITE		10.445	**10.445**		1.950	**1.950**
STONES, GRAVEL, CRUSHED STONE		2.406	**2.406**		1.301	**1.301**
SEPIOLITE		1.000	**1.000**		1.200	**1.200**
PROVISIONS	26		**26**	406		**406**
QUICKLIME, SLAKED LIME AND LIME MORTAR	6.472		**6.472**			
CHARCOAL, BULK		50	**50**			
NATURAL SANDS NOT IRONSAND		10.501	**10.501**			
BEET PULP		3.486	**3.486**			
	2.649.653	**2.031.538**	**4.681.191**	**2.104.390**	**1.563.572**	**3.667.962**

Stored in the open air
The entire process is carried out in the open air

Source: Port Authority of Bilbao; List of solid bulk cargoes and amounts stored during 2019-2020.

References

[1] Guide on good practices regarding the handling and storage of solid bulk cargo in port facilities.State Ports (2015)

[2] IMSBC code. International Maritime Solid Bulk Cargoes Code. International Maritime Organization

Subsequent amendments

[3] Guide for the prevention of diffuse particle emissions

[4] Docks and terminals of the Port of Bilbao