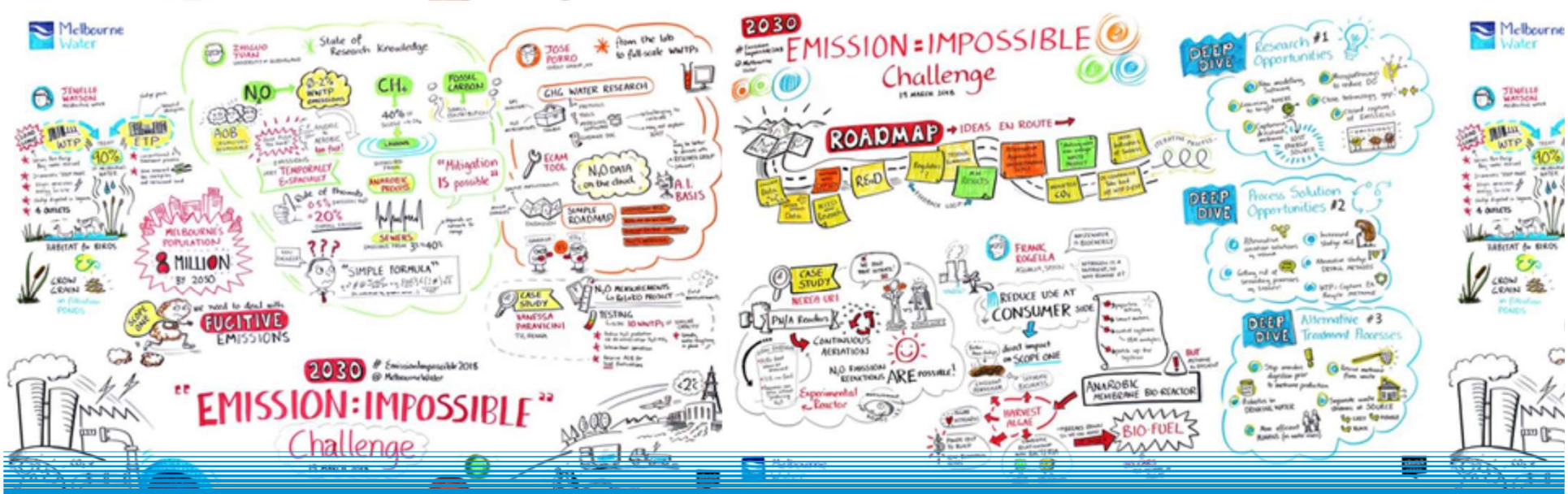


Emission Impossible

Outcomes

State Government Victoria

Melbourne Water

Executive Summary

Purpose

To bring together global and local expertise in a one-day workshop,

to identify innovative concepts to reduce direct greenhouse gas (GHG) emissions from wastewater treatment

Executive Summary

Background and approach

Melbourne Water has developed a pledge that is commensurate with its water sector carbon contribution and in consideration of an accelerated pathway to reach net zero emissions by 2030.

A multi-faceted program of work has been developed in order to meet this pledge. On 19th March 2018, Melbourne Water hosted an international "Emission impossible" workshop to identify and foster novel treatment and resource recovery ideas that meet licence discharge requirements whilst producing significantly less scope 1 emissions.

The workshop focused on four areas:

- Building a strategic roadmap towards reaching net zero emissions
- Identifying R&D gaps
- Process optimisation at ETP & WTP
- Alternative treatment approaches

Executive Summary

The Outcome

Key learnings from the workshop include:

- Quantification of GHG emissions is regarded as a necessary first step
- Development of modelling tools
- Investigate avoidance approaches
- Optimise the process

The outcomes of this workshop will provide focus areas and themes for an upcoming Innovation Challenge, and will also provide insights into novel concepts and approaches for further investigations.

Purpose & objectives

Purpose

To bring together global and local expertise in a one-day workshop, to identify innovative concepts to reduce direct greenhouse gas (GHG) emissions from wastewater treatment

Objectives

- Identify concepts to reduce Scope 1 direct GHG emissions
- Contribute to meeting the target of zero net emissions by 2030
- Connect with local and international organisations and individuals who are committed to reducing scope 1 emissions
- Identify potential future opportunities for collaboration to meet this challenge
- Provide direction for the development of a future innovation prize/challenge for innovative concepts for reducing Scope 1 direct GHG emissions

Project overview

2030

Zero net emissions

Approach

Emission Impossible Workshop

- Building a strategic roadmap towards reaching net zero emissions
- Identifying R&D gaps
- Process optimisation at ETP & WTP
- Alternative treatment approaches

Outcomes

Key learnings from the workshop include:

- Quantification of GHG emissions regarded as a necessary first step
- Development of modelling tools
- Investigate avoidance approaches
- Optimise the process

Feed into

Innovation Challenge Phase 2 Insights

Background

In response to the Paris agreement which sets in place a durable and dynamic framework for all countries to take climate action from 2020, the Victorian Government is rolling out a collective climate change policy initiative to reach net zero emissions by 2050. Melbourne Water has made a commitment to the Victorian State Government to achieve zero net carbon emissions from its operations by 2030 (Melbourne Water's Carbon Pledge). A significant proportion (approximately half) of Melbourne Water's greenhouse gas emissions are attributed to direct or fugitive emissions of nitrous oxide and methane from its wastewater treatment operations. At this point in time routine direct measurement of emissions and solutions for reduction are limited.

Background

To this end a multi-faceted program of work has been developed, which includes:

- A comprehensive literature review of GHG production, measurement, flux estimation and accounting schemes
- Development of miniaturised, aerial drone-based GHG sensors and algorithms
- Stakeholder consultation and planning for future update of federal GHG accounting
- Monitoring of nitrous oxide production in treatment processes to better understand process and operational factors influencing emissions
- Delivery of an international "Emission Impossible Challenge" workshop (this workshop) and innovation challenge (to be commenced) in 2018 to identify and potentially foster novel direct GHG emission reduction and measurement concepts

Approach

An 'Emissions Impossible' Challenge was held on the 19th March 2018, in order to help meet Melbourne Water's commitment to zero net carbon emissions. The Challenge comprised of a one day workshop aimed at identifying concepts and finding solutions to reduce direct greenhouse gas emissions (Scope 1 emissions) from wastewater treatment.

Expertise from around Australia and the world were brought together to identify and explore innovative ideas for both reduction and measurement of emissions.

Delegates participated in:

- Developing a roadmap
- Identifying research & development gaps and opportunities
- Identifying process optimisation opportunities at ETP & WTP
- Identifying alternative and radical approaches

The outcomes of this workshop will help inform a future program of works for Melbourne Water and contribute to the body of industry knowledge on Scope 1 emissions. These outcomes are provided in the following slides.

**Nb. This report presents a summary of the workshop delegates' raw input generated on the day. The outcomes have not been filtered or prioritised by Melbourne Water.*

Approach

As part of the Emission Impossible Challenge delegates also heard from a range of local and international speakers:

- Prof. John Thwaites – Chair Melbourne Water, Chairman Monash Sustainable Development Institue & ClimateWorks Australia
- Jenelle Watson – Manager Treatment & Resources, Melbourne Water
- Prof. Zhiguo Yuan (Director) – Advanced Water Management Centre, UQ: *State of research knowledge*
- Dr. Jose Porro (CEO) – Cobalt Water Global: *From lab to full scale*
- Nerea Uri (Research Engineer) – VCS Denmark: *Experiences mitigating N2O at Ejby Mølle WWRF*
- Dr. Vanessa Parravicini (Researcher) - Institute of Water Quality, Resources and Waste Management, TU Wien: *Reduction of direct N2O-emissions*
- Frank Rogalla (Director of Innovation) – Aqualia: *Carbon neutral treatment projects*

Discovery

Why are we here?

Why is it Important?

Roadmap

Work Streams	Short-term horizon (2020)	Medium term horizon (2025)	Long-term horizon (2030)
Measuring & Monitoring	• Monitoring and measurement program • Focus on large area sources • Understand what GHG emissions and risks are at a granular level • Study dissolved methane at WTP	• Modelling • What influences emissions at a process train level?	• Collate global data to introduce "smarter" GHG models • Using consistent and established protocols to improve process optimisation • Standardising carbon monitoring across the water sector worldwide
Technology, Process Innovation & R&D	• Investigate alternative processes • Research into influence of process configuration • Look at N2O risk and CH4 and follow risk roadmap to determine opportunities • Extensive literature review • Look at opportunities to enhance N2O removal with minor modifications • Investigate high rate algal ponds	• Investigate recovery from sewage (novel anaerobic digestion) • Divide waste streams • Struvite recovery • Decouple DO from aeration • Research collaboration partnerships • Implement N2O risk assessment tool • Implement process changes to minimise emissions while maintaining WQ standards	• Improve source control • Consider decentralised treatment options • Shift N process to fixed film • Examine new processes and technologies • Reduce demand and level of treatment e.g. primary treatment + deep ocean outfall like Sydney Water • Integrate water and waste management
Funding & costs	• Link GHG drivers to Trade Waste management and pricing • Prioritise opportunities based on cost vs % reduction	• Understand connection between scope 1 emission and operating costs • Understand cost implications to customer	• Using schemes as offsets and influencing EPA to approve them
Legislation & Regulation	• Develop a strategic framework	• Regulators committed to the target • Persuade regulators to change NGERS to reflect actual emissions	• Be able to negotiate with regulator to accept new products
Stakeholder Engagement	• Identify high water users and evaluate alternative	• Increased collaboration between MW, retailers, councils, government etc. • Awareness campaigns	• Increase visibility of N2O performance creates positive influence on culture • Work across industry to assess N2O risk and status quo • Educate community on issue

Roadmap

Work Streams	Short-term horizon (2020)	Medium term horizon (2025)	Long-term horizon (2030)
Measuring & Monitoring	Establishing a measurement and monitoring strategy. Then using the data for modelling and process optimisation.		
Technology, Process Innovation & R&D	Investigate new technologies and have a framework that allows effective technology adoption. With continued evaluation of new and current technologies.		
Funding & costs	Understanding costs to MWC and the consumer when choosing alternatives		
Legislation & Regulation	Have regulators as committed as you are.		
Stakeholder Engagement	Customer engagement on the issue to lessen issues at the source.		

R&D Gaps

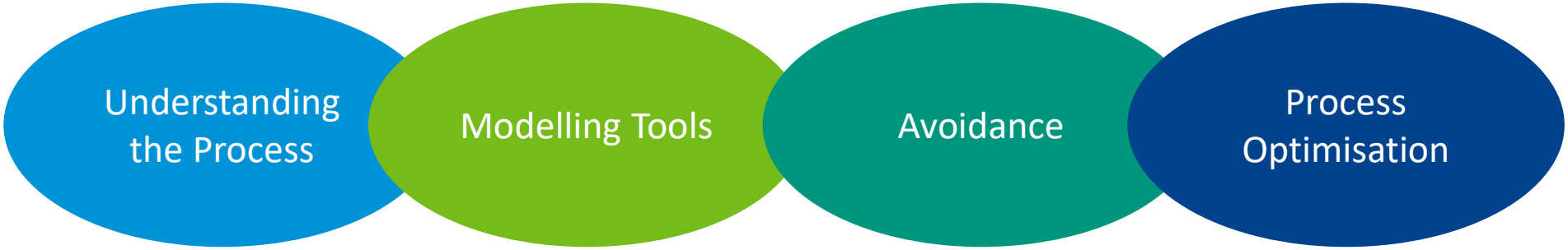
Common Themes

- Understanding the process
  - What is the proper instrumentation for monitoring and control?
  - Quantifying the baseline emissions for each stage
  - Influence of downstream processes
- Model validation
  - Quantify & validate N2O emissions
  - Building models
  - Predictive analytics
- N2O and CH4 capture technologies
- Avoidance
  - Minimising N input
  - Diverting large sources of NH3

Common Outcomes

- New models and modelling tools for emissions from the process
- New targeted control philosophies / automated controls
- Detailed understanding of the system as a whole
  - Locations and quantities of emissions
  - Effects on downstream processes

R&D Gaps



Quantifying emissions and **understanding** how they interact with **upstream and downstream processes.**

Developing **modelling tools** for process emissions.

What i**nstrumentation** is needed?

What parameters to **monitor/control**?

Predictive analytics.

Source separation.

Decentralised treatment.

Reduce treatment. (Ocean outfalls)

Monitoring and control of DO, pH, SRTs etc.

Automation.

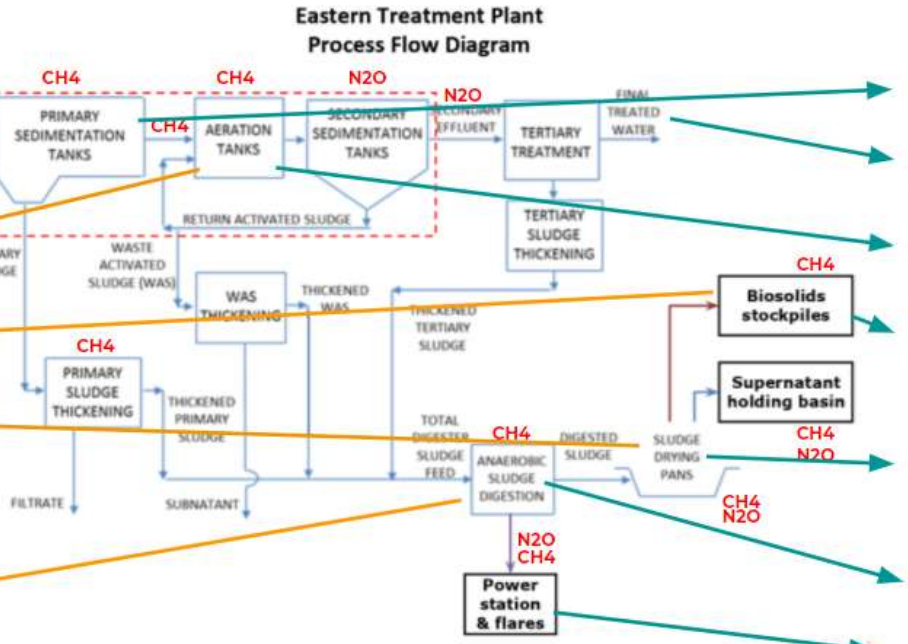
Resource recovery.

Where can **easy reductions** be made?

Eastern Treatment Plant – Process Optimisation

Mitigation

- **Reduce** sludge
- **Process optimisation** (DO, DRT, zone sizing, nitrite accumulation)
- **Reuse upstream**
- **Dissolved CH4**
- Improve process for **lower Volatile Solids** to the Sludge Drying Pans



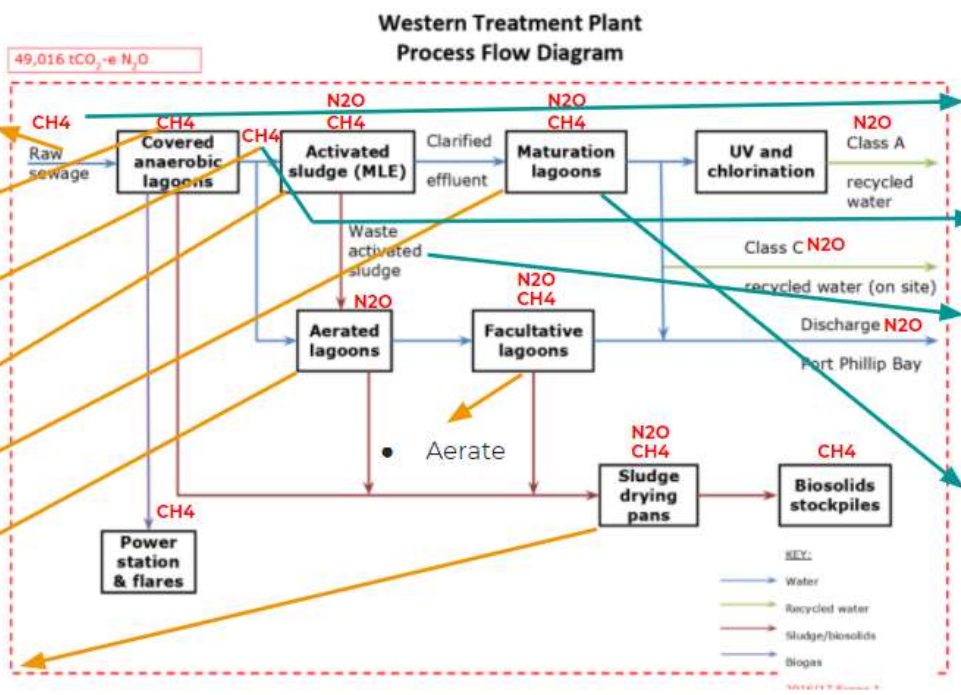
Elimination

- **Cover**
- **Extend outfall**
- **Reduce** treatment
- Cover and **process off gas**
- **Agri**/Compost
- **Alternate** drying method
- Mechanical Dewatering
- Incineration
- **Residual Digestion**
- **Eliminate leakage**
- **Avoid** natural gas use

Western Treatment Plant – Process Optimisation

Mitigation

- **Onsite** treatment
- **Chemically enhance**
- **Improve** digestion
- **Air stripping**
- Carbon diversion
- **DO control**
- Cover and capture
- Aerate
- Dredge
- **DO Control**
- **Thermal/Pressure** (Cambi, SCO, THP)
- **Dry Stacking**



Elimination

- **Avoidance**
- **Degassing**
- **Digestion**
- **Eliminate** this unit - use **advanced N/P process** and control O2 level

Alternative Processes

Common Themes	Impact on GHG Emissions	Additional Benefits

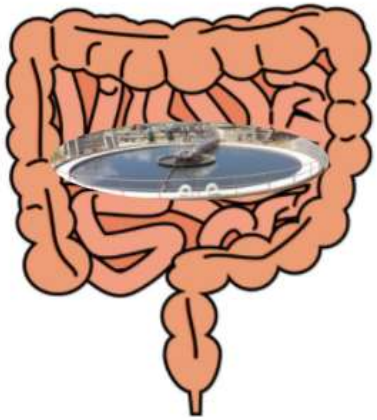
• Source Treatment
  ○ Household / precinct treatment
  ○ Pre-treatment of trade waste
	• Separation of waste streams
	• More targeted treatment
	• Avoid biological processes
	• Locally treated - not diluted
		• Community involvement
		  ○ Household / precinct treatment
		  ○ Targeted treatment

• Onsite Integrated Resource Recovery
  ○ Decentralised digestion
  ○ Advanced resource recovery
	• N irrigation displace fertiliser emissions
	• Reduce treatment burden
		• Local harnessing of energy
		• Reduced transfer costs
		• Circular economy
		• Community involvement

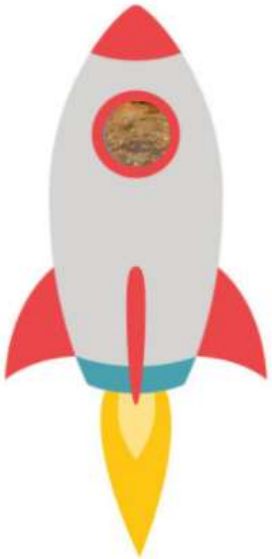
• Preclude digestion in AD process prior to biogas generation • Using algae	• Generate high value products (e.g. proteins, Volatile Fatty Acids) instead of low value products (CH4 and CO2)	• CH4 not produced • Reuse of nutrients • Lower energy consumption

Alternative Processes

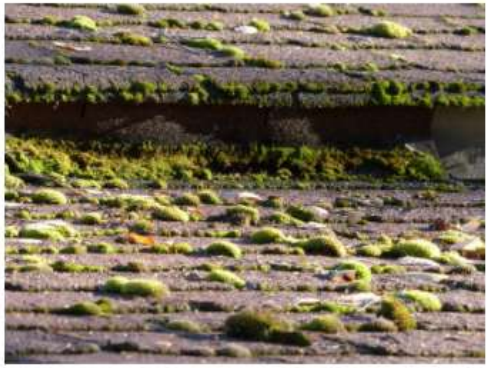
Digestive System Pre-treatment



Load it into space



Algae roofs



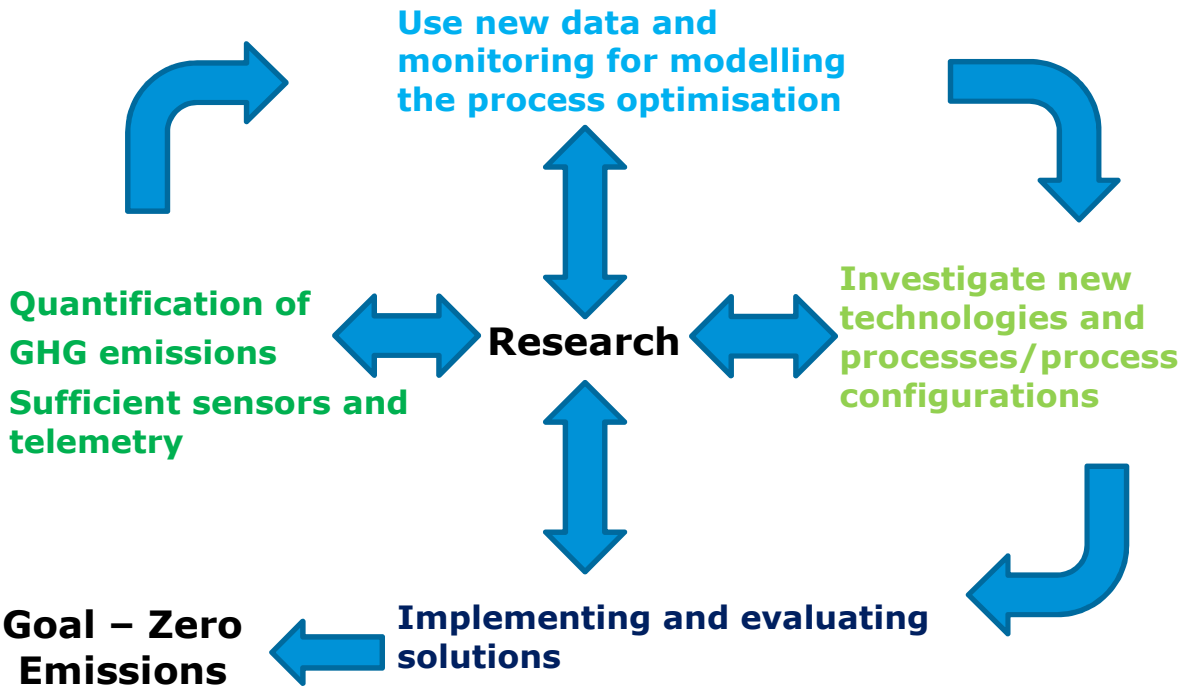
Next Steps

Research

Baseline

Monitoring

Prioritise



Innovation Challenge

- Following the recent 'Emissions Impossible' workshop Melbourne Water will be running an Innovation Challenge.
- The outcomes of this workshop will provide focus areas and themes for the Innovation Challenge, and will also feed into Phase 2 of this initiative by providing insights into novel concepts and approaches for further investigations
- Themes can include the following areas:
  - Emissions quantification
  - Emissions modelling tools
  - Avoidance approaches
  - Process optimisation