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Mapping the jungle of integrated models: Towards a new guide to appraise the model toolbox

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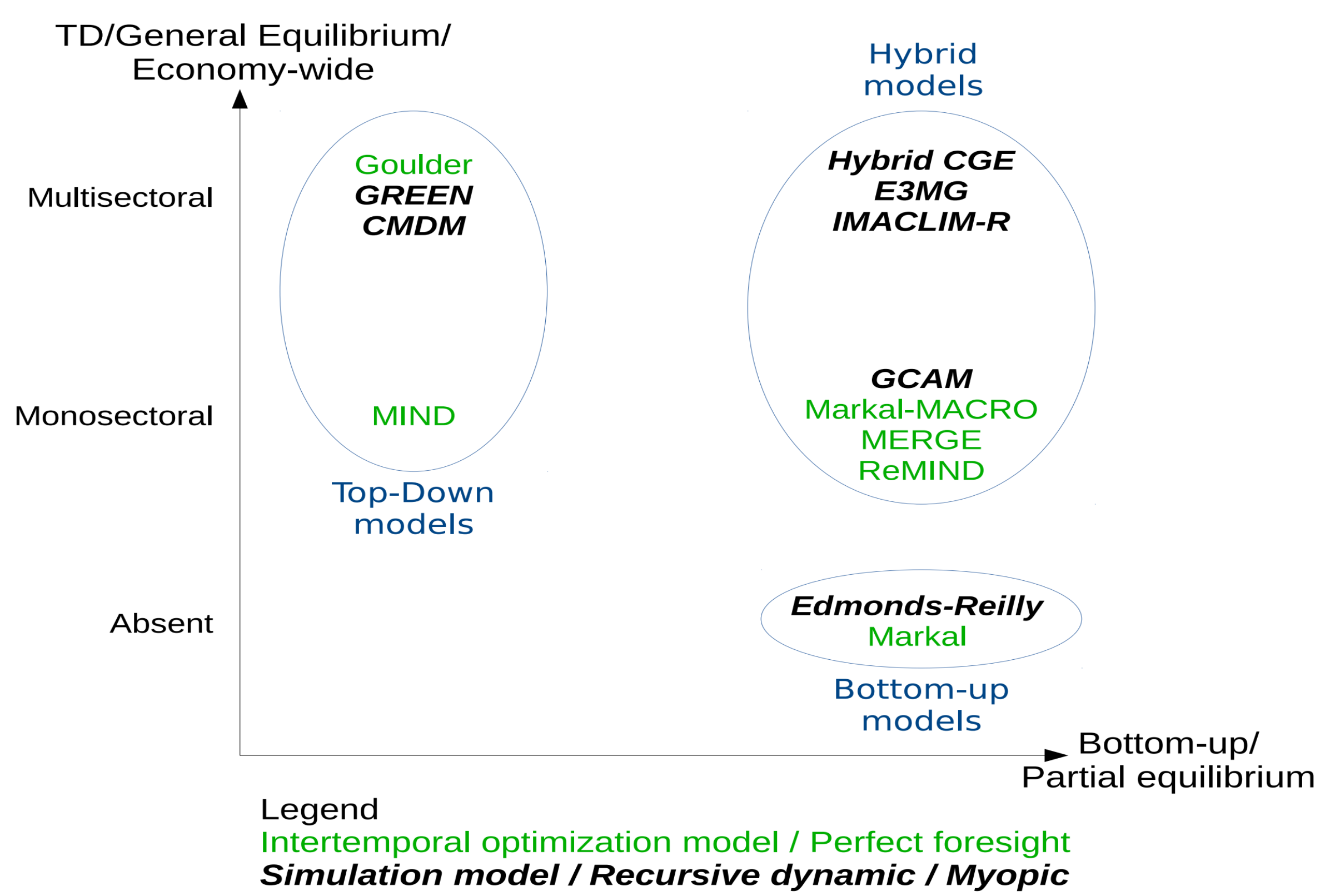
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1 Towards a new guide for integrated models

Standard taxonomy



The standard taxonomy shows limitations in mapping integrated models :

- The *hybrid* concept combining *bottom-up* and *top-down* features covers a too large spectrum of very different models
- The *optimization-simulation* dichotomy pertains to the mathematical formulation of the model, remains ambiguous and hides crucial differences in model conception

There is a need to better capture the structural diversity of models, as a prerequisite for a needed appraisal of the model toolbox

A deeper approach: the "lego game" of building blocks

Any model's structure can be re-built as the assembly of identified *building blocks*.

In this view, models differ by the set of building blocks incorporated, the modeling option chosen for each one and possibly the nature of the links between them.

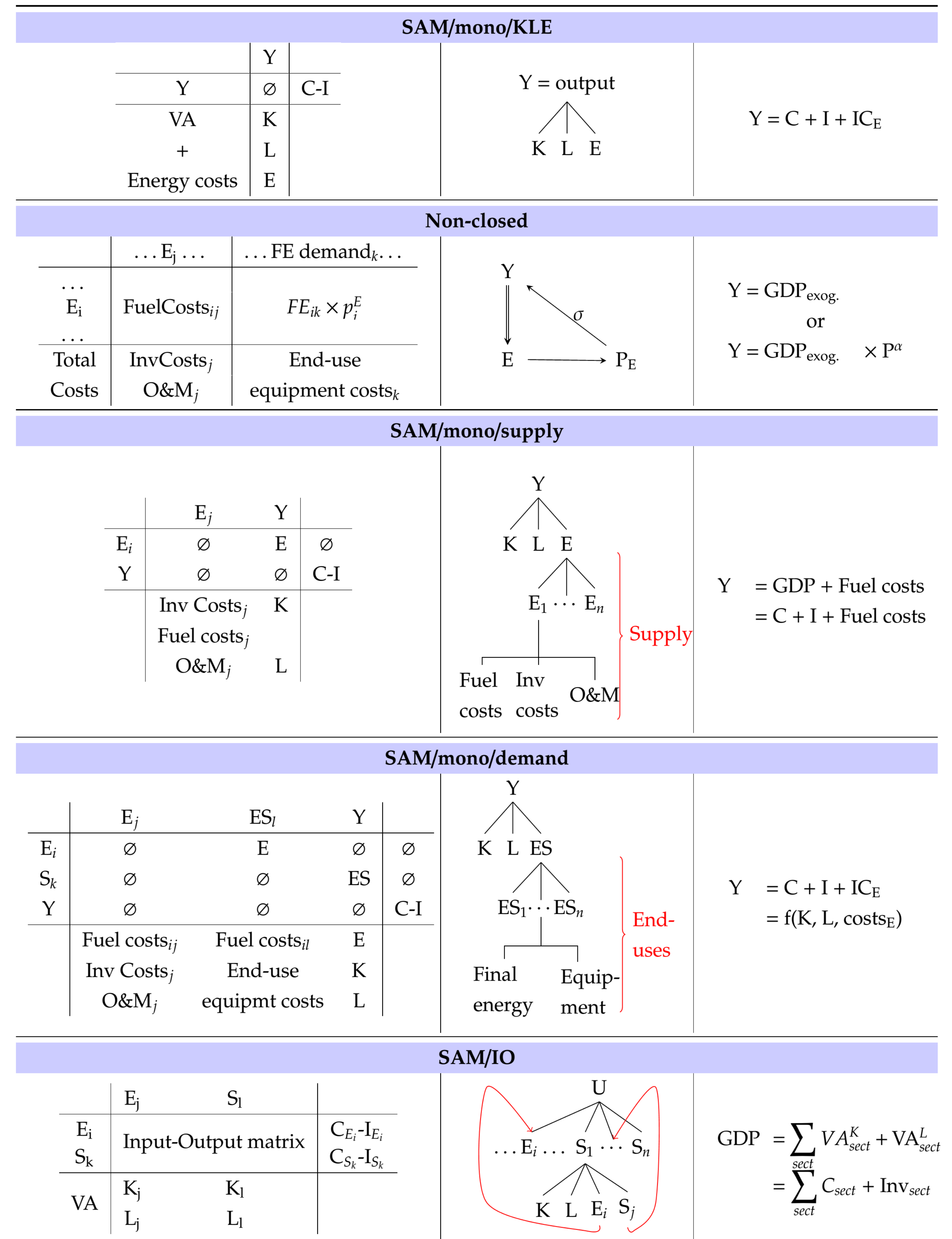
SET OF BUILDING BLOCKS	BUILDING BLOCKS
	Scope
Bottom-up aspects	Primary energy supply Secondary energy supply Final energy demand (from activity levels) Capacities
Top-down aspects	Activity levels (structural change) Corresponding units of energy services Markets of goods Markets of factors (K, L) Trade
Choice representation	Decentralization level Modalities (agents' program) Information level (foresight)
Growth engine	Base engine Technical progress Inertia of capital at the macro level Short-term maladaptation representations
Evolutionary factors	Energy-specific technical change Consumption patterns

A new guide in 3 axes

The model internal « vision » can further be assessed along three axes : (i) the type of **interdependences** represented as the static picture of the system , (ii) the **transformation** drivers of this picture over the long run and (iii) the **transition** dynamics around the threefold interplay of technical constraint, economic behaviors and market forces

	Interdependences	Transformation	Transition
GCAM CIMS	non closed	exogenous growth engine	Energy pathway
REMIND MARKAL-MACRO MERGE	SAM/mono/demand	idem + endogenous energy TC	Intertemporal equilibrium
WITCH	SAM/mono/supply	idem	Intertemporal equilibrium
EPPA	SAM/multi/IO	idem + evolution of consumption patterns	Intratemporal equilibrium
IMACLIM-R	SAM/multi/IO	idem	Disequilibrium
E3MG	SAM/multi/IO	idem	Disequilibrium
T21	non closed	idem	Phenomenological

2 Axis 1: interdependences



3 Axis 3: transition dynamics

Model	Transition type
GCAM	Energy transition with limited economic feedback ⇒ no information on economic transition
WITCH-REMIND	Transition in intertemporal equilibrium ⇒ implicit first best equilibrium
EPPA	Transition in intratemporal equilibrium ⇒ explicit first best equilibrium
IMACLIM-R	Transition in disequilibrium ⇒ non-neoclassical equilibrium (in second-best with partial utilization of capital)
E3MG	Transition in disequilibrium ⇒ implicit dynamics

4 Conclusion

- The class of integrated models at energy-economy-climate interface is supposed to answer the same issues : the transformation pathways in the context of climate mitigation
- The difference of model conception implies that these models provide different insights about these pathways
- We propose here a new guide to better assess the domains of competence of models based on their internal structure and « vision »
- This guide serves for the assessment of existing models and to build new models
- Assess the internal vision of models is the first step of model evaluation before looking at model simulations and outcomes.
- It gives crucial indications about model performance and domain of competence in terms of the questions to be assessed : technological issues, links between energy, economic growth and the broader macroeconomy, transitional dynamics in a second best setting, etc