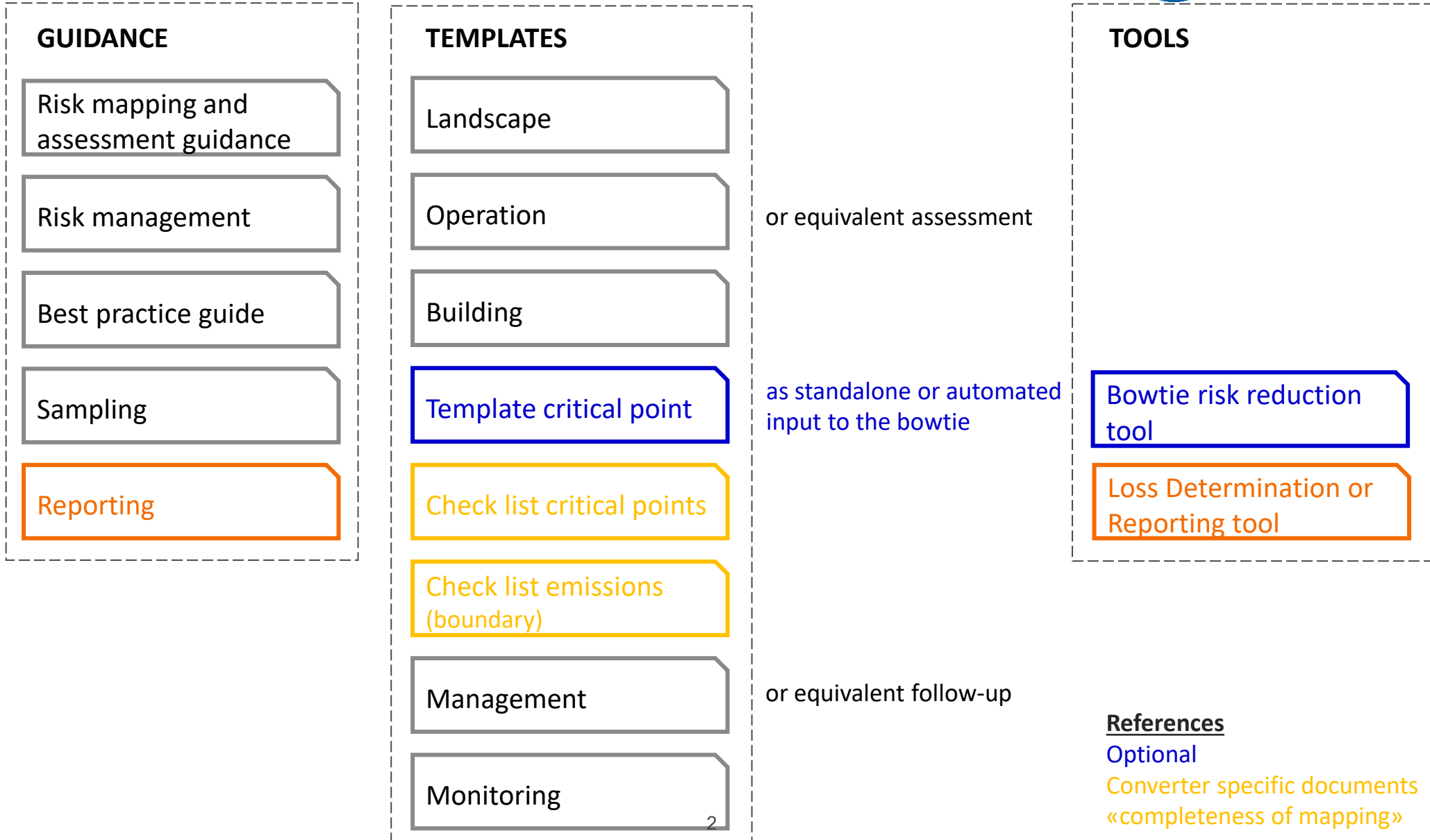




Risk mapping, management and pellet loss evaluation - Focus session

May 2023

Recap guidance and tools



References

Optional

Converter specific documents
«completeness of mapping»

Risk mapping & risk management methodology



Which approach? For what purpose? When?

Approach/tool	Purpose	Stage
Risk analysis by likelihood of event	Prioritization/scoping	Initial assessment
Risk analysis based on assessment by location	Focus on material flows	Complement initial assessment. Refinement.
Assessment by location (Bowtie model)	Finding right balance between measures/ Quantification	Refinement
Simplified bowtie	Reporting	Since start

Some definitions



Plastic Pellets (OSPAR)

Mass of preformed moulding material, having relatively uniform dimensions, is used as feedstock in plastic product manufacturing operations. Source: EN ISO 472:2013+A1:2018 (modified).

- NOTE 1: throughout this document **plastic pellets, powders, flakes, and dust**, including recycled material, are referred to as “pellets”
a) Plastic powder: fine particulate matter that serves as a feedstock in plastic product manufacturing operations.
b) Plastic flake: small flat-shaped matter with a regular or irregular form that serves as a feedstock in plastic product manufacturing operations or plastic that has been shredded. Plastic flakes can be manufactured or generated through the agglomeration of plastic dust or powder when plastics are processed.
c) Plastic dust: fine particulate matter with irregular form and size, produced when plastics are manufactured, handled, conveyed, machined, or processed.
- NOTE 2 Pellets are produced in many colours. Plastic pellets are also known as “granules” or “nurdles” and are normally spherical or lenticular in shape.
- NOTE 3 In some countries, plastic can also be termed “resin”.

Some definitions



Spill and Losses

Spill	One-off or prolonged release of pellets that when effectively contained do not result in a loss to the environment.
Loss	One-off or prolonged release of pellets <u>OUTSIDE</u> the operating boundary into the environment (e.g. water, soil...) and which are not recovered.

Definitions reviewed by OCS EU TC for alignment with OSPAR.

Barriers

Preventive barrier	Physical barrier that prevents a spill from occurring.
Mitigating barrier	Specific barrier after the spill that ensures it does not become a loss. It, therefore, covers both equipment such as filters and clean-up procedures.

Typical activities along the value chain

Activity	Actor	Process
Raw material production	 producer	A producer ships at Goods Out: virgin powder, pellets or flakes.
Compounding	 compounder	A compounder prepares masterbatches from the producer to be used by the converter.
Converting	 converter	A converter transforms virgin material and masterbatch to product.
Recycling	 recycler	A recycler reprocesses post-industrial waste produced by the converter and compounds it back into virgin material.

Typical activities along the value chain



For each process, the likelihood of spills may depend on various process layouts: closed and continuous processes will reduce the occurrence of spills, while the batch process may be required in some productions.

The location of the process and the probability of spillage may directly influence the probability of a loss: processes outside buildings and processes without confinement are more at risk than fully confined processes.

A location-specific assessment might be required in order to implement the necessary measures to prevent spills and loss.

3. Risk Mapping approach

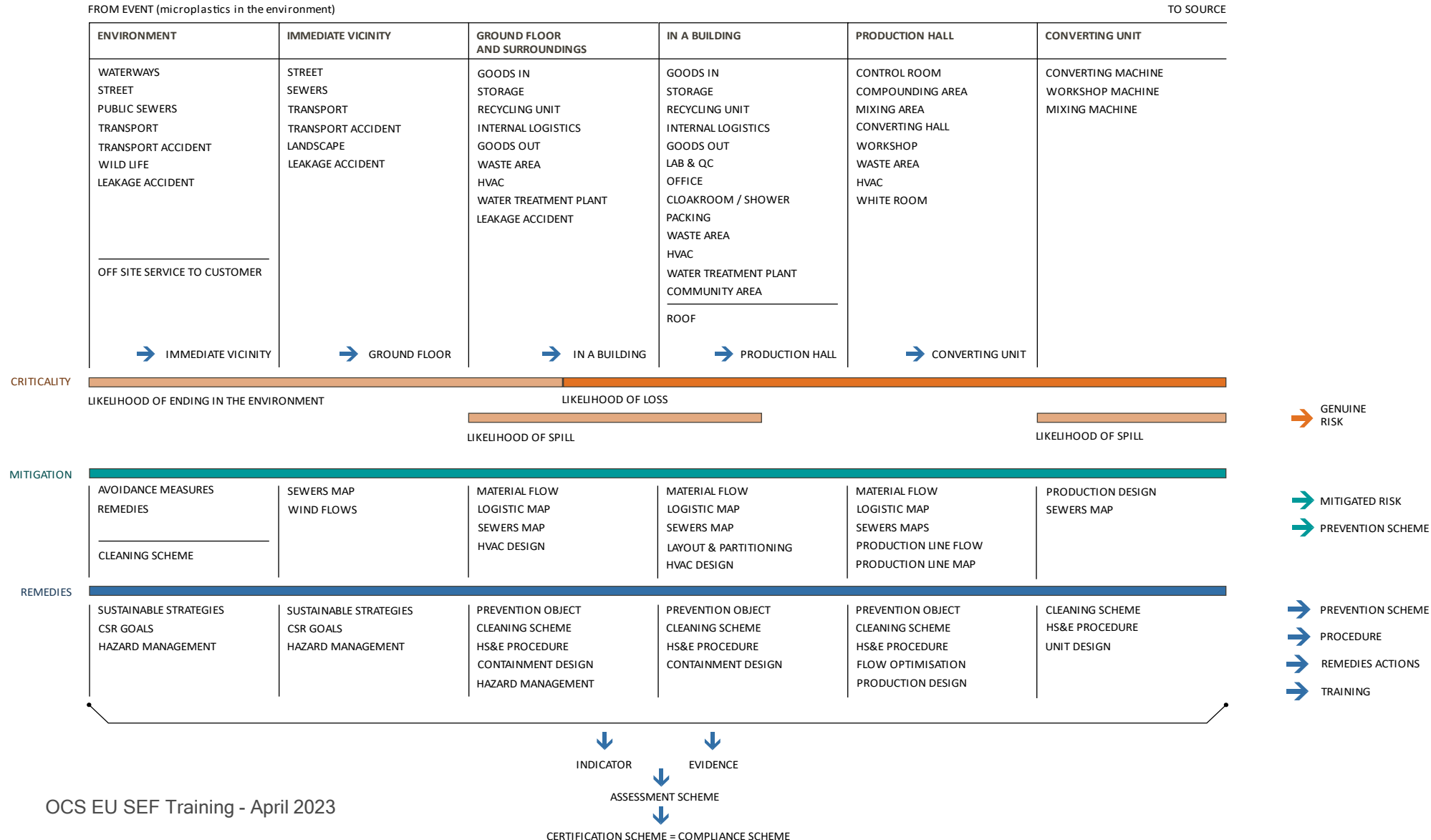


The purpose of the risk analysis is to identify the source of pellet loss in the environment and to set up appropriate remedies, with respect to the characteristics of the plant, in its surroundings.

Two approaches may be followed:

- A) an assessment based on the likelihood of event like pellet loss or pellet spill, from the outside of the plant to where the loss is observed inside the plant (source of the spill)
- B) an assessment per location of spills which may result in a loss in the environment

A) Risk Analysis based on the likelihood of event



A) Risk Analysis based on the likelihood of event



When it comes to assessing the risk of spill, the risk of loss and their criticality, it is fundamental to identify the measures that are taken in order to contain the risk: this might require complete information on material flow, plant layout, sewer map, HVAC design, production flow map, etc.

The appropriate remedies should then be taken in order to contain a spill event and to implement the risk minimisation plan.

Once the possible sources of loss are identified in the high-risk areas of the plant, a specific assessment per location can be carried out, focusing on the barriers and procedure in place to contain both spill and loss.

B) Risk Analysis based on the assessment per location



The assessment per location is based on a survey approach. It allows to have an accurate description of risk, according to the probability of occurrences. The approach narrows down the occurrence of spills and consequent possible loss, by targeting primarily the highest root causes.

There are several levels of efficiency to perform an assessment per location:

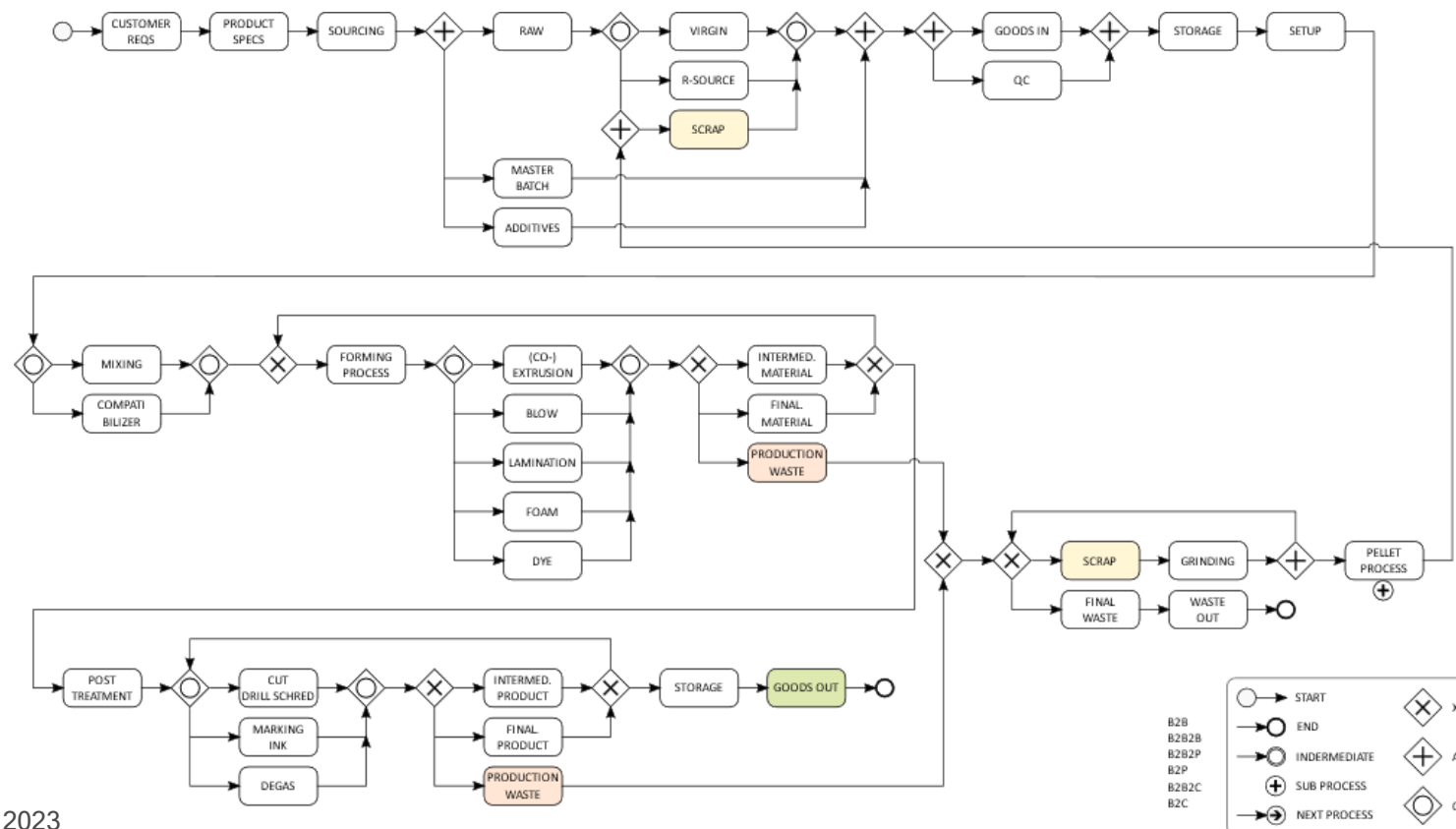
- Flow diagram approach
- Material flow mapping approach
- Description of operations approach

The three methods can be combined and complemented in order to obtain a complete and more informative risk assessment

B) Risk Analysis based on the assessment per location



The **flow diagram** describes stages in one or many production schemes in the plant. The description is focusing on the process relevant for pellet loss and spill. This allows to further describe the process with occurrence of spills.

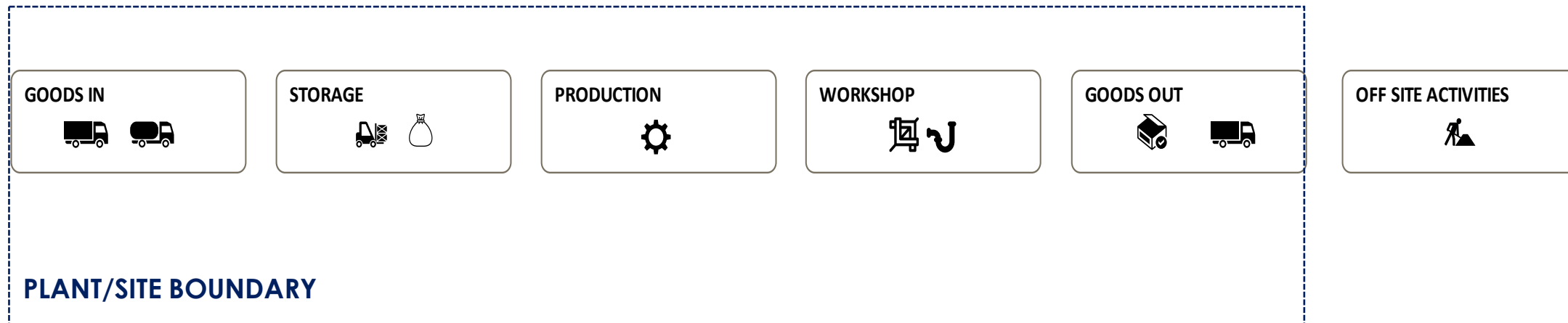


B) Risk Analysis based on the assessment per location



The **material flow mapping** is focusing on the routes taken by the material from entrance (goods-in) until exit (goods-out) or even for on-site construction. Some operational macro area can be identified:

Material Flow approach



B) Risk Analysis based on the assessment per location

In order to perform a risk mapping, for those macro areas of the plant/site with a higher risk of spill and loss it is necessary to identify the critical points of the plant and/or critical operations carried out in the plant where spill and loss might occur. These points should be clearly indicated in the plant map to identify their physical location.

For each identified critical point/operation, complete information on preventive and mitigating barriers and/or procedures should be provided (e.g. barrier efficiency, reliability, dependability, etc.)

Risk Mapping approach: Overview

Assessment	Advantages	Drawbacks
based on the likelihood of event	Reasonable approach for a first evaluation	Does not allow to understand the system as a whole and the interaction between barriers
per location	• Tiered implementation of preventive measures • Useful approach to quantify streams and perform thorough reporting	Normalised approach which could disregard significant “details”

Both approaches are complementary: if used together, they achieve maximum completeness

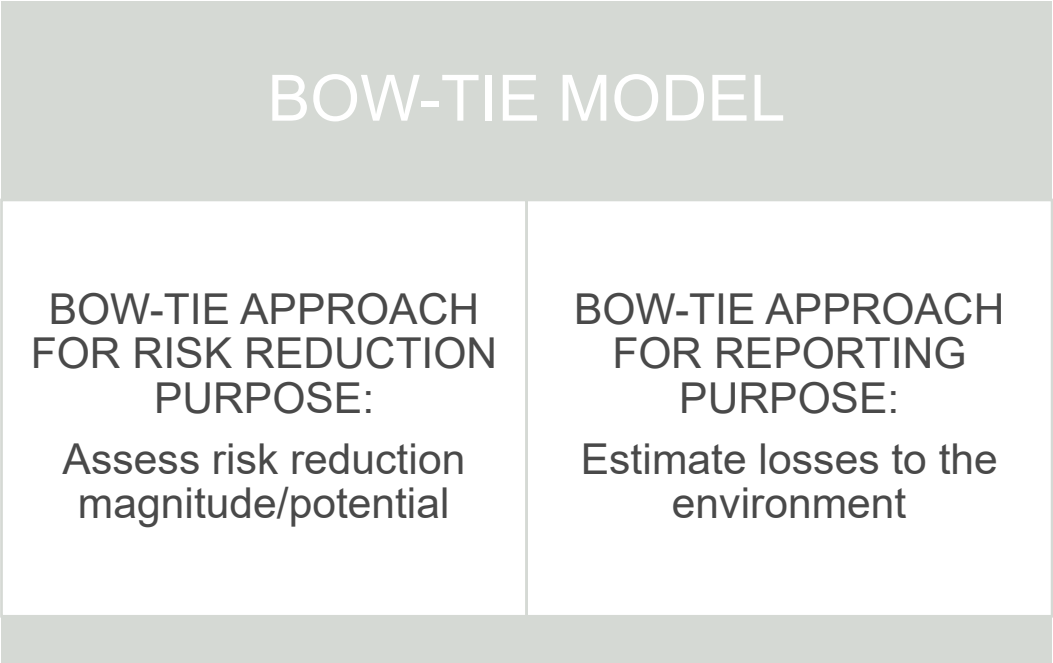
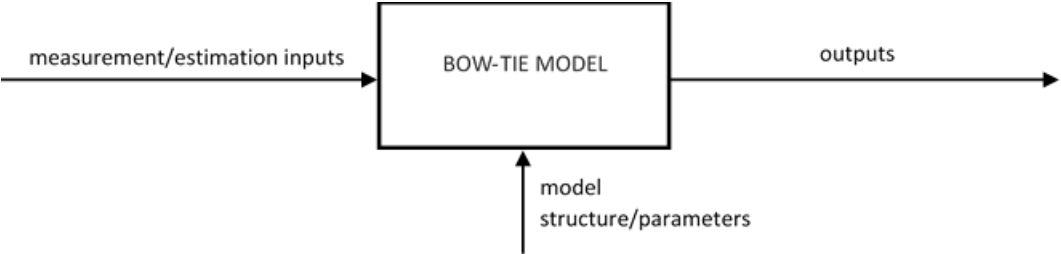
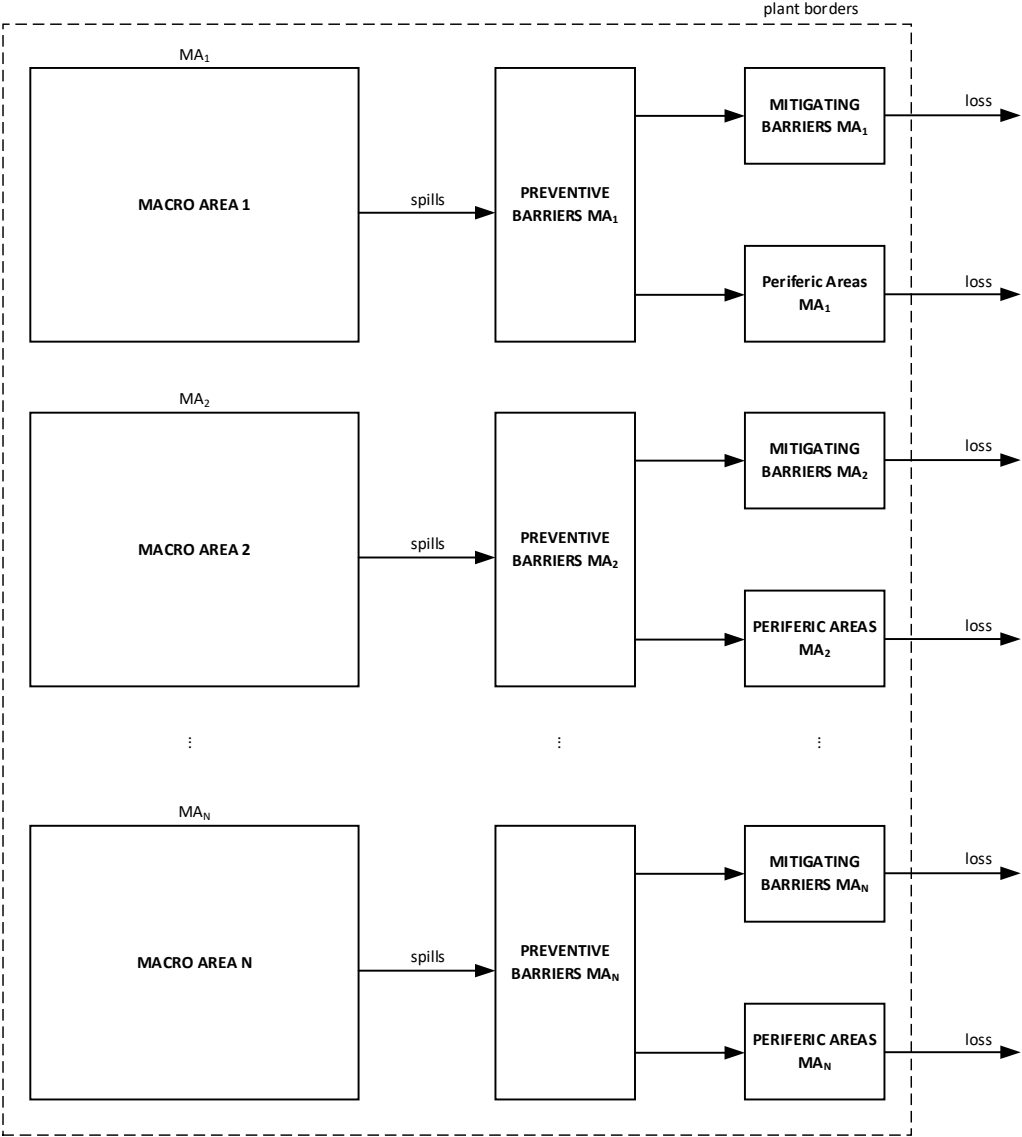
Evaluation of losses during operation





Acronym	Meaning
MA	Macro Area
PA	Peripheric Area
CP	Critical Point
PB	Preventive barrier
MB	Mitigating barrier
AS	Annual Spill
CPB	Material Collected at Preventive Barrier
CMB	Material Collected at Mitigating Barrier
SB	Spill after Barrier
L	Loss

Bow-Tie Model



Pellet spills and loss conceptual diagram

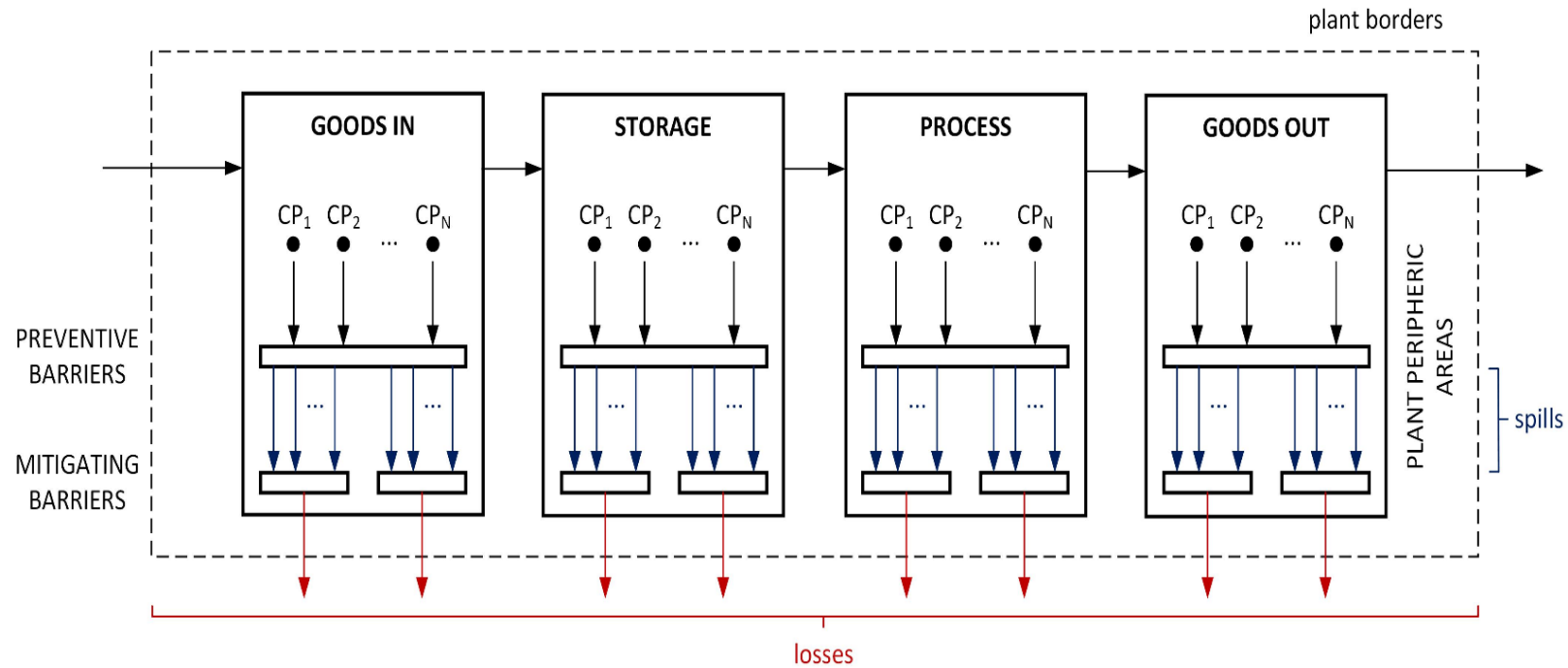


Figure 1. Pellet spills and loss – Plant Material Flow Diagram (example)

Evaluating operating losses: approaches based on available input data/plant layout (1/3)



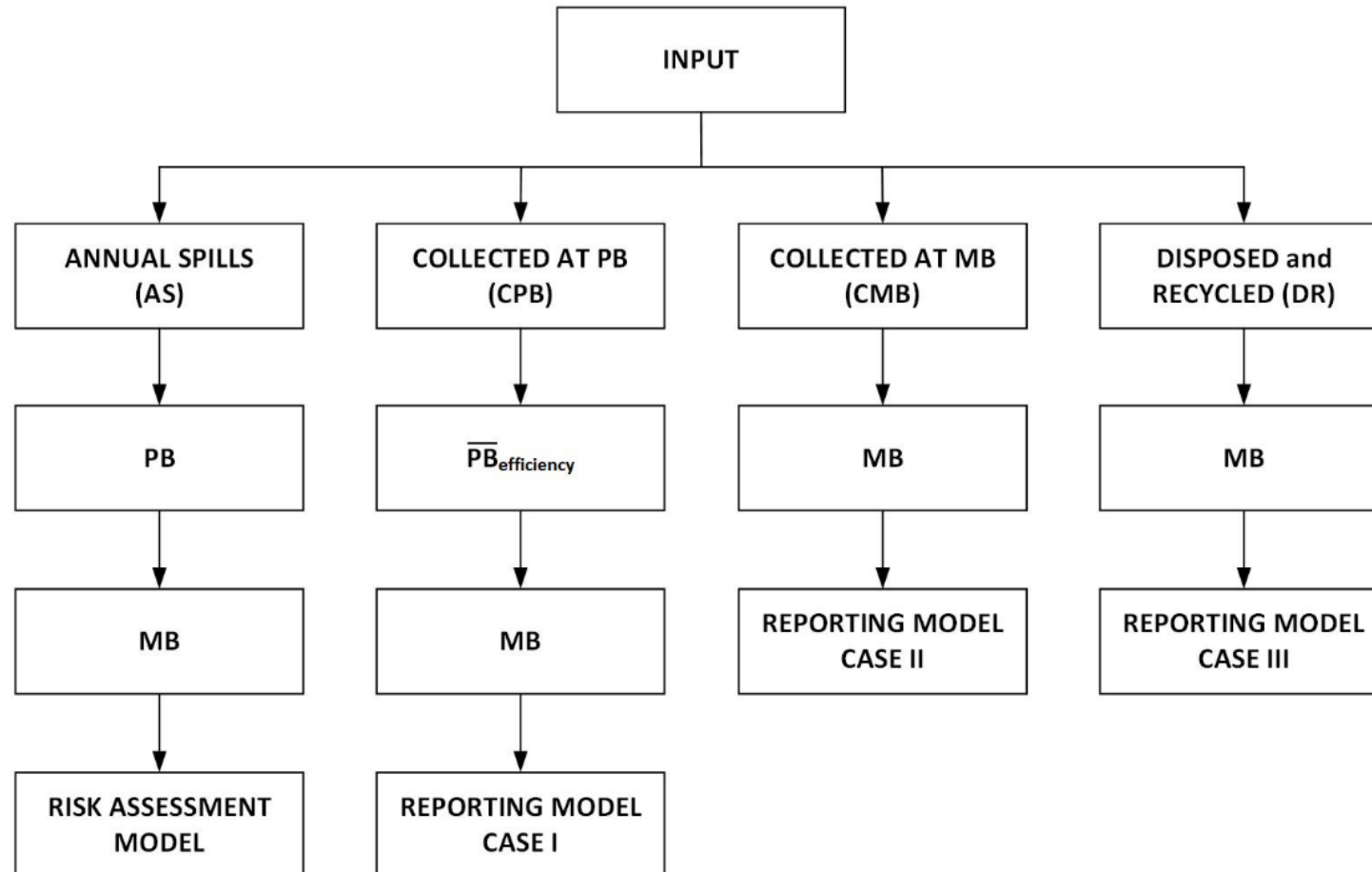
- Tiered approach:
- Approaches 1-3 - simplified input - worst case estimates

Starting point	Tier
Approach 1: Pellets sent to recycling/waste management	1
Approach 2: Pellets collected in mitigating barriers	1
Approach 3: Pellets collected in preventive barriers	1,5
Approach 4: same as risk reduction	2

Evaluating operating losses: approaches based on available input data/plant layout (1/3)



Decision-making tree



Evaluating operating losses : approaches based on available input data/plant layout (2/3)



Starting point	Information needed	Relevant parameters	Field of applicability/limitations
Approach 1: Pellets sent to recycling/waste management	Quantity of pellets sent to recyclers and/or waste management companies	Quantity of collected material sent to recycling and/or waste management+ efficiency of mitigating barriers	- Mostly for «closed systems» (limited preventive barriers needed) - Not applicable if the macroplastic waste generated cannot be differentiated from microplastics - Typical example: resin production
Approach 2: Pellets collected in mitigating barriers	Quantity of pellets collected in the mitigating barriers	Quantity of pellets collected in the mitigating barriers+ efficiency of mitigating barriers	- First quantitative scoping - disadvantage: gets focus away from preventive barriers - Well suited however with first implementation (outside in)

Tier 1

Tier 1

Evaluating operating losses : approaches based on available input data/plant layout (3/3)



Starting point	Information needed	Relevant parameters	Field of applicability/limitations
Approach 3: Pellets collected in preventive barriers	Quantity of pellets collected in the preventive barriers and a generic efficiency factor for the latter	CPB + average efficiency of preventive barriers+ efficiency of mitigating barriers	This approach considers spills collected in preventive barrier in a more holistic way (default realistic worst case efficiencies). This means that it is mainly applicable when preventive barriers have already been implemented in all the plant macro-areas. Not applicable to closed systems.
Approach 4: same as risk reduction	Detailed info on barrier efficiency, estimated and/or measured pellets in barriers	Same as risk reduction	A refined model for risk minimisation. Applicable to plant at a further implementation stage after the first risk identified by risk mapping has been addressed.

Tier 1,5

Tier 2

THANK YOU FOR YOUR ATTENTION. ANY QUESTIONS ?

European Plastics Converters Aisbl

Avenue de Cortenbergh 71
B-1000 Brussels
Belgium

E-mail: maelys.makotta@eupc.org
geoffroy.tillieux@eupc.org

Website: www.plasticsconverters.eu

Tel.: +32 (0)2.732.41.24
Fax: +32 (0)2.732.42.18

