To pdf - BLUES

From IAMC-Documentation

Reference card - BLUES

Contents

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	BLUES 1.0
Institution and users	Centro de Economia Energetica e Ambiental/Programa de Planejamento Energetico (Cenergia), Brazil, http://www.coppe.ufrj.br/pt-br/pesquisa/laboratorios/centro-de-economia-energetica-e-ambiental-cenergia. main users: Alexandre Köberle, Pedro Rochedo, Andre Lucena, Alexandre Szklo, Roberto Schaeffer
Documentation	

BLUES documentation consists of a referencecard and detailed model documentation

Model scope and methods

Model documentation: Model scope and methods - BLUES

Temporal dimension Base year:, time steps:, horizon:

Spatial dimension Number of regions:

Socio economic drivers

Model documentation: Socio-economic drivers - BLUES

Exogenous drivers

- ☐ Exogenous GDP
- ☐ Total Factor Productivity
- ☐ Labour Productivity
- ☐ Capital Technical progress
- ☐ Energy Technical progress
- ☐ Materials Technical progress
- ☐ GDP per capita

Development

- ☐ GDP per capita
- ☐ Income distribution in a region
- ☐ Urbanisation rate
- ☐ Education level
- ☐ Labour participation rate

Macro economy

Model documentation: Macro-economy - BLUES

Economic sectors

- ☐ Agriculture
- ☐ Industry
- ☐ Energy
- ☐ Transport
- ☐ Services

Cost measures

- ☐ GDP loss
- ☐ Welfare loss
- ☐ Consumption loss
- ☐ Area under MAC
- ☐ Energy system costs

Trade

- ☐ Coal
- ☐ Oil
- ☐ Gas
- ☐ Uranium
- ☐ Electricity
- ☐ Bioenergy crops
- ☐ Food crops
- ☐ Capital
- ☐ Emissions permits
- ☐ Non-energy goods

Energy

Model documentation: Energy - BLUES

Resource use	☐ Coal ☐ Oil ☐ Gas	☐ Uranium ☐ Biomass
Electricity technologies	☐ Coal ☐ Gas ☐ Oil ☐ Nuclear	☐ Biomass ☐ Wind ☐ Solar PV ☐ CCS
Conversion technologies	☐ CHP ☐ Heat pumps ☐ Hydrogen	☐ Fuel to gas ☐ Fuel to liquid
Grid and infrastructure	☐ Electricity ☐ Gas ☐ Heat	☐ CO2 ☐ H2
Energy technology substitution	☐ Discrete technology choices ☐ Expansion and decline constraints	☐ System integration constraints
Energy service sectors	☐ Transportation ☐ Industry	☐ Residential and commercial

Land-use

Model documentation: Land-use - BLUES; Non-climate sustainability dimension - BLUES

Other resources

Model documentation: Non-climate sustainability dimension - BLUES

Other resources	☐ Water ☐ Metals	☐ Cement

Emissions and climate

Model documentation: Emissions - BLUES; Climate - BLUES

Green house gasses	☐ CO2 ☐ CH4 ☐ N2O	☐ HFCs ☐ CFCs ☐ SF6

Pollutants	☐ NOx	☐ OC
	☐ SOx	☐ Ozone
	☐ BC	
Climate indicators	☐ CO2e concentration (ppm)	☐ Temperature change (°C)
	☐ Radiative Forcing (W/m^2)	☐ Climate damages $ or equivalent

Model Documentation - BLUES

The Brazilian Land Use and Energy System (BLUES) model is a perfect-foresight, least-cost optimization model for Brazil. It chooses the energy system configuration with the least total system cost over the entire time horizon of the study, in this case 2010 to 2050. The model minimizes costs of the entire energy system, including electricity generation, agriculture, industry, transport and the buildings sectors. BLUES finds optimized mixes for the energy system as a whole, rather than evaluating sectorial optimal solutions. It includes CO2, CH4 and N2O emissions associated with land use, agriculture and livestock, fugitive emissions, fuel combustion, industrial processes and waste treatment.

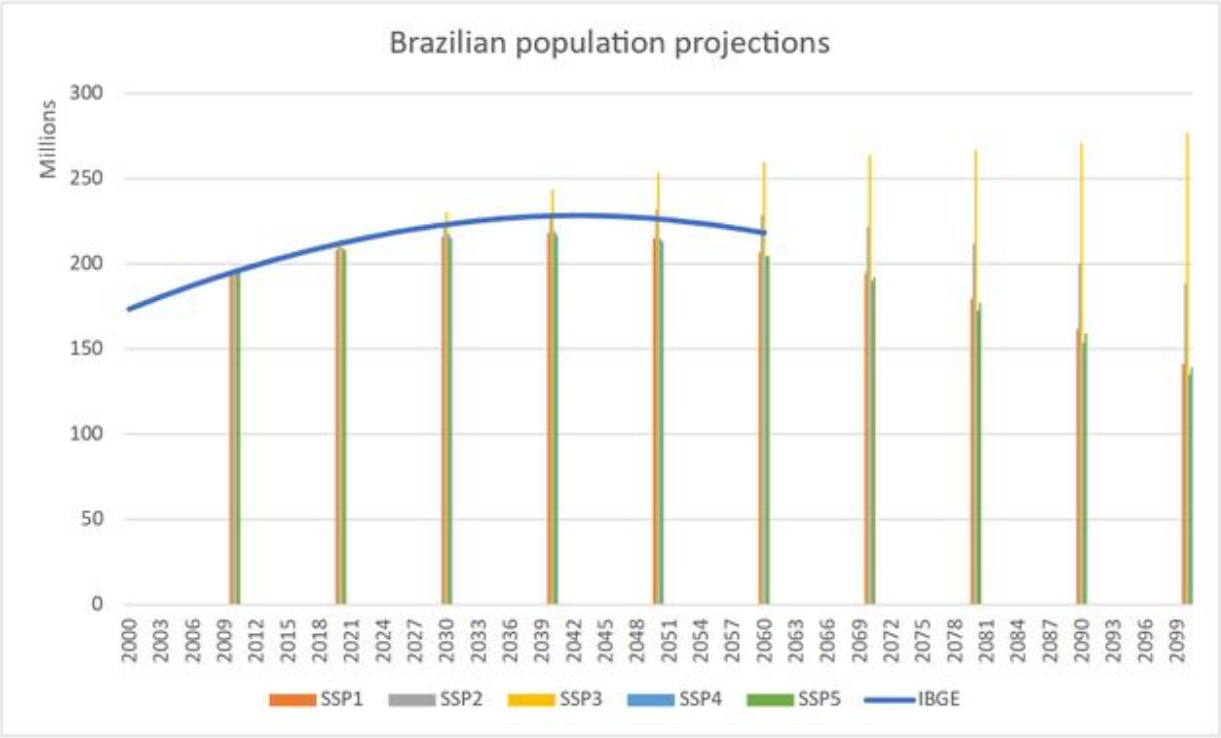
BLUES has six native regions. One main overarching region into which five sub-regions are nested following the geopolitical division of the country. The energy system is represented in detail across sectors, with over 1500 technologies available in and customized for each of its six native regions. The representation of the land-use system includes forests, savannas, low- and high-capacity pastures, integrated systems, cropland, double cropping, planted forests, and protected areas. Cropland is made up of Land useis also regionalized and customized for each subregion, with yields and costs varying from region to region. Demand is exogenous but endogenous energy efficiency measures permit demand responses through technological options.

2) Socio-economic drivers - BLUES

Population and GDP (MER) are the main exogenous socio-economic drivers behind demand projections in the Reference scenario implemented in BLUES. Demand projections are derived from GDP and population projections through econometric and regression techniques.

2.1) Population - BLUES

Population projection through 2050 was taken from the Instituto Brasileiro de Geografia e Estatistica (IBGE 2016). It compares well with the projection for SSP2 (KC & Lutz 2017), as shown in the figure below.



Population projections for Brazil from IBGE and SSPs/caption>

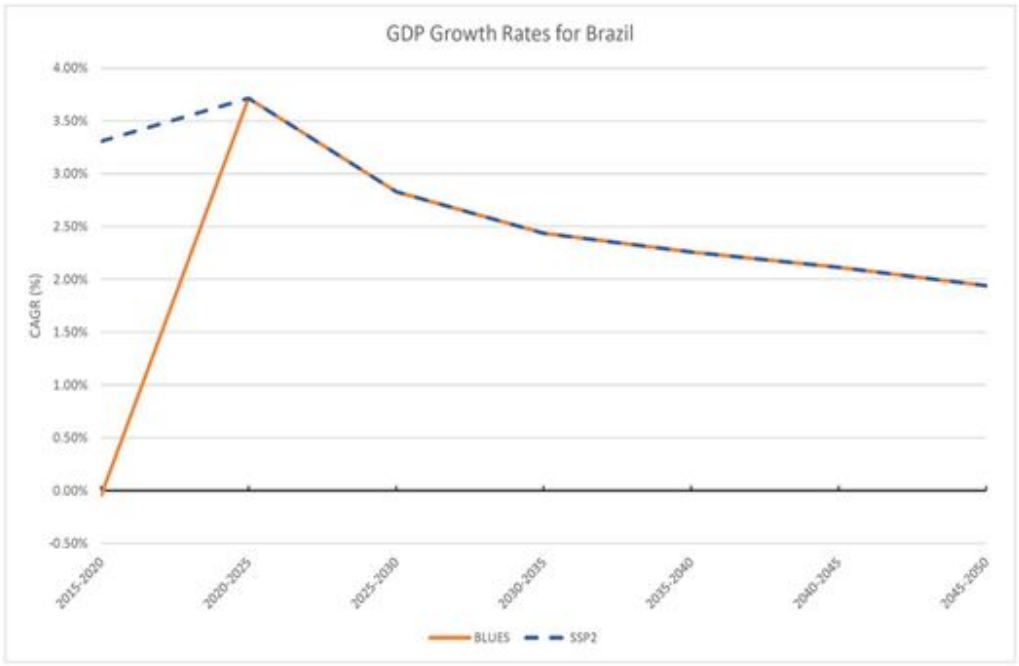
References

IBGE (2016). Projeção da População do Brasil por sexo e idade: 2000-2060. Instituto Brasileiro de Geografia e Estatistica. Accessed online on July 1 2015 at https://ww2.ibge.gov.br/home/estatistica/populacao/projecao_da_populacao/2013/default.shtm

KC, S., Lutz, W., 2017. The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100. Glob. Environ. Chang. 42, 181–192. doi:10.1016/j.gloenvcha.2014.06.004

2.2) Economic activity - BLUES

GDP growth rate projections are based largely on SSPs projections (Dellink et al 2015), with adjustments made for the short-term to reflect current economic activity in Brazil. Short-term projections through 2020 are based on The Focus Bulletin published by the Brazilian Central Bank (BCB 2017). The GDP projection of the Reference scenario in BLUES is shown in the figure below.



<caption> Population projections for Brazil from IBGE and SSPs/caption>

References

BCB. (2017). Sistema de Expectativas de Mercado. Retrieved September 01, 2017, from https://www3.bcb.gov.br/expectativas/publico/consulta/serieestatisticas

Dellink, R., Chateau, J., Lanzi, E., Magné, B., 2015. Long-term economic growth projections in the Shared Socioeconomic Pathways. Glob. Environ. Chang. IN PRESS, 1–15. doi:10.1016/j.gloenvcha.2015.06.004

3) Macro-economy - BLUES

3.1) Production system and representation of economic sectors - BLUES

3.2) Capital and labour markets - BLUES

3.3) Monetary instruments - BLUES

3.4) Trade - BLUES

3.5) Technological change - BLUES

4) Energy - BLUES

Techno-economic parameters that form the input deck of COPPE-MSB were derived from various sources (Koberle et al., 2015; Nogueira et al., 2014; J Portugal-Pereira et al., 2016; Soria et al., 2015). Techno-economic input parameters of IAMs in general, and also of COPPE-MSB, include specific investment costs (CAPEX, in US$/kW), construction times (years), conversion efficiency (%), and any technical or economic specifications that may be required to appropriately model the performance of an energy technology (investment and O&M costs, minimum utilization time, inputs and outputs, auxiliary inputs and secondary outputs among others).

4.1) Energy resource endowments - BLUES

4.1.1) Fossil energy resources - BLUES

4.1.2) Uranium and other fissile resources - BLUES

4.1.3) Bioenergy - BLUES

4.1.4) Non-biomass renewables - BLUES

4.2) Energy conversion - BLUES

4.2.1) Electricity - BLUES

4.2.2) Heat - BLUES

4.2.3) Gaseous fuels - BLUES

4.2.4) Liquid fuels - BLUES

4.2.5) Solid fuels - BLUES

4.2.6) Grid, pipelines and other infrastructure - BLUES

4.3) Energy end-use - BLUES

4.3.1) Transport - BLUES

4.3.2) Residential and commercial sectors - BLUES

4.3.3) Industrial sector - BLUES

4.3.4) Other end-use - BLUES

4.4) Energy demand - BLUES

4.5) Technological change in energy - BLUES

5) Land-use - BLUES

Land Use classes

A representative set of distinct land use classes were chosen to optimize representation and minimize computational requirements in the MESSAGE framework. The starting point were the CSR-UFMG maps uso_da_terra_2013 representing land use in 2013 as allocated by the land use model OTIMIZAGRO (http://maps.csr.ufmg.br/). The map represents the cultivated area of 14 crops, double crop areas, planted forests and pastures, plus the natural remnants of forests and savannas, both inside and outside of protected areas (Soares-Filho et al., 2016). It also shows urban areas and water bodies which were used to create an exclusion mask for agricultural activities. These land use class were aggregated for our purposes according into 9 base-year land use classes:

Cropland, Double crop areas, Pastures, Planted Forests, Savannas, Savannas in Protected Areas, Forests, Forests in Protected Areas.

Pastures were then divided into two categories of grazing intensity: Low-capacity pastures with <0.8 AU/ha and High-capacity pastures with >0.8 AU/ha.

The spatial allocation and area calculation of the two classes of pastures was derived from the "Lotação Bovina no Brasil" map from LAPIG (http://maps.lapig.iesa.ufg.br/lapig.html).

To these base-year LU classes was added the Integrated Systems LU class. It represents Crop-Livestock-Forest Integrated Agricultural Systems and is not represented in the initial area allocation as it occupied a negligible area in the base year. However, this production system has gained much attention in recent years and is one of the cornerstones of future intensification of Brazilian agriculture, and an important mitigation measure in the Brazilian Low Carbon Agriculture Plan (MAPA, 2011).

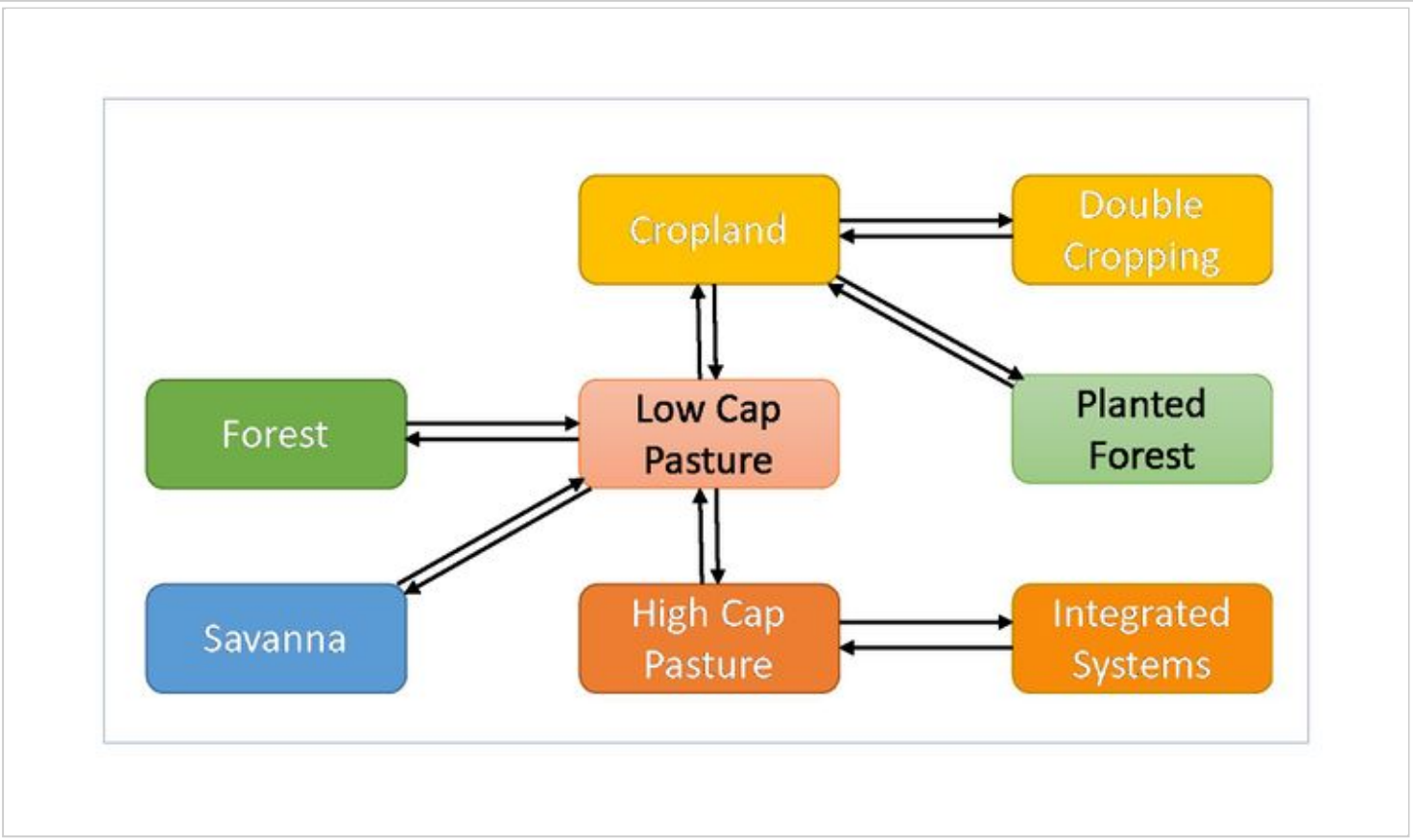
5.1) Agriculture - BLUES

5.2) Forestry - BLUES

5.3) Land-use change - BLUES

Land Use Transitions

The figure below shows the allowed land use transitions in BLUES. Note that a unit area may undergo more than one transition in each time step.



<caption> BLUES Land Use Transitions diagram

5.4) Bioenergy land-use - BLUES

5.5) Other land-use - BLUES

5.6) Agricultural demand - BLUES

5.7) Technological change in land-use - BLUES

6) Emissions - BLUES

6.1) GHGs - BLUES

6.2) Pollutants and non-GHG forcing agents - BLUES

6.3) Carbon dioxide removal (CDR) options - BLUES

7) Climate - BLUES

7.1) Modelling of climate indicators - BLUES

7.2) Climate damages, temperature changes - BLUES

8) Non-climate sustainability dimension - BLUES

8.1) Air pollution and health - BLUES

8.2) Water - BLUES

8.3) Other materials - BLUES

8.4) Other sustainability dimensions - BLUES

9) Appendices - BLUES

9.1) Mathematical model description - BLUES

9.2) Data - BLUES

10) References - BLUES

- Content is available under unless otherwise noted.