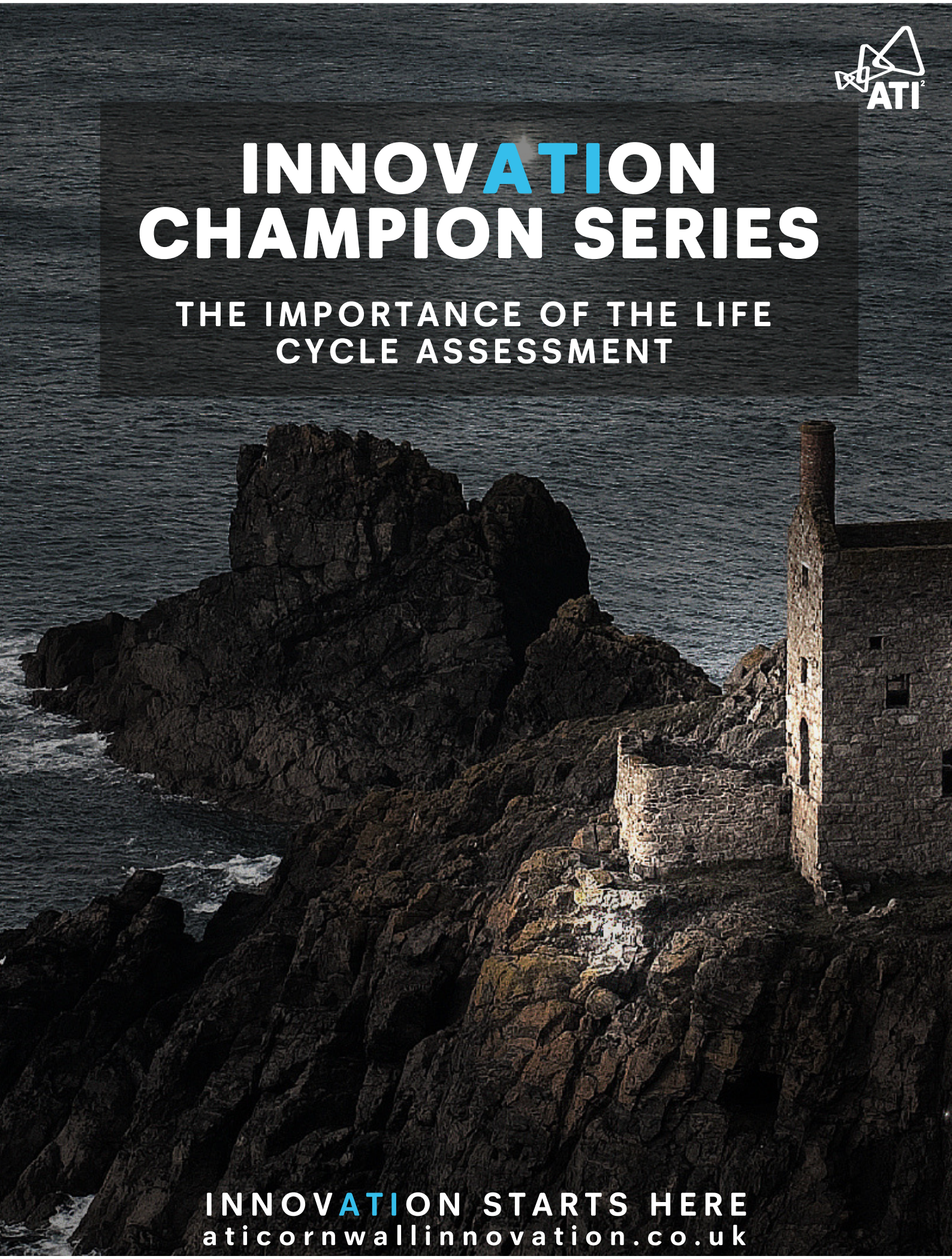

INNOVATION CHAMPION SERIES

THE IMPORTANCE OF THE LIFE CYCLE ASSESSMENT

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ACCELERATION THROUGH INNOVATION

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INNOVATION CHAMPION SERIES
The Importance of the Life Cycle Assessment

About the Innovation Champion Series

Innovation is an integral part of developing a resilient and diverse business. In today's changing business landscape, understanding key trends within sustainability practices, funding, collaboration and innovation development are pivotal in ensuring a business is able to fortify itself in changing market conditions. This report forms part of the Innovation Champion series. Developed by the Acceleration Through Innovation's Innovation Champion in collaboration with university academics, it services as a reference guide for businesses on relevant trends that have proven popular over the last two years, which can enhance the innovation journey. Innovation Champion reports on the following areas are available through ATI2's digital platform: The Innovation Studio:

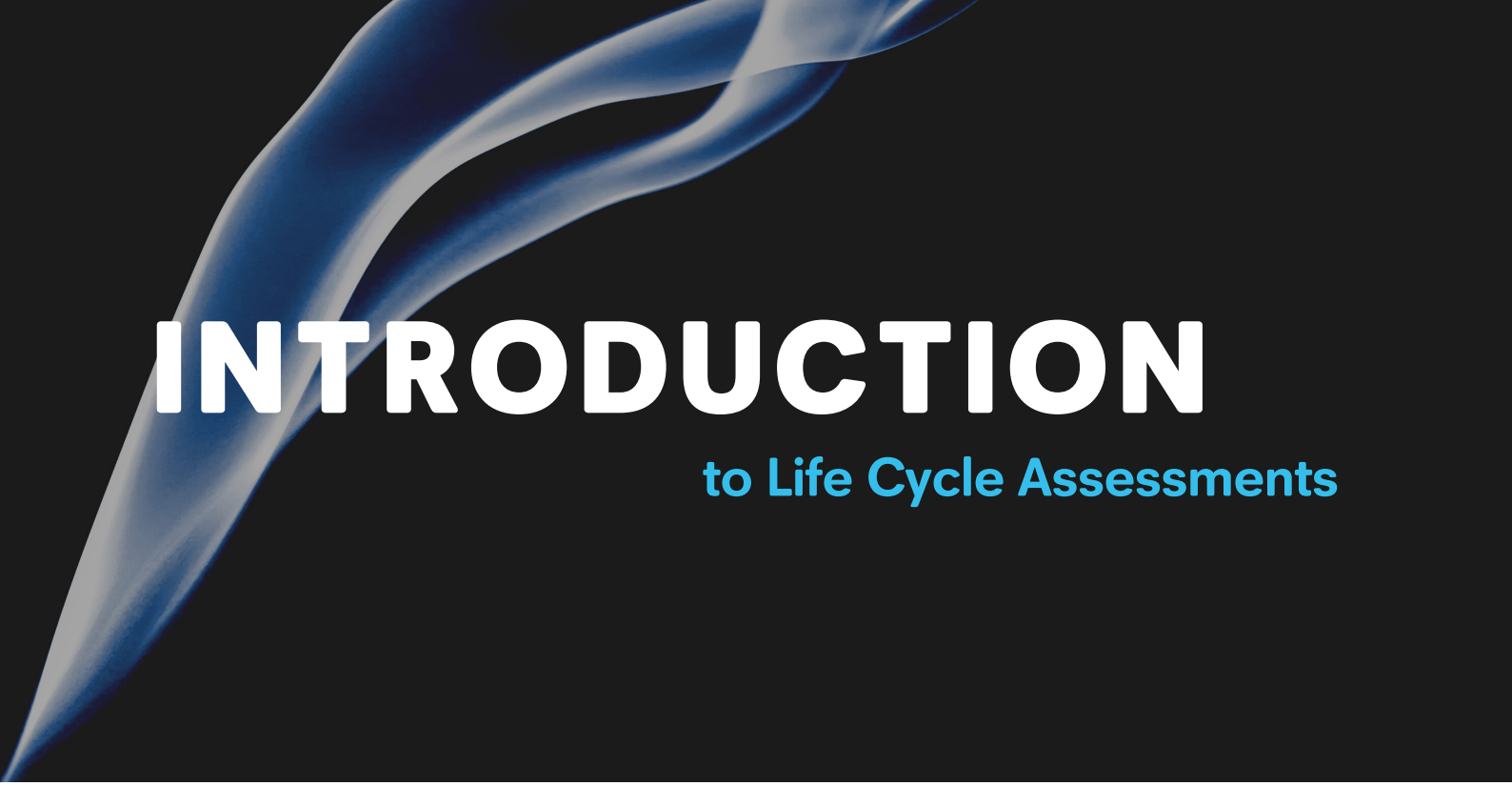
- Beginning your Innovation Journey with Stakeholder Mapping
- Understanding your Market with a Competitor Analysis
- The importance of Life Cycle Assessment
- Research and the Importance of Horizon Scanning
- Efficient Supply Chain Management for Businesses
- Universities as a Collaborative Partner
- Students as a Valuable Resource
- Sustainable Packaging
- Legislation and British Standards

If you would like any more information about The Innovation Champion Series, please email ati.research@plymouth.ac.uk

ABOUT THE ACCELERATION THROUGH INNOVATION PROGRAMME

Acceleration Through Innovation 2 (ATI2) is a three year £3.4 million European Regional Development Fund (ERDF) project which supports business innovation across Cornwall and Isles of Scilly. Led by the University of Plymouth, the project drives a culture of innovation, supporting businesses who are looking to adopt innovative processes or who have aspirations to bring a new product or service to the market.

Businesses working with ATI2 benefit from fully funded support in a number of areas, including access to: valuable university resources, world-class research and innovation expertise, market research, specialist consultancy, guidance on IP and prototyping, and innovation grants.



INTRODUCTION

to Life Cycle Assessments

There is an increasing focus for the business landscape on environmental, social and economic sustainability credentials of companies and products. Increasingly understanding your products life cycle is a fundamental aspect for business, not just assessing the environmental factors, but examining the cost of sourcing, manufacture and disposal in order to enable savings and diversification that can enhance and strengthen the organisation.

Concerns over the limitations of raw materials and energy resources in the 1960s sparked interest in finding a way to account for energy usage and project future supply issues. In 1969, researchers undertook an internal study for The Coca-Cola Company that compared different drinks packaging to determine which had the lowest environment impact and was least affected by the supply of natural resources, examining the raw materials and fuels used and the environmental impact from the manufacturing processes for each container. This style of report used the fundamental actions of the current methods of life cycle assessment that are still used today by many sectors, thus introducing the life cycle assessment to the business landscape.

WHAT IS A LIFE CYCLE ASSESSMENT?

The Life Cycle Assessment is a comprehensive environmental accounting tool that helps businesses to assess environmental impacts associated within all stages of a product's life in a 'cradle to grave' approach, from raw material extraction through material processing, manufacture, distribution, use, repair and maintenance and disposal or recycling. The assessment verifies the ecological benefits of a product are as the company has stated or in some cases it can evidence that it is more environmentally sustainable to re-use the materials already produced, rather than produce newer eco products. It is a standard tool with well-established procedures and methods that are governed by specific rules and standards. British standards have defined the process is BS EN ISO 14040: Environmental management. Life cycle assessment. Principles and framework.

It is recommended that any LCA be performed according to BS EN14040 standards.

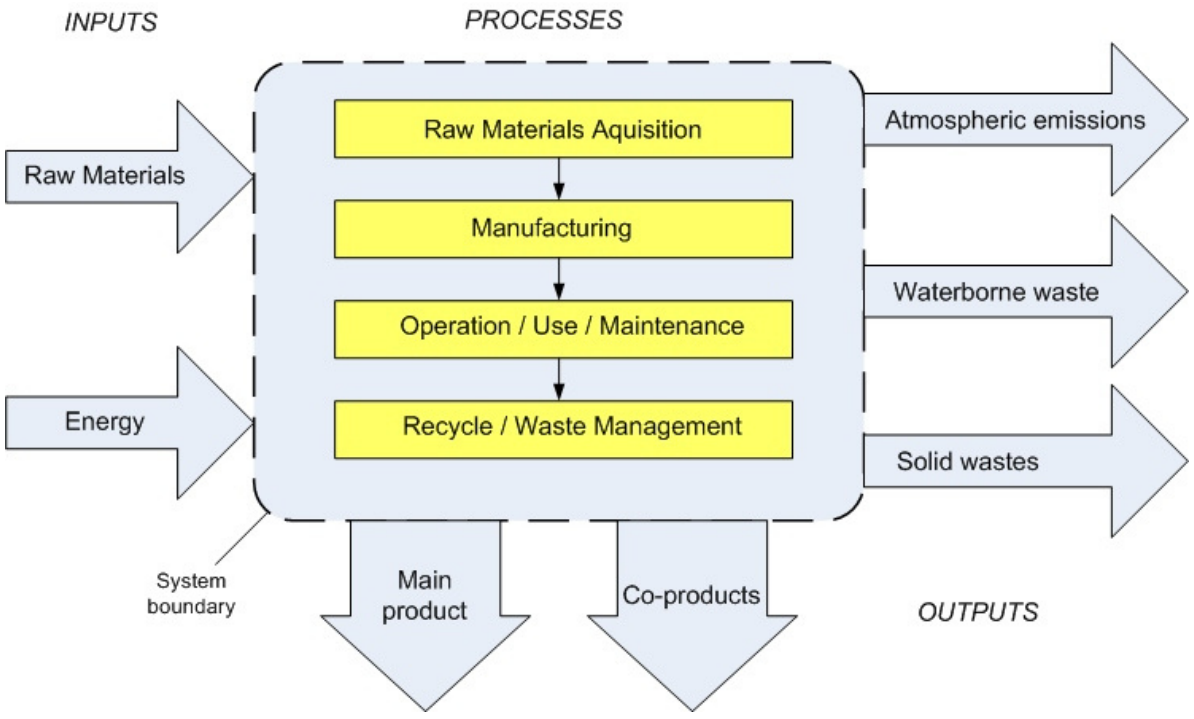
According to SETAC, the "Life Cycle Assessment is a process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and materials used and releases to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product, process or activity, encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use,

WHAT IS A LIFE CYCLE ASSESSMENT?

maintenance; recycling, and final disposal."[1]

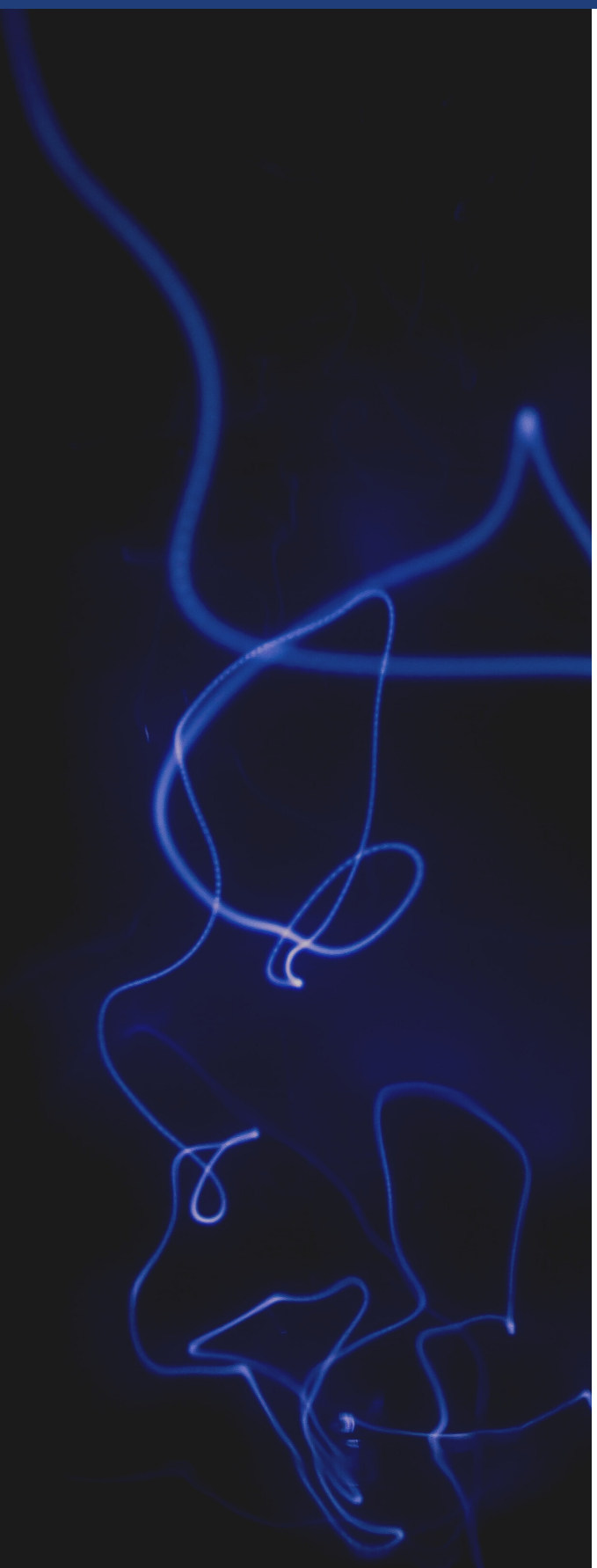
Simply stated - for each stage of the life cycle, all processes are identified (e.g. extraction of raw materials, transportation of raw material to factory), and for each process, all the inputs (e.g. fossil fuel, electricity) and outputs (e.g. CO2, packaging waste) are identified. Each of the inputs and outputs are then compiled and categorised into potential impacts on the environment. Once the impacts are calculated, the sum of theair, water and soil impacts are interpreted and considered together against the original goals of the LCA.

This holistic approach has enabled businesses to go further with the sustainability of their products and processes. The circular economy and closed loop production methods are being adopted by more and more companies, looking at every product within the LCA, assessing each of the outputs and seeing if there are uses for all by products.



[1] Guidelines for Life-Cycle Assessment: A 'Code of Practice', SETAC, Brussels

BENEFITS
of Life Cycle Assessments



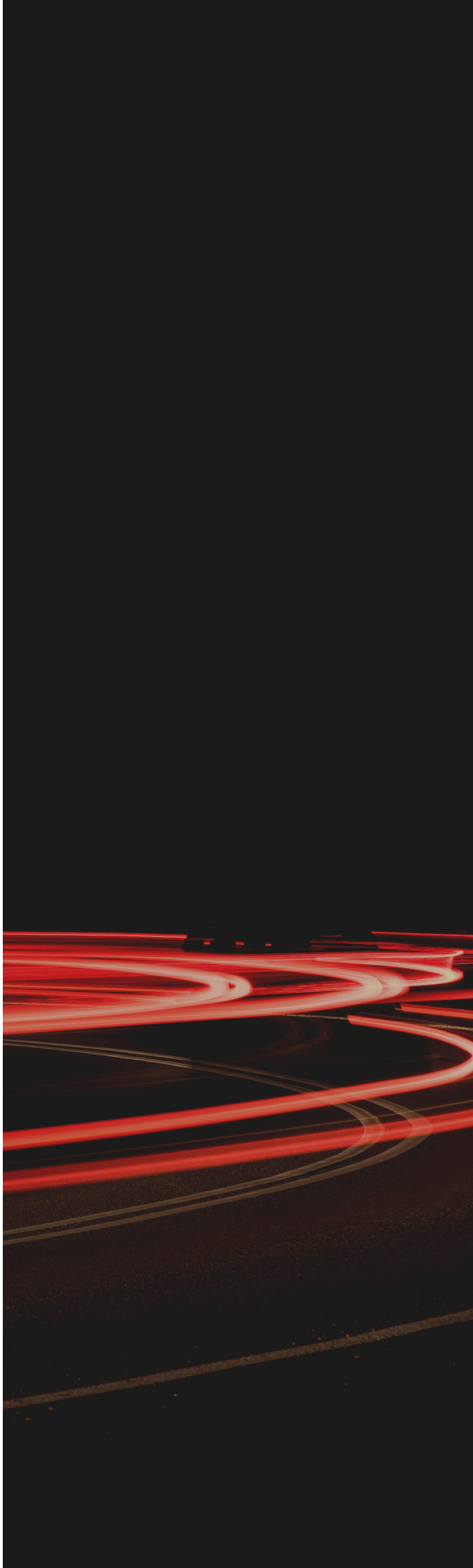
An LCA is an important tool and has benefits that reach past just examining the environmental impact of your product.

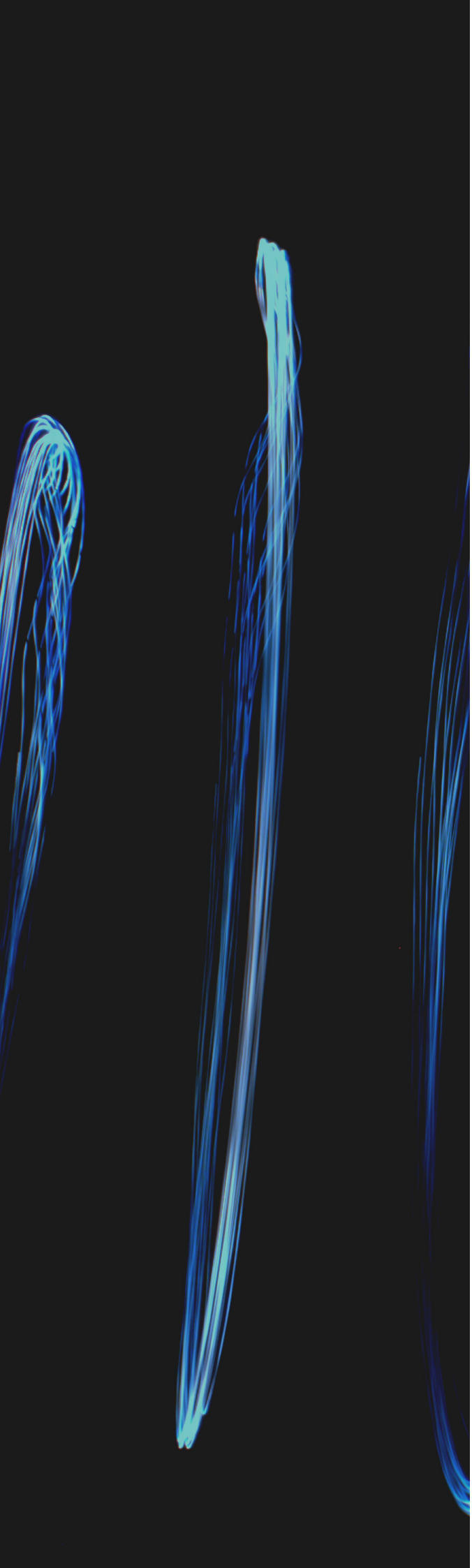
Performance Indicators

- An LCA enables a business to examine in detail the processes used to produce their product. This can enable the company to reduce costs with any wasteful steps in the process that can be removed. It can also mean, like British Sugar, the diversification of waste products which could increase income.
- An LCA enables the business to target investment more effectively, as the process has been examined and all costs are accounted for, the tool can be used to effectively forecast costs for future investments.
- Improving the product is the ultimate aim of the life cycle assessment. If there are any flaws within the system and product the assessment will highlight these.
- Identifying the whole environmental impact picture should be part of all businesses. Many companies have an environmental policy on their website.

Customer Satisfaction

- Today's customers are becoming increasingly aware of the environmental impact of the products they use and buy. They are also very interested in the provenance of their products and are happy to pay for a more premium brand if they understand the process the product has gone through and the steps a company is making in regards to reducing their environmental impact.
- LCAs provide the basis for developing Environmental Product Declarations (EPDs) which will be needed for legislation and will be a useful tool in terms of provenance and environmental policy.
- A key strength of the LCA is the ability to communicate the multiple benefits of different initiatives a company has underway. Either communicating one or teo elements or all of the environmental benefits. This could be in terms of an impact within the carbon footprint, water or energy consumption which could be marketed to the customer base.



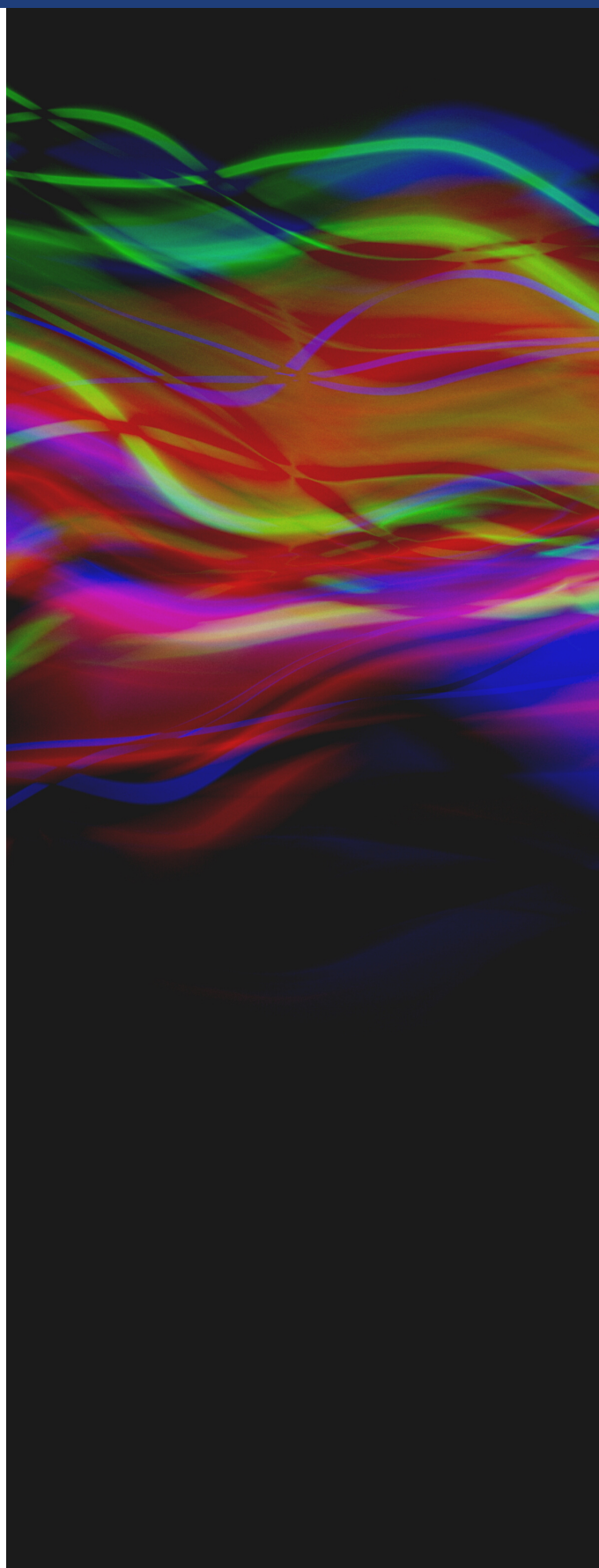


Legislation Requirements

- Understanding each part of the process enables a business to adapt elements and include any legislation brought in. Although current legislation does not require businesses to record their environmental impact, due to the governmental promises, this may change soon.
- The UK government pledged earlier this year to net zero greenhouse gases by 2050. Currently this target is falling behind leading to the idea of an introduction of legislation to help enable the process.
- There is also a commitment by the UK Government to introduce a deposit return system for cans and bottles which may affect your product.
- Extended producer responsibility for packaging will come into force by 2023.
- In December 2018 the government released ‘Our Waste, Our Resources: A Strategy for England’ which detailed the problems of waste and its disposal and how it is paid for in the UK. This may mean changes and reducing waste will be a benefit if new legislation is introduced.

LIMITATIONS

to Life Cycle Assessments



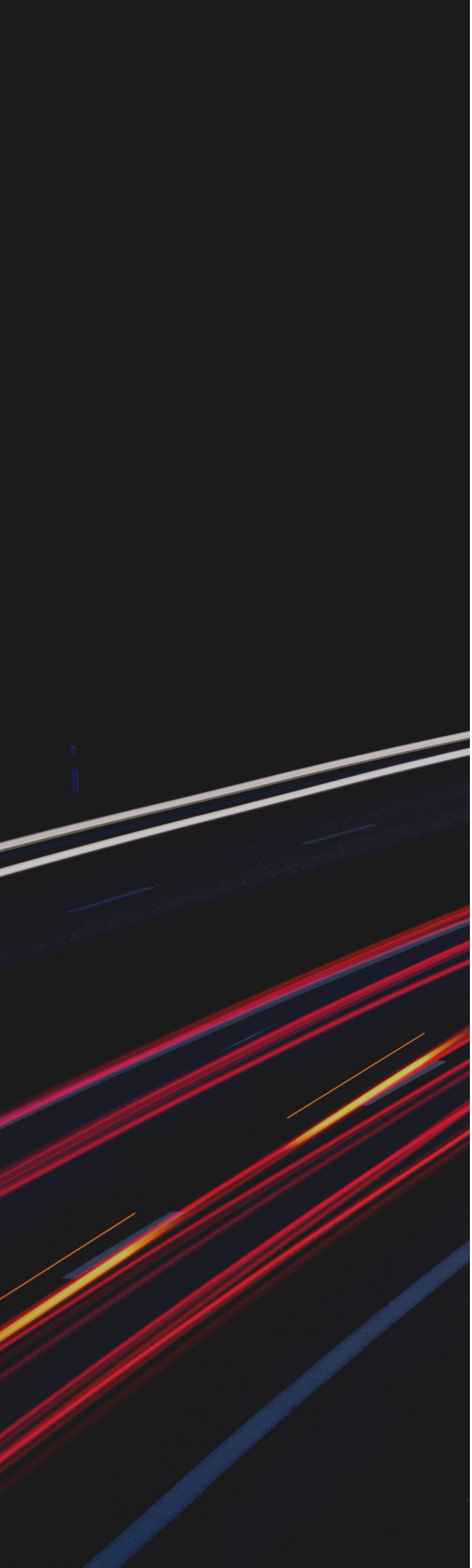
Understanding the LCA's limitations during the planning phase will help to ensure that goals of the assessment can be achieved. At this stage it is important to look at the process to determine whether the one you have planned requires amending. Understanding of both the benefits and limitations will enable you to assess other LCAs in terms of advantages or disadvantages to each, which will ensure better planning.

A Snapshot in time

- The LCA is planned for a limited time period, so it only captures the process at any one time. Any intermittent changes over time are not taken into account, this may include changing in raw supply costs. However, LCA practitioners are actively studying ways to address this issue.

Quantitative Data

- The LCA is a quantitative tool it generates a very large amount of data, particularly to calculate all the inputs and outputs for every step. All of this data needs to be interpreted, which can enable a difference of opinion. There are numerous assumptions which have to be made during the assessment. For example, practitioners have to make assumptions about the



allocation of electricity used in plant which produces multiple products from the same equipment.
- Unlike other tools there is no pass ofrfail result.

Precision Difficulties

- LCA is an environmental accounting tool with an inherent level of uncertainty, it does not have same level of precision as financial accounting. Much of the data is generally taken from databases, as it is impractical to collect all the necessary data from original sources (e.g. you may not be able to get specific power plant data from where the electricity may be sourced). Databases are improving, but practitioners need to understand all the assumptions, the age of the data, etc.
- Turning the inputs and outputs into impacts on the environment is not currently an exact science and there are several credible methodologies that are used for impact assessment.

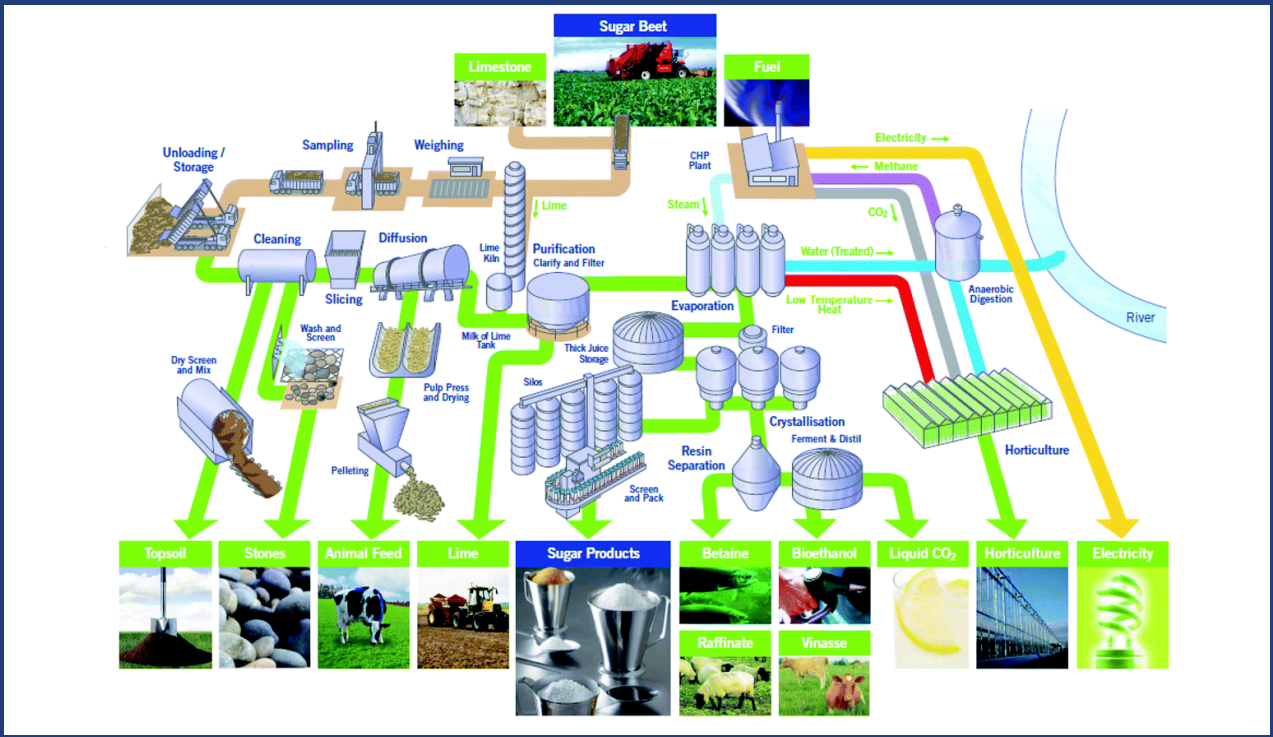
Not addressing other aspects

- Some approaches do not address the economic or social aspects of a product, however the life cycle approach and methodologies described in the ISO standards could be applied to these aspects and need to be added in to the planning phase of the assessment.

BRITISH SUGAR

British Sugar at Wissington is a good example of an LCA assessment. British Sugar is the sole processor of the UK's beet sugar crop, working in partnership with over 3,000 growers to produce their product. They process around eight million tonnes of sugar beet and produce up to 1.4 million tonnes of sugar each year. Their innovative approach to manufacturing has enabled them to create a range of co-products from power generation and bioethanol, to animal feed and more. The company acknowledges that there are three pillars of sustainability: economic, social and environmental. Researching these areas and placing resources and investment in these pillars have enabled them to make a positive change, giving structure, direction and unity to all their sustainability efforts.

Precise understanding of the energy and resource flows have enabled continual improvement and collaboration system thinking. Initially producing their prime product of sugar from sugar beet, the factory now has diversified their production methods and have 12 products for usage across different sectors. Each part of the process was examined as part of their LCA to determine the best usage of all waste they produce. As seen in the diagram it now works as a network of resource flows rather than a linear approach to production previously established. The team have developed a resilient and diverse business that has sustainable outputs all year round.



CASE STUDY

to Life Cycle Assessments

THE FUNDAMENTAL STEPS OF A LIFE CYCLE ASSESSMENT

According to the ISO standards, there are four steps in an LCA:

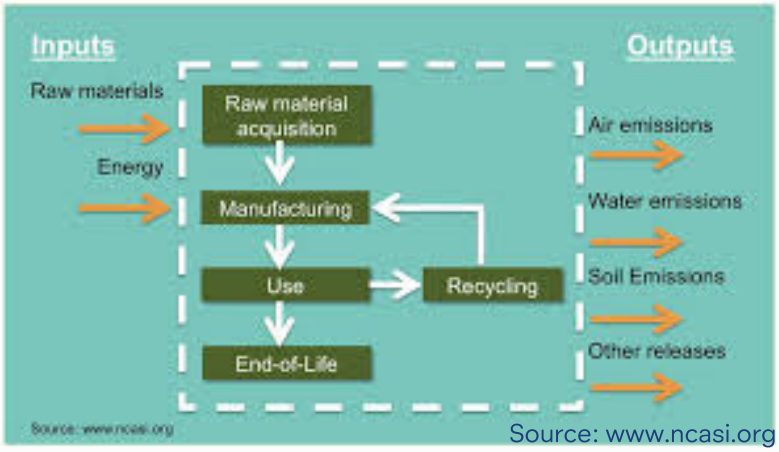
1. **Goal and Scope Definition**
2. **Inventory Analysis**
3. **Impact Assessment**
4. **Interpretation of the results**

Goal and Scoping Definition

This first stage and the most important question to consider is why is the organisation considering carrying out an LCA? Although this is not required within the standard, it will help to define the level of assessment requirement. Effective LCAs require statements of the goals you want to achieve through the assessment, what the product does for the user, the scope of the study, the data required (including any database information and its assessment and any data collection processes the company needs to introduce), how this information will be collated and categorised in a computer model (either a dedicated software package or excel spreadsheet) and how it is to be communicated publicly.

- Goal example - "As part of the organization's environmental performance improvement efforts, the R&D team have developed new processes that should reduce the products' environmental impact.The LCA will measure and confirm the perceived improvements and establish other opportunities that could be exploited to optimize the environmental performance of the product."

- Scope – This should describe the life cycle stages and processes that are included or excluded in the scope of the LCA. Listing the steps of the life cycle, as well as how relevant the upstream and downstream phases are. Certain stages and/or processes may be excluded because of a deliberate decision to narrow the focus but the reasons for withdrawal should be stated.



Source: www.ncasi.org

THE FUNDAMENTAL STEPS OF A LIFE CYCLE ASSESSMENT

Life Cycle Inventory Analysis

The inventory analysis stage compiles and quantifies all the inputs and outputs for the chosen processes/stages. Inputs can include all the raw materials and energy. Outputs include any waste or releases - emissions to air (e.g. carbon dioxide), water (e.g. phosphates) and soil (e.g. heavy metals).

Impact Analysis

This stage takes the information from the environmental flows (from the input and output data) identified and measured and categorises them into impact categories using developed methodologies, it is not enough just to note there are certain pollutants being released. These impact categories can include: abiotic depletion, acidification, climate change, human toxicity, ecological toxicity, fossil fuel depletion, photooxidant smog formation and stratospheric ozone depletion. They will be defined as either endpoints or midpoints. An endpoint category seeks to represent the resulting damage to the environment or human health. A midpoint category (e.g. smog formation) aims to cover an environmental problem that stands somewhere between the inventrory 9i.e. an emission) and an endpoint result. The categories may be then weighted in terms of importance.

Interpretation of the results

The reporting stage of the assessment, results are then interpreted in order to fulfil the study objectives. Overall assessment may include reviewing which life cycle stages contribute the most towards each impact category. For example, if one of the goals was to improve the environmental performance of a product, and if a waste reduction method was chosen, the LCA results could be studied to identify the main sources of waste (e.g. waste generated during a certain step of the manufacturing process, or the production of a certain raw material, etc.) and help the organisation design effective solutions to reduce these waste sources.

To find out more please visit:
The International Reference Centre for the Life Cycle of Products, Processes and Services
Established in 2001, the International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG) is a centre of expertise in life cycle issues recognised for its solid scientific research work and its ten years of applied experience. The CIRAIG supports the industry, governments, organisations and consumers in their path towards a true sustainable development supported by life cycle thinking.

The Acceleration Through Innovation programme can support you further on undertaking the Life Cycle Assessment for your products as part of our service on process and product innovation.
Please contact your Innovation Business Advisor for further information.

If you have any questions or comments regarding the contents of this paper, please contact ati.research@plymouth.ac.uk

The views expressed within this paper are those of the Innovation Champion and are not necessarily representative of the University of Plymouth.

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