

Snapshot of - AIM-Enduse India

Archive of AIM-Enduse_India, version: 1.0

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Model Documentation - AIM-Enduse India

Reference card - AIM-Enduse_India

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	AIM/Enduse India 1.0
Model link	http://www.nies.go.jp/media_kit/16.AIM/Enduse.html ; https://doi.org/10.1016/j.energy.2021.120464
Institution	Indian Institute of Management Ahmedabad (IIMA), India, https://www.iima.ac.in/ .
Documentation	AIM-Enduse India documentation consists of a referencecard and <u>detailed model documentation</u>
Process state	in preparation

Model scope and methods

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

Model type	<input type="checkbox"/> Integrated assessment model <input checked="" type="checkbox"/> Energy system model	<input type="checkbox"/> CGE <input type="checkbox"/> CBA-integrated assessment model
Geographical scope	<input type="checkbox"/> Global	<input type="checkbox"/> Regional
Objective	National	
Solution concept	<input type="checkbox"/> Partial equilibrium (price elastic demand) <input checked="" type="checkbox"/> Partial equilibrium (fixed	demand) <input type="checkbox"/> General equilibrium (closed economy)
Solution horizon	<input checked="" type="checkbox"/> Recursive dynamic (myopic)	<input type="checkbox"/> Intertemporal optimization (foresight)
Solution method	<input type="checkbox"/> Simulation	<input checked="" type="checkbox"/> Optimization
Temporal dimension	Base year:2000, time steps:Annual, horizon:	
Spatial dimension	Number of regions:1	
	1. India	

Time discounting type	<input checked="" 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 checked="" type="checkbox"/> Feed-in-tariff <input checked="" type="checkbox"/> Portfolio standard <input checked="" type="checkbox"/> Capacity targets	<input checked="" type="checkbox"/> Emission standards <input checked="" type="checkbox"/> Energy efficiency standards <input checked="" type="checkbox"/> Agricultural producer subsidies <input checked="" type="checkbox"/> Agricultural consumer subsidies <input checked="" type="checkbox"/> Land protection <input checked="" type="checkbox"/> Pricing carbon stocks

Socio-economic drivers

Model documentation: *Socio-economic drivers - AIM-Enduse_India*

Population	<input checked="" type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Population age structure	<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 checked="" type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
GDP	<input checked="" type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Income distribution	<input type="checkbox"/> Yes (exogenous)	<input type="checkbox"/> Yes (endogenous)
Employment rate	<input type="checkbox"/> Yes (exogenous)	<input 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)
	<input type="checkbox"/> Yes (exogenous)	<input checked="" type="checkbox"/> Yes (endogenous)

Autonomous energy efficiency improvements

Macro-economy

Model documentation: Macro-economy - AIM-Enduse_India

Economic sector

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

Macro-economy

Trade	<input type="checkbox"/> Coal <input type="checkbox"/> Oil <input type="checkbox"/> Gas <input type="checkbox"/> Uranium <input type="checkbox"/> Electricity	<input type="checkbox"/> Bioenergy crops <input type="checkbox"/> Food crops <input type="checkbox"/> Capital <input type="checkbox"/> Emissions permits <input type="checkbox"/> Non-energy goods
Cost measures	<input type="checkbox"/> GDP loss <input type="checkbox"/> Welfare loss <input type="checkbox"/> Consumption loss	<input checked="" type="checkbox"/> Area under MAC <input checked="" type="checkbox"/> Energy system cost mark-up
Categorization by group	<input type="checkbox"/> Income <input checked="" type="checkbox"/> Urban - rural <input checked="" type="checkbox"/> Technology adoption	<input type="checkbox"/> Age <input type="checkbox"/> Gender <input type="checkbox"/> 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

No technological change

Exogenous technological change

Energy conversion technologies **Endogenous technological change****Energy End-use** No technological change change
 Exogenous technological **Endogenous technological change****Material Use** No technological change change
 Exogenous technological **Endogenous technological change****Agriculture (tc)** No technological change change
 Exogenous technological **Endogenous technological change**

Energy

Model documentation: [Energy - AIM-Enduse_India](#)

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

- | | |
|---|--|
| <input checked="" type="checkbox"/> Geothermal power | <input checked="" type="checkbox"/> Wind power |
| <input checked="" type="checkbox"/> Nuclear power | <input checked="" type="checkbox"/> Wind power-onshore |
| <input checked="" type="checkbox"/> Solar power | <input type="checkbox"/> Wind power-offshore |
| <input checked="" type="checkbox"/> Solar power-central PV | <input checked="" type="checkbox"/> Hydroelectric power |
| <input checked="" type="checkbox"/> Solar power-distributed PV | <input type="checkbox"/> Ocean power |
| <input checked="" type="checkbox"/> Solar power-CSP | |

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)

 Other

Note: Waste 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
- 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
- Iron and steel
- Non-ferrous metals
- Other Industries

*Note: Textile, Chlor-Alkali,
Fertilizer, Chemical, Brick Kiln,
Sugar Plant*

Residential and commercial

- Space heating
- Space cooling
- Cooking

- Refrigeration
- Washing
- Lighting

Land-use

Model documentation: Land-use - AIM-Enduse_India

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

Model documentation: Emissions - AIM-Enduse_India, Climate - AIM-Enduse_India, Non-climate sustainability dimension - AIM-Enduse_India

Greenhouse gases **CO2 fossil fuels** N2O land use **CO2 cement** N2O other **CO2 land use** CFCs CH4 energy HFCs CH4 land use SF6 CH4 other PFCs N2O energy**Pollutants** CO energy SO2 other CO land use BC energy CO other BC land use NOx energy BC other NOx land use OC energy NOx other OC land use VOC energy OC other VOC land use NH3 energy VOC other NH3 land use SO2 energy NH3 other SO2 land use**Climate indicators** Concentration: CO2 Radiative forcing: F-gases Concentration: CH4 Radiative forcing: Kyoto gases Concentration: N2O Radiative forcing: aerosols Concentration: Kyoto gases Radiative forcing: land albedo Radiative forcing: CO2 Radiative forcing: AN3A Radiative forcing: CH4 Radiative forcing: total Radiative forcing: N2O 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 - AIM-Enduse India

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