ITOM-Cement | *Brief description*

Version: January 2026

Model purpose

The cement sector is one of the most energy-intensive and CO2-intensive sectors of all. It is responsible for 7% of all energy and industry-related CO2 emissions worldwide and 4% of such emissions in the EU. The European cement industry faces significant decarbonisation challenges due to its high energy intensity and inherent process-related CO2 emissions. ITOM-Cement models the EU cement industry's current landscape – including existing production sites and installed technology capacities – and thus calculates transformation pathways towards a climate-neutral future. Running different scenarios makes it possible to identify pivotal technological shifts and boundary conditions for a successful transformation and assess the impact of policy measures on the sector's evolution.

Model description

ITOM-Cement implements the ITOM[1] model framework for the European cement sector. The production chain (see figure below) represented in ITOM-Cement includes production of cement clinker from limestone as well as the production of cement from clinker and supplementary cementitious materials (SCMs), such as ground blast furnace slag and calcined clays. The model incorporates cement demand along with the cement clinker kilns in the EU27+UK and cement mills aggregated at the level of 14 regions. ITOM-Cement features a rich representation of clinker production technologies, including carbon-capture technologies, as well as different cement types. Demand is specified by cement application areas (called "Concrete X" in the figure), which may be restricted to certain cement types due to requirements regarding compressive strength, durability or other concrete properties. The model's main driver is to satisfy an externally defined level of cement demand from concrete applications in each region, while externally defined parameters (such as energy costs, SCM availability and carbon prices) change over time. While the temporal resolution is flexible, ITOM-Cement is typically used for scenarios with five-year steps.

Key features

- Differentiation of cement demand by country and applications with specific requirements
- Differentiated representation of cements (eight different types of cement)
- Spatially differentiated availability of SCMs and alternative fuels
- Representation of four carbon-capture technologies (amine-based, oxyfuel, LEILAC and cryogenic)

[1] ITOM stands for Industry Transformation Optimisation Model – see supplementary information below.

- Flexible, endogenous switch between and blending of fuels (such as coal, waste-based fuels, pet coke and biomass) for clinker production
- Spatially differentiated representation of transport and storage costs for captured carbon and consideration of storage capacities in three aggregated storage regions (EU North, EU South and Onshore)

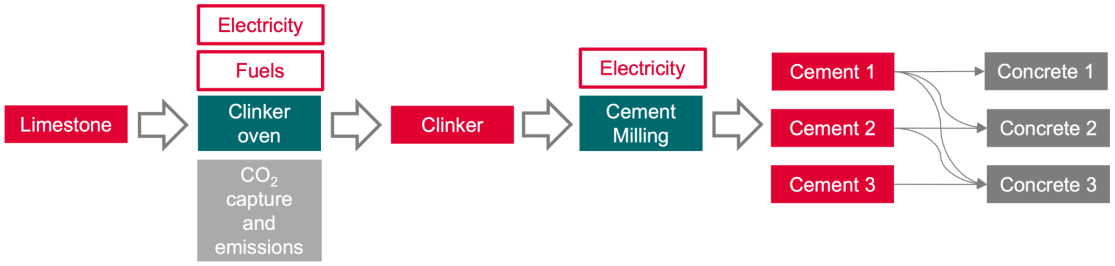

Figure: Production chain modelled in ITOM-Cement

Key model inputs and outputs

Inputs

Parameter	Description
Cement demand	Yearly demand for cement per concrete application and per region
Energy cost	Yearly and per country cost data for relevant energy carriers (e.g. electricity)
ETS price	Yearly carbon price development
CO_2 transport and storage costs	Yearly cost data differentiated by site and spatial storage zones (e.g. onshore, offshore)
Alternative fuels cost and availability	Yearly and per country data on availability and costs of biomass (for industrial use) and waste-based fuels
SCM availability	Yearly and per country data on availability of blast furnace slag and clays
Installed plants	Capacity and age of existing plants and announced (or expected) projects

Outputs

Parameter	Description
Production volume by technology / mode of operation	Per product (final or intermediate), and per region / location and year.
Material use, including use of SCMs	Per region and year
Installed capacity by technology	Per region / country / location and year. Can be used, for example, to examine intra-EU relocation.
Energy use	Per technology, and per region / country / location and year
CO2 emissions	Per technology, and per region / country / location and year

Captured and stored CO2	Per country / location / storage region and year

Project references

TRANItioning towards an Efficient, carbon-Neutral Circular European industry (TRANSIENCE)
Period: 01/2024 – 12/2027
Sponsor: European Commission, Horizon Europe

The project is developing a consistent, fully open-source model ecosystem for the transformation of European industry (MIC3 – Model for European Industry Circularity and Climate Change mitigation) to map and analyse the transition to a climate-neutral, sustainable and circular industry.
https://www.transience.eu/

EU Industry Pathways
Runtime: 08/2025 – 03/2026
Client: Agora Industry

In this project, researchers from Agora Industry, the Wuppertal Institute and the University of Kassel are developing and comparing three transformation scenarios for the European steel, petrochemical and cement industries with regard to Europe's strategic sovereignty – as well as the potential advantages of a moderate relocation of energy-intensive production steps within Europe.
https://wupperinst.org/p/wi/p/s/pd/2521/

Supplementary information

ITOM GitHub code repository: https://github.com/wupperinst/itom

ITOM code documentation: https://itom.readthedocs.io/en/latest/index.html

ITOM Cement model and full documentation: https://zenodo.org/records/15773258

Contact

Alexander Kling – alexander.kling@wupperinst.org
Georg Holtz – georg.holtz@wupperinst.org