Snapshot of - RICE50+

Archive of RICE50+, version: 2.0.0

Contents

Reference card - RICE50+

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 RICE50+ 2.0.0

Model link	https://github.com/witch-team/RICE50xmodel; https://www.eiee.org/tool/rice50/
Institution	Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC), Italy, https://www.cmcc.it/.
Documentation	RICE50+ documentation is limited and consists of a reference card
Process state	published

Model scope and methods

Model type	☐ Integrated assessment model	☐ CGE
	☐ Energy system model	☑ **CBA-integrated assessment model**
Geographical scope	☑ **Global**	☐ Regional
Objective	Welfare function	
Solution concept	☐ Partial equilibrium (price elastic demand)	☑ **General equilibrium (closed economy)**
	☐ Partial equilibrium (fixed demand)	
Solution horizon	☐ Recursive dynamic (myopic)	☑ **Intertemporal optimization (foresight)**
Solution method	☐ Simulation	☑ **Optimization**
Temporal dimension	Base year:2015, time steps:5 years, horizon: 2300	
Spatial dimension	Number of regions:57	

Note: 57 regions is the default version. Also features an almost all country resolution with 160 ISO3 countries.

☐ Discount rate exogenous	☑ **Discount rate endogenous**

Time discounting type		
Policies	☑ **Emission tax** ☑ **Emission pricing** ☑ **Cap and trade** ☐ Fuel taxes ☐ Fuel subsidies ☐ Feed-in-tariff ☐ Portfolio standard	☐ Capacity targets ☐ Emission standards ☐ Energy efficiency standards ☐ Agricultural producer subsidies ☐ Agricultural consumer subsidies ☐ Land protection ☐ Pricing carbon stocks

Socio-economic drivers

Population	☑ **Yes (exogenous)**	☐ Yes (endogenous)
Population age structure	☑ **Yes (exogenous)**	☐ Yes (endogenous)
Education level	☑ **Yes (exogenous)**	☐ Yes (endogenous)
Urbanization rate	☑ **Yes (exogenous)**	☐ Yes (endogenous)
GDP	☐ Yes (exogenous)	☑ **Yes (endogenous)**
Income distribution	☐ Yes (exogenous)	☑ **Yes (endogenous)**
Employment rate	☑ **Yes (exogenous)**	☐ Yes (endogenous)
Labor productivity	☐ Yes (exogenous)	☐ Yes (endogenous)
Total factor productivity	☑ **Yes (exogenous)**	☐ Yes (endogenous)
Autonomous energy efficiency improvements	☑ **Yes (exogenous)**	☐ Yes (endogenous)

Macro-economy

Economic sector

Industry	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)
Energy	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)
Transportation	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)
Residential and commercial	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)
Agriculture	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)
Forestry	☐ Yes (physical) ☐ Yes (economic)	☐ Yes (physical & economic)

Macro-economy

Trade	☐ Coal ☐ Oil ☐ Gas ☐ Uranium ☐ Electricity	☐ Bioenergy crops ☐ Food crops ☐ Capital ☐ Emissions permits ☐ Non-energy goods
Cost measures	☑ **GDP loss** ☑ **Welfare loss** ☑ **Consumption loss**	☐ Area under MAC ☐ Energy system cost mark-up
Categorization by group	☑ **Income** ☐ Urban - rural ☐ Technology adoption ☐ Age	☐ Gender ☐ Education level ☐ Household size
Institutional and political factors	☐ Early retirement of capital allowed ☐ Interest rates differentiated by country/region	☐ Regional risk factors included ☐ Technology costs differentiated by country/region

☐ Technological change differentiated by country/region

☐ Behavioural change

differentiated by country/region

☐ Constraints on cross country financial transfers

Resource use

Coal	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Conventional Oil	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Unconventional Oil	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Conventional Gas	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Unconventional Gas	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Uranium	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Bioenergy	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Water	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Raw Materials	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)
Land	☐ Yes (fixed) ☐ Yes (supply curve)	☐ Yes (process model)

Technological change

Energy conversion technologies	☐ No technological change ☐ Exogenous technological	change ☐ Endogenous technological change
Energy End-use	☐ No technological change	☐ Exogenous technological change

☐ Endogenous technological change

Material Use	☐ No technological change ☐ Exogenous technological change	☐ Endogenous technological change
Agriculture (tc)	☐ No technological change ☐ Exogenous technological change	☐ Endogenous technological change

Energy

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
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	☐ Biomass to hydrogen w/o CCS
	☐ Coal to hydrogen w/ CCS	☐ Biomass to hydrogen w/ CCS
	☐ Natural gas to hydrogen w/o CCS	☐ Nuclear thermochemical hydrogen
	☐ Natural gas to hydrogen w/ CCS	☐ Solar thermochemical hydrogen
	☐ Oil to hydrogen w/o CCS	☐ Electrolysis
	☐ Oil to hydrogen w/ CCS	
Refined liquids	☐ Coal to liquids w/o CCS	☐ Bioliquids w/o CCS
	☐ Coal to liquids w/ CCS	☐ Bioliquids w/ CCS
	☐ Gas to liquids w/o CCS	☐ Oil refining
	☐ Gas to liquids w/ CCS	
Refined gases	☐ Coal to gas w/o CCS	☐ Oil to gas w/ CCS
	☐ Coal to gas w/ CCS	☐ Biomass to gas w/o CCS
	☐ Oil to gas w/o CCS	☐ Biomass to gas w/ CCS
Heat generation	☐ Coal heat	☐ Geothermal heat
	☐ Natural gas heat	☐ Solarthermal heat
	☐ Oil heat	☐ CHP (coupled heat and power)
	☐ Biomass heat	

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	☐ Hydrogen LDVs
	☐ Buses	☐ Hybrid LDVs
	☐ Light Duty Vehicles (LDVs)	☐ Gasoline LDVs
	☐ Electric LDVs	☐ Diesel LDVs

☐ Passenger aircrafts

Freight transportation	☐ Freight trains	☐ Freight aircrafts
	☐ Heavy duty vehicles	☐ Freight ships
Industry	☐ Steel production	☐ Paper production
	☐ Aluminium production	☐ Plastics production
	☐ Cement production	☐ Pulp production
	☐ Petrochemical production	
Residential and commercial	☐ Space heating	☐ Refrigeration
	☐ Space cooling	☐ Washing
	☐ Cooking	☐ Lighting

Land-use

Land cover	☐ Cropland	☐ Managed forest
	☐ Cropland irrigated	☐ Natural forest
	☐ Cropland food crops	☐ Pasture
	☐ Cropland feed crops	☐ Shrubland
	☐ Cropland energy crops	☐ Built-up area
	☐ Forest	
Agriculture and forestry demands	☐ Agriculture food	☐ Agriculture non-food crops
	☐ Agriculture food crops	☐ Agriculture non-food livestock
	☐ Agriculture food livestock	☐ Agriculture bioenergy
	☐ Agriculture feed	☐ Agriculture residues
	☐ Agriculture feed crops	☐ Forest industrial roundwood
	☐ Agriculture feed livestock	☐ Forest fuelwood
	☐ Agriculture non-food	☐ Forest residues
Agricultural commodities	☐ Wheat	☐ Sugar crops
	☐ Rice	☐ Ruminant meat
	☐ Other coarse grains	☐ Non-ruminant meat and eggs
	☐ Oilseeds	☐ Dairy products

Emission, climate and impacts

Greenhouse gases	☑ **CO2 fossil fuels**	☐ CH4 land use
	☑ **CO2 cement**	☐ CH4 other
	☑ **CO2 land use**	☑ **N2O energy**
	☑ **CH4 energy**	☐ N2O land use

- ☐ N2O other
- ☐ CFCs
- ☐ HFCs
- ☐ SF6
- ☐ PFCs

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**

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