CLEAN clinKER by calcium looping for low-CO_2 cement

CLEANKER

CO2 GeoNet Autumn Webinar 20-21 September 2021

Low carbon cement (CLEANKER)

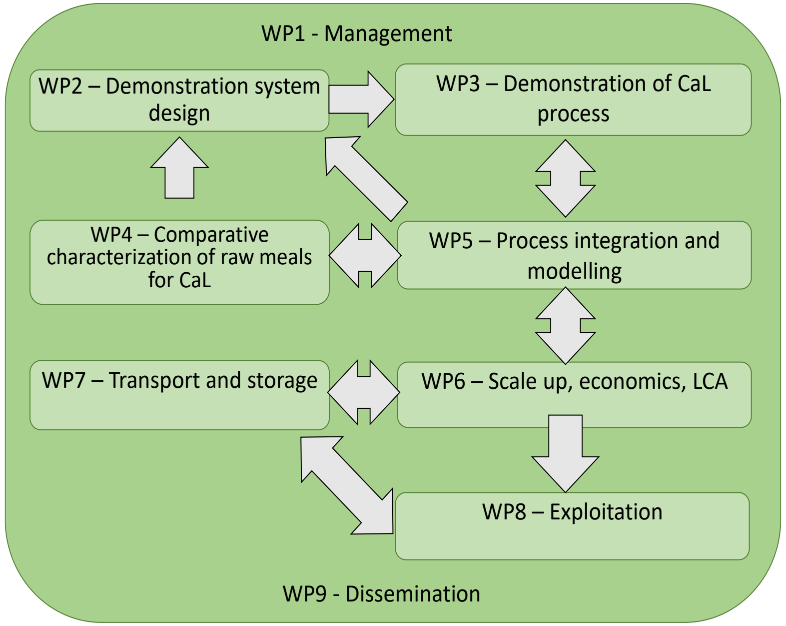
Alla Shogenova,TalTech
Martina Fantini, LEAP s.c.a r.l.
and all CLEANKER colleagues

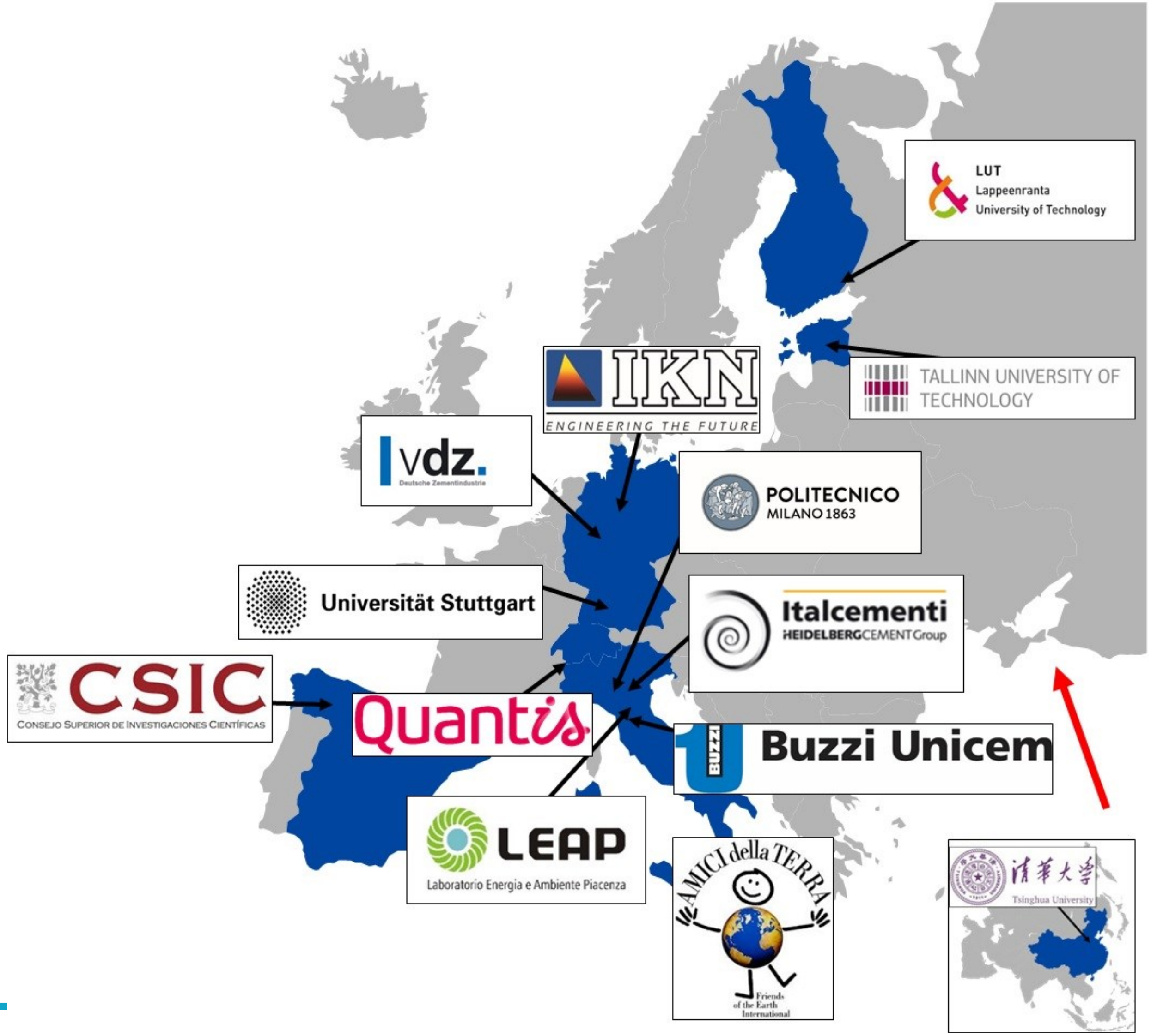
Summary

- CLEANKER overview
- Project objectives
- Calcium looping capture in the cement industry
- Configuration of CLEANKER pilot
- CLEANKER timeline
- The demo plant
- Experimental campaigns
- WP7 on CO2 transport, use and storage
- Dissemination and communication

CLEANKER - Overview

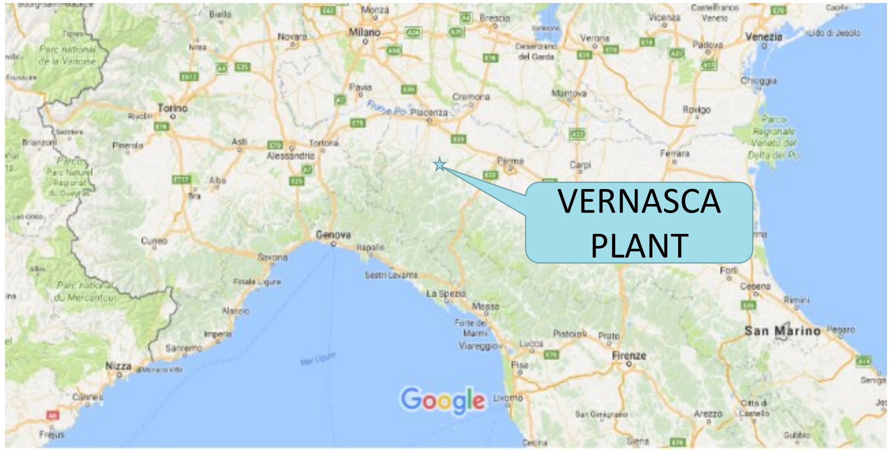
- Starting date: October 1st 2017
- Duration: 4 years + 6 months
- Total budget: € 9.237.851,25
- UE co-financing: € 8.972.201,25
- Chinese governement founding: 265.650 €
- Partner: 13 from 5 EU member states + Switzerland and China





Primary project objectives

The ultimate objective of CLEANKER is advancing the integrated Calcium-looping process for CO_2 capture in cement plants.



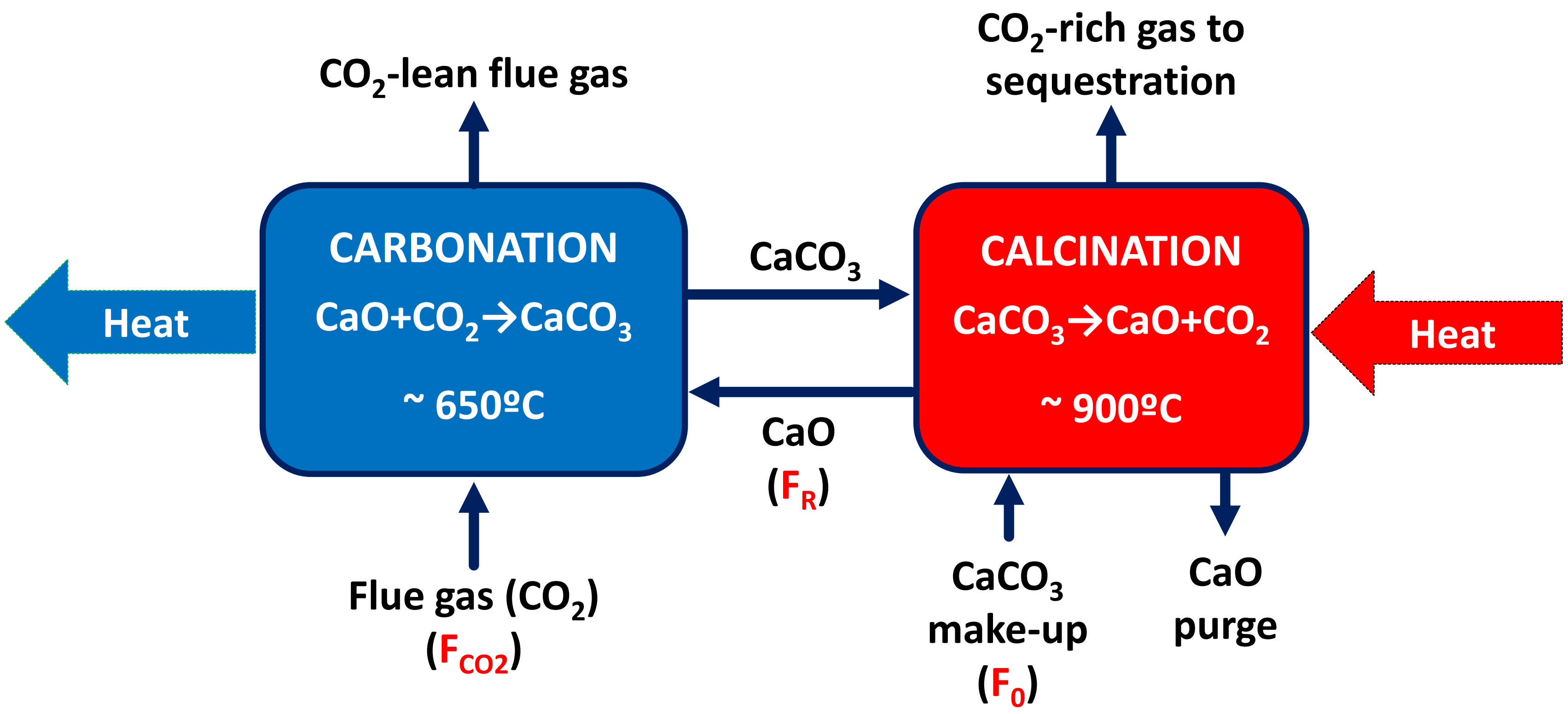
This fundamental objective include the following primary targets:

- Demonstrate the integrated CaL process at TRL 7, in a new demo system connected to the operating cement burning line of the Vernasca 1.300.000 ton/y cement plant, operated by BUZZI in Italy.
- Demonstrate the technical-economic feasibility of the integrated CaL process in retrofitted large scale cement plants through process modelling and scale-up study.
- Demonstrate the storage of the CO_2 captured from the CaL demo system, through mineralization of inorganic material in a pilot reactor of 100 litres to be built in Vernasca, next to the CaL demo system.

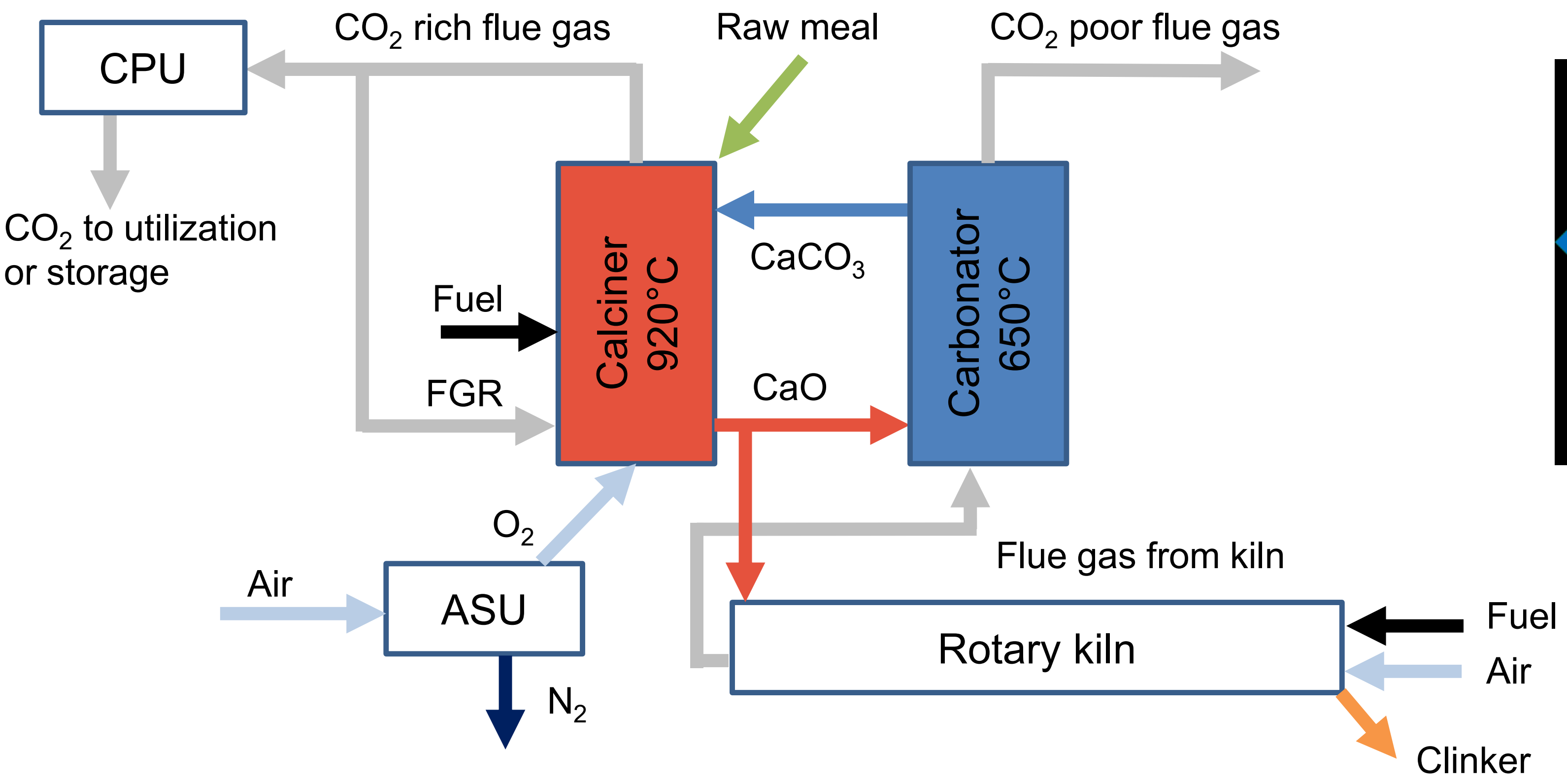
Co-funded by the Horizon 2020 Framework Programme of the European Union

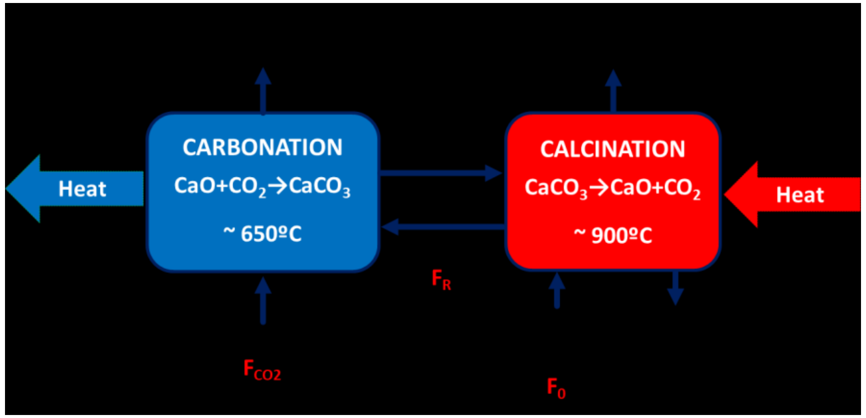
Calcium looping for CO2 capture: history and process fundamentals

- Originally proposed by Shimizu et al., 1999. A twin fluid-bed reactor for removal of CO_2. Chem. Eng. Res. Des., 77.
- Continuously developed since 1998, mainly for application in power plants
- Several fluidized bed pilot facilities - demonstrated up to 1.7 MW (La Pereda, Oviedo – Spain)



Calcium looping in cement industry – integrated configuration





General information:

- **CaL calciner coincides with the cement kiln pre-calciner**
- **Calcined raw meal as CO2 sorbent in the carbonator**
- **Sorbent has small particle size (d50=10-20 µm) -> entrained flow reactors**

Calcination:

$CaCO_3$ + O_2 + fuel (CH) → CaO + CO_2 + CO_2 + H_2O (920°C)

+ CO_2 (650°C)

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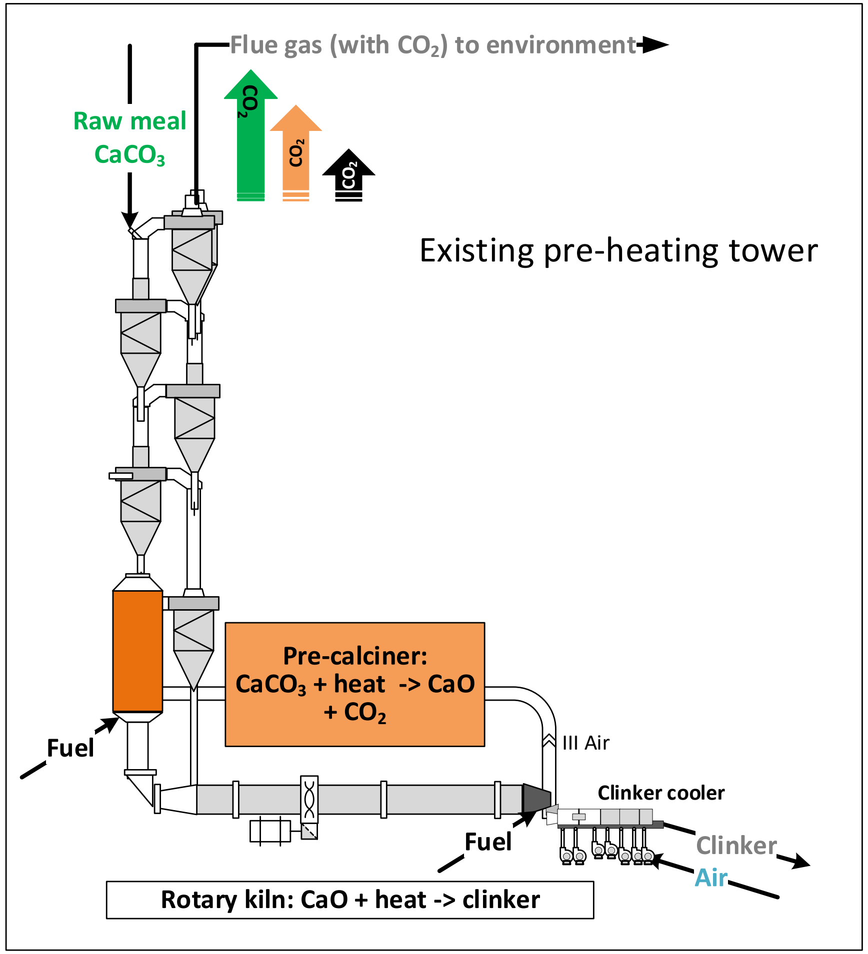
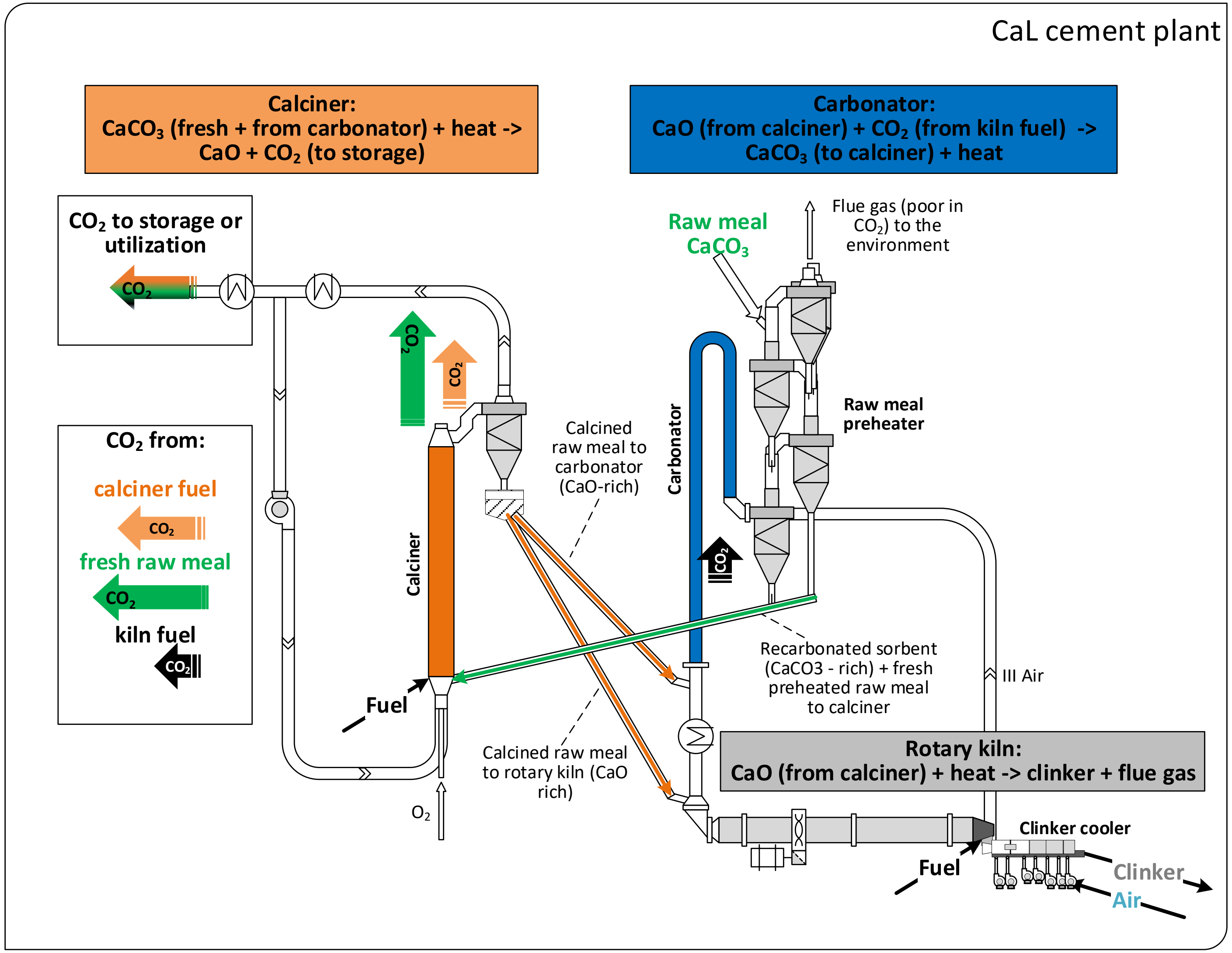
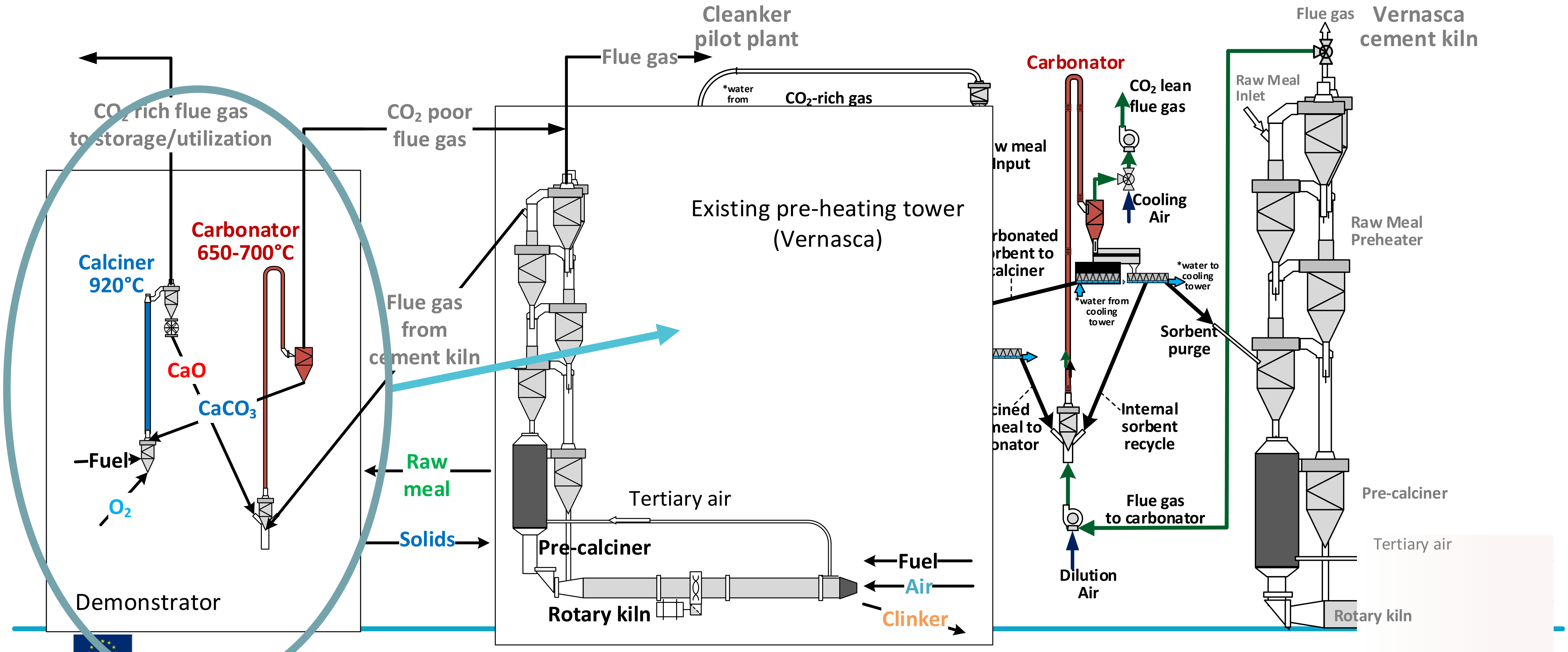
Calcium Looping – Integrated





Indicative configuration of the CLEANKER pilot



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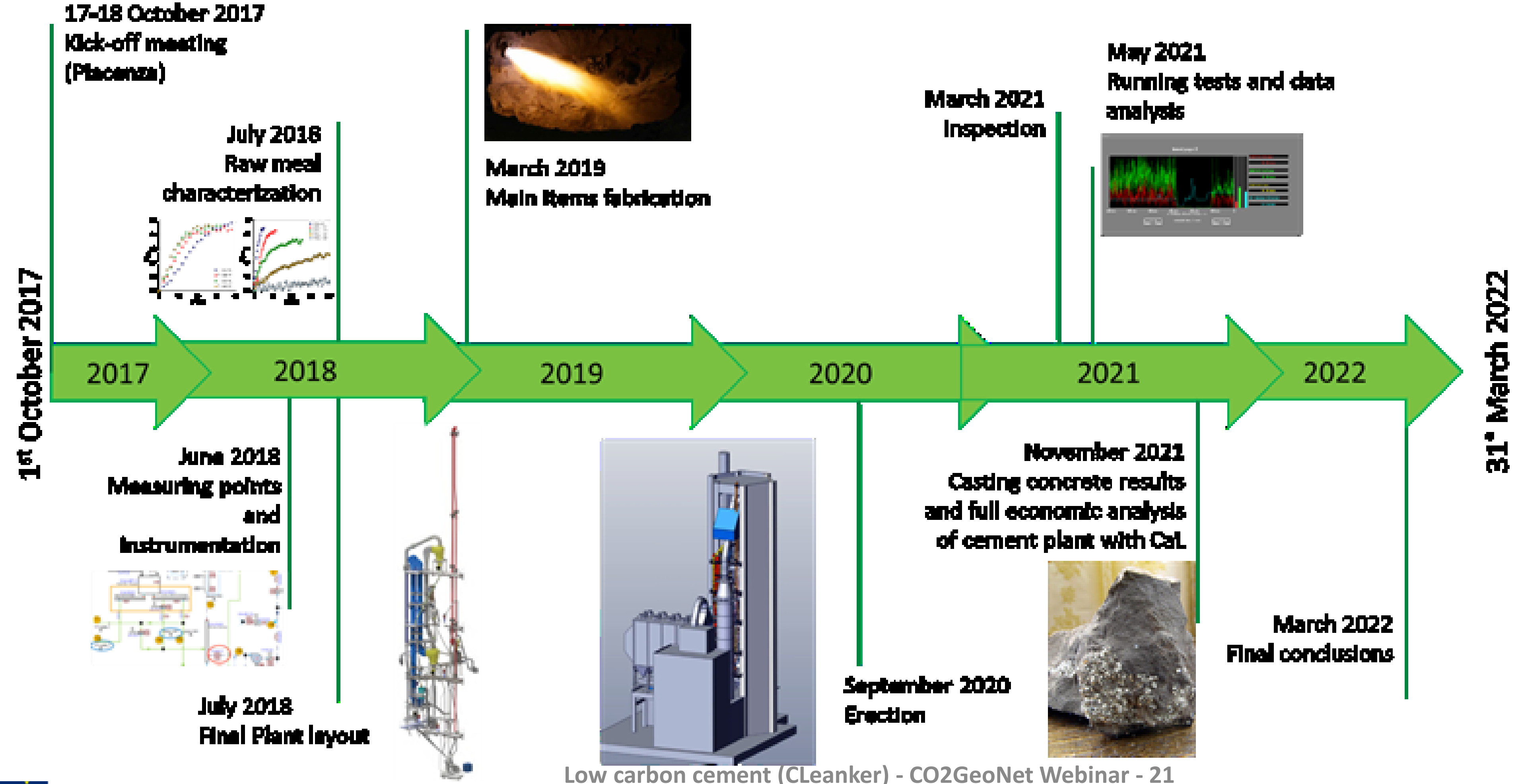
CLEANKER TIMESCALE



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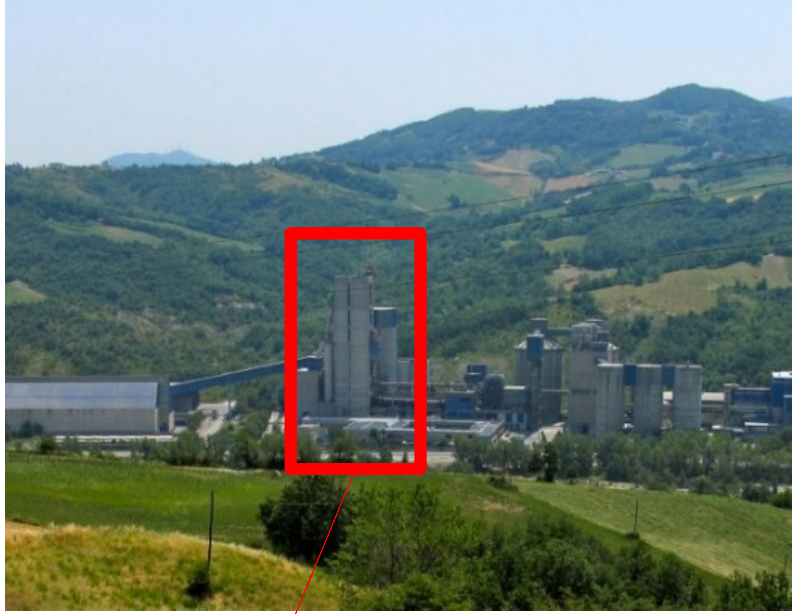
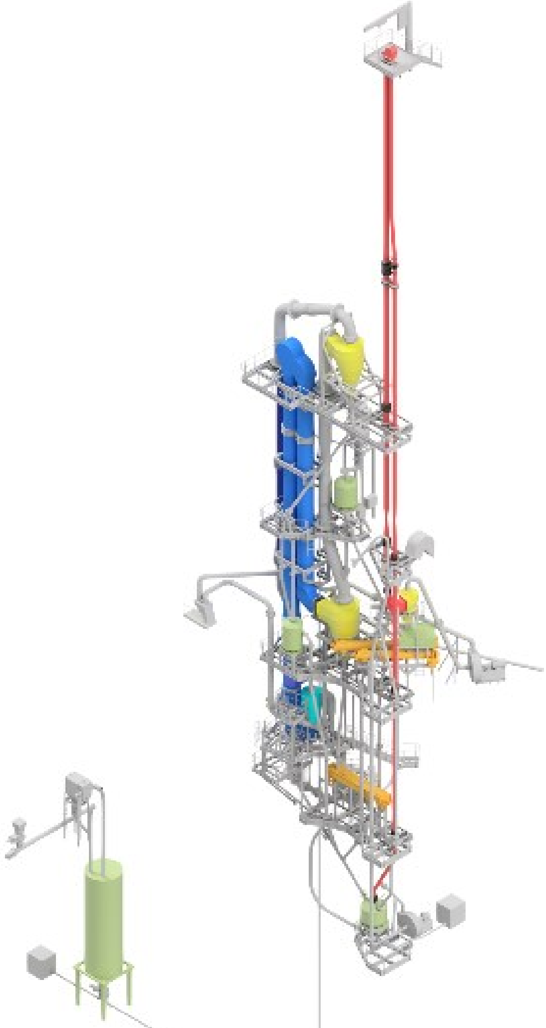
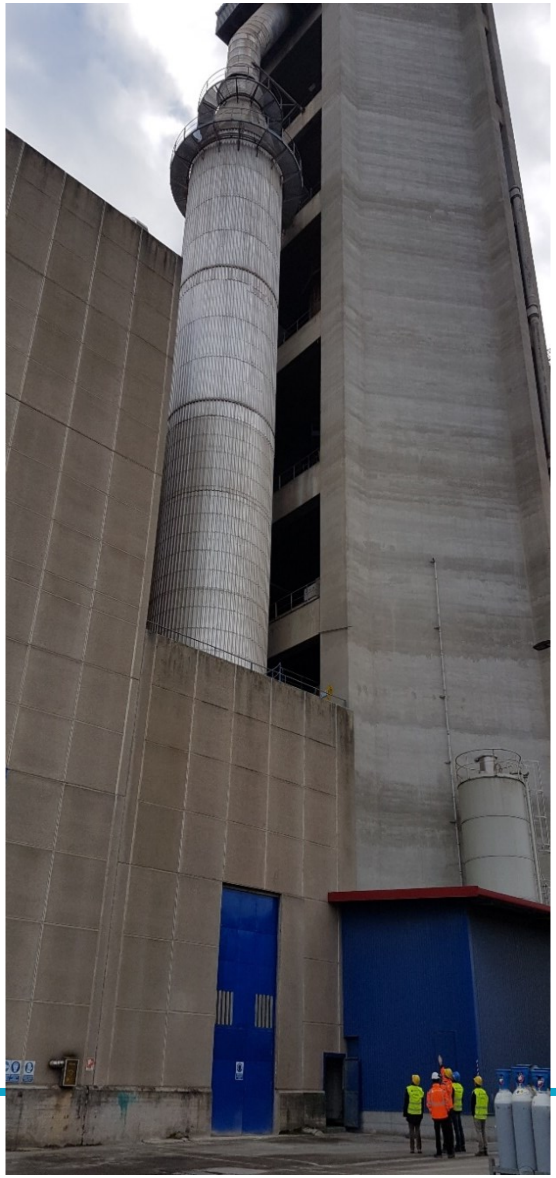
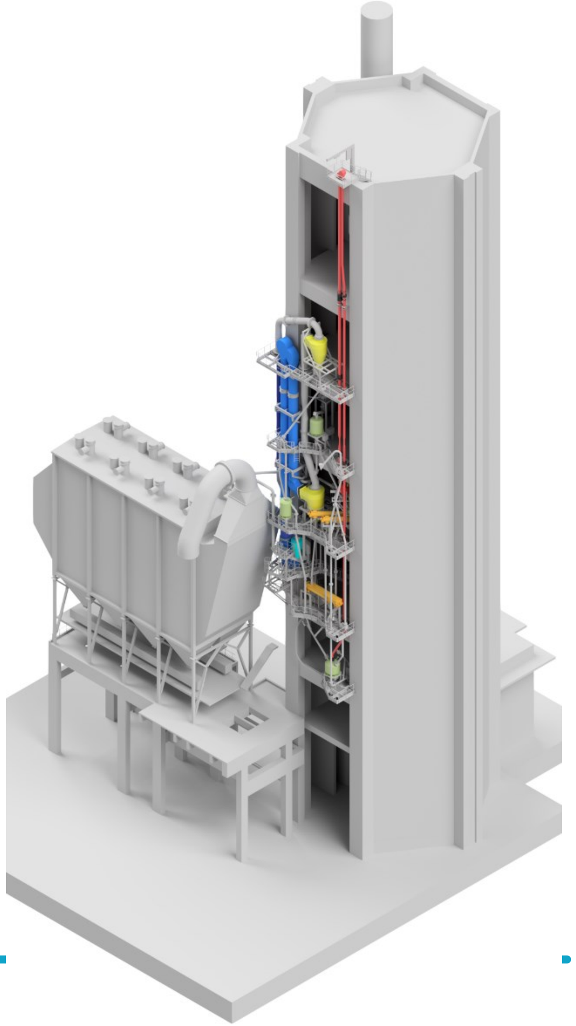
CLEANKER demo system



Preheater tower







The demo plant in place

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Opening event: 9th October.

Framework Programme of the European Union

Experimental campaigns

Nine experimental campaigns have been scheduled, five short tests of three days each one and 4 long tests of one week each one.

The aim of the short tests is to identify the most attractive operating conditions for the longer test runs. Therefore, particular attention will be given to the analysis of the governing parameters of the CaL process, namely:

1. Oxydant for the calcination process: Air/Oxygen;
2. Calciner outlet temperature;
3. Type of CO2 sorbent;
4. Gas flow rate at carbonator inlet;
5. Solid to gas ratio in the carbonator;
6. Solids temperature at carbonator inlet.

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WP7 on CO2 transport, use and storage

CLEAN clinKER by calcium looping for low-CO_2 cement

Coordinated by TalTech (2 departments, Estonia), participants TalTech, ITC-HCG, BUZZI

Objectives:

- Developing common methodology for modelling of local and regional CCUS scenarios in Europe using international expertise;
- Modelling local and regional CCUS scenarios, relevant for cement plants owned by the end-users, in particular: a Baltic regional scenario including Kunda Cement Plant in Estonia and Slantsy Cement Plant in Russia (both of ITC-HCG); a local Italian scenario including BUZZI Vernasca Cement Plant in Italy;
- Assessing regulatory issues for transport, utilization and storage in the selected scenarios;
- Defining of suitable BUZZI and ITC-HCG cement plants for CO_2 capture in Europe, North America and Asia-Pacific region based on transport and storage opportunities of CCS clusters already well documented in the literature;
- Demonstrating mineral carbonation of CaO-rich waste ash from Estonia, and concrete demolition waste (CDW) from cement plants with CO_2 captured from the demo system in Vernasca BUZZI plant.

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WP7 on CO2 transport, use and storage - Results

Task 7.1. Development of common methodology for techno-economic modelling of CCUS scenarios (M1-M12) - ready

Task 7.2. Techno-economic modelling of CO_2 transport, storage, utilization scenarios including database collection (M1-M40) - ready

Task 7.3. Regulatory issues for transport, utilization and storage (M1-M10) - ready

Task 7.4. Definition of BUZZI and ITC-HCG cement plants suitable for first-of-a-kind CCS plant based on transport and storage opportunities (M13-M34; ITC-HCG, BUZZI, TUT) - ready

Task 7.5. Mineral trapping of CO_2 from the demo system (M1-M48) - ongoing

Task 7.6. Testing the carbonated materials for reuse in concrete (M44-54) – 2022

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Education activities within CLEANKER in TalTech

TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

School of Science
Department of Geology

Estonian-Latvian Transboundary Carbon Dioxide Capture, Transport and Storage (CCS) Scenario for the Cement Industry

Master thesis

Student: Karl Simmer, 162972YAEM
Supervisor: Alla Shogenova, Department of Geology, senior researcher
Study program: Earth Sciences and Geotechnology

Tallinn 2018

TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

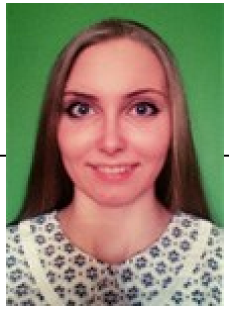
Department of Materials and Environmental Technology

WET ROUTE CARBONATION OF INDUSTRIAL WASTES FOR CEMENT INDUSTRY DECARBONIZATION

TÖÖSTUSJÄÄTMETE POOLKUIV KARBONISEERIMINE CO_2 EMISSIOONIDE VÄHENDAMISEKS TSEMENDITÖÖSTUSES

Student: Anastassia Zuravljova
Student code: 178127KAYM
Supervisor: Mai Uibu, Kadriann Tamm

Tallinn, 2019



TALLINN UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING

Department of Civil Engineering and Architecture

EXPERIMENTAL STUDY OF CO_2 MINERALIZATION IN BURNT OIL SHALE AND CEMENT BYPASS DUST BASED SYSTEMS

SÜSINIKDIOKSIIDI MINERALISEERIMISPROTSESSI UURIMINE PÕLEVKIVI- NING TSEMENDITÖÖSTUSE JÄÄTMETEL PÕHINEVATES SÜSTEEMIDES

MASTER THESIS

Student: Mustafa Cem Usta
Student code: 177351
Supervisor: Dr. Can Rüştü Yörük
Co-supervisor: Dr. Mai Uibu

Tallinn, 2019

TAL TECH
GEOLOOGIA INSTITUUT

Integration of cement plants into CCUS hubs and clusters in Europe: case study from United Kingdom

Master thesis

Student: Glea Habicht, 192230LARM
Supervisor: Alla Šogenova, Department of Geology, senior researcher
Study program: Georesources

2021

Co-funded by the Horizon 2020 Framework Programme of the European Union

Education activities within CLEANKER in TalTech: Master thesis is defended in 2020 in cooperation with ENOS project

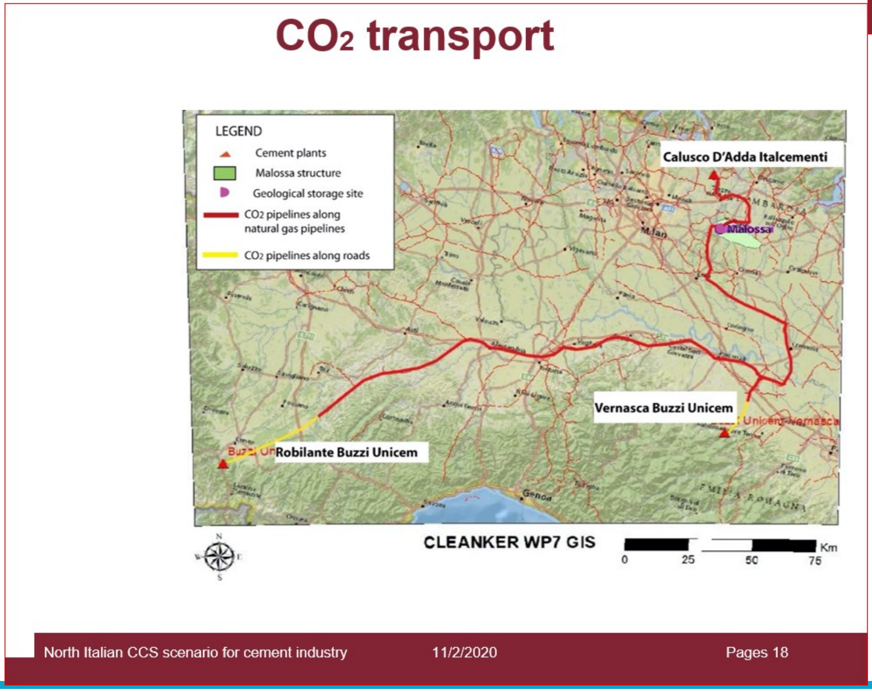
TALLINN UNIVERSITY OF TECHNOLOGY

SAPIENZA UNIVERSITÀ DI ROMA

North Italian CCS scenario for the cement industry

Student: Martina Mariani
Supervisors:
Dr. Kazbulat Shogenov, researcher
Dr. Alla Shogenova, senior researcher
(Tallinn University of Technology)

Roma, 2020



Innovative synergy CCUS and renewable energy project offshore Baltic using CO_2 emissions from the cement industry

TAL TECH DEPARTMENT OF GEOLOGY

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Scenario

Shogenov & Shogenova, 2021

- It is proposed **to capture CO_2 from the Kunda Nordic Cement** and from the **Eesti PP in Estonia**, from the **Lithuanian Acmene CP** and **Latvian TEC-2** (Fig. 2, Table 1).
- After CO_2 will arrive at the offshore platform or drilling rig of the E6 storage site, it will be injected into the CO_2 storage reservoir for **CGS and GCS** and to the oil-bearing reservoir to **enhance oil recovery** (Fig. 3). We are planning to drill **6 wells**: **3 wells for injection** (one for CO_2-EOR in the Saldus oil reservoir, two for GCS and CGS in the Deimena Formation), **2 for liquids recovery** (one for oil recovery from the Saldus Formation and one for warm water recovery form the Deimena Formation) and **1 for monitoring**.
- Small **wind offshore floating plant** is planned to be installed around the rig (Fig. 3).
- **Solar panels** will be installed at all available free surfaces of the rig and gained solar energy will be added to the project electricity net for covering energy needs of the project or for selling energy.

Table 1. Technical parameters of the Baltic offshore scenario for 2019

Country	Estonia		Total Estonian share	Latvia	Lithuania	Total Baltic CCUS
Emissions sources	KNC	EPP	2 plants	TEC-2	LACP	4 plants
CO_2 emissions produced per year, Mt	0.55	3.43	3.98	0.90	0.97	5.84
CO_2 emissions captured (95%), Mt	0.52	3.26	3.78	0.85	0.92	5.55
CO_2 emissions avoided per year, Mt	0.49	3.09	3.58	0.81	0.87	5.26
Total CO_2 emissions captured for 30 years, Mt	15.59	97.76	113.34	25.59	27.50	166.44
Total CO_2 emissions captured for 30 years, %	9.37	58.73	68.10	15.38	16.52	100.00
Total CO_2 emissions avoided for 30 years, Mt	14.77	92.61	107.38	24.25	26.06	157.68

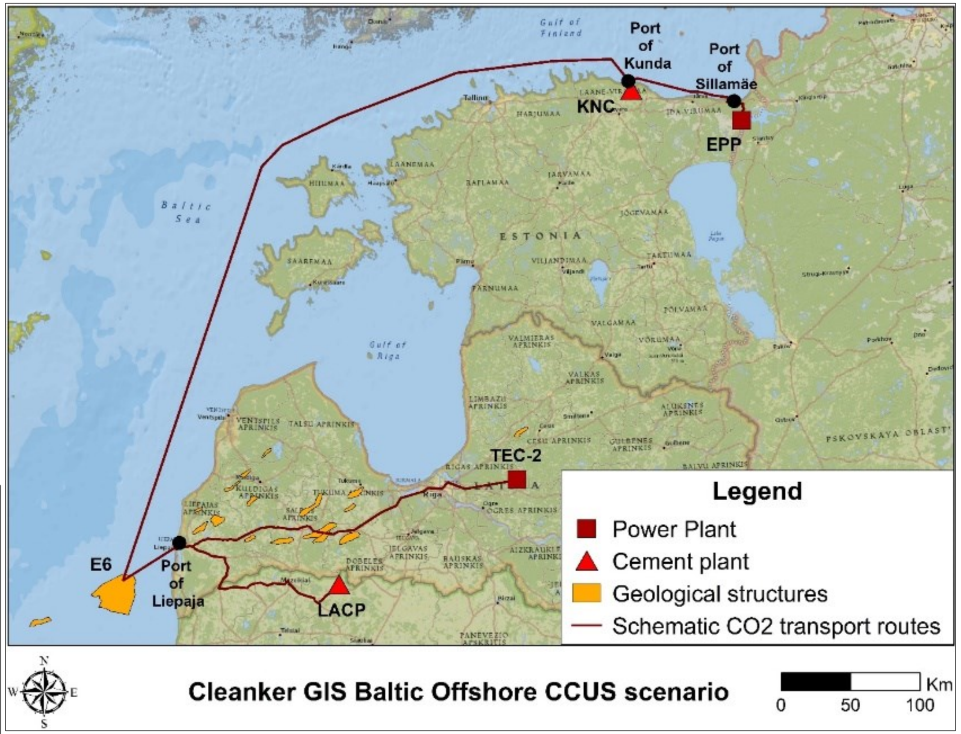

Fig. 2. Transport model of the proposed innovative synergy CCUS and renewable energy project offshore Baltic using CO_2 emissions from the cement industry and energy production from Estonia, Latvia and Lithuania

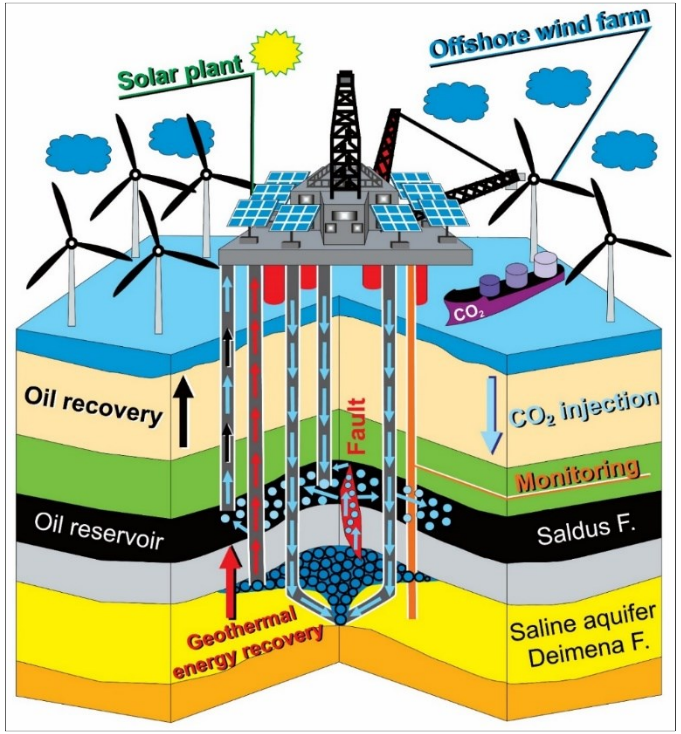

Fig. 3. Conceptual techno–ecological schematic model of CCUS project with different green renewable energy recovery technologies in the structure E6 including synergy of (1) CGS, (2) GCS, (3) CO_2-EOR/EOR+ in different geological formations in the same storage site and (4) solar energy and (5) wind energy recovery

Table 2. CO_2 pipelines distance and diameter of the Baltic offshore scenario

Country	Estonia		Total Estonian share	Latvia	Lithuania	Total Baltic CCUS
Emissions sources	KNC	EPP	2 plants	TEC-2	LACP	4 plants
Pipeline distance to the ports, km/diameter in mm	4.5/100	30/300	34.5	230/250	145/220	409.5
CO_2 transport by ship, km	615	75+615	690	45	45	735

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Techno-economic modelling of the Baltic CCUS onshore scenario

- Proposed scenario:
- ✓ 6 CO2 emission sources
- ✓ CO2 use: Mineral Carbonation Plant (CO2 + Oil Shale Ash)
- ✓ Pipeline transport
- ✓ North-Blidene Storage site in Latvia
- ✓ Cambrian saline aquifer: Deimena Formation sandstones
- ✓ CO2 emissions: 2019

Mineral Carbonation Plant

- 110 kg of CO_2 /t OSA
- 250 kg of PCC (precipitated $CaCO_3$) from one t OSA
- 0.42 Mt CO2+3.8 Mt OSA= 0.95 Mt PCC/year

Revenues

- avoided EEAP 40 Euro/t CO_2
- 3 €/t OSA for OSA disposal
- 50 €/t PCC

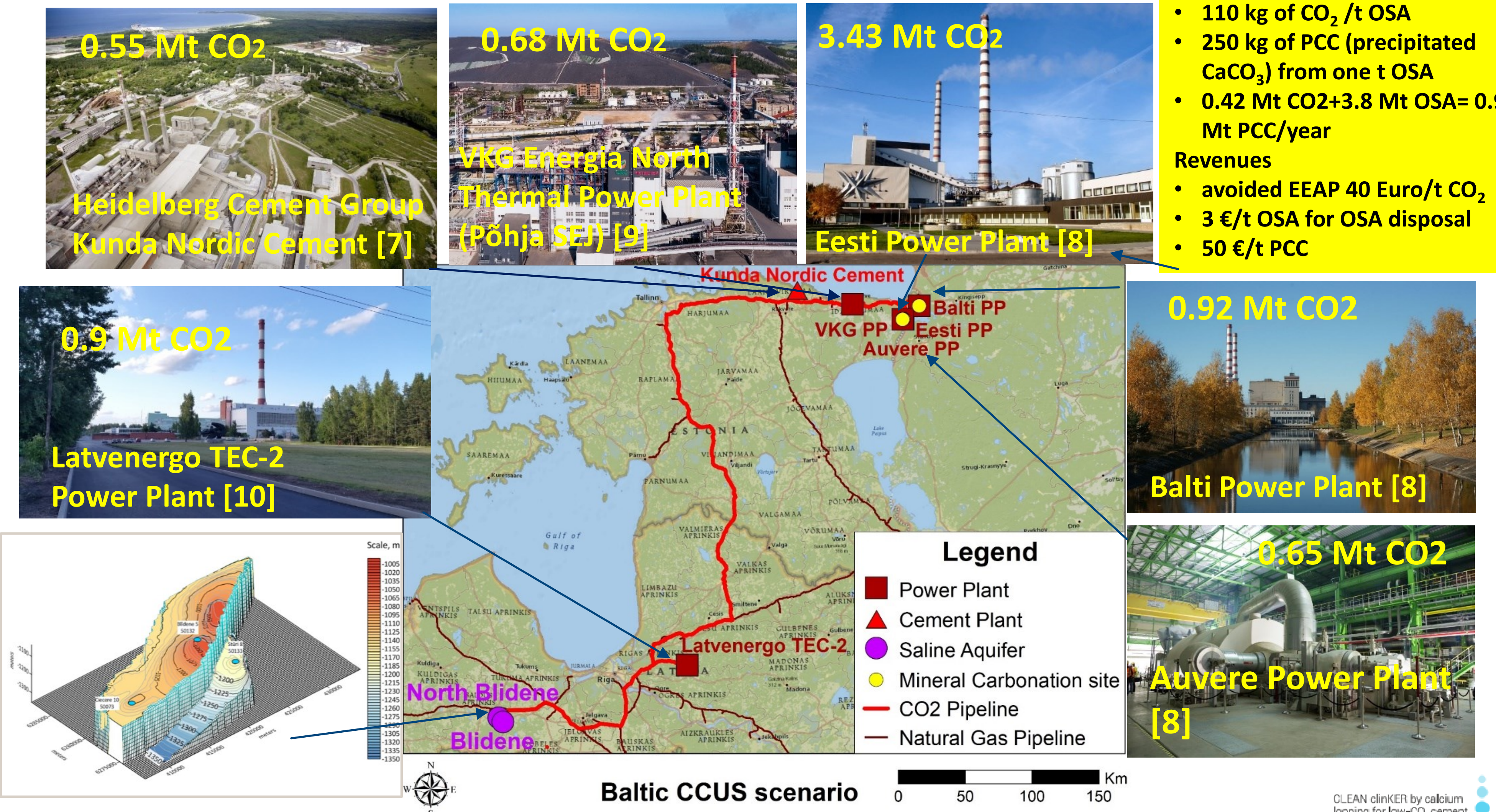

Fig 2. Baltic CCUS scenario.CO2 emissions produced in 2019 are shown in yellow colour (Shogenova et al, 2021)

Co-funded by the Horizon 2020 Framework Programme of the European Union

Techno-economic modelling of the Baltic CCUS onshore scenario

- **Annually 6.8 Mt CO_2 could be captured, transported and injected, including 6 Mt CO_2 avoided using transport and storage and 0.42 Mt avoided using MC of Estonian OSA.**
- **During 30 years nearly 204 Mt CO_2 will be captured, used and stored, while 193 Mt CO_2 could be avoided.**
- **CCUS scenario includes CO2 use of 0.47 Mt CO_2 produced at Eesti PP and using 3.8 Mt of fresh OSA produced during combustion of OS at three Eesti Energia PP.**
- **6.4 Mt of captured and compressed CO_2 will be transported annually for onshore CO_2 storage site in Latvia (North Blidene) via pipelines.** CO_2 will be injected into the 50 m thick Cambrian Series 3 Deimena Formation reservoir sandstones at the depth of 1035-1150 m.
- 6. The total average transport and storage cost of the scenario is 18.4 €/tCO_2 injected. This cost depends on the transport distance, according to the applied methodology, and it is the most expensive for the Eesti Energia PPs.
- The lowest T&S cost of 5.54 €/tCO_2 injected will have Latvenergo TEC2 PP located at the smaller distance from storage site.
- At the price of EEAP of 40 €/t CO_2 and 50 €/t PCC the CCUS scenario could be beneficial for three Eesti Energia and Latvenergo TEC-2 PPs. For the KNC and VKG Energia plants without CO_2 use options, the higher EEAP of about 50 €/t CO_2 is needed to cover all CCUS costs including capture, compression, T&S and monitoring.
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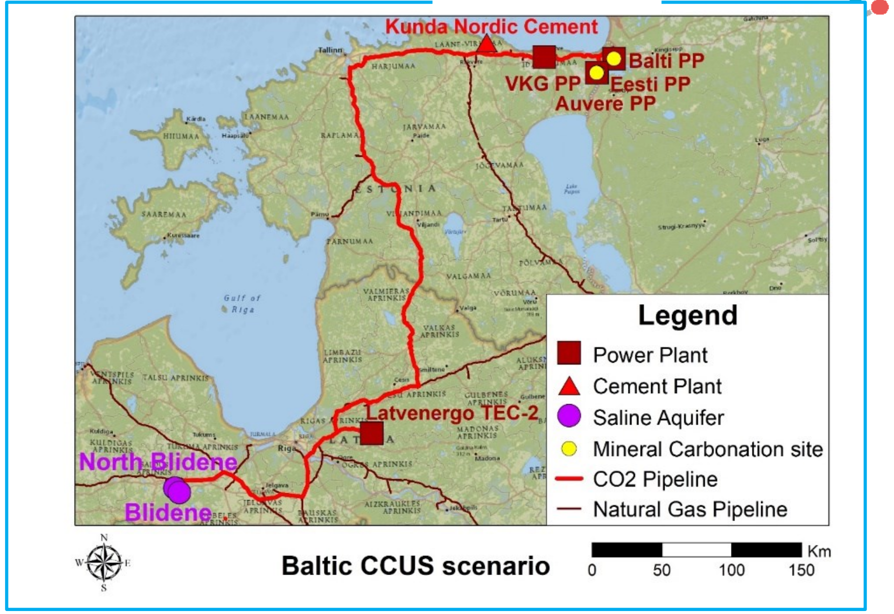
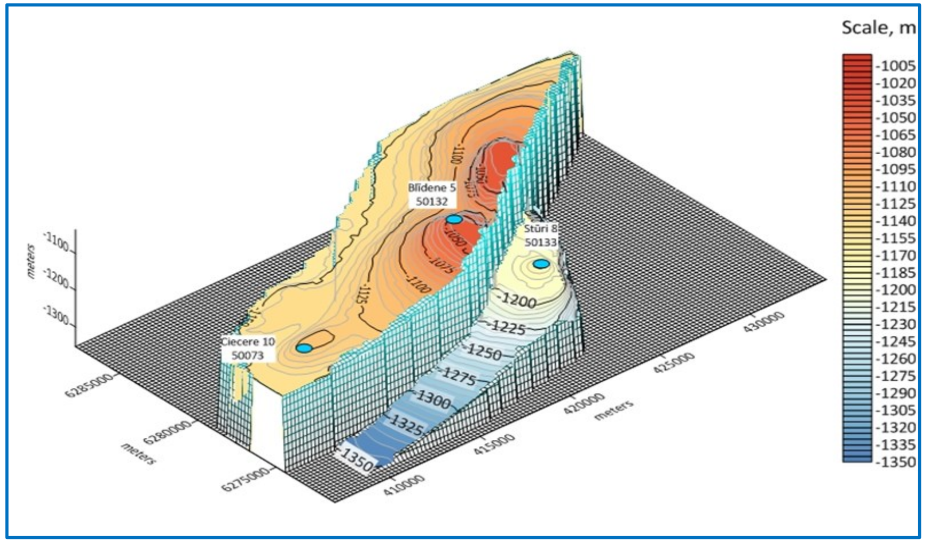




(Shogenova et al, 2021)

Co-funded by the Horizon 2020 Framework Programme of the European Union

Integration of Buzzi and Heidelberg cement plants into the first operating and planned CCUS cluster projects worldwide

- Technical and geological parameters of the 12 large CCUS cluster projects worldwide were included into the CLEANKER ArcGIS Database and integrated with 12 HCG and BU CPs prospective for CLEANKER Ca-looping technology exploitation.
- CO_2 transport distance from the CP to the CO_2 storage site and maturity of the projects permitted to propose priority for the possible CPs integration (recommendations sent to HeidelbergCement in 2020).
- The **HCG Norcem Brevik CP** is the first worldwide CP already included into the Longship project with Northern Lights infrastructure.
- The second world candidate CP for integration into the cluster project is **HCG Edmonton CP** located at the **170 km** from the Clive DOF of the **ACTL** project in Alberta State in Canada. The CO_2 capture pilot is developing now at the Edmonton CP.
- Among three operating CO_2-EOR cluster projects in USA the first candidate for integration is **BU Maryneal C**P, located at 81 km from Sacroc depleted oil field in the Denver City operating cluster project in Texas.
- All CPs proposed for integration into the European cluster projects has close, or relatively close location in the limits of **50-300 km** to the storage sites.
- Among three CPs proposed for UK clusters, the **Padeswood CP** has the closest location to offshore storage site (about **60 km onshore and offshore**). **In 2021 HeidelbergCement's British subsidiary Hanson UK has became a partner in the HyNet North West consortium with Padeswood cement plant.**
- All the proposed CPs are producing clinker and cement and suitable for exploitation study of the CLEANKER project Ca-looping capture technology.

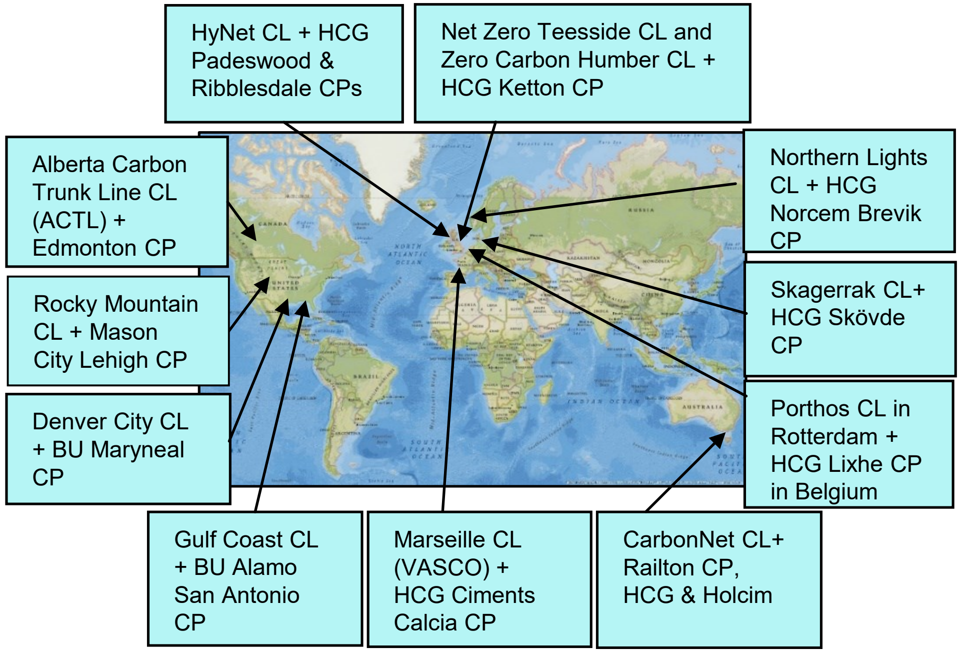
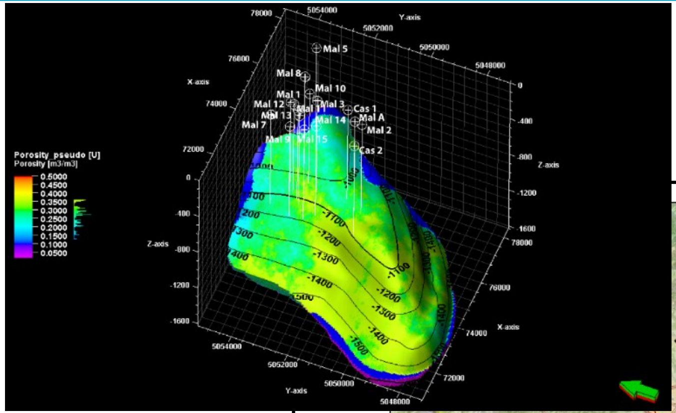


Fig.1. 12 CCUS Cluster Projects (CL) with Cement Plants (CP) proposed

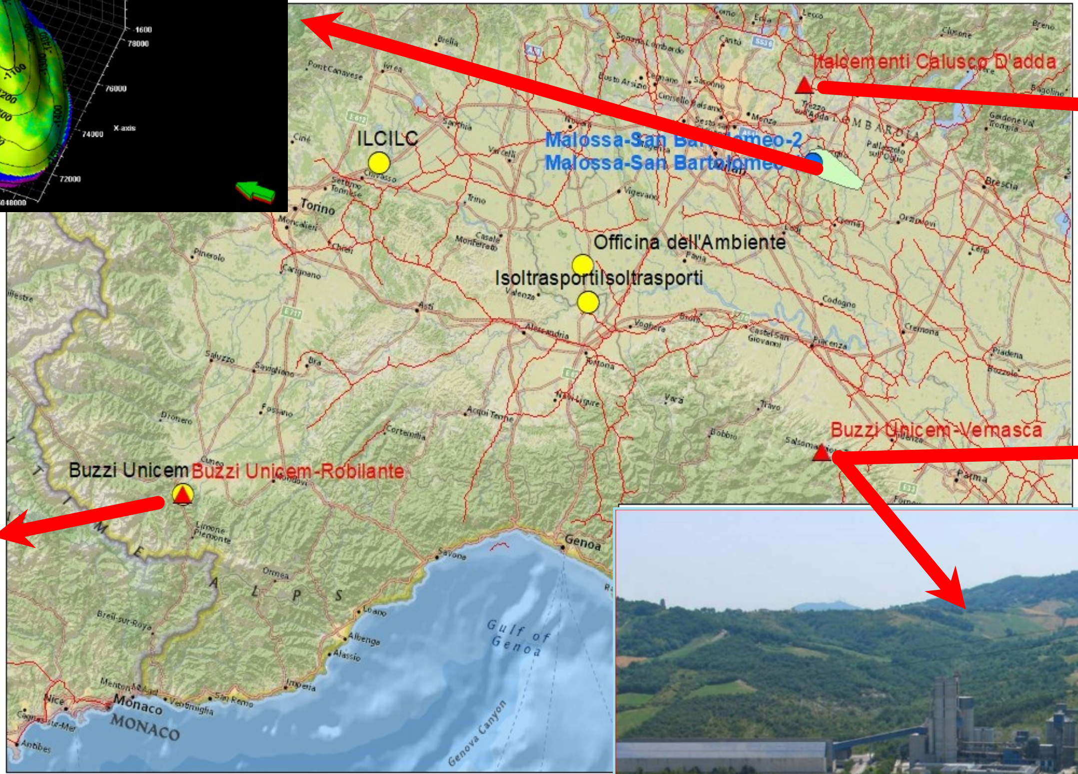
Results and recommendations from this study was sent to HeidelbergCement Group in December 2020

NORTH ITALIAN CCUS SCENARIO FOR THE CEMENT INDUSTRY

CO_2 emission sources



3D Model of Malossa Structure



CLEANKER WP7

One of the largest cement plants in Europe

Heidelber Cement Italcementi plant Cementeria di Calusco d’Adda

Kiln 2 at Robilante Cement plant

Buzzi Unicem is the second largest industry player in the country

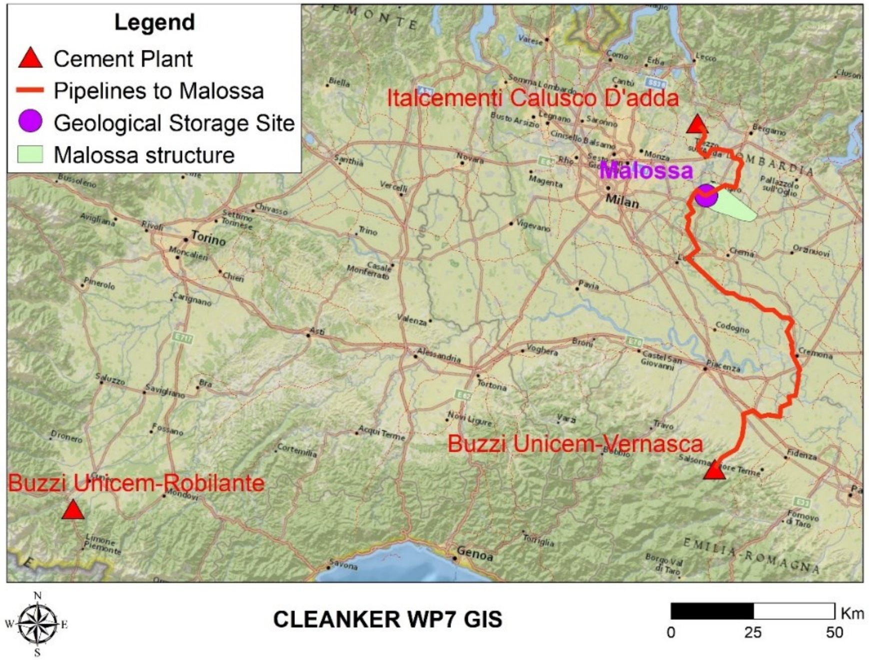
Buzzi Unicem Vernasca Cement plant

CO_2 capture pilot cement plant opened in October 2020 at Vernasca Cement plant

Techno-economic modelling of 2-plants scenario for the Northern Italy

- Economic modelling of CCS scenario for the Nortern Italy includes Buzzi Unicem Vernasca and HCG Italcementi Calusco D'adda CPs with total 1.2 Mt CO_2 emissions produced in 2020
- It is possible to capture, transport and store 1.1 Mt CO_2 annually and 23 Mt during 20 years of the project into Malossa structure, considering the limited CO_2 storage capacity of the Sergano Gravel Reservoir Formation with the estimated average optimistic capacity of 24 Mt CO_2.
- Considering 5% of additional emissions produced during CCS operations, only 21.8 Mt of CO_2 could be avoided during 20 years of the project.
- CO_2 transport, storage and monitoring cost for this scenario is the most economic for Italcementi Calusco D'adda CP, estimated as 4 €/t CO_2 avoided, explained by close location to Malossa storage site. About 34 km of pipelines along available natural gas pipelines will be constructed.
- CO_2 transport, storage and monitoring cost is 15.1 €/t CO_2 (about 4 times more expensive) for Vernasca CP explained by 4 times longer pipeline distance and needed CO_2 recompression.
- For a more economic scenario for Vernasca CP, it is highly recommended to use the depleted gas field of ENI located in Cortemaggiore field (Piacenza) located only 30 km from the Vernasca CP and with good options for CO_2 use for enhanced gas recovery.
- The total costs for the CCS scenario will depend on the final costs of Ca-looping CO_2 capture at the Vernasca at the end of the CLEANKER project. At the present time, the cost at the reference Ca-looping capture cost is 58 €/t CO_2 avoided, (De Lena et al., 2019), but could be cheaper for CLEANKER pilot at Vernasca (D5.11 of the CLEANKER project).
- The maximum total CCS cost for Vernasca with the transport and storage in Malossa site could be 73 €/t CO_2 avoided and will be feasible for CO_2 price in EU ETS of about 75 €.

Company	B[illegible] Unicem	[illegible]erg Cement	Total costs/(average per t CO_2) for 2 Italian cement plants
Plant	Vernasca	Italcementi Calusco D'adda	
Parameters			
CO_2 injected per year, Mt	0.50	0.65	1.15
TPC (Total Plant Cost), M€	57.23	16.34	73.56
COSTtotal, €/t CO_2 injected	14.32	3.75	8.31
COSTtotal, €/t CO_2 avoided	15.1	3.95	8.74



CO_2 transport scenario from Buzzi Unicem Vernasca and Italcementi Calusco D'adda cement plants to Malossa storage site in Sergano Gravel Formation reservoir.

Mineral trapping of CO_2 from the demo system

- One of the objectives of the Horizon 2020 project CLEANKER is the construction of a CO2 mineralization reactor for the Ca-looping demonstration system that will capture CO2 in the cement plant operated by Buzzi Unicem sited in Vernasca.
- In the case of CO2 mineralization, captured carbon dioxide gas is stored in the form of thermodynamically stable carbonate minerals, which, by eliminating the greenhouse effect of CO2 allows environmentally safe disposal or recycling of CO2.
- The pilot testing **(in 200 L reactor)** was preceded by lab-experiments **(in 46 L reactor)**, the aim of which was to select the best potential CO2 binders and to find the optimal carbonation conditions.
- Laboratory tests were performed **using wet and dry carbonation routes**.

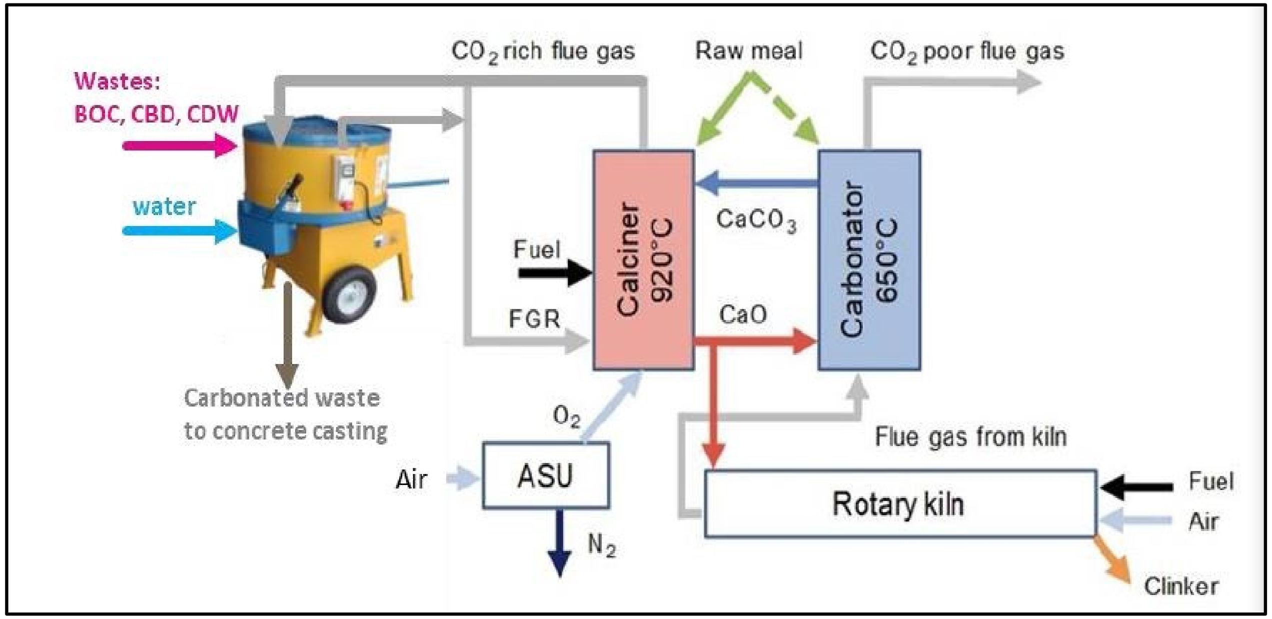


Figure 1: Process scheme.

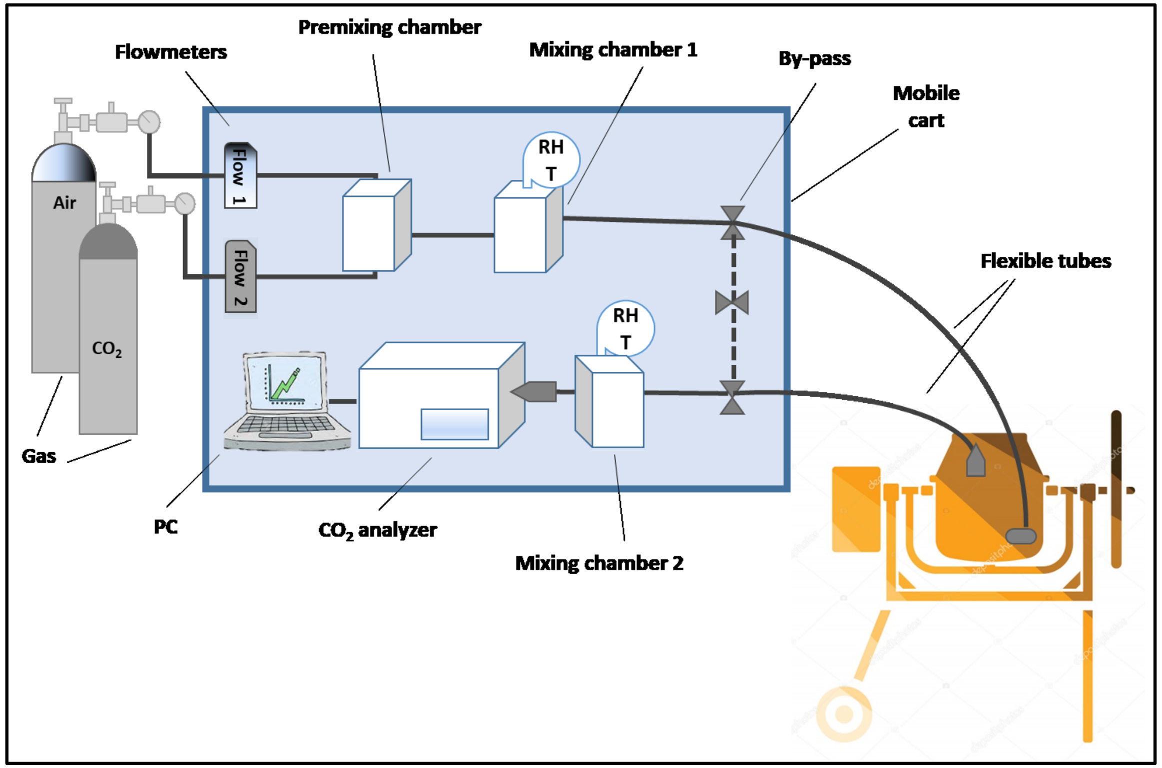


Figure 2: Preliminary experimental design (Usta et al, 2021).

Mineral trapping of CO_2 from the demo system

Figure 3:Testing equipment (flowmeters, mixing chambers, RH/T probes, by-pass connections, CO2 analyzer) shown from the side (left) and from the top (right) (Usta et al, 2021).

- The results showed that selected types of burnt oil shale and cement wastes could be used as efficient binders in both dry and wet CO2 mineralization systems with binding capacities up to 0.18 kg of CO2 per kg of BOS and up to 0.24 kg of CO2 per kg of CBD.
- The activating effect of hydration as a pre-treatment method showed that at lower operating temperatures, the same level of CO2 capture can be achieved, thereby rendering the carbonization processes of similar industrial wastes more energy efficient.
- Finally, the wet carbonation route (L/S=0.2 – 0.3) was chosen for pilot testing.
- The pilot (200 L) was designed based on a commercially available concrete mixer integrated into CLEANKER Calooping demo system and equipped with CO2 inlets and outlets, as well as CO2, temperature, and moisture sensors to detect the reaction progress.
- Preliminary testing confirmed that CO2 could be mineralized from gas mixture by burnt oil shale in proposed wet conditions.
- The testing will continue using CO2 directly from Ca-looping calciner to produce re-carbonated wastes for concrete casting to demonstrate the quality of the commercial product in the following stages of the project.

Co-funded by the Horizon 2020 Framework Programme of the European Union

Dissemination and communication ACTIVITIES: Climate change and CCUS in Estonian media

CLEANKER
CLEAN clinKER by calcium looping for low-CO_2 cement

TALTECH
DEPARTMENT OF GEOLOGY

POSTIMEES МНЕНИЕ СПОРТ ВИДЕО КУЛЬТУРА КРАСОТКА LIMON КИНОЗАЛ ЗДОРОВЬЕ БАРБОС

Rus.Postimees.ee > Экономика > Ученые знают, как спасти сланцевую энергетику Эстонии не в ущерб экологии, но их не слыша

269 1 17 октября 2019, 18:31

Ученые знают, как спасти сланцевую энергетику Эстонии не в ущерб экологии, но их не слышат

Добавлен комментарий Eesti Energia

Олеся Лагашина

Казбулат Шогенов со своей докторской диссертацией, посвященной хранению углекислого газа.
ФОТО: Олеся Лагашина

В ТТУ утверждают, что знают, как решить проблему неэкологичной сланцевой энергетики, не закрывая производство. Однако пока ученым не внемлют ни политики, ни энергетики. О том, почему так происходит и как работает

EestiPäevaleht UUDISED ARVAMUS VÄLISMAA ÄRILEHT KASULIK KULTUUR SPORT LP LOE TÄNAS

KLIIMA 31. OKTOOBER 2019

Teadlane: ka Eesti maapõues saaks CO_2 ladustada ja siis näiteks maasooja toota

23

Maasooja tootmine CO_2 abiga on Alla Šogenova sõnul täiesti võimalik. „Seda pole ma veel kellelegi Eesti rääkinud. Olen juba rääkinud teile rohkem, kui peaks!"

RAIMO POOM
raimo.poom@epl.ee

JAGA 56 KUULA

Kui süsihappegaas Eestis kinni püüda, siis on Alla Šogenova sõnul olemas väga head ärivõimalused, kuhu ja kellele seda müüa.
FOTO: RAUNO VOLMAR

Ярослав Тавгень • 7 ноября 2019 Поделиться:

НОВОСТИ Только для подписчиков

Группа захвата CO_2

В США разработаны технологии, позволяющие устранить 90% выбросов CO_2 в атмосферу. Их можно применять и в Эстонии. Но есть проблема: они невероятно дорогие.

Казбулат Шогенов, научный сотрудник Таллиннского технического университета

Co-funded by the Horizon 2020 Framework Programme of the European Union

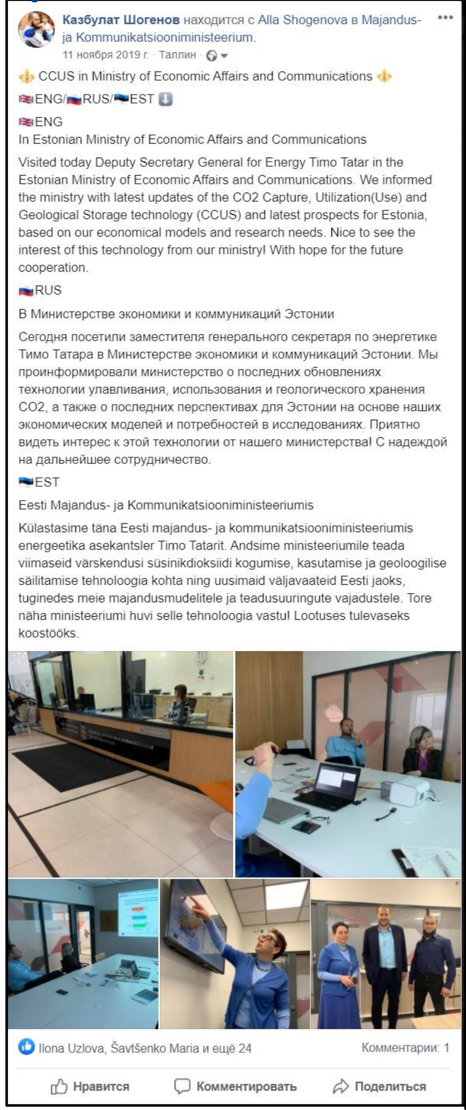
Dissemination and communication ACTIVITIES: CCUS prospect presented for some Estonian Parliament members and Policy makers **(2019)**

https://www.facebook.com/Kazbulat):

a) **Presenation at the Estonian Ministry of Economic Affairs and Communications, Timo Tatar - Deputy Secretary General for Energy at Ministry of Economic Affairs and Communications for Estonia**

b) **Presentations to Estonian Parliament member – Viktoria Ladõnskaja ,**

c) **Presentations to Estonian Parliament member – Erki Savisaari juures**



Казбулат Шогенов находится с Alla Shogenova в Majandus- ja Kommunikatsiooniministeerium.
11 ноября 2019 г. · Таллин

CCUS in Ministry of Economic Affairs and Communications

ENG/RUS/EST

ENG
In Estonian Ministry of Economic Affairs and Communications

Visited today Deputy Secretary General for Energy Timo Tatar in the Estonian Ministry of Economic Affairs and Communications. We informed the ministry with latest updates of the CO2 Capture, Utilization(Use) and Geological Storage technology (CCUS) and latest prospects for Estonia, based on our economical models and research needs. Nice to see the interest of this technology from our ministry! With hope for the future cooperation.

RUS

В Министерстве экономики и коммуникаций Эстонии

Сегодня посетили заместителя генерального секретаря по энергетике Тимо Татара в Министерстве экономики и коммуникаций Эстонии. Мы проинформировали министерство о последних обновлениях технологии улавливания, использования и геологического хранения CO2, а также о последних перспективах для Эстонии на основе наших экономических моделей и потребностей в исследованиях. Приятно видеть интерес к этой технологии от нашего министерства! С надеждой на дальнейшее сотрудничество.

EST

Eesti Majandus- ja Kommunikatsiooniministeeriumis

Külastasime täna Eesti majandus- ja kommunikatsiooniministeeriumis energeetika asekantsler Timo Tatarit. Andsime ministeeriumile teada viimaseid värskendusi süsinikdioksiidi kogumise, kasutamise ja geoloogilise säilitamise tehnoloogia kohta ning uusimaid väljavaateid Eesti jaoks, tuginedes meie majandusmudelitele ja teadusuuringute vajadustele. Tore näha ministeeriumi huvi selle tehnoloogia vastu! Lootuses tulevaseks koostööks.

Ilona Uzlova, Šavtšenko Maria и ещё 24 · Комментарии: 1

Нравится · Комментировать · Поделиться

A

Казбулат Шогенов находится с Vladimir Libman.
29 октября 2019 г.

Riigikogu

ENG/RUS/EST

ENG

For the first time in the Estonian Parliament - Riigikogu. At last our politicians started interesting the CO2 Capture and Geological Storage technology. With hope to save Estonian energy security and independence, giving a last chance to stabilize Estonian economy and social sector. With ambitions to save the WORLD! Historical moment

RUS

Впервые в Эстонском парламенте - Рийгикогу. Наконец наши политики начали интересоваться технологией улавливания и геологического хранения CO2. С надеждой на сохранение энергетической безопасности и независимости Эстонии, что дает последний шанс для стабилизации экономики и социального сектора Эстонии. С амбициями спасти МИР! Исторический момент

EST

Esmakordselt Eesti Vabariigi parlamendis - Riigikogus. Lõpuks hakkasid ka meie poliitikud tundma huvi CO2 kogumise ja geoloogilise ladustamise tehnoloogiatest. Lootuses päästa Eesti energiajulgeolek ja iseseisvus, mis annab meile viimase võimaluse stabiliseerida Eesti majandus- ja sotsiaalsektor. Päästa maailma ambitsioonikalt! Ajalooline moment

Ilona Uzlova, Inga Tukk и ещё 104 · Комментарии: 23

Нравится · Комментировать · Поделиться

B

Казбулат Шогенов находится с Alla Shogenova.
13 ноября 2019 г.

Riigikogu 2

ENG/RUS/EST

ENG

My second visit of the Estonian Parliament - Riigikogu. Informed Environment Committee of the Estonian Parliament- Erki Savisaar with latest developments in CO2 Capture and Geological Storage technology and possible solutions for Estonia to avoid Estonian energy security and independence and financial collapse.
Doing what we can!

RUS

Мой второй визит в эстонский парламент - Рийгикогу. Информировали комитет по охране окружающей среды эстонского парламента- Эрки Сависаар, с последними разработками в области технологии улавливания и хранения CO2 и возможными решениями для Эстонии, чтобы избежать краха эстонской энергетической безопасности, независимости и финансового коллапса.
Делаем, что можем!

EST

Minu teine visiit Eesti parlamenti - Riigikogu. Eesti parlamendi keskkonnakomisjon - Erki Savisaar - informeeritud süsinikdioksiidi kinnipüüdmise ja geoloogilise säilitamise tehnoloogia uusimate arengutega ning võimalike lahendustega Eesti jaoks Eesti energiajulgeoleku ja iseseisvuse ning finantskrahhi vältimiseks.
Teeme, mida suudame!

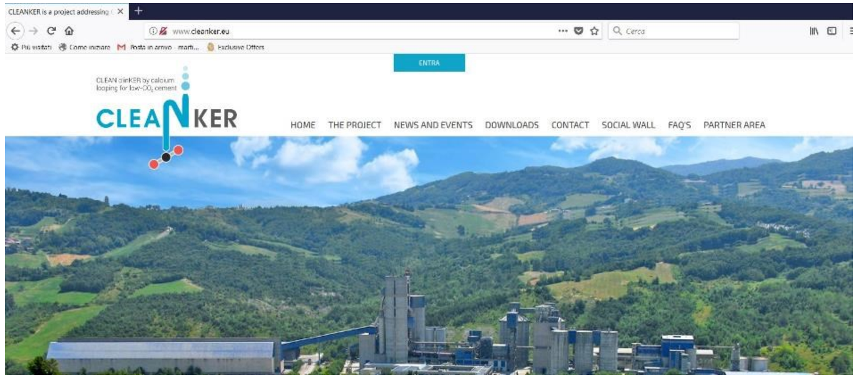
Ilona Uzlova, Inga Tukk и ещё 85 · Комментарии: 2 Поделились: 1

Нравится · Комментировать · Поделиться

C

Co-funded by the Horizon 2020 Framework Programme of the European Union

Dissemination and communication



www.cleanker.eu

https://www.youtube.com/watch?v=7X8YJeR65cM&t=33s

CLEANKER community in Zenodo: https://zenodo.org/communities/cleanker?page=1&size=20

26° August 2020, RAI1, SUperQuark, Piero Angela - https://www.youtube.com/watch?v=oQcrWfRbFJg

Acknowledgments

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