



# **Decarbonising Industry**

long-term transformation pathways of Swiss industry in view of a zero-carbon energy system

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## **Decarbonising Switzerland**



CO<sub>2</sub> emissions from fuel combustion and industrial processes MtCO<sub>2</sub>/yr



Further Net-Zero scenario variants:

- **ANTI**: limited potentials for new energy carriers and imports
- **SECUR**: significant independence of imports
- **MARKETS**: forced market integration
- **EFFORT**: cost-efficient mitigation across all sectors
- **INNOV**: accelerated innovation

### Salient model features:

- ✓ Whole energy system model
- Existing and new technologies with technical and economic characteristics
- ✓ Cost-minimisation approach (total discounted system costs)
- ✓ Long time horizon combined with hourly time steps
- Dynamic model and optimisation for entire time series (i.e., transition pathways)
- ✓ Representation of long-term investment choices and short-term operation
- $\checkmark$  Full-scale model calibrated to the latest Swiss energy statistics
- ✓ Imports/exports of energy
- ✓ Advanced features for system flexibility, renewable integration, sector coupling, demand-side-management
- $\checkmark$  Existing and future policies and regulatory targets

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## Modelling the industry sector

- 5 industrial subsectors (cement, paper, food, • chemical, other)
- Industrial processes, energy conversion ٠ technology (fossil & renewable) and energy saving options
- Different products represented •
- Material flows in addition to energy flows •
- Several process heat levels ٠
- System flexibility options, such as load shift ٠ and storage
- Interdependencies with the supply sector • and competition with other energy sectors
- Industry-related policy instruments, such as • ETS, fuel tax, standards, etc.

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### Example: paper industry modelled with different products and process steps:



### Selected insights on decarbonising industry



### Pulp and paper sector\*

**Cement sector\*** 





Sources: Obrist, M. et al. (2021), Obrist, M. et al. (2022) N.B.: \* rather constant demand for industrial products assumed over time

Heat

supply

Motors

Process

integr.

Drying

2050

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