ITOM | *Brief description*

Version: January 2026

Model purpose, model concept & key features

The Industry Transformation Optimisation Model (ITOM) is a framework that provides the basic structure for building geographically and technologically detailed models for the long-term development and evaluation of industrial sectors. It focuses on sectors within the basic materials industry, including petrochemicals, steel and cement. The model can take account of spatially explicit distributed production sites and their transport connections. The modelled value chains can provide a rich technological basis for the processes involved in manufacturing (intermediate) products from raw materials and preliminary products.

Models developed with ITOM optimise the overall system costs for expanding and deploying production capacity. The main requirement for achieving such optimisation is to produce an externally defined quantity of end products while externally defined parameters such as emission limits, energy costs and carbon prices change over time. ITOM endogenously determines where, with which technology and with what energy the different products are manufactured in a cost-optimal manner. A key feature of ITOM is, therefore, the endogenous optimisation of production networks across locations and stages within the value chain.

Model architecture and data handling

The ITOM framework is flexible and modular, allowing modellers to adapt it to their specific needs and research questions. It is based on the principles of open-source software and enables transparency and collaboration in the development of industrial system models.

The framework defines a set of parameters, variables and equations that form the constraints of the linear programming (LP) problem. These equations model various aspects of a basic industrial sector, such as:

- Investment decisions in production capacities (new or retrofitting)
- Restrictions on expansion and investment rates
- Mode of operation and utilisation of production facilities
- Restrictions on the availability of raw materials
- Transportation of raw materials and products between production sites
- Emissions from production activities
- Accounting for and discounting of investment, operating, transportation and emission costs

Exogenous parameters are required to calibrate a model for a specific industry and scenario using ITOM. These are primarily technical economic parameters, such as:

- Final demand for products (main driver)

- Existing production capacities
- Various costs (CAPEX, OPEX, energy costs, etc.)
- Discount rates
- Production yields
- Emissions intensities
- Transport routes
- Lifetime of plants

The data for the exogenous parameters can be imported into the ITOM model in CSV files. The results (model variables) are also provided as CSV files. The results include:

- Total costs
- Shadow prices
- Investment volume
- Production volume
- Transport volume (including imports and exports)
- Emission volume
- Energy and raw material demand

The equations, parameters and variables listed above are usually provided in high spatial, technological and temporal resolution according to:

- Region
- Location
- Year
- Technology
- Product
- Mode of operation of plants
- Transport technology
- Emissions

Collecting and preparing detailed, consistent, high-quality data for exogenous parameters is a key requirement for ITOM to produce useful models. The required level of data detail depends on the specific question being asked.

Supplementary information

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

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

Brief descriptions of sectoral models implemented with ITOM are available on the Wuppertal Institute website:

- Petrochemicals: https://wupperinst.org/link-zu-kurzbeschreibung_itom-petchem.pdf
- Steel: https://wupperinst.org/link-zu-kurzbeschreibung_itom-steel.pdf
- Cement: https://wupperinst.org/link-zu-kurzbeschreibung_itom-cement.pdf

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