Briefing PAPER May 2018

Bridging the Gap between Modelling and New Policy Expectations

Contents

EXECUTIVE SUMMARY

BPIE and Climact were asked by EIT Climate-KIC to identify key gaps between previous modelling approaches and the expectations and demands for new, improved approaches that better meet policy expectations consistent with Paris Agreement goals. The objective of modelling is to support policy makers so that they can develop a better sense of what is possible now and what shall be done in future and take better informed decisions.

This piece of work is intended as a thought starter, and certainly not as an exhaustive review of the topic. We have worked mostly based on interviewing members of some of the key modelling teams in Europe as well as users of modelling (policy makers and NGOs). Following up on these interviews, a survey was built to capture further input. More information on the survey is available in the Appendix.

This paper is structured around three main issues: highlighting some of the developments required to be in line with well-below 2°C trajectories; illustrating some of the barriers policy making is striving to break and where modelling fits to do so; and proposing ways to improve the link between models and their use by policy makers.

Here are the key messages:

Modelling how to reach Well-Below 2°C requires further innovation

1. **In general, model adaptability can be improved,** as the energy system is constantly evolving, models need to adapt to reflect its rapid evolutions. Accounting for innovation trends like the prices for solar and wind, as well as their integration in the electricity grid, or the rise of autonomous vehicles are key to properly capture the transition.
2. While modelling suites such as Euclimit cover the whole GHG emitters, some sectors as **forestry, agriculture and food should be further detailed** across energy and climate models. These sectors play a key role and will be even more significant in the future
3. There is room to **improve sector integration** to reflect the trade-offs in climate mitigation accurately and possible interactions between sectors (systemic approach). The links between sectoral activities (eg. transport demand), products required for these activities (eg. cars) and their related material flows (eg. steel and plastic) deserve to be better reflected and integrated to address the full mitigation potential and the functional economy[1]. Complex issues such as rebound effects also deserve attention.
4. All GHG emitting sectors require massive reductions to reach net-zero latest by mid-century. This translates to very challenging **trend breaks** (e.g., increasing deep retrofits in buildings from ~0,1% to 3% per year) and even **paradigm shifts** (e.g., centralized to decentralized power production, complete shifts in diets, etc), which are not easily captured in traditional modelling. New approaches, either through complex system dynamics modelling or more simple simulation models are needed. Innovation is required to properly capture both the trend breaks and what is required to materialize these trend breaks.
5. Existing models should also be complemented with new approaches capturing aspects of **behavioural economics** such as choice-based modelling to properly test the implementation of some of these mitigation solutions. We should also capture the effect of climate change

[1] For example, the material switch in the building sector could lead to emission changes in the industry sector.

on the economy, behavioral and social effects are underrepresented in international and global scenarios.

6. Climate change is one of many **externalities which the current economic system is not properly accounting for** (others include air quality, congestion, biodiversity losses, ocean pollution from plastics, etc.). Models also fail to capture comprehensively these externalities and account for the large array of services provided by nature. It is key to better represent these and to support policy makers in overcoming this market failures of not integrating externalities. It is paramount to reach futures that are desirable with respect to both our environment and human society.
7. To better **convert national targets to concrete local action**, better linking macro-economic and micro-economics may be helpful. This can help disaggregate the necessary action and assess a balanced contribution of regions, sectors, stakeholders and actors. However, this is also a political process. Models should contribute with a suitable level of geographic and demographic granularity to take into account the regional diversity.

Policy Needs and Gaps

8. Policy makers must continue to **increase their understanding of the barriers to the transition** to a net zero carbon economy **and continue their sustained efforts to remove them**. Key dimensions to do so include deeper understanding of specific sector issues, of cross-sectoral issues, and increased transparency of models and assumptions.
9. However, there is limited ambition for **systemic design and analysis to better set, develop or test policy**. Policy communities tend to commission modelling aligned with their sectorial or territorial perspectives. Without a deliberate systemic viewpoint that works across these perspectives we remain limited by boundary conditions or design conditions too small to tackle the systemic challenge. This risks locking-in action too slow to meet the acute challenges of delivering on the Paris climate change commitments, by focusing only on single point innovation/solutions aligned with current sectorial or territorial conditions.

10. Europe is uniquely placed to lead in this regard, with the European Union providing the context to support systemic innovation across current sectors (within the largest single market globally) and experiment with the multi-level governance spanning EU, member state and local (region or city) based levels.

    The transition from the current Multi-annual Funding Framework to the next is the time to harness the collective energy and creativity of the European policy machinery, to match the effort expended on designing new instruments and interventions with creating the conditions to better **foster supply-demand dialogue between a broader set of policy makers** – deliberately focusing on the boundaries and gaps between the emitting sectors and the territorial domains.

Improving the Link between modelers and policy makers

11. **Increase model transparency –** understanding and using models is enhanced when input assumptions are comparable. This can be supported by using standard data formats and interfaces. It could include a section on open development of visualization templates that could then be applied to various data sets.
12. **Provide an Open Data hub** and encourage projects which have the ambition to be used by policy makers to use it is an important step in this direction. Their use can be facilitated by providing an aligned source as a common basis for calculations. The Open Data Portal is a first attempt at bringing together data from EU institutions, agencies and bodies, but a stronger

move in that direction for modelling purposes is done by the JRC with the IDEES[2] database developed in the context of the new EU model called Potencia[3]. Another initiative outside of the EU institutions that supports the open-source nature of models is OpenMod (a platform for open source models in the EU), and Open EI is an example from the US.

13. **Introduce a staged knowledge build-up and transfer process**, where in-depth modelling projects acquire new insights and introduce them into existing open online tools (i.e. projects do not need to each develop a new tool but provide their results through an existing model structure). This increases comparability and can help refine the insights provided by such a shared model. This could be formalized as a requirement in EU requests for quotation. As joint development over time needs to meet very strict development, testing and documentation standards will enhance the transparency, maintainability and thus lifetime of such online tools. If model descriptions followed a common format they would be more easily comparable, see for example the metadata structure (ESMS) for the European Statistical system (ESS).
14. This also means **someone needs to own and quality control the online tools** and their required upgrades. This could be integrated as part of the tasks of the EU Commission (and potentially outsourced), or a specific body could be created, in the line of what E3G suggested in their 2015 briefing paper on the EU approach to policy making in the energy sector. They encourage the creation of a new independent institution – the European Energy and Climate Risk Observatory – to provide the necessary substance to bring the Energy Union concept to life.[4] The launch of the competence centre on modelling at the JRC[5] could bring this closer to reality. We will see how much this body becomes more central in EU policy making, and whether it receives the means to be heard in policy making
15. All the above should help **improve the comparability of models** – the initiatives which compare energy models in the same way as some of the climate models are compared (see for example the model intercomparison project). This requires a commitment on several dimensions, e.g. on using aligned framework data. This will also help build transparency in models and it will stimulate the cooperation between modellers.

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[2] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108244/kjna28773enn.pdf
https://ec.europa.eu/jrc/en/publication/jrc-idees-integrated-database-european-energy-sector-methodological-note
https://ec.europa.eu/jrc/en/news/launch-commission-competence-centre-modelling

[3] https://ec.europa.eu/jrc/en/publication/potencia-new-eu-wide-energy-sector-model

[4] https://www.e3g.org/docs/The_Energy_Union_needs_a_new_approach_to_policy_making.pdf

[5] https://ec.europa.eu/jrc/en/news/launch-commission-competence-centre-modelling

Context of this work

Analytical models are used in multiple contexts to represent the systems that surround us, and they have become increasingly important to define policies for the rapidly evolving energy system. They can support decision-making by providing quantified assessments on ever more complex issues.

The EU's energy policy – secure, sustainable, and competitive energy for all in Europe as illustrated in Figure 1.

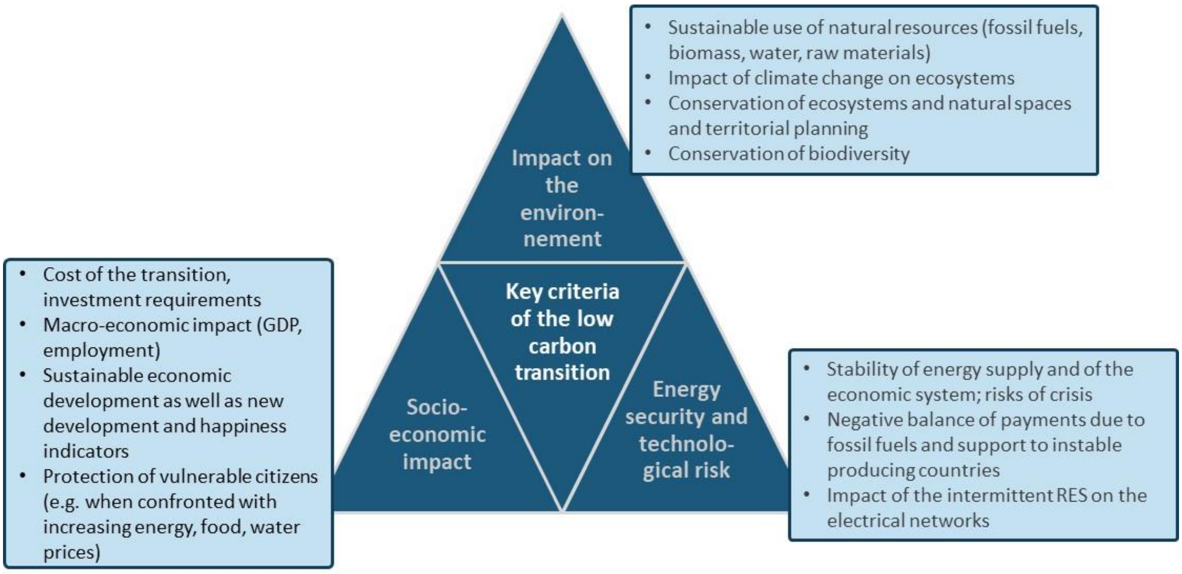


Figure 1. Energy trilemna

The role of the EU Commission in this context is central, as it is one of the motors of new policy development. Several DGs are involved in the energy and climate policies.[6]

Understanding the impacts of various energy and climate policies often requires credible modelling tools. These models allow dealing with complex inputs (e.g., clarifying energy production and consumption and GHG emissions for multiple uses), complex analysis (e.g., impact of policies on climate mitigation, contribution of various sectors or countries, social distribution effects, etc.), and complex outputs (e.g., scenario analysis under various framework conditions).

However, by essence such representations of complex systems are simplifications, and they are directly dependent on the quality of the input parameters and the way the models are constructed. Understanding and communicating on these limitations is key to avoid misleading conclusions.

There is an extensive number of existing models addressing energy and climate issues, but few can directly or easily be used by the EU Commission and other policy makers, which means their outputs are not always comparable and usable for policy making.

[6] See https://ec.europa.eu/energy/en/about-us and https://ec.europa.eu/clima/about-us/mission/ for more details on the roles of DG ENER and DG CLIMA

Also, the transparency and usability of these tools is limited. This leads to limited comparability of models and of their results. And differing underlying data and assumptions impair their understandability.

On top of that, it has become very clear that the climate imperative requires much deeper GHG cuts than historical trends, which existing models are often not good at including in their assumptions.

How can modelling and model-based consulting processes be further improved to bring relevant information to policy makers and make sure to engage them on the relevant issues, particularly in the context of the massive reductions required to reach WB2°C?

In this context, as shown in Figure 2, this briefing paper looks at :

- Some limitations of current models and innovation requirements
- The needs of policy makers
- The link between policy makers and modelers

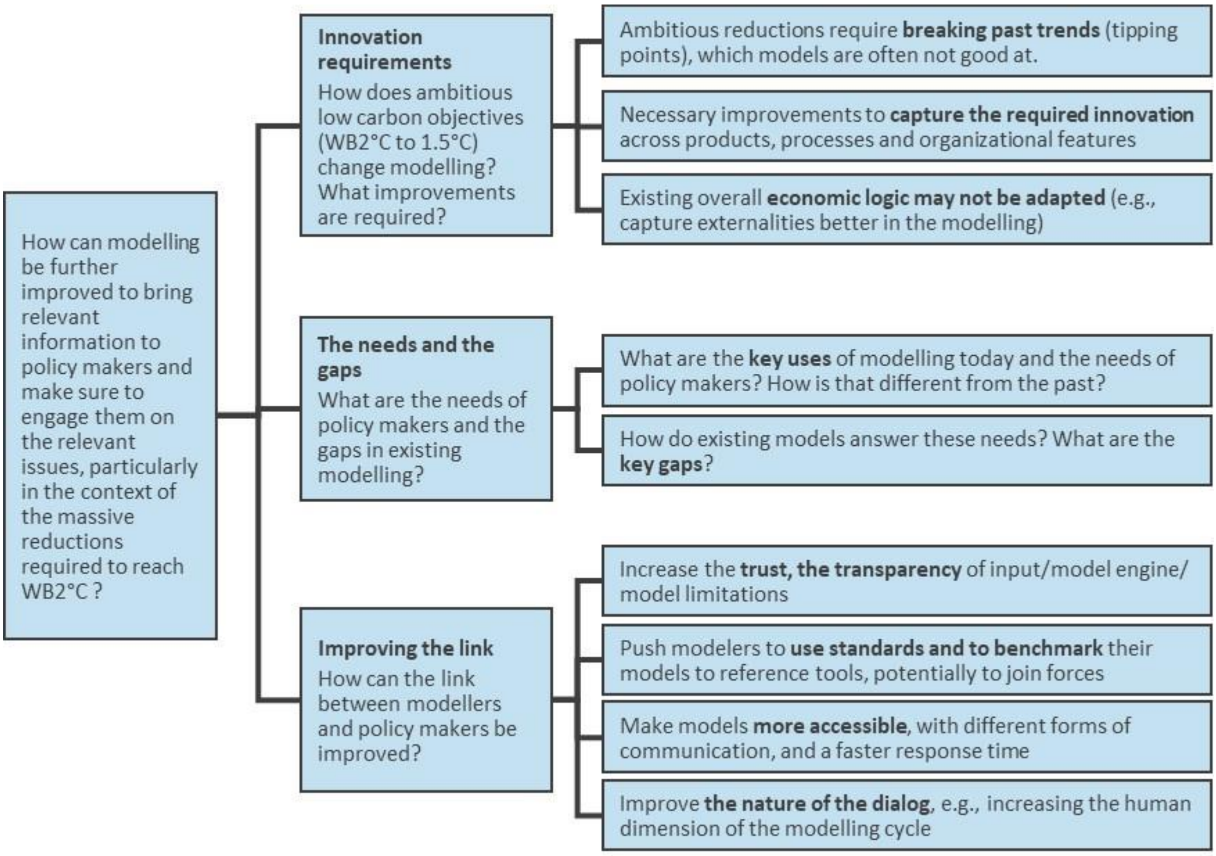


Figure 2. How can modelling be improved?

In doing so, it recognizes that policy making is an extremely complex issue, where two levels interact: (1) work is being done within each of the EU political bodies (the EU Commission, the EU parliament, the EU Council and their links to Member States), and (2) then these bodies interact and negotiate to reach consensus (including the famous trialogue).

This second higher level of policy making discussions tends to become less transparent as negotiations are taking place between these multiple parties, and exposing facts and truths becomes sometimes less helpful. The role of modelling in that process is to provide evidential support to the things that matter in the negotiations, to the main concerns of each of the parties. In this context, as described by E3G in their 2015 paper[7], policy making tends to become incremental instead of transformational, as it is much easier to focus on the one extra step that each member state is ready to make instead of finding consensus for a major policy overhaul.

Both these levels need to be addressed, but this paper focuses on the first. At the first more technical level, we can look at how modelling processes can be adapted to improve the quality of policy making proposals.

[7] https://www.e3g.org/docs/The_Energy_Union_needs_a_new_approach_to_policy_making.pdf

1 Innovation – the climate challenge requires improvements in modelling

The energy system is complex, and it is changing rapidly, influenced by transformations at all levels: globally, regionally but also at the very local level. One of these massive trends is the scale of transformation that is required in order to deliver on global climate and EU energy ambitions.

Figure 3 highlights some of the challenges it faces, with changes in the overall context, the market and regulatory dimension and the physical energy system.

Challenges of the emerging energy system

Overall context

- **Complex and uncertain geopolitics affecting high fuel prices** (energy security issues)
- **Climate change** is an increasingly important issue
- **Economic crisis**, key competitiveness issues
- **New network industries** are changing the landscape, with the energy infrastructure struggling to follow

Market and regulatory

- High **pressure on fossil fuels** and higher prices **volatility**
- Increasing EU **market integration**, and **difficulties in adapting the electricity market** to new technologies
- Increasing **regulatory constraints** (e.g. ETS) and trend towards intervention

Physical Energy System

Demand

- Increasing focus on **energy efficiency**
- Electrification (EV, heat pumps) and more **integration** between heat/gas & electricity systems
- Increasing focus on **demand flexibility and elasticity**

Supply

- Increasing **decentralized** (e.g., wind, small biomass) and auto-production (e.g., PV, cogeneration)
- Increasing share of **intermittent** production
- Increasing **storage** requirements (electricity and gas)
- Innovation and new technologies can lead to **breakthroughs** in the systems

Integration of systems (electrification, CHP, district heating)

High uncertainty in the evolution of the system

Figure 3. Challenges facing the energy system that need to be captured in analytical modelling.

We have interviewed members of some of the key modelling teams in Europe as well as users of modelling (policy makers and NGOs). Following up on these interviews, a survey was built to capture further input. The following paragraphs will display the questions asked and the answers we received, survey results will underpin the results with a quantitative indication.

In this changing and increasingly complex energy systems, what are **key improvements** required **in modelling** to support policy makers in defining and putting in place the relevant policies to achieve the massive changes that are required to limit climate change? How can **trend breaks**, **paradigm shifts**, and regime switches be integrated in models?

Integrate paradigm shifts (breakthrough, tipping points)

- Models that seek an equilibrium are not designed to show trend breaks or regime switches. They show different stable states (equilibriums) but have difficulties to describe the path. Another approach, the system dynamics approach, contains feedback loops that will show changes in a system over time including tipping points and trend breaks. This approach is not well represented today and many macroeconomic models, use an equilibrium approach. Results and conclusions for the macro-economic development are strengthened by using a **variety in modelling approaches**, in this case the equilibrium and the system dynamics approach.

Granularity: the devil is in the details – breaking down national targets to local action - a need for further modelling?

- The survey results in Figure 4 show that the aggregation level and the granularity of modelling assessments is perceived as insufficient. The achievement of national targets depends on the contribution of many actors. These actors need to be triggered, encouraged, and supported to take the required initiative for energy saving and other greenhouse gas emission reduction.
- A main question is, how detailed and to what extent of accuracy the contributions of the actors need to be described, for policy makers to create the according triggers and support instruments.
- A second question is, how well the contributions may be described, when energy saving approaches and technologies are – at least in some sectors – subject to substantial innovation. From our interviews we received a divided picture on this question. On the one hand, there is the wish for most accurate and detailed reduction potentials and costs. On the other hand, there are limited data and technological and market uncertainties. It is a common approach to balance the wish for detail with the cost of uncertainty. From the answer we found that more granularity may be feasible in the following areas:
    - **National-Regional granularity**: linking national targets to local action on a model level … to then develop the incentives for local action on a political level
    - **Demographic granularity**: effects will vary depending on growth/shrinkage of a city/region and depending on the age of the actors

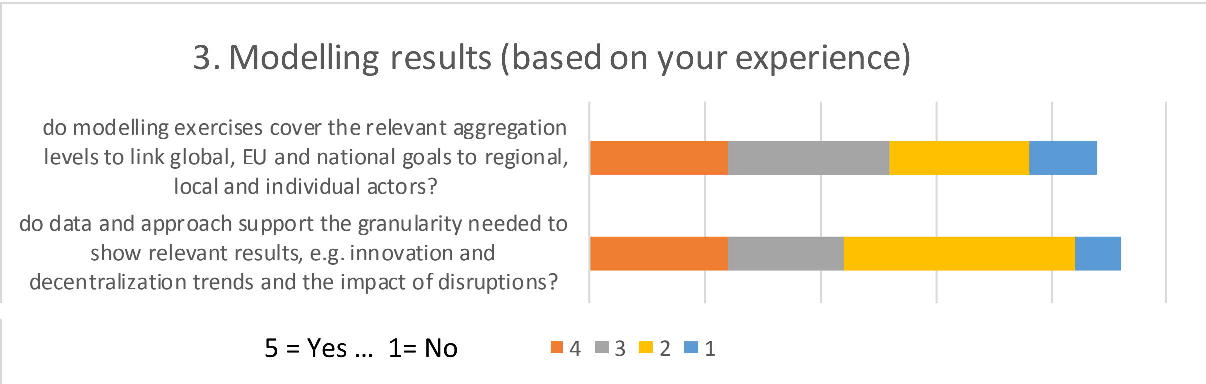


Figure 4. Survey questions on the modelling results.

How are innovations in processes, organizational features and products along the supply chain (touching several sectors) included in a model or in a system of interlinked models?

- Existing modelling frameworks need to be improved to capture the required innovation across products, processes, organizational features, and also the links between these products, materials and industrial production.
- As described in Figure 5, our survey respondents found that indirect emissions are not sufficiently well covered. This includes the energy necessary for extraction, production and transport, installation before the use of a product. This thinking goes into the direction of the Lifecycle Assessment, which requires a detailed knowledge of the product and processes. These are abstractly reflected in a modelling exercise for national or European energy savings making a lifecycle assessment subject to a lot of assumptions and thus uncertainty. However,

there are some models that contain attempts to cover and assess indirect emissions for products with a substantial margin of indirect emissions. The display of relevant linkages between different products and processes in the supply chain still require research efforts.

- Industry processes and the related environment and climate protection measures are very diverse and detailed. In addition, microeconomics drive these corporate actions. Especially the measures in a complete supply chain are not easily accessible and described. The related GHG emission reduction potential and its costs are thus not easily assessed.

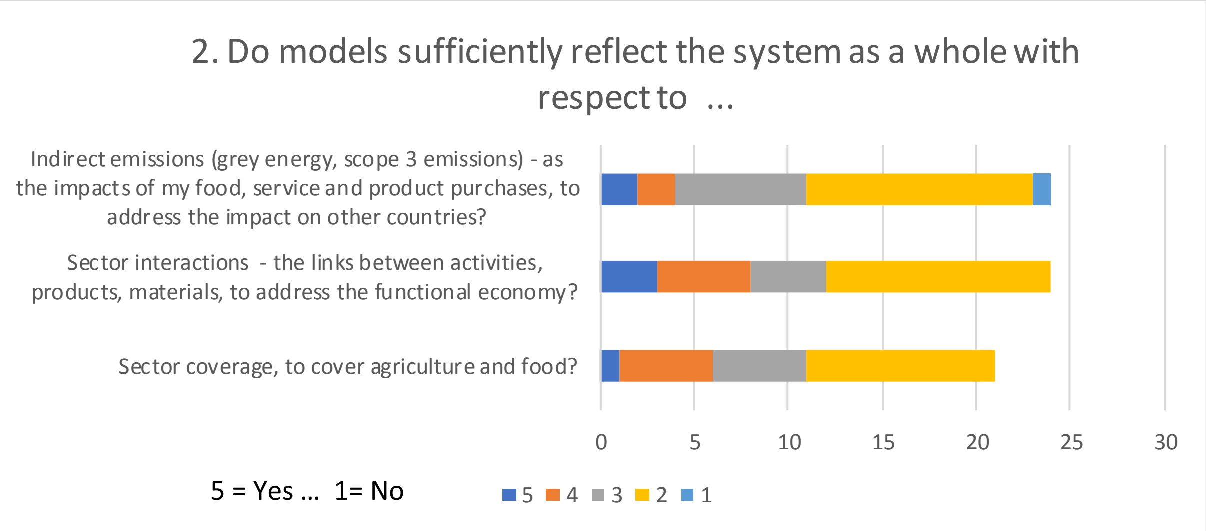


Figure 5. Survey question on how much modelling covers certain innovative issues.

How should models include the impact of externalities and the related services we get free from nature that are not captured in the current economic and modelling logic? (e.g., impact on the climate, on air quality, on reduced resources or on biodiversity).

- Figure 6 shows that **considering externalities is perceived as important (question 14) and that they are not sufficiently reflected in the modelled carbon price** (question 13). However, the answers to question 12 could indicate that capturing externalities within a model, potentially creates results that are not supported by the currently existing incentives and requirement.
- Existing overall economic logic may not be adapted in models that create desirable futures, e.g., models will capture externalities better.
- **Behavioural economics** is seen as one way to integrate externalities into modelling. For example, it can reflect the decisions behaviour of the actors that will change with the income and wealth level of the actors, but also with their age.
- **Agriculture and food area also 2 sectors which are often not well covered by existing models**, and most often not in direct links with energy and climate implications. The integration of these sectors will enable a better reflection of the supply chain, as already mentioned above. In addition, the impacts of climate change on these sectors will help to quantify the costs of not taking climate protection measures.

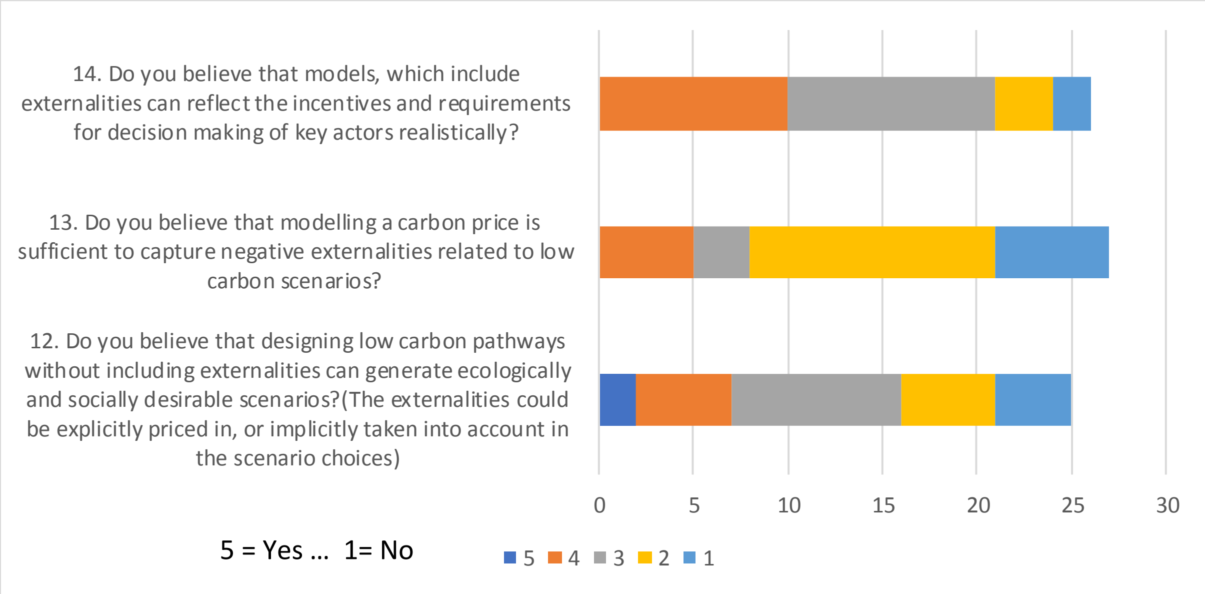


Figure 6. Survey questions on externalities.

2 Policy needs and gaps

Models are by essence partial representations of the energy system, its operations and its key mechanisms. All rely on inputs and assumptions and one single model cannot catch all dimensions of a given systemic question. There is no “one-size-fits-all model”, no model can argue to have all the answers. On the contrary, models are designed to answer certain type of questions. Accordingly, no public institution should rely on a single model, not even a single suite of models, but a variety of them to capture all issues properly and complementarily.

Beyond the choice in the type of model, certain trade-offs need to be made before embarking into a new modelling exercise. Figure 7 describes some of the major ones to keep in mind[8].

1	**Reference model** + A reference model allows easier comparison between scenarios + This model can be invested in and improved over time – Reference cannot be used by some (proprietary/too complex)	VS	**Model diversity** + Different aspects might be better addressed by different models + Competing theories might require model diversity – Issue of standardization of models (who selects the reference?) – More models can lead to less control over results – Results can point to many different directions
2	**Make your own model** + No dependence on supplier (natural monopoly) – Cannot be used by external parties (proprietary/too complex)	VS	**Buy the model from a provider** + Efficiencies of scale and scope for providers – Control over modeling content and timing within administrations becomes more difficult
3	**Models at the research frontier** + Ensure models include major available improvements – Harder to understand by all decision makers or stakeholders	VS	**Wide participation** + Sufficiently stable models, possibly compatible with previous data + Widely understood and used by the stakeholders
4	**Focus on rigor** + More thorough and reliable answers, more reusable/long term + Cover all EU countries with sufficient detail – Slower, more expensive	VS	**Focus on relevance and speed** – Answers to complex issues not always as complete + Quicker turnaround, lower cost, sometimes easier to communicate
5	**Intransparent / proprietary** + Lower cost as the process is much easier to manage + Can help the administration to avoid having to justify all its choices, therefore simplifying policy-making + Avoids potential misuse or twist by external organizations	VS	**Transparent / open** + Strong signal for credibility + Allows larger stakeholder participation + Allows spotting errors – Increases the management time and cost – Potentially higher cost if the IP of the model has to be paid for

Figure 7. Key trade-offs in modelling developments.

2.1 Initiatives taken by the EU Commission in the past few years to improve modelling

Aware of the limitations in modelling capacity, the Commission has taken a variety of steps in the past few years to increase the number of alternative models.

They are pursuing various objectives with this to make better choices on the 5 trade-offs described above:

1. **Bring more model diversity**: with various initiatives pursued in parallel, the EC is encouraging a higher model diversity to tackle more dimensions of the energy system. At the same time, it is reinforcing PRIMES, its current reference model.
2. **Have a better mix between models owned by the EC or related institutions and external providers.** Therefore, improving the independence of its modelling, avoiding to rely solely on one external supplier.

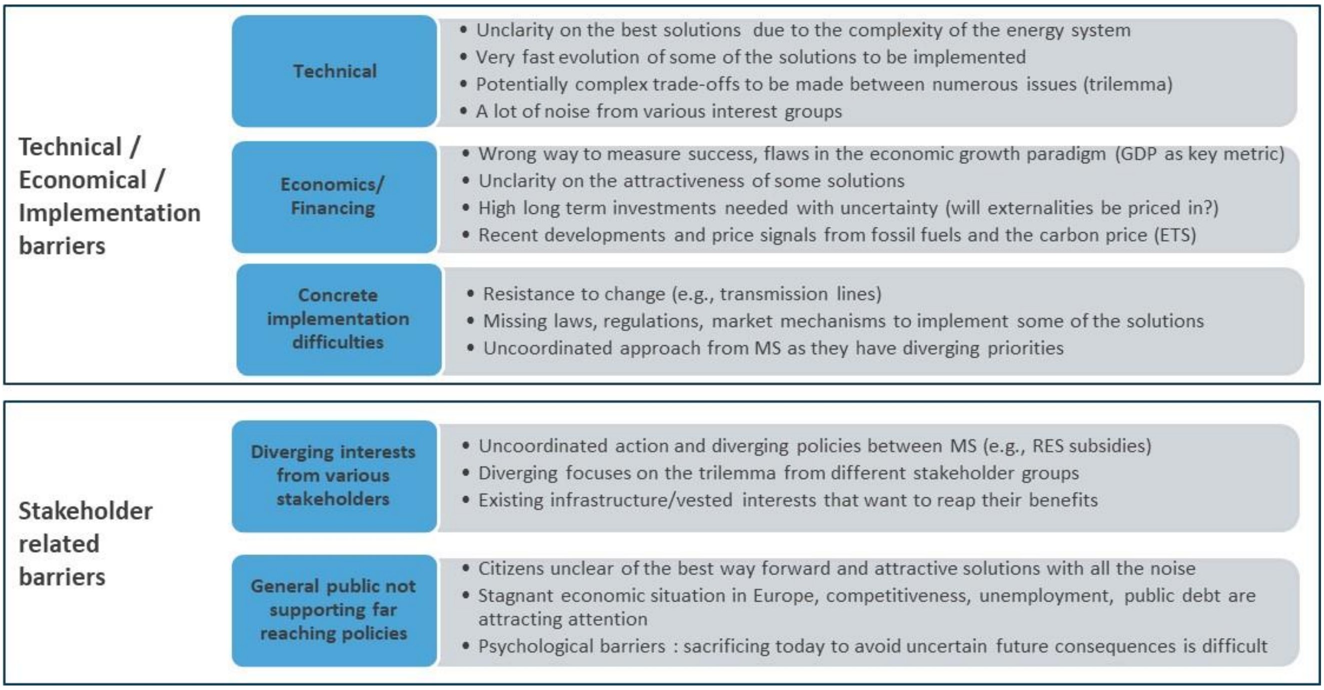
[8] These are inspired by the Bruegel presentation on “Modelling for energy policy making” http://bruegel.org/events/energy-modelling-for-policy-making/

3. **Improving the quality of its modelling** (staying at the research frontier): the EC wants to fill some of the gaps identified in its modelling of specific issues, particularly markets, markets designs and transport and distribution grids, and also seeking to improve its macroeconomic analysis of energy and climate policies.
4. **Improving the flexibility and speed of its modelling power**: at the same time, the EC is eager to have access faster and more efficiently to modelling intelligence, with a much faster turnover of modelling results. As described just below, METIS will be installed on EC machines for complete control and use and to allow the EC to perform its own analyses
5. **Improving the transparency and openness of its modelling**: the EC has hired a software company (ARTELYS) who is ready to open its model to other parties, thereby making it more transparent and also more open. It is also looking into publishing PRIMES results more thoroughly than the current limited reporting, potentially through an online dashboard accessible to all.
6. **Capture recent innovations and costs developments, eg technology, new business models, etc.**

2.2 Modelling can help remove some of the barriers to the energy transition

A series of barriers are slowing the climate and energy transition, they are both of technical/economic nature as well as an issue of diverging stakeholders, strong lobbies and lack of understanding of the key issues.

The figure below shows some of these barriers structured around techno-economical issues and stakeholder related ones.



Models are required for a variety of reasons, but they can help removing some of these barriers.

Technical / Economical / Implementation barriers	Better understand key issues and clarify potential solutions	▪ **To better understand the energy system**, and the potential evolution of its key drivers (e.g., through transparent assumptions and scenarios) ▪ **To clarify the tradeoffs** between options, their concrete consequences and the overall scale of action required to achieve certain goals
	Synthesize existing findings, involve and align relevant stakeholders	▪ **To support relevant discussions between stakeholders** on assumptions/models/ recommendations to give decision makers a better understanding of the issues ▪ **To provide a common language for stakeholders** to express their views about the energy system, and minimize the impact of diverging interests
Stakeholders related barriers (diverging interests of key stakeholders, limited support from the general public)	Communicate on the issues and the solutions	▪ To communicate on all the above with **more interactive models** ▪ To **illustrate clearly key choices**, and identify which issues are distractions

Building on this, we believe that a variety of models are required to cover each of these objectives, as illustrated in Figure 8**.**

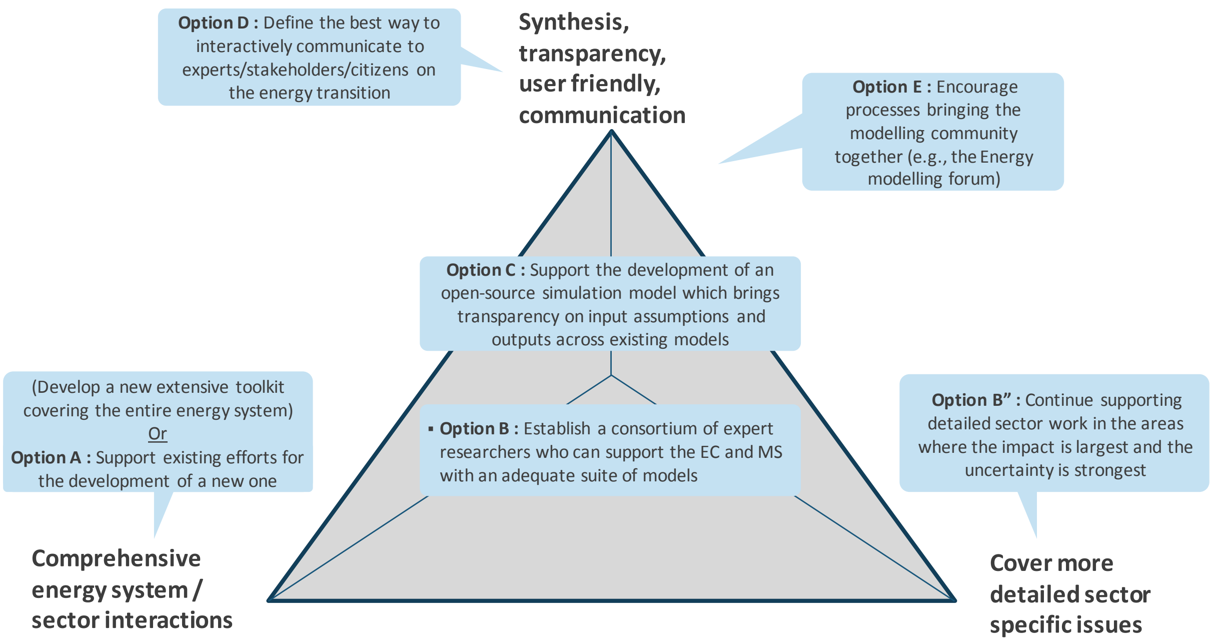


Figure 8. Various options to support improvements in modelling

Better understand the issues and clarify potential solutions/ implementation

- Continue the **development of new more transparent models used by EU institutions and Member States** to ensure they capture the key dimensions for policy making
- Support alternatives from a variety of researchers who can support the EC and MS with **adequate models pushing back the research frontier**

Synthesize existing findings, involve and align relevant stakeholders

- Support decision makers with **open-source simulation models which bring transparency** on input assumptions and outputs on certain issues, or across existing models, making it easy for decision makers to compare and replicate existing scenarios, **and understand their trade-offs**
- Encourage tools which **improve the sharing of best practice policies** across regions and countries
- Encourage **processes bringing the modelling community together** (e.g., the Energy modelling forum)

Communicate on the issues and the solutions

- Define the best way to **interactively communicate to experts/stakeholders/citizens** on the energy transition. Develop the tool with key stakeholders and communicate widely
- Find **other ways to remove barriers** and ease the process, **increasing the human factor in the modelling process**

Question 3 in the online survey asked for the resemblance of modelling results in policy making with respect to the climate change. Figure 9 shows that **the majority of participants feel that model results are indeed being used and can be recognized in policy making, which underlines again the importance of having the right type of modelling being used.**

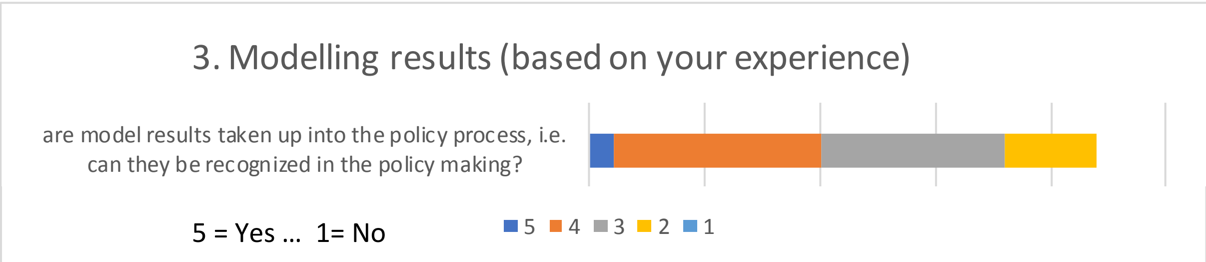


Figure 9. Survey questions on the modelling results.

3 How can the link between modellers and policy makers be improved?

Figure 10 shows which of these areas were considered key to improve in modelling by our survey respondents. **Trust in models as well as data quality and availability, transparency of models, and proper communication of modelling outputs all came out with the highest respondents, together with the policy process itself, which was highlighted above as being obviously key**.

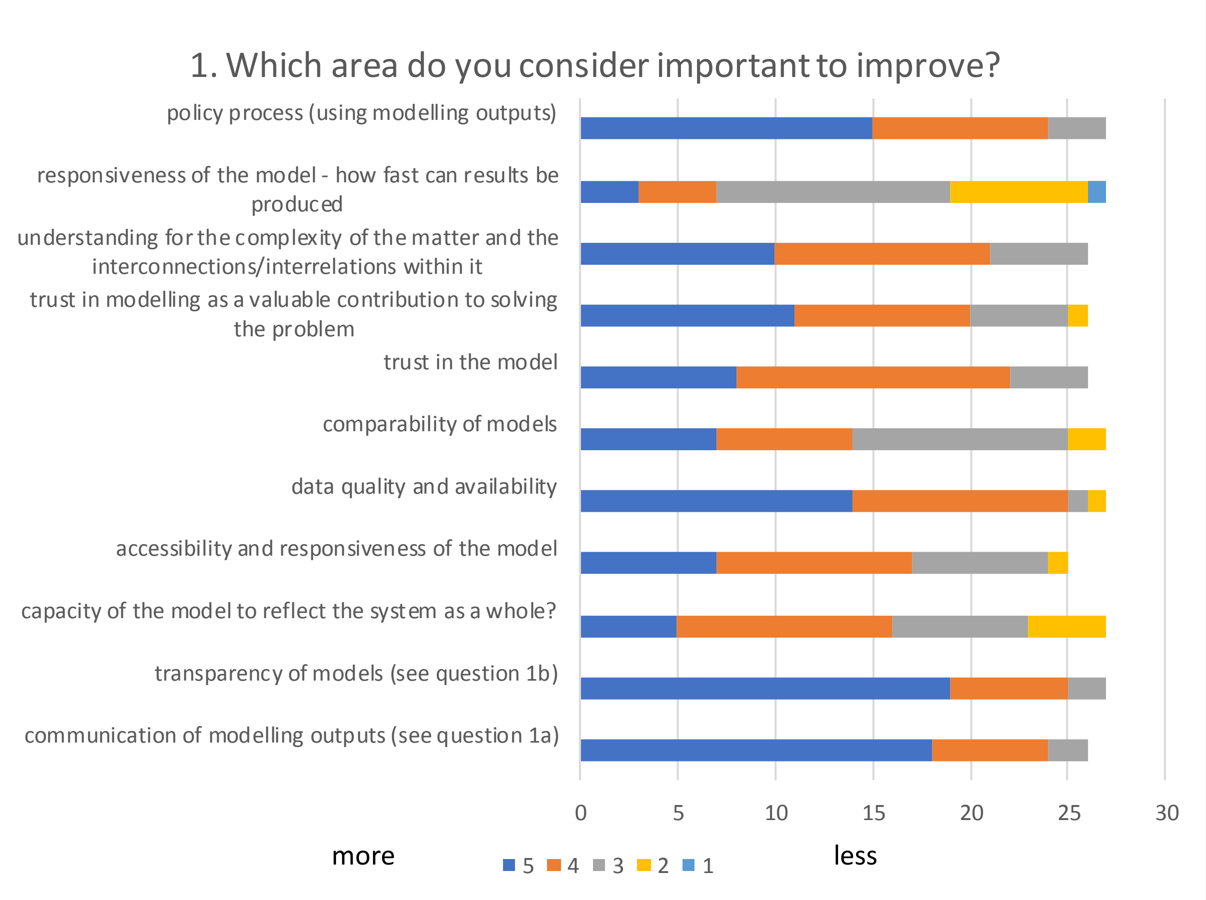


Figure 10. Survey results: areas considered more or less important to improve in modelling

Based on the success of previous modelling exercises and discussions with a variety of stakeholders as well as the survey, some **qualitative hallmarks or features of modelling exercises were identified as independent of the problem nature and key to improve the strength of policy making**.

Among others:

- **Use a variety of models,** to harness the collective capabilities of multiple models to ensure the strength of each can be leveraged. While there are some advantages to work with a reference model, there are many drawbacks, particularly when this reference is owned by an external provider and not transparent enough;
- **Ensure transparency, impartiality and neutrality** so that other experts can add to the knowledge base and add credibility. Input assumptions should be fully transparent and ideally discussed and shared with stakeholders; concretely

- **Improve the comparability of models** – We must increase the initiatives which compare energy models in the same way as some of the climate models are compared (see for example the model intercomparison initiatives). This requires a commitment on several dimensions, e.g. on using aligned framework data. This will also help build transparency in models and it will stimulate the cooperation between modellers.
- **Increase model transparency –** understanding and using models is enhanced when input assumptions are transparent and comparable. Figure 11 shows how survey respondents suggested that all assumptions and the modelling approach should be made more transparent, but particularly intrinsic assumptions which are logically most hidden in the modelling logic. This can be supported by using standard data formats and interfaces. It could also leverage open development of visualization templates that could then be applied to various data sets.

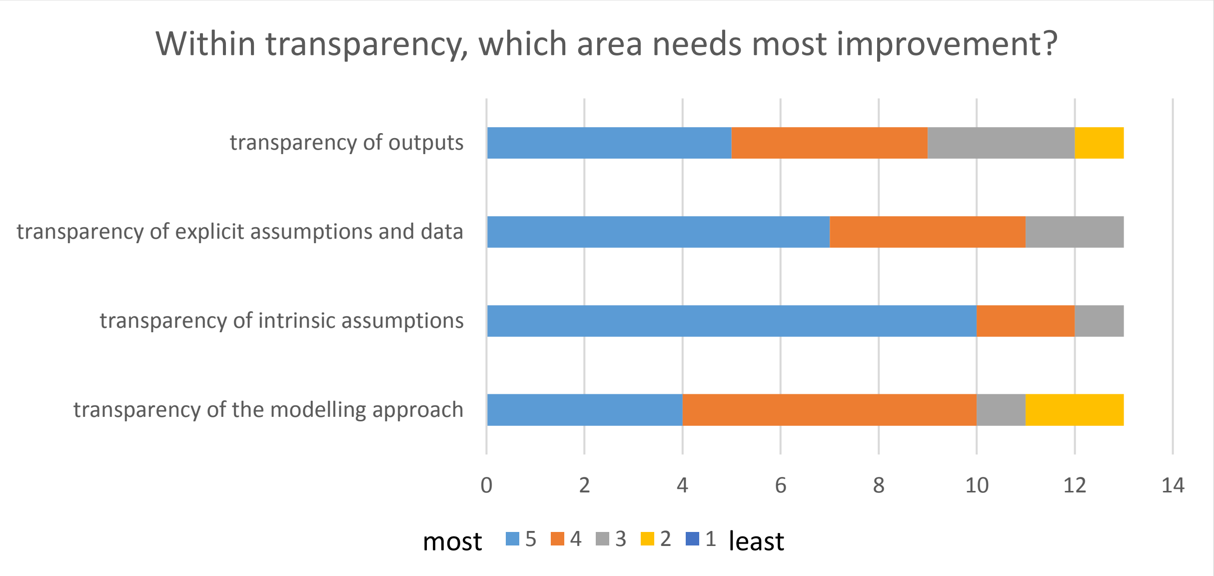


Figure 11. Survey results: areas where transparency is most important.

- **Provide more open source models and an Open Data hub** and encourage projects which have the ambition to be used by policy makers to use it is an important step in this direction. Figure 11 shows that, while survey respondents have mixed feedback on the fact that open-source would make models more qualitative, they do believe the open-source nature of models can help support the trust in models, and mostly increase their transparency (of both their logic and their assumptions).

  Their use can be facilitated by providing an aligned source as a common basis for calculations. The Open Data Portal is a first attempt at bringing together data from EU institutions, agencies and bodies, but a stronger move in that direction for modelling purposes is done by the JRC with the IDEES[9] database developed in the context of the

[9] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108244/kjna28773enn.pdf
https://ec.europa.eu/jrc/en/publication/jrc-idees-integrated-database-european-energy-sector-methodological-note
https://ec.europa.eu/jrc/en/news/launch-commission-competence-centre-modelling

new EU model called Potencia[10]. Another initiative outside of the EU institutions that supports the open-source nature of models is OpenMod (a platform for open source models in the EU), and Open EI is an example from the US.

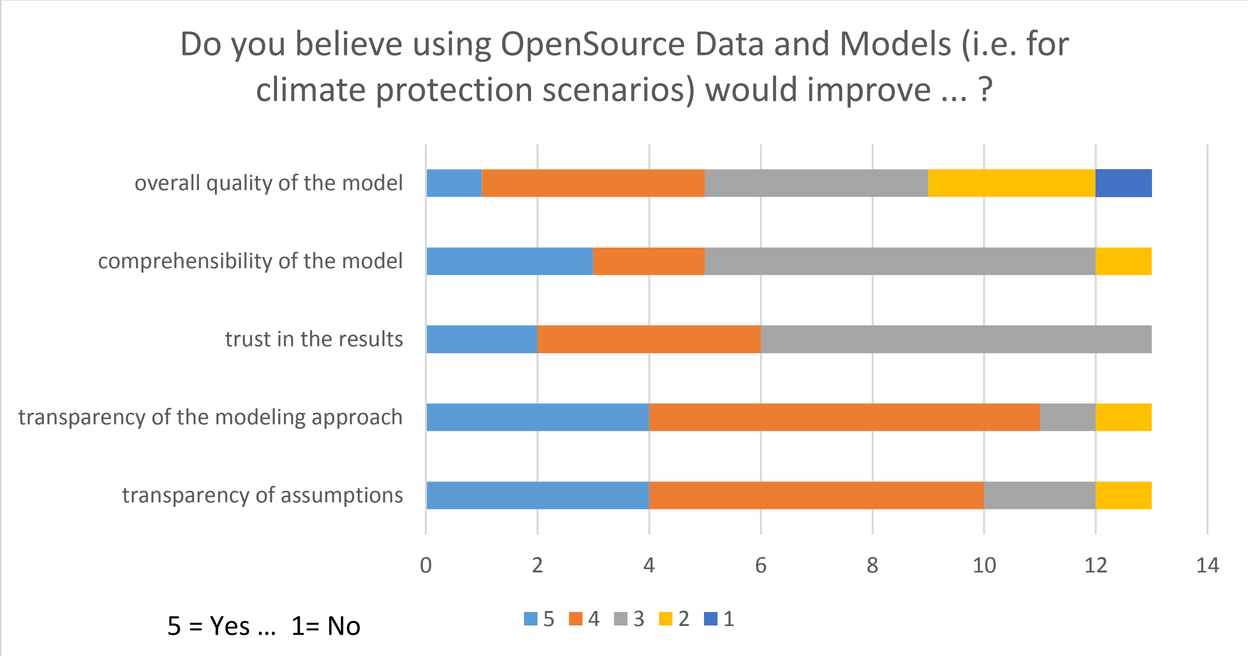


Figure 12. Survey results: what can open source data and models be most helpful for?

- **Carefully interpret the results and recognize potential limitations** as they are directly dependent on the underpinning methodology and assumptions (e.g., pricing of electricity based on marginal or average cost, how far are behavior levers assessed, how complete is infrastructure representation, etc).

We think it would be helpful to increase the use of a staged knowledge build-up and transfer process (see Figure 13 as illustration), where in-depth modelling projects acquire new insights and introduce them into existing open online tools (i.e. projects do not need to each develop a new tool but provide their results through an existing model structure). This increases comparability and can help refine the insights provided by such a shared model. This could be formalized as a requirement in EU requests for quotation. As joint development over time needs to meet very strict development, testing and documentation standards will enhance the transparency, maintainability and thus lifetime of such online tools. If model descriptions followed a common format they would be more easily comparable, see for example the metadata structure (ESMS) for the European Statistical system (ESS).

[10] https://ec.europa.eu/jrc/en/publication/potencia-new-eu-wide-energy-sector-model

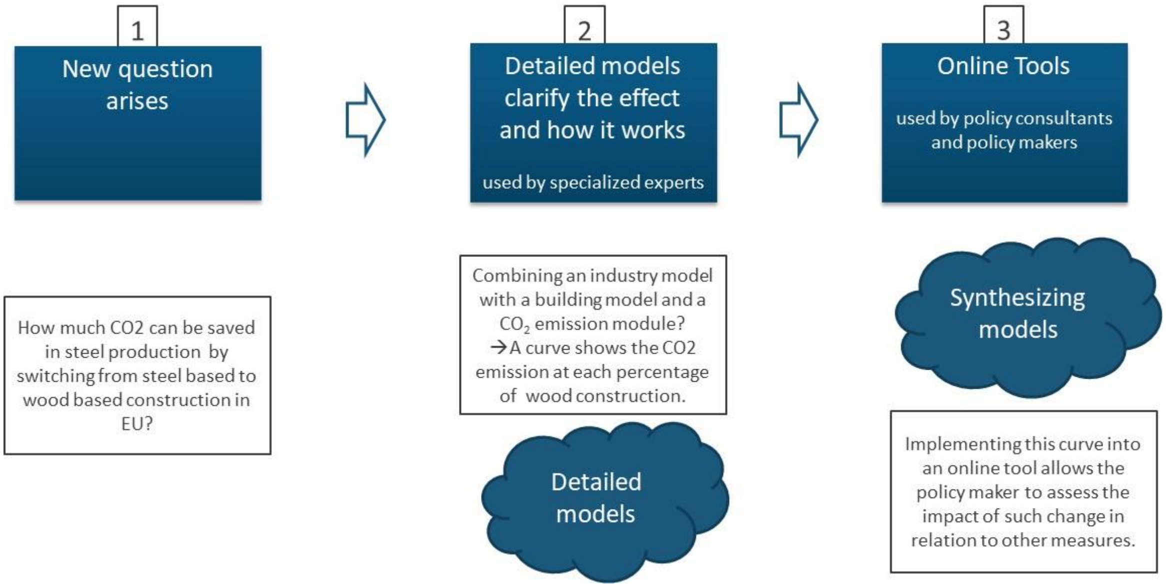


Figure 13. Using different models in a staged process to integrate answers into policy decision making

This also means **someone needs to own and quality control the online tools** and their required upgrades. This could be integrated as part of the tasks of the EU Commission (and potentially outsourced), or a specific body could be created, in the line of what E3G suggested in their 2015 briefing paper on the EU approach to policy making in the energy sector. They encourage the creation of a new independent institution – the European Energy and Climate Risk Observatory – to provide the necessary substance to bring the Energy Union concept to life.[11] The launch of the competence centre on modelling at the JRC[12] could bring this closer to reality. We will see how much this body becomes more central in EU policy making, and whether it receives the means to be heard in policy making

[11] https://www.e3g.org/docs/The_Energy_Union_needs_a_new_approach_to_policy_making.pdf

[12] https://ec.europa.eu/jrc/en/news/launch-commission-competence-centre-modelling

CONCLUSION

We have highlighted some of the key features of modelling above (i.e., potential for strategic analysis from various models, the open source nature of modelling, communication and exchange of best practices) and the need to assess current and future energy and climate modelling available at the Commission and in other EU bodies to ensure that they effectively support the climate and energy transition and challenges.

There is clearly work to not only make models more comprehensive and ensure that they capture the energy system better, but also to increase the ease of use and the comparability of these models. Some of the existing modelling is not used to its full potential and deserves to be made more accessible and better understood by policy makers.

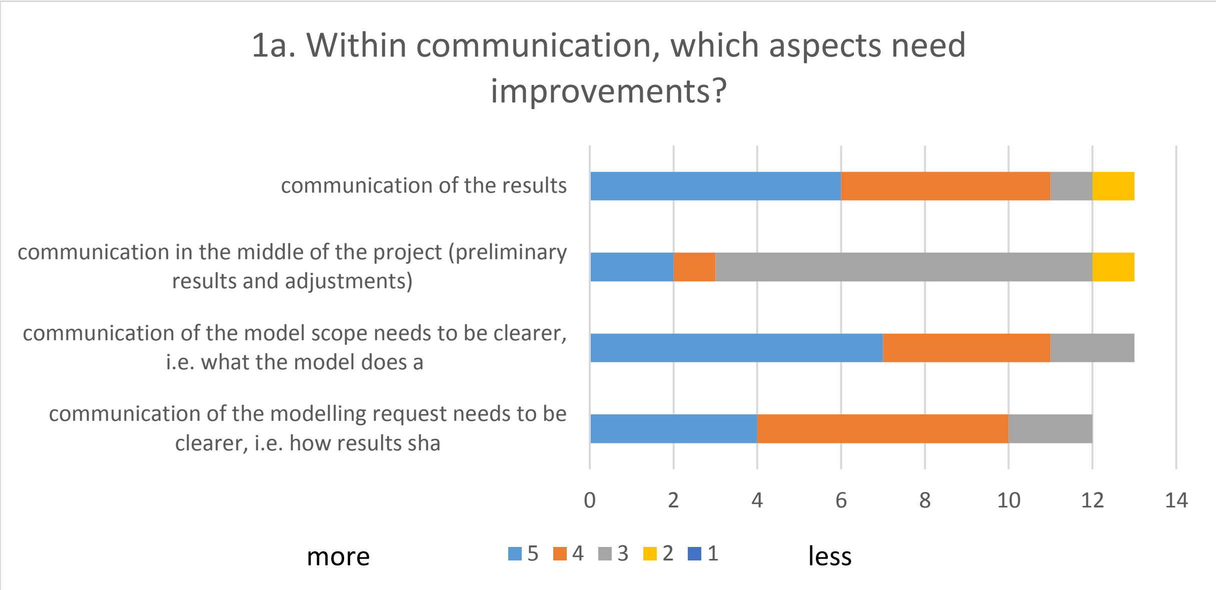
Our work is just one contribution in the process of identifying the key improvements in how modelers and policy makers can better work together. We encourage the entire modelling community to bring this thinking further, and we fully recognize that for a such as the Energy Modelling Forum are a great way to do this.

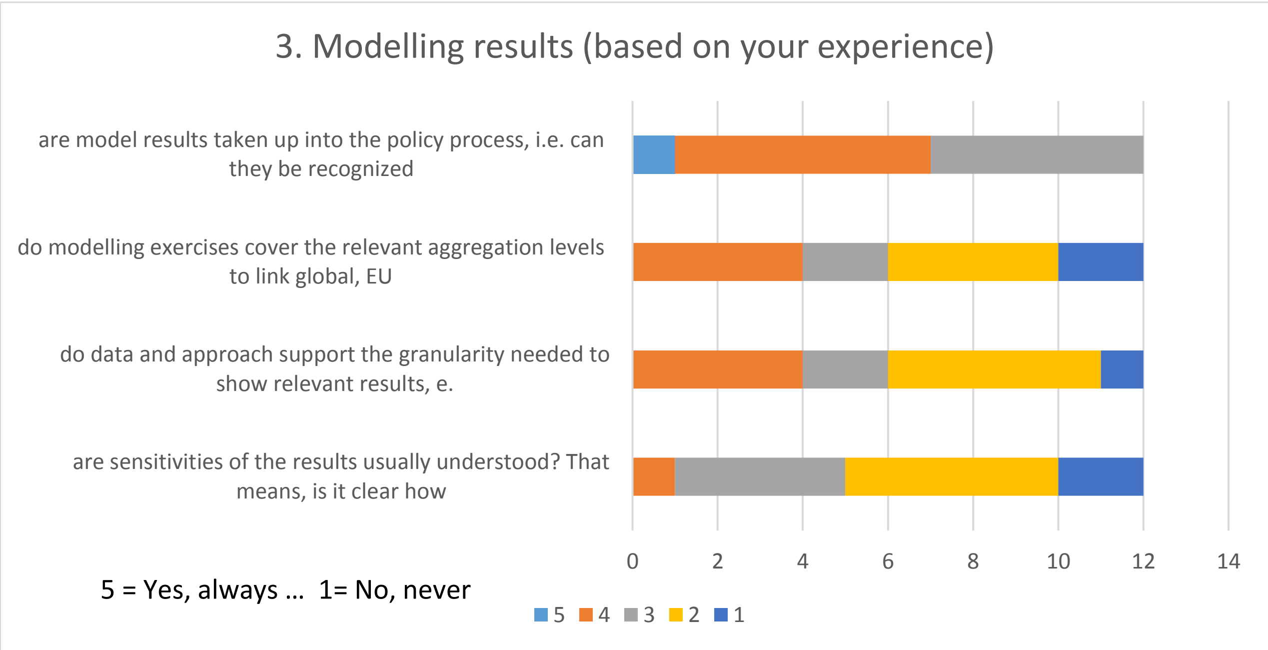
4 APPENDIX

4.1 Respondents to the survey

Maarten Degroote : BPIE
Vincent van Steenberghe : Belgian environment administration
Berit Mueller : Reiner Lemoine Institut
Daniel Huppmann : IIASA
Franziska Holz : DIW
Agnese Beltramo: KTH Royal Institute of Technology
Franz Josef Schafhausen : Institut für Klimaschutz, Energie und Mobilität
Boris Thurm : EPFL
Floor Brouwer : WUR
Silke Karcher : BMUB bund
J.A. Mercure : Radboud University
Panagiotis Fragkos : National Technical University of Athens
Stefania Tron : OEGUT
Jan Kiso : BEIS UK
Laszlo Szabbo : REKK Hungary
Luis Costa : Potsdam Institute for Climate Impact Research (PIK)
Alessandra Prampolini : WWF
Shane Slater : Element Energy
Frank Meinke Hubeny VITO
Ludwig Huelk : Reiner Lemoine Institut
Eva Schmid : Germanwatch
Robbie Morrison : Anonymous participant
Konstantinos Sakellaris : DG Clima
Kuishuang Feng : University of Maryland
Martin Baumann : Austrian Energy Agency

4.2 Other results from the online survey





4.3 Interview questions

4.3.1 How do ambitious low carbon goals (WB2°C to 1.5°C) change the modelling objectives? What improvements are required to meet them?

How can models better include **breaking past trends**, **paradigm shifts** and regime switches to reach the level of change required but often not well represented in models? Should this be captured through the model itself or the modelling process?

How are innovations in processes, organizational features and products along the supply chain (touching several sectors) included in a model or model conglomerate? How can that be improved?

How should models include the impact of externalities and the related services we get free from nature that are not captured in the current **economic and modelling logic?** (e.g., impact on the climate, on air quality, on reduced resources or on biodiversity)

4.3.2 What are the needs of policy makers, the key uses and the gaps in existing modelling?

What are the key uses of modelling today and why model-based advice is needed? How do existing models answer these needs? What key needs of policy makers are not met by current models? What are the key gaps?

Modelling results
From your experience, do you find policy recommendations from modelling projects helpful? What was helpful about them & what is not easy to use?
(same as in online survey)
… Are the sensitivities of the results clear? That means, is it clear how much impact single assumptions, i.e. the interest rate, have on the results?
… Do data and approach support the granularity needed to show relevant results, i.e. innovation and decentralization trends?
… Do modelling exercises cover the relevant aggregation levels to link global, EU and national goals to regional, local and individual actors?

Do **responsive online tools [1,2]** as the national & global calculators **help** with these questions? What is helpful, what is difficult?
Do you see an advantage in the responsiveness, as you can shift ambition in different sectors which changes the results?
Do you see an advantage in the transparency of the results, as you can compare the different levers effects on results?

[1] http://webtool.my2050.be

[2] http://tool.globalcalculator.org/

Do your results have an impact on the policy process? What's helpful, what isn't?

How are the policy maker needs and the key uses of modelling different from the past?

Do you consider interactive tools as the national & global calculators help timing and transparency, as the user can play around with your own results?

Do you integrate your model with other models? Regularly in Projects? Constantly even between projects? Are you integrating your model as part of an Open Source project? Which part of your model? Only input data, or only outputs/results?

4.3.3 How can the link between modellers and policy makers be improved?

Cooperation and linking models
What are your experiences in joining models?
Do you link internal and external models? Only for projects or continuously?

How many of these partnerships do you maintain in your organization?
How often do you work joined forces for EU research?

Improvement areas
From your experience, what are the main improvement areas for model-based advice?
(same as in online survey)
… transparency
… communication
… data quality and availability
… comparability of models
… trust in the model
… trust in modelling as a valuable contribution to the problem
… understanding for the complexity of the matter
… responsiveness of the model - how fast can results be produced

Improvement parameters
How could models and model results be improved to better serve the policy needs?
Would it help you ….
… if models' response time was faster?
… if models were accessible to different experts?
… if assumptions, input data and modelling approach was accessible?
… if such model documentation was standardized?
… if model results needed to be compared to a reference scenario?

Improvement options
Would you consider **Open Source** concepts for Data and Models for the climate issue?
As private Modellers maintain their models as assets for about twenty years and base their revenue on this as an asset. There is currently no incentive for them to create an Open Source model which need lots of resources to be maintained.
Who do you think would be responsible for driving incentives for such Open Source activity? And what options do you see to do this?

What **other options** do you see for increasing transparency and trust in model results? (similar to the online survey)
… modelling *standards,* like for IT processes or accounting: transparent documentation, change approval, peer review?
… *benchmarking* to a *reference* model or a benchmark scenario using a uniform comparison process with transparent documentation of deviations?
… *certification* of models or scenarios by a independent certification body?
… independent testing and comparison of models

Would comparability between models help? What exactly would be needed: standard comparison processes for scenarios with transparent documentation of deviations? Could there be a standard comparison processes for scenarios with transparent documentation of deviations?

What advantages and disadvantages would it bring if modelers joined forces? What are workable solutions and business models? Would it help to create incentives for modelers to potentially to join forces or do you believe standards need to be introduced as a requirement? What are suitable incentive structures and how could the barriers be overcome?

Did you ever experience a deviation of model results and **political interest**? How did it resolve? Did results get accepted and published?

4.4 Three main new modelling initiatives from the European Commission

Three main developments are happening within the Commission on energy modelling. They are described below, as well as their process and potential opportunities for the wider community.

4.4.1 Continued improvement and use of PRIMES

PRIMES is the most used model to represent the EU energy system for the Commission. Most of the Commission's policy making relies (directly or indirectly) on PRIMES results, since the mid-nineties, when it was used for the first time during the negotiations phase for the Kyoto Conference.

PRIMES is also the cornerstone of the EUCLIMIT modelling suite[13] as shown in Figure 14. The objective of EUCLIMIT is to bring several models together from various categories (incl. a macro-economic model, a model on fuel prices, an energy system model, and a biomass model). This modelling suite is the standard approach when doing the Reference Scenario or EU Trends publications, combining an international energy model (which used to be POLES, then replaced by PROMETHEUS), a macro-economic model (namely GEM-E3), PRIMES together with transport, gas, biomass and other modules. These are further complemented by the IIASA modelling suite (GAINS, CAPRI, Globiom). Check in the EU Trends publications for the full description.[14]

The models are used together to perform model-based scenario quantification which supports the European Commission widely in undertaking impact assessments and analyzing policy options for implementing and further developing the Climate and Energy package and other climate-relevant policies in the EU. The 5 core models in the modelling suite focused on energy are owned by the National Technical University of Athens (NTUA).

[13] http://www.euclimit.eu/Default.aspx?Id=2

[14] https://ec.europa.eu/energy/en/statistics/energy-trends-2050

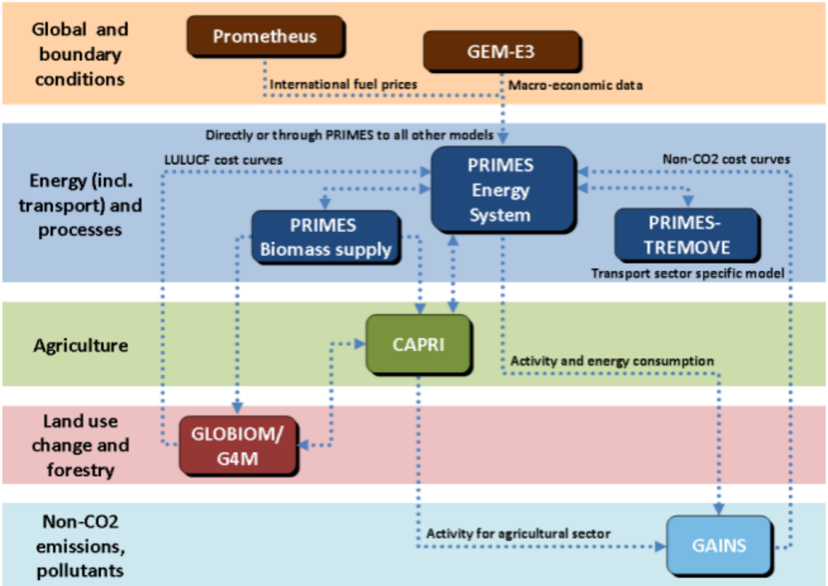


Figure 14 : EUCLIMIT modelling suite

Seen the repeated criticism on PRIMES on certain dimensions, the EC is eager for PRIMES to be improved, particularly in the context of its multi-year framework modelling contract: input data is being improved, key parameters are being discussed [15], the impact of various support schemes are being tested in the model, as well as a specific module on the electricity market, and there is also an improved gas module and a better representation of industry. Energy efficiency and RES have also been improved.

Altogether, PRIMES will still be part of the modelling landscape for the years to come and the EU energy community must continuing asking for more information and transparency. The EC seems to encourage the PRIMES modelling team to increase its transparency, but the process of recent modelling exercises, like the new Reference scenario scheduled to come out early next year, still does not include external experts apart from Member States who are asked to scrutinize results for their national data, although data transparency has increased.

4.4.2 POTEnCIA: a new model at the JRC

The Commission is also aware of the constraints of using only an external-run model for the core of its scenario development. It is developing an alternative in the form of the development of Potencia, a model similar to PRIMES. Scheduled to have modules delivered in 2012, it is suffering delays but slowly coming to a usable state.

POTEnCIA is meant to address EU specific energy scenarios and the corresponding policy impact assessment better than POLES which is more focused on the global energy market. It is advertised to become a “pan-EU energy market model, designed to specifically address not only supply-side-based policies but also decentralized energy-efficient technology adoption and decentralized renewable energy sources. Technology dynamics, and technology substitution are treated with high detail. One of the key features is the vintage formulation not only in the supply side, but also in the demand side.

[15] Particularly its Energy Efficiency dimension which the EC has commissioned Fraunhofer to research.

It is geared to support overall EU energy/climate scenarios, complementary to the JRC-EU-TIMES model that performs more detailed techno-economic analyses. Innovative approaches are being followed to better address demand issues of crucial interest, i.e. asymmetric price response as well improving the modelling of energy trade collaborations."[16]

The model would have the potential to become the cornerstone of policy analysis for the Energy and Climate scenarios. The owner of the model will be the JRC, but it also aims at being distributed to Member States and stakeholders to discuss scenarios, policy implementation plans, etc. in a transparent way. **It is key to continue emphasizing to the EC/JRC how important it is that they give wider access to this model to external stakeholders**: the downsides are few if the process is well managed and the risks of misuse are limited (as a good example, the Times-Markal model has great credibility although it is used by a very large amount of institutions who each try to derive their own messages). This could also help identify parts of the model which can be further improved, potentially with the help of external parties.

4.4.3 METIS: model development for better energy market modelling

In parallel, another tender[17] was issued by the Commission and assigned end of 2014 to ARTELYS (http://www.artelys.com/en/home), a French company developing optimization software. This is a modelling effort of the EU energy system customized to the EU Commission needs.

Here are some of its key characteristics:

- It simulates the main aspects of the EU energy system with data covering the 28 MS + candidates and analyze the effects of policies and trends on regional, national and EU level by running scenarios for different time horizons.
- It covers electricity, gas and heat sectors (in supply, transmission, distribution and final demand, as well as all associated markets) with a special focus on infrastructures. Most importantly, specific attention will be given to the rapid uptake and the mass integration of renewables.
- Typical questions it analyze are the following: Generation adequacy analysis based on certain new investments (evaluation of LOLE); effects of gas system constraints on Security of Supply of gas and electricity; interests for new storage / interconnections / demand response capacities; synergies between electricity, gas and heating networks; impact of RES on distribution networks; etc.
- METIS takes major infrastructure deployments for granted (driven from PRIMES or ENTSO-E/G), and can optimize capacity for project dimensioning (e.g. optimal dimensioning of a given interconnection, assuming other infrastructures being fixed).

This project is ambitious in terms of scope and depth and will likely be a significant contributions to some key energy policies of the EU commission in the future. It is not aimed to replace PRIMES or POTEnCIA but to complement them.

Importantly, the approach from the Commission in the case of this development is very different from previous ones as the model will be installed on the computers of various Commission officials who will be trained to use it. In its "standard use" decision makers will be able to change some parameters,

[16] https://setis.ec.europa.eu/system/files/Modelling_conference_2013_2_Low_carbon_economy.pdf

[17] http://ec.europa.eu/dgs/energy/tenders/doc/2014/2014s_152_272370_specifications.pdf

create and simulate alternative scenarios, and analyze results through detailed interfaces. Experts would additionally be able to modify the model, adding new asset models to the library, etc.

Also the models will be owned by the EC[18] , which means they could decide to make it open source, and let other research institutions leverage these modelling assets or even develop new modules for the Commission.

[18] The European Commission will own the source code, excluding the optimization engine and its modelling interface