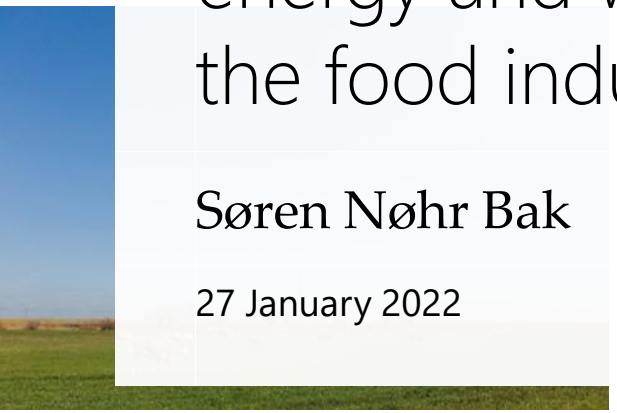
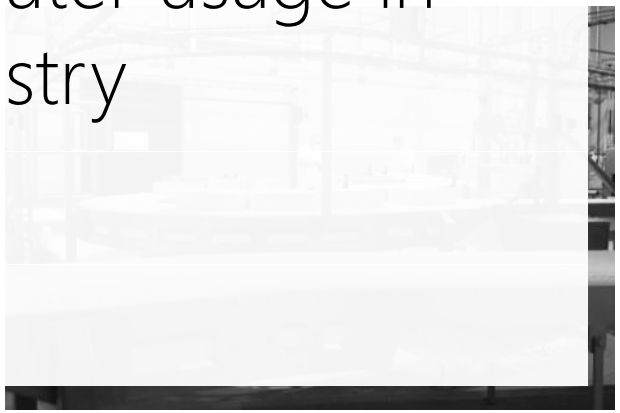








# How technology and innovative thinking reduce energy and water usage in the food industry

Søren Nøhr Bak

27 January 2022

# Agenda

1. Introduction NIRAS Food & Beverage
2. Sustainability trends in the Food & Beverage industry
3. What is happening in the industry? – some case examples
   - **Sustainability assessment in Operation**
   - **Integration of sustainability in CAPEX projects**
   - **Innocent - a carbon zero greenfield factory**
   - **The fossil free dairy – only a dream?**
   - **Game changing within water efficiency**
4. Questions

# NIRAS delivers a broad range of services supporting the Food & Beverage business

**Building**

**Development Consulting**

**Environment & Ecology**

**Food & Beverage**

**Infrastructure**

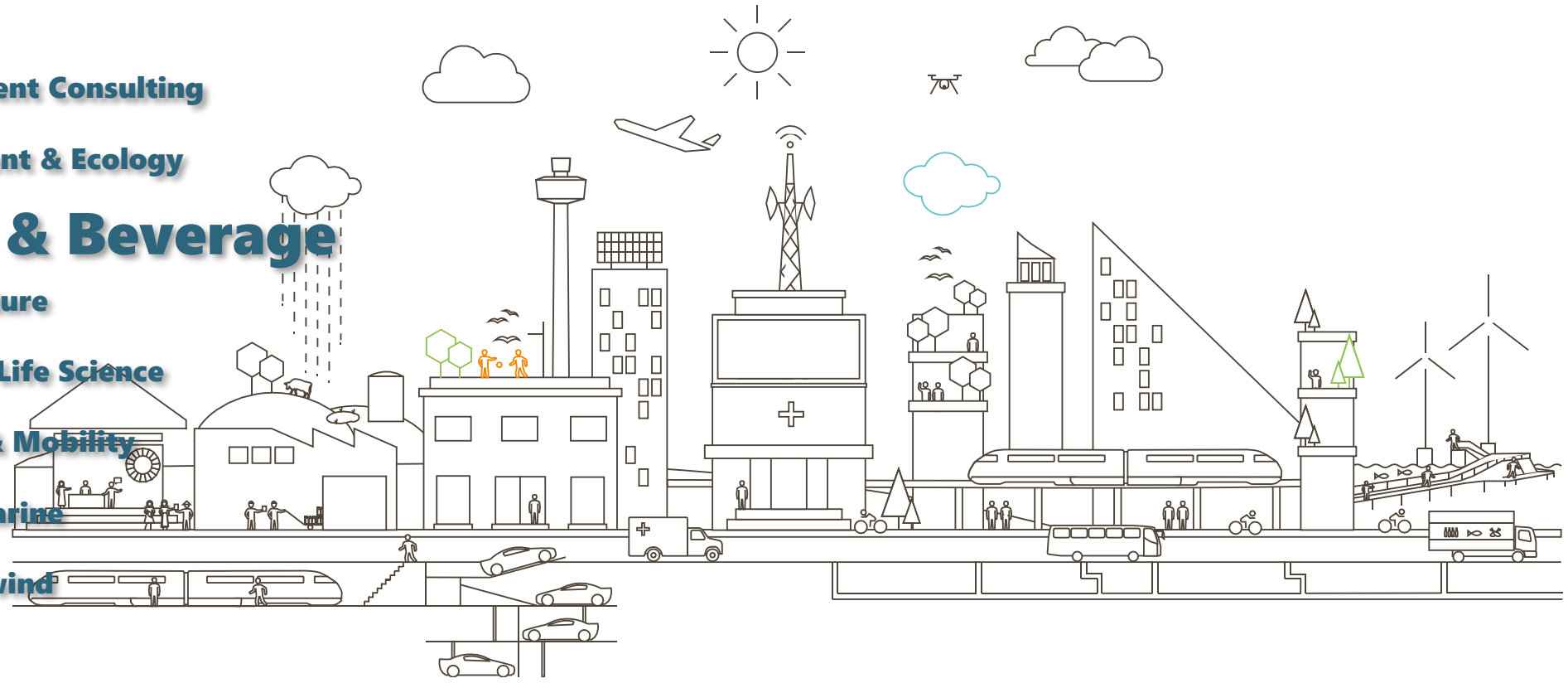
**Pharma & Life Science**

**Planning & Mobility**

**Ports & Marine**

**Offshore wind**

**Water**



# Our worldwide presence in numbers

**31**
countries

**54** offices

**2,300**
experts

**1,000+**
Greenfields and large CAPEX expansions in 75 countries

**7,000 projects**

# Sustainability in the Food & Beverage industry

**Society driven**

- Climate/carbon neutrality
- Ecology
- Plant based diets
- Reduction of food waste

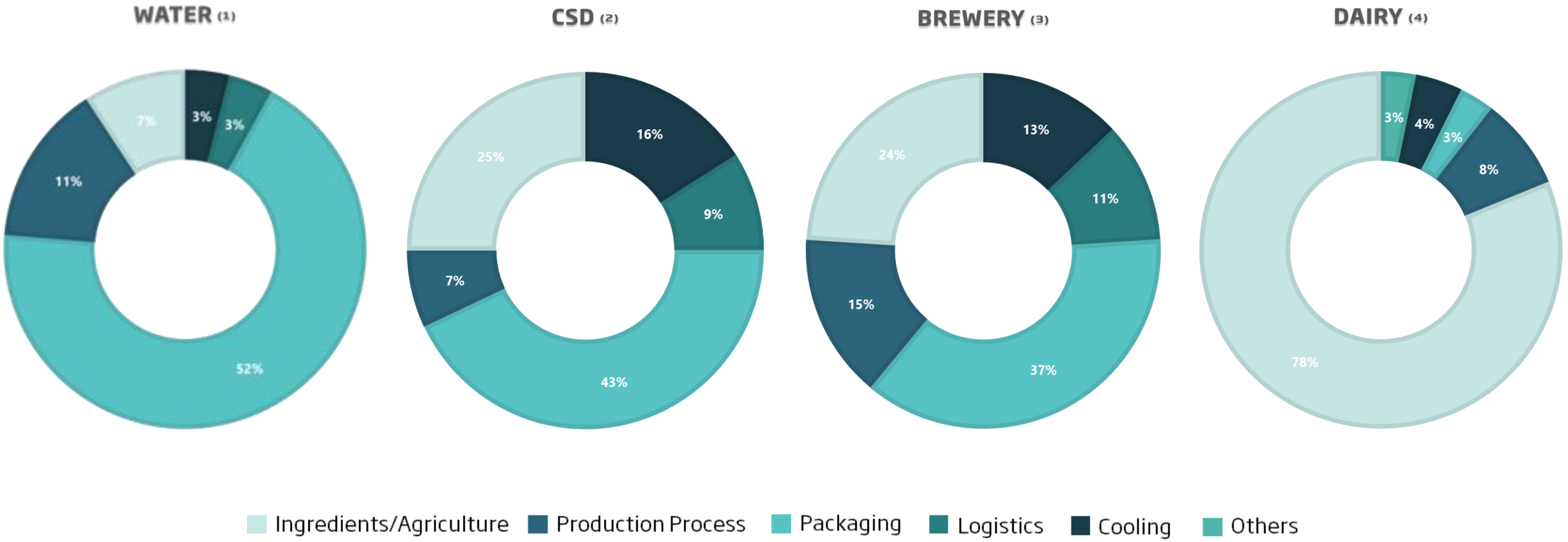
**Technology driven**

- Electrification
  - Boilers
  - High temperature heat pumps
- Smart grids
- Process water purification
- Biorefining processes

**Business driven**

- Sustainability investment
  - Plant based
  - Biotech ingredients
- Financing - covenants
- Localisation - symbiosis
- Emerging brands

# CO2 footprint within beverage industry




(1)Gerolsteiner Brunnen GmbH & Co. KG (2) Coca-Cola Europacific Partners; (3) Krones - CSR Reports Breweries;
(4) Klima-und Energierechner für die Deutsche Milchwirtschaft (ressourcenrechner.de 29.12.2021)

# Timeline – focus is shifting

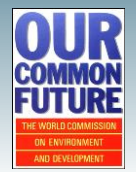
**The "Social License to Operate" discussion is becoming a hot topic**

1972 1980 1987 1997 2000 2015 2016 2017 2018 2020 2021

**Nations:**

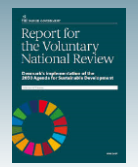
**International goal setting and legislation**

**National legislation**










**Companies**

**Corporate functions driving sustainability**

**Localization**











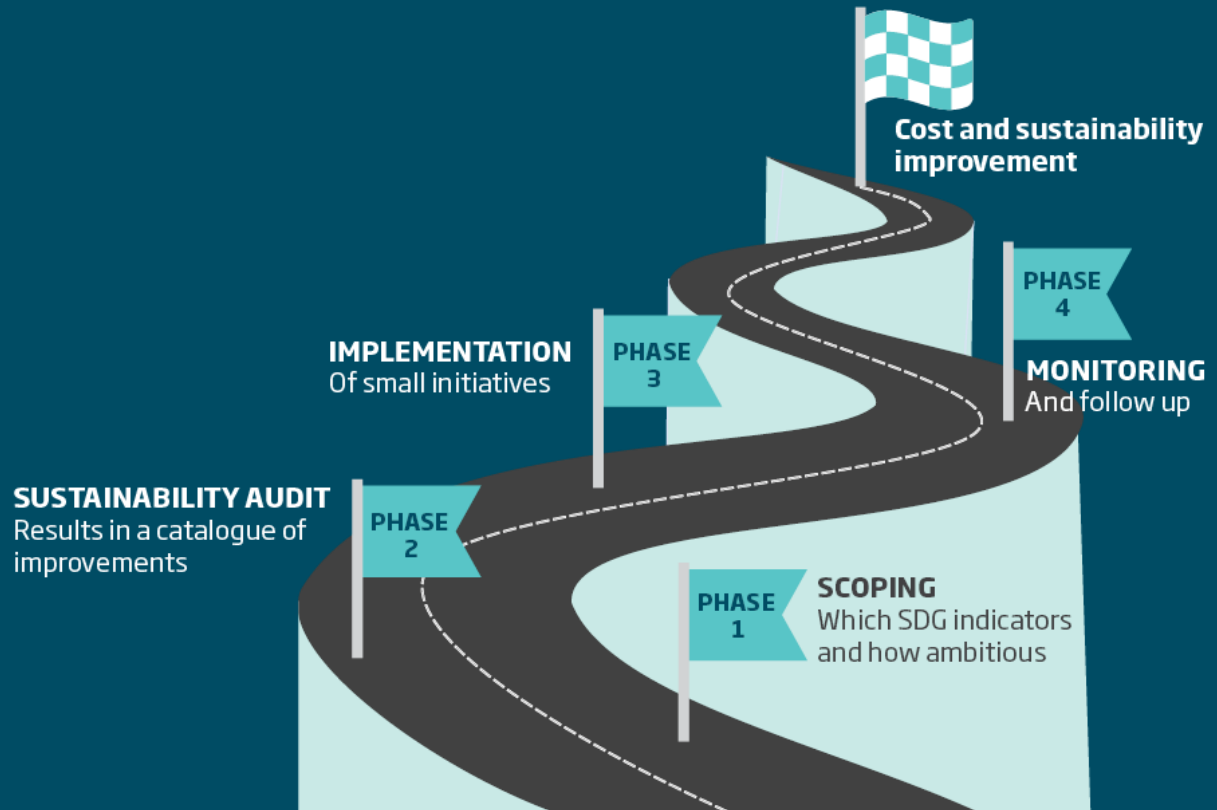


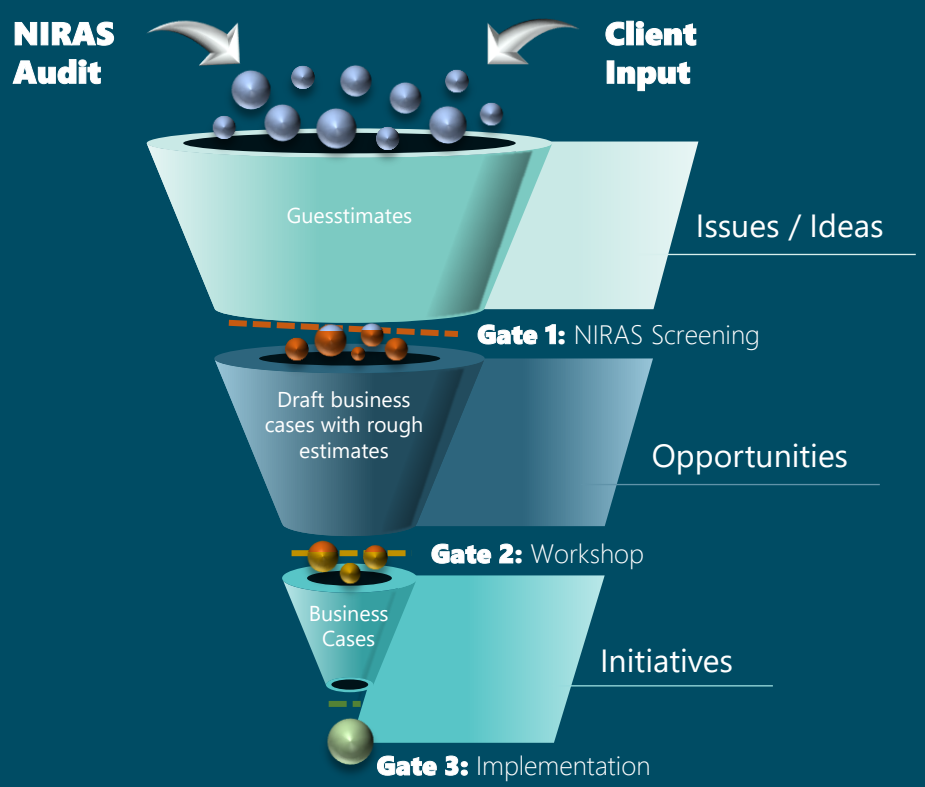



NIRAS

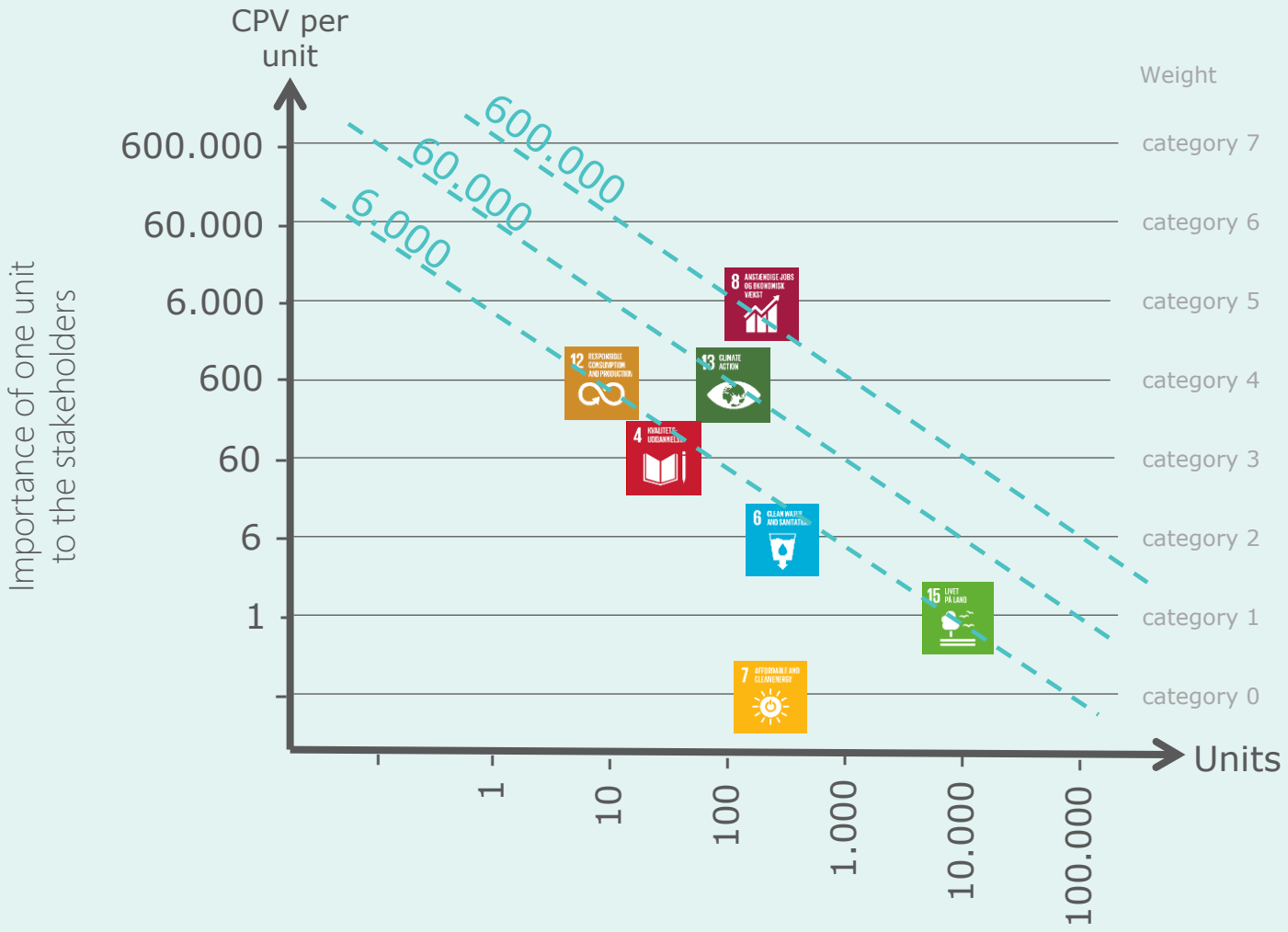
# Sustainability assessment in Operation

| SDG Balance Scorecard | | Footprint | | | Efficiency | | |
|---|---|---|---|---|---|---|---|
| Indicator | | Actual | Weight category | Weighted Value | Actual | Target | Diff% |
| #6 Clean water and sanitation | Water | 110,000 m³ | 2 | -1.100.000 | 0.73 m³/ton | 0.70 m³/ton | -5% |
| #7 Affordable and clean energy | Energy | 14,822 GJ | 1 | -14.822 | 98.8 MJ/ton | 66.1 MJ/ton | -49% |
| #12 Responsible consumption and production | Waste | 23 Tons | 4 | -23.000 | 0.15 kg/ton | 0.15 kg/ton | 0% |
| #13 Climate action | Climate | 2,120 Tons | 4 | -2.120.000 | 8.2 kg/ton | 8.2 kg/ton | -72% |
| #15 Life on land | Land use | 20,233 m² | 1 | -20.233 | 0.127 m²/ton | 0.127m²/ton | -6% |



# Materiality assessment




- 4.4.1 Training days
- 6.4.1 Water usages $m^3$
- 7.3.2 Energy usage GJ
- 8.5.1~ Sick leave above avr.
- 12.5.1~ Waste in ton
- 9.4.1 CO2 ton scope 1+2
- 15.1.1~ Industrialized area $m^2$

# Case: Sustainability Improvements and Strategy

For a Danish Dairy

| | |
|---|---|
| Industry | Dairy, Cheese |
| Gross income: | DKK 278 million |
| Employees: | 101 |
| Project: | Aug. until Nov. 2021 |

**Assignment**

The aim of Them Dairy is to become climate neutral on their sites (Scope 1 and 2). NIRAS was assigned to creating a business model based on increased sustainability:

1. Establish a baseline and a full scope climate footprint
2. Identify opportunities for improvements
3. A sustainability and climate strategy

**Tools and methods**

- SDG INITIATOR – for evaluating and prioritizing the business cases
- CO2 calculator – for establishing a full CO2 baseline.
- Business Model Canvas and Sustainability Compas for analyzing the current situation and the opportunities.

**Results**

- Prioritized action plan with 13 initiatives
- Potential cost savings of DKK 3 million
- Sustainability footprint potentially reduced by a third
- Guide for the organizational anchoring of sustainability

# Sustainability in CAPEX projects

When and where to integrate into the project?


**Materiality assessment:**

Determine focus areas within sustainability by ranging of:

Importance to business success

Importance to external stakeholders

What is important to the specific project?

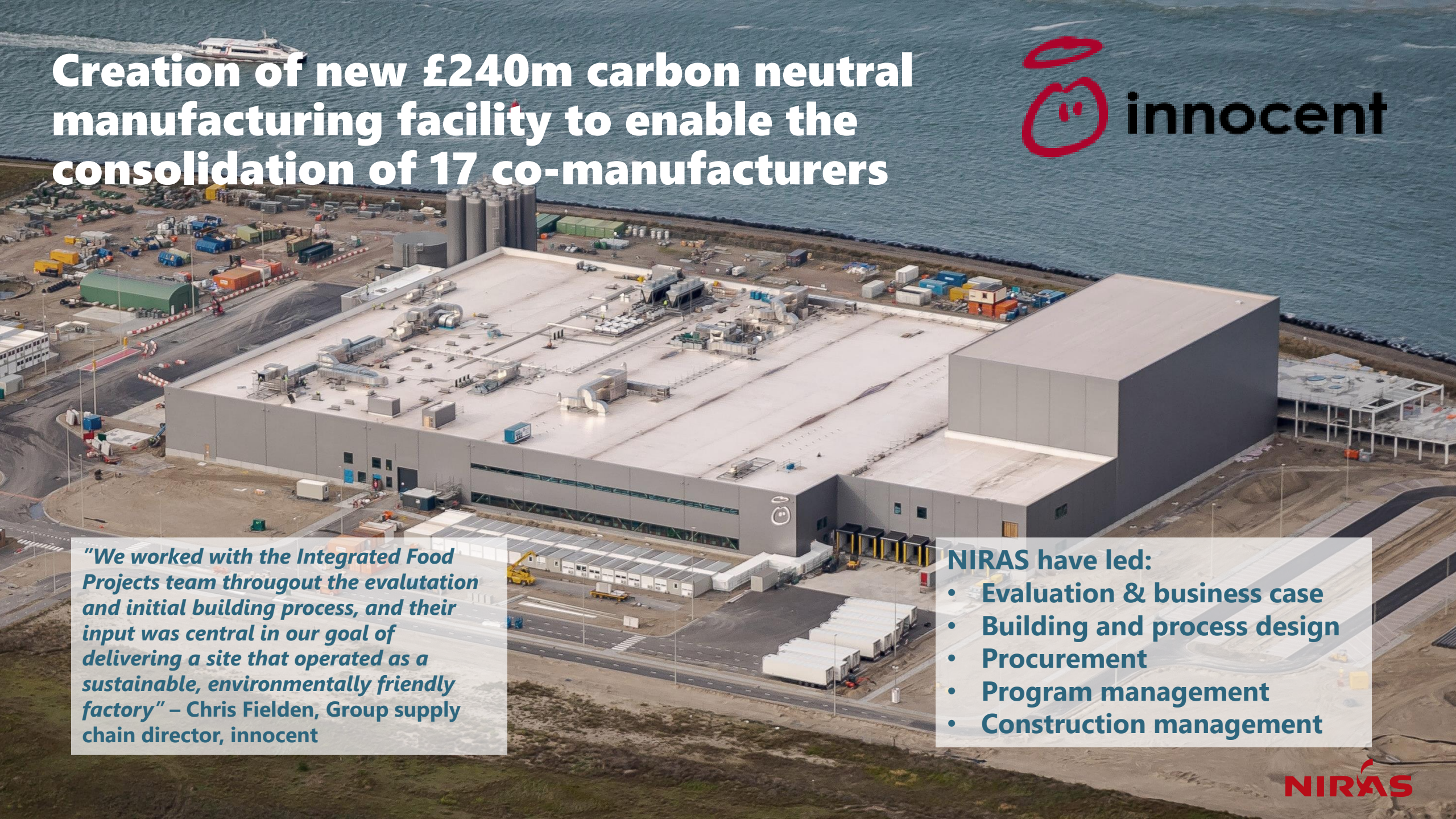
**Actions:**

Defining the level of ambition for sustainability

Preparing a prioritized action plan to implement

Setting up a process for sustainable plant planning, design and establishing

# Creation of new £240m carbon neutral manufacturing facility to enable the consolidation of 17 co-manufacturers



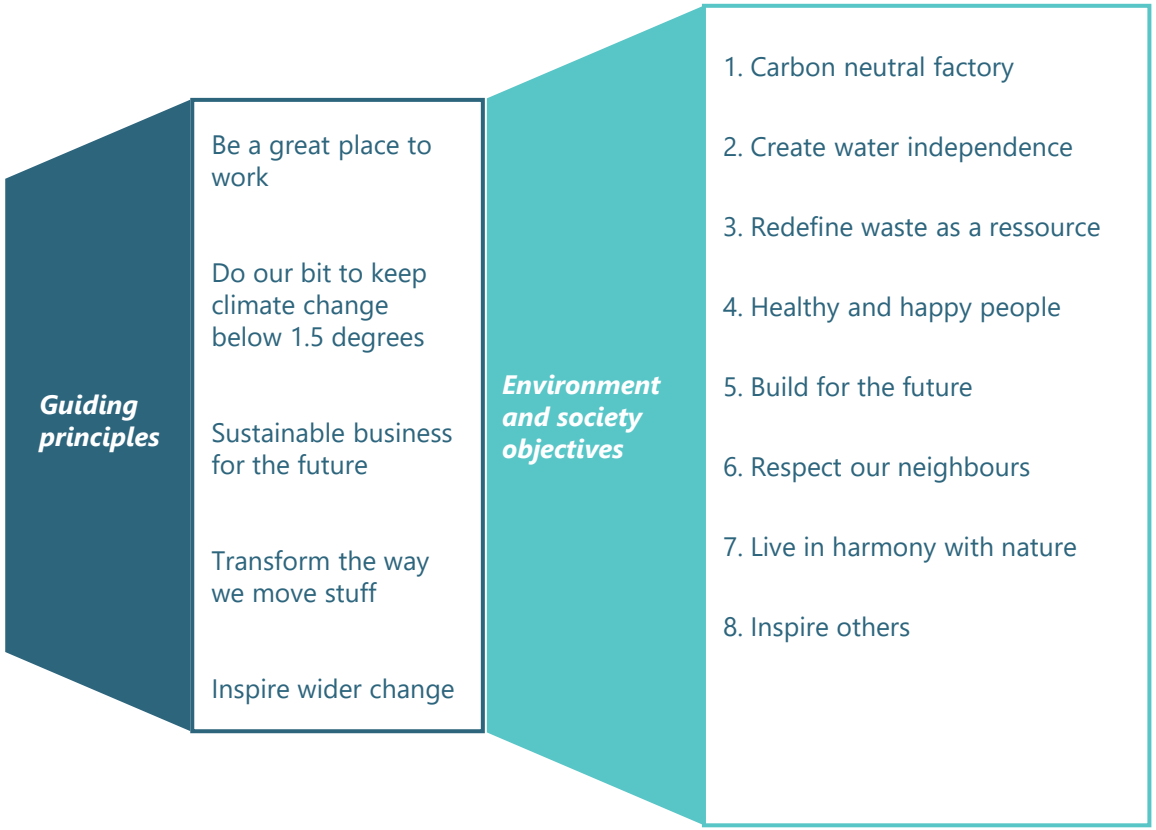
*"We worked with the Integrated Food Projects team througout the evalutation and initial building process, and their input was central in our goal of delivering a site that operated as a sustainable, environmentally friendly factory"* – Chris Fielden, Group supply chain director, innocent

**NIRAS have led:**

- Evaluation & business case
- Building and process design
- Procurement
- Program management
- Construction management

# Innocent had a clear vision to create facility which enabled them to deliver their sustainability ambitions

***The Earth's favourite little healthy drinks factory***

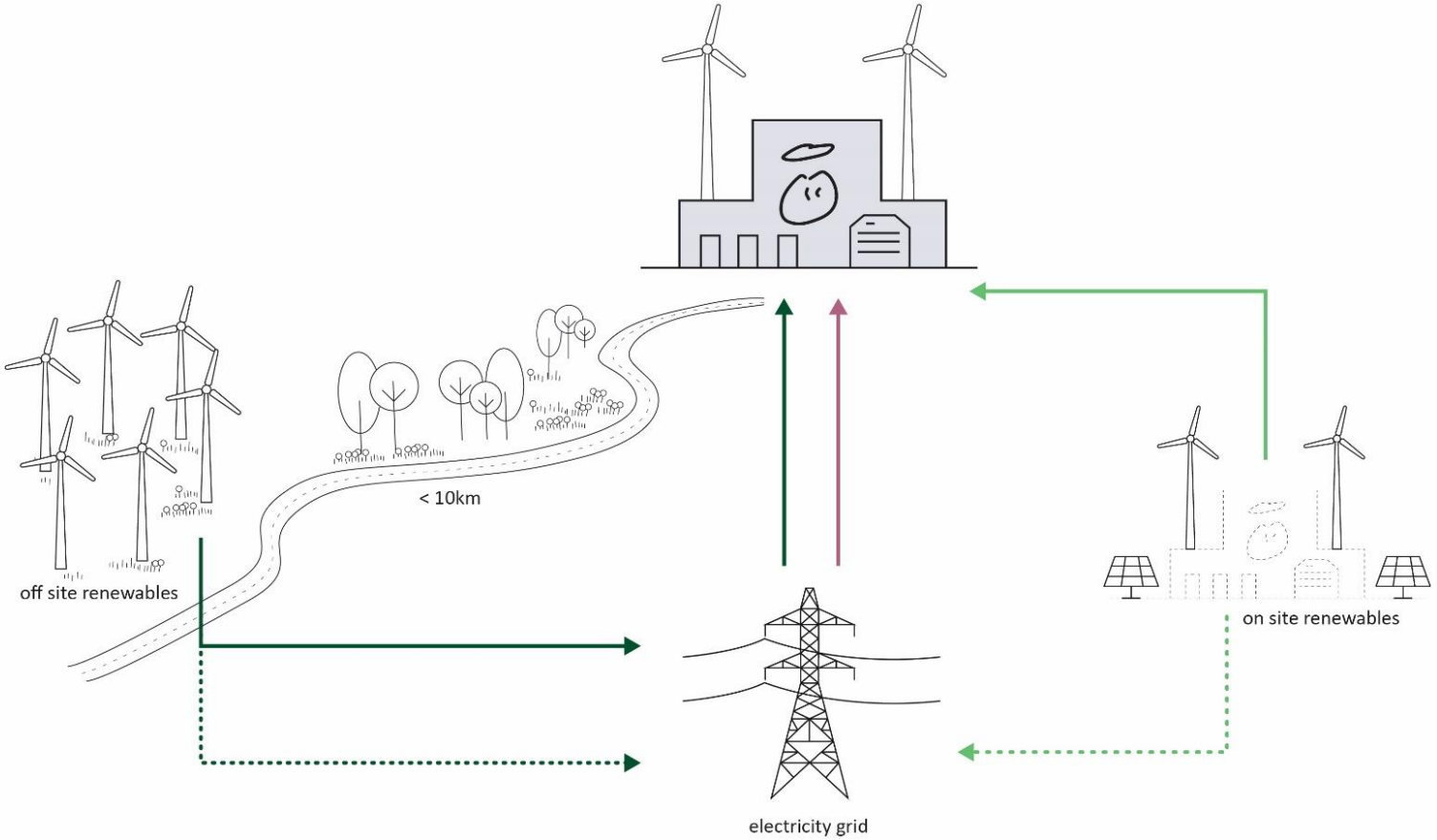


# Sustainable sourcing and generation was key to achieving carbon neutrality

To achieve a carbon neutral, self sufficient site innocent have adopted:

- An all electric energy strategy, in line with legislation
- BREEAM - excellent

And to reinforce its employer of choice credentials the site is also WELL certified



# All processes are focused on reducing usage

A number of key innovations have been included:

Revolutionary heat pumps that create a thermically balanced system to reduce energy consumption

FluiVac - a revolutionary line cleaning technology, which helps save an estimated 81,000 litres of water every single day.

The simplicity revolution – holistic automation

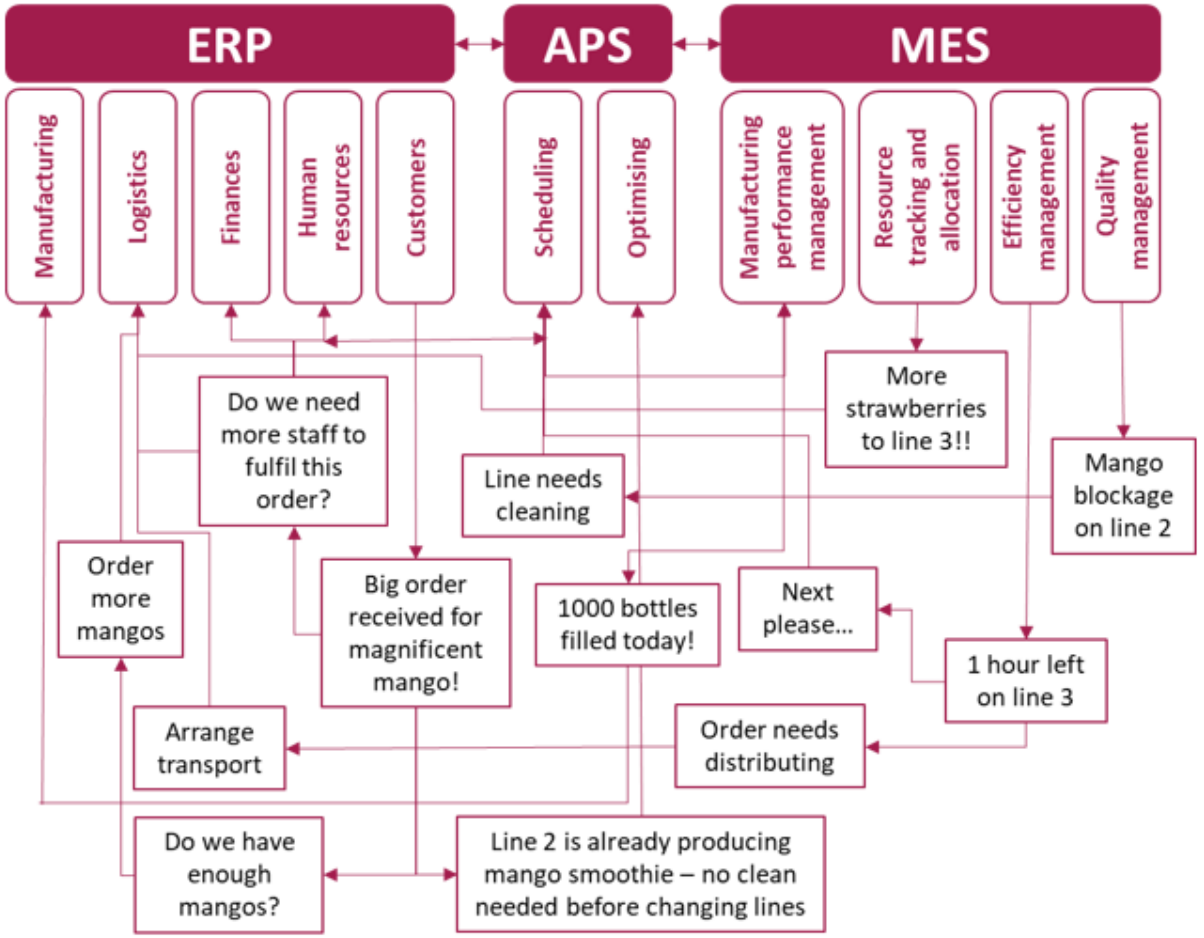



*Figure 6: The relationship between the ERP, APS and MES in the blender's production process*

# Digital tools enable cuts in CO2 emissions and raw material waste

## Digital Twin Simulations identify sources for CO2 emissions & waste in food factories, in a simulated operation environment through identification of bottlenecks and operation optimisation


The simulation model is typically delivered as an integrated part of factory design projects to validate optimal new factory design and peak production scenarios

# Green transformation – the fossil free dairy plant

Which paths to pursue?

## Energy sources

- Green electricity from wind turbines and solar panels (PV)
- Solar energy
- Biogas
- Power Purchase Agreement (PPA)

## Energy utilisation

- Optimisation through review and EMS

## Energy production

- Heat pumps
- Separation of temperature levels
- Electrical boilers to benefit from low tariff periods
- Energy storage

## Symbioses

- District heating
- Neighbouring industries

# Heat pumps can reuse waste heat

**Heat recovery / source**

Cooling system

Cooling towers

Sewage stream

Air exhaust from drying processes

Heat pumps have a high efficiency (COP), typical range: 2.5 – 5

Technology is undergoing rapid development

Standard solutions based on $NH_4$ for supply of 90°C

Systems based on $CO_2$ and He can supply 150-180°C

Future heat pumps maybe up to 200°C

# Increase water efficiency through the 4 R's

| REDUCE, e.g. | REUSE, e.g. | RECYCLE, e.g. | RETHINK, e.g. |
|---|---|---|---|
| Replacement of water seal pumps and vacuum systems<br><br>Optimized floor cleaning and cleaning drain channels | Cascading CIP plant<br><br>Collect water from a Pasteurizer and use this in a cooling tower | Recover product from dilute stream with membrane technologies<br><br>Wastewater recycling | Reconsider production formulas, which create waste<br><br>Industrial symbiose |

# Define the ambition

Case: Specific water consumption

## Best in Class

Defining Best in Class for juice manufacturing & bottling
Through collection of industrial data and from production network

Result: 0.45 l/l

## Stretched target

Define a stretched target of 0.20 l/l
Search of innovative and water efficient technologies
Open dialog with both known and innovative technology providers

## Project target

Evaluation of dialog
Determination of project ambition

Result: 0.3 l/l

# Reduce: Cleaning with less water

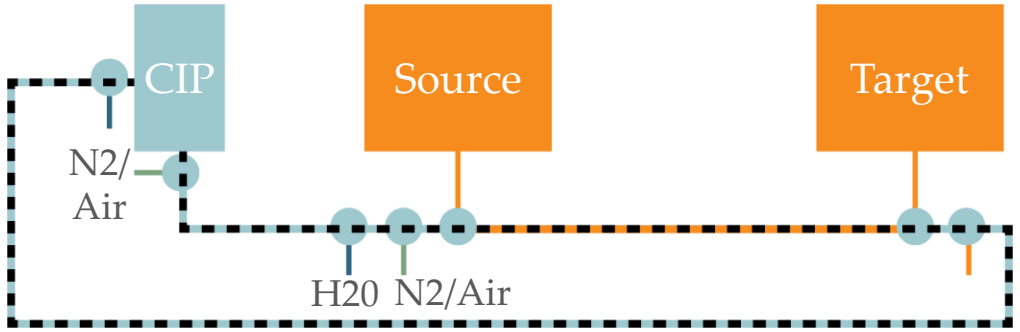
Juice factory example

Conditioning based cleaning of equipment

New detergent

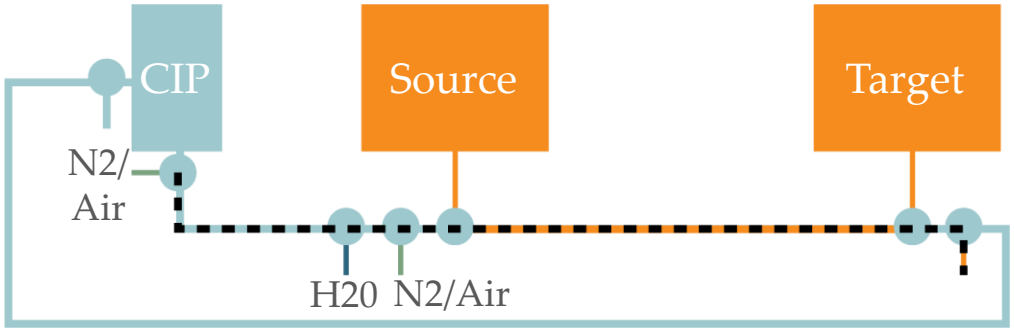
Pigs or gas purges to reduce water consumption

**CIP CLASSIC**




3 Minutes: weekly water consumption: app. 915.000 Litre/week

**CIP GAS PURGES**




Weekly water consumption: app. 31.000 Litre/week
Savings: 884.000 Litre/week
Pipe empty when done – no mixing with caustic

# Carlsberg has a strategic ambition on reducing water consumption

New recycling concept developed in research partnership – Industry, Universities (NL & DK), Food authorities

Feasible to reduce water to beer ratio < 1.7hl/hl from 4.0 hl/hl

- May reaching 1.5 hl/hl
- Target to reach 1.4 hl/hl

Implementation of a 2000 m3/day Water Recycling Plant will:

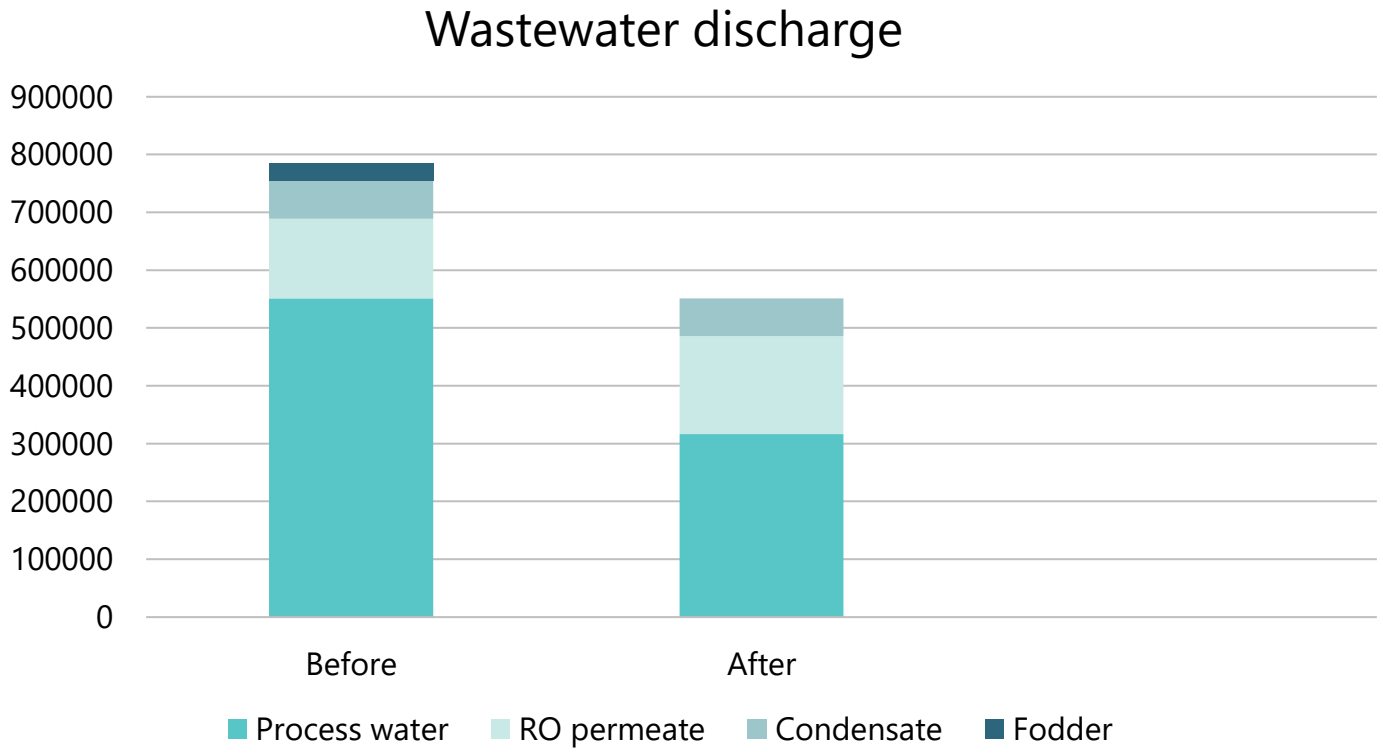
- Save 560,000 m3/year
- Deliver water of drinking water quality
- Net production of energy equivalent of 9.6% of full CB-Denmark site consumption

## The water recycling process

Screening → Anaerobic reactor → Aerobic reactor (N/DN) → Ultrafiltration (UF) → Reverse osmosis (RO) → Advanced oxidation process (AOP) → Chlorine dioxid

# Rethink

Turning by-product to product and reducing wastewater discharge




- Case: Large cheese and powder dairy
- Exceeding discharge requirements
- Large quantity of by-product used as animal fodder
- Reformulated products
  - Enabling recovery of proteins and fat
  - Water for re-cycling
- Pay-back 1.3 year

# To summarize

**Improving sustainability is a journey - and it’s up to you to act!**

**Set stretching targets!**

**The Technology is ready!**

**Seek inspiration and focus on the main things!**

# Q&A

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