|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A Economic structure | B Technology treatment | C Treatment of agents’ behaviour and time | D Appearance of government and central bank | F Energy supply sector | E Integration of the environment |
| (1) Role of and structure of the market  (2) Production function  (3) Supply or demand-led?  (4) Pricing  (5) Investment  (6) Unemployment and representation of skills  (7) Employment/labour supply  (8) Wage rate  (9) Household consumption  (10) Income distribution  (11) Finance and money supply  (12) Interest rates (central bank policy rate & avg. interest rates) | (1) Productivity | (1) Models’ ontology  (2) Representation of behavioural equations  (3) Treatment of heterogeneity of agents and interactions between them  (4) Treatment of time | (1) Role of the government  (2) Role of central bank | (1) General information  (2) How is the market-share of different energy-production technologies included?  (3) Technical constraints | (1) Simulation of greenhouse gases  (2) Other relevant information |

Table 1: Overview on the evaluated model structures

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | Type of model | Geographical coverage | Time scale | Purpose of the model | Information sources |
| E3ME | * Econometric (system) model * Large-scale * Empirical (Instrumental variable estimation | Global (multi-country-model) | 1995 to 2050 | The model was designed to address conventional macroeconomic policy questions. However, in particular, it can be used to evaluate impacts of Energy-Environment- Economy (E3) policies (e.g. impacts of carbon prices). The model was designed for addressing both the short-term and medium-term economic effects as well as, more broadly, the long-term effects of such policies (e.g. Cambridge Economics (CE), 2014). | * Cambridge Economics (CE) (2019); Barker et al. (2012; 2016); Pollitt & Mercure (2018); Mercure (2012); Mercure et al. (2014); Mercure & Salas (2013) * Interview with Hector Pollitt and Jean-François Mercure on 19.06.2018 |
| PANTA RHEI/GINFORS | * Econometric model * Large-scale * Empirical (OLS-regression) | National (can be connected to the global multi-country model Grinfors) | to 2050 | The main purpose of the model is to analyze questions in the environmental economics field. It models long-term structural change in economic development and in environmental-economic interdependencies. In addition, it also models energy consumption, air pollution, transport and land use and housing to a high level of detail. | * Bockerman et al. (2000); Groẞmann & Lutz (2015); GWS (2018); Lutz (2011); Lutz & Meyer (2009); Lutz et al. (2009); Meyer (2005); Meyer & Lutz (2007); Wiebe & Lutz (2016); Meyer et al. (2012); Wiebe et al. (2016) |
| MEDEAS | * System Dynamics model * Large-scale * Empirical (OLS-regression) | Global (one-country-model) | 2016 to 2100 | The main purpose of the model it to simulate a sustainable Energy System transition under Environmental and Socioeconomic constraints. In particular, the model can be used to assess the impacts and limitations of the energy production/consumption system transition to a low-carbon sustainable socio-economy (e.g. Capellán-Pérez et al., 2017). | * Sun et al. (2016); Capellán-Pérez et al. (2017) * Model available at: <http://medeas.eu/model/medeas-model> * Interview with Jaime Nieto on 22.07.2018 |
| Threshold 21/SDGi | * System Dynamics model * Large-scale * Empirical | National model (can be tailored to any country) | 1990 to 2030 | „The model simulates the fundamental trends for SDGs until 2030 under a business-as-usual scenario, and supports the analysis of relevant alternative scenarios” (MI, 2017). Further, the model integrates in a single framework the economic, social, and environmental aspects of development planning. The T21 iSDG model is a broad, flexible and integrated tool to support the design and evaluation of policy-strategies to achieve the SDGs. | * Millennium Institute (2007; 2017); UNEP (2011); Bassi & Shilling (2010) * E-mail exchange with Matteo Petercini in October 2019 |
| EURACE | * SFC agent-based model * Large-scale * Calibrated to empirical data | Europe (multi-country model) | Fictitious time span of twenty years. | The EURACE model is a sophisticated agent-based model of the EU’s economy that addresses a variety of economic areas, including questions on labour-market liberalization to the effects of quantitative easing or effects of a feed-in tariff policy (on national level. | * Cincotti et al. (2010); Deissenberg et al. (2008); Ponta et al. (2018); Raberto et al. (2011; 2018) * Information available at: <http://www.eurace.org/?page_id=6> * E-mail exchange with Marco Raberto in August 2018 |
| EUROGREEN | * System Dynamics * Post-Keynesian SFC model | Calibrated to France | 2014 to 2050 | EUROGREEN is designed to provide a concrete understanding of some important policy challenges associated with the transition to ecologically sustainable and socially equitable post-growth societies in the European Union. The model aims to test, in a formal setting, the effectiveness and coherence of Green economic policies (incl. low-carbon energy policies), to support the creation of widely attractive narratives about possible futures. | * D’Alessandro et al. (2020) * E-mail Exchange with Simone D’Alessandro in October 2018 |
| S&B, 2017[[1]](#footnote-1) | * Agent-based model * Small/stylized * Calibrated to data | Not specified (Electricity sector is based on the UK-data) | Fictitious time span of 1000 years. | This model can be applied to investigate macroeconomic effects of sustainability policies along three dimensions: environmental effectiveness, financial stability and socio-economic consequences. Thereby, the following instruments considered in the model: distributive policy; renewable energy subsidies, and regulations of bank lending to firms. | * Safarzynska & van den Bergh (2011; 2017) |
| ENGAGE/DSK[[2]](#footnote-2) | * Agent-based * Small/stylized model * Calibrated to data | ENGAGE: National model (calibrated to U.S)  DSK: Global model | 2000 to 2100 | ENGAGE was built to explore “the effect of domestic actors on international and domestic climate policies” (Gerst et al., 2013a). In particular, ENGAGE “is designed to investigate international climate policy bargaining, based on domestic constraints, and its feedback on domestic policy as well as technological development and economic growth” (Gerst et al., 2013a). | * ENGAGE: Gerst et al. (2013a;b) * DSK: Lamperti et al. (2018a;b) |
| Naqvi, 2015[[3]](#footnote-3) | * SFC model * Small/stylized model * Roughly calibrated to data | Roughly calibrated to Europe | Fictitious time span of 100 years. | This model is designed to address the impacts of policies that address the issues of growth, distribution, and the environment simultaneously. | * Naqvi, 2015 * E-mail exchange with Syed Ali Asjad Naqvi in July 2018 |
| LowGrow SFC | * SFC System Dynamics * Partly estimated with econometrics | Calibrated to Canada | 2017 to 2067 | The purpose of LowGrow SFC is to explore the economic and financial implications of the transition to a low-carbon sustainable economy (incl. the energy sector) in Canada. | * Victor & Jackson (2019); Jackson & Victor (2015; 2016; 2018) * E-mail exchange with Tim Jackson in October 2018 |
| Eirin | * SFC hybrid System-Dynamics Agent-based model * Small/stylized model | Shaped to a high-income country of the EU, which signed the Paris Agreement, is committed to the EU2030 targets and has a high level of energy dependency. | Fictitious time span of 140 units (short-term time horizon) | The model aims at investigating “the implications on sustainable development of the gradual phasing out of fossil fuels subsidies, whose revenues could be used by the government to subsidise energy investments in green capital (e.g. solar panels), either via fiscal policies or green bonds; With the aim to provide policy-makers relevant information on the economic, financial and distributive effects of phasing out fossil fuels subsidies in high-income countries” (Monasterolo & Raberto, 2018b). | * Monasterolo & Raberto (2016; 2018; 2019); Dunz et al. (2018;2019) * Interview with Irene Monasterolo on 09.10.2018 |

Table 2: Overview on the reviewed models

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Desired features of a ‘new approach in economics’** | **E** | **SD** | **ABM** | **SFC** | **Relevance for the understanding of energy transitions** |
| **1** | Complexity, non-linearity, non-ergocity and deep uncertainty | ✓ | ✓✓ | ✓✓ | \* | * Impacts model results and policy implications (see section 3); * Energy transitions are influenced by, and impact, other areas such as consumption, production or labour market (e.g. changes in skills requirements) and include delays (e.g. changes in regulations, in skills etc.) and are thus characterised by complexity. * Non-ergocity relevant is relevant as in sustainability transitions future changes are likely to be different to past data patterns. |
| **2** | Importance of time, path-dependency, lock-in and irreversibility | ✓ | ✓✓ | ✓ | * Representation of infrastructure lock-in or cost decreases due to learning effects; * Technical potential for different energy sources or availability of resources required for equipment; * Changes in actor behaviour over time. |
| **3** | Agents’ heterogeneity and behavioural elements | ✓ | ✓ | ✓✓ | * Investigation of consumer, energy producer, financial investor and government interactions; * Understanding renewable energy technology innovation or adoption from a bottom-up perspective; * Representation of the different skill requirements; * Evaluation of distributional effects of policy interventions. |
| **4** | Interdisciplinary | ✓ | ✓✓ | ✓✓ | * Simulation of the relevant political, social, institutional, technical, organisational or economic aspects on energy transitions |
| **5** | Role of institutions and social context | ✓ | ✓✓ | ✓✓ | * Representation of institutional influences on regulations or frameworks (e.g. climate related risk disclosures); * Influences of syndicates or other interest groups on wage formation process; * Representation of lobbying on political processes, regulations or frameworks. |
| **6** | Ethical and moral philosophical aspects | ✓ | ✓✓ | ✓✓ | * Relevant to understand how different policy objectives should or could be prioritised when there are trade-offs between them; * Understanding of what does a ‘just energy transition’ mean; * Ethics might be relevant for actor’s behaviour. |
| **7** | Finance | ✓ | ✓ | ✓ | ✓✓ | * How can the energy transition be financed? * What are the implications of a (very quick or very slow) energy transition on the stability of the financial system? * What are the effects of increased investments on GDP? (see section 3) |
| **8** | Multiple equilibria/disequilibrium | ✓✓ | ✓✓ | ✓✓ | ✓✓ | * Impacts model results and policy implications (see section 3); * Energy-transitions involve deep structural non-marginal changes and are therefore likely out-of-equilibrium transitions’. |

Table 3: Overview on evaluated features compared to the potential of different modelling approaches to capture them

*\* This depends with what modelling approach the SFC approach is combined (see section 4.1.4.)*

*Legend:*

*E: Econometrics*

*SD: System Dynamics*

*ABM: Agent-based modelling*

*SFC: stock-flow-consistent modelling*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Production function** | | | | | |
|  | **Static I/O-coefficients** | **Dynamic I/O-coefficients** | **CES-function** | **AK-growth model** | **CB-function** | **Other** |
| **E3ME** |  | X |  |  |  |  |
| **PANTA RHEI/**  **GINFORS** |  | X |  |  |  |  |
| **MEDEAS** | X |  |  |  |  |  |
| **T21/SDGi** |  |  |  |  | X |  |
| **EURACE** | X (E) |  |  |  | X (C&L) |  |
| **EUROGREEN** |  | X |  |  |  |  |
| **S&B, 2017** |  |  | X |  |  |  |
| **ENGAGE/DSK** |  |  |  |  |  | X |
| **Naqvi, 2015** | X |  |  |  |  |  |
| **LowGrow SFC** |  | X |  |  |  |  |
| **EIRIN** | X (C, L, E) |  |  |  |  |  |

Table A 1: Overview on the Production function

|  |  |  |
| --- | --- | --- |
|  | **Demand vs. Supply-led production function approach** | |
|  | **Demand-led** | **Supply-led** |
| **E3ME** | X |  |
| **PANTA RHEI/**  **GINFORS** | X |  |
| **MEDEAS** | X |  |
| **T21/SDGi** |  | X |
| **EURACE** |  |  |
| **EUROGREEN** | X |  |
| **S&B, 2017** | X |  |
| **ENGAGE/DSK** | X |  |
| **Naqvi, 2015** | X |  |
| **LowGrow SFC** | X |  |
| **EIRIN** | X |  |

Table A2: Overview on subtopic (3) Supply vs. demand-led production function approach

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Pricing** | | |
|  | **Static Mark-up** | **Dynamic Mark-up** | **Excluded** |
| **E3ME** | X |  |  |
| **PANTA RHEI/**  **GINFORS** | X (depends on market structure of each industry) |  |  |
| **MEDEAS** |  |  | X |
| **T21/SDGi** |  |  | X |
| **EURACE** | X |  |  |
| **EUROGREEN** |  | X |  |
| **S&B, 2017** |  | X |  |
| **ENGAGE/DSK** |  | X |  |
| **Naqvi, 2015** | X |  |  |
| **LowGrow SFC** | Implicitly by the ratio of aggregate demand and supply |  |  |
| **EIRIN** | X |  |  |

Table A3: Overview on the subtopic (4) Pricing

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Investment function (determination of Gross fixed capital)** | | | | |
|  | **Capacity utilisation/output** | **Interest rates** | **Prices of other inputs** | **Profit/Rate of return/NPV** | **Other** |
| **E3ME** | X | X | X |  | X (labour costs, oil-prices, lagged change in investment) |
| **PANTA RHEI/**  **GINFORS** | x | X |  | X | Capital productivity of the sector and chg. In CPI |
| **MEDEAS** | X |  |  | X |  |
| **T21/SDGi** |  |  |  | X |  |
| **EURACE** | X |  |  | X | Inventory stock |
| **EUROGREEN** | X |  |  | X | Availability of finance |
| **S&B, 2017** | X | X | X |  | Availability of finance |
| **ENGAGE/DSK** | X |  |  |  |  |
| **Naqvi, 2015** | X |  |  |  |  |
| **LowGrow SFC** | X |  |  | X | GDP-Growth |
| **EIRIN** | X |  |  |  | Constrained by credit-availability |

Table A4: Overview on subtopic (5) Investment

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Unemployment** | | |
|  | **Residual** | **Different skills included** | **Excluded** |
| **E3ME** | X |  |  |
| **PANTA RHEI/**  **GINFORS** | X |  |  |
| **MEDEAS** |  |  | X |
| **T21/SDGi** | X | X |  |
| **EURACE** | X | X |  |
| **EUROGREEN** | X | X |  |
| **S&B, 2017** | X |  |  |
| **ENGAGE/DSK** | X |  |  |
| **Naqvi, 2015** | X |  |  |
| **LowGrow SFC** | X |  |  |
| **EIRIN** | X | X |  |

Table A5: Overview on subtopic (6) unemployment and representation labour skills

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Wage rate** | | | |
|  | **Unemployment** | **Other variables** | **Exogenous** | **Excluded** |
| **E3ME** | X | External industry & regional wage rates, productivity, benefit rate, consumer prices, wage retention rate, normal/actual output and the lagged change in wage rates |  |  |
| **PANTA RHEI/**  **GINFORS** | X | Sector-specific productivity, macroeconomic labour productivity, deflator for aggregate consumption |  |  |
| **MEDEAS** |  |  |  | X |
| **T21/SDGi** |  | Total factor productivity |  |  |
| **EURACE** |  |  |  |  |
| **EUROGREEN** |  | Industry-specific employment, (automation-)technology |  |  |
| **S&B, 2017** |  | Supply and demand of labour |  |  |
| **ENGAGE/DSK** |  | Changes in average labour productivity |  |  |
| **Naqvi, 2015** |  |  | X |  |
| **LowGrow SFC** |  |  | X |  |
| **EIRIN** |  |  |  |  |

Table A6: Overview on subtopic (8) Wage rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Household consumption** | | | | |
|  | **Disposable income** | **Wealth** | **Static Propensity to consume/save** | **Dynamic propensity to consume** | **Other** |
| **E3ME** | X | x |  | X | Unemployment on short-term consumption, child dependency ratio, CPI, lagged change in consumers expenditure |
| **PANTA RHEI/ GINFORS** | X |  |  | X | Nr. of households |
| **MEDEAS** |  |  | X (labour share instead of real disposable income) |  | Labour-share of GDP |
| **T21/SDGi** | X |  |  | X |  |
| **EURACE** | X | X |  |  |  |
| **EUROGREEN** | X |  | X |  |  |
| **S&B, 2017** |  |  |  |  | Interdependence of preferences of consumers (e.g. snob and network effect) |
| **ENGAGE/DSK** | X |  |  |  | X |
| **Naqvi, 2015** | X | X | X |  |  |
| **LowGrow SFC** | X | X (consumption is restricted by the loan-to-income ratio) | X |  |  |
| **EIRIN** | X | X |  |  | Applies a target-wealth to income ratio |

Table A7: Overview on subtopic (9) Household consumption

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Household consumption** | | | | | **Income distribution** | |
|  | **Disposable income** | **Wealth** | **Static Propensity to consume/save** | **Dynamic propensity to consume** | **Other** | **Functional income distribution** | **Wage income distribution** |
| **E3ME** | X | x |  | X | Unemployment on short-term consumption, child dependency ratio, CPI, lagged change in consumers expenditure | X | X |
| **PANTA RHEI/ GINFORS** | X |  |  | X | Nr. of households | X |  |
| **MEDEAS** |  |  | X (labour share instead of real disposable income) |  | Labour-share of GDP | X |  |
| **T21/SDGi** | X |  |  | X |  | X | X |
| **EURACE** | X | X |  |  |  | X | X |
| **EUROGREEN** | X |  | X |  |  | X | X  (3 wage income categories) |
| **S&B, 2017** |  |  |  |  | Interdependence of preferences of consumers (e.g. snob and network effect) | X |  |
| **ENGAGE/DSK** | X |  |  |  | X | X |  |
| **Naqvi, 2015** | X | X | X |  |  | X |  |
| **LowGrow SFC** | X | X (consumption is restricted by the loan-to-income ratio) | X |  |  | X | X(exogenous) |
| **EIRIN** | X | X |  |  | Applies a target-wealth to income ratio | X | X |

Table A8: Overview on subtopics (9) Household consumption and (10) Income distribution

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Treatment of Finance** | | |
|  | **Implicit inclusion of endogenous money supply** | **Includes finance in the model and assumes endogenous money supply** | **Implicit exogenous money supply** |
| **E3ME** | X |  |  |
| **PANTA RHEI/**  **GINFORS** | X |  |  |
| **MEDEAS** | X |  |  |
| **T21/SDGi** |  |  | X |
| **EURACE** |  | X (SFC, inclusion of commercial banks) |  |
| **EUROGREEN** | X (inclusion of different types of assets (.e. bonds, equity)  In which different actors invest |  |  |
| **S&B, 2017** |  | X (Inclusion of interbank lending market and debt of firms, tracks financial flows) |  |
| **ENGAGE/DSK** | X |  |  |
| **Naqvi, 2015** |  | X (SFC, inclusion of commercial banks) |  |
| **LowGrow SFC** |  | X (SFC, inclusion of commercial banks) |  |
| **EIRIN** |  | X (SFC, inclusion of commercial banks) |  |

Table A9: Overview on subtopic (11) Treatment of finance

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation of the avg. interest rate** | | | |
|  | **Exogenous mark-up of the CB-rate** | **Other (endogenously)** | **Exogenously given** | **Excluded** |
| **E3ME** | X |  |  |  |
| **PANTA RHEI/**  **GINFORS** |  | X (lending & borrowing of institutional transactors, US interest rates for government bonds) | X (for countries of the EURO area) |  |
| **MEDEAS** |  |  |  | X |
| **T21/SDGi** |  | X (influenced on aggregated level by the level of debt in the economy) |  |  |
| **EURACE** |  | X (credit-worthiness) |  |  |
| **EUROGREEN** | x |  |  |  |
| **S&B, 2017** |  |  | X |  |
| **ENGAGE/DSK** |  |  | X |  |
| **Naqvi, 2015** |  |  | X |  |
| **LowGrow SFC** | X |  |  |  |
| **EIRIN** |  | X (debt-to equity ratio of firms) |  |  |

Table A10: Overview on subtopic (12) interest rates

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Total factor productivity** | | | **Labour productivity** | | | **Energy efficiency** | | |
|  | **Endogenous** | **Exogenous** | **Excluded** | **Capital or R&D Investments** | **Other** | **Exogenous** | **Endogenous** | **Exogenous** | **Excluded** |
| **E3ME** | Technological progress: Investment and R&D expenditures |  |  | X |  |  |  | X |  |
| **Panta Rhei /**  **GINFORS** |  |  | X |  | Real wage rate and technological trends |  | Cost-push and time-trend |  |  |
| **MEDEAS** |  | GDP-growth-trend |  |  |  | X | Price pressure (due to energy scarcity) - transport sector |  |  |
| **T21/SDGi** | Macro-stability, openness to trade, energy prices, governance, climate change, education, health, access to electricity, female participation and transportation infrastructure |  |  | X | Education, cost of technology/cost of labour vs. energy, global avg. Technology level |  | Cost of technology, cost of labour vs. energy, global avg. Technology level |  |  |
| **EURACE** | X (quality of capital and skills of workers) |  |  |  | Individual learning effects dependent on skills and produced output |  |  | X |  |
| **EUROGREEN** |  |  | X | X | - technical change Increases of labour productivity, substitutes middle-skill and complements high-skill workers  -driven by labour costs and Innovation |  | Energy-costs |  |  |
| **S&B, 2017** | Firms engage in a search process for better technological solutions through R&D activities or by copying the industry's best practices |  |  | X |  |  | X |  |  |
| **ENGAGE/DSK** |  |  | X | X |  |  | R&D investments |  |  |
| **Naqvi, 2015** |  |  | X |  |  | X |  | X |  |
| **LowGrow SFC** |  |  | X | X |  |  | Investments in brown vs. green capital |  |  |
| **EIRIN** |  |  | X |  |  | X |  | X |  |

Table A11: Overview on the models’ core B (Technology treatment)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation of behavioural equations** | | | |
|  | **Econometric estimations** | **Econometric studies or other studies** | **Expert knowledge** | **"Heuristics"** |
| **E3ME** | X | X |  |  |
| **PANTA RHEI/**  **GINFORS** | X |  |  |  |
| **MEDEAS** | X | X | X |  |
| **T21/SDGi** | X | X | X | X |
| **EURACE** |  |  |  | X |
| **EUROGREEN** | X | X |  | X |
| **S&B, 2017** |  |  |  | X |
| **ENGAGE/DSK** |  |  |  | X |
| **Naqvi, 2015** |  |  |  | X |
| **LowGrow SFC** | X | X |  | X |
| **EIRIN** |  |  |  | X |

Table A12: Overview on subtopic (2) Representation of behavioural equations

|  |  |  |
| --- | --- | --- |
|  | **Heterogeneity of agents/interactions of agents** | |
|  | **Aggregated/sectorial level** | **Heterogeneous agents and interactions between them** |
| **E3ME** | X |  |
| **PANTA RHEI/**  **GINFORS** | X |  |
| **MEDEAS** | X |  |
| **T21/SDGi** | X |  |
| **EURACE** |  | X |
| **EUROGREEN** | X |  |
| **S&B, 2017** |  | X |
| **ENGAGE/DSK** |  | X |
| **Naqvi, 2015** | X |  |
| **LowGrow SFC** | X |  |
| **EIRIN** | X |  |

Table A13: Overview on subtopic (3) Heterogeneity of agents and interactions of agents

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Government** | | | **Central bank** | | | |
|  | **Treatment of policies: Implementation challenges of policies are not accounted for in the model** | **Captures Government income and expenditure** | **Other policies than carbon price is simulated in the model** | **Sets interest rate** | **Provides money to commercial banks/lender of last resort** | **No role assigned** | **Other** |
| **E3ME** | X | X | X | X |  |  |  |
| **PANTA RHEI/ GINFORS** | X | X | X | X |  |  |  |
| **MEDEAS** | X |  | X |  |  | X |  |
| **T21/SDGi** | X | X | X | X |  |  |  |
| **EURACE** | X | X | X | X | X |  | X (Quantitative easing) |
| **EUROGREEN** | X | X | X | X | X |  |  |
| **S&B, 2017** | X |  | X |  | X |  |  |
| **ENGAGE/DSK** | X | X |  |  |  | X |  |
| **Naqvi, 2015** | X | X |  |  | X |  | X (Quantitative easing) |
| **LowGrow SFC** | X | X | X | X | X |  |  |
| **EIRIN** | X | X | X | X | X |  |  |

Table A14: Overview on the models core D (Appearance of government and central bank)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Primary energy** | | **Simulation of the market-share of each technology** | | | **Simulation of costs of renewable energy** | | | **Simulation of constraints** | | | |
|  | **Yes** | **No** | **(LCOE)/NPV** | **Other** | **Exogenous** | **Learning rates** | **EROI** | **Exogenous** | **Availability of primary energy** | **Renewable energy constraints** | **Material constraints** | **Not considered** |
| **E3ME** | X |  | X | X |  | X | X |  | X | X |  |  |
| **Panta Rhei GINFORS** | X |  | X |  |  | X |  |  | X | X |  |  |
| **MEDEAS** | X |  |  | X | X |  | X | X | X | X | X |  |
| **T21/SDGi** | X |  | X |  |  |  |  | X | X | X |  |  |
| **EURACE** | X |  | X |  |  | X |  |  |  |  |  | X |
| **EUROGREEN** | X | X |  |  | X |  |  | X |  |  |  | X |
| **S&B, 2017** |  | X | X | X |  |  |  | X |  |  |  | X |
| **ENGAGE/DSK** |  | X | X |  |  | X |  |  |  |  |  | X |
| **Naqvi, 2015** |  | X |  |  | X |  |  | X | X |  |  |  |
| **LowGrow SFC** |  | X | X |  |  |  |  | X |  |  |  | X |
| **EIRIN** |  | X | X |  |  |  |  | X |  |  |  | X |

Table A15: Overview on the models’ ‘Energy supply core’

1. S&B, 2017 refers to the model introduced in Safarzyńska & van den Bergh (2017). [↑](#footnote-ref-1)
2. The Dystopian Schumpeter meeting Keynes (*DSK) model can be seen as evolution of ENGAGE that is on the global level.*  [↑](#footnote-ref-2)
3. Naqvi, 2015 refers to the model introduced in Naqvi (2015). [↑](#footnote-ref-3)