34th Annual INCOSE international symposium

hybrid event

Dublin, Ireland
July 2 - 6, 2024

Designing Sustainable Products

Submission 175

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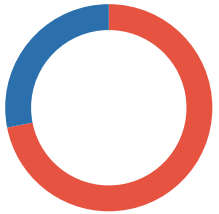
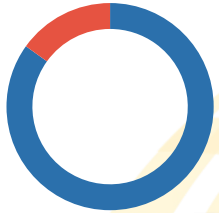
Why are we concerned with sustainability?



Government Entities sustainability mandates – current and upcoming

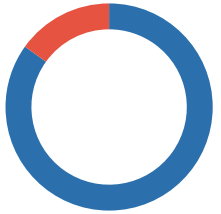


Industry or corporate goals

Be a good global citizen

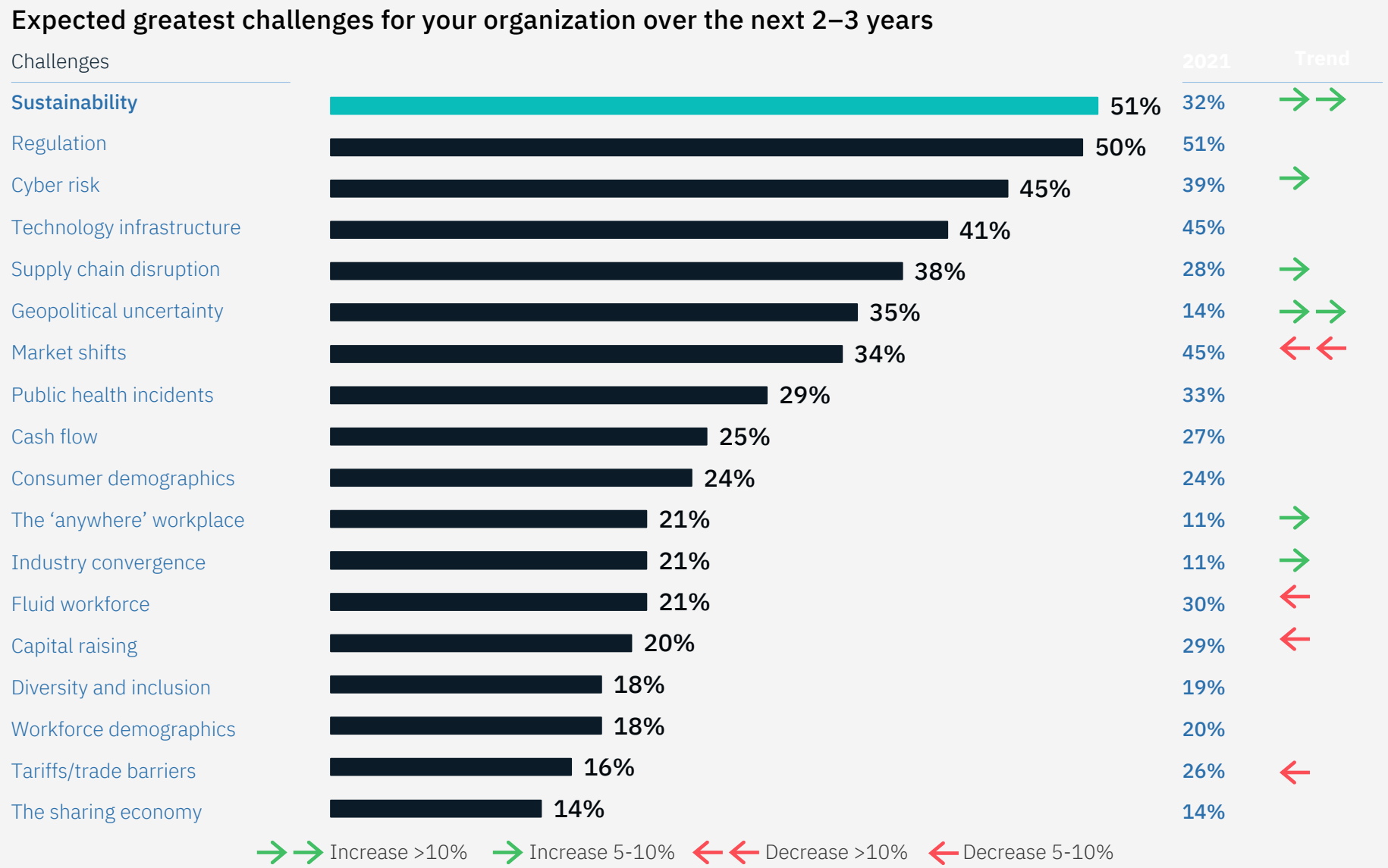
EU Taxonomy Regulation

Singapore 2025



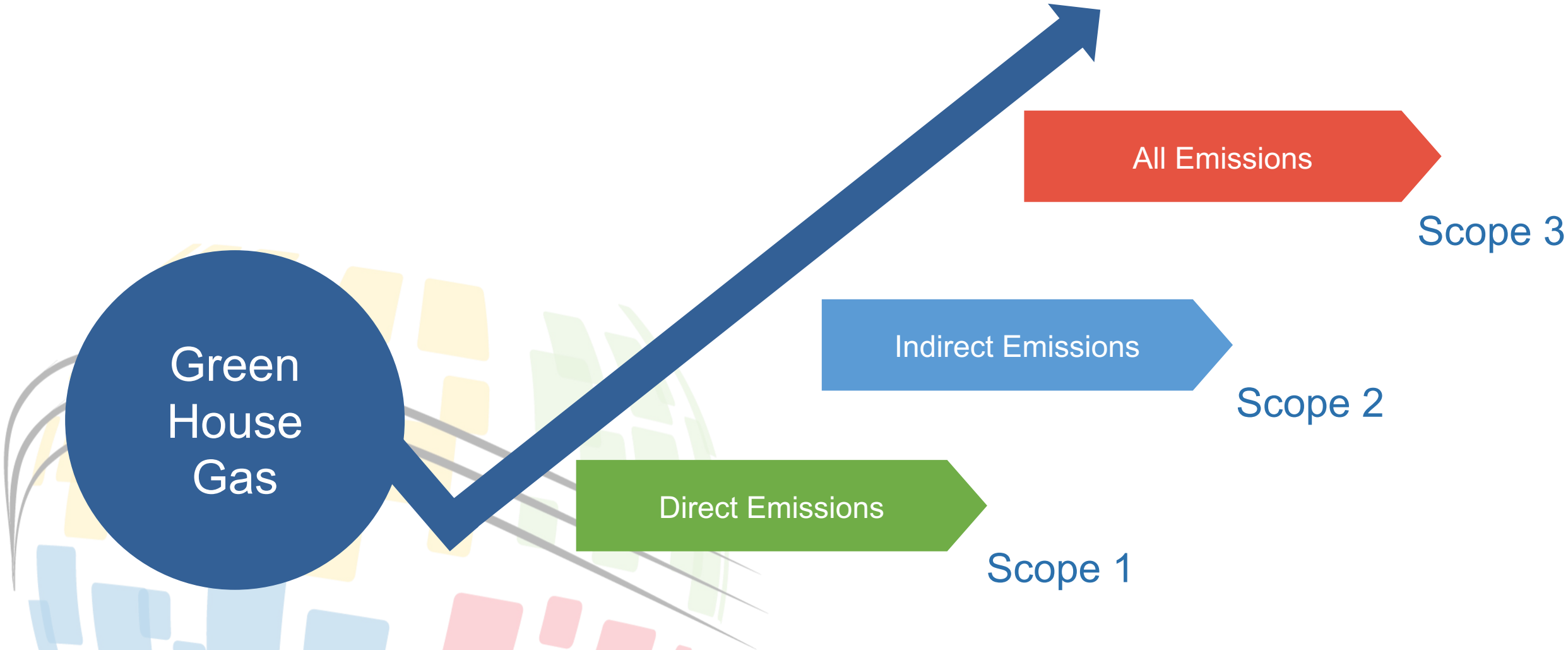
US Securities and Exchange Commission (SEC)

CEOs most frequently identify sustainability as their greatest challenge



Q2. What do you expect will be the greatest challenges for your organization over the next 2–3 years?

Sustainability Emissions Tracking and Reporting



Two Engineering Dimensions

- Sustainably Designing Products
  - Becoming more efficient in the actual development, building, creation of products process.
- Designing Sustainble Products
  - Building Products that meet efficiency goals
    - Consume less raw, materials, less enegy, new efficiency methods, reusable products

“Sustainable Design” is a series of deliberate choices to create products with a positive impact on the world

Definition

Sustainable design is an approach to creating products that have minimal negative impact on the environment and society, while maximizing positive economic, social and environmental benefits

Sustainable design aims to…

- ✓ Optimize the product lifecycle
- ✓ Extend the life cycle by designing products to last
- ✓ Design for disassembly and plan for the product’s next life
- ✓ Make recycling part of your design strategy
- ✓ Prioritize energy efficiency with:
  - efficient design
  - sustainable power sources and
  - materials with low embodied energy
- ✓ Use fewer resources by light-weighting designs
- ✓ Avoid materials that increase pollution
- ✓ Choose materials that are abundant and sustainable

Source: https://www.crowdspring.com/blog/sustainable-product-design/

The demand for sustainable design is growing as consumers and regulators demand sustainable products

Consumers

"**Over 70%** of respondents are willing to pay a **premium** for **sustainable products**"	- McKinsey & Company (2021)
"Sales of **sustainable products** in the U.S. **grew by 20%** between 2014 and 2019"	- Nielsen (2019)
"**Sustainable brands** grew **69% faster** than the rest of the business"	- Unilever (2019)
"Products with **sustainability claims** on their packaging **outperformed** their counterparts in sales growth **by 5.6%"**	- Nielsen (2018)
"**60%** of consumers in the U.S. and Canada said they are **more environmentally friendly** today than they were 5 years ago, and **76%** said they intend to be **even more environmentally friendly** in the next 5 years"	- Accenture (2018)
"**61%** of Gen Z consumers are willing to **pay more for eco-friendly** products"	- Global Web Index (2019)

Regulators

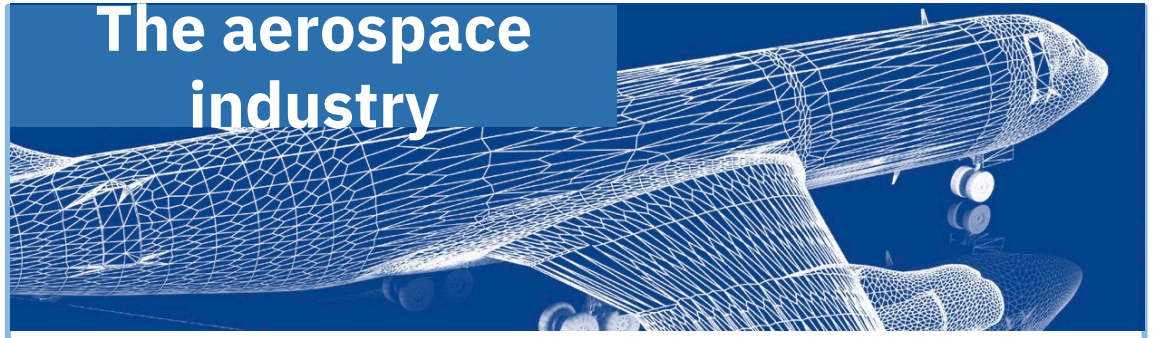
EU 2005	**The Ecodesign Directive** aims to reduce the environmental impact of energy-related products throughout their lifecycle
EU 2008	The **Waste Framework Directive** sets out waste hierarchy, which prioritizes waste prevention, reuse, and recycling over disposal
EU 2007	**REACH** regulation requires companies to register and assess the risks of chemicals used in their products
US Government 1993	**Federal Green Procurement Program** requires federal agencies to purchase environmentally preferable products and services
EU 2022	**Sustainable Products Initiative** aims to make products more sustainable throughout their lifecycle, from design to disposal
EU 2015	The **Circular Economy Action Plan** is a set of initiatives and policies developed to transition to a more circular economy

The demand for sustainable design is particularly strong within auto and aerospace

The auto industry

- OEMs have stated goals to **slash CO_2 emissions**, often by **more than 50%** within the **next 10 years**
- A key focus is on adjusting and **reducing the quantities** of raw materials used per vehicle
- They are also incorporating **full product lifecycle perspectives**, such as designing products and operations to support battery recycling
- OEMs are embedding **sustainability approaches into the design and development** of all vehicles

The aerospace industry

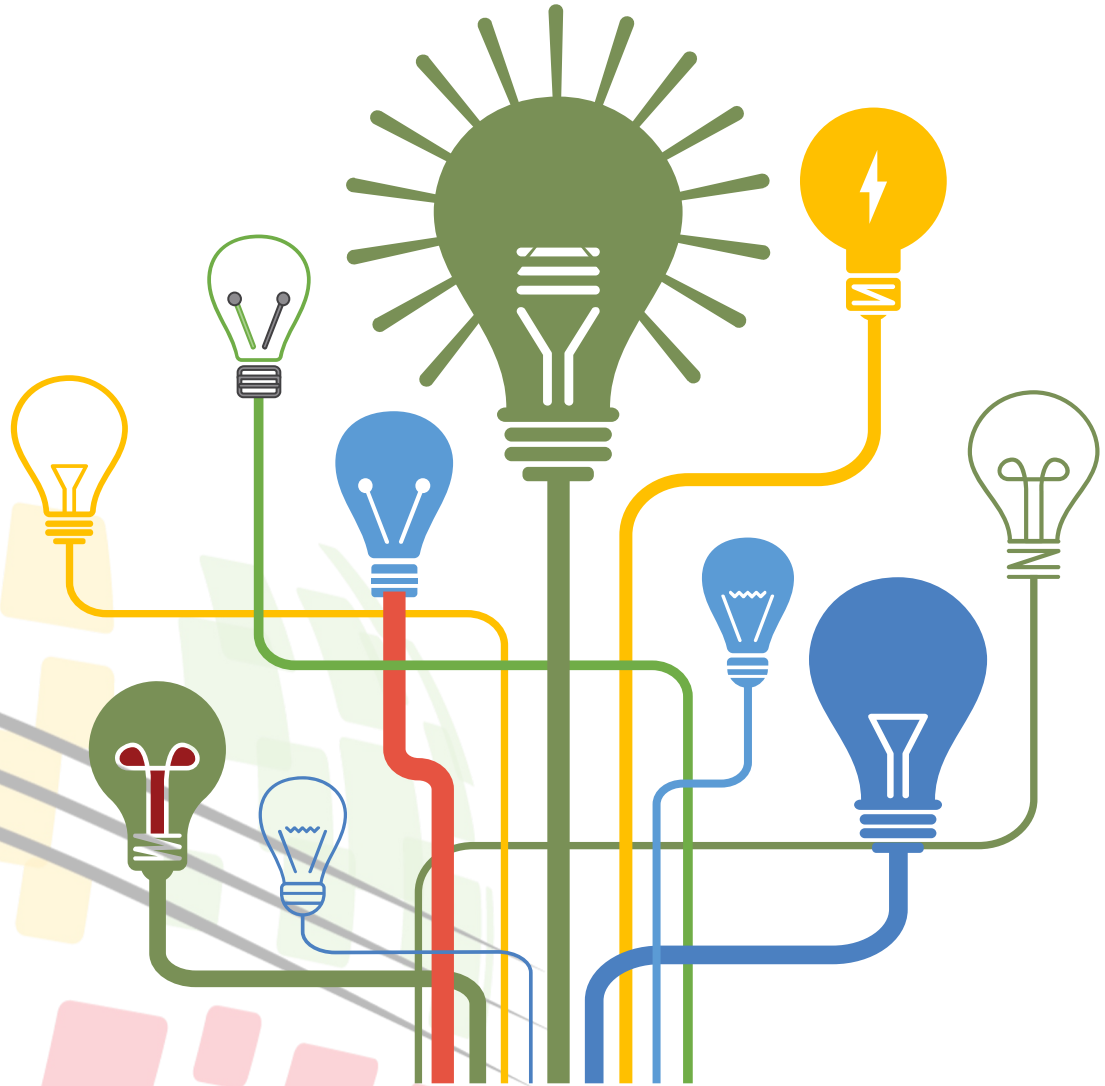


- In 2019, Airbus announced the development of **three zero-emission** concept aircraft and in 2020, Boeing announced plans to test a **fully electric aircraft**
- Boeing's 787 is designed to be **20% more fuel-efficient** than previous models, and uses **lighter materials** to reduce weight and increase efficiency
- In 2020, the Air Transport Action Group launched a campaign encouraging travelers to make **more sustainable choices**

Achieving sustainability demands a transformation of thought

How do we meet our sustainability goals?

It doesn't happen by chance.



It must be designed and engineered

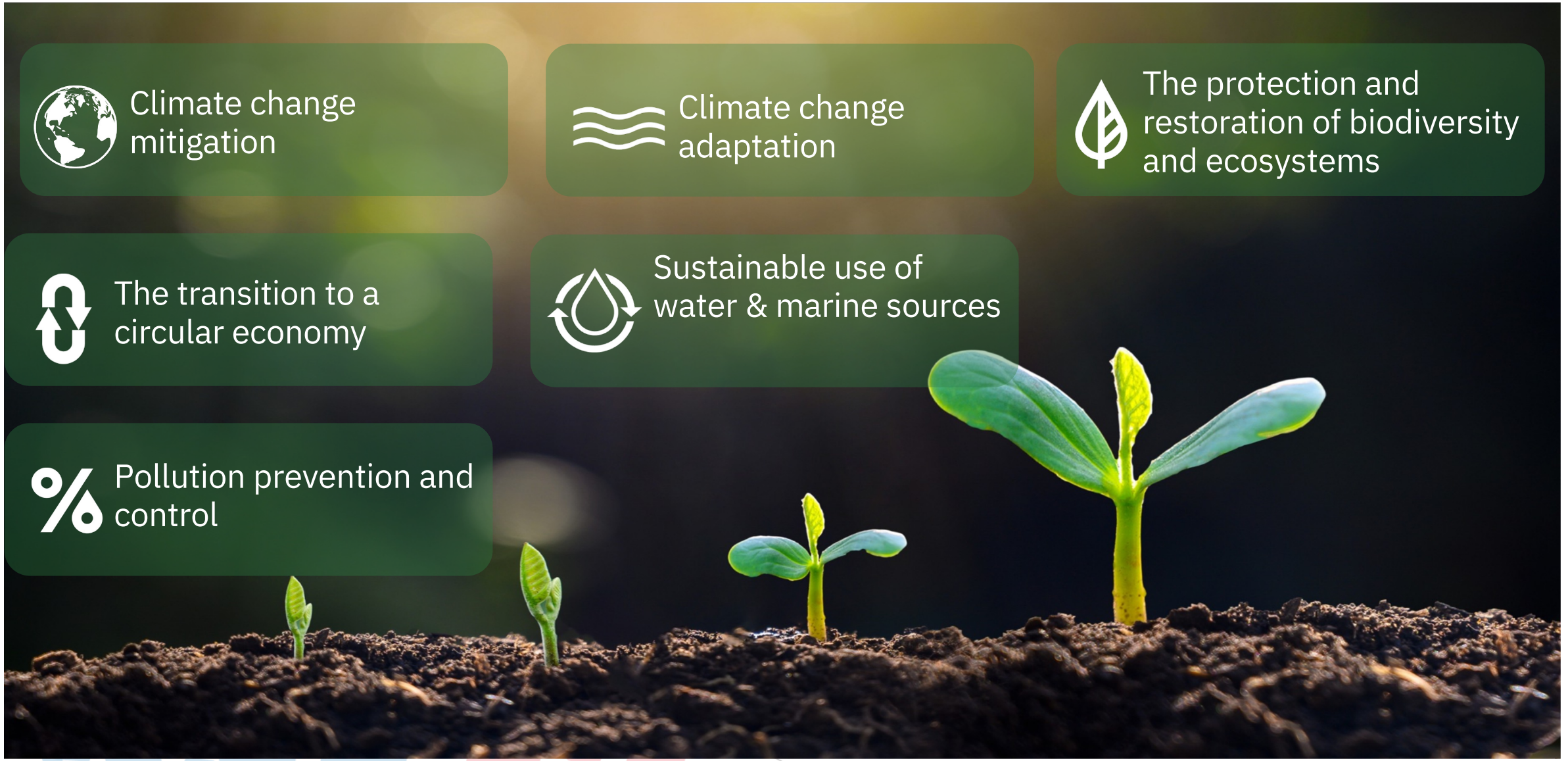
European Union Taxonomy Regulation

"The EU Taxonomy is a green classification system that translates the EU's climate and environmental objectives into criteria for specific economic activities for investment purposes".

It is a transparency tool that will introduce **mandatory disclosure** obligations on some companies and investors, requiring them to disclose their share of Taxonomy-aligned activities." ec.europa.eu, 2023.

https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/sustainable-finance-taxonomy-faq_en.pdf

EU Taxonomy Regulation Objectives



How do we consume the directives?

Compliance — Coverage Analysis

Dabbling at the edges no longer suffices, must start at the design phase. “80% of a product’s lifetime emissions is determined by product design”. Fuchs, 2022.

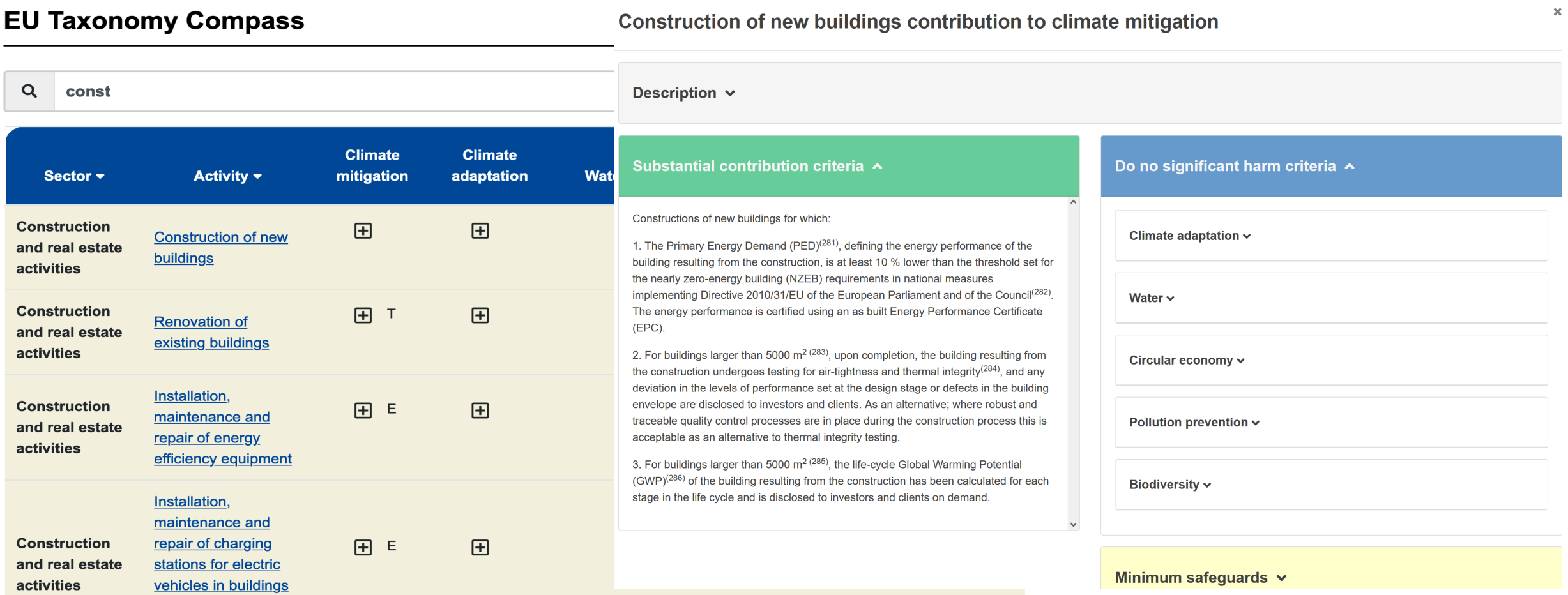
Mitigating Risks — What could go wrong?

Single Version of Truth — Transparency

Audit Ready — Built in Process

80% Emissions

EU Taxonomy Compass



https://ec.europa.eu/sustainable-finance-taxonomy/tool/index_en.htm

Sustainability Steps in Systems Engineering

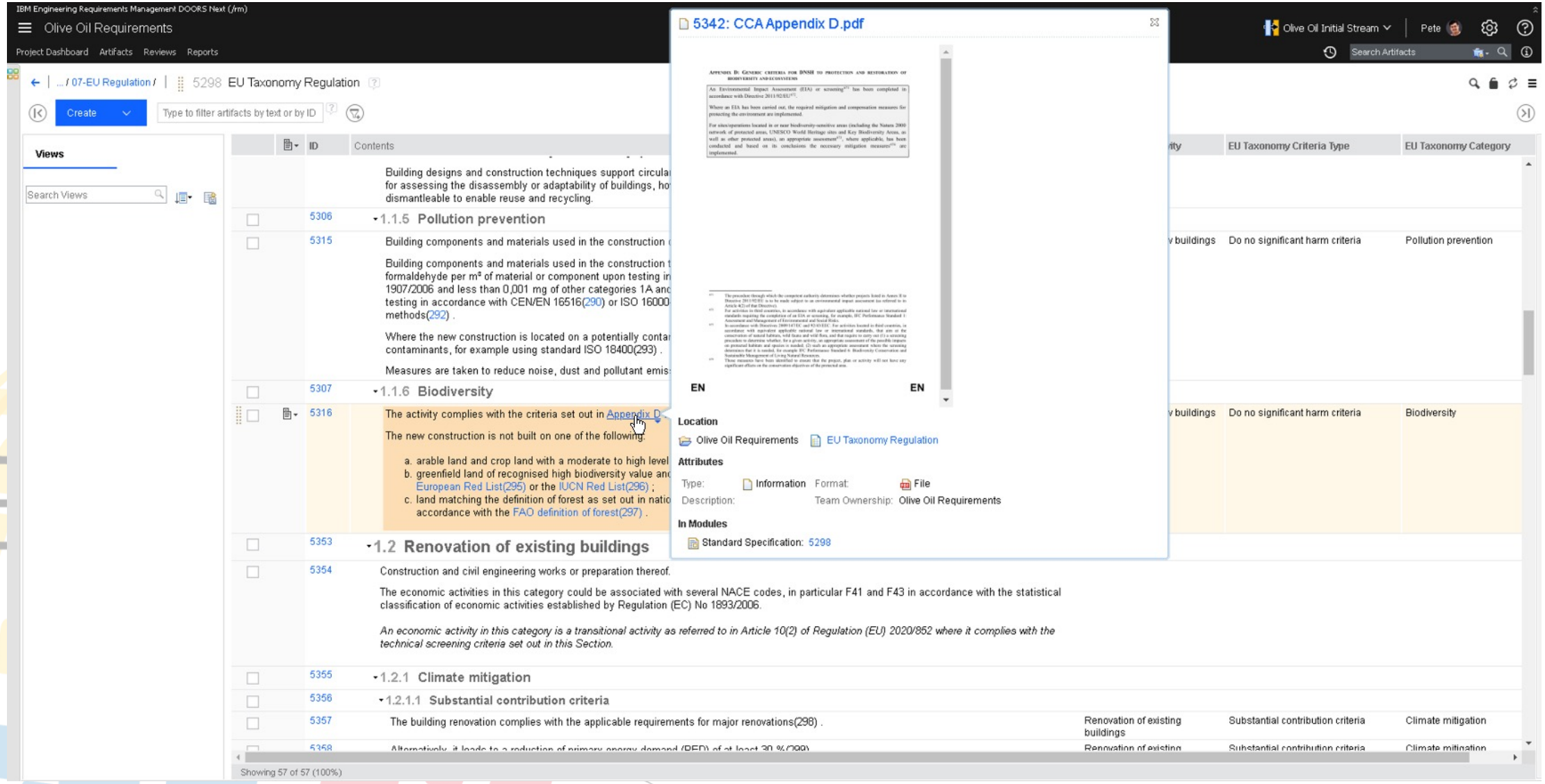
Step 1: Allocate Requirements

Step 2: Develop design requirements and show compliance

Step 3: Validate the requirements using MBSE and model validation

EU Taxonomy Regulations

Structured document view with links and metadata



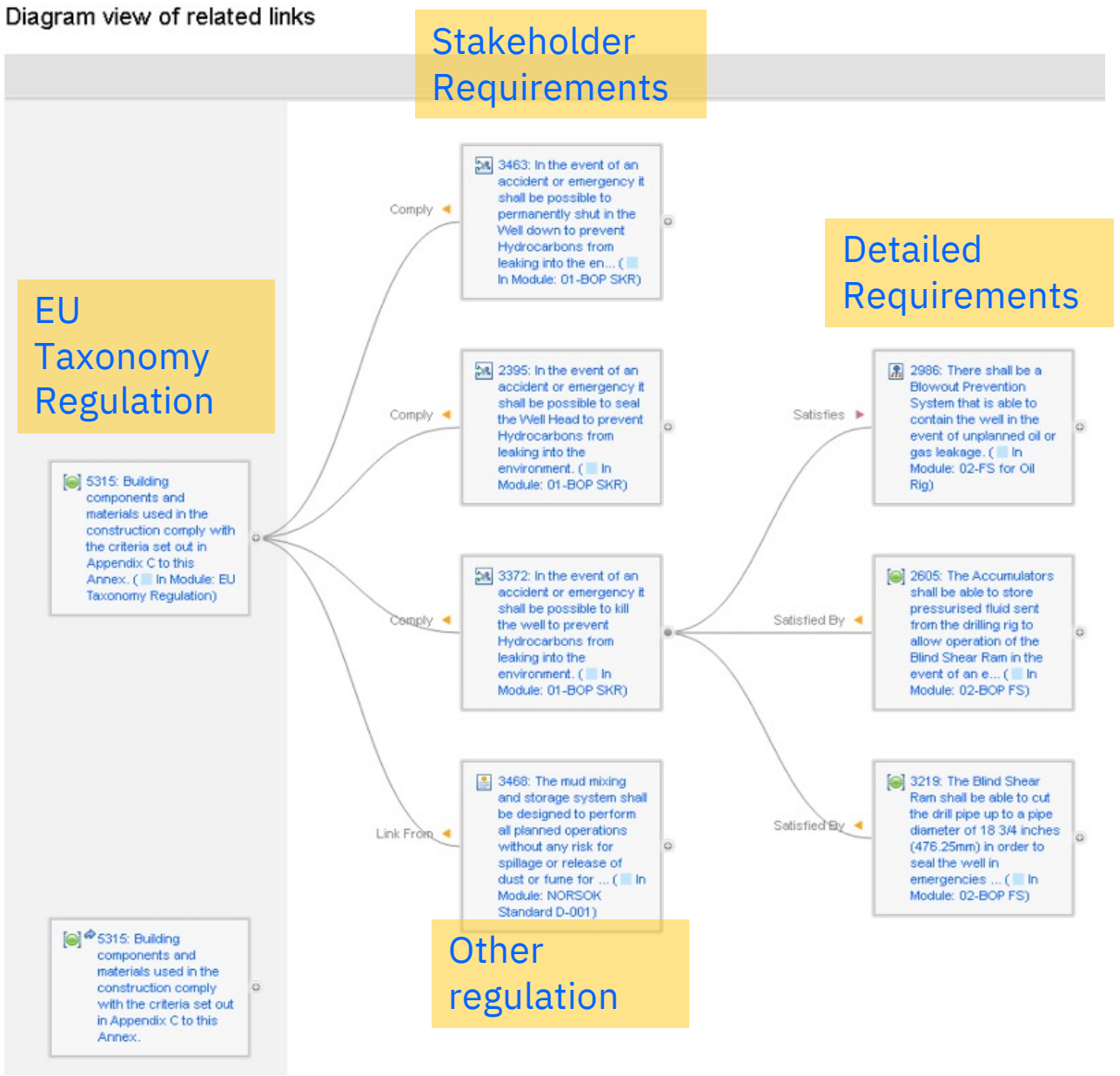
EU Taxonomy Regulations

Structured document view with links and metadata

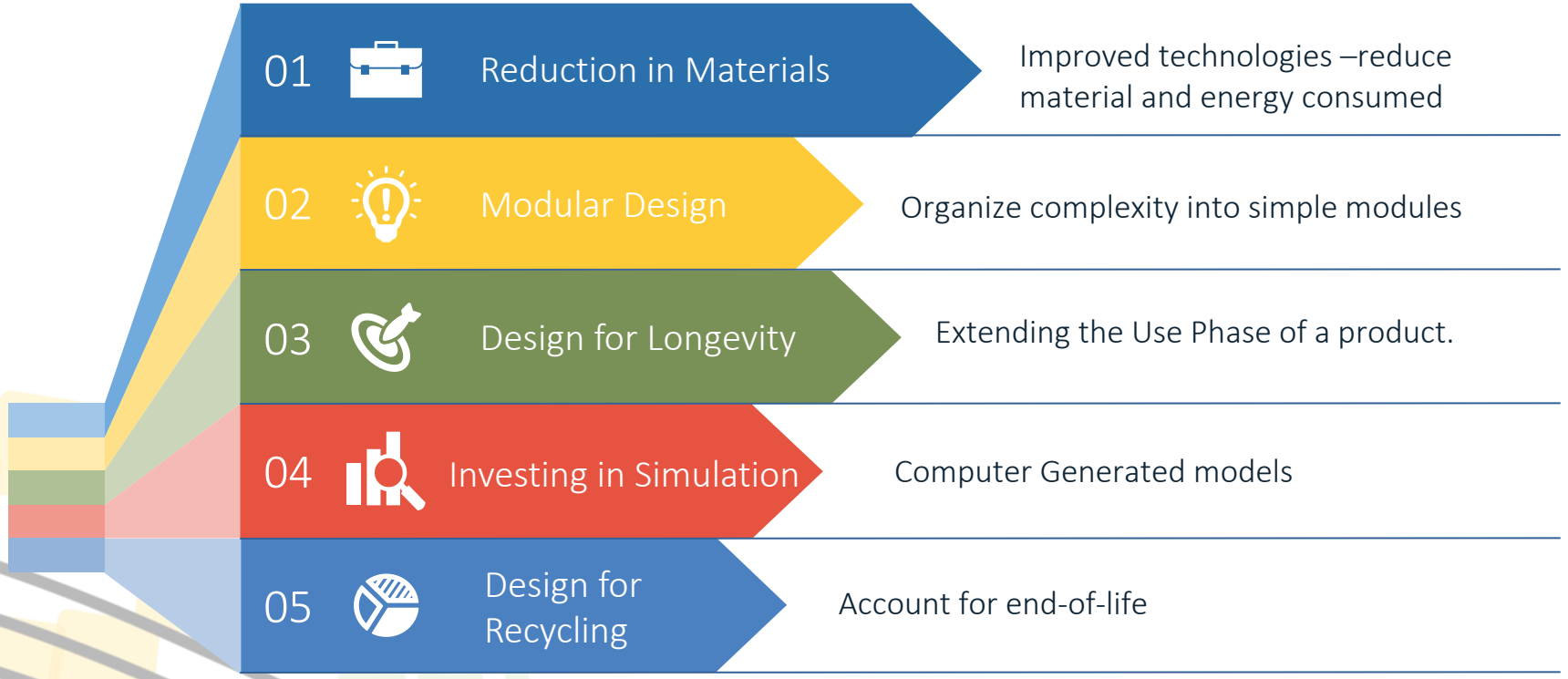
ID	Contents	EU Taxonomy Activity	EU Taxonomy Category	EU Taxonomy Criteria ...	Comply
	demonstrate, with reference to ISO 20887(288) or other standards for assessing the disassembly or adaptability of buildings, how they are designed to be more resource efficient, adaptable, flexible and dismantleable to enable reuse and recycling.				
141525	▾ 1.1.5 **Pollution prevention**				
141248	Building components and materials used in the construction comply with the criteria set out in Appendix C to this Annex. Building components and materials used in the construction that may come into contact with occupiers(289) emit less than 0,06 mg of formaldehyde per m^3 of material or component upon testing in accordance with the conditions specified in Annex XVII to Regulation (EC) No 1907/2006 and less than 0,001 mg of other categories 1A and 1B carcinogenic volatile organic compounds per m^3 of material or component, upon testing in accordance with CEN/EN 16516(290) or ISO 16000-3:2011(291) or other equivalent standardised test conditions and determination methods(292) . Where the new construction is located on a potentially contaminated site (brownfield site), the site has been subject to an investigation for potential contaminants, for example using standard ISO 18400(293) . Measures are taken to reduce noise, dust and pollutant emissions during construction or maintenance works.	Construction of new buildings	Pollution prevention	Do no significant harm criteria	141559:In the event of an accid... 142868:In the event of an accid... 142836:In the event of an accid...

EU Taxonomy Regulations

Digital Transformation view of linked data to do impact assessments and get an overview of compliance links



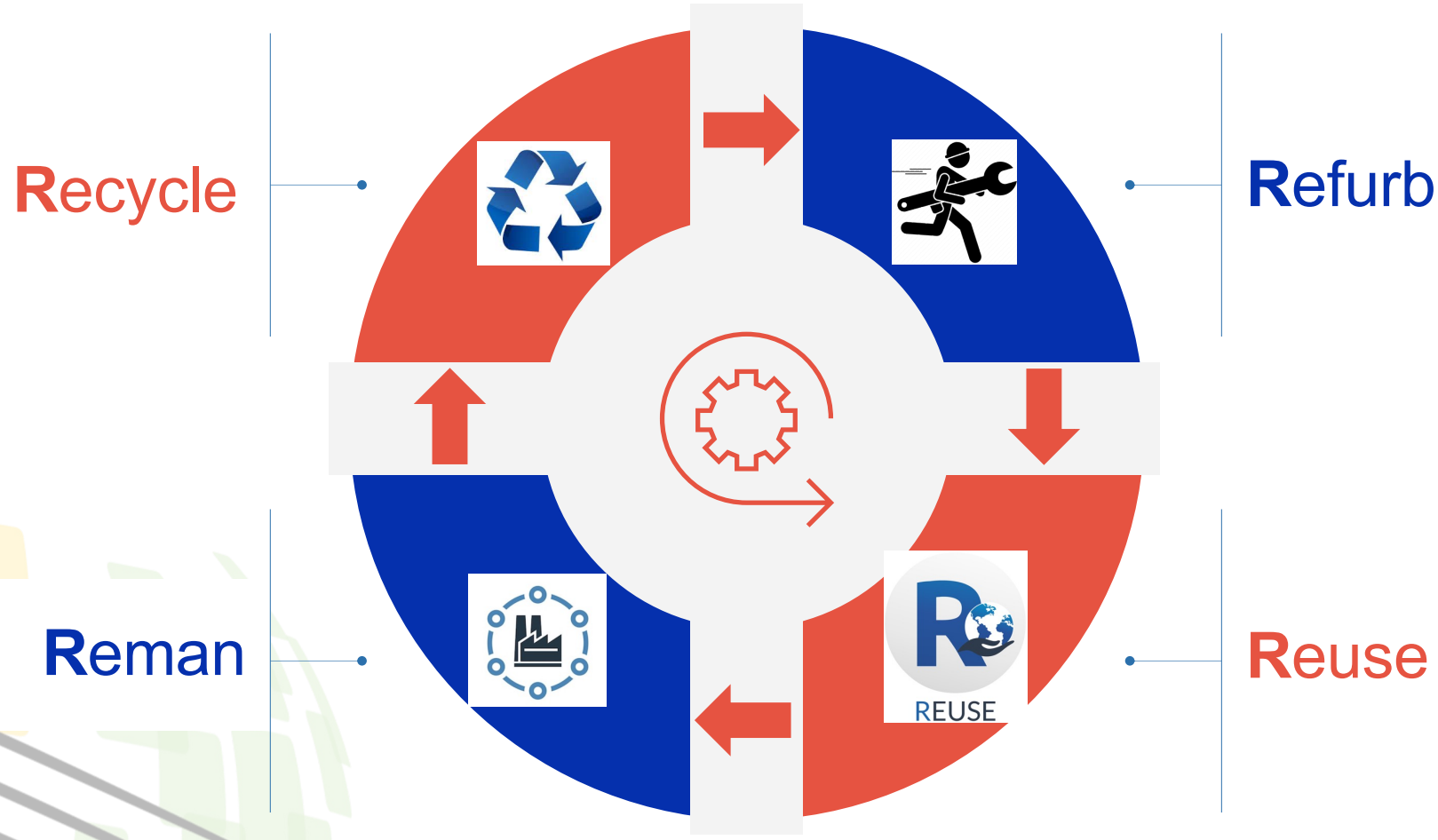
Design for Sustainability -- D*f*S



Near Net Zero

Design for Circular Economy

Target Markets:
Automotive
Aerospace & Defence
Electronics
Medical Devices
Universities & Research Centers



4R Strategy

Cross Compliance – Automotive Space

In **2022**, the European Parliament approved a **new directive on battery management.**

-- govern the entire product life cycle, from design to consumption and all the way to recycling into new products

"...propose stronger **requirements on sustainability**, performance and labelling,"

New regulations → demonstrates **compliance**
New regulations → to adopt **4R strategy: Reman - Recycle - Reuse - Repair**

DfS in Action

Whirlpool

- Reduce use of nonrenewable resources and lower product carbon and water footprint
- Lifecycle approach: design manufacturing use end of life
- Reduction of Scope 3 emissions by 65% (2005 – 2022)
- Recent washer saves up to 45% water and 30% energy per load.

http://whirlpoolcorp.com/2022SustainabilityReport/environmental/sustainable-products/innovation.php

Honeywell

- The Micro Vapor Cycle System is a cooling solution for urban air mobility aircraft and military & civil helicopters
- 35% lighter and 20% more efficient than conventional vapor cycle systems
  - Reduce product development cycle time by half
  - Reduce R&D investment by 30%
  - Leverage common base design across multiple variants

https://aerospace.honeywell.com/us/en/about-us/blogs/honeywell-micro-vcs-game-changing-cooling-system-boosts-military-capabilities


Turn sustainability ambition into action
Chríochnaigh & Ceisteanna
Finish & Questions

References

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Council Adopts New Regulation on Batteries and Waste Batteries, www.consilium.europa.eu/en/press/press-releases/2023/07/10/council-adopts-new-regulation-on-batteries-and-waste-batteries/.

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www.incose.org/symp2024
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