University of Stuttgart
Institute of Combustion and Power Plant Technology
Prof. Dr. techn. G. Scheffknecht

Advanced oxyfuel burner technologies

Cynthia Kroumian and Jörg Maier

AC²OCem and ANICA Workshop

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AC²OCem project and consortium memebers

Academic and research institutes

University of Stuttgart Germany

ifk

SINTEF

vdz.

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

NTNU

Industry end-users

HOLCIM

HEIDELBERGCEMENT

TITAN

TotalEnergies

Technology providers

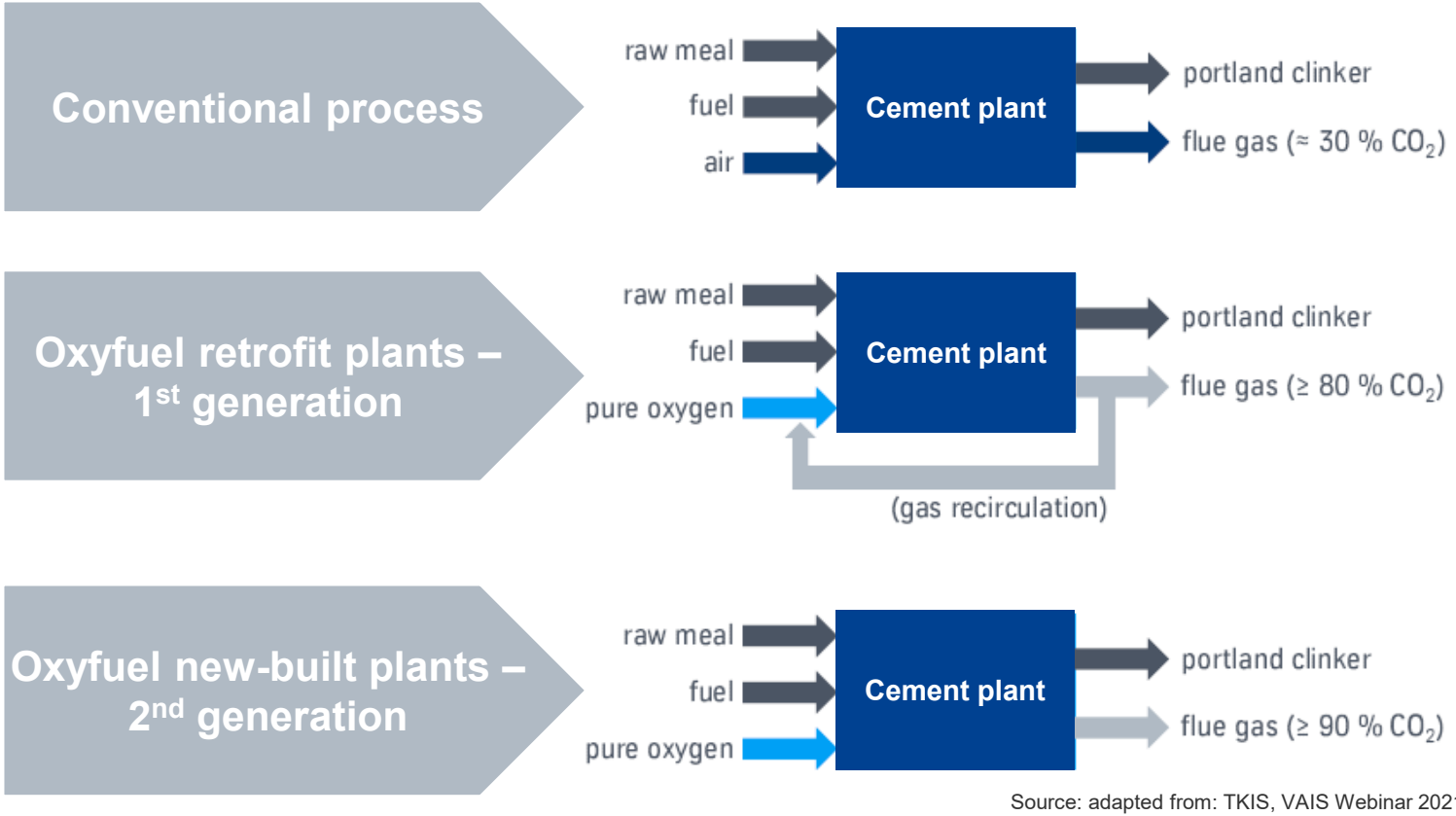
Air Liquide

thyssenkrupp

Project Duration	36 + 6 months
Start	1.10.2019
ACT Project No.	299663
ACT funding	€ 3.042.274
Total funding	€ 4.273.911

Oxyfuel technology in the cement industry

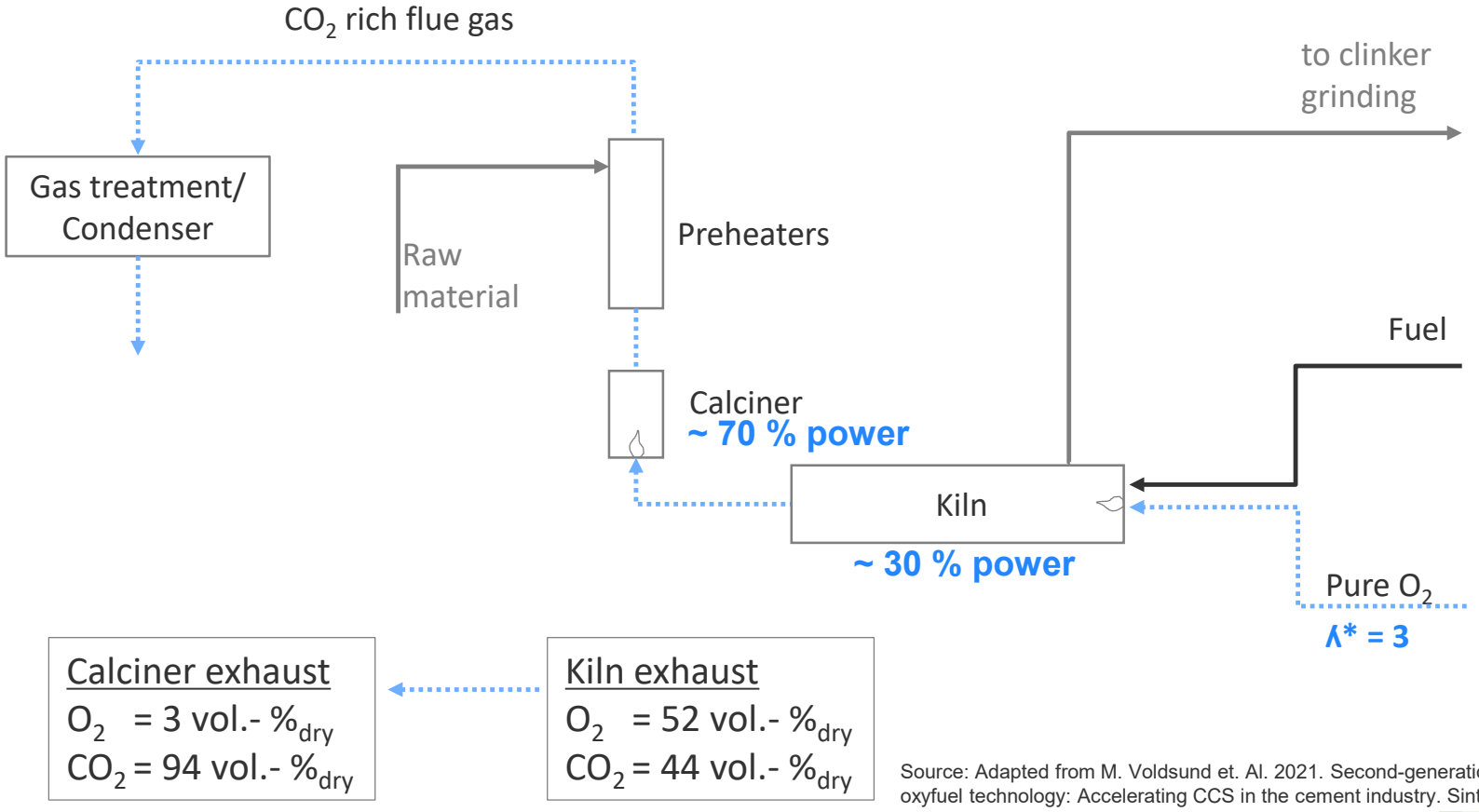
Retrofit and new-built plants



Source: adapted from: TKIS, VAIS Webinar 2021

Scheme of oxyfuel cement plants

2nd generation, no flue gas recirculation

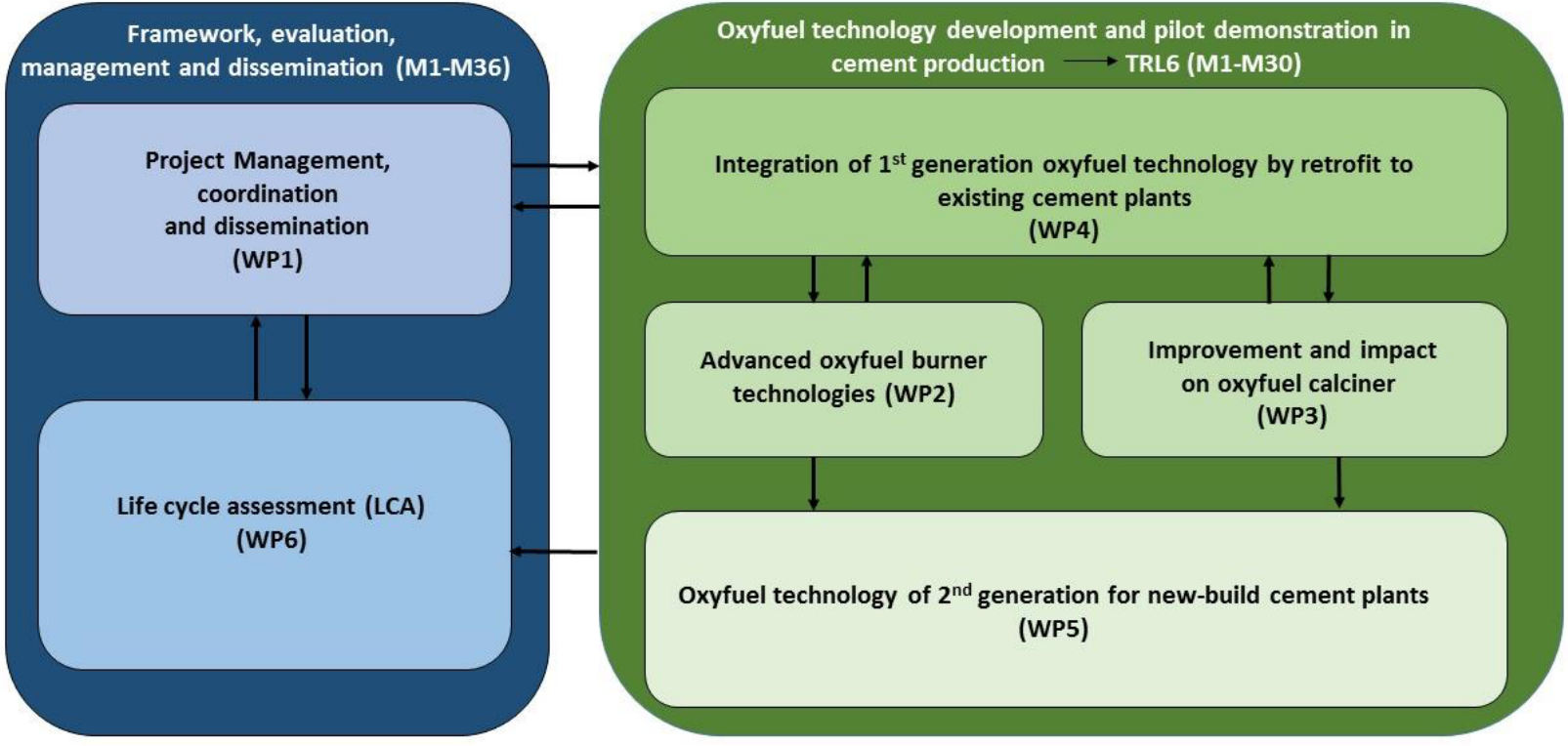


Source: Adapted from M. Voldsund et. Al. 2021. Second-generation oxyfuel technology: Accelerating CCS in the cement industry. Sintef Blog

AC²OCem project objectives

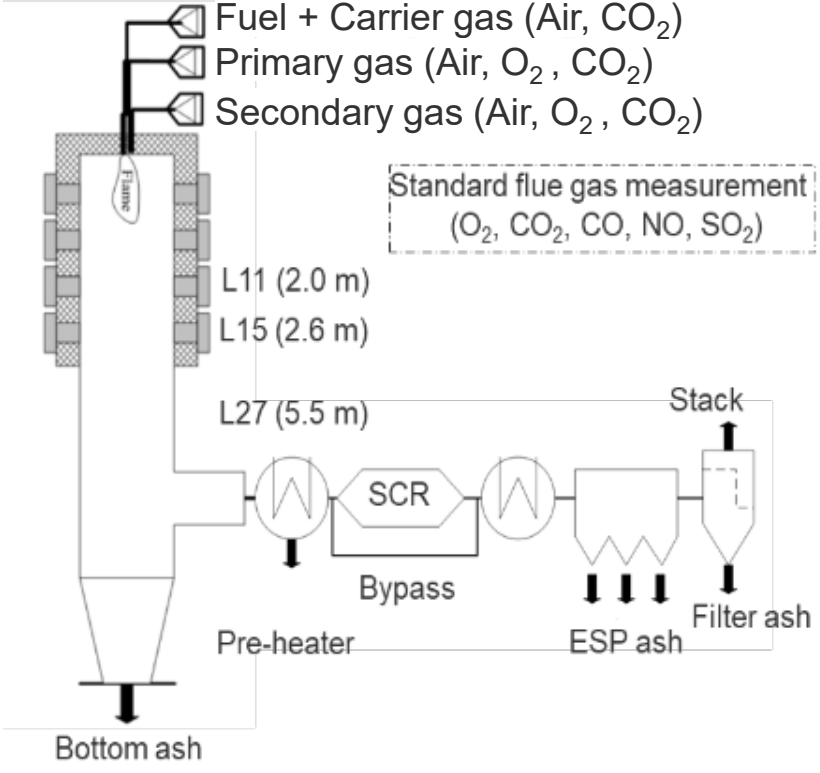
- Optimization of the oxyfuel cement process with the ultimate goal of **lowering the CO_2 avoidance cost**
- Advancing the 1st & 2nd generation oxyfuel technology for utilization of up to **100% alternative fuels** and up to **100 % oxygen**
- Boosting the technology to achieve CO_2 negative cement plants via **Bio-CCS**
- **Techno-economic analysis** and **design optimization** of **1st generation oxyfuel** cement plants, based on boundary data from two real cement plants
- Experimental and analytical investigations of the **2nd generation oxyfuel technology without flue gas recycling**, associated with a high reduction potential of energy demand

AC²OCem work packages

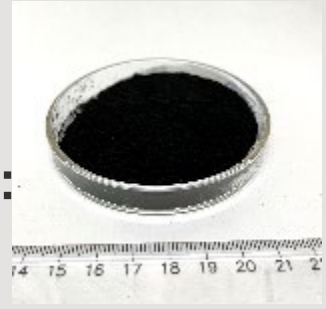


Oxyfuel kiln-burner tests

500 kW Facility • Universität Stuttgart



Coal for reference:

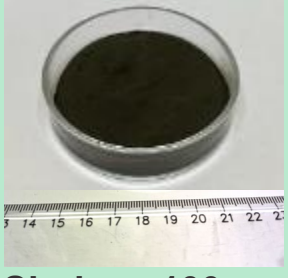


Coal 100 µm

Alternative fuels used:

SRF 1 mm

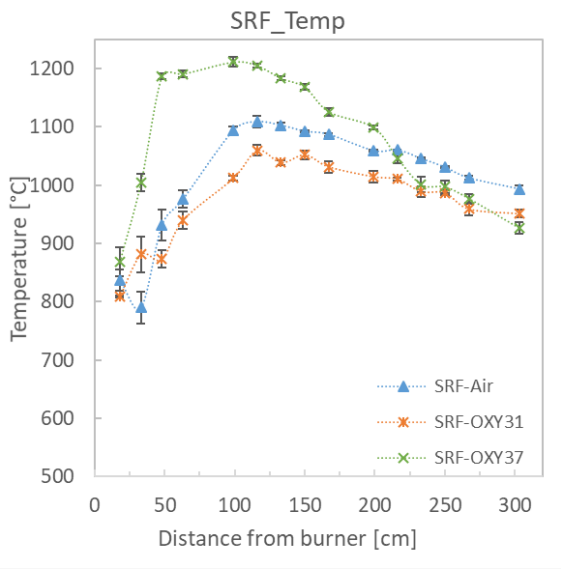
Wood pellets 1 mm

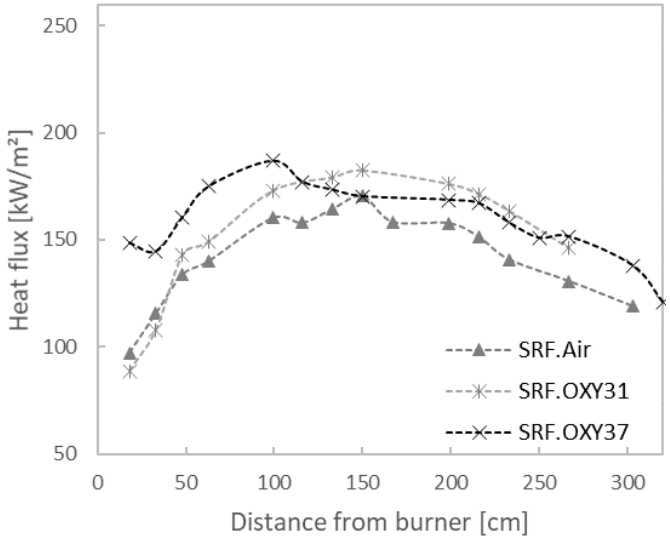


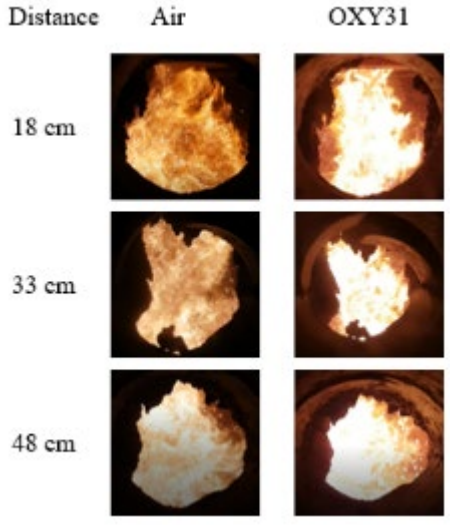
Sludge ~100 µm

Temperature and heat flux profiles

SRF combustion in air and oxyfuel conditions



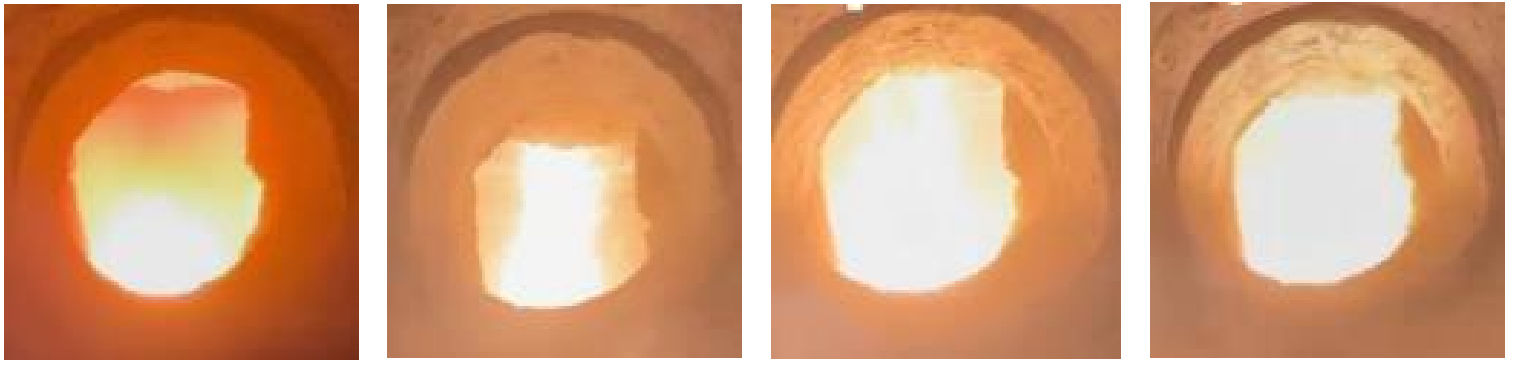




Effect of larger particle size and volatile matter influence the combustion behavior
→ causes a delay in the char combustion resulting in a flatter temperature profile

Pilot-scale experiments with coal and up to 100 % oxygen

Temperature profiles



Air λ*2 λ*3 λ*4

- The temperature profiles showed that the air case had the lowest temperature at the burner tip
- The maximum measured temperature was in the λ*2 case
- The effect of cooling with excess oxygen was confirmed in the λ*4 case

Conclusions

- Utilization of **100% alternative fuels** in **oxyfuel** conditions is one measure to reduce CO_2 emissions from the combustion process in the cement industry
- CO_2 and O_2 affect the **flue gas composition,** both are not inert gases and react with the different radicals in the combustion zone
- Pilot-scale oxyfuel experiments with **100% SRF** exhibit stable combustion conditions
- The alternative fuel flame was **wider**, **less intense** and **longer** in comparison to the coal flame
- **Excess O_2** is a suitable diluent to reduce and control the flame temperature in the combustion chamber

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University of Stuttgart

Thank you!

Dipl.-Ing. Jörg Maier

Joerg.maier@ifk.uni-stuttgart.de
+49 711 685 63396

University of Stuttgart
Institute of Combustion and Power Plant Technology
Pfaffenwaldring 23, 70569 Stuttgart

M.Sc. Cynthia Kroumian

cynthia.kroumian@ifk.uni-stuttgart.de
+49 711 685 66211

University of Stuttgart
Institute of Combustion and Power Plant Technology
Pfaffenwaldring 23, 70569 Stuttgart

Accelerating CCS Technologies

AC²OCem

http://ac2ocem.eu-projects.de/