Project number 327341
ACT – Accelerating CCS Technologies

SCOPE - Sustainable OPEration of post-combustion Capture plants

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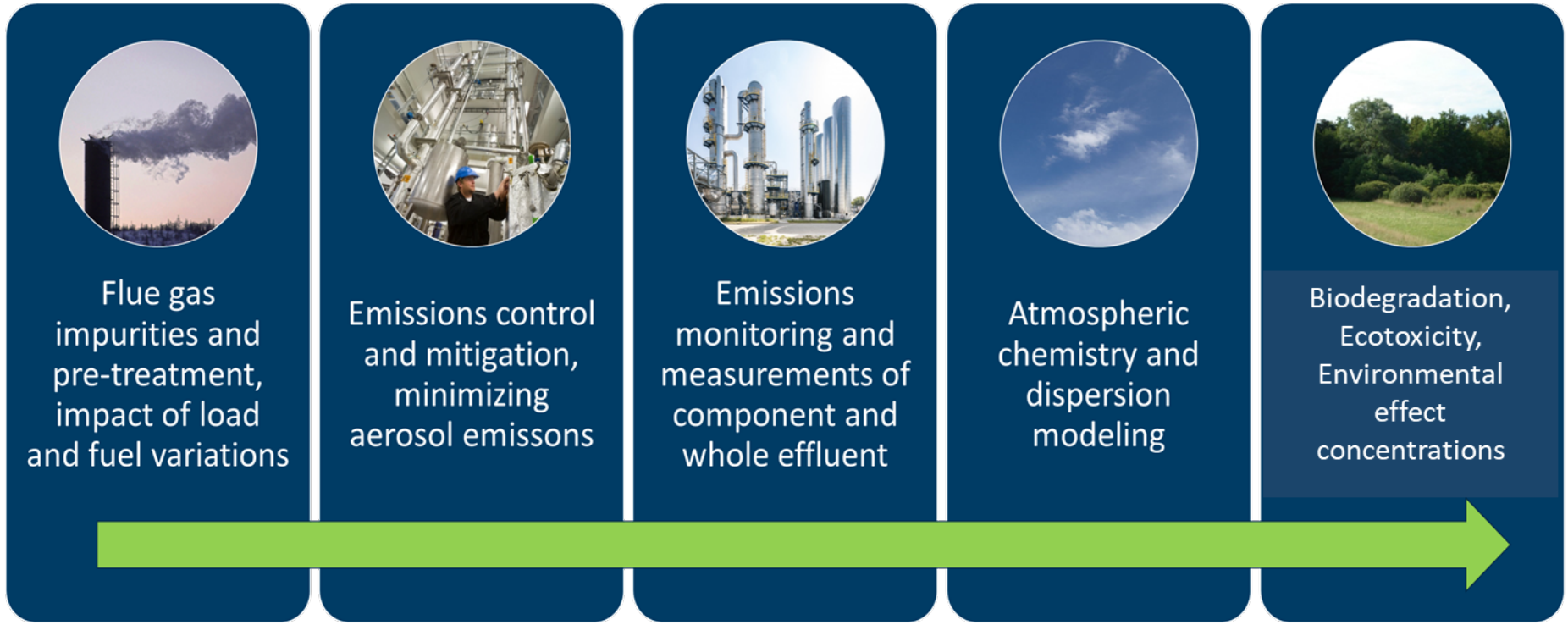
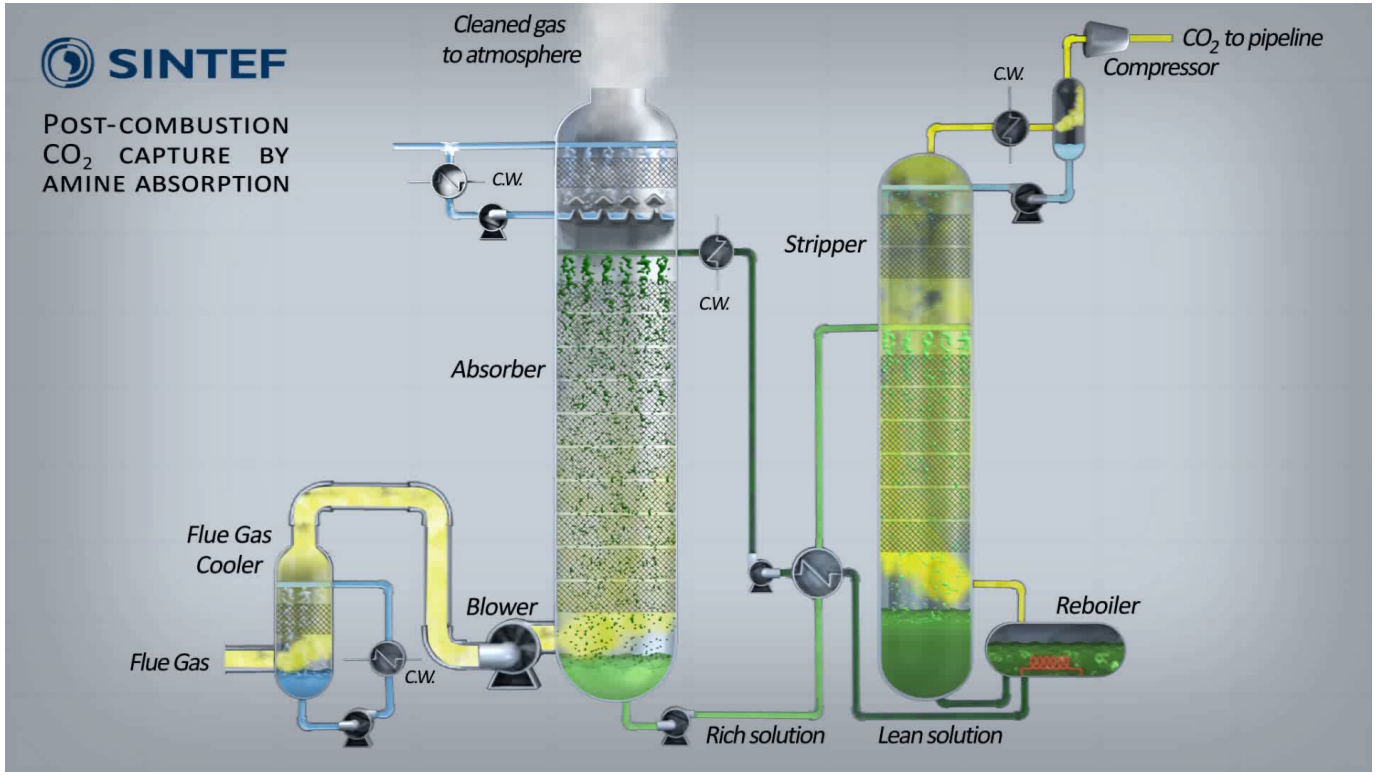
SCOPE – Sustainable OPEration of post-combustion Capture plants

Building upon ACT 1: ALIGN-CCUS and ACT2: Launch: Follow the continuous path of the treated gas from source to recipient and ensure a sustainable and environmentally safe operation of the capture plant

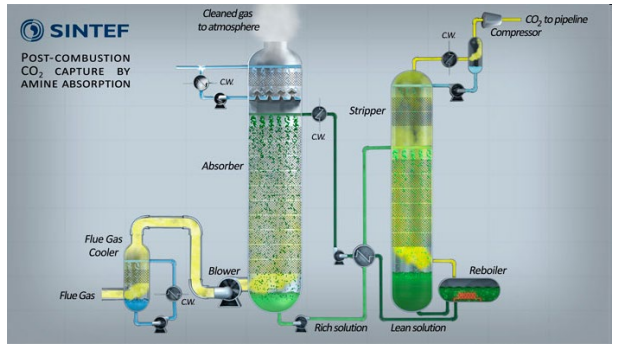


Solvent emissions from a CO_2 capture plant

- Two main mechanisms:
  1. **Volatility** of amine
  2. Via the formation of **aerosols** containing amine
- Aerosol formation may lead to amine excessive amine emissions >100 ppm or more
- Focus on emissions of amine and degradation products:
  - **Low amine emission limits to be expected**
  - **Essential that CO_2 capture plants are environmentally safe and well regulated**



Solvent emissions from a CO_2 capture plant *cont.*



Plant design, solvent management and control, regulation, emission limits

Local or long distance transport in the atmosphere

Reactions and partitioning in the atmosphere

Fate and degradation rates in the environment

Acceptable concentration for components in the environment?

Our vision and impact

At the end of the SCOPE project:

1. **Plant operators** will have access to **new tools and data**;
2. **Authorities** will have **new regulatory guidelines** for setting environmental quality and health standards;
3. **Decision-makers** seeking to support CCUS commercialisation will have clarity on the **governance requirements** needed to secure a social license to operate in diverse national settings.

Main focus areas

1. SCOPE will **develop efficient online monitoring systems** and effective management guidelines for emissions control.
2. SCOPE will **improve the predictions of amine emissions** from CO_2 capture plants by further development of existing models and validating them against **high quality pilot plant data.**
3. SCOPE will integrate science on environmental impact to **support risk assessment** of amine-based CO_2 capture plants
4. SCOPE will determine policies and practices that strengthen public trust in the governance of amine-based CCUS and establish a **Stakeholder, Policy, Research and Industry NeTwork** (SPRINT) forum to facilitate discussions aimed at closing important knowledge gaps for advancing large-scale deployment of CCUS solutions.

SCOPE: test facilities

- Small pilots to larger demonstration plants

Tiller CO_2 Lab (SINTEF IND), NO

Biomass or propane incineration:
30-40 kg CO_2/h
Solvent: CESAR1
Flue Campaign operation
gas: CO_2 11vol.-%, O_2 4vol.-%,

Alkmaar (HVC), NL

Waste-to-energy plant 540 kg CO_2/h
Solvent: MDEA/Piperazine blend

Flue gas: CO_2 15,3 vol.-%, O_2 5,6 vol.-%,

24/7 operation.

SCOPE: test facilities (*cont.*)

- Small pilots to larger demonstration plants

Niederaussem (RWE), DE

Lignite-fired power plant: 300 kg CO_2/h / Solvent: CESAR1 (blend of AMP and PZ))
Long-term test campaigns
Various emission mitigation tools

Hengelo (Twence), NL

Waste-to-energy plant 500 kg CO_2/h

Solvent: 30% MEA,

Flue gas: CO_2 9,5 vol.-%, O_2 8,3 vol.-%,

24/7 operation.

SCOPE: test facilities (*cont.*)

- Small pilots to larger demonstration plants

Tuticorin site, India

Alkali Chemicals and Fertilizers: 60 kt CO_2/a
Solvent: CDRmax (Proprietary solvent of Carbon Clean Ltd)

Flue gas: CO_2 ~ 12 vol.-%, O_2 8 vol.-%,

24/7 operation

SCOPE: Overview

- ❑Project period:
  - ✓01.10.2021-30.09.2024
- ❑Estimated project cost:
  - ✓6 044 881 €
    3 703 477 € funding from ACT)
- ❑Partners:
  - ✓ 19 from 4 European countries
    (Norway, Netherlands, UK, Germany)
  - ✓3 from India
  - ✓2 from USA

#	Partner name	Partner short name	Partner country
1	SINTEF AS by its institute SINTEF Industry	SINTEF IND	Norway
2	SINTEF Ocean AS	SINTEF OC	Norway
3	NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET	NTNU	Norway
4	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK	TNO	The Netherlands
5	Imperial College	IMPERIAL	UK
6	RWE Power Aktiengesellschaft	RWE	Germany
7	Total Energies EP Norge AS	TEPN	Norway
8	University of Sussex	SPRU	UK
9	Heriot-Watt University	HWU	UK
10	NILU	NILU	Norway
11	Technology Centre Mongstad	TCM	Norway
12	Herøya Industripark	HIP	Norway
13	Hovyu	Hovyu	The Netherlands
14	Twence B.V.	Twence	The Netherlands
15	HVC	HVC	The Netherlands
16	Linde Gmbh, Linde Engineering	Linde	Germany
17	OGT	OGT	USA
18	Guru Gobind Singh Indraprastha University	GGS IPU	India
19	National Energy Technology Laboratory	NETL	USA
20	Environment Agency	EA	UK
21	Indian Institute of Technology Kharagpur	IITKGP	India
22	Microfilt India Pvt. Ltd.	MIPL	India
23	Cambridge Environmental Research Consultants Ltd.	CERC	UK
24	Aker Carbon Capture	ACC	Norway

TRL4 - 5 → TRL6 - 7

Preparation for demonstration

TNO, SINTEF, NTNU, Heriot Watt University, hovyu, CCSI², Technology Centre Mongstad – catching our future, TOTAL, Microfilt, Guru Gobind Singh Indraprastha University, OGT, Linde, hvc energie en hergebruik, HERØYA INDUSTRIPARK, Twence, RWE, AKER CARBON CAPTURE

Technology Demonstration

Twence, RWE, hvc energie en hergebruik, Linde, Microfilt, SINTEF, Guru Gobind Singh Indraprastha University, Heriot Watt University, TNO

Environmental impact assessment

Imperial College London, SINTEF, NILU, Guru Gobind Singh Indraprastha University, CERC, Technology Centre Mongstad – catching our future, TOTAL, HERØYA INDUSTRIPARK, Environment Agency, AKER CARBON CAPTURE

Deployment of amine based CCUS projects

Societal impact, risks, barriers, techno-economics and SPRINT Forum

University of Sussex, TNO, SINTEF, Microfilt, Twence, hvc energie en hergebruik, AKER CARBON CAPTURE, Imperial College London, hovyu, Technology Centre Mongstad – catching our future, Guru Gobind Singh Indraprastha University, RWE, Linde, TOTAL, HERØYA INDUSTRIPARK

Societal readiness and Plan for Exploitation

Project management, administration and external communication

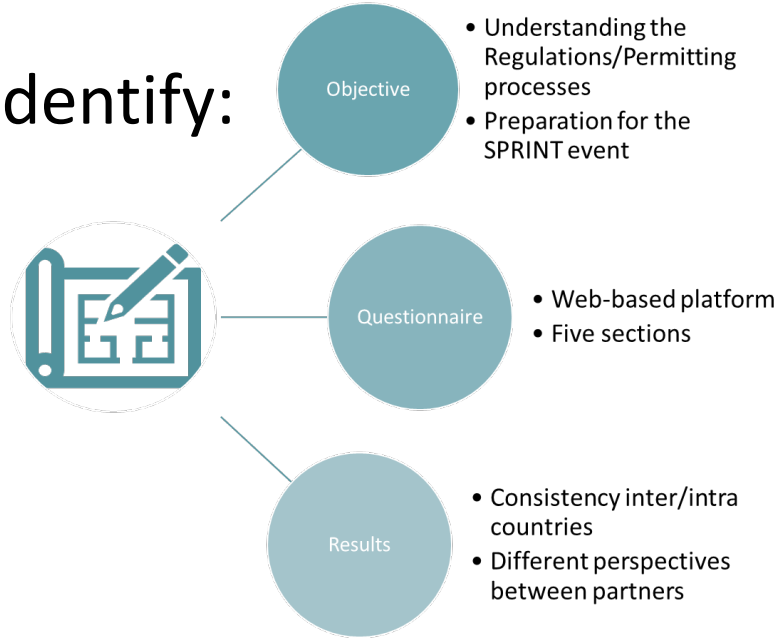
SINTEF, TNO, RWE, Imperial College London, University of Sussex, Guru Gobind Singh Indraprastha University, CCSI²

SPRINT (Stakeholder, Policy, Research and Industry NeTwork) forum - events

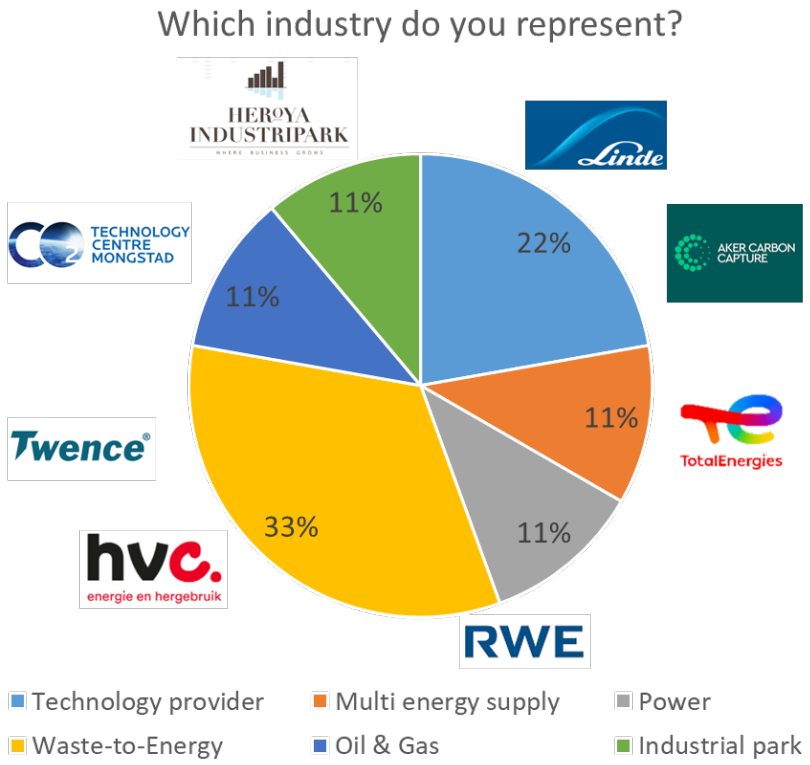
- Six SPRINT events over the course of the project will be organized, encompassing, workshops, symposium/courses and site visits to pilot projects
  - **Event #1:** Local workshop, “Regulations, Permitting and a Review of the Guidelines for Emissions Control” workshop (TCM | 3rd May 2022)
  - **Event #2:** Local workshop, “Developing best practices for emissions control,” with site visit to a WtE plant (RWE, Linde | M12).
  - **Event #3:** Local workshop, “Mitigating environmental impacts" (GGS IPU, MIPL | M18)
  - **Event #4:** Global symposium, “Review of SCOPE progress and preliminary findings” (SINTEF IND | M21)
  - **Event #5:** Local workshop, “Emission mitigation technologies for post-combustion capture plants” (TNO, Twence/HVC | M31).
  - **Event #6:** Global symposium, “SCOPE: Project results and recommendations for future research and policy initiatives.” ” (IMPERIAL | M36).

SPRINT event # 1: Regulations, Permitting and a Review of the Guidelines for Emissions Control

- Invited keynote speaker: Ling Yuan Hem, case officer for Fortum Oslo Varme's waste-to-energy CCS project at the Norwegian Environmental Association
- Results of a (internal) stakeholder survey to identify:
  - Consistencies and differences in regulatory and permitting processes across five European countries
  - Variations in levels of state support for carbon capture technologies



Identification and main conclusions



Main conclusions

- Capture plant operators have to comply with a wide variety of regional, national and international regulations
- In all surveyed countries where a specific permit is needed to operate a capture plant, the requirements are considered **clear** and the processes are **described as extensive**.
- The event provided important background for the work in SCOPE on **harmonizing the regulatory environment** for carbon capture by establish recommendations to improve the legitimacy of capture projects and regulation

Acknowledgements

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