

Snapshot of - IMACLIM

Archive of IMACLIM, version: 1.0

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Reference card - IMACLIM

The reference card is a clearly defined description of model features. The numerous options have been organized into a limited amount of default and model specific (non default) options. In addition some features are described by a short clarifying text.

Legend:

not implemented

implemented **implemented (not default option)**

About

Name and version IMACLIM- R 1.0

Model link https://github.com/CIREDD/IMACLIM-R_World

Institution Centre international de recherche sur l'environnement et le développement (CIRED), France, <http://www.centre-cired.fr.>, Societe de Mathematiques Appliquees et de Sciences Humaines (SMASH), France, <http://www.smash.fr.>, École Nationale des Ponts et Chaussées (ENPC), France, [https://ecoledesponts.fr/.](https://ecoledesponts.fr/), Centre National de la Recherche Scientifique (CNRS), France, <https://www.cnrs.fr/fr.>, AgroParisTech (AgroParisTech), France, [https://www.agroparistech.fr/.](https://www.agroparistech.fr/), Centre de coopération International en Recherche Agronomique pour le Développement (CIRAD), France, [https://www.cirad.fr/.](https://www.cirad.fr/)

Documentation IMACLIM documentation consists of a referencecard and detailed model documentation

Process state published

Model scope and methods

Model documentation: [Model scope and methods - IMACLIM](#)

Model type Integrated assessment model **CGE**
 Energy system model CBA-integrated assessment model

Geographical scope **Global** Regional

Objective Imaclim-R is intended to study the interactions between energy systems and the economy, to assess the feasibility of low carbon development strategies and the transition pathway towards low carbon future.

Solution concept Partial equilibrium (price elastic demand) demand)
 Partial equilibrium (fixed **General equilibrium (closed economy)**)

Solution horizon	<input checked="" type="checkbox"/> Recursive dynamic (myopic)	<input type="checkbox"/> Intertemporal optimization (foresight)
Solution method	<input checked="" type="checkbox"/> Simulation <input type="checkbox"/> Optimization <input checked="" type="checkbox"/> Imaclim-R is implemented in Scilab, and uses the fonction	fsolve from a shared C++ library to solve the static equilibrium system of non-linear equations.
Anticipation	Recursive dynamics: each year the equilibrium is solved (system of non-linear equations), in between two years parameters to the equilibrium evolve according to specified functions.	
Temporal dimension	Base year:2001, time steps:Annual, horizon: 2050 or 2100	
Spatial dimension	Number of regions:12	
	1. USA 2. Canada 3. Europe 4. China 5. India 6. Brazil	7. Middle East 8. Africa 9. Commonwealth of Independant States 10. OECD Pacific 11. Rest of Asia 12. Rest of Latin Amercia
Time discounting type	<input type="checkbox"/> Discount rate exogenous	<input type="checkbox"/> Discount rate endogenous
Policies	<input checked="" type="checkbox"/> Emission tax <input checked="" type="checkbox"/> Emission pricing <input checked="" type="checkbox"/> Cap and trade <input checked="" type="checkbox"/> Fuel taxes <input checked="" type="checkbox"/> Fuel subsidies <input type="checkbox"/> Feed-in-tariff <input type="checkbox"/> Portfolio standard	<input checked="" type="checkbox"/> Capacity targets <input checked="" type="checkbox"/> Emission standards <input checked="" type="checkbox"/> Energy efficiency standards <input type="checkbox"/> Agricultural producer subsidies <input type="checkbox"/> Agricultural consumer subsidies <input type="checkbox"/> Land protection <input type="checkbox"/> Pricing carbon stocks

Socio-economic drivers

Model documentation: *Socio-economic drivers - IMACLIM*

Population **Yes (exogenous)** Yes (endogenous)

Population structure	age	<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Education level		<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Urbanization rate		<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
GDP		<input type="checkbox"/> Yes (exogenous)	<input checked="" type="checkbox"/> Yes (endogenous)
Income distribution		<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Employment rate		<input type="checkbox"/> Yes (exogenous)	<input checked="" type="checkbox"/> Yes (endogenous)
Labor productivity		<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Total factor productivity		<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Autonomous energy efficiency improvements		<input checked="" type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)

Macro-economy

Model documentation: Macro-economy - IMACLIM

Economic sector

Industry	<input type="checkbox"/> Yes (physical)	<input type="checkbox"/> Yes (physical & economic)
	<input checked="" type="checkbox"/> Yes (economic)	
Energy	<input type="checkbox"/> Yes (physical)	<input checked="" type="checkbox"/> Yes (physical & economic)
	<input type="checkbox"/> Yes (economic)	
Transportation	<input type="checkbox"/> Yes (physical)	<input checked="" type="checkbox"/> Yes (physical & economic)
	<input type="checkbox"/> Yes (economic)	
Residential and commercial	<input type="checkbox"/> Yes (physical)	<input checked="" type="checkbox"/> Yes (physical & economic)
	<input type="checkbox"/> Yes (economic)	

Agriculture Yes (physical) Yes (physical & economic) **Yes (economic)****Forestry** Yes (physical) Yes (physical & economic) Yes (economic)**Other economic sector** **Construction**

Note: The energy sector is divided into five sub-sectors: oil extraction, gas extraction, coal extraction, refinery, power generation. The transport sector is divided into three sub-sectors: terrestrial transport, air transport, water transport. The industry sector has one sub-sector: Energy intensive industry.

Macro-economy**Trade** **Coal** Food crops **Oil** **Capital** **Gas** **Emissions permits** Uranium **Non-energy goods** **Electricity** **Refined Liquid Fuels** **Bioenergy crops****Cost measures** **GDP loss** Area under MAC **Welfare loss** Energy system cost mark-up **Consumption loss** **Equivalent Variation****Categorization by group** Income Gender Urban - rural Education level Technology adoption Household size Age**Institutional and political factors** Early retirement of capital allowed**differentiated by country/region** Interest rates differentiated by country/region **Technological change differentiated by country/region** Regional risk factors included **Behavioural change differentiated by country/region** **Technology costs** **Constraints on cross country financial transfers**

Resource use

Coal	<input type="checkbox"/> Yes (fixed) <input checked="" type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Conventional Oil	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input checked="" type="checkbox"/> Yes (process model)
Unconventional Oil	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input checked="" type="checkbox"/> Yes (process model)
Conventional Gas	<input type="checkbox"/> Yes (fixed) <input checked="" type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Unconventional Gas	<input type="checkbox"/> Yes (fixed) <input checked="" type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Uranium	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Bioenergy	<input type="checkbox"/> Yes (fixed) <input checked="" type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Water	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Raw Materials	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)
Land	<input type="checkbox"/> Yes (fixed) <input type="checkbox"/> Yes (supply curve)	<input type="checkbox"/> Yes (process model)

Technological change

Energy conversion technologies	<input type="checkbox"/> No technological change <input type="checkbox"/> Exogenous technological	change <input checked="" type="checkbox"/> Endogenous technological change
Energy End-use	<input type="checkbox"/> No technological change <input type="checkbox"/> Exogenous technological	change <input checked="" type="checkbox"/> Endogenous technological change
Material Use	<input type="checkbox"/> No technological change <input type="checkbox"/> Exogenous technological	change <input type="checkbox"/> Endogenous technological change

Agriculture (tc)

- No technological change
- Exogenous technological change
- Endogenous technological change

Energy

Model documentation: [Energy - IMACLIM](#)

Behaviour

Price response (via elasticities), and non-price drivers (infrastructure and urban forms conditioning location choices, different asymptotes on industrial goods consumption saturation levels with income rise, speed of personal vehicle ownership rate increase, speed of residential area increase).

Energy technology substitution**Energy technology choice**

- No discrete technology choices
- Logit choice model**
- Production function
- Linear choice (lowest cost)
- Lowest cost with adjustment penalties

Energy technology substitutability

- Mostly high substitutability
- Mostly low substitutability
- Mixed high and low substitutability
- Discrete technology choices with mostly high substitutability in some sectors and mostly low substitutability in other sectors**

Energy technology deployment

- Expansion and decline constraints**
- System integration constraints**

Energy**Electricity technologies**

- Coal w/o CCS**
- Coal w/ CCS**
- Gas w/o CCS**
- Gas w/ CCS**
- Oil w/o CCS**
- Oil w/ CCS**
- Bioenergy w/o CCS**
- Bioenergy w/ CCS**
- Geothermal power
- Nuclear power**
- Solar power**
- Solar power-central PV**
- Solar power-distributed PV**
- Solar power-CSP**
- Wind power**
- Wind power-onshore**
- Wind power-offshore**
- Hydroelectric power**

Ocean power

Hydrogen production

- Coal to hydrogen w/o CCS
- Coal to hydrogen w/ CCS
- Natural gas to hydrogen w/o CCS
- Natural gas to hydrogen w/ CCS
- Oil to hydrogen w/o CCS
- Oil to hydrogen w/ CCS

- Biomass to hydrogen w/o CCS
- Biomass to hydrogen w/ CCS
- Nuclear thermochemical hydrogen
- Solar thermochemical hydrogen
- Electrolysis

Refined liquids

- Coal to liquids w/o CCS
- Coal to liquids w/ CCS
- Gas to liquids w/o CCS
- Gas to liquids w/ CCS

- Bioliquids w/o CCS
- Bioliquids w/ CCS
- Oil refining

Refined gases

- Coal to gas w/o CCS
- Coal to gas w/ CCS
- Oil to gas w/o CCS

- Oil to gas w/ CCS
- Biomass to gas w/o CCS
- Biomass to gas w/ CCS

Heat generation

- Coal heat
- Natural gas heat
- Oil heat
- Biomass heat

- Geothermal heat
- Solarthermal heat
- CHP (coupled heat and power)

Grid Infra Structure

Electricity

Yes (aggregate)

Yes (spatially explicit)

Gas

Yes (aggregate)

Yes (spatially explicit)

Heat

Yes (aggregate)

Yes (spatially explicit)

CO₂

Yes (aggregate)

Yes (spatially explicit)

Hydrogen

Yes (aggregate)

Yes (spatially explicit)

Energy end-use technologies

Passenger transportation

- Passenger trains
- Buses
- Light Duty Vehicles (LDVs)

- Electric LDVs
- Hydrogen LDVs
- Hybrid LDVs

Gasoline LDVs **Diesel LDVs** **Passenger aircrafts****Freight transportation**

- Freight trains
- Heavy duty vehicles

- Freight aircrafts
- Freight ships

Industry

- Steel production
- Aluminium production
- Cement production
- Petrochemical production

- Paper production
- Plastics production
- Pulp production

Residential and commercial

- Space heating
- Space cooling
- Cooking

- Refrigeration
- Washing
- Lighting

Land-use

Model documentation: [Land-use - IMACLIM](#)

Land cover

- Cropland
- Cropland irrigated
- Cropland food crops
- Cropland feed crops
- Cropland energy crops
- Forest

- Managed forest
- Natural forest
- Pasture
- Shrubland
- Built-up area

Agriculture and forestry demands

- Agriculture food
- Agriculture food crops
- Agriculture food livestock
- Agriculture feed
- Agriculture feed crops
- Agriculture feed livestock
- Agriculture non-food

- Agriculture non-food crops
- Agriculture non-food livestock
- Agriculture bioenergy
- Agriculture residues
- Forest industrial roundwood
- Forest fuelwood
- Forest residues

Agricultural commodities

- Wheat
- Rice
- Other coarse grains
- Oilseeds

- Sugar crops
- Ruminant meat
- Non-ruminant meat and eggs
- Dairy products

Emission, climate and impacts

Model documentation: [Emissions - IMACLIM](#), [Climate - IMACLIM](#), [Non-climate sustainability dimension - IMACLIM](#)

Greenhouse gases **CO2 fossil fuels**

- CO2 cement
- CO2 land use
- CH4 energy
- CH4 land use
- CH4 other
- N2O energy

- N2O land use
- N2O other
- CFCs
- HFCs
- SF6
- PFCs

Note: The non-CO2 forcing agents that are not explicitly tracked are represented in the climate module by an exogenously given additional forcing factor.

Pollutants

- CO energy
- CO land use
- CO other
- NOx energy
- NOx land use
- NOx other
- VOC energy
- VOC land use
- VOC other
- SO2 energy
- SO2 land use

- SO2 other
- BC energy
- BC land use
- BC other
- OC energy
- OC land use
- OC other
- NH3 energy
- NH3 land use
- NH3 other

Climate indicators

- Concentration: CO2
- Concentration: CH4
- Concentration: N2O
- Concentration: Kyoto gases
- Radiative forcing: CO2
- Radiative forcing: CH4
- Radiative forcing: N2O
- Radiative forcing: F-gases

- Radiative forcing: Kyoto gases
- Radiative forcing: aerosols
- Radiative forcing: land albedo
- Radiative forcing: AN3A
- Radiative forcing: total
- Temperature change
- Sea level rise
- Ocean acidification

Carbon dioxide removal **Bioenergy with CCS**

- Reforestation
- Afforestation

- Soil carbon enhancement
- Direct air capture
- Enhanced weathering

Climate change impacts

- Agriculture
- Energy supply
- Energy demand

- Economic output
- Built capital
- Inequality

Co-Linkages

- Energy security: Fossil fuel imports & exports (region)**
- Energy access: Household energy consumption**
- Air pollution & health: Source-based aerosol**

emissions

- Air pollution & health: Health impacts of air Pollution
- Food access
- Water availability
- Biodiversity

Model Documentation - IMACLIM

Introduction

The IMACLIM-R model is a hybrid dynamic general equilibrium model of the world economy that covers the period 2001–2100 in yearly steps through the recursive iteration of annual static equilibria and dynamic modules. The annual static equilibrium determines the relative prices, wages, labour, value, physical flows, capacity utilization, profit rates, and savings at a year t as a result of short-term equilibrium conditions between demand and supply of goods, capital, and labour markets. The dynamic modules are sector-specific reduced forms of technology-rich models, which take the static equilibria at a year t as an input, assess the reaction of technical systems to the economic signals, and send new input–output coefficients back to the static model to allow computation of the equilibrium for year $t + 1$. IMACLIM-R is part of the IMACLIM suite of models, further information on which is available on the [IMACLIM](http://www.imaclim.centre-cired.fr/Imacli) (<http://www.imaclim.centre-cired.fr/Imacli>) homepage.

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References

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