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A technical approach to decarbonisation in the Food and Drink Sector

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Agenda

The Decarbonisation Challenge

GHG Emissions Reduction Strategy - Overview

Technical Approaches to Decarbonisation

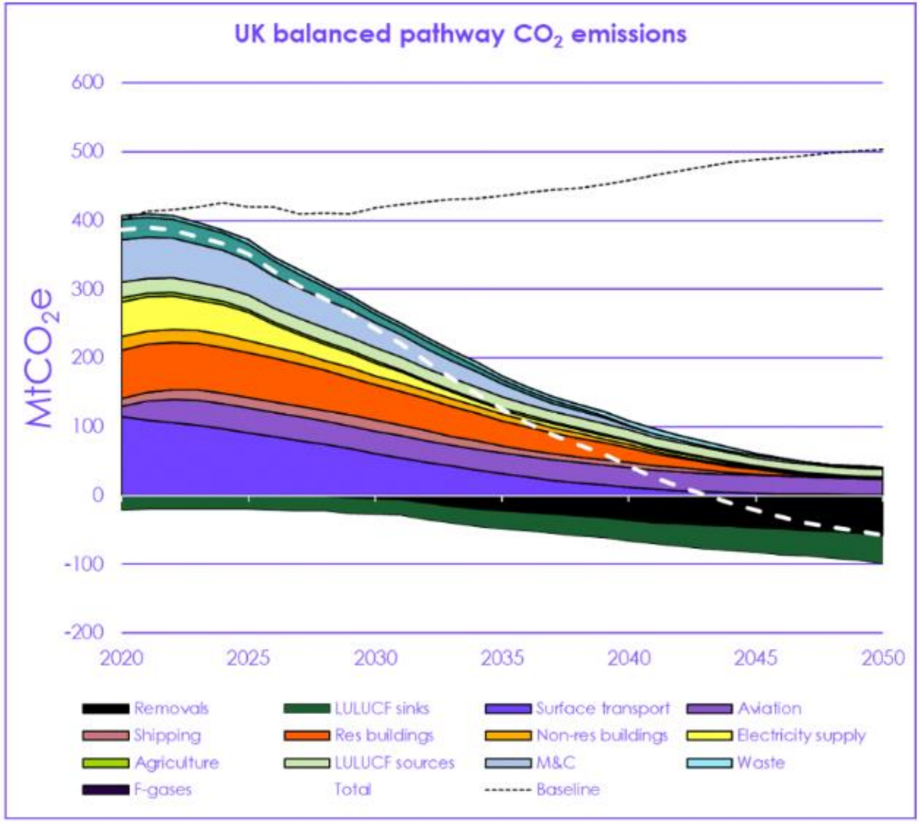
SLR's 5-Step Approach

Q&A

The Decarbonisation Challenge

Decarbonisation: The Challenge

- UK Government Targets
  - 68% by 2030 compared to 1990 levels
  - Net zero by 2050
- Climate Change Committee sets 5-year Carbon Budgets for the UK economy
  - Sixth Carbon Budget (2033-2037) requires 78% reduction in GHG emissions by 2025
  - Increase in low carbon solutions: electrification of transport, industry shift to electricity or hydrogen, increased uptake of CCU/S
  - Increase in low carbon electricity supply (zero carbon by 2030, was 2035), 40 GW offshore wind by 2030 and 100GW+ by 2050 (electricity demand set to double/treble by 2050.
  - Increase of use of hydrogen for shipping/transport/ industry
  - Reduction in demand for higher carbon activities (inc. implications for food and drink), reduced travel demand
  - Change in land use and increase in GHG removals.

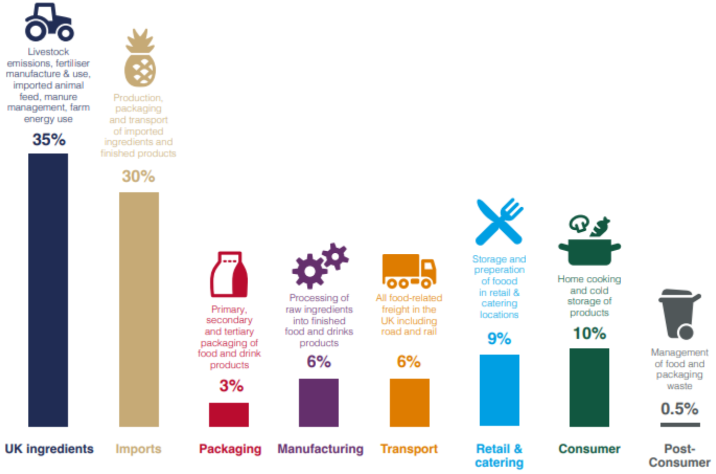


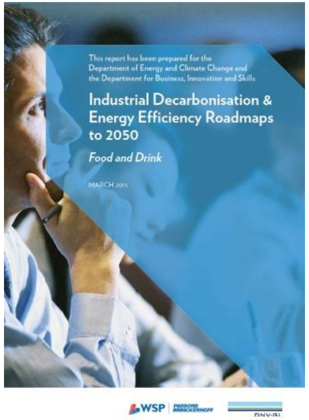
UK Food Sector – FDF and Sector Commitments

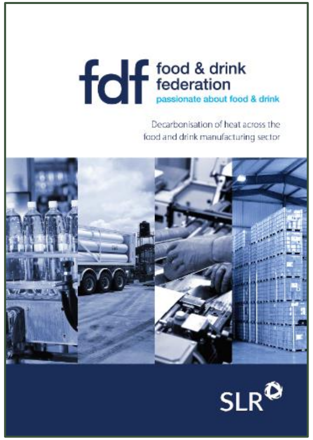
- FDF 2021 commitment to reach Net Zero by 2040
  - Ambition 2030: Contribute to a 50% absolute reduction in emissions across the agrifood supply chain by 2030 (2015 baseline)
- Requires rapid reduction in GHG emissions, with action <u>now</u>
- Other sector commitments:
  - Individual food and drinks companies have set Net Zero targets (e.g. Danone, Innocent, McCain, Nestlé and Tate & Lyle).
  - All major UK supermarkets aim to achieve Net Zero by 2040 at the latest (for Scope 1 & 2 emissions)
  - NFU's goal of Net Zero emissions across the whole of agriculture in England and Wales by 2040.

Energy Demand in the Food and Drink Sector

- UK's food and drink sector responsible for 158 million tCO_2 in 2019
- Approximately 22% of the UK's carbon footprint.
- Around two thirds of manufacturing energy demand is for thermal processing (heat)
- 97% of UK heat demand in the sector is met by gas







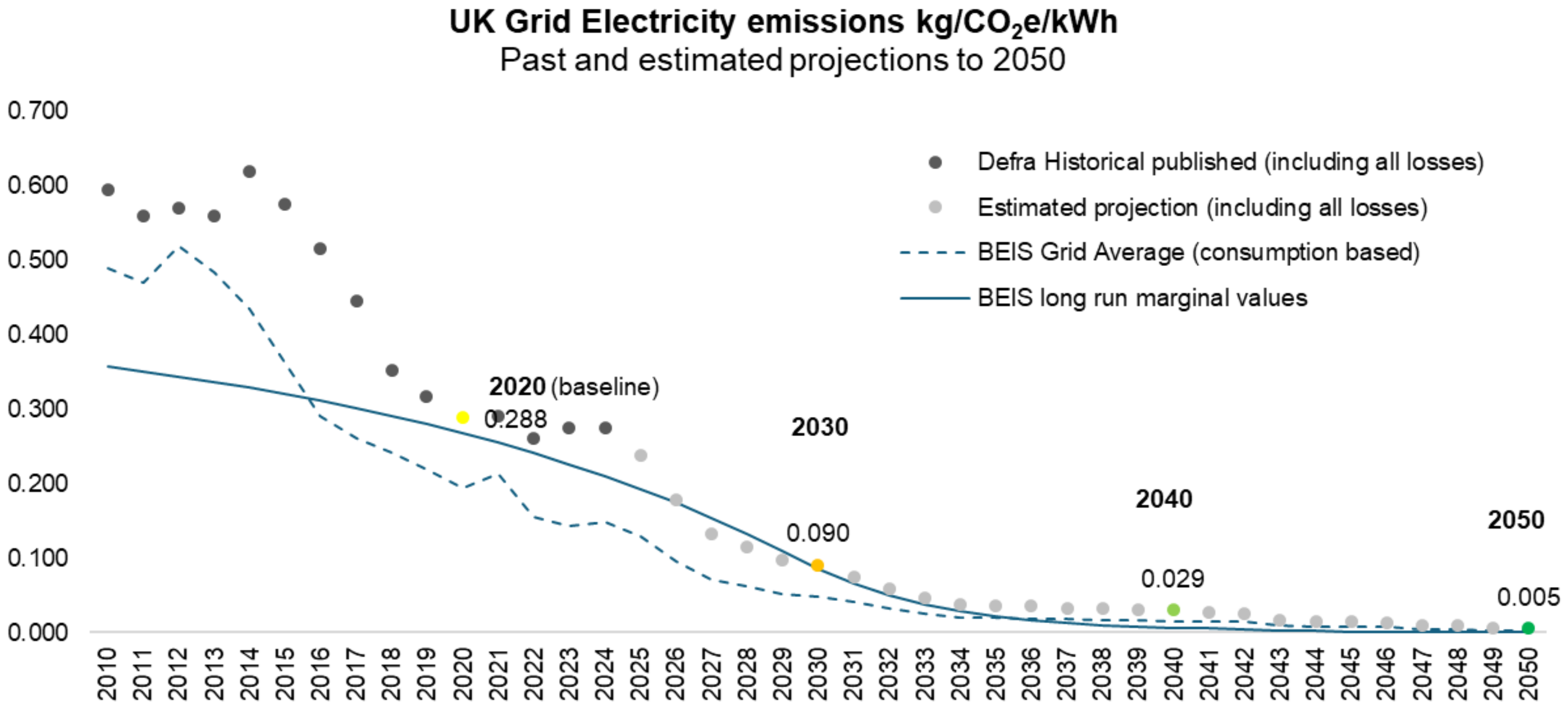
Energy Users in Food and Drinks Manufacture

- Electrical users
  - Process cooling (chillers, cooling towers)
  - Chilled and cold storage
  - Processing (mixing, stirring, grinding, conveying, etc.)
  - Pumping
  - Ventilation and air movement
  - Compressed air and vacuum
  - Building services:
    - HVAC
    - Lighting
    - Hot water

- Heat users (steam, hot water, thermal fluid, etc.)
  - Cookers
  - Kettles
  - Fryers
  - Ovens
  - Evaporators
  - Pasteurisers
  - Spray driers
  - CIP
  - Process hot water

Grid Decarbonisation: a primer

UK Electricity Generation Carbon Emissions Forecast



Based on DESNZ Projections, 2023

Decarbonisation of the Gas Grid

- UK gas grid based on natural gas (North Sea gas or imported LNG)
- Mainly methane
- Potential for decarbonisation of the UK blending <u>some</u> biomethane – ultimately limited by the availability of biomethane from AD/landfill gas
- Plans to blend in hydrogen into the gas grid:
  - Up to 20% could be accommodated with no changes to combustion equipment
  - 100% conversion would require major changes to all combustion plant and massive infrastructure upgrades to accommodate higher pressures required
  - Unlikely to happen due to safety concerns and availability of “green hydrogen” (electrification may win the argument)
  - Ultimately a national energy security policy issue.

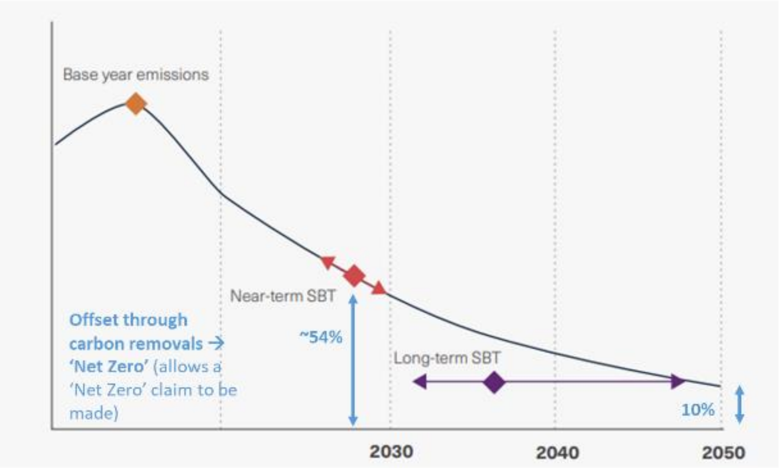
GHG Emissions Reduction Strategy

Steps to Decarbonisation

1. Discovery:
    1. Baseline Scope 1 (direct) and Scope 2 (indirect)
    2. Facility and process mapping – understand the carbon hotspots
    3. Setting targets – internal or externally disclosed, e.g. Science-Based Targets
2. Do the basics first!
    1. Maintenance
    2. Optimisation of plant and equipment
    3. Energy efficiency
3. Fuel switching
    1. Electrification
    2. Biofuels (Biomass/Biogas)
    3. Hydrogen / other fuels
4. On-site/off-site renewables or low carbon supplies
5. Scope 3 emissions…

Discovery Phase

- Scope 1 and 2 carbon footprint
  - Scope 1 - direct emissions – gas/fuel oils, transport fuels (where direct responsibility of user), F-gases and other GHGs
  - Scope 2 – indirect emissions – grid electricity, other imported energy, e.g. purchased heat or coolth
- Process mapping
  - Requires good data – sub-metering
    - Heat use by process stages
      - Steam/heat/coolth metering
    - Electricity use by processes and equipment
      - Sub-metering
    - Production inputs/outputs
    - Load curves and regression analyses
- Setting Targets
  - Targets are useful to focus attention and secure investment (capital/resources)
  - Internal targets or external? e.g. SBTi

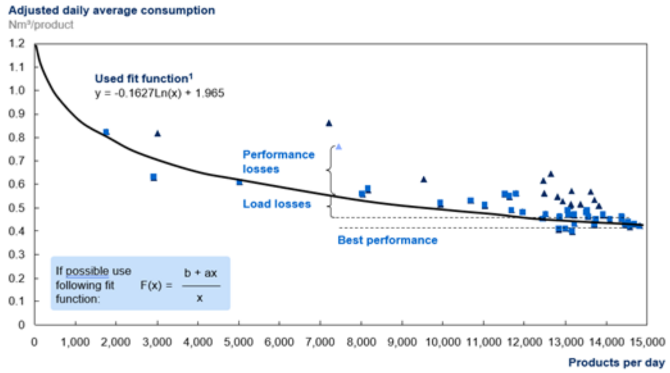


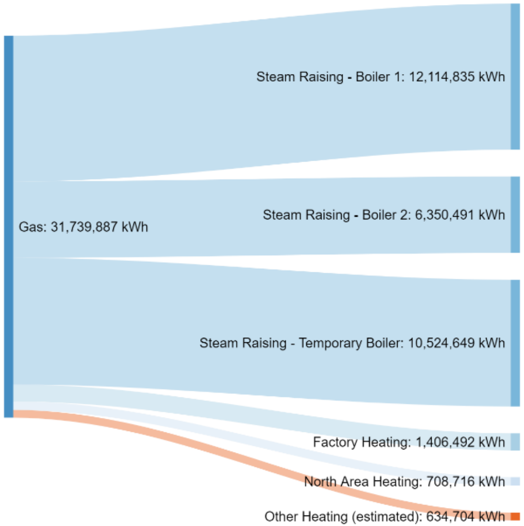
Technical Approaches to Decarbonisation

- Optimisation
- Energy Efficiency
- Fuel Switching
- On-site/off-site renewables

Doing the Basics

- Process Optimisation
  - What does "good" look like?
  - What is the absolute best the plant can manage? Why? Can we repeat it? How?
  - Operator awareness – how good is your data – and do operators know where to find it and how to interpret it?
- Maintenance
  - Sensor calibration and measurement and control accuracy
  - Cleaning of heat exchangers
  - Repairing compressed air leaks
  - Checking steam traps
  - Maintaining plant/pipework insulation
  - Optimisation of combustion efficiency, etc.





Energy Efficiency

- Low-cost investments:
  - LED lighting
  - Lighting controls
  - Improved plant insulation
  - Improved controls
- Medium cost
  - High efficiency motors
  - Variable speed drives (VSDs/inverters) on fans and pumps
  - Replacement/upgrading of heat exchangers
  - Implementation of heat recovery systems
- Higher cost
  - Replacement of older plant and equipment (air compressors, cooling towers, chillers, vacuum pumps, etc.)
  - Process change, investment in new production plant, etc.

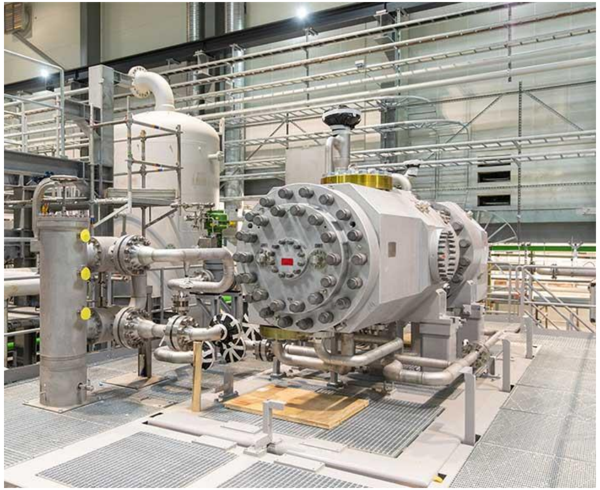
Fuel switching (1)

Gas has historically been cheap and low carbon (compared to oil or coal), but remains a carbon intensive fuel – so, what are the alternatives?

- Electric boilers
  - Simple, “front of pipe” solution, lower capex than alternatives
  - BUT! (very) high opex – recommend look carefully at steam demand and sizing before proceeding
- Heat storage boilers
  - Useful for storage of surplus renewable energy, peak lopping or buying cheaper off-peak electricity for use at peak times
  - Can generate steam, thermal oil, hot water
  - Low heat loss over 24 hours
  - Cheaper option than battery storage.

Fuel switching (2)

- Heat pumps
  - Established technology for low temperature heat demands
  - Higher temp options coming to market capable of steam generation up to 150°C or more (cascade systems, butane/pentane, ammonia, HFO refrigerants)
  - Can be used heat recovery between process streams – upgrade low-grade waste (e.g. condensate, cooling water, refrigeration systems) to higher grade process heat, including steam generation
- CHP
  - Offers better use of gas than stand-alone boilers + grid electricity and may save operating costs
  - Carbon savings are being eroded over time compared to grid – no longer considered a low carbon technology



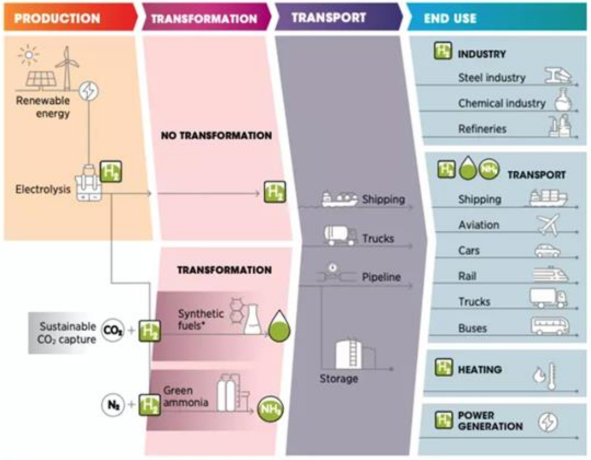
Fuel switching (3)

- Solid Biomass
  - Potentially a good option if you have a suitable biomass source which is low cost, sustainably sourced, etc.
  - May be more expensive than gas, but lower carbon (taking into account emissions associated with harvesting and transportation)
  - Also consider vehicle movements for fuel delivery, ash removal and disposal, local air quality issues, planning and permitting, etc.

- Anaerobic digestion
  - Food waste from manufacturing sites almost certainly already going to either animal feed or off-site anaerobic digestion
  - Why not use it to generate biogas on site?
  - Gas can be used in boilers from process heat, CHP, etc.

Fuel switching (4)

- Hydrogen
  - Unlikely to see widespread (grid-level) deployment
  - May be suitable for hard to decarbonise sectors or specific processes – e.g. direct fired ovens, fryers
  - Consider source ("colours") of hydrogen
    - "Grey" hydrogen from steam methane reforming vs "green" hydrogen from electrolysis driven by renewable electricity
  - Long term "green hydrogen" purchase agreements available
  - Can be blended with natural gas. Existing heating plant will require adaptation.
  - Issues around fire and explosion risk, low energy density, need for compression/gas tightness risks, NO_x, etc.



Fuel Switching for Food and Drink Heating Applications

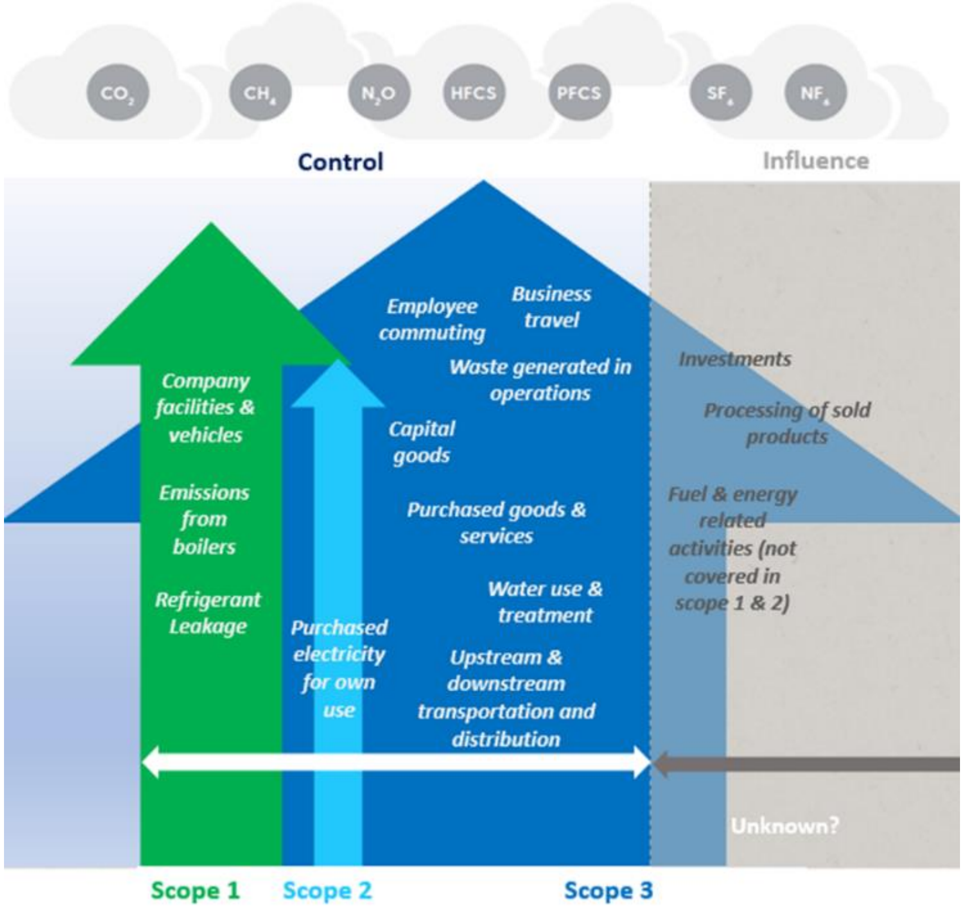
Application	Current Heating	Potential Decarbonisation Routes
Cookers	Indirect steam or hot water, thermal fluid or direct fired	Decarbonised steam, electrification (including microwave or RF)
Fryers (direct-fired)	Gas or LPG	Hydrogen (local) or electrification
Grills	Gas, LPG or electric	Hydrogen (local) or electrification
Kettles	Indirect steam or hot water	Decarbonised steam, electrification
Ovens (direct-fired)	Gas or LPG	Hydrogen (local) or electrification
Blanchers	Indirect steam or hot water	Decarbonised steam, electrification
Retorts	Steam or hot water	Decarbonised steam, electrification
Pasteurisers	Steam or hot water	Decarbonised steam, higher efficiency heat recovery, potential future microwave or RF pasteurisation technologies
CIP systems	Indirect steam or hot water	Decarbonised steam, electrification, heat recovery
Packing Lines	Electric, occasionally steam	Continued use of electricity,

On-site renewables (or off-site via PPA)

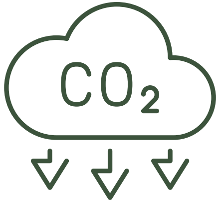
- Solar Photovoltaics
  - Costs have reduced and are still reducing
  - Low generation density – hard to make an impact in an energy-intensive manufacturing environment unless there is a lot of spare land (or water)
- Onshore Wind
  - Most cost-effective renewable technology, £/MW
  - Removal of planning restrictions should restart the market – need land and consistent windspeeds, suited to less urban areas
- Geothermal
  - Can be viable, in areas with suitable resources – high cost to extract – heat at ~95°C

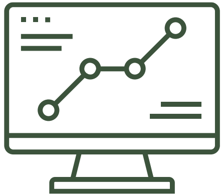
Scope 3…

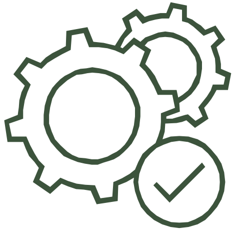
- **Scope 1** includes all direct emissions from owned or controlled sources
- **Scope 2** includes indirect emissions from the generation of purchased electricity/heat
- **Scope 3** includes all other indirect emissions that occur in a company's value chain.
  - Typically, Scope 3 makes up the majority of a carbon footprint and is the hardest to tackle.
  - Start with mapping, then improvements in data quality, then target hotspots



SLR – Five Steps to Decarbonisation







1

Understanding the position today – your emissions baseline

2

Developing your strategy – where do we need to be, and by when?

3

The Decarbonisation Roadmap – how are we going to get there, and how much will it cost?

4

Implementing the Decarbonisation Roadmap

5

Reporting – keeping on track and taking corrective action when needed

Do you have any questions?

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