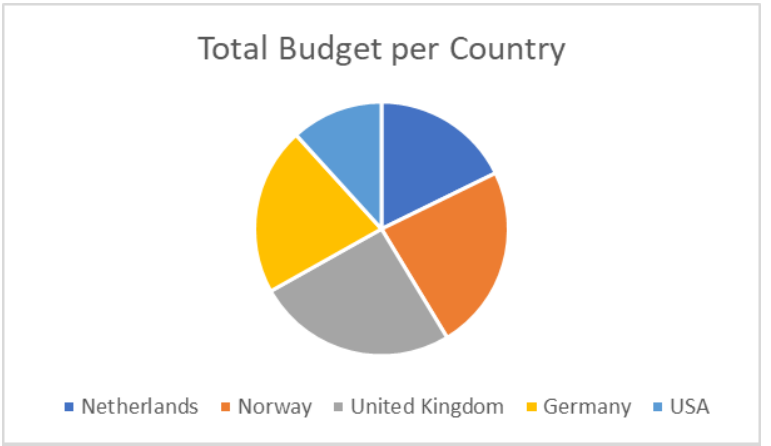
Project overview and results

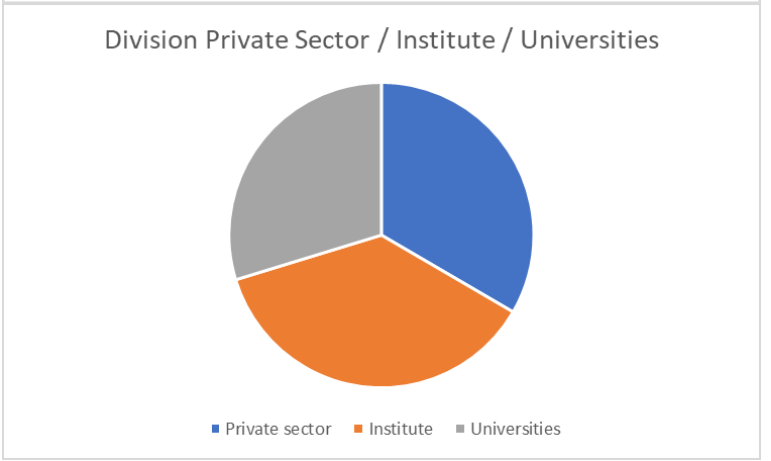
Peter van Os, TNO, Project Coordinator

The LAUNCH Project

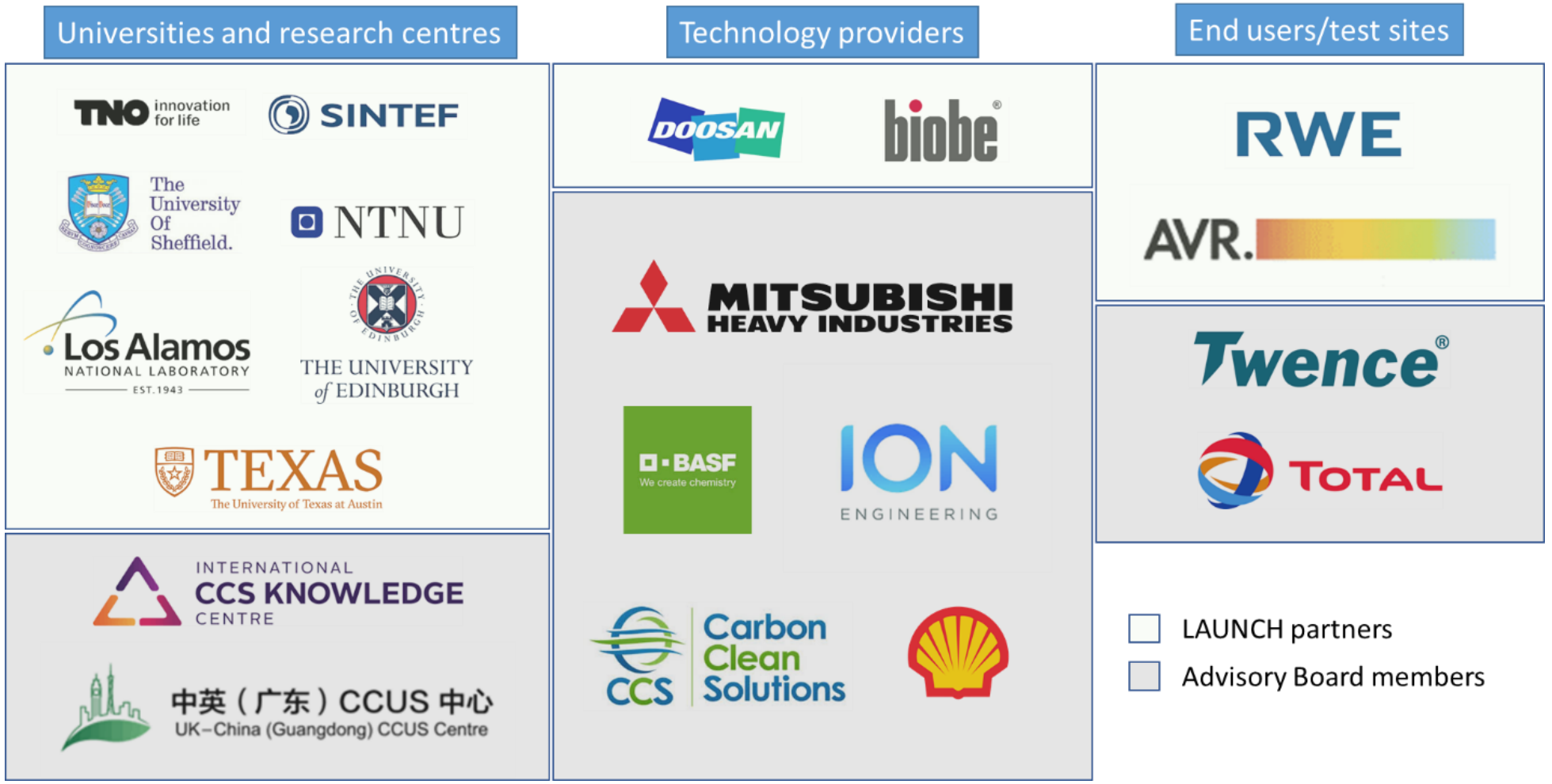
Lowering Absorption process UNcertainty, risks and Costs by predicting and controlling amine degradation

- 11 partners from NL, UK, DE, NO, USA
- Total budget: € 7.248.625
- Total funding: € 5.090.849





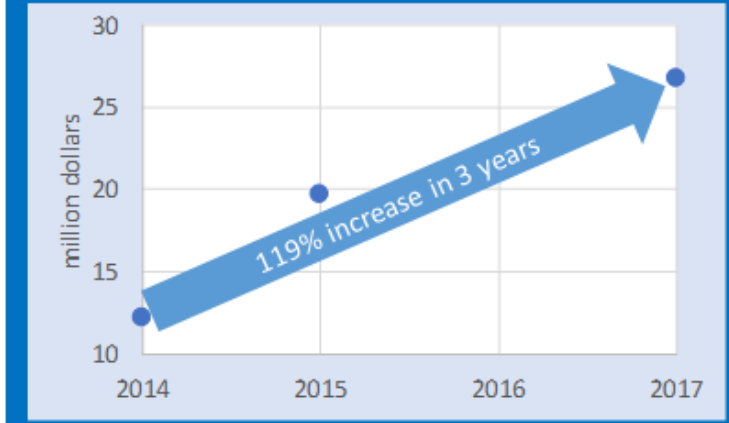
The LAUNCH Consortium



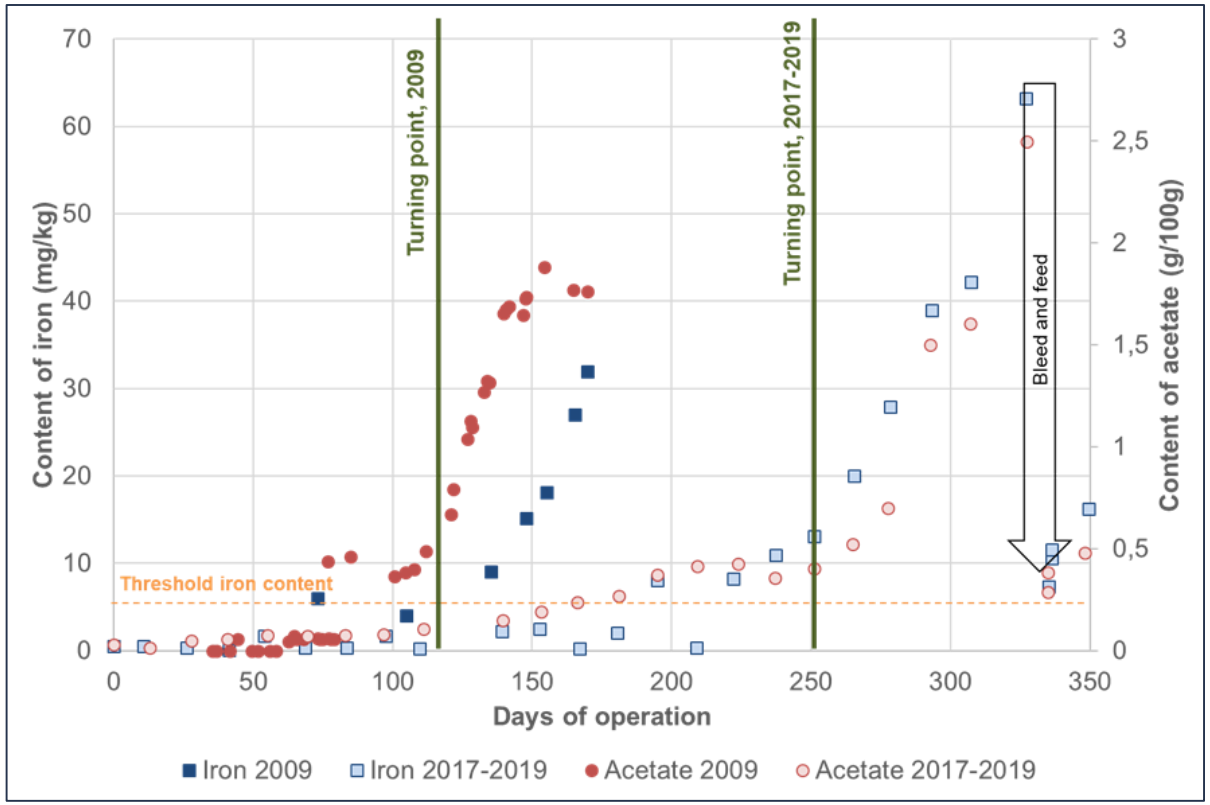
The ISSUE LAUNCH want to tackle

The costs of degradation – A real-life, full-scale example

The CCS facility at Boundary Dam Three (BD3), is a real-life full-scale example of how costly degradation can be. BD3 has reported that the costs of operation and maintenance are much higher than anticipated, because the solvent degrades more quickly than expected [25]. As a result, the BD3 operation and maintenance costs have risen from $12.2 million in 2014 to $26.7 million in 2017 [26].



BD3 operation and maintenance costs



The results of the MEA campaign at the RWE pilot plant in Niederaussem within the ALIGN project are a perfect example of the importance of the chosen process conditions. The degradation "turning point" was only achieved after 250 days of operation. This is a major contrast with the 2009 MEA campaign run at the same plant, in which the turning point was reached at around 100 days of operation.

The LAUNCH GOAL

Development of **The LAUNCH Solvent Development Protocol** → This protocol will be made **public**.

This protocol will include:
Guidelines for using the LAUNCH-developed solvent degradation database and the degradation network model for pre-evaluating solvents and management strategies;

Guidelines for solvent testing and the drawings of a generic LAUNCH test rig.

The LAUNCH Objectives

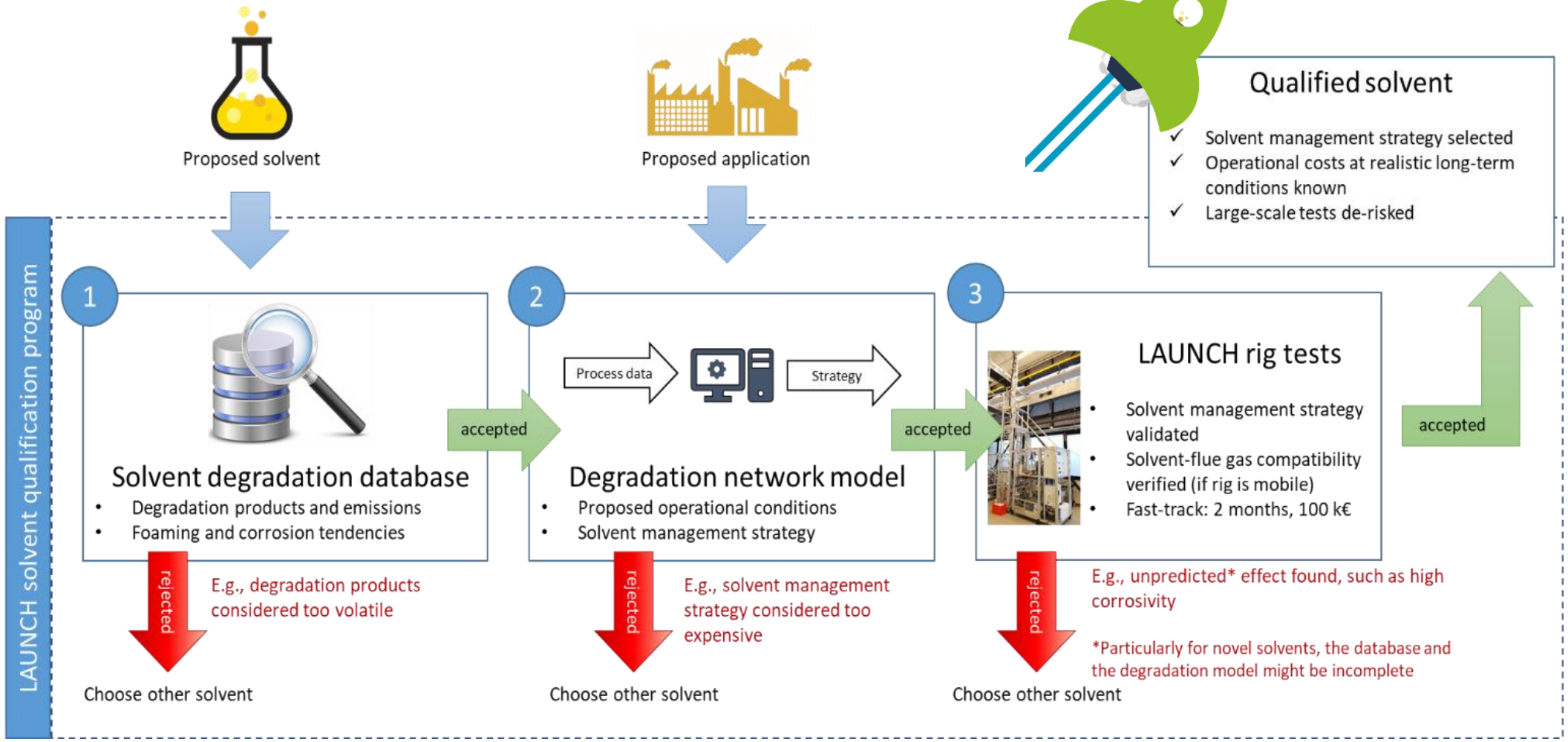
Main Objective:
Accelerate the implementation of CO2 capture in various industries and support the development and qualification of novel solvents by establishing a fast-track, cost-effective de-risking mechanism to predict and control degradation of capture solvents.

Sub-objective #1:
Developing the ability to predict degradation of (novel) CO2 capture solvents.

Sub-objective #2:
Developing strategies to control degradation, minimizing solvent loss and therefore the environmental impacts of CO2 capture.

Sub-objective #3:
Sub-objective #3: Developing and demonstrating the LAUNCH solvent qualification program.

LAUNCH Solvent Qualification



Work packages in LAUNCH

	Name	Participants (**Leader**)	
WP1	Predicting degradation	**SINTEF IND**, NTNU, TNO, RWE, UnivShef	Andreas Grimstvedt
WP2	Controlling degradation	**TNO**, LANL/UT, RWE, Biobe, NTNU	Juliana Monteiro
WP3	Closing degradation knowledge gaps	**NTNU**, SINTEF IND, LANL/UT	Hanna Knuutila
WP4	Development of LAUNCH solvent qualification program	**UnivShef**, TNO, SINTEF IND, NTNU, LANL/UT, DOOSAN, UEDIN	Jon Gibbins
WP5	Demonstration of LAUNCH solvent qualification program	**RWE**, AVR, LANL/UT, TNO, NTNU, UnivShef	Peter Moser
WP6	Techno-economic evaluation	**DOOSAN**, TNO, RWE, BIOBE	Jonathan Slater
WP0	Management, dissemination and exploitation	**TNO**, SINTEF IND, NTNU, UnivShef, UEDIN, RWE, DOOSAN	Peter van Os

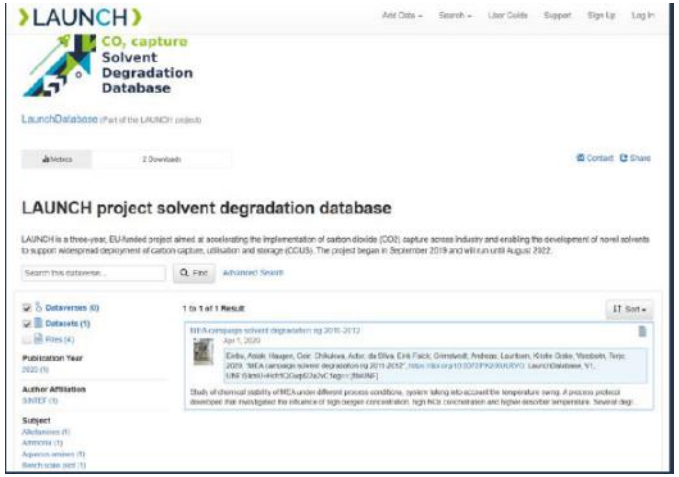
LAUNCH Predicting Degradation

Setting up a searchable database with plant data, gathered from literature, experiments and other projects. Made public at the end of the project.

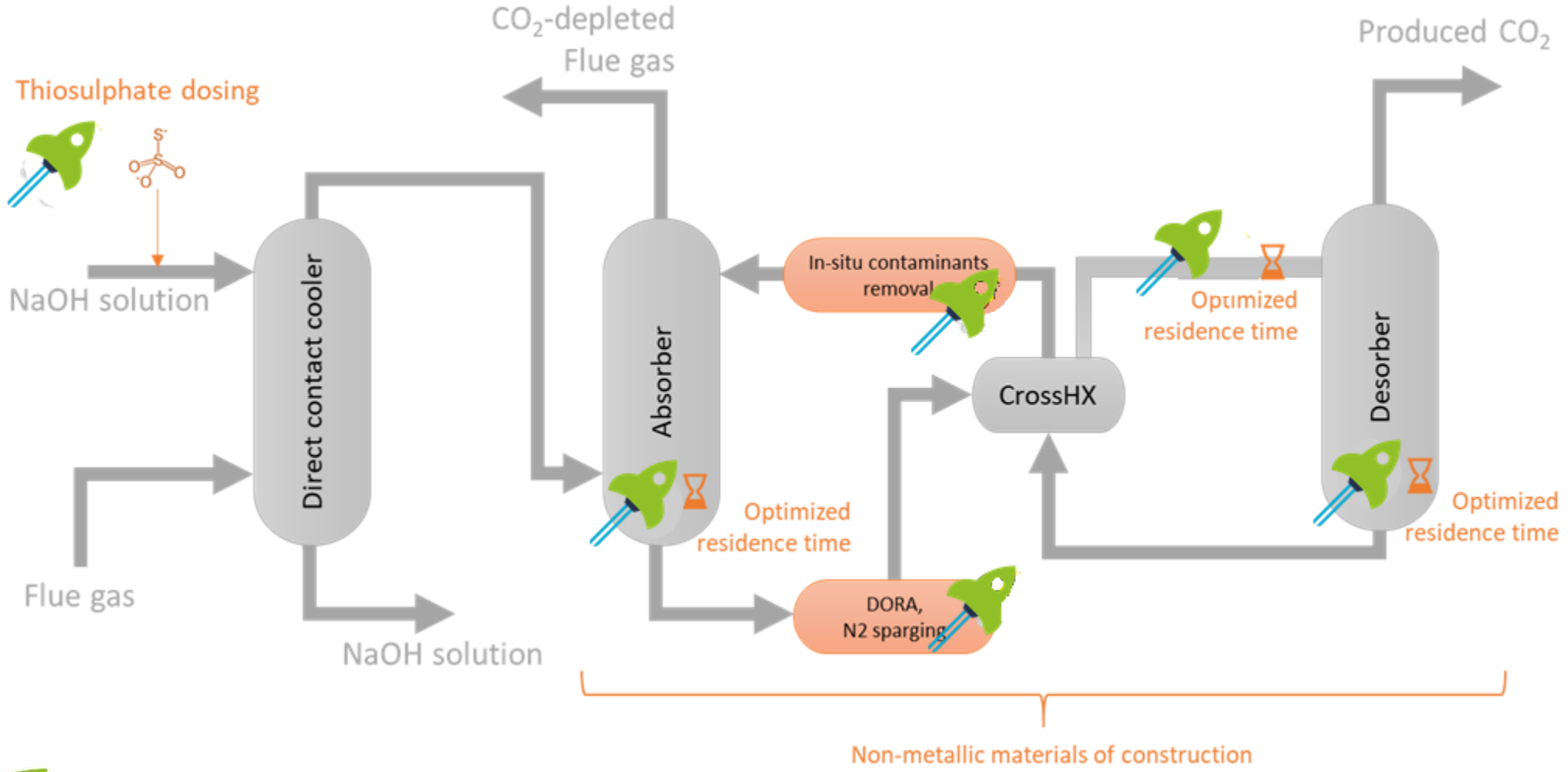
Data base has been created. First data is going in and will be further extended in the LAUNCH project. Data will be used to develop models.

Development of models to predict degradation as function of flue gas and plant design. The model will be validated within LAUNCH and made public at the end of the project. This can serve as a screening tool for potential solvents.

First version has been developed and will be extended and refined. First big dataset being analyzed.



LAUNCH Technology Development



LAUNCH Technology Development

Thiosulphate dosing: To remove NO2 from the flue gas. Installation and demonstration at the SO2 scrubber at RWE.

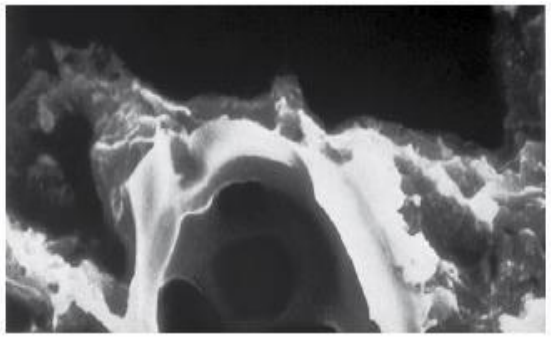
Design, installation and demonstration at the SO2 scrubber at RWE done. First test campaign in 2019, further tests delayed due to COVID-19. Tests also planed at NCCC with PZ.

In-situ contaminate removal: In situ iron removal will be developed at lab scale and validated at pilot scale at RWE and the NCCC pilot.

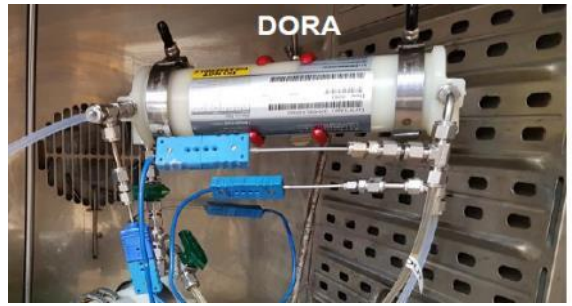
In situ iron removal tests ongoing in lab. Activate carbon selected, fist results promising. At the moment a unit for the TNO mini plant is being constructed for testing different solvents. Further demonstration at RWE. Experiments with removal contaminates from PZ at University of Texas. Corrosion experiments at University of Texas.

DORA: Upscaling and demonstration for 2nd and 3rd generation solvents at RWE.

On site tests with real flue gas completed (+3000 hrs of operation). Ability to control degradation is proven. New membrane material identified and should lead to better performance, longer operation. Testing with other solvents (CESAR1) in preparation.



Solid adsorbents



DORA membrane module

LAUNCH Technology Development

Non-metallic materials of construction: An non-metallic rig will be build to run corrosion free degradation studies.

P&ID and component selection completed. All contact areas non-metal. Columns, packing, demisters, Pumps, heat exchangers, reboiler, Temperature, flow, pressure and level sensors. Commissioning May 2021 at TNO.

Thermal and Ion-Exchange reclaiming tests included in programme.

Lab scale reclaiming experiments being carried out with degraded MEA from a WtE facility in The Netherlands. Up to 85% MEA recovered, further analysis of samples to be carried out. Reclaiming setup and experiments for TNO mini plant also being designed. An Ion-Exchange reclaimer will be tested at RWE Q1 next year for two solvents

Thermal reclaiming lab tests

Ion Exchange reclaiming

LAUNCH Solvent Qualification

Demonstration by experiments at multiple scales:

- The LAUNCH rigs (up to 25 kgCO2/day)
- PACT
- RWE pilot
- AVR full scale plant
- NCCC test facility

New Solvents:

Thermal degradation testing of water lean solvents and high concentration MEA in lab ongoing. No firm conclusions yet.

Qualification of LAUNCH rigs to evaluate solvent degradation.

Comparison of degradation profiles at different scales in controlled circumstances. Qualifications of rigs ongoing (concentrated MEA 35%). Campaign at TNO started, campaign at PACT delayed due to flooding at Pact and COVID-19.

LAUNCH Technology Development and Solvent Qualification

Head to head campaigns with solvent rigs at RWE and AVR. CESAR1 operated in RWE pilot plant for more then 12000 hours (continuation from ALIGN-CCUS campaign. Very stable operation during the whole run time.

Test with TNO LAUNCH rig delayed, at the moment, no onsite campaigns are possible. Tests with a second solvent (to be selected) at RWE in second half of the project. Testing at AVR in 2021.

Miniplant of TNO

Techno-Economical Evaluation

A techno-economic evaluation that categorises a number of solvent degradation control options, highlighting the optimum concepts against agreed benchmarks.

The cost of solvent qualification based on the LAUNCH solvent qualification program will be determined with the target marginal cost set at 100 k€ per solvent.

This will contribute to the acceleration and maturation of CCS technology with respect to solvent degradation management

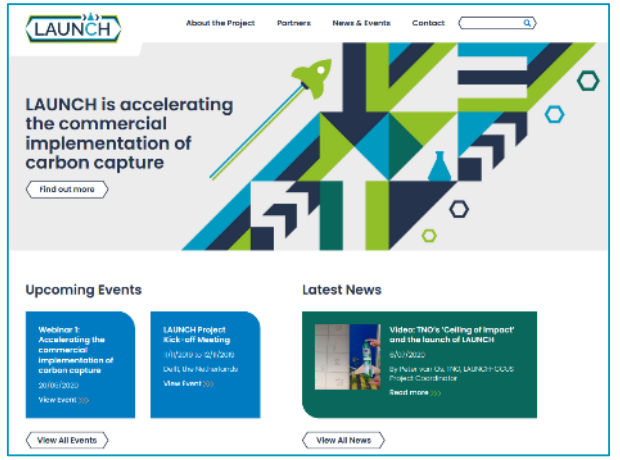
Dissemination activities

Project website: www.launchccus.eu

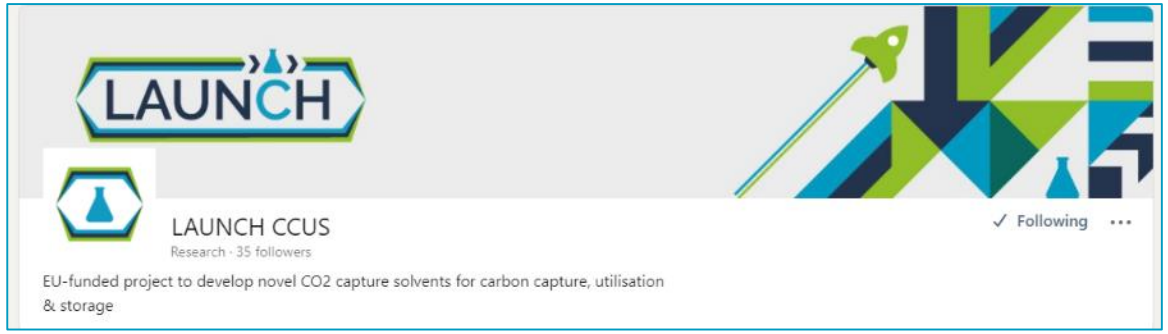
Twitter: @launchccus

LinkedIn: https://www.linkedin.com/company/launch-ccus/

GHGT15 March 2021 (on line event) Posters and oral presentations



Website



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Project briefing

Accelerating the delivery of safe and cost-effective carbon capture

Capturing CO_2 from industrial activity and power generation supports our net zero carbon transition. The LAUNCH project, involving science and industry experts from Europe and the USA, is tackling a key barrier to its deployment at scale: the degradation of solvents used in CO_2 capture processes.

WP0 – Management, Dissemination and Exploitation
Dissemination will ensure that the resulting tools, technologies and solvent qualification protocol are shared with industry stakeholders.

WP1 – Predicting Degradation
Our results will aid solvent design from lab to full-scale implementation by developing methodologies and models to predict solvent degradation.

WP2 – Controlling Degradation
We will develop generic degradation countermeasures that can be used for various solvent/flue gas combinations, aiding the safe deployment of industrial CO_2 capture.

WP3 – Closing Degradation Knowledge Gaps
Detailed research into second and third generation solvents will provide a fundamental understanding of the connection between degradation, corrosion and foaming.

WP4 – Development of Solvent Qualification Programme
Our protocol will align with industry timelines for deploying CO_2 capture. LAUNCH's small-scale capture plants will significantly lower the cost and time required for solvent testing.

WP5 – Demonstration of Solvent Qualification Programme
Four large-scale facilities in Germany, the Netherlands, the UK and USA will be used to assess and manage solvent degradation and validate our solvent management technologies.

WP6 – Techno-economic Evaluation
Using benchmark methodologies, we will assess the best solvent degradation control options from a techno-economical aspect; contributing to the technology's maturation and speed of delivery.

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Why is this research important?

- The degradation of chemical absorbents used to capture CO_2 from industrial and energy sectors currently results in higher costs for project developers and creates an economic barrier to delivering CO_2 capture projects.
- Our aim is to accelerate the uptake of CO_2 capture technologies by supporting the development of novel solvents and establishing a fast-track, cost-effective de-risking mechanism to predict and control the degradation of capture solvents.
- Our results will be shared with our stakeholders through a range of events, resources and techniques tailored to fit the relevant sector and target audience.
- Carbon capture and storage (CCS) technology is recognised as an essential route to achieving carbon reduction goals and supporting a global transition to a net zero carbon future.

What will LAUNCH achieve?

We will deliver the knowledge and tools to allow post-combustion CO_2 capture plants to operate in a more controlled and cost-efficient way. Our capture solvent development programme will also accelerate work on new solvent concepts, which will contribute to bringing down costs. We will:

Improve · Develop · Apply · Provide · Accelerate

Innovation front #1: solvent qualification
Protocols and tools for qualifying novel solvents regarding their degradation behaviour; matching solvents to specific flue gases; choosing the best mitigation strategy; 2nd and 3rd generation solvents qualified through the LAUNCH programme.

Innovation front #2: technology develpment
Technologies for controlling degradation incorporated to LAUNCH rigs and tested at pilot scale Re-design of CO_2 capture plants for minimizing degradation.

The three-year LAUNCH project No. 299662, which began in September 2019, is funded through the ERA-NET Accelerating CCS Technologies 2 (ACT2) initiative, established by the European Commission under the Horizon2020 programme for research and innovation.

Funding has been provided by Netherlands Enterprise Agency (the Netherlands); the Federal Ministry for Economic Affairs and Energy (Germany); Gassnova SF (Norway); and the Department for Business, Energy and Industrial Strategy (UK), with extra funding from the US Department of Energy (USA).

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Available to download and share:
https://launchccus.eu/about-project/overview

Issues / COVID-19 Impact

We have some challenges in LAUNCH:

The PACT facility was flooded in November 2019. PACT is now being moved to another location and rebuild. It will be operational at the end of Q1 2021. This has caused a significant delay in testing.

The COVID-19 pandemic affects LAUNCH. Due to home working, travel restrictions and closure of labs delays occur in project activities. The situation at this moment is that we face severe delays in **on site work.** This especially affects the mini plant campaign at RWE and AVR.

For the onsite work we are actually 5 months behind on schedule (and still counting)

Mitigation measures are discusses and implemented, but the situation is still unsure

Acknowledgements

The LAUNCH project (Project No. 299662) is co-funded by the ERA-NET Accelerating CCS Technologies initiative, which supports the delivery of safe and cost-effective carbon capture, utilisation and storage. The governments of each participating country have contributed funding through the ACT2 initiative.

Financial contributions have been made by Netherlands Enterprise Agency, Netherlands; The Federal Ministry for Economic Affairs and Energy, Germany; Gassnova SF, Norway; and the Department for Business, Energy & Industrial Strategy, UK, with extra funding from the US Department of Energy. All funders are gratefully acknowledged.

Thank you for listening and stay safe!

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