Energy and emissions: model characteristics and baseline sources of represented CGE models

Default:								
Model	**General scope and features**	**Fuel supply**	**Power supply**	**Energy demand**	**Agriculture and Land use**	**Emissions**	**Markets**	**Central data sources**
Default	Global - recursive dynamic - 1-year-steps Monetary input-output structures	CES factor demand Aggregate production function also including Transmission/distribution Resource input energy: coal, oil, gas exogenous factor-augmenting productivity growth option to exogenize fossil fuel prices	CES factor demand Aggregate production function energy: coal, oil, gas exogenous factor-augmenting productivity growth	*In households:* Energy use split between transport and housing in CES demand systems usually in composites with vehicles and buildings, resepctively *In firms:* Standard CES factor demand where energy use for transport, buildings and processes usually are merged, as is capital. Transport sector split into air, water and other, but freight and passenger transport merged. Exogenous factor-augmenting technical change	Agriculture represented by 1-12 GTAP-based insdustries, while Forestry is a separate industry Exogenous changes in productivity	CO_2 and often also non-CO_2 Kyoto gases Physical units (t CO_2-equivalent) Linked to demand/combustion of coal, oil, gas in all sectors Fixed emission coefficients	Competitive	GTAP incl. GTAP-Power, I EA/WEO, Enerdata, OECD/EO, GECO, econometric studies National SAMs, emission inventories

Supplements and advancements of represented models:									
Represented model (Organisation)	**General scope and features**	**Fuel supply**	**Power supply**	**Energy demand**	**Agriculture and Land use**	**Emissions**	**Markets**	**Central data sources**	**Documentation**
ADAGE (RTI International/EPA)	Also intertemporal version 5-year steps Physical accounting of energy, land use and agriculture, transport services	Multiple technologies Dynamic resource depletion Renewable fuels	Multiple technologies Physical accounting of energy	*Transport in households:* Multiple types of vehicle and associated fuel demand. Vintage transport capital *Commercial transportation:* Disaggregated. Vintage transport capital	Endogenous land use change between cropland, pasture, managed forest, natural forest, and natural grass Physical accounting of land types	Endogenous abatement, including from land use change		US DOE Energy Information Administration GCAM model FAOSTAT	Ross (2009) Cai et al. (2018)
AIM/CGE (National Institute for Environmental Studies)	In a linked system with AIM/Enduse (Energy System model), AIM/Transport and AIM/PLUM (Spatial land use model)	Multiple technologies Dynamic resource depletion Renewable fuels	Multiple technologies Intermittent renewables Bioenergy potential linked to spatial land use model	*Buildings in households:* A version with energy services demand modelling and detailed technology selection	Land allocation is determined by multinominal logit function.	Non-Kyoto emissions to air have emissions factors according to GAINS emissions scenarios in SSPs. (CO, NH3, NMVOC, NOX, SO2, BC, OC, CFCs) Physical units Non-energy- related GHG emissions abatement are detremined by exponential abatement function.		EDGAR, RCP, IMAGE, own database reconciling international statistics, FAOSTAT/GAEZ AIM/Enduse, AIM/Transport models, AIM/PLUM	
DART-BIO (Kiel institute of the world economy)		Learning by doing Renewable fuels	Vintage capital Learning by doing Renewable Energies		Optional hard-link with PROMET dynamic crop growth model used for studies focused on yield impacts				
EC-PRO/EC-MSMR (Environment and Climate Change Canada)	SOE Canada disaggregated with provinces and global, respectively Soft-link to energy model (E3MC)	Multiple technologies	Multiple technologies Physical accounting of energy		Land use change	Endogenous emission abatement from land use change		E3MC model IEO	Ghosh et al. (2017), Böhringer et al. (2016) Ghosh et al (2012), Zhu et al. (2018)

Represented model (Organisation)	General scope and features	Fuel supply	Power supply	Energy demand	Agriculture and Land use	Emissions	Markets	Central data sources	Documentation
ENVISAGE (GTAP)		Renewable fuels			Total agricultural land governed by logistic curve Nested A/CET-specification for land supply across agriculture activities				
ENV-LINKAGES (OECD)	Soft-link to IEA's WEM (energy model) Physical accounting of energy, land use and crops. Capital vintages		Multiple Power technologies - Nested	*Energy in households and firms:* Specific nest for energy demand *Food in households:* Specific nest for agriculturual food products demand	Fertilizer in crops and feed in livestocks are more substitutable with land inputs than other goods CET-specification for land supply across agriculture activities Productivity over time based information from PE agriculture sector models	Edogenous process emissions in Manufacturing and Agriculture as specific CES-bundle in production function Air pollutant emissions		Macroeconomics: OECD, IMF, World bank Energy: IEA-WEM / Agriculture: IFPRI-IMPACT, OECD, IIASA-GLOBIOM Emissions: IIASA-GAINS, IEA, EDGAR	Chateau et al. (2014)
EPPA (MIT)	Physical accounting of energy	Multiple technologies Dynamic resource depletion Renewable fuels	Multiple technologies Intermittent renewables	*Transport in households:* Multiple types of vehicle and associated fuel demand *Commercial transportation:* Disaggregate, physical accounting, vintage transport capital	Endogenous land use change between cropland, pasture, managed forest, natural forest, and natural grass Physical accounting of land types	Endogenous Abatement	Market power in oil market		Paltsev et al. (2005) Chen et al. (2016)
GEM-E3 (Joint Research Centre)	Linked with energy model (e.g., POLES-JRC) Physical accounting of energy 5-year steps (currently to 2050)	Multiple technologies	Multiple technologies	*In households:* Consumption of 2 types of durables (residential and transport) that goes with the consumption of linked non-durables (fuels)	Agriculture is split into 3 subsectors: Crops, livestock and forestry Bottom-up MAC curves for crops and livestock separately	Endogenous abatement (sector-wise MAC curves) Process emissions in Manufacturing		GAINS model Energy models (e.g. POLES-JRC, PRIMES)	Capros et al. (2013) Weitzel et al. (2019a)
IMACLIM-R (CIRED)		Multiple technologies Dynamic resource depletion	Multiple technologies	*Transport in households:* Multiple types of vehicle and associated fuel demand, minimum mobility consumption, travel time and congestion *Commercial transportation:* Infrastucture capacity, vintage transport capital *Buildings in households:* Physical accounting og square meters that determine energy demand			Market power in oil market	World Energy Model	Waisman et al. (2012a)
MAGNET (Thünen Institute of Market Analysis)		Multiple technologies R&D in biofuels			CET-specification for land supply across agriculture activities		Blending targets	FAOSTAT & IMAGE	
REMIND (PIK)			Learning by doing						Luderer et al. (2015)
SNOW (Statistics Norway)	SOE Norway or global (SNOW-GLO) SOE Norway intertemporal (SNOW-DYN)	MAC curves		*Transport in households:* Multiple types of vehicle and associated fuel demand	Land represented as an exogenous natural resource input in *Agriculture and Forestry*	Process emissions in Manufacturing, Fossil fuel extraction and Agriculture Endogenous abatement (sector-wise MAC curves) Air pollution compounds linked to energy and processes		Norwegian Env. Agency	Bye et al. (2018) Fæhn, and Isaksen (2016) Rosnes et al. (2019)
TEA (COPPE, Universidade Federal do Rio de Janeiro)	Softlink to energy model (COFFEE) Physical accounting of energy	Multiple technologies	Multiple technologies		*Agriculture and Forestry; Cattle; Other Animals Production; Fishery.* Represented by GTAP-based industries.	Process emissions in Manufacturing		COFFEE model	Rochedo (2016) Cunha (2019) Garaffa et al. (2018)
WEGDYN (Wegener Center for Climate and Global Change, University of Graz)	SOE Austria (WEGDYN_AT) Global (WEGDYN) 5-year steps until 2050		Exogenous portfolios of technologies Coupled with vintage-based electricity sector investment module	*Transport in households:* exogenous technology switch (in WEGDYN_AT) *Commercial transportation:* Disaggregate land transport, incl. infrastructure services (in WEGDYN_AT) *Manufacturing:* Exogenous technology switch		Industrial process emissions in Manufacturing (Iron&Steel, Sement)		EnergyDatasheets: EU-28 Countries (EC, DG ENER) UNFCCC emission inventory for industrial process emissions	WEGDYN_AT: Bachner et al. (2018) WEGDYN (global): Mayer et al. (2019); Schinko et al (2014); Bednar-Friedl et al. (2012);