SYENSQO
ADVANCING HUMANITY

Syensqo's

SPM
SUSTAINABLE PORTFOLIO MANAGEMENT

Sustainable Portfolio Management

About this Guide

This guide is targeted to companies that want to have a fact based analyses of the environmental and social impact of their product portfolio in the end markets these products are used.

With the fact based analyses of the SPM, companies can drive their business decision and allocate their resources and capital to further promote and valorize their solution portfolio. Also the guide identifies early market signals and potential risks of the portfolio enabling opportunities for innovation and development of more sustainable alternatives.

Since 2009 Syensqo (prior company of the Solvay group) has used SPM in its business decision process. Per the SPM tool, as of 2023, we have achieved more than 85% coverage of our full product portfolio. Currently 60% of our portfolio is considered a sustainable solution and 80% of the innovation pipeline is also a sustainable solution.

The intent of this guide is to support other companies in incorporating Sustainability in their business decisions. We continue to explore further opportunities with our customers and stakeholders to bring sustainable solutions into the marketplace.

Table of contents

1. Overview

SYENSQO

Investing in sustainable **Solutions** is the smartest decision for Syensqo and society at large

"Sustainability is our license to operate and it has to inform any decision we are making in business development, strategy, innovation, capital expenditure, and M&A. Among the tools we use, the Sustainable Portfolio Management (SPM) is our compass to grow our business AND be good for people and our planet.

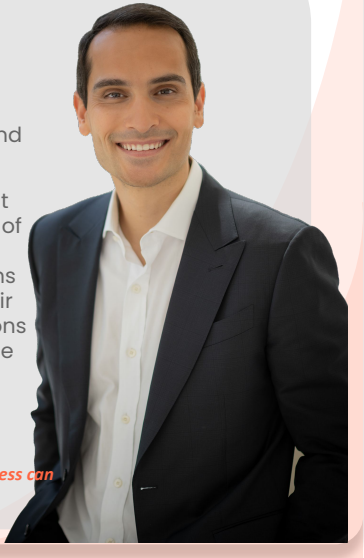
At Syensqo, we are explorers pursuing breakthroughs that advance humanity. We invest in science, creating advanced, sustainable solutions that help drive better growth."

Ilham Kadri
Chief Executive Officer
Syensqo

"Thousands of organizations have now made commitments to deliver better sustainability outcomes. However, few organizations have developed the necessary tools and management practices to drive strategy implementation and achieve those outcomes in a way that is profitable and therefore scalable.

The sustainable portfolio management tool represents an important example of such much needed management innovations that will allow organizations to integrate sustainability issues in their strategy and capital allocation decisions making sustainability not a compliance issue but a driver of innovation and growth."

George Serafeim
Charles M. Williams Professor
Harvard Business School
& author of "Purpose + Profit: How Business can lift up the World"



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1.1 KEY DECISION-MAKING TOOL

SPM is a primary **tool to integrate the sustainability dimension** in strategic and operational decisions of key business processes: strategy, research and innovation, investments, marketing and sales, mergers and acquisitions.

As our compass, the SPM tool guides us towards the creation of business value by bringing sustainability attributes into our business offer.

As of 2023 **60%** of group sales contribute to Solutions and **13%** contribute to circular economy.

Sustainability creates an opportunity to innovate and grow faster - more than **85%** of our innovation pipeline is in Solutions.

We are committed to advancing humanity by investing in innovation and sustainable growth

TITTA ROSVALL-PUPLETT
Chief Sustainability Officer

"SPM analyzes the environmental and social impact of a **product and portfolio related** operations, **considering** market and **regulatory** trends **impacting the business**. It is a key framework that enables Syensqo to integrate sustainability in investment and business decisions. It is instrumental to drive **better** growth, **sustainable** innovation and value creation for Syensqo, our customers and all **stakeholders**. "

SPM too covers all scopes of management processes

- Portfolio management decisions and differentiation strategy
- Strategic project-related decisions in Research and Innovation (R&I), capital expenditures (CAPEX) and Mergers and Acquisitions (M&A)
- Product footprint improvement
- Business development
- Procurement

The SPM Methodology is applied to:

- ➔ More than 85% of the existing product portfolio in a consistent way (i.e. total revenue)
- ➔ All R&I and M&A Projects
- ➔ All CAPEX projects

SUSTAINABILITY IN KEY BUSINESS PROCESSES

SPM is a compass, steering us towards the right investments, research projects and portfolio decisions

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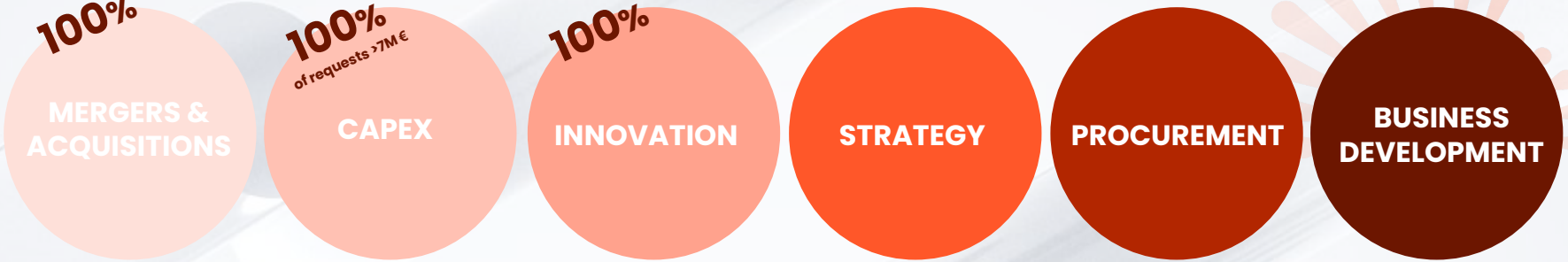
> 85% of our existing product portfolio



ASK NEW QUESTIONS ⟷ GET NEW ANSWERS

2. The methodology

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2.1 METHODOLOGY IN A NUTSHELL

The SPM tool in Syensqo is often referred to as a camera as it takes a snapshot of a product's sustainability risks and opportunities in their competitive business environment.

It develops a dynamic vision of sustainability market signals and their potential impact on portfolio and strategic projects helping the business:

- Take the right decisions to address successfully sustainability needs of the marketplace, To meet customers and stakeholders expectations both today and tomorrow.
- The SPM snapshot is projected on a heat map matrix where products in their applications are plotted according to two axes (see figure below):

1) Operations Vulnerability (vertical axis)

Goal:
We assess the environmental impact of our products based on life cycle assessment thinking (cradle to gate). We monetize the impacts based on the principle of the polluter as the payer. Then we compare the value we bring to the market (willing to pay) ensuring that our value creation is not contributing to a high environmental expense. We assess risks and opportunities of substitution.

- The higher the ratio, the higher the risk for Syensqo to lose business to more sustainable solutions.
- The lower the ratio, the higher the probability to displace a less environmental-friendly competing technology.

2) Market Alignment (horizontal axis)

Goal:
Answer: Does our product in its applications is part of the problem or part of the solution from a market and customer perspective. It covers a series of sustainability; environmental, health and social. We assess risks and opportunities to be selected in or out by the market.

How:
Analyzing the market signals of sustainability benefits and roadblocks and categorizing productions on a five-scale spectrum from "challenged" to "star potential"

3) Sales volumes

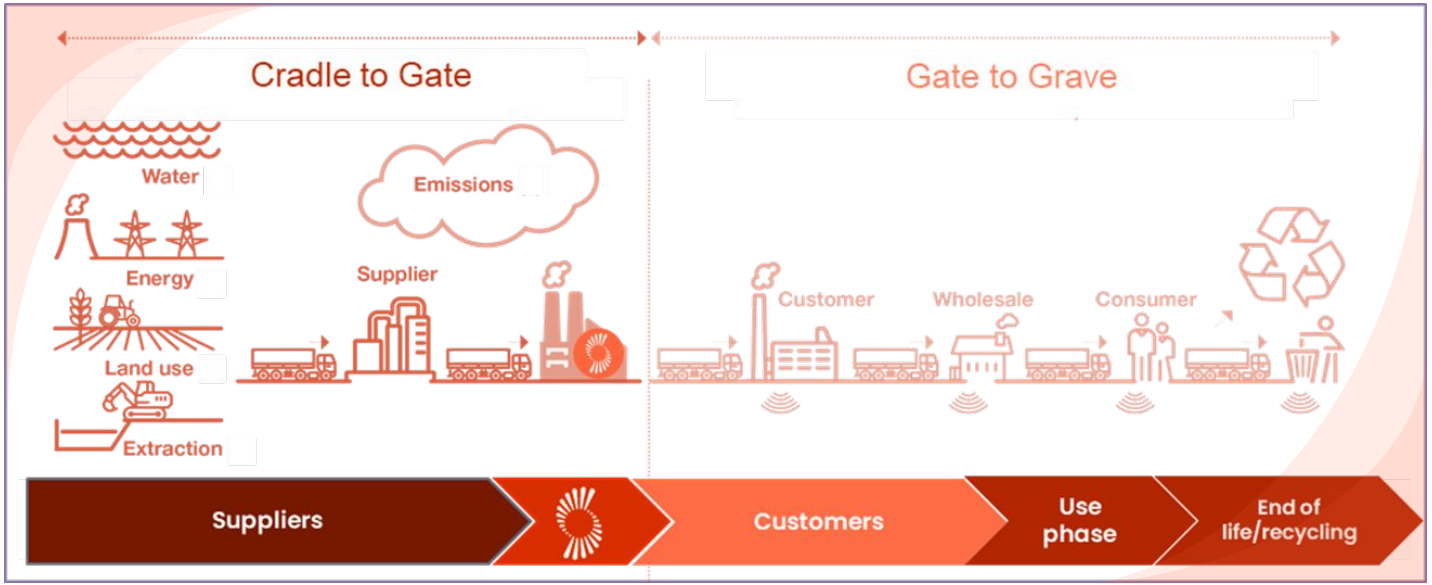
Sales turnover is the third dimension represented in the SPM Heat Map. The darker the shading the higher the revenue at stake.

2.2 SCOPE OF SPM

The tool covers:

Operation vulnerability analysis: the upstream, cradle-to-gate scope of the value chain to define sustainability related business risks and opportunities based on a quantitative LCA. 21 product impact points analyzed, monetized and compared to sales value using LCA methodology.

Market alignment analysis: the entire value chain (up and downstream), cradle-to-cradle to pinpoint sustainability benefits and roadblocks in the product portfolio applying evidence-based analysis of market signals.



2.3 MEASURING OPERATIONS VULNERABILITY: THE VERTICAL AXIS

Operational Vulnerability Calculation Steps:

1 IMPACT ASSESSMENT

1. Calculation of a product's ecoprofile

- We calculate the ecoprofile of a product using a Life-Cycle Assessment (LCA) performed by our in-house experts in line with the ISO 14040 and ISO 14044 standards.

2 IMPACT EVALUATION

2. Monetization of negative impacts

- We use 'shadow costs' drawn from authoritative scientific sources to define what it would cost to remedy or prevent negative impacts.

3 IMPACT EVALUATION

3. Financial risk of negative impacts (externalities)

- The risk of losing business or the opportunity of gaining new business depends on the balance between the economic value and the damage that is created.

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2.4 ASSESSING MARKET ALIGNMENT: THE HORIZONTAL AXIS

Qualitative, evidence-based collection of sustainability-related market signals in order to understand the risks and opportunities arising in the value chain, the right signals have to be captured from different stakeholders.

Similar approaches from peers, leading to the WBCSD(World Business Council for Sustainable Development) establishment of a (Portfolio Sustainability Assessment) PSA guidance.

While Life-Cycle Analysis is limited to environmental impacts, SPM analysis also addresses **social issues** such as healthcare or ageing population.

The questions are based on a number of authoritative sources to understand what sustainability means for a chemist and for chemical products. The questionnaire is structured around 4 themes:

- Health and safety,
- Climate change,
- Resources
- Opinion leaders.

This helps to identify market signals and holistically assess a product's social & environmental performance in its applications.

Products are analyzed in their end-user applications, based **on Product-Application Combinations** (PACs). One product can have several.

The Market Alignment analysis of PACs consists of two steps:

STEP 1
MARKET ALIGNMENT PROFILING

To identify the sustainability signals for each PAC, a Working Group answers the relevant questions on environmental and social issues to collect information on obstacles, concerns, benefits, benchmark and amplifiers.

STEP 2
IMPACT ASSESSMENT

The information gathered is applied to a decision tree, which positions the product on a 1-5 scale.

[1]Our benchmark shows that quantitative, e.g. monetized analysis of impacts occurring in the entire value chain requires lengthy and costly procedures that are difficult to use in fast-paced strategic corporate decision-making cycles, as well as in operational decisions on allocation of future spending such as innovation projects.

Questionnaire covers Circular Economy approach

- The SPM methodology considers both risks and opportunities with regards to the requirements of the circular economy.
- The SPM methodology doesn't assess the full circularity of the value chain a given product in given application is involved in.
- SPM helps only to identify the building blocks towards a more circular economy and not circular business models.
- All the answers are also recorded in the Global SPM Database and are fully-auditable.

Taxonomy

- Taxonomies are classification systems created by authorities, institutions , and investors that are used to determine and report which activities are sustainable.
- The set up of specific sustainability criteria per activity that are shared and recognized will have to be integrated in sustainability performance tools such as SPM. In this respect SPM will remain consistent with the development of the PSA guidance of the WBCSD with regard to the integration of European taxonomy criteria and thresholds. Others to be considered e.g. Climate Bonds or Corporate Knights taxonomies

The override option

- The market alignment decision tree aims at identifying market signals for any relevant sub-themes without any compromise on negative signals and regardless their materiality level. Therefore the results may look counter intuitive with regards to observed market trends. The SPM expert after analysis may decide as per clear exception to override the market alignment results provided that a deeper investigation will be carried on the PAC with a review by a third party. The PAC under override procedure will be by default part of annual review by third party(i.e. external auditor).
- For transparency's sake the number of PACs under override as their turnover at stake will be reported. Reviews of the Market Alignment methodology application are conducted on a regular basis by a third party.
- The % of the product portfolio assessed and the % of sustainable have been reviewed by the statutory auditor with reasonable assurance.

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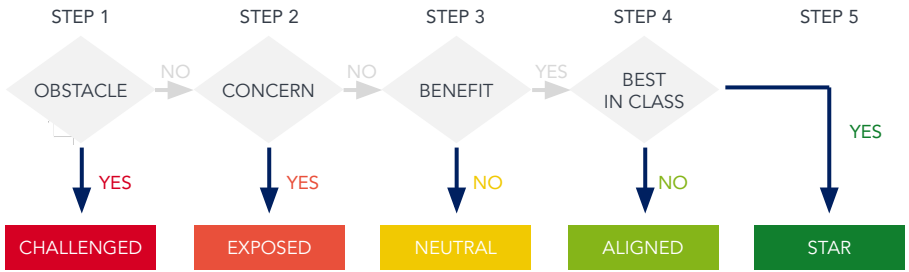
Qualitative, evidence-based sustainability-related market signals are assessed using the questionnaire and are then run through a decision tree.
The questionnaire is structured around 4 main themes : Health & Safety, Climate Change , Resources and Opinion Leaders and 29 sub-themes.

1	**Health and Safety**	Human Toxicity Classifications
		Eco Toxicity Classifications
		Substance Lists
		SIN List
		Medical Care
		Chronic Diseases
		Healthy Habits
		Food Availability
		Water and Air Quality
		Safety and Prevention
		Limitation from aging
		Topical Care
2	**Climate Change**	Climate Change
3	**Resource**	Energy Efficiency
		Renewable Energy
		Resource Efficiency
		Renewable-based Materials
		Scarce Materials
		Freshwater
		Availability
		Waste Generation
		Waste Valorization
		Recyclability
		Biodegradability
		Raw Materials
4	**Opinion Leaders**	Countries
		Major Customers
		Ecolabels
		Downstream Sustainability

For each sub-theme that is material for the PAC, we look first at Obstacles and Concerns (Steps 1 and 2). Any Obstacle identified will immediately rank the PAC as Challenged and anything raising Concern as Exposed.
Then we turn our attention to the positive signals (Steps 3-5). If we find no negative and no particularly positive impacts, we categorize the PAC as Neutral (Step 3). If the PAC analyzed demonstrates a direct, significant and measurable benefit to the market, impacting positively upon at least one of the sustainability benefits assessed, we list the product as Aligned (Step 4). If, in addition, the PAC shows outstanding benefits that it can be considered as the benchmark and actively replacing a less efficient PAC, the PAC is categorized as Star (Step 5).

Fast track SPM Market Alignment decision tree:

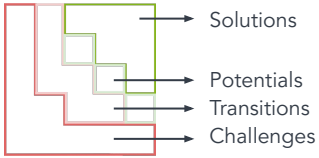


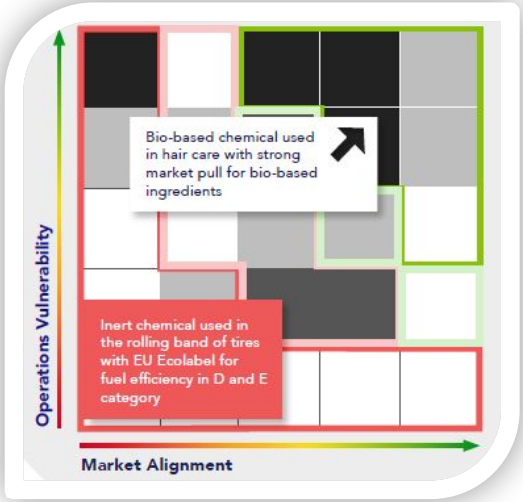
2.5 MAPPING RESULTS – SPM HEAT MAP

The Results of the **Operations Vulnerability** and **Market Alignment** assessments are plotted on a heat map which shows the risks and opportunities of the PACs for Syensqo. Business Units receive a drilled-down report which allows them to suggest actions to maintain or improve performance and reach Group-level targets.

The heat map is the highest-level portfolio steering instrument of the SPM assessment. It categorizes products and PACs in four higher level categories.

SPM Heat Map 3.0





- The **Potentials** category mirrors the potential to join the Solutions category by acting on the manufacturing environmental footprint. These are products that consumers need, but which environmental footprint can be improved
- The **Transitions** category identifies low negative sustainability concerns, here both on the manufacturing axis and on the market axis.
- The **Solutions** category identifies PACs with a better sustainability contribution to Syensqo's customers and value chain, combined with a favorable balance between value and environmental impact.
- The **Challenges** category are either strong negative signals resulting from sustainability drivers, or serious operations vulnerability challenges, leading to potential significant negative impact on revenue over time or products that may disappear.

Changes in the business perimeter during the year are taken into account in the scope of the year (Y) SPM.

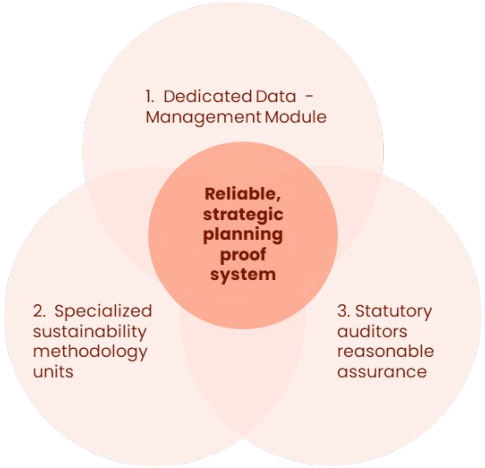
2.6 AUDITABILITY FOR RELIABLE DATA & EXTERNAL RECOGNITION

The sustainability assessment framework developed which can be audited by third-party accounting and sustainability assessment experts thanks to:

1. Dedicated data management module for SPM
Data from both axes of the SPM assessment are documented and recorded in Syensqo's Global SPM Database.

2. Specialized sustainability methodology audits
Third-party verification of the Market Alignment assessments is carried out at PAC level with a certain number submitted per year for review by a third party ensuring the robustness of the assessment.

3. Statutory auditor limited to reasonable assurance
Each year, we report Group-level turnover breakdown following the SPM Heat Map categories (Challenges, Transitions, Potentials and Solutions).



The Syensqo's SPM tool is now considered as a benchmark by stakeholders, investors, customers and suppliers, authorities and academia. A few examples of external recognition are:

- The European commission, DG Enterprise & Industry
- SusChem, EUropean Technology Platform for Sustainable Chemistry and Kohlberg Kravis Roberts (KKR), CIRAIG
- The Conference Board,
- The WBCSD, PSA Group

3. A key decision making tool

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3.1 STRATEGY

The SPM tool is also applied to strategic projects using the same logic as for the portfolio to make sure that they are heading toward business solutions to support growth and value creation.

- In the early stages of projects, we use what we call SPM "Fast track" assessments, a simplified approach of SPM which does not involve too many resources. It gives directions towards integrating sustainability dimensions among others straight from the beginning of the project before performing a full SPM assessment when the project is confirmed in a stage gate process
- The SPM logic around project assessment is to:
  - Prepare an SPM snapshot of the starting point and the anticipated end-point of any project and continuously review the latter as the project evolves
  - Position the project within the BU/GBU portfolio where it belongs

All SPM snapshots are taken by the SPM team and are linked to financial performance bridges in a similar way as in the Business Strategy Review process.

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SPM is a compass to help key business processes integrate the sustainability dimension. ‘Ask new questions, get new answers!’ is the SPM motto

EMBEDDED IN KEY BUSINESS PROCESSES

SPM is a compass, steering us towards the right investments, research projects and portfolio decisions

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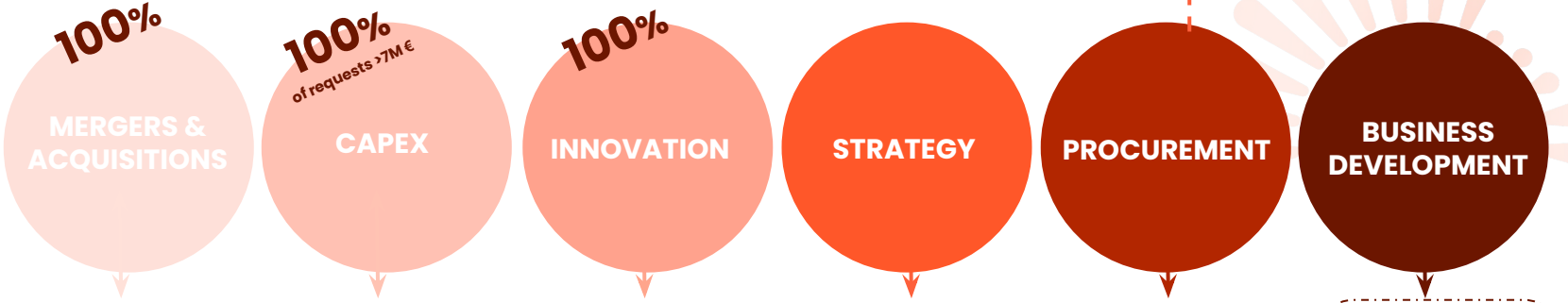
> 85% of our existing product portfolio



A full analysis is performed before sending the binding offer

CAPEX projects are submitted to the tool, providing long term sustainability signals to investment decisions.

100% of R&I projects are analyzed with the tool, from the ideation phase.

The tool is applied to strategic projects with the same logic as the portfolio to ensure solutions are supporting growth and value creation, integrating sustainability dimension from the beginning.

The tool engages dialogue with suppliers to find new ways of delivering sustainable solutions downstream.

The tool can position sales revenue on a heat map at customer level, helping to identify challenges and anticipate trends.

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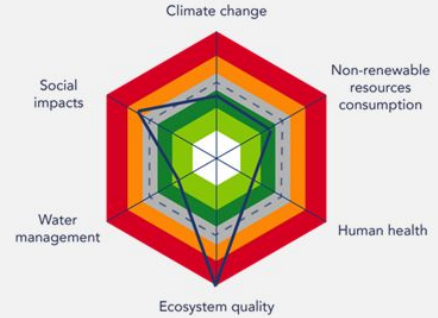
SPM logic and tool applied to innovation projects: SPM ranking gives the position from major improvement to major deterioration of the manufacturing footprint in absolute value of the target vs the reference. While SPM Heat map gives a position based on relative value following Operations Vulnerability and Market Alignment. It is important as a project that scores in SPM heat Map Solutions may presents a SPM ranking very deteriorated that need to be addressed before moving forward namely through Eco-design

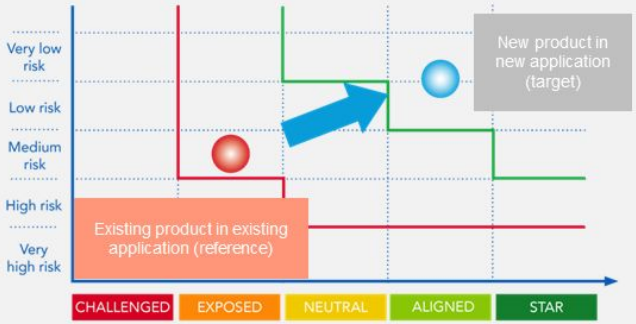
Manage project portfolio

Operation Vulnerability (cradle to gate)

New product in new application vs. existing product in existing application (Reference)



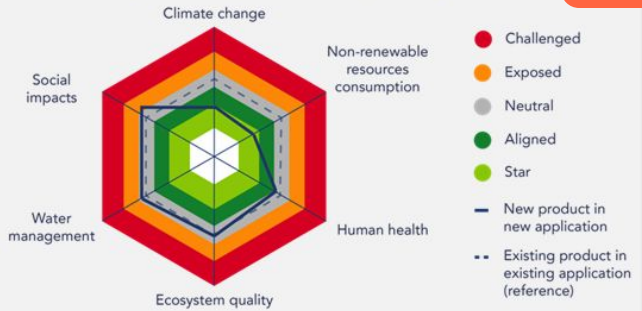
Guide for Eco-design



SPM applies simultaneously and consistently to:

- **The "starting point" of the project (the reference)**
- **The "expected output" of the project (the target)**

Market alignment (cradle to grave)



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3.4 SPM & FULL LCA are complementary

- **The SPM tool** is flexible and can be adapted to the needs and maturity level of projects in the different key business processes (Strategy, R&I, CAPEX, Marketing & Sales, M&A, Procurement…).

- The Fast track SPM assessment can be applied to screen projects from R&I, CAPEX, Marketing, Procurement… so that we ensure the sustainability dimension is taken into account at the earliest stage in the selection of the projects.

- While the SPM Heat Map reports the 2 axes of Operations Vulnerability (vertical axis) and Market Alignment (horizontal axis) in a single matrix, those complementary assessments can be done independently showing the operational flexibility of the SPM tool in its implementation.

When a deeper analysis is necessary, an additional full cradle-to-cradle LCA can be performed for a specific product in specific applications.

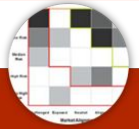
LCA is a longer lasting scientific examination that can be considered to complement the SPM assessment either to confirm environmental benefits along the full value chain or to compare products e.g. to benchmark better technical performance and environmental footprint.

Stages of SPM & LCA:

Stage 1: SPM Fast Track

Scoring based on SD expertise and expert intuition

Resource requirements:
10 products in applications: 1 hour (business self assessment with or without the support of the SPM team)



Stage 2: Full SPM

Thorough assessment, auditable and fact-based
(X axis: questionnaire –
Y axis: based onEco profile)

Resource requirements:
- **Y AXIS:** Quantitative LCA assessment (cradle-to-gate ecoprofile) depending on the number and the complexity of the products: about one month (run by LCA expert team)
- **X AXIS:** Qualitative fact based questionnaire (market alignment): 10 products in applications: 1 day (run by SPM team)

Stage 3: Full LCA

Fully quantitative assessment, auditable, full (cradle-to-cradle) data needed

Resource requirements:
3 months
(run by LCA expert team)

4. Assessment for practitioners

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4.1 THE PROCESS

The SPM assessment process takes place year-round and involves both Corporate SPM Expert and Business Unit SPM Correspondent.

The **SPM Correspondent** is coordinates the assessment to ensure the right expertise is brought in and clarifies expectations on both sides. Product and market experts are also key contributors in defining the relevant Product-Application Combinations (PACs) and going through the process.

The **Corporate SPM** team provides a comprehensive executive report of the assessment to the Business Unit management team. The SPM Corporate Expert ensures that the results and learnings are embedded in the decision-making process and action plans of the Business Unit at strategic and operational level.

Preparation for the assessment: the tool reflects Syensqo's organizational structure, built around product lines. For each axis of the Heat Map, a segmentation analysis is done with the relevant Business Unit experts:

For **operational Vulnerability:** industrial, technology experts and LCA practitioners work together.

For **Market Alignment:** market experts are in charge though risks and potential negative impacts are analyzed on a holistic basis.

4.2 OPERATIONS VULNERABILITY - THE VERTICAL AXIS

Analyzing the business risks of sustainability

4.3.1. The product segmentation

In the product segmentation, we assume that the criteria (inventory threshold, characterization model, mid-points etc.) for establishing an ecoprofile have already been defined.

In order to define a product segment and assess its environmental impact, the following 3-step approach is undertaken at Business Unit-level:

1 Analysis of existing products and production processes (LCA perspective)

The SPM expert, the LCA expert and the Business Unit representative analyze the eco profiles of existing products, where one product can be manufactured in many different factories, using different raw materials, or using different energy sources etc.

The analysis looks for similarities or significant differences in the cradle-to-gate value chain processes and raw material supply, which may allow several products to be merged in the SPM analysis into the products segment.

2 Identification of differentiating factors in eco profiles (LCA perspective)

Eco Profiles are compared and differentiating factors are examined to determine if the differences are material enough to justify a separate SPM product assessment.
If the differences are material, the procedure is repeated with the next product in the family.

If the differences are not material, the procedure is repeated to check if the reference product could be integrated in a product segment at a higher level in the value chain.

3 Revenue segmentation to identify SPM products (Financial perspective)

Within the product segment, the identified revenue per product line is plotted (at the lowest level of financial reporting).

Products are selected to cover at least over 85% of the annual external revenue of the Business Unit portfolio. For the last 15% of products that are not covered by the SPM, there will be a screening to ensure that all risks are addressed and to avoid any highly problematic issues e.g. hazardous products.

Internal sales are out of scope.

4.2.1 BASED ON MONETIZED ECO PROFILES

Monetized Ecoprofile

Ecoprofile

Σ

Environ. Impact *(kg CO2eq)*

Energy
Global warming

- LCA bound to cradle-to-gate
- ISO 14040/44 standard
- Produced by LCA practitioners,

x

Shadow cost *(€ / kg CO2eq)*

Energy
Global warming

- Estimation of the 2020 "cost for the planet"
- Science-based approach ("polluter pays" principle")
- Defined by external authoritative bodies
- Eg: CO2 shadow cost: €100 € (= internal price)

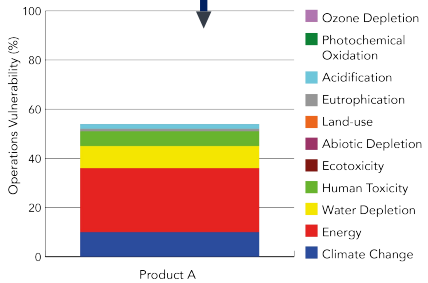
/

Average sales price *(€)*

- 5-year rolling average to smooth the impact of fluctuations

=

Operations vulnerability *(%)*



4.2.2. The Operational Vulnerability Assessment

Operations Vulnerability calculation steps:

The product segmentation

In the product segmentation, we assume that the criteria (inventory threshold, characterization model, mid-points etc.) for establishing an ecoprofile have already been defined.

In order to define a product segment and assess its environmental impact, the following 3-step approach is undertaken at Business Unit-level:

STEP 1

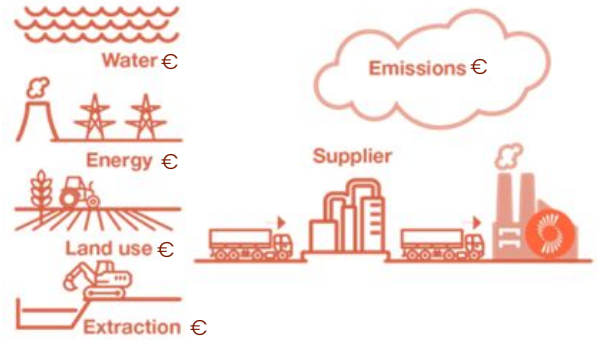
Impact Assessment: calculation of a product's ecoprofile
We calculate a product's ecoprofile using a Life-Cycle

Assessment (LCA) procedure performed by LCA practitioners in conformity with the ISO 14040 and ISO 14044 standards using publicly-available and Syensqo specific scientific data.

This allows us to create an inventory of all the environmental impacts of a product (resource consumption, emissions to soil, air and water) including human toxicity in a 'cradle-to-gate' approach, from raw material extraction to production until it leaves Syensqo's premises.

Cradle to Gate scope of ecoprofile

Syensqo Product Manufacturing
Cradle to Gate – Upstream Value Chain
Environmental impacts monetized among shadow costs (€)



STEP 2:
Impact Valuation: Monetization of negative impacts

Impact Valuation assigns a monetary value to very different impact measurement categories following the 'polluter pays' principle. Such monetization outlines the financial cost for Syensqo if the externalities had to be paid based on the shadow costs calculation. A shadow cost is an estimation of the 'cost for the planet', a theoretical monetization (in euro) of each environmental impact (scientifically called mid-point) of the ecoprofile in order to consolidate and compare them. Monetization can be seen as the cost for society at large. The shadow cost is calculated based on what it would take to prevent environmental or human toxicity damage (avoidance cost route) or to remediate the damage caused (repair cost route). A range of values is defined for both routes and each ecoprofile indicator for the year 2020, resulting in an average, a minimum and a maximum value to be used in sensitivity analysis. Detailed examples of how we define shadow costs are included in the QUANTIS report dated 2019.

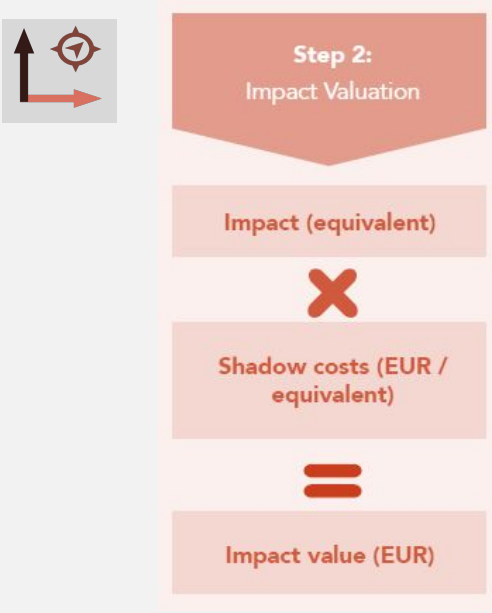
Shadow costs are not yet available in standardized databases for all environmental impacts so Syensqo and the consultancies supporting the development of the SPM tool had to find and reference authoritative research and sometimes make in-house analysis and decisions on monetary figures. For Syensqo, the shadow costs estimation should not be considered as an objective as such but as a tool to integrate the environmental costs in business decisions, to reflect on how to reduce them for existing products or minimize them at an early stage for new product development projects. This is why the option was taken to keep the shadow costs for 5 to 10 years for comparison purposes to measure the progress versus the initial assessment. In addition this does not prevent the use of minimum, maximum values or other database values to carry out a sensitivity analysis of the business model.

The time horizon used in the SPM methodology is 10 years – currently to 2030 – with a revision of the data planned every 2-3 years. First, shadow costs used by SPM were set up by TNO in 2009 and some revised in 2012. In 2018, Syensqo appointed QUANTIS to make a deep review based on extensive literature research and critical analysis then to make their best recommendations for Syensqo decisions. The new shadow costs were implemented for 2021 assessments (see Annex 1.3 p 53).

Calculation

Once impact equivalents have been determined, we multiply them by the shadow costs to arrive at the monetized value of external environmental impact per kg of product.

The Impact Valuation element of the Operations Vulnerability calculation:



Finally, we add the monetized impact values to the product's ecoprofile for each impact category, adding the value of all categories to give the total external environmental impact value for one kg of a product.

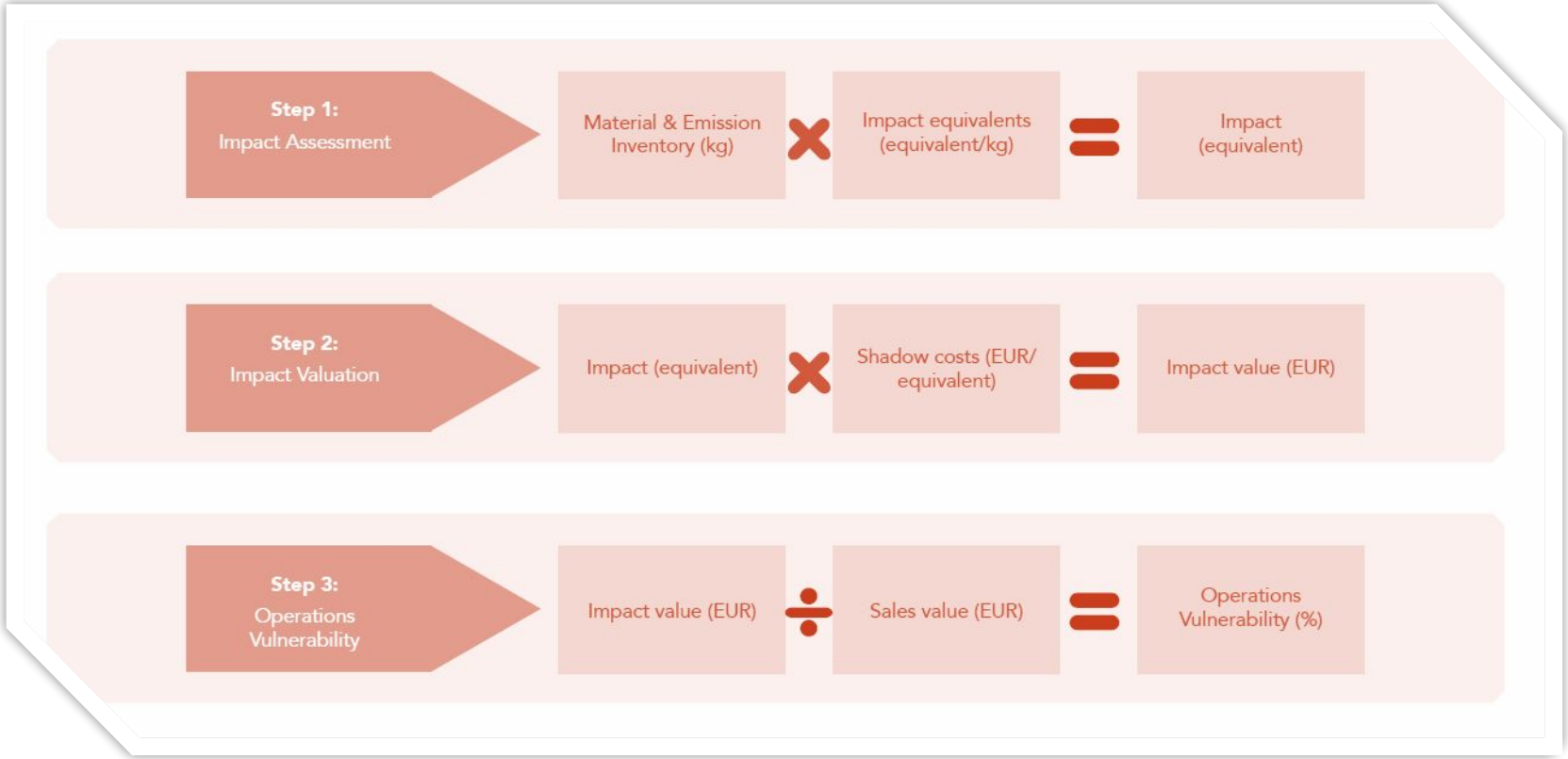
STEP 3:
Operations Vulnerability calculation: financial risk of negative impacts (externalities)

The risk of losing business or the opportunity to gain additional business depends on the balance between the economic value and the environmental damage created. The absolute financial value of the potential impacts of one kg of product is not sufficient to inform the decision-maker. This is why the implications of the financial impacts are calculated by dividing the value of the impacts by the sales value of the product. The result is the Operations Vulnerability ratio expressed as a percentage which can range from 2% to over 200% of the sales value of the product. While monetization of the environmental footprint brings sustainability considerations closer to decision makers, to ensure the externalities are taken into consideration in strategic and operational decisions, our products' environmental footprints are compared to the value added of our activities.

The best approximation of this comparison is to use the products' sales price against the monetized environmental footprint of the products. The calculation is a simple division of the Impact Value expressed in EUR and the annual average of the product sales value (to mitigate the impact of price fluctuations). This gives the Operations Vulnerability (OV) rate. This is expressed in a five scale levels of OV in the following order from the bottom to the top of the vertical axis : very high risk , high risk, median risk, low risk and very low risk The higher the rate, the higher the sustainability risk of the particular product. The lower the ratio, the higher the opportunity to displace a less environmentally-friendly competing product.

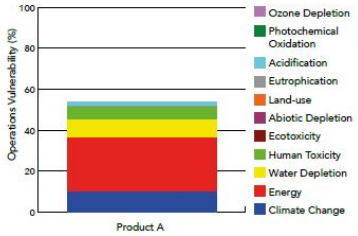
On the one hand, the rate compares the environmental footprint to the value added to society at large. The best approximation of the latter is the sales price offered on the market. On the other hand, the rate also expresses how risky environmental footprints can be if buyers on the market are looking for intermediary products with a low environmental footprint. Operations Vulnerability expresses whether a product presents a long-term risk or opportunity in sustainability-oriented markets.

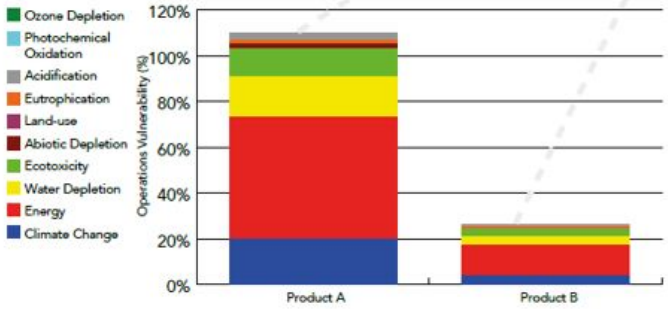
This concludes the 3-step Operations Vulnerability calculation process, which we summarize below.

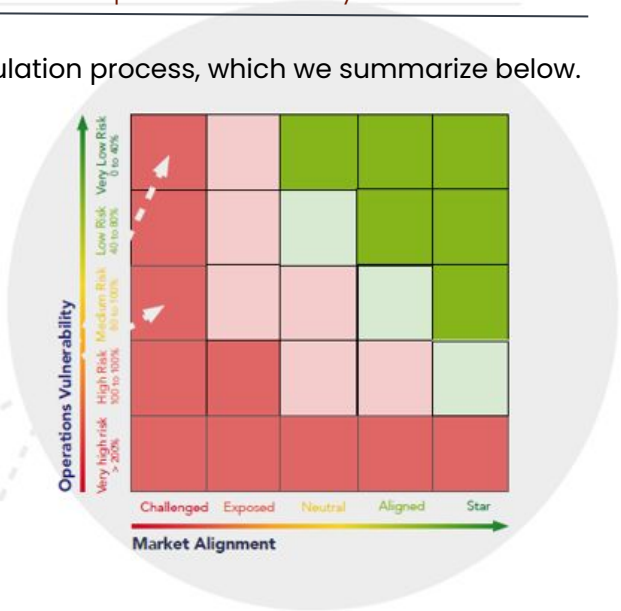


This concludes the 3-step Operations Vulnerability calculation process, which we summarize below.

The **Operations Vulnerability** of a product is represented on a chart, detailing the monetized contribution of each impact category. Note that the ratio can be higher than 100% **if the cost of impacts exceeds the sales value**. The same presentation can be built for a group of products (e.g.: BU's portfolio), aggregated according to their turnover.







Advantages of Operations Vulnerability approach:

- Quantitative
- Analyzes one product in one application over one fiscal year
- Scientific Life-Cycle Assessment based on ISO standards
- Cradle-to-gate to ensure feasibility of calculations and reasonable leverage
- Comprehensive: takes into consideration air, water, soil emissions, human
- toxicity and energy consumption
- Monetization based on authoritative academic sources
- Auditable
- LCA-expert review

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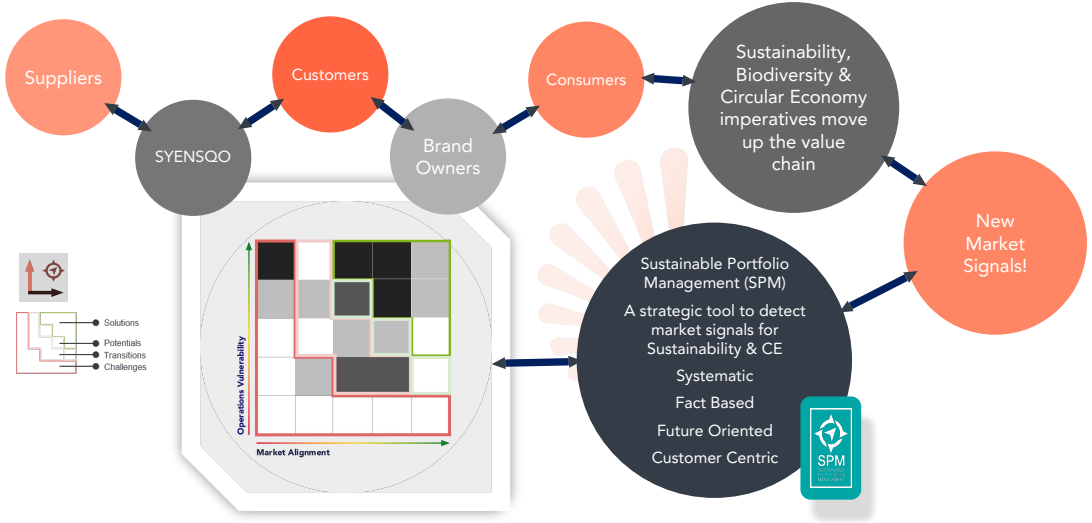
4.3 MARKET ALIGNMENT - THE HORIZONTAL AXIS

In order to understand the risks and opportunities arising from the value chain, the right signals have to be captured from different stakeholders.

Market sustainability trends

Detecting early market signals allows us to act in a timely fashion and make the necessary changes in the portfolio by anticipating the future of a product in its application in terms of environmental, health, economic and social sustainability.



Cradle to Cradle - Downstream Value Chain

Signals captured from: regulators, NGOs, IOs, clients, consumers on sustainability trends

Syensqo's products are not sold directly to the consumer but consumers' purchasing decisions impact our business. It helps us to understand the applications for our products and their potential to reduce consumers' environmental footprint.

[3] Our benchmark shows that quantitative, e.g. monetized, analysis of impacts occurring in the entire value chain would take too long and be too costly and not be practical for application in a fast-paced strategic corporate decision-making environment.

4.3.1 Product Application Combination (PAC)

In order to define the right application segment to focus on, the following steps are taken at Business Unit-level and per product segment:

1 Market-based application segmentation

a. For a product processed or used in the downstream value chain, close to the consumer, we look at internal commercial reporting (at financial consolidation level) with a market expert from the relevant Business Unit.

b. For products processed or used higher up the downstream value chain, further from the consumer, we use market reports from authoritative sources to identify market/application segmentation

2 Sustainability-driven application segmentation

The application level derived from both previous steps, a) or b), is unlikely to mirror sustainability drivers in the market and further segmentation is required, based on expert considerations.

3 Revenue segmentation to identify SPM applications

For a product segment, applications accounting for more than 80% of annual external revenue are selected, and possibly problematic products added to the selection (e.g. products blacklisted in the downstream value chain).

Application segmentation is done from a global point of view. Further application segmentation according to regional characteristics is only acceptable when there are positive market signals for Syensqo which may increase the relevance of the solutions in the market.

However regional segmentation should not be used for negative signals as global regulation or corporate rules generally supersede the regional approach. For the regional approach, we are guided by the World Business Council for Sustainable Development (WBCSD) approach

We analyze products in their end-user applications, based on Product-Application Combinations (PACs). One product may have several PACs.

1 Market Alignment Profiling

Identifying sustainability signals for each PAC by answering the questionnaire on environmental and social issues to collect information on obstacles, concerns, benefits, benchmark (Star) potential and amplifiers.

The questionnaire is structured around 4 themes:

- Health & Safety
- Climate
- Resources
- Opinion Leaders

... and 29 sub-themes.
Each sub-theme includes a description of the topic that is covered. A specific question has been developed for each level of performance in such a way that the answer should only be Yes or No.

2 Market Alignment Categorization

For the relevant sub-theme, the information gathered and the answer are applied to a decision tree which positions the product on a 1-5 scale of performance level as Challenged (1), Exposed (2), Neutral (3), Aligned (4), Star (5). This category is then added to the SPM Heat Map for the relevant sub-theme.

3 Sustainability Signals

We look for positive and negative sustainability signals on the Product Application Combinations (PACs) taking the entire value chain into consideration in a 'cradle-to-cradle' approach, from raw material extraction through product use, disposal or recycling at the end of life.

Market Alignment Categories:

1	2	3	4	5
CHALLENGED	EXPOSED	NEUTRAL	ALIGNED	STAR

Market Alignment Analysis Steps

Step 1: Market Alignment Profiling (via questionaire) ▶ **Step 2:** Market Alignment Categorization (via decision tree)

SPM SUSTAINABLE PORTFOLIO MANAGEMENT

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4.3.2 The key questions

The Market Alignment questionnaire formulates questions assessing the applicability of each trend to a specific product in its application. Questions are formulated simply

CLIMATE CHANGE	
Benefit	Does <Product> in <Application> help consumers or actors in the upstream or downstream value chains to directly, measurably and significantly reduce emission of substances with a GHG potential?
Concern	Is <Product> in <Application> reported by at least one authoritative body to contribute directly, measurably and significantly to climate change (absolute or relative)?
Obstacle	Is <Product> in <Application> reported by at least one authoritative body as a major direct, measurable and significant contributor to climate change in the marketplace and being actively displaced by solutions that have a significantly better profile?
Star	Is <Product> in <Application> reported by authoritative body amongst the best-in-class solutions in the market to directly, measurably and significantly reduce emissions of substances with a GHG potential AND actively displacing less efficient solutions?
Amplifier	From the standpoint of climate change, from cradle to grave, and in comparison with its next best comparably priced alternatives, the <Product> in <Application> is anticipated to lead to: • Worse profile? • No significant change? • Better profile?

Hereunder are examples of questions addressing the sub-themes Climate change and Raw materials.

RAW MATERIALS	
Benefit	Does <Product> in <Application> present direct, measurable and significant positive social impact in its raw materials sourcing, which is valorized by actors in the downstream value chain?
Concern	Does <Product> in <Application> present direct, measurable and significant negative social impact in its raw materials sourcing, which is leading to delisting by actors in the downstream value chain?
Amplifier	From the standpoint of raw materials sourcing and its social impact for workers, small holders or communities, among others, and in comparison with its next best comparably priced alternatives, the <Product> in <Application> is anticipated to lead to: • Higher negative impact? • No significant change? • Higher positive impact?

Examples of questions

An obstacle-type question on a product ban is strict:

> Is the Product in its Application banned or restricted for use by at least
>
> .* one supranational **OR** .* two OECD members or key partners **OR** . * the state of California and one OECD member or key partner?

A concern of the same category is less strict:

> Is the Product in its Application banned or restricted for use by at least
>
> .* one OECD member or key partner **OR** .* the state of California?

A benefit-type question on energy efficiency is formulated as follows:

> Does the Product in its Application help consumers or actors in the upstream or downstream value chains to directly, measurably and significantly reduce their energy consumption?

The corresponding amplifier will compare energy efficiency potential to that of a competing product:

> From the standpoint of energy efficiency, from cradle to grave, and in comparison with its next best comparably priced alternatives, the Product in its Application is anticipated to lead to:
>
> Lower energy efficiency **OR** No significant change **OR** Higher energy efficiency.

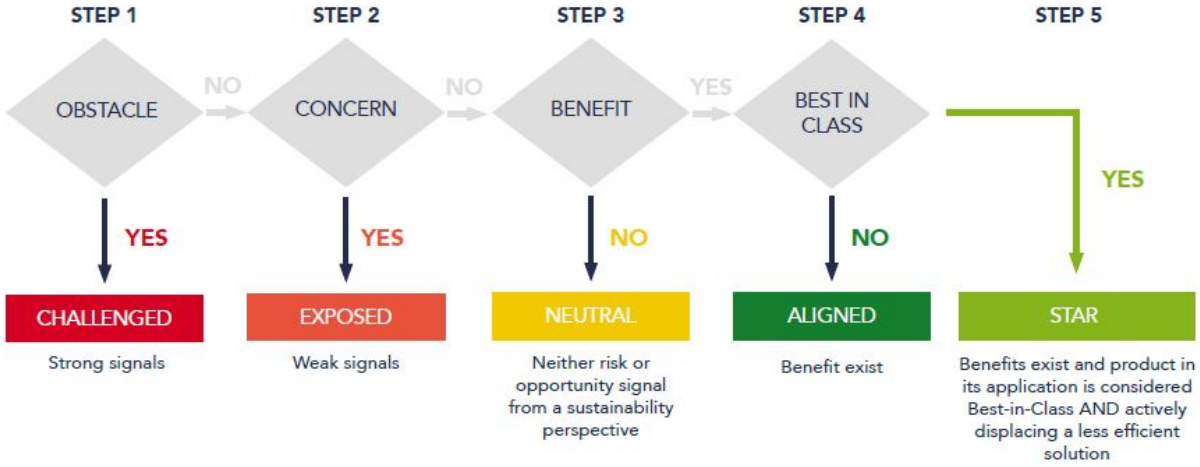
The Amplifier should be considered as a point of attention to be reviewed regularly according to the market trends but does not influence the SPM scoring.

Questions are formulated simply leading to a Yes or No answer regardless of the materiality in order to mark the signals. Answers have to be supported by fact based evidence.

Market Alignment Categorization

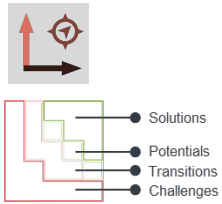
The decision tree guides the SPM expert in plotting the PAC on the horizontal axis of the SPM Heat Map, based on the answers collected to the questions in the market alignment questionnaire. One 'Yes' or 'No' answer is sufficient to move to the next stage in the decision tree. As explained in the Product Segmentation subchapter above, Syensqo does not compromise on negative signals. If an obstacle is identified then the product is classed as Challenged or if a concern is found it will be classed as Exposed.

Market Alignment Decision Tree



- **Challenged:** PAC with strong negative signals resulting from sustainability drivers in the marketplace. These are products those revenue could experience a significant negative impact and eventually disappear.
- **Exposed:** PAC with weak negative sustainability signals. These are products which might negatively impact or have difficulty growing due to sustainability drivers.
- **Neutral:** PAC with neither positive nor negative signals resulting from sustainability drivers in the marketplace. These are products that consumers need but which do not contribute to environmental footprint reductions.
- **Aligned:** PAC with positive sustainability signals where the revenue is expected to grow moderately from sustainability drivers, but where the growth is curbed by competing solutions from the existing market leader. These are products that customers want to buy because they contribute to decreasing their own environmental footprint or/and bring positive social contribution.
- **Star:** PAC with positive sustainability signals, with revenue expected to grow substantially from sustainability best in class solutions as they are displacing less efficient solutions in the market. The PAC comes from a fast-growing sustainability driven market e.g. wind energy and where the Syensqo product outperforms the leading alternative.

Once the product's Market Alignment category is defined, 'Amplifier' questions on benefits and drawbacks help position the PAC. This set of questions is a good instrument to cross-check answers to other questions and drive Ecodesign. The SPM team assesses the signals for each PAC with the related businesses. Any answer must be agreed between the Business Unit and the SPM expert to ensure both 'business knowledge' and 'methodological integrity' are taken into consideration. In case of disagreement between the business representative and the SPM Expert, the answer of the business is recorded, with a comment explaining the different point of view of the SPM Expert. The SPM Expert after analysis may still decide to activate the override option as a clear exception as described in the guide 2.4 page 10.

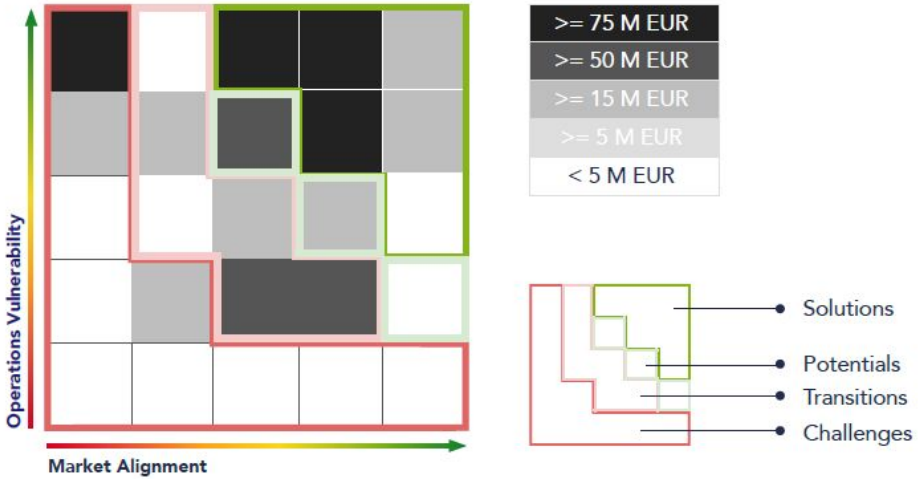


4.4 MAPPING OUT RESULTS – SPM HEAT MAP

The process helps sensitize business experts to the importance of sustainability in marketing and the results allow senior executives to make strategic decisions on a portfolio level, while practitioners identify improvement areas related to single products.

The SPM Heat Map (for more details)

The single most important output of the assessment is the SPM Heat Map, which shows business positions related to environmental footprint and sustainability-related market opportunities or challenges through the lens of Syensqo's turnover.



Results of the **Operations Vulnerability** and **Market Alignment** assessments are plotted on a heat map which shows the risks and opportunities of the PACs for Syensqo.

Business Units receive a drilled-down report which allows them to analyze the PAC's position on the heat map and suggest actions to maintain or improve performance and reach Group-level targets.

The heat map is the highest-level portfolio steering instrument of the SPM assessment. It categorizes products and PACs in four higher level categories.

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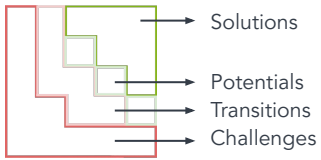
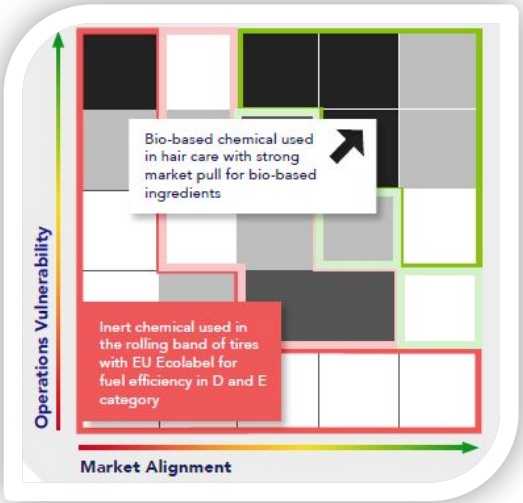
The heat map is the highest-level portfolio steering instrument of the SPM assessment. It categorizes products and PACs in four higher level categories.

SPM Heat Map 3.0





- The **Potentials** category mirrors the potential to join the Solutions category by acting on the manufacturing environmental footprint. These are products that consumers need, but which environmental footprint can be improved
- The **Transitions** category identifies low negative sustainability concerns, here both on the manufacturing axis and on the market axis.
- The **Solutions** category identifies PACs with a better sustainability contribution to Syensqo's customers and value chain, combined with a favorable balance between value and environmental impact.
- The **Challenges** category are either strong negative signals resulting from sustainability drivers, or serious operations vulnerability challenges, leading to potential significant negative impact on revenue over time or products that may disappear.

Changes in the business perimeter during the year are taken into account in the scope of the year (Y) SPM.

4.4.1 ILLUSTRATIVE SPM ASSESSMENTS

<MAX HT®> in <Scale Inhibitor (AI)>

MAX HT® sodalite scale inhibitor is an innovative alumina processing aid designed to prevent the formation of sodalite that can commonly accumulate during the Bayer Process. By delivering outstanding performance and eliminating scale at the source, MAX HT® reduces energy and freshwater consumption, improving the sustainability profile of alumina processing.

Market Alignment Theme(s):
Resource **Sub-Theme**: Energy Efficiency & Fresh Water Availability

1) Does MAX HT® in Scale Inhibitor (AI) help consumers or actors in the upstream or downstream value chains to directly, measurably and significantly reduce their energy consumption?

Benefit (Y), Obstacle, Concern, Amplifier
The scale inhibitor eliminates or avoids the sodalite deposit in heat exchangers. Such deposits reduce the Heat Transfer in the heat exchanger. So, there is a direct, significant link between the use of the scale inhibitor and the energy saving.

2) Does MAX HT® in Scale Inhibitor (AI) help consumers or actors in the upstream or downstream value chains to directly, measurably and significantly. * reduce freshwater consumption OR. * increase fresh water production or improve its supply chain efficiency (from production until consumption)?

Benefit (Y), Obstacle, Concern, Amplifier
In process at the heat (evaporation), generating fresh condensate to re-use in process decreasing the input of fresh water. 15 tons recovered to use back into the process (20% recovery). High temperature water minimizes the use of water treatment chemicals.

Operations Vulnerability: Ecoprofile MAX HT® 550

Impact Category	%
Non Renewable Resources	29.6
Human Health	27.2
Climate Change	21.3
Ecosystem Quality	16.7
Water Management	5.2
Social Impact	0.0

Syensqo SPM Assessment Profile:
SPM Highlight: (+)Energy: scale inhibitor (+)Water: fresh condensate reuse
Operations Vulnerability: Very Low Risk
Market Alignment: Aligned
SPM Heatmap: Solutions

4.4.2 EXTERNAL RECOGNITION

MAX HT® sodalite scale inhibitor is an innovative alumina processing aid designed to prevent the formation of sodalite that can commonly accumulate during the Bayer Process. By delivering outstanding performance and eliminating scale at the source, MAX HT® reduces energy and freshwater consumption, improving the sustainability profile of alumina processing.

- It is estimated that for every ton of alumina produced, using MAX HT® can save 0.1-0.5 tons of steam, reduce CO2 emissions by 13-92 kg, and reduce pickling waste liquid by 0.9-2.7 kg

- MAX HT® sodalite scale inhibitor is recognized as a Solar Impulse Foundation Efficient Solution, acknowledging Syensqo's dedication to protecting the environment while contributing to profitable processes.

- MAX HT® prevents the formation of impurities and contaminants in heaters resulting in optimized energy consumption and reduced emission. Our technology prevents the formation of solid particles, resulting in higher heat transfer rates reducing the need for energy to maintain high temperatures and enabling the generation of fresh condensate which is recycled in process, decreasing the injection of fresh water.

MAX HT® - Solar Impulse Efficient Solution

Maximizing Recovery - International Mining

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ADVANCING HUMANITY

RESPONSIBLE EDITOR : BRUNO VAN PARYS

Appendix

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Note to highlight the update we have made on LCA methods and shadow costs to adopt the best practices of the LCA discipline:

Over the years, the LCA standards and database have evolved regularly in order to give a better evaluation of the environmental impact.
Therefore we have integrated these evolutions in our methodology in order to keep up with the developments underway in the LCA discipline as SPM needs up-to-date and robust information to make the right decisions.

Methods were adjusted by our LCA experts and reviewed by third-party QUANTIS for external validation.

For most of the eco profiles, the quality is estimated by an LCA expert mixing completeness of primary data input, complexity to access robust secondary data, ease to build the proxies, age of the data versus relevance of the technology,... The quality is defined on a 5-level scale: Very Good, Good, Fair, Poor, Very Poor. In the framework of SPM analysis, the quality level of the ecoprofile is not a critical parameter but needs to be defined according to the criticality of the SPM position on the vertical axis.

Nevertheless, in order to ensure a consistency across SPM assessments, the minimum quality level recommended for the ecoprofile is “Fair”.
Syensqo considers an ecoprofile valid as long as the production technology, including the effluent treatment, utility management and emissions control remain unchanged. If no change, an ecoprofile should then be revised about every 5 years.

As of today, LCA experts use LCA software Simapro to calculate the ecoprofile for SPM assessment purposes. Simapro relies on existing databases: Ecoinvent V 3.8, ELCD, Agrifootprint, Industry data 2.0.

The ecoprofile of a product is reported in a table and the data is stored in specific software used by the expert team and also in Syensqo’s SPM Database. For a sample of an ecoprofile reporting table, see Annex 1.2 p 51

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Environmental impact : Syensqo ecoprofile table

Impact category	Unit	Methods
IPCC GWP100a - 2013	kg CO2 eq	IPCC 2013
Trapped Biogenic CO2	kg CO2 eq	Computation
Human Toxicity, Cancer	DALY	USEtox 2
Human Toxicity, non-Cancer	DALY	USEtox 2
Respiratory Inorganics	DALY	UNEP recommendation methodology
Freshwater ecotoxicity	CTue	USEtox 2
Mineral Resource Depletion	kg Sb eq	CML 2022 (ultimate reserve)
Land Use Occupation	m2a	Land use
Terrestrial Acidification	kg SO2 eq	CML IA baseline
Freshwater Eutrophication	kg P eq	Eutrend / ILCD 2011
Marine Eutrophication	kg N eq	Eutrend / ILCD 2011
Ozone Depletion	kg CFC-11 eq	ODP Steady State
Photochemical Ozone Formation	kg NMVOC eq	Lotos-Euros model
Water Consumption	m3	Inventory
Renewable, Biomass	MJ	Inventory
Renewable, Solar, Water, Wind	MJ	Inventory
Coal Energy	MJ	Inventory
Crude Oil Energy	MJ	Inventory
Natural Gas Energy	MJ	Inventory
Nuclear Energy (Uranium)	MJ	Inventory
Primary Forest Energy	MJ	Inventory
Non-renewable Energy	MJ primary	Inventory
Particulate Matter	kg PM2.5	Inventory

ANNEX 1

1.1 THE 21 INDICATORS (MID-POINTS)

	Impact Category / Mid-Point	Description	Characterization method and Equivalent measurement tool
1	Greenhouse gas emissions	Reports the potential contribution to climate change, through the greenhouse effect of gases. It is the sum of the individual contributions of each greenhouse gas emitted, the 'Global Warming Potential (GWP)' (characterization factor) multiplied by the emitted quantity. The GWP is the ability of the gas to absorb or reflect UV radiation, integrated over a given time horizon (100 years according to the Kyoto Protocol: GWP100) in the atmosphere, compared to (divided by) GWP100 of CO2.	IPCC GWP100a - 2013
2	Biogenic CO2 uptake	A complete assessment of CO2 exchange with the atmosphere takes into account CO2 uptake from the atmosphere from plants growing during the photosynthesis process, in the case of bio-sourced products. As a consequence, on a cradle-to-gate basis, bio-sourced products establish a trap for CO2 until their destruction into CO2 again (total oxidation). The CO2 uptake is computed from a theoretical biogenic CO2 content in the product under consideration.	Theoretical computation Unit: kg of CO2 equivalent (kg CO2 eq.).
3	Human Toxicity, Cancer	Eco and Human Toxicity Assessment: Toxicity assessment models, such as the USEtox™ model, provide consensus-based, chemical specific characterization factors that quantify the environmental fate of chemical emissions and their impact on human health and on ecosystems, by assessing exposure and effect. We move from CTUn unit to Daly in 2021.	USEtox2
4	Human Toxicity, non Cancer		USEtox2
5	Respiratory inorganics (particle matter)		UNEP-SETAC recommended methodology
6	Freshwater Ecotoxicity		USEtox2

7	Mineral Resource Depletion	Abiotic resources are natural resources such as ores, minerals or other resources which are regarded as non-living. Abiotic depletion reflects the speed of decrease in the total reserve of resources. For each substance, the rate of extraction (in kg/yr) is considered, as well as the quantity of the ultimate resource. The reference substance is Antimony (Sb), one of the substances that will disappear first and for which ultimate resource data is robust. Note that for fossil substances, the ultimate resources are considered, based on their energy content (Higher Heating Value HHV).	ILCD 2011 - based on CML 2002 - Ultimate Reserve
8	Land Use Occupation	Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements. It has also been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it". Land use may have a large impact on the services of ecological systems and the natural capital stocks that produce them and which are critical to the functioning of the Earth's support system. Examples of ecosystem services are: nutrient cycling, soil formation, recreation, water regulation and supply, climate regulation, habitat, flood and storm protection, food and raw materials production, genetic resources, atmospheric gas balance and pollination. The method used simply inventories the land occupation for the production of 1 kg of the product: surface area multiplied by the time of occupation.	Land Use
9	Terrestrial Acidification	Some acidic substances (Sulfur Dioxide (SO2), Nitrogen Oxide - NOx, Ammonia) emitted to the air fall back to the soil or water in the rain (the well-known acid rain phenomenon), disturbing the development of certain living species. The acidification potential indicator not only considers the intrinsic acidity of the substance but also its lifecycle in the atmosphere after its emission, based on the RAINS-LCA model (transportation over regions and probability for deposition in a given region depending on its geographical point of emission). An average is then calculated to get a global characterization factor.	CML IA baseline

10	Freshwater Eutrophication	Eutrophication is defined as the enrichment of water and soil in nutrients (Nitrogen and Phosphorous), as a result of human intervention. Oxygen depletion is a possible consequence of this enrichment. The method used takes account of the emission of nitrogenous and phosphorous substances in three compartments: air, water and soil. It is based on the ability of a substance to contribute to the profusion of algae (biomass potential).	Eutrend / ILCD 2011
11	Marine eutrophication		Eutrend / ILCD 2011
12	Ozone Depletion	Ozone molecules in the stratosphere absorb large quantities of UV radiation coming from the sun, thus removing the life-threatening UV-C radiation and reducing the harmful UV-B radiation. The destruction of the stratospheric ozone layer (particularly over the Poles) is mainly due to a catalytic destruction of ozone by atomic Chlorine and Bromine. The main source of these halogen atoms in the stratosphere is photo dissociation of chlorofluorocarbon (CFC) and bromofluorocarbon compounds. These compounds are transported into the stratosphere after being emitted at the surface of the earth, mainly due to human activity. Characterization factors are established according to the effective destruction of the ozone layer attributable to the annual emission of a given substance, as compared to the effective destruction attributable to the annual emission of CFC-11.	ILCD 2011 - based on ODP Steady State
13	Photochemical Ozone Formation	Under certain climatic conditions, air emissions from industry and transport can react in a complex manner under the influence of solar radiation and lead to photochemical ozone formation responsible, in particular, for possible respiratory problems. As a measure for estimating airborne substances' potential for forming atmospheric oxidants, POCP (Photochemical Ozone Creation Potential) values are used. The POCP value of a particular hydrocarbon is a relative measure of how much the ozone concentration measured at a single location varies if emission of the hydrocarbon in question is altered by the same amount as that of a reference hydrocarbon, usually ethylene. The POCP value is not a constant, but can vary over distance and time, since formation of oxidants along the path of an air pocket is determined by the composition of the prior mixture and the meteorological conditions, which can also vary spatially and chronologically.	ILCD 2011 - based on Lotos-Euros model

14	Water Consumption	The impact category on water scarcity is accounted for by measuring the amount of freshwater consumption from ground and surface water sources presently available in life-cycle inventory databases. With regard to SPM global approach we do not take into account the assessment at regional or local level. However in case of specific project, using methodologies that include water stress (e.g. Aware) can be considered.	Inventory
15	Renewable, Biomass	Syensqo analyzes energy consumption by its origin or primary source. All energy sources are accounted for to be able to identify the cost of the externality. Primary energy sources are divided into renewable and non-renewable resources. For determining the energy content of resources, the method considers the fundamental material input and the net calorific.	Inventory
16	Renewable, Solar, Water, Wind		Inventory
17	Coal Energy		Inventory
18	Crude Oil Energy		Inventory
19	Natural Gas Energy		Inventory
20	Nuclear Energy [Uranium]		Inventory
21	Primary Forest Energy		Inventory

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1.2 EXAMPLE OF AN IMPACT ASSESSMENT TABLE

Impact Category	Element	per kg of product	Unit	External costs (in €/kg)
IPCC GWP100a - 2013	IPCC GWP100a - 2013	1.3535692	kg CO2 eq	0.135357
Trapped Biogenic CO2	Computation	0	kg CO2 eq	0
Human Toxicity, Cancer	USEtox2	0.000000739415	DALY	0.051759
Human Toxicity, non Cancer	USEtox2	0.000001399925	DALY	0.097995
Respiratory Inorganics	UNEP recommendation methodology	0.000001677015	DALY	0.117391
Freshwater Ecotoxicity	USEtox2	64.573609	CTUe	0.003158
Mineral Resource Depletion	CML 2022 (ultimate reserve)	0.000002954993	kg Sb eq	0.000005
Land Use Occupation	Land Use	0.053900155	m2a	0.011858
Terrestrial Acidification	CML IA baseline	0.0066189059	kg SO2 eq	0.035742
Freshwater Eutrophication	Eutrend / ILCD 2011	0.00028164648	kg P eq	0.000524
Marine Eutrophication	Eutrend / ILCD 2011	0.0013646383	kg N eq	0.006073
Ozone Depletion	ODP Steady State	0.00000020521	kg CFC-11 eq	0.000015
Photochemical Ozone Formation	Lotos-Euros model	0.0056062091	kg NMVOC eq	0.011773
Water Consumption	Inventory	0.019303969	m3	0.019304
Renewable, Biomass	Inventory	0.37083804	MJ	0.001113
Renewable, Solar, Water, Wind	Inventory	0.37892107	MJ	0
Coal Energy	Inventory	5.7424041	MJ	0.02297
Crude Oil Energy	Inventory	35.914542	MJ	0.646462
Natural Gas Energy	Inventory	11.037956	MJ	0.088304
Nuclear Energy [Uranium]	Inventory	1.0013342	MJ	0.00015
Primary Forest Energy	Inventory	0.0007133867	MJ	0.000039

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CO2	Syensqo followed a scientific logic to define a reasonable long-term estimation. This figure went through sensitivity analysis before being deployed. Such a measurement can drive the development of new products which can contribute to reducing CO2 emissions.Overall, while the carbon price is shown to increase in future, the exact amount and the range remains very uncertain. The price calculations for carbon based on IPCC targets have been made for a 2°C pathway. With regard to the IPCC recommendations of a 1.5°C target, there are not yet reliable numbers for carbon pricing. However, carbon prices to achieve this objective are likely to be a lot higher than for the 2°C target. The IPCC special report mentions a factor of 3 to 4. The International Energy Agency (IEA) develops in its World Energy Outlook (IEA 2017) a "Sustainable Development Scenario", which sets a pathway to achieve key energy-related components of the United Nations Sustainable Development Agenda, including urgent action to tackle climate change (SDG 13), in line with the Paris Agreement. In the Sustainable Development Scenario, the use of carbon pricing instruments becomes much more widespread, especially within the advanced economies (IEA 2017). As a consequence, the price for CO2 is higher as with the other policy scenarios. For 2025, the price of carbon would be 63$, in 2040 140$, which corresponds to 125 Euro. We decided to take 100 EUR per ton of CO2 equivalent as the shadow cost in our calculations also consistent with the cost of the Carbon Capture Storage.	100 EUR/ metric ton of CO2

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1.3 SHADOW COST VALUATION IN SELECTED IMPACT CRITERIA

Impact Category	Element	per kg of product	Unit	External costs (in €/kg)
IPCC GWP100a - 2013	IPCC GWP100a - 2013	1.3535692	kg CO2 eq	0.135357
Trapped Biogenic CO2	Computation	0	kg CO2 eq	0
Human Toxicity, Cancer	USEtox2	0.000000739415	DALY	0.051759
Human Toxicity, non Cancer	USEtox2	0.000001399925	DALY	0.097995
Respiratory Inorganics	UNEP recommendation methodology	0.000001677015	DALY	0.117391
Freshwater Ecotoxicity	USEtox2	64.573609	CTUe	0.003158
Mineral Resource Depletion	CML 2022 (ultimate reserve)	0.000002954993	kg Sb eq	0.000005
Land Use Occupation	Land Use	0.053900155	m2a	0.011858
Terrestrial Acidification	CML IA baseline	0.0066189059	kg SO2 eq	0.035742
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Ozone Depletion	ODP Steady State	0.00000020521	kg CFC-11 eq	0.000015
Photochemical Ozone Formation	Lotos-Euros model	0.0056062091	kg NMVOC eq	0.011773
Water Consumption	Inventory	0.019303969	m3	0.019304
Renewable, Biomass	Inventory	0.37083804	MJ	0.001113
Renewable, Solar, Water, Wind	Inventory	0.37892107	MJ	0
Coal Energy	Inventory	5.7424041	MJ	0.02297
Crude Oil Energy	Inventory	35.914542	MJ	0.646462
Natural Gas Energy	Inventory	11.037956	MJ	0.088304
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Primary Forest Energy	Inventory	0.0007133867	MJ	0.000039

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ANNEX 2

JOURNEY

Why did Solvay & Syensqo develop a proprietary tool to manage its portfolio in a more sustainable way?

The CEO and top management of Solvay wanted to understand how sustainability trends impact the profit and loss account of the company. The question was raised by Christian Jourquin, CEO of Solvay in 2006 and the SPM tool was launched in 2008 to become a strategic management tool in 2015. At the time when Solvay started developing the SPM tool, there were no ready-made sustainable portfolio assessment methodologies available which combined scientific robustness with the specifics of the corporate financial decision-making processes. CEO Ilham Kadri of Syensqo pushes it further together with innovation as sustainability is not negotiable to ensure the future growth of the company . SPM embeds sustainability into all decision-making processes and trigger the portfolio shift towards opportunities that grow sustainable solutions to deliver on the Group business ambition.

METHODOLOGY

Is the environmental manufacturing footprint more acceptable when the product value is high?

SPM works with acceptable environmental footprints to make the methodology viable in present-day context. The 'Solutions' category of products, however, will not tolerate Operations Vulnerability below median risk and Market Alignment below Neutral. Syensqo's strategy moves in the direction of favoring Solutions over Potentials and Transitions PACs, or those with Challenges.

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Why not do a full LCA analysis (cradle to cradle) on Product Application Contribution (PAC) ?

For the SPM tool to be robust enough for decision-making on strategic and operational levels, we drew on scientific knowledge as much as possible, especially on Life-Cycle Assessment (LCA). With such a goal in mind, we needed to ensure a good balance between the reliability and time-efficiency of the analysis.
On the vertical axis (Operations Vulnerability) of the SPM Heat Map, a cradle-to-gate scope of the value chain is covered, because this is where we have control over raw materials and production processes. On this axis a quantitative LCA based calculation resulting in a ecoprofile is carried out.
However, on the horizontal Market Alignment axis, a full cradle-to-cradle LCA would:
- Be excessively time-consuming as detailed information on application and end-use phases is often not available
- Not cover important elements such as healthcare
- Be less focused on elements that are material for Syensqo e.g. toxicity and ecotoxicity

In addition the time needed to complete such cradle-to-cradle LCA will come out of the timeframe of business decision-making process and therefore become not relevant anymore.
Such decisions cannot be put on hold for several months for a full LCA to be carried out. This challenge prompted us to use an LCA-minded approach to assess relevant sustainability trends from a consumer and market perspective on the horizontal axis.

DECISION MAKING

Why is Syensqo not conducting a comprehensive, quantitative and monetized Life-Cycle Assessment of products from cradle-to-cradle?

Full-scale, cradle-to-cradle Life-Cycle Assessment (LCA) is a thorough, yet time-consuming scientific examination of a product in its different applications along the value chain. Therefore we limit the assessment to the manufacturing phase cradle-to-gate. It helps to confirm and ascertain the environmental benefits of a single product compared to competing products in the market. These benefits could come from better technical performance, lower energy consumption or lower pollutant emissions during the use phase. The SPM tool relies on qualitative thinking in the Market Alignment phase to complete the LCA-snapshot and make sure that other material topics (e.g. healthy living) are addressed in the analysis, which LCA does not cover.

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Why is the Market Alignment analysis not quantified and monetized?

Monetizing market signals and impacts without reliable scientific data gives significant uncertainty about the reliability of the calculations. Basing long term strategy on such numbers would be even more difficult and risks getting stuck in discussions on the validity of the analysis. Also, the monetization of the entire value chain on a long-term horizon would be very time-consuming, Syensqo opted for a qualitative analysis of market signals. This analysis is robust, rigorous and auditable.
On the horizontal Market Alignment axis, a full cradle-to-grave LCA would:
- Be excessively time-consuming as detailed information on application and end-use phases is often not available
- Not cover important elements such as healthcare
- Be less focused on elements that are material for Syensqo e.g. toxicity and ecotoxicity

In addition the time needed to complete such cradle-to-grave LCA will come out of the timeframe of business decision-making process and therefore become not relevant anymore.
Such decisions cannot be put on hold for several months for a full LCA to be carried out. This challenge prompted us to use an LCA-minded approach to assess relevant sustainability trends from a consumer and market perspective on the horizontal axis.

Are authoritative sources changing at the same pace as the revision of tool, or are there compromises to be made on that front?

Syensqo is continuously scanning authoritative sources, particularly during the annual reviews of the SPM snapshots. If strong signals are received on a changing trend which would significantly affect the validity of the tool, a review process cycle is activated to update the tool, which also implies changing all snapshots. However, the sustainability megatrends we have taken into consideration have not changed so far and we do not expect them to change significantly before 2020. Signals on volatility in e.g. commodity prices, legislative behavior etc. are continuously collected and funneled into the Market Alignment analysis.

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How does SPM contribute to the UN Sustainable Development Goals (SDGs)mapping and integration in our non financial targets?

The chemical industry manufactures intermediate products used in a wide variety of applications around the world. In essence, it is the industry of industries. As such, the chemical industry is at the heart of whether global sustainable development challenges are impacted negatively or positively.

These global issues are well known and captured in the UN Sustainable Development Goals (SDGs) launched in 2015, and can be summed up as:
- Climate Change
- Increasing global population
- Scarcity of raw materials
- Scarcity of water
- Geopolitical environment changes
- Human development gaps
- Biodiversity stress

SPM contributes particularly to the following SDGs:
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Ensure healthy lives and promote well-being for all at all ages
6. Ensure availability and sustainable management of water and sanitation
9. Ensure access to affordable, reliable, sustainable and modern energy for all
11. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.

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For Syensqo, as a leading and responsible science company, we need to understand the business meaning and impact of sustainability trends underlying such global issues. In the long-term, these trends are key elements of risk mapping and the drivers of business growth.

Syensqo continuously analyzes stakeholder expectations related to these global issues. Our sustainability strategy and toolbox, ONE Planet are built around these expectations. In general, we see the following:

- Customers increasingly ask for products and services with sustainability benefits, which can decrease their impact on the Planet and on other citizens.
- Institutional investors, hedge funds and responsible, Environmental-Social-Governance (ESG)-minded investors are increasingly considering and requiring proof of the link between addressing sustainability challenges and business performance, especially in relation to climate change.
- Corporate responsibility for and management of sustainability are moving beyond companies' own operations and into the entire value chain.
- Legal instruments targeting corporate sustainability are on the increase. Transparency requirements are present in countries on all continents and are especially on the rise in Europe.
- Circular economy business models and moving towards cradle-to-cradle thinking and reducing waste is gaining ground in all sectors (governments, civil society and corporate).
- Corporate improvement goals related to sustainability are becoming factors of market competitiveness, as more and more companies are using them.
- NGOs, rating agencies, governments are scrutinizing companies on their commitments and performance.

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KYOTO AGREEMENT SCOPE 3: Scope 3 emissions: An organization's indirect emissions other than those covered in Scope 2. They are from sources that are not owned or controlled by an organization, but which occur as a result of its activities. From the Carbon Disclosure Project Supply Chain Report 2010 - CDP.

MID-POINT: The direct measure of an externality expressed with an indicator, as opposed to the damage caused by an externality, which is called an end-point.

OPERATIONS: All the production processes and related activities executed to manufacture a product. (In SPM, we define Operations as covering the cradle-to-gate phase).

OPERATIONS VULNERABILITY: All the production processes and related activities executed to manufacture a product. (In SPM, we define Operations as covering the cradle-to-gate phase).

PAC (PRODUCT APPLICATION COMBINATION): The combination of a product and one of its market applications as seen by the final consumer (e.g. Sodium Carbonate in double glazing). The PAC is the key element of the Market Alignment assessment.

PRODUCT: A product is in essence a product family (e.g. soda ash, Na2 CO3). If different products have several production processes which can lead to significant differences in environmental impacts or in energy consumption, several products will be registered and analyzed with the SPM tool, and named with the following formula 'product + production process'. E.g. 'Na2 CO3 synthetic dense' and 'Na2 CO3 natural Trona-process').

R&I: Research and innovation, both a Group- and business-level function.

RARE EARTHS: Rare earth elements are a series of chemical elements found in the Earth's crust that are vital to many modern technologies, including consumer electronics, computers and networks, communications, clean energy, advanced transportation, healthcare, environmental mitigation, national defense and more. Because of their unique magnetic, luminescent and electrochemical properties, these elements help make many technologies perform with reduced weight, reduced emissions, and energy consumption, or give them greater efficiency, performance, miniaturization, speed, durability and thermal stability. http://www.rareearthtechalliance.com/What-are-Rare-Earths

SHADOW COSTS: The shadow costs are the conversion factor (in EUR per unit of impact) for monetizing the overall cost for the community of individual impacts on the surrounding ecosystems e.g. for ozone depletion in EUR/kg CFC11 equivalent.

SPM SNAPSHOT: As an assessment tool, SPM defines the practical risks and opportunities of the 'sustainable development' dimension of product and innovation portfolios, with an accurate profile of the portfolio at a particular point in time.

SUSTAINABILITY: Products and processes that meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

SUSTAINABILITY TRENDS/MEGATRENDS:
Megatrends are long term processes of transformation with a broad scope and a dramatic impact. They are considered to be powerful factors which shape future markets. There are three characteristics in which megatrends differ from other trends:

1. Time horizon: megatrends can be observed over decades. Quantitative, empirically unambiguous indicators are available for the present. They can be projected, with high probabilities, at least 15 years into the future.

2. Reach: megatrends impact comprehensively on all regions, and result in multidimensional transformations of all societal subsystems, whether in politics, society, or economy. Their precise features vary according to the region in question.

3. Intensity of impact: megatrends impact powerfully and extensively on all actors, whether it is governments, individuals and their consumption patterns, or corporations and their strategies."

(Source: "20 most important megatrends", Zpunkt, 2007)

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