



EUCALC

Explore sustainable European futures

Concluding workshop for Call for Evidence

D8.8

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Short Description

This deliverable describes the concluding workshop for the EUCalc Call for Evidence. To contextualise it, the report describes the feedback inclusion process, the Call for Evidence, the workshop event, the feedback received and to what degree it has been incorporated in EUCalc.

Quality check

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Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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1 Executive Summary

This deliverable describes the concluding workshop for the EUCalc Call for Evidence. To contextualise it, the report also describes the feedback inclusion process, the scientific/pre-Call for Evidence, the public Call for Evidence, the workshop event, the feedback received and to what degree it has been incorporated in EUCalc.

The Call for Evidence - an online consultation process - provided an opportunity to gather feedback on all the project aspects, from model development assumptions to web-tool features and was an important part of the co-design process for the EUCalc model. This Call for Evidence was opened first to an invited group of scientists and later to all stakeholders, providing them with access to, at the time, the most recent versions of the modules composing the EUCalc model, alongside its documentation. This enabled the stakeholders to test the model and challenge its underlying assumptions and functionalities.

To conclude the Call for Evidence, a workshop was held in Windsor on November 13-14 2019. It enabled to refine the feedback on dimensions which require face-to-face interactions. Furthermore, it enabled to deepen the feedback on several levers. The workshop was executed as part of the 2050 Calculator international conference organised by BEIS¹. The workshop enabled to gather feedback from users and developers of 2050 calculators from around the world.

Based on the Call for Evidence and the concluding workshop, on an iterative and ongoing basis, the consortium assessed the most important improvements to be made in the model.

The long list of feedbacks gathered by the consortium is available in the appendix of this document (in more than 60 pages of feedback). These feedbacks have all been addressed by the EUCalc team. These feedbacks enabled to improve the user experience of the Transition Pathway Explorer and to improve the model quality, along its three KPIs on quality monitoring. An 8 pages summary of the feedbacks is summarized in the table 1 here below to facilitate the reading of this report.

Table 1 - Call for evidence summary

The Transition Pathways Explorer	<ul style="list-style-type: none"> - The tool is easy to use and self-explanatory. The current drawbacks are that: <ul style="list-style-type: none"> ○ there is a lot of information and choices to play with right from the beginning, ○ it is not easy to access the underlying assumptions, ○ notion of carbon budget is less easy to understand at first and lack a hover text. There is a confusion with the notion of cumulative emissions. ○ some would prefer as objective the time to net zero, ○ the graph headers could be better contextualized (what they mean, which levers impact them...), ○ the predefined pathways are useful, but the pathway descriptions are not ergonomically positioned calculations are slow.
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¹ Department for Business, Energy and Industrial Strategy of the UK Government

	<ul style="list-style-type: none"> - The choice of levers is considered relatively relevant, because it provides support to a wide scope of analysis scope: <ul style="list-style-type: none"> o there are comments about covering the financial sector and the waste sectors. - The predefined pathways are appreciated with some improvement suggestions: <ul style="list-style-type: none"> o their descriptions are still not up to standard o several requests for more features to compare scenarios. - The lever descriptions and ambition levels are not aligned in terms of depth and specificities. - Request for more information on national specific. - The member state information is appreciated. There is a request for more comparison functionalities. - The graphs are clear overall with some improvement suggestions: <ul style="list-style-type: none"> o the tool currently lacks a Sankey diagram, o in the interaction with graphs, the pop-ups would gain by having less information (only the underlying line, maybe also the total, but not all categories), o the GHG section lacks a graph per gas type, o some abbreviations which are not explained. o many figures in the graphs should be rounded o y-axis units not always appropriate (units and scale). o several requests to have Y-axis always starting at zero, o levers are only visible from 2020 onwards, it would be useful to see the historic, o some confusions between the lever positions as 1234 and as ABCD, and o when clicking on the graphs (outputs and one pagers on the levers), we should be able to access more information on the sources and assumptions. - The warnings are appreciated. - The budget could be provided for each country, not only for EU. - The costs should provide information on the investment required: <ul style="list-style-type: none"> o there are requests to provide cost features of economic models (carbon price, taxes, GDP impacts). This is currently not in line with the model logic. - The modelling dynamics are not clearly understandable when playing with the tool. - The calculator could be used professionally for : <ul style="list-style-type: none"> o understanding the relative contribution of sectors in a common target, o assisting member states in defining their ambition targets, carbon budgets and strategies, and
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	<ul style="list-style-type: none"> ○ better informing policy people, students, businesses and investors.
Lifestyles	<ul style="list-style-type: none"> - Travel: <ul style="list-style-type: none"> ○ the ambition has been increased following several requests, ○ the aviation sector is missing in this section, ○ several lever descriptions require further cleaning, ○ it is confusing to have “freight modal share” classified under technology and “passenger modal share” classified under behaviour, and ○ occupancy levels are not well accepted by stakeholders. - Consumption: <ul style="list-style-type: none"> ○ internet activities (e.g. videos) are missing in behaviours, ○ emissions generated outside Europe are missing, ○ there are requests to change the ambition levels for “paper and packaging”, “product substitution rate”, and “waste”, and ○ a better sensitivity on the product lifetime would be useful. - Homes: <ul style="list-style-type: none"> ○ the appliances terminology is confusing, ○ there are requests to change the ambition levels 2-4 for “Living space per person”, “% cooled space”, with level 4 for “appliance owned”, and ○ the term “computer” should be specified. - Diets: <ul style="list-style-type: none"> ○ emissions generated outside Europe are missing, and ○ stakeholders are not convinced with the assumptions on “meat consumption”.
Buildings	<ul style="list-style-type: none"> - Requests regarding clarifications of terminology: <ul style="list-style-type: none"> ○ there appears to be a confusion between the terms “Buildings envelope” and “insulation”, ○ the district heating description is confusing, ○ the notions of “heating and cooling” and use by the model would gain further clarifications, ○ the terminology “shallow” needs to be changed, Terminology needs to be more familiar to ordinary people. Also, “plus energy” needs to be defined. ○ the notion of “appliance efficiency” leads to interpretation confusions, and ○ district heating share is difficult to relate to tangible technologies and actions. - Feedbacks on the model logics and underlying assumptions: <ul style="list-style-type: none"> ○ the assumption that buildings in timber are more sustainable is questioned, and

	<ul style="list-style-type: none"> ○ the material switch lever does not directly impact the envelope performance. This is questioned. - Requests for more graphs: <ul style="list-style-type: none"> ○ in building types, a graph with the energy demand per floor area per building type could also be interesting and useful. - Feedback for higher granularity in the interface: <ul style="list-style-type: none"> ○ The lever “technologies and fuel shares”, on Level 4; especially regarding biomass use.
Transport	<ul style="list-style-type: none"> - Positive feedbacks about the quality of the documentation and lever coverage. - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ the documentation currently uses tons in cases where metric ton or tonne would be more appropriate, ○ lever descriptions still show some inconsistencies, also abbreviation which are not explained, and ○ freight should show a KPI on tCO₂/t.km. - Feedback relative to expectations of economic features (such as governance, taxes or policies) not in line with the model logic, suggesting the expectations have not been clearly set out. - Suggestions to have more coverage of aviation and marine. - Request for higher granularity in the interface: <ul style="list-style-type: none"> ○ on splitting the passenger and freight efficiency per technology, ○ on splitting the biofuel from the e-fuels and hydrogen levers, and ○ on the freight vehicle utilisations. - Feedback on the underlying assumptions and logic: <ul style="list-style-type: none"> ○ the implications of car ownership or hiring are not clear, ○ the rationale of the model stock logic is not clear to the user, ○ the biomass lever is considered overambitious, ○ there is some feedback to change the ambition 3 to 2 and add a new, more ambitious level 3, ○ there is a request to increase the ambition levels 1 & 2 of passenger technology, ○ there are some requests to better link the freight activity to the manufacturing activity. Others appreciate the current independence of the freight activity lever, ○ the implications and origins of e-fuels are unclear, ○ e-fuels are mentioned, but linked alternatives (ammonia, ethanol, methanol) are not well covered for transport,

	<ul style="list-style-type: none"> ○ the model lacks a lever on stranded assets, where vehicle lifetime is shortened to fasten the transition, and ○ the material switch lever does not directly impact the vehicles performance. This is questioned.
Manufacturing	<ul style="list-style-type: none"> - Positive feedbacks about the quality of the documentation and lever coverage: <ul style="list-style-type: none"> ○ the implications of the material switch level remain unclear (less manufacturing emissions, less emissions over the lifecycle, impact on the other sectors), and ○ some feedbacks on the underlying assumptions and logic. - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ there is a suggestion to replace the lever "technology efficiency" by "deployment of innovative technologies", ○ using ambition levels to increase imports is considered misleading, and ○ some technologies lack clarifications (e.g. HIsarna). - Feedbacks on the underlying assumptions and logic: <ul style="list-style-type: none"> ○ the endogenous specification of the cement, lime and aluminium demand is questioned (due to the high variability generated by the demand sectors), ○ the historical production between 1990 and 2000 is missing, ○ the carbon capture then usage is not clear for fuels logic, ○ the material switch ambition levels 3 & 4 are too ambitious. The substitution of concrete by timber in buildings is particularly questioned, ○ the energy efficiency level 4 is too ambitious, ○ the fuel switch level 4 is too ambitious, ○ the carbon capture and usage are too ambitious, ○ the modelling of geopolymers with 0 emissions is questioned, and ○ the energy sector should not be the main driver behind the demand for aluminium. - Requests for further graphs: <ul style="list-style-type: none"> ○ adding a graph on process emissions.
Minerals	<ul style="list-style-type: none"> - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ oil and gas are not "minerals", the alternative "minerals and fossil fuels" is recommended. - The "phosphate" and "potash" demand peaks in 2002 should be reviewed.
Land use and Agriculture	<ul style="list-style-type: none"> - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ the levers are considered too technical for lay users, ○ use of abbreviations (LSU),

	<ul style="list-style-type: none"> ○ scope of several energy carriers (e.g. biogasoline), ○ a definition of “freed-up lands” should be added in the “land management “ lever one-pager, and ○ “pulses” should be changed to “pulse (leguminous crops)”. - Requests for more relevant granularity in the interface: <ul style="list-style-type: none"> ○ the comment is general, ○ suggestion to expand the “other land area” category, and ○ the diet is expressed in kcals and could also be expressed in weight. - Feedback on the underlying assumptions and logic: <ul style="list-style-type: none"> ○ demand sectors (transport, buildings, energy) can model very large switches to biomass, furthermore, they do not have a cap on the biomass demand, ○ the cascading use of biomass is not clear and should be illustrated. Underlying assumptions are challenged, ○ the underlying logic for land allocation is not always clearly understood, ○ the use of other sources is suggested for biofuel ambition levels, ○ the use of lever on carbon sequestration intensity by forests is proposed, ○ assumptions on biofuels and the timber use in buildings are challenged as over optimistic, ○ the diet lever misses the insects and lab meat, and ○ the implications of the levers “smart crop/livestock production” and “alternative protein sources” are not clear.
Power / Balancing / CCUS	<ul style="list-style-type: none"> - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ how is carbon capture performed, and does it involve DACS, and ○ “nuclear fuel” should be replaced by “nuclear energy”. - Requests for higher granularity in the interface: <ul style="list-style-type: none"> ○ segmenting the levers hydropower, geothermal and tidal, and ○ coal should be segmented from lignite. - Feedbacks on the underlying assumptions and logic: <ul style="list-style-type: none"> ○ suggestion to use additional sources in literature, ○ the gap in carbon capture rates between industry and power is challenged, ○ the carbon capture applied to coal follows a non-credible curve, ○ the use of fossil thermal plants as a “buffer” is not clearly understood by the audience, ○ the model logic for e-fuels is not clear, ○ the interactions between e-fuels and refineries are missing,

	<ul style="list-style-type: none"> ○ refineries are currently not assessed with enough details. Furthermore, there is no lever enabling them to use low carbon feedstocks (e.g. biomass or old plastics), ○ the grid congestion is currently not modelled, ○ flexibility and DSM are not modelled, ○ there is no possible comparison between different technologies (e.g. batteries vs power-to-gas vs DSM), ○ the model lacks the possibility to phase-out nuclear in all countries, ○ the model lacks the possibility to simulate a 100% RES pathway, ○ challenges the ambition of the fuel switches to biofuels and e-fuels are over optimistic, and ○ challenges currently minor role of pumped storage.
Water	<ul style="list-style-type: none"> - Having information on the sea water level would be interesting. - Request for a lever on "water reuse". - Several comments on bugs already corrected in the meantime.
Climate	<ul style="list-style-type: none"> - Requests for terminology clarifications: <ul style="list-style-type: none"> ○ consider replacing "global mean temperature" by "global mean temperature anomaly". - Feedbacks on the underlying assumptions and logic: <ul style="list-style-type: none"> ○ the fact the EU emissions are decorrelated from Climate is challenged, and ○ the fact the EU trade balance currently has no impact on rest of the world emissions. - For the emissions until 2100, it would be relevant to provide different scenarios for the rest of the world.
Health	<ul style="list-style-type: none"> - Feedbacks on the choice of KPIs. - Recommendation for DALYs instead of "air pollution related morbidity".

2 Call for evidence

2.1 Objective

The key objective of the Call for Evidence was to engage with interested members of the public (both sectoral experts and non-experts) to test the user interface of the EUCalc model – the Transition Pathways Explorer² – as well as to ensure the robustness of the analysis, assumptions and data used before it is released for wider application. More specifically, the Call for Evidence aimed to:

² The web interface to the model.

- Gather insights about the user experience and the friendliness of the Transition Pathways Explorer (TPE). For example, verifying that we provided appropriate information to our audience, the right functionalities and information on complexity of the model.
- Gather sectoral feedback based on predefined lever selections and preliminary quantitative results of the EUCalc model. For example, are the assumptions in each sector acceptable? Are the ambition levels³ adequately reflecting the discussion space amongst stakeholders? Is the granularity of the analysis sufficient to ensure credibility? Can the model provide an answer to key questions regarding the trade-offs and implications of the low carbon transition?
- In addition, identify new use cases of the EUCalc model which were not identified previously.

The Call for Evidence process ensured the inclusion of data sources from multiple sectors and improvement of data quality by validation and verification. Ultimately, this enhances public acceptability and engagement resulting to collaboration around evidence-based policy making.

The Call for Evidence ran between September 18 to 30 (first round) and November 5 to 26 2019 (second round). It was preceded by an invitation-only scientific Call for Evidence which was implemented from April to June 2019.

2.2 Target groups and audience

The Call for Evidence was open to all stakeholders. This took into consideration any interested party, including individuals and organizations, either from Civil Society (Non-governmental organisation, platform or network, Trade unions, Professional associations, Advocacy groups, Media, etc.), Research and Academia (Science institutions, Universities and schools, etc.), Public sector (European Commission, European Parliament, National, regional or local authority), Private sector (Corporations and businesses, Consulting companies, etc.) and International Organizations (IFIs, International bodies, etc.).

Invitation to participate in the Call for Evidence was published on the EUCalc website and social media, as well as disseminated via email to participants of sectoral expert workshops⁴ and to other stakeholders mapped throughout the project⁵. A total of 29 online feedback forms were received, as detailed in the appendix.

Based on the contributions submitted during the public Call for Evidence, the demographics of the feedback received are illustrated below in figures 1, 2 and 3. (See appendix 5.2.1 for list of participants).

³ The degree of climate mitigation effort.

⁴ 10 expert consultation workshops were organized between June 2017 and April 2019, each engaging between 10 and 20 experts (total number of 171). Through this process, the experts were asked to assess and communicate on a number of issues relevant to the design of sectors/modules included in the EUCalc.

⁵ For more information on Stakeholder mapping see Deliverable 9.2

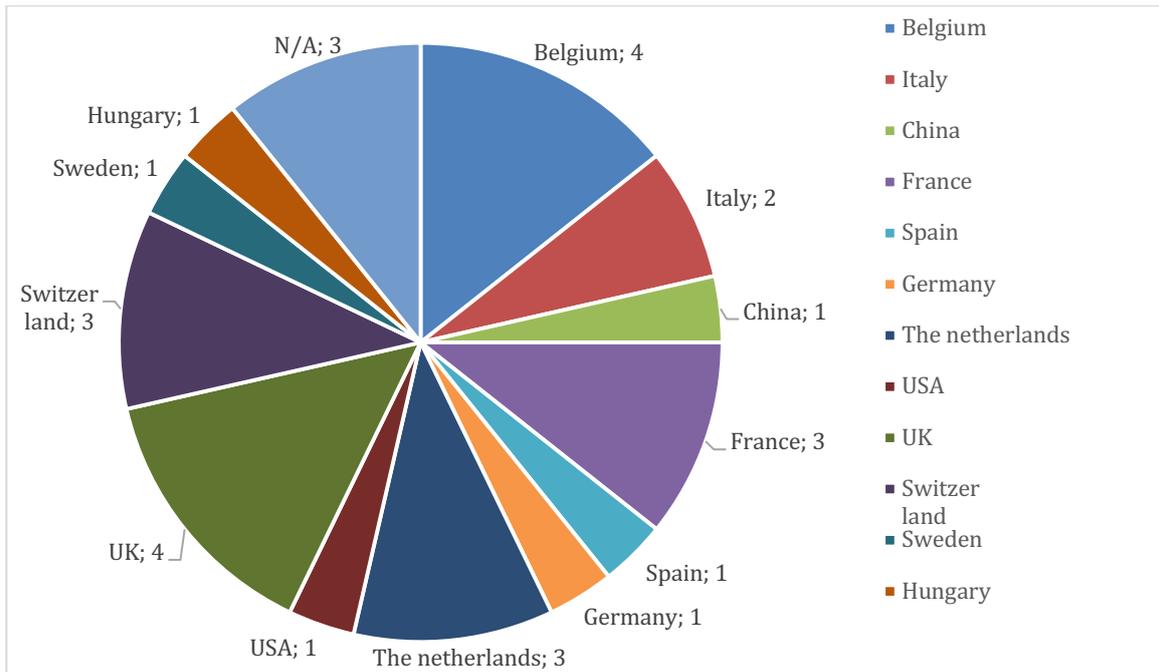
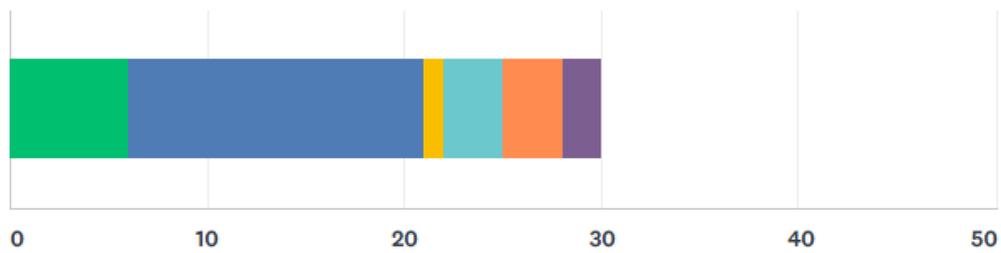


Figure 1. Country of residence or operation (25 answers out of the 29 participants)



- Civil Society (Non-governmental organisation, platform or network, Trade unions, PI)
- Research and Academia (Science institutions, Universities and schools, etc.)
- Public Institution (European Commission, European Parliament, National, regional o)
- Private Enterprise (Corporations and businesses, Consulting companies, etc.)
- International Organizations (IFIs, International bodies, etc.)
- Other (please specify)

Figure 2. Type of organization of respondents (27 answers out of the 29 participants)

Gender

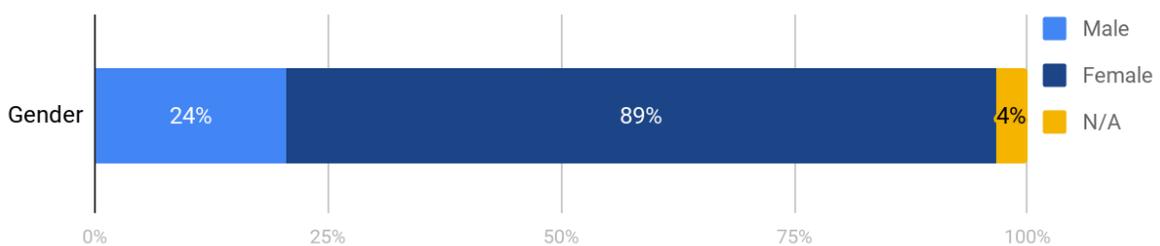


Figure 3. Gender of respondents (n=29)

2.3 Process

The Call for Evidence ran between September 18 to 30 (first round) and November 5 to 26 2019 (second round).

All stakeholders were provided with a draft model together with its documentation. More specifically, a specific [page](#) was performed for the Call for Evidence. This page provided access to:

- All the project report [deliverables](#);
- The [Transition Pathways Explorer](#);
- The model [documentation](#) of each sector;
- An online [feedback form](#);
- The source code of the EUCalc model (GitHub and [instructions](#)).

This enabled the stakeholders to test the model and challenge the underlying assumptions and functionalities.

The appendix 5.2.2 includes all the comments, together with how the consortium reacts to the feedback and incorporates them.

3 Concluding workshop

3.1 Objective

The external concluding workshop was performed in Windsor on 13-14th November 2019.

Through this concluding workshop, we looked for more specific feedback that could not be obtained through the online questionnaire. In addition, we wanted to deepen the insights and the feedback on specific levers.

To ensure synergies, the workshop was combined with a 2050 Calculators international event organised by the UK Department for Business, Energy and Industrial Strategy (BEIS). This also provided access to a community developing new or improving existing calculators in more than 20 countries worldwide.

3.2 Target groups and audience

The stakeholders were invited to the Call for Evidence in conjunction with BEIS, leading to the workshop being part of the 2050 calculator conference.

More than 60 international delegates - policy makers, modellers, academics, civil society etc. working on national 2050 calculators were present at the event, the list is detailed in appendix 5.3.1. The audience demographics was as follows (figures 4, 5 and 6):

Origin of respondents

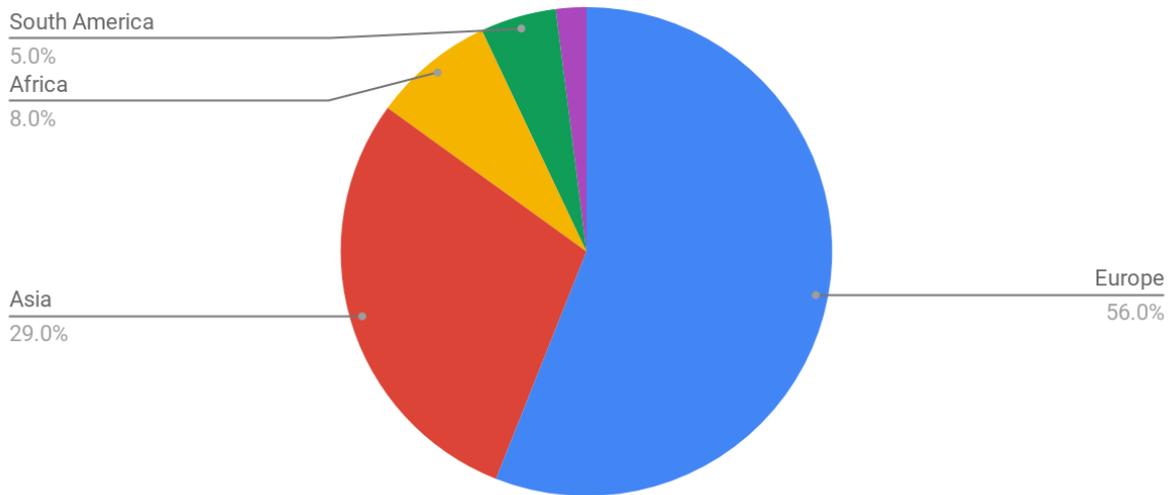


Figure 4. Country of residence or operation

Organisation type

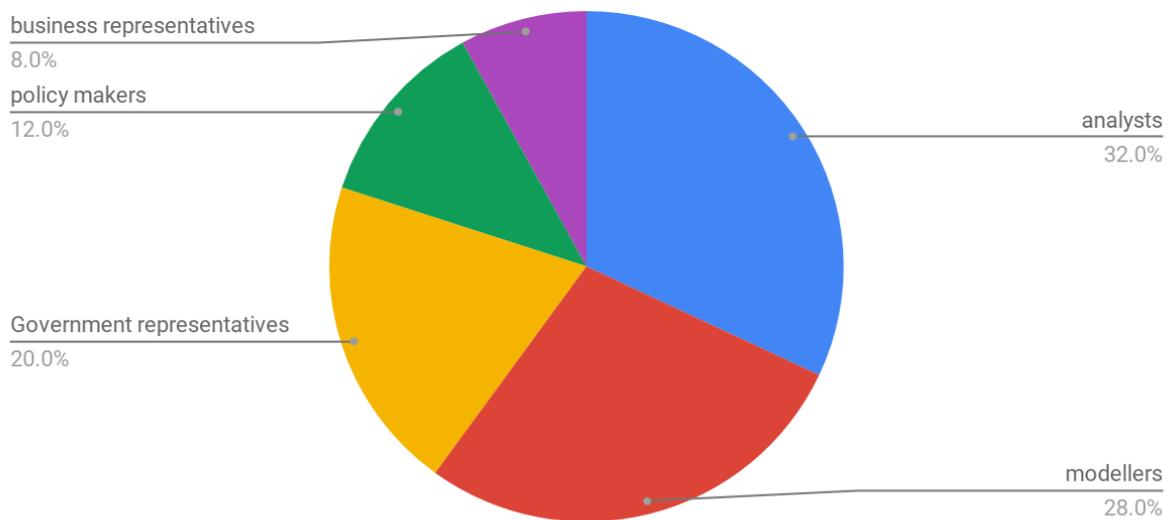


Figure 5. Type of organization of respondents

Gender

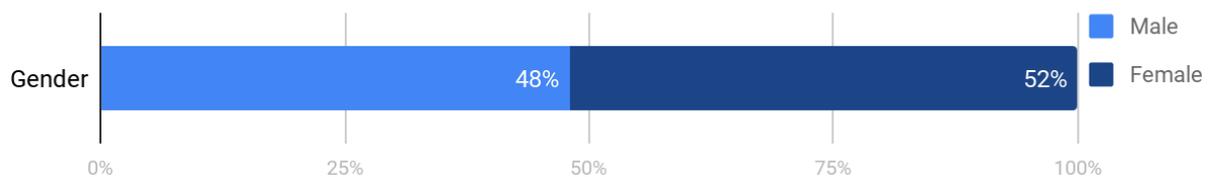


Figure 6. Gender of respondents

3.3 Process

The workshop was structured in three parts. We briefly explain here below, for each part, both their content and objective:

- Plenary Talks:
 - Content: A presentation was given introducing the EUCalc, followed by a live demonstration, the explanation of key choices and a Q&A session.
 - Objective: To ensure all the audience had the required awareness level prior providing feedback

- Group Discussions:
 - Content: Moderated group discussions were held, segmenting the audience in 10 tables, each assessing in detail the interface of the TPE, its usability and the general perceived advantages and disadvantages of the tool. In addition, each table reviewed the ambition level descriptions of two sectors, as described in table 2 and 3.
 - Objective: To maximize the feedback by making the 10 subgroups work in parallel on different topics.

- Workshop Summary:
 - Content: A summary of the feedback from the discussion session was provided to the audience.
 - Objective: To share the feedbacks amongst the different groups and provide opportunities to make feedback links between sectors.

In addition, the audience was asked to set priorities in terms of new features addition, as described in table 4. The objective of this question was to get an external feedback on the model development roadmap.

Table 2 - Thematic and sectoral segmentation of discussion tables in the final workshop

Table	Themes and sectors covered
1	Key Behaviours- Travel Tech. & Fuels- Transport
2	Tech. & Fuels- Transport Key Behaviours- Home
3	Res. & Land Use- Water & Biodiversity Res. & Land use- Food & Land
4	Key Behaviours- Consumption Res. & Land Use- Water & Biodiversity
5	Res. & Land use- Food & Land Key Behaviours- Diet
6	Tech. & Fuels- Buildings Tech. & Fuels- Manufacturing
7	Key Behaviours- Home Tech. & Fuels- Buildings
8	Tech. & Fuels- Power Key Behaviours- Travel
9	Tech. & Fuels- Manufacturing Tech. & Fuels- Power
10	Key Behaviours- Diet Key Behaviours- Consumption

During the group discussions, the moderators from the EUCalc team around each table asked the following questions, as described in tables 3 and 4.

Table 3 - Questions during the sessions moderated per table

Questions	Choices
Open questions	<ol style="list-style-type: none"> 1. Does the EUCalc model provide features/capabilities that you would expect or need for your policy and decision making? Are there any features or capabilities missing to answer your needs? 2. Do you find the relevant trade-offs represented to enhance policy making? 3. How could the user interface to the model be changed to be as clear, simple and user-friendly as possible, both with respect to content as well as to its presentation? 4. How could the cost analysis be most helpful to you? What limits/advantages do you see in this cost approach? When was the last time a cost assessment was the determinant for your decision? 5. Are the novel features of the EU Calculator model(s) of potential interest to your own model development? 6. If so, what are the features that you would particularly like to adopt? 7. What would you need to be able to adopt them in your modelling approach?
Questions on levers ⁶ choices, descriptions and ambition levels	<ol style="list-style-type: none"> 1. Do the basic assumptions and levels of ambitions across the levers and model seem relevant? 2. Do the levels reflect the right range of ambition and the relevant transformational nature of the transition? (also considering we are limiting the TLR levels of technologies included in the tool)? 3. Do you see the opportunity to couple other models to the EUCalc, e.g. impacts of models of yield loss/forestry die-back/extreme temperature/shutting down power plants?

Table 4 - Preferences regarding the addition of new features

Questions	Choices
Importance of the following levers	Air Quality, Water, Biodiversity, Jobs
Importance of the following types of 'security'	Environmental Security, Food Security, Energy Security, Human Development Security

The details of this feedback are available here in appendix 5.3. These workshop feedbacks have all been consolidated and merged with the Call for Evidence feedback in section 5.2.2.

⁶ Sliders which move from a minimal abatement position (level 1) to an extremely ambitious position (level 4).

4 Inclusion of the Call for Evidence feedback

4.1 Feedback received and inclusion by the EUCalc team

The Call for Evidence feedback document (provided in appendix 5.2) structured the feedbacks along the following two columns:

Call for Evidence Comments	Inclusion by EUCalc team
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The right column of each table specifies for each feedback if the comment has/is/will be addressed and provides short explanation if needed. As mentioned above, the Call for Evidence feedback encompasses the feedback from the Windsor concluding workshop. To review the raw Windsor feedback, please refer to the appendix 5.3 of this document.

4.2 Conclusion

The call for evidence had a major impact on improving the EUCalc. On the Transition Pathway Explorer interface, several layout changes have been incorporated. The notion of carbon budget is now better explained, the lever descriptions are easier to read and the warnings in each scenario appear in a more visible manner.

On the model, the feedback inclusion enabled the following key improvements:

- the lever ambitions here been refined in several cases,
- the model rationale has been challenged in several sectors,
- the KPIs improved along the three quality assurance dashboards mentioned in section 5.1 especially regarding scenario calibration, and
- a list of future improvements has been performed.

5 Appendix

5.1 Feedback inclusion process

5.1.1 Ongoing improvement and prioritisation

The consortium members have continued to meet on a weekly basis for several years to assess and address key project issues, deliberate on the way forward and the next steps on the EUCalc model improvement and harmonisation.

The model improvement and management has been split into two separate but interdependent groups. These are the KNIME⁷ programming and modelling content groups. In each of these groups, short term tasks, those needed to implement these tasks and clear deliverables are specified. Minutes of these weekly meetings are recorded and circulated to all project partners.

5.1.2 Quality assurance

Prior to launching the Call for Evidence, we ensured several quality thresholds had been reached.

5.1.2.1 Documentation quality assurance

Regarding the deliverables and sectoral documentation for the Call for Evidence, internal peer reviewing had been performed. The Call for Evidence could therefore rely on model descriptions across all sectors.

5.1.2.2 Model quality assurance

Three dashboards have been used to monitor the model quality.

Table 5 - Model quality assurance dashboards

Interface matching	<p>Through this quality assurance check, we ensured each module output was understood as an input by another module.</p> <p>This is the first level of quality assurance and a good tool to ensure ongoing modifications performed by each module were taken into account in the other modules.</p>
Calibration process	<p>In this quality assurance check, we ensured the model generates, on historical years, values close to the official ones on emissions, energy and resource use.</p> <p>This is the second level of quality assurance and enables to ensure model inputs are interpreted correctly, enabling model outputs to be in line with official figures. This quality assurance tool was instrumenting in removing model bugs and remains a key source to identify future model improvements.</p>

⁷ An open source visual programming tool. It views the model as a calculation flow.

Scenario match making process	<p>In this quality assurance check, we ensured the EUCalc can generate scenarios in line with the literature, encompassing some of the scenarios of the EU Commission.</p> <p>This is the third level of quality assurance and enabled to ensure most key dynamics assessed in the other publications and models are assessed in EUCalc. This quality assurance tool enabled to benchmark the relative importance and impact of the key low carbon solutions.</p>
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These three dashboards (table 5) generated intensive feedback and guided the iterative improvements applied to the model during the last year and a half. As mentioned above, the key results from the feedback inclusion (both call for evidence and workshop) is the improvement of these three quality assurance dashboards; especially the scenario matching.

5.1.2.3 Ongoing inclusion of new data

One of the quality assurance strengths of EUCalc is the versatility of the tool on incorporating new data. We have implemented an automated process extracting data from Eurostat through the IDEES database. Automated data extraction has been performed on energy and emissions up to the year 2015. When this data will be updated in IDEES in the coming years, the model will automatically extract the new data. Furthermore, the last year of data extraction can easily be modified.

5.2 Call for Evidence feedback

This section details the Call for Evidence feedback. The Workshop feedback is provided in the next section 5.3.

5.2.1 Call for Evidence audience

Table 6 - Call for evidence audience

Hervé Jeanmart of UCLouvain	Jean-Baptiste Decoppet of EPFL
Antonio Argenziano of Gioventù Federalista Europea (GFE)	Pierre Maudoux of FAO
Giuseppe Forino of UAE	Lisa Höglind of Swedish University of Agricultural Science (SLU)
Yuanzhi Ni of Shanghai Academy of Environmental Science	Charles Ayoubi of EPFL
Tiffany Vass of IEA	Aurélien Alfaré of ACCTEES *
Jacques Charroy	Marc-Edouard Schultheiss of EPFL
Dries Acke of ECF	Vincent Renken of TU Delft BioTech Delft
Victoria Hoare of Imperial College London	Alan Lewis of Smart Freight Center *

María Guerrero Hidalgo of Cetaqua	Richard Templer of Imperial College London
Federal Energy Efficiency Center (BfEE) Federal Office for Economic Affairs and Export Control (BAFA) of the Federal Ministry for Economic Affairs and Energy (BMWi) *	Jörg Mühlenhoff of CAN Europe *
Kasper Ampe of TU Delft	Eric Sievers of ClonBio Group *
Steve Peterson of Thayer School of Engineering at Dartmouth	Jan Ole Kiso
Rupert J Myers of Imperial College London	Alexandre Strapasson of Imperial College London
Paisan Sukpanit of Imperial College London	Alba Soler Estrella of Concawe *

* Asterisked participants provided inputs on behalf of their organisations. Others participated in individual capacity not necessarily reflecting the opinions of their institutions. One participant did not agree to name disclosure.

5.2.2 Call for Evidence feedback per question

The following questions and replies are from the public call for evidence and the ones from the concluding workshop follow in section 5.3.

5.2.2.1 Transition Pathways Explorer

Q1. Overall, how would you describe the experience of testing the Transition Pathways Explorer? For instance, is the design (layout, structure etc.) clear and useful? Does it support the understanding of what is used as input to the model and the results it provides?

Easy to use

Call for Evidence comments

- *Already used a similar tool (Belgium Low Carbon 2050) but this one works really fine. Pretty intuitive and easy to use.*
- *Yes, it is. Quite intuitive and simple to read.*
- *Overall, this looks great! Visually appealing and well-laid out. The explanations are clear, and the detailed supporting documentation is very helpful.*
- *The overall layout and structure are clear. The pop-up description of each lever is helpful*
- *The use of the calculator is relatively intuitive. The information concerning the sector which we obtain when we click on a lever is sufficient for experts to understand the main modelling hypotheses. Nonetheless, you could maybe state them more clearly. Also, I do not know if it is possible, but I could not find a way to produce my own scenarios.*
- *The tool has a good interface, with an interactive approach and good visual structure. It is rather clear and useful with a broad diversity of measures and scenarios.*
- *The design and layout are clear, with only a few minutes needed to familiarise myself with the layout. The info bubble is extremely helpful, although understanding how the outputs work took slightly more time and maybe more info bubbles to describe some of what the different outputs constitute on the drop-down lists may have been helpful. Would have been good to be able to set my own levels instead of being restricted to the present list, although I understand that this is not possible at this time during the time lag between inputs and outputs.*
- *Yes, it is a friendly-user tool. It could be more useful if they user could play with the different assumptions / parameters*
- *Everything seems quite well explained and once you get the mechanism, quite easy to read.*
- *After some time of familiarization, the tool seems to be usable and intuitive. What initially makes it counterintuitive and complicated, is the huge amount of options and data. Contrary to this, the general application of the tool and its interface is rather self-explanatory and straightforward*

- *The total design is very clean - an improvement on the global calculator.*
- *I like the intro page idea. I think it can be improved by being more specific on the different environmental issues. E.g., rather than "high heat-related morbidity..." actually state the number of DALYs for the scenario. The layout of the explorer is visually appealing. The pop out boxes to understand the inputs into the model are informative. I'm unsure if the factors on the LHS panel comprehensively cover the model inputs. I like the idea of including a second country.*
- *Useful and educational*
- *The input data used as a starting point for the levers is transparent. Users can intuitively find their way through the menus. The pop-up windows explaining briefly the categories and the levels of ambition are very helpful. The explanation of the rationale behind the proposed pathway examples however seems to be a bit short.*
- *The layout and graphs/visuals are good, also work fast, although the explanations are more appropriate for a report than for instructions in a website. I would recommend making instructions and explanations of paths, etc more concise and clearer*
- *I like the usability and the one pagers.*
- *Overall, really nice layout that quickly provides users with a sense for what the tool does and how it works. Nice job, team!*

Not so easy to use

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Does not work on Safari. Had to use Chrome :-(Took more than 30 minutes to review the tool ;-)	YES
<ul style="list-style-type: none"> • The design could be clearer. I did not immediately understand the upper bar of each graph included several features to be clicked on. • Not so clear, first it's not clear that it is about CO2 emissions. second, one expects, when seeing the 'levers' shown the way they are, to be able to tweak them individually. finding out that's not the case takes a bit of time. a 'custom' setting would be useful to create an own scenario • As you know me, I believe the user should understand the 'game function' right from the beginning. I do not get this with the current look & feel. 	<p>NOT SURE what "upper bar of each graph" means</p> <p>NO ACTION NEEDED</p> <p>YES, reformulate GHG budget part of introduction or add additional text in introduction explaining what to achieve</p>
<ul style="list-style-type: none"> • There is a lot of information and choices in the interface. However, if I am looking for something specific, e.g. development of livestock units in Sweden under certain assumptions etc, I find the information that I want. It is not clear though what input and references are used. • It seems rather hard though to properly grasp the conditions of construction of the graphs in terms of assumptions and results obtained. • It took a while to get the hang of it, but eventually realised that it was dynamically responding to the option chosen. The graphs try to provide a good quality image, fall down a bit when there is a lot of detail to present. The coupling between the documentation and the TPE itself could be closer. • I do not understand the dots next to "Key behaviours" nor what the "key behaviours" calculate really. It is not clear to me what the purpose of the key behaviours are in the interface. Some have 1, some have B. What does it mean and/or represent? • it is difficult in some cases to know what is in the underlying model. • Providing a link to the main assumptions of the model could sometimes improve the 	<p>YES, either link documentation or provide short text below each graph</p> <p>YES, See above</p> <p>YES, directly link to the specific documents on the EUCalc website. Put a "back" button there linking back to the documentation page (http://www.european-calculator.eu/documentation/) with all the files.</p> <p>NO Cannot reproduce this issue</p> <p>NOT SURE Text below the graphs could solve that</p> <p>NOT SURE Text below the graphs could solve that</p>

<p>understanding of the results (ex.: The results for temperature could appear counter-intuitive for a non-expert).</p>	
<ul style="list-style-type: none"> • "Determine the European GHG budget" is clear and easily understood and well justified. The pathways could have their own step just as "Determine the European GHG budget" which would make it more intuitive in my opinion. As for inputs used, it is not clear. Observe that in "climate smart crops" and "climate smart livestock" the graph uses numeric, but the description uses letters. • it took me 5 minutes to get familiar with the features and what is possible to learn with the calculator. I do not really understand the green flag where we set the scenario (also I randomly clicked the flag, should be more obvious that it links to another page). The "European share of the resulting global budget" is not so clear. Same for the blue line under the green flag. By reading in detail we understand, but I'd expect to get it straight away. • The look & feel has much improved. I like the shaded area, which nicely divides the fixed past from the changeable future. I still have endless debates with Bernd on whether the overall target should be 'remaining carbon budget' or 'year of net zero'. I believe from a marketing/public recognition perspective the 'year net zero debate' is much more attractive and reflective of current public debate in our various countries. But I do understand Bernd's point from a scientific viewpoint. I believe he wanted to check whether the top right could have the 'EU net-zero: 20xx' info for each chosen pathway. 	<p>YES, One additional page for the introduction or other introductory measures. And YES, the ABCD / 1234 thing is a bug</p> <p>YES, Make the bar more prominent</p> <p>YES, Add a "EU net-zero: 20XX" on the top right</p>
<ul style="list-style-type: none"> • I feel the explanation of the output from the model could be clearer. It is not understandable what the different circles mean for each of the items on the left-hand menu after the calculations are displayed. • I think the tabs for water, transport etc could perhaps benefit from a very short header describing how the data you are looking at is affected by the changes you have made to a slider. 	<p>YES, one additional page for the introduction or other introductory measures.</p> <p>NO Is to be explored. In case of warnings, this is explicitly pointed at.</p>
<ul style="list-style-type: none"> • There should be a user manual for this tool. Either it does not exist, or I could not find it. I did not see that there was a possibility to Determine the European GHG budget. It should be written that first you have to choose this. Then it should be written that the green bar is the objective and the blue one the actual emissions depending on the pathway • It took me awhile to understand what I was looking at when I first entered the explorer. It may be helpful to have a short guidance document that explain how to use the explorer. • Instructions and explanations. Also, a clear and concise heading on the top of the webpage. Check https://ourworldindata.org/ for inspiration (in case you don't know it yet). • It would be better if there's more of a 'how to' and 'what to expect when using it' explanation, rather than diving into a how it works and all the technical background. 	<p>YES, Screencast and/or direct on-screen how-to will be implemented.</p> <p>YES, See above</p> <p>NO There is an introduction for this task.</p> <p>NO See above</p>

<ul style="list-style-type: none"> I believe it still comes across a bit grey... maybe colour code the different levers? Make level four red and level 3 brownish. 	NO This is on purpose
<ul style="list-style-type: none"> As said, calculations are too slow. I did not check that in depth yes, it is clear. Only calculating takes a lot of time. I hope you can make it shorter. And it would be nice if you could have a 'compare' option (two or three settings next to each other) 	<p>YES, we have implemented a smart and learning caching solution and we will fill it with pre-calculated results for thousands of scenarios.</p> <p>NO Compare option is out of scope. There are the browsers back and forth buttons to compare scenarios. Also, for different countries, the user can open a second browser window.</p>

Q2. Which features of the Transition Pathways Explorer do you find most/least relevant?

Q3. Are there any parts of the Transition Pathways Explorer that felt counterintuitive or unnecessarily complicated? What would you suggest improving to maximize its friendliness?

Levers and scope

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Levers have become more numerous and more relevant than in previous versions.	NO ACTION NEEDED
They (features) are all useful, I think the topic makes urgent to explore all the dimensions	NO ACTION NEEDED
The broad approach is very interesting: The possibilities to choose between different pathways and the direct visualization of the effect is very useful. In order to estimate the selected pathway scenario, the scales (four circles) are quite helpful.	NO ACTION NEEDED
All features seem very relevant and the key contribution of the tool is to have a broad set of angles and measures to cover a large scope of the impact of climate change on the society.	NO ACTION NEEDED
It is very complete information and data wise.	NO ACTION NEEDED
Jobs is a good addition, as are the biodiversity levers	NO ACTION NEEDED
Our interest is largely in a single sub-issue - freight transport's contribution to future climate impact and how to reduce it - so the key is to ensure that is correctly represented rather than digging into the full detail	NO ACTION NEEDED for details on the representation of freight in the EUCalc model please refer to the transport documentation .
The most relevant feature for us is that the refining sector seems to be modelled only for producing fossil fuels. We have conducted a study where we progressively replace oil by low carbon feedstocks (e-fuels, biomass) in the existing EU refining system, achieving significant GHG reductions, making use of the synergies with existing assets	NO ACTION NEEDED for details on the representation of freight in the EUCalc model please refer to the supply documentation .
It took me some time to find passenger transport behavioural levers since transport is separated between key behaviours and technology and fuel. Especially since freight modal share is classified under technology. It is also confusing that technical	YES, Regarding the confusion on where to find the documentation of the levers. We will now directly link the one-pager description of the lever directly to the respective documentation instead of pointing out to a general page with all the documents of the module.

information concerning those levers are given in the transport module document (WP2_Transport).	
Very much like that you have a diet section and I like the levers	NO ACTION NEEDED
Also, level of forestation is an interesting lever.	NO ACTION NEEDED
It's nice to explore some pre-specified pathways. In the final version, will it be possible to adjust the levers to create your own pathway? This would be a great feature to have. (Similar comments: It seems that we can't create our own pathway. Why? / Counter-intuitive: that levers can't be individually adjusted. that should be the case. the mouse-following. / I am unable to click on the level on each lever to make my own pathways. I am not sure if it is because it is not available yet. But I believe the users would intuitively want to create their own pathways by simply clicking on the levels they see appropriate.)	YES: Will be possible in the launch version (for integer ambition levels).

Predefined pathways

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Maybe (there are) too many pathways, or the titles are not self-explanatory enough. the explanation per subsection. Then you get an idea of what has to happen to reduce greenhouse gasses.	YES, there will be improvements on the titles and descriptions, but we will not reduce the number of pathways. The strength of the EUCalc model is exactly to show a large number of possible scenarios.
...Also, the "info" button explaining the different pre-specific pathway could be made to stand out more (example big button saying click hear to understand the pathways),	NO Other users do not have problems to spot the info button
I think there is still room for improvement. I wasn't satisfied with the descriptions of the pathways: The names of the pathways do not tell much about what these scenarios are all about. They should be less equivocal. Also, I've spotted many typos in the pathways descriptions, you should proofread it. In particular, the "Key behaviours" scenario is poorly defined and the definition refers to itself ("Key behaviours: This scenario portraits the maximum ambition level in the EU Calculator regarding Key behaviours" is a definition that left me more confused after reading it). In addition, this "Key behaviours" pathway gets referred to in several other descriptions, so it's paramount to clearly define it.	YES, there will be improvements on the titles and descriptions. Typos will be corrected.
A text summary of the different pathway scenarios compared to one another might help.	NO, only the scenario description will be improved in its current form, that is, a pop-up window listing all scenarios and respective definitions.
In pathway descriptions, please copy-edit the text. I've identified some typos:	YES, there will be improvements on the titles and descriptions. Typos will be corrected.
Levers do not work for me, only the example pathways can change the levers at the moment. For example, pathways, one could also have 'max demand' and 'max supply'. This answers the question quickly whether we can just change our behaviour and reach the target or just change fuels – probably no on	NO ACTION NEEDED. Firstly, levers are the most defining feature of the EUCalc, and we tried to make them as intuitive to use as possible. That said for some users this will remain challenging. Secondly, the comment is well taken but the possibility to choose for a predefined pathway contrasting what GHG savings

both.	we can do via behavioural change and fuels is already implemented. It seems that the comment is just pointing at a change in the names of the predefined pathways.
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Levels descriptions / specific vs vague, non-technical vs technical etc.

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Some of the level descriptors feel quite vague whilst others seem very specific. some leaps from 3 to 4 seem extreme, whilst the leaps from 1 through 3 seem more measured/smaller (maybe less ambitious)	Yes improvements on the description of levers and levels were considered.
Harmonise the level of details and complexity in the pop-up explanations coming after clicking on items. Some are straightforward, others are way too technical: the meaning of changing the level from 1 to 4 is lost to the user that must read the detailed pdf file.	
Behaviour (Transport) Description of 'Car own or hire' include something about heating and residential floor space. Are they belong to this sector?	
The description/levels for occupancy and car own or hire are very similar (concerning the behaviour in car sharing)	
Buildings (Technology and fuels) The description/levels for district heating share and 'technology and fuel share' are very similar and can be confusing	
Small description of countries specificities could be helpful (e.g. why such a large land use change for Bulgaria). I found no answer about this.	
I think the phrase 'boundary conditions' is too technical for the general public. So is discount factor. Check throughout and make the language non-technical.	
It is not mentioned how difficult it is to reach the higher values for the different levers. In some cases, it is rather "easy" in others, it will remain a dream.	
The detail around each of the sub-levers is fantastic. But it is not obvious that you'll get this detail if you click on a sub-lever. Can you put an info button somewhere on the screen, maybe next to each heading (for example, next to technology and fuels)	
Would be good to provide hover text for each high-level lever (e.g., transport, buildings, travel)	
For many sub-levers, the detailed descriptive text has a blank space where the user expects a graph. The user expects to see something in this white space. Can you easily remove the white space when it is not needed? Or maybe you can provide some simple	YES, this has been resolved.

graphic representation of the different ambition levels. For example, this should be possible for the occupancy lever.	
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EU and member state comparisons

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
The comparison between member states and EU level is very interesting. Would be great to have also the possibility to compare directly member states among each other.	NO Out of scope, can be done with two browser windows open
Perhaps an overlay for the comparisons would be good - for instance, seeing Italy versus Europe, with different lines to show how far Italy is from the rest of the European average.	YES, may be done for specific graph where EU and MS numbers are comparable (e.g., per capita numbers)
The "Europe" item that can be selected in order to choose other nations is not very intuitive. Some users may not realise that by clicking on "Europe" (or on the "+" sign), it is possible to run simulations per country level.	YES, will be tested with other users and potentially changed (e.g. to "+MS", add popup)
None of the graphs were visible in the World tab.	YES, no data yet, will change

Visualizations and graphs (time scales, granularity, clarity, readability, etc.)

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Graphs coupled with levers--this is really straightforward. I look forward to being able to create my own scenarios!	NO ACTION NEEDED
Most relevant feature - the clear and colourful interactive graphs. Least relevant - N/A	NO ACTION NEEDED
I think it could be better to include information pop ups (like there are next to the dropdown example pathways menu) to better communicate what the different levels mean, what the results mean.	YES, lever levels have popups, but group lever levels don't. See comment above. Explanation to results may go below graphs as text.
The horizontal list of clickable graphs could also use some reference text to understand what is meant, e.g. what is included/excluded.	NOT SURE: mouse over on menu items?
I liked the comparison between past trends and ambitious targets.	NO ACTION NEEDED
...if you go over the graph, all number pop up. I would let that pop up per line (not all lines). And the significant numbers are many (e.g. with transport). I would reduce. If you want, you have the Excel file.	YES, good suggestion, will be tested with more users
I like that each pathway is broken down in so many categories of emissions, along with scores and	NO ACTION NEEDED

captions when the user hovers on the scale. That was quite interesting to explore	
Being able to download the data (figure or raw data) is very useful.	NO ACTION NEEDED
The graph outputs are very visual and helpful, extremely relevant to understanding what they all mean. GHG emissions per country is helpful to isolate which countries are doing what but the graph is a bit messy so an option to have specific countries show up etc may be helpful	NO, this feature is there (click on key)
Emissions tab: In GHG emissions (Y axis of the main graph), in order to clarify that the emissions are per year rather than cumulative, I would recommend using MtCO ₂ eq y Moreover, it would be useful to have a graph per type of GHGs on this emissions tab.	YES, add "/year" to the vertical axis key NOT SURE
The value plotted within the diagrams are confusing in some cases. Maybe the axis prefixes can be used to shorten the number of digits (e.g. "4,4 T" instead "4392279177922").	YES, will be rounded
Unclear y-axis legend on the graphs in 'Technology and fuel share', 'Heating and cooling efficiency', 'appliances efficiency' Manufacturing (Carbon Capture to fuel) - Confusing graphs with different ambition levels (are they telling the same story?)	YES, carbon capture to fuel: (the lever settings were misleading between 0-1 but y-axis title in % → the change is under development)
Figures are too detailed: e.g. 372208.98 Values should be rounded.	YES, will be done
There are some parts where the code is not clear (Land use, costs, world, etc...). On the graph area, you should choose another name for the "total" line. It took me a moment to figure out exactly what it was. I would call it "Total net emissions" or something similar. It's important to use the term "net" so that the user understands that it amounts to emissions plus negative emissions.	YES, will be changed to "net total emissions"
if we take for example the agriculture tab: The Y-axis name doesn't make sense to the non-expert. I guess "LSU" refers to something like "Livestock units", but I'm not sure. Please spell it out. When you hover over the chart with your mouse, the tooltip should indicate the total for all categories. Also, in the tooltips, show the figures rounded and as millions (e.g. instead of "Lying hens: 7478723.26", show "Lying hens: 7.5M", it would be infinitely clearer. Also, animal units should always be integers. Finally, it is spelled "Laying hens", unless you're referring to mythomaniac fowl)	YES, will be spelled out and will be rounded Typo corrected: "Lying hens" -> "Laying hens",
Also, some graphs seem a bit surprising in their results (linear relationship in Climate).	NOT SURE what is meant
The online tool is well structured and very user-friendly, despite the high complexity of its content. A missing element is the direct comparability of different pathways. It would be nice to offer split screen that could show a default example pathway on the left and users' own detailed input on the right so that the most striking differences would be visualised.	NO Easy to do with two browser windows. No need to provide for this.
I would try to make it more "catchy" to interact with, with the buttons for download, etc. at hand (or eye).	NO, matter of taste

Just to note some graphs appear to be missing (ex. Chemicals material demand and energy, graphs for some of the industry levers)	YES, will change
Graphs. In the area graphs, the "total" shows up in the middle of the list. Would be better if it always appears at the top of the list, perhaps emboldened to distinguish from the other items? Also, suggest experimenting with use of pattern (e.g.,) for the total so as to distinguish from other uses.	YES, will be tested
Units for "flow-y" concepts seem inconsistent. For example, graph above shows greenhouse gas emissions as Mt. but the graph for energy & emissions from el. Generation shows MT CO2e/yr.	YES, y-axis keys will be harmonized
The numbers in the title bar seem out of place when shown on a 1920x1080 screen, but it makes much more sense when shown at the bottom of a resized window	No, this is a feature catering for different screen sizes, not a bug. Design will slightly change
In the above, the reference to 215 GT is not clear. Can you provide some hover text to explain?	YES, hover text will be considered
Should graphs in lever text be zero-based? (see space heating and cooling).	NO
General comment on graphs. It will be helpful to provide an info button on the graph page to provide directions for how to navigate the screen. You may want to use a  to indicate the drop-down rather than 	YES, will be considered
Water" tab. When you hover your mouse over the map, the tooltip should indicate what the WEI value is for the region selected, and what water exploitation category that relates to	NOT SURE Would it be possible in the TPE? We do send the information, so it is more about how to display it

Warnings

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
I like the '!' warning symbol by water and climate	NO ACTION NEEDED

GHG budget/emission targets/ challenge

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
The scale in the "headline" of the tool helps to rank the selected pathway and is rather good.	NO ACTION NEEDED
...and the line at the top comparing the emissions of the pathway to the target pathway should have been much larger and with labels (would be nice to also have it calculate the % above or below the target).	YES

<p>I don't know what the horizontal blue bar with "X Gt" represents. I should be able to click or hover over this and for it to provide a description.</p>	<p>NO ACTION NEEDED: It is clickable, mouse-over will be added</p>
<p>The sector specific emissions under the assumptions of GHG budget (is relevant feature).</p>	<p>NOT SURE what this means</p>
<p>Design-wise, I would move the GT graph to a more central position. I also first thought I would be able to click/change the different grey bullets.</p>	<p>NO, bullets will be clickable</p>
<p>The general public will want to simply play with the sliders and see what happens to emissions. Indicating what emissions targets are desirable would be good as I think that this is what they will want to understand.</p>	<p>NO ACTION NEEDED</p>
<p>Providing 'targets' for emissions would be really helpful. The nice part of the global calculator was the target temperature, which you cannot do here but emissions you can. In this respect there would immediately arise the question of how to get emissions to zero. I believe that greenhouse gas removal methods will very soon become a ground for active debate in Europe so it would be great to open that up through the calculator.</p>	<p>The target temperature (set by the user in the introduction to the tool) will be reached with 50% chance if the respective global GHG budget is not exceeded. If the European fair share of the global budget is met by the pathway, that is currently set by the user, can be seen by comparing the blue bar (cumulated European emissions 2020-2050) with the green flag (EU fair share of the global budget) in the header of the website. The temperature anomaly graph (http://tool.european-calculator.eu/app/climate/global-mean-temperature) also includes the emissions of the rest of the world set by the „Global mitigation effort“ lever and the European emissions after 2050 set by the „EU emissions after 2050“ lever.</p>
<p>the GT of CO2 displayed at the top are not really useful. The figures do change when changing the country.</p>	<p>NO, the numbers do not change</p>
<p>Also, the emissions reductions goal should be clearly shown on the graph. I'm guessing in most cases the goal is net-zero emissions, but is it the case for all scenarios? Maybe turn the "total" line green when it gets under 0, to show the goal was reached. I feel like this was the idea behind the introduction of the blue line and the green milestone on the top of the screen, but you really need to better explain what those are (e.g. with a caption or descriptive text). There should be no ambiguity in terms of interpretation of any of the GUI elements.</p>	<p>The introduction has been updated to make this more clear</p>
<p>On behaviour and consumption, it would be interesting to integrate avoided emissions outside of the EU more directly.</p>	<p>YES, out of scope</p>
<p>This (modelling dynamics) is a potential risk area, and there is no way to assess sector interactions and/or feedbacks from the graphs and the levers.</p>	<p>YES, this comment is correct and valid for many modelling exercises. In order to evaluate the interactions across sectors the user will have to explore different results and experiment with different lever positions.</p>
<p>The most relevant impacts are well displayed. In order to make full use of the data in view of EU policies, it would be helpful to optionally display the EU climate and energy targets in the charts showing emissions and energy results.</p>	<p>See below for the reply on the same issue.</p>

Other

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Hamburger menu on home page	NO ACTION NEEDED
Legal page (http://tool.european-calculator.eu/legal). At bottom of page is this text: "The TPE reflects the author's views..." What is TPE.	YES, will be spelled out
Suggest that links all operate in same way. Some open new window, others do not...	YES, will be taken care of
Users should be able to feed detailed national or EU-wide own assumptions into the online tool. Such an entry option should be offered to users who want to scrutinise effects of certain national policies and targets, for instance. Proposals related to certain sectors would need to be filled in in an individual way.	NO, out of scope
The "ambition" grades out of 4 are counterintuitive to me. I'd rather set a scale of "emissions" or something like that. So, if my pathway scenario tells me 1,5/4 in Appliance use, it means people will drastically reduce their use. Currently it is the opposite. 1,5/4 means I have low ambitions.	NO, singular opinion

Comments provided at the 2050 Calc Conference in Windsor:

Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
The calculation speed is a bit too slow to be as useful for policy makers.	YES, the database will be populated, see above
The calculator covers most of what you'd expect, some of the levers are very big so should be quite comprehensive.	NO ACTION NEEDED
Feature on the TPE that reflect the level of investments in Europe.	YES, the EU Calculator now provides sectoral level of investments in CAPEX and OPEX.
...Only the carbon budget notion was not fully understood, one may clarify the link between cumulative emissions and carbon budget. The only member familiar with this suggested to add another setting to the budget such as based on historical emissions. After explanation, the carbon budget was highlighted as something which should be a key component for the education part of the tool/project.	The introduction section of the tool has been updated to better explain the carbon budget. Three animated videos were produced that also include explanations of the budget approach.
Budget approach should be described better, in particular the fairness approach: Though the clarity of the European share is PHRASED too vaguely. Not just gdp counts but also needs/requirements.	The existing fairness approaches have been described better. Adding more than the two existing fairness approaches is out of scope of the project. More restrictive approaches may also lead to negative GHG budgets for Europe which would make it very difficult to understand.
There was a need for target emissions to be explained. The visuals of the TPE are good.	See above.

Going into a country's calculator is not intuitive and may take the user a long time to figure it out; adding a "pick a country" label may be better.	We made the plus sign as big as the "i"-sign behind the example pathways and added a mouse-over functionality with the text "Zoom into a country within Europe"
One stakeholder notified that they would like to see the details of each country in the 1-pagers rather than the EU overall picture.	NO This would generate unreadable plots (given the heterogeneity of some metrics across countries) and too much information, upfront, for the user. We keep the approach that if the user wants more information on a country, then she or he can search for it in the documentation.
Air should be renamed to air quality/Highlighting the affected sections based on the levers perhaps.	NO We opted to keep the short version of the tab name.
Jobs addition is important.	NO ACTION NEEDED The jobs module has been added and results available.
Water is a good feature.	NO ACTION NEEDED
A short run through of how to use the calculator (on the page itself) would be helpful.	YES, done.

Q4. Do you envisage using the Transition Pathways Explorer in your area of work and for what? Answered 23 Skipped 4

Yes 87% (20)	No 13% (3)
<i>Yes, in classes</i>	<i>No</i>
<i>To understand on which area it is more strategic to act in order to reduce emissions at a European level in the shortest term. That would help a more focused and efficient debate about the policies to ask to political parties and institutions.</i>	<i>Probably not, because it doesn't look at freight transport in the level of detail we would use. It's of passing interest to see the relative contribution compared to other sectors' impact on the bigger picture.</i>
<i>Yes, I work on climate change too and therefore these data are useful for sure to understand sectoral contributions</i>	<i>No</i>
<i>Yes, to help Member States understand choices and carbon budgets in their Long-Term Strategies and Climate Laws.</i>	
<i>Yes, data collection and comparison. I will be researching how different people utilise and interpret calculator inputs and outputs</i>	
<i>Yes, for scenarios set up in future estimations.</i>	
<i>The tool seems useful to compare several scenarios as well as to get information and data about current and future aspects in different sectors. Therefore, the output may find its way into some studies and / or proposals. Additionally, the predicted values may help to evaluate and crosscheck results of other projects.</i>	
<i>Possibly--It might be useful in a teaching context to help people think about the major drivers of climate.</i>	
<i>It would be nice to see what the consequences (of the supply chain) and impacts of a marginal change in technology cause. This could be used to justify research directions in e.g., materials science. I would like to do this, but it seems that a higher level of detail would be needed in the interface.</i>	
<i>Yes, to apply to my PhD thesis.</i>	
<i>Yes, I see myself use the TPE as a baseline or as a comparison for more specific scenarios.</i>	
<i>Yes, for finding sector specific developments under assumption of GHG budget. however, I would like the references and inputs to be a bit clearer to avoid "black-box" feeling when I get the results</i>	
<i>Yes, I believe the tool brings great insights on a broad range of fields that can be very useful for an environmental economics researcher like myself.</i>	
<i>Perhaps if it were tweakable and the data input could be adjusted at a more granular level. The visual aspects of the output graphs are excellent, I would use those graphs in a presentation or talk about different pathway scenarios.</i>	

<i>Yes. I will mostly use the hypothesis.</i>	
<i>As a transport engineer, may be interesting to motivate my effort to reduce car use.</i>	
<i>Yes. But for me I would make a choice: exact numbers to give exact input for people or less exact to tell a story (for more mainstream public). I got overloaded with all the numbers. I would like it more if I see the consequences of the numbers (warmer earth/ higher risk of ... etc.). I also miss the overall story. The line on top gives me little insight in the severeness of going over the green line.</i>	
<i>Yes, for demand estimations among other uses</i>	
<i>Informing policy people, students, start-ups, business leaders and investors.</i>	
<i>We are currently participating in the PAC project (Paris Agreement Compatible scenarios for energy infrastructure) by compiling a set of key parameters for an own 100 % renewable energy scenario. This scenario will be submitted to grid operators to feed their modelling of the European Ten-Year Network Development Plan with a more ambitious, Paris compatible scenario. In order to run a sanity check of our own scenario and in order to verify emission pathways, we would be very interested in using the EU Calc online tool. For certain key parameters such as installed capacities, storage and other flexibility options, granularity of our scenario data partially might be too high to be entered into the online tool.</i>	

5.2.2.2 General

Reaching zero

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
I cannot stress enough that the current debate is no longer whether we reach zero at some time, but when! It would be a real opportunity lost, if the EU Calc cannot focus on the question whether we should reach net-zero in 2060/50/40/30 – you probably just heard that the UK moved to net zero in 2050, but the Labour opposition Party just agreed to go for a net-zero target in 2030. That is a very life debate and will remain so for many years to come...	YES, we will reflect this in the online interface.

Curve shapes:

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
It appears that most ambition levels are expressed as straight lines. Arguably exponentials and s-shaped patterns should be considered.	NO ACTION NEEDED We chose the most appropriate shape for lever trajectories and documented the choice in the sectoral documentation. In case there are better suggestions please let us know.

Costs

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
<ul style="list-style-type: none"> From the perspective of energy scenario building, the carbon price is a key parameter for the merit order of installed capacities in the electricity sector as well as for the use of different fossil fuels in heating, transport and industry. There however seems to be no direct 	NO, the carbon price (and all prices) are crucial variables in economic models since agents' decisions are the result of an optimization process. However, the calculator has a different logic: the user can explore a pathway (e.g. installation of power capacities) and the associated cost is provided as an

<p>lever that allows to define different carbon price levels.</p> <ul style="list-style-type: none"> It seems that there is nothing about CO2 tax or tax in general. 	<p>output. Hence, the user can simulate even “non-optimal” pathways, and thus better understand the trade-offs behind the different pathways.</p>
<ul style="list-style-type: none"> It seems that there is nothing about financial sector: will it go green? will we, as consumers, invest in green bonds? etc. 	<p>NO, indeed this version of EUCalc did not explicitly consider the financial sector due to modelling complexity and data constraints. However, the investment needed for decarbonization will be displayed in the cost tab.</p>
<ul style="list-style-type: none"> It would be interesting to have an idea of the economic impact of the different scenarios in terms of GDP/GDP per capita. I understand it is very complicate though. the amount of money/economical effort which goes into this vs. economical destruction on the long term. I would also like to see costs (money) regarding all levers and settings. 	<p>NO, it would be possible to compute such indicators from the employment module. However, it will likely not be integrated in this version of the calculator due to time constraint.</p> <p>NO, the “economical effort” (investment) will be displayed in the cost tab. We thought about displaying the “economical destruction” (impacts of CC on GDP) in the Climate tab. However, comparing them would not yield interesting insight: (1) the method to compute the effort & destruction would not be the same; (2) our scope is not sufficient (i.e. lots of benefits and costs would not be included); (3) the negative impacts of CC would only depend on the “Global mitigation effort” lever, i.e. the EU effort has a very limited impact.</p> <p>YES, the costs will be displayed in the cost tab.</p>
<p>Costs tab: Only costs for the industrial sector were shown in the assessed version, and the graph is displaying only fuel costs. Issues related to international balance of industrial goods (i.e. imports vs. exports) may also substantially affect the cost estimates.</p>	<p>YES, the costs calculations were improved, and they are now displayed in the cost tab.</p>

Modelling dynamics

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<ul style="list-style-type: none"> This is a potential risk area, and there is no way to assess sector interactions and/or feedbacks from the graphs and the levers. I worry about how feedback effects and interactions between levers are represented. This is difficult to see from the interface. 	<p>NO The team understands that interactions might not be directly observable from the Transition Pathways Explorer but they are very clear from the documentation of each module. There are limits to the amount of critical information that can be conveyed through the TPE without overburdening the user (some of the feedback indeed already points to much information upfront). The team does the best it can at this point to mitigate this feedback, which is, to provide access to all documentation and code where the interactions between modules are explained and computed.</p>
<p>There is a disconnect between the measures under 'Manufacturing' and those under the end use products 'Transport' and 'Buildings'. E.g., material switch will have an impact on building energy use. Is this interplay modelled? Also, embodied emissions seem to be missing in these end use products. It seems some parts of the life cycles of these products are captured (e.g., the use phase in freight efficiency and material switch in production), but not all. Maybe some are also overlapping. What is the scope of this assessment?</p>	<p>NO ACTION NEEDED. The effect of the energy switch on the energy demand in buildings is considered insofar as the material need is approximated considering to a certain extent also the insulation requirements. This specific approximation can be refined in the future.</p> <p>The embodied emissions are systematically included where they occur in the whole EUCalc model. This means that emissions to produce steel or concrete for buildings occur and are recorded in the manufacturing</p>

	sector. Also, the storage of renewable carbon can in the future accounted for in alignment with the forestry/agriculture/land-use modules.
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Other

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
A definition of GHG emissions seems to be missing. What characterisation model is being used?	NO ACTION NEEDED. The model is explicit in that it provides CO2eq emissions, more details how this was calculated please refer to del 1.2.
High diffusion of green technologies scenarios seems a bit underrepresented, but they are probably over optimistic.	NO ACTION NEEDED

5.2.2.3 Lifestyles

Q5. When you look at the mitigation options ("levers") displayed on the Transition Pathways Explorer, do they reflect the main action areas that can be taken to mitigate climate change? Is there anything missing?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Maybe isolation of houses at Key behaviours/Homes	NO "Building envelope" (of which isolation is one of the many parameters) is a combination of several parameters like renovation rate) that depend less on individual behaviour than the other levers related to homes under the Key behaviour section. We do understand the rationale of the comment but unfortunately there is not always a clear cut between a technical and a behavioural lever. If we make this change, we will make other lever grouping less consistent, for example, the choice for a petrol/electric car (currently under the "Transport") could also be argued to belong in "Key behaviours" travel.

Q9. Does the scope of mitigation options ("levers") and the range of levels of ambition presented for sector(s)/module(s) you are reviewing cover the full range of credible futures? If not, what evidence suggests that the scope of levers and/or range of levels should be broader than those presented?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
I think you may want to allow for more radical levels of change with the levers that represent personal	YES, the ambition level of behavioural change was increased for distance travelled but not for diets. We

<p>choice (diet for example). The purpose being to allow people to see how powerful individual choice can be if acted on collectively. Informing 'political' choice seems important as an element to engage people.</p>	<p>consider the level chosen to already reflect a high degree of ambition able to substantially reduce agriculture emissions. Increasing even further the ambition on behaviours could be counterproductive as one would shift a large burden of the responsibility to individuals that may not always have a choice to opt for very ambitious change. Furthermore, we believe that the levels of ambition on key behaviours to strike a good balance between what is achievable in terms of social change and its ability to generate significant emissions reduction. As currently implemented changes in key behaviours would decrease GHG emissions in the EU by 54% in 2030 and 73% in 2050 compared to those in 1990. Accordingly, adopting ambitious behaviours as currently considered in the EUCalc would suffice to reach the 40% reduction targets while keeping current trends of technology innovation, a fair deed.</p>
<p>Behaviour (Transport): Aviation seems to be missing from 'mode of transport' and 'occupancy'.</p>	<p>YES, aviation is computed apart from other modes: the passenger km done by plane are separated from the inland passenger modes. The passenger km computed by the lifestyles module are expressed for inland transport (urban and nonurban areas) and for aviation. Hence the modal share lever applied on the inland passenger transport demand does not include aviation, by definition. In order to make this more explicit to the user, the description of the "Passenger distance" lever now includes a line stating that the passenger distance includes the "the urban, non-urban and aviation above 1000km (non-shiftable) categories".</p> <p>The occupancy of planes is not mentioned because it is not modelled: planes are considered to have a constant and homogenous occupancy ratio as there is far less room for improvement in plane occupancy than it is the case for cars.</p>

Comment provided in other sections:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Behaviour (Transport) - Description of 'Car own or hire' include something about heating and residential floor space. Are they belong to this sector?</p>	<p>YES. This has been corrected.</p>
<p>The description/levels for occupancy and car own or hire are very similar (concerning the behaviour in car sharing)</p>	<p>YES. This has been adapted</p>
<p>Key behaviours are one of the most relevant (features of TPE), I found the lack of explanation of the Constraints a challenge and therefore less relevant because it could not be easily understood.</p>	<p>NOT SURE Hard to interpret what is meant in this comment. In case "Constraints" refers to constraints in changing key behaviours it is advisable to read the rationale for level selection in the Lifestyle documentation. In case the comment is targeted at more explanation of the sub-levers under the "Constraints" group, then YES, the descriptions will be updated to better explain the rationale behind each lever.</p>
<p>It took me some time to find passenger transport behavioural levers since transport is separated between key behaviours and technology and fuel. Especially since freight modal share is classified under technology. It is also confusing that technical</p>	<p>NO ACTION NEEDED We acknowledge that the categorization of some levers is not always intuitive for every user, but we have tried to make the classification at least internally consistent. For example, under the transport group levers that allure</p>

<p>information concerning those levers are given in the transport module document (WP2_Transport).</p>	<p>more to the technical aspect of the sector (as the group naming indicated) are included, while the levers are more related to individual decisions come under travel.</p> <p>YES, Regarding the confusion on where to find the documentation of the levers. We will now directly link the one-pager description of the lever directly to the respective documentation instead of pointing out to a general page with all the documents of the module.</p>
<p>I wasn't satisfied with the descriptions of the pathways: The names of the pathways do not tell much about what these scenarios are all about. They should be less equivocal. Also, I've spotted many typos in the pathways descriptions, you should proofread it. In particular, the "Key behaviours" scenario is poorly defined and the definition refers to itself ("Key behaviours: This scenario portrays the maximum ambition level in the EU Calculator regarding Key behaviours" is a definition that left me more confused after reading it). In addition, this "Key behaviours" pathway gets referred to in several other descriptions, so it's paramount to clearly define it.</p>	<p>YES, there will be improvements on the titles and descriptions. Typos will be corrected.</p>
<p>In the key behaviours, it seems that you forgot online internet videos, which have a huge GHG impact (see for example: https://theshiftproject.org/en/article/unsustainable-use-online-video/).</p>	<p>NO, The GHG impacts from data consumption was equated at the start of the EUCalc project but abandoned due to the lack of time and the complexity of the task ahead. In particular discerning how much data consumed in each European country originated elsewhere in the rest of the world (row) and what emissions intensities data centres located outside the EU28 was proven difficult. In addition, although there was some data available for the recent years on data usage for Europe, we did not find a convincing database for EU members. We equated using the total value and break it up per capita into countries but the approach would be so crude that the idea was abandoned.</p>
<p>In the key behaviours, there is nothing about green energy contracts that we can subscribe as a consumer.</p>	<p>NO Indeed there is not. The penetration of "green energy" in the EUCalc is done under the "Technology and Fuels" grouping in the Power drop-down. Although opting from green energy contracts is a behavioural decision, the consumer not always has the choice to do so. Furthermore, the most recent example of European progress towards green energy (Germany and the Energiewende) has been a classic example of a top-down decision of the government paid by the consumer. Given that the separation between what constitutes a behavioural lever and a technical one is not always clear cut, and subject to endless discussion, we favour leaving the penetration of green energy being decided at the technology level.</p>
<p>The Key behaviours? I am not sure. I cannot see how they are reflected in the graph. Am I looking at level 1,2,3 or 4 in the graph? If they are represented by the dots, how do I change that? And how come they can be 1,6? What behaviour is chosen? It is not clear to me.</p>	<p>NO ACTION NEEDED</p>
<p>On behaviour and consumption, it would be interesting to integrate avoided emissions outside of the EU more directly.</p>	<p>YES, At the time of the call for evidence the consequences for GHG of EU28 decision on the rest of the world (row) was still not available. The EUCalc will make use of GTAP to capture what GHG increase/avoided are entailed in the behavioural and technological decisions done at the EU28 level.</p>

They (levers) are basically all there, but I have doubts on the key behaviours levers. These could be interesting to build a long-term strategy, but I find very hard to believe in real changes in the short term. There should be then mentioned also all the possible scenarios not involving substantial key behaviours variations.	NO ACTION NEEDED. The possibility to generate scenarios without "involving substantial" behavioural change is already feasible. E.g., by choosing the predefined pathways of "Past trends".
Very much like that you have a diet section and I like the levers ¹	NO ACTION NEEDED. Thanks!
Regarding the one-pager for population, not sure one can talk about 'ambition levels'	YES, we will reflect on changing the wording "ambition" from the population lever. This is a recurrent discussion within the project.
"Car own or hire" lever. This lever seems to me to be redundant. Don't you have enough information to generate emissions from travel if you know km/person/yr, occupancy, and transport mode? Isn't sharing of cars implicit in occupancy?	NO, the lever is relevant to have because it allows the user to evaluate the effect of having less car ownership but without changing our traveling habits in terms of occupancy or distance. Keeping the lever increases the options for the user.
Car own or hire text. This text seems wrong. It talks about floor space per person	YES, this has now been fixed.
Product substitution rate text. In the US, I am not familiar with the term "White appliances". Here we use the phrase "major appliances". Also, the text here describes level 2 as minimum level of ambition. But it appears that level 1 is minimum. ALSO—this really is an appliance retirement rate not a product substitution rate (which I think has a meaning to people who have taken economics classes which is different than what you intend).	YES, indeed it is not entirely correct to use the term product substitution rate. We take on board the suggestion to call this lever "appliance retirement" but we will skip "rate". What the lever does is extend/shorten the time when an appliance is substituted by a new one. Therefore, we rename the lever to "appliance retirement timing".

Comments provided at the 2050 Calc Conference in Windsor:

Key Behaviours - Travel

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Passenger Distance <ul style="list-style-type: none"> • Generally agree, ambition could be increased • More scenarios could see a decrease in travel distance • Primarily agree on the middle two levers • Mode choice will determine the distance to a large extent • There should be a greater ambition for level 4 	YES, Given the general feedback pointing towards a higher level of ambition for level 4, we decided to further reduce the amount of distance travelled in this lever. This is done by alleviating the "rebound effect" of increasing travel for the purposes due to a reduction from the need to travel to work/study and access to services. In the original version of the EUCalc, all countries converge to the current level of travel for leisure as in rich EU countries by 2050. This assumption is alleviated so that the travel for leisure drops in 2050 to 80% of the value typically found in rich countries today. This would represent a shift in preferences for people to commute smaller distances for the purposes of leisure. This change is noted in the Lifestyle documentation, together with the remark that the change has been undertaken following the consultation feedback.
Mode of Transport <ul style="list-style-type: none"> • Not flying to leisure should be reflected in the model • Levels 1-3, all participants were neutral • Level 4 was all neutral, all but one disagrees, they felt ambition could be 	NO ACTION NEEDED This suggestion has been reflected in the previous comment.

greater	
Occupancy <ul style="list-style-type: none"> Should it be about getting more people onto trains, or getting more trains Needs to account for rural/urban setting Almost all levels were received neutrally, level 4 was spread across all three, with majority disagreeing 	YES, Trains are modelled with a fixed occupancy ratio, unlike cars or buses, because there is less room for improvement in trains than in cars. Hence, in the model, getting more people to take the train automatically implies to have more trains. The split between urban and non-urban areas is indeed interesting but cannot be part of this mission due to missing time until the end of the project. The same remark holds for the revision of the occupancy levels.
Car own or Hire <ul style="list-style-type: none"> Rural and Urban needs to be reflected 75% of car travel can be via automation 	YES, automation is out of scope for this project and cannot be addressed until its end. The same remark holds for the distinction between rural and rural utilization rates.

Consumption

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Use of Paper and Packaging <ul style="list-style-type: none"> Majority agree with level 1 Level 2 should show an increase in glass consumption; most disagreed Level 3 the majority disagreed with, stating that they disagreed with the stagnation of plastic consumption by 2050 	YES, Glass packaging increases in all levels. Level 4 ambition of plastic packaging reflects the maximum technical potential of reducing plastic items (which includes packaging) at the <u>household level</u> set at 10% in Moran et al (2018). We will investigate if a more ambitious scenario for plastic reduction is available, if yes, level 3 will become what is now level 4, and level 4 the new scenario. Moran D, Wood R, Hertwich E, Mattson K, Rodriguez JF, Schanes K, Barrett J. Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions. Climate Policy. 2018 Dec 14:1-1.,
Product Substitution Rate <ul style="list-style-type: none"> Table primarily agreed with level 1, however not with level 2-4. Level 2 was because they disagreed with the reason changing phones regularly due to trend dictated by retail sales Level 3, the point was raised that the culture if repair has disappeared in Europe so the 155% needs to be changed as this indicator seems wrong. How about communal laundry use? 	NO ACTION NEEDED There is no mention of a 155% rate in any of the appliances under this lever. The maximum is 130%. As for communal laundry use this is reflected in a drop of washing machines per household in the lever "Appliances owned". The levers illustrate possibilities and therefore even if the repair culture is claimed to have disappeared (although the increases of initiative like repair cafes seem to contradict this) we still stand by the options made for level 3.
Food Waste at Consumption Level <ul style="list-style-type: none"> All levels had majority disagreeing Level 1 should be set as level 2 is due to the new policies about climate change. This then should be cascaded through the levels. Level 4 should be set at 90% to be ambitious enough 	NO, the policies about climate change regarding emission from organic and other types of waste are mostly at the landfill level, not at the household. The level 4 already reflects an improvement of the already ambitious target expressed in the agenda 2030 on sustainable development goals. Furthermore, a 90% reduction of waste <u>at the household level</u> is impossible, as this would require extreme planning level of each meal. The EU itself, in its latest policy issue on food waste does not go beyond a 50% reduction target for 2030, the same as our level 4.
Freight Distance <ul style="list-style-type: none"> Level 1 was thought to be too high a percentage use. The group was split between agree and disagree The group agreed with level 2, but not 3 or 	NO ACTION NEEDED. No clear information required for action.

<p>4</p> <ul style="list-style-type: none"> Level 3 was because of behavioural change and the group felt level 3 should have been used for level 4 	
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Home

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Living Space per Person</p> <ul style="list-style-type: none"> All agreed with level 1 All disagreed with level 2-4 Level 2 is not very ambitious, should be constant, as it is easier to understand than a relatively slow decrease Level 3 showed very precise fractions, when they shouldn't be. Level 4 could be more ambitious, as it is already a reality in some European countries (e.g. Bosnia) 	<p>NO ACTION NEEDED. The level of precision in the fractions is consistent across other "key behaviour levers" and in some cases important to keep. We agree that some countries (e.g., Romania) are already levelling in the same m2 as proposed in level 4. But what level 4 proposes is that every EU country converges to this level. A slight increase of living space in level 2 is still more in line with our definition of level 2 being an "intermediate scenario, more ambitious than business as usual but not reaching the full potential of available solutions".</p>
<p>% of Cooled Living Space</p> <ul style="list-style-type: none"> All agreed with level 1 All disagreed with level 2-4 Some lack of clarity in the description specifically regarding the '21.7%' Level 4 should be better explained; Level 3 and 4 seem very similar 	<p>YES, the descriptions of the levels will be revised.</p>
<p>Space Cooling and Heating</p> <ul style="list-style-type: none"> All agreed with levels 1-3, with only one person disagreeing with level 4 Relationship between indoor and outdoor climate does need to be better explained- it is hard to contextualise 'room temperature' Gender portion should be mentioned; this was the main common argument that there is a gender issue here 	<p>NO ACTION NEEDED</p>
<p>Appliances Owned</p> <ul style="list-style-type: none"> All agreed with level 1-3 All disagreed with level 4 Level 4 is very ambitious, in particular for computers; no info on any other electronic devices (e.g. smartphones) 	<p>NO ACTION NEEDED. Level 4 is and should be very ambitious, even transformational, so there is no reason why 1 computer per household, as currently the reality in many EU countries, cannot be achieved.</p> <p>YES. Agree to also include information on smartphones.</p>
<p>Appliances Used</p> <ul style="list-style-type: none"> All agreed with levels 1-4 The term "computer" should be specified 	<p>NO ACTION NEEDED.</p>

Diet

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Calories Consumed</p> <ul style="list-style-type: none"> Level 1, 2 & 4 had a mix of agreed, neutral and disagreed responses. The majority were neutral for level 3 For level 4, obesity can be caused by other factors 	<p>NO ACTION NEEDED. No clear information required for action.</p>

<p>Type of Diet</p> <ul style="list-style-type: none"> 80% of the group agreed for levels 1-4, with 20% being neutral The group agreed that WHO's recommendations are good for health and the environment The group were not convinced about the assumptions on meat consumption 	<p>NO ACTION NEEDED. No clear information required for action.</p>
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5.2.2.4 Buildings

Q5. When you look at the mitigation options ("levers") displayed on the Transition Pathways Explorer, do they reflect the main action areas that can be taken to mitigate climate change? Is there anything missing?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Maybe isolation of houses at Key behaviours/Homes</p>	<p>YES, this is included. However not in the Key Behaviour but in the Technology section under Building Envelope. We can think about renaming the building envelope to insulation.</p>

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Manufacturing (Technology and Fuels): the assumption that timber-based buildings being more climate-friendly can be controversial as the source of timber is not mentioned to be from a sustainable source, thus this could mean an import of timber from deforestation in other countries, shifting emissions out of Europe to other countries instead.</p>	<p>YES, this question addresses the forestry management more than the material switch lever in the manufacturing module or the building module.</p> <p>This depends on how the forest is used. The Climate-Smart-Forestry lever set the harvest-rate. The self-sufficiency balance is then computed given the demand and supply which may indeed imply deforestation outside of Europe. We are looking to display this information in the TPE either through a warning or direct self-sufficiency balance graph.</p>

Other comments:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Buildings (Technology and fuels) - The description/levels for district heating share and 'technology and fuel share' are very similar and can be confusing</p>	<p>YES, this is updated as of January 8th</p>
<p>Unclear y-axis legend on the graphs in 'Technology and fuel share', 'Heating and cooling efficiency', 'appliances efficiency'</p>	<p>YES, this has been partly remediated as there is a Label below the graph now. The issue with the wrong unit (40% instead of 0.4%) has been remediated in the Interface google sheet and is being addressed with Roman and Bernd in an Email from Monday 6th of January.</p>

<p>The first sentence in the sub-lever hover text should indicate clearly if the item is an average or per-capita measure. For example, on "Appliances owned" you could change the hover text from "How many appliances will we have in our households" (which suggests a total number of appliances) to "What will be the <i>average</i> number of appliances per household"</p>	<p>NO ACTION NEEDED The EU Calculator model does not cover explicitly all the household appliances but only a subset of these. Accordingly, it would be as miss leading to add "average number of appliances per household" as it is "How many appliances will we have in our households".</p>
<p>There is a disconnect between the measures under 'Manufacturing' and those under the end use products 'Transport' and 'Buildings'. E.g., material switch will have an impact on building energy use. Is this interplay modelled? Also, embodied emissions seem to be missing in these end use products. It seems some parts of the life cycles of these products are captured (e.g., the use phase in freight efficiency and material switch in production), but not all. Maybe some are also overlapping. What is the scope of this assessment?</p>	<p>NO ACTION NEEDED. The effect of the energy switch on the energy demand in buildings is considered insofar as the material need is approximated considering to a certain extent also the insulation requirements. This specific approximation can be refined in the future.</p> <p>The embodied emissions are systematically included where they occur in the whole EU Calc model. This means that emissions to produce steel or concrete for buildings occur and are recorded in the manufacturing sector.</p> <p>Also, the storage of renewable carbon can in the future accounted for in alignment with the forestry/agriculture/land-use modules.</p>
<p>Slight problems in understanding 'space cooling and heating. Level one should be following the historical business as usual trend. But in the EU Calc it appears to be going down quite radically. Any additional level goes higher on the degrees and should, thus increase energy consumption. Should it not be the other way? Is the historical trend not going up...or am I underestimating the impact of cooling in Southern Europe?</p>	<p>NO. The user did not read the full description of the lever, which says: "This level sets the room temperature within residential buildings." Past trends in this case go down reflecting people's behaviour to cool more than necessary their rooms.</p>
<p>Do not fully understand levers for 'buildings envelope'. Why do they start at different levels in 2020 and never change?</p>	<p>Yes, done.</p>
<p>Appliance efficiency lever goes against 'Calculator principle'. This is the visual from the one pager: Please have level 1 stay at today's level! Much easier to communicate and no reason why it should stay stable for 25 years and then in the last 5 make a step??? Level 1 and 2 and 3 should also not be the same. The experts in this area cannot tell me that they have truly explored all possible options of this appliance efficiency sector and in 2050 there are only two options which the sector might end up with?!?! The point of the four levels is to explore the whole range from close to no action or business as usual, to the maximum that is possible. So, for level 4 in appliance efficiency only a 0.01 rate of change is possible??? I doubt it.</p>	<p>YES Done. This was a unit issue.</p>
<p>Should graphs in lever text be zero-based? (see space heating and cooling).</p>	<p>NO ACTION NEEDED. The comment is relevant but basing all the graphics on 0 (zero), to be consistent, would mean that for some cases (levers) the user would then not be able to differentiate visually the difference of trajectories of each level.</p>
<p>Product substitution rate text. In the US, I am not familiar with the term "White appliances". Here we use the phrase "major appliances". Also, the text here describes level 2 as minimum level of ambition. But it</p>	<p>YES, indeed it is not entirely correct the term product substitution rate. We take on board the suggestion to call this lever "appliance retirement" but we will skip "rate". What the lever does is extend the time when</p>

appears that level 1 is minimum. ALSO—this really is an appliance retirement rate not a product substitution rate (which I think has a meaning to people who have taken economics classes which is different than what you intend).	an appliance is substituted by a new one. Therefore, we rename the lever to “appliance retirement extension”.
Building envelope. I don’t understand this graph showing building envelope ambition levels. I think this may be because of the units. I think we want to be showing %/yr and explicitly label as renovation rates. Is there/should there be another lever that looks at new construction? And we may want to show as a set of bars rather than time series?	YES, the graph was remediated, and the units are fixed in the next update. The new construction is included also explicitly in the descriptions now.
Technology and fuel share. (It is not clear what is on the vertical axis of this graph. The percentages are not consistent with the numbers described in the different ambition levels).	YES, the graph was remediated, and the units are fixed in the next update.
Appliances efficiency. Same comment as with technology and fuel share. (It is not clear what is on the vertical axis of this graph. The percentages are not consistent with the numbers described in the different ambition levels). The reader expects an upward sloping curve here!	YES, the graph is remediated, and the units fixed the changes are shown in the next update.
Regarding the GHG emissions per use, is air conditioning for cooling also represented in this graph? Perhaps in household appliance? If so, this is not clear. The categories used in this graph could be more intuitive for non-expert users.	YES, the categories will be revised in this graph.
Categories used in “Energy demand per use” could also be improved, for example, what is the difference between “services” and “service appliances”?	YES, the categories will be revised in this graph.
In building types, a graph with the energy demand per floor area per building type could also be interesting and useful.	NOT SURE We will look into this and see if we can provide this graph.

Comments provided at the 2050 Calc Conference in Windsor

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Building Envelope</p> <ul style="list-style-type: none"> Level 1 was mostly neutral, with one disagree - decided that it seems very unrealistic since over the next 30 years at least all houses will replace windows, perhaps increase ambition a bit. Windows will get replaced by 2050 Level 4 was split equally between neutral and agree - It was considered physically possible, but it would likely require entire budget for Net zero to go to buildings (e.g. Scotland) hence hard to deliver <p>Descriptions: Shallow needs to be changed, Terminology needs to be more familiar to ordinary people. Plus, energy needs to be defined. People do not understand these terms, no-one knows that plus energy house produces energy.</p> <p>Graphs: There is no value in terms of information that the graph provides. Consider to show % of houses instead or annual rate of renovation for graph to give a feeling of difference.</p>	<p>YES, the graph was improved to show that the building envelope improves also in the Level 1 scenario.</p> <p>NO, the naming of the renovation quality levels have been discussed multiple times. It is not clear what terminology would be more familiar to ordinary people across Europe.</p> <p>YES However, the definition of each quality level is now given in the description. The improvement in the graph and in the descriptions will show in the next update.</p>

<p>District Heating Share</p> <p>Descriptions: Very difficult to relate to. Nobody knows what Heat Roadmap Europe project is (https://heatroadmap.eu/) nor what it suggests. Consider that link might be out of function in a year or two.</p>	<p>YES, the mouse-over descriptions are remediated, and fixes will show in the next update.</p>
<p>Technology and Fuel Share</p> <ul style="list-style-type: none"> Majority were neutral for levels 1-4, with one person on each level disagreeing Level 4; too much biomass, the mix should be more complicated, and more choice needed for the user to fine tune the mix of heat pumps and biomass. Phase out of fossil fuels should be a separate lever <p>General comments:</p> <ul style="list-style-type: none"> This lever is exceptionally important, and it would be better to have 2 levers instead (one for phase out and one for substitution). Too much biomass across levels, give people more choice about biomass. Is there an option of using hydrogen? UK plans to use existing gas network which is huge and expensive and replace gas with hydrogen (Note: biogas was mentioned, also green electricity in relation to hydrogen - due to 2 ways to produce hydrogen; one that requires energy input, the other that produces CO₂ and requires CCS). <p>Description: very complex. Graphs need to be properly labelled (not very clear what is currently presented on the graph), the same applies to units which were note very straightforward or easy to understand. (Fossil fuel use reduction in 2050: gas - 30%; coal -68%; oil -30%. The reduction is covered by heat pumps (30%), and biomass (70%).)</p>	<p>NO Action Needed. The levers, their number and scope and their design were approved in the stakeholder review process in mid-2018.</p> <p>However, it is theoretically foreseen to implement a separation of the fossil fuel phase out from the selection of the alternative technology and fuel choices.</p> <p>YES, the graph and in the descriptions are revised and the improvements will be shown in the next update.</p>
<p>Heating and Cooling Efficiency</p> <p>NA</p>	<p>NO ACTION NEEDED.</p>
<p>Appliances Efficiency</p> <ul style="list-style-type: none"> Majority were neutral for levels 1-4, with one person on each level disagreeing For level 1, may be interesting to show no change and even less than 38% improvement i.e. level 1 is too ambitious <p>Descriptions: The appliance efficiency is set to 38% is not very clear, does it mean that efficiency rate improves by 38% or 38% of energy is saved per unit (hour of use) or else? Graph is difficult to read, and units need to be more straightforward.</p>	<p>NO ACTION NEEDED.</p> <p>NOT SURE We will review the Level 1 definition.</p> <p>NOT SURE We will review the description.</p> <p>YES, the graphs are remediated, and the units fixed and will be shown in the next update.</p>

5.2.2.5 Transport

Q7. Do the sector(s)/module(s) you are reviewing answer the right questions, with the appropriate depth and modelling logic?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>In its current stage, I feel like EUCalc 's Transport module is very well suited for the impact assessment of scenarios. However, in a policy-oriented perspective, the levers might be too general for a decision-maker. I can imagine that a policymaker</p>	<p>YES, this is out of the scope of the project, which does not take economic/policy inputs into account. It rather simulates behaviour and technical changes and their results. Such economic effects have to be reflected by the user in its lever choice</p>

would rather want to understand the effect of a specific policy on the transportation sector and thus on the general impact. An example of a question could be: "What effect has a tax on haulage on the modal share of Europe?" EUCalc 's current structure analyses thresholds rather than specific policies.	
We're not convinced about the distinction in approach between road freight transport and the other modes. Total tonne km is the ultimate driver of freight transport demand in the economy, and it's the way it's distributed between the modes, efficiency within each mode and the carbon intensity of the energy source that will ultimately combine to deliver the impact. The ability to switch between modes implies that they should all be treated in the same way. Also load factor is a relevant lever for all freight modes	YES, there is a misunderstanding of the module functioning here. We do start from the total ton.km demand and then split it into the different modes. Hence, the modal shift is properly modelled. As for the load factor, it was considered that modes different from trucks already have a high loading factor, hence they were considered to have a constant load factor.
Yes, many factors integrated, great work. The WP2 - Transport module documentation is very informative.	NO ACTION NEEDED.

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
As previously mentioned, the inputs are limited if the user wants to understand specific lever of action to influence transport. To my understanding, the rest of the transport module manages the inputted data disaggregating and reaggregating them in a form usable for the next module. This methodology seems very robust in a scenario-oriented model but lacks some flexibility to model real transportation behaviour as a response to political and socio-economic inputs.	YES, As mentioned above, policy and economic effects should be manually reflected by the user lever choice.
Read Alan McKinnon's book: Decarbonizing Logistics	NO ACTION NEEDED

Q9. Does the scope of mitigation options ("levers") and the range of levels of ambition presented for sector(s)/module(s) you are reviewing cover the full range of credible futures? If not, what evidence suggests that the scope of levers and/or range of levels should be broader than those presented?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Freight transport levers are reasonable, although not convinced as to the relevance of vehicle utilization as it is currently described. I freight transport utilization rate is commonly used to reflect the combination of load factor and loaded operation (i.e. non-empty running) so in conflict with what you have	YES, the choice to aggregate the utilization rate in terms of vehicle.km/vehicle/year and load factor as ton.km/vehicle.km comes from the need to make the web interface simpler. The data used for load factor is supposed to represent empty running.
Why is the Freight mode split in technology? And I expected to have a Governance / Policies tab.	YES, we model the uptake of new low- and zero-emission technologies in freight as it is the case in passenger transport to be able to decarbonize freight transport, e.g. by electrifying shipping. As mentioned above, the model is not supposed to model policies as such, but the lever settings choice should reflect

	these.
Behaviour (Transport): Aviation seems to be missing from 'mode of transport' and 'occupancy'.	YES, this is because aviation is treated differently. The demand for passenger aviation transport is supplied by the lifestyles module. Furthermore, the occupancy of planes is supposed to be constant.
As an example, level 4 of ambition in the fuel mix (100% of biofuels providing the total transport demand) seems pretty optimistic	YES, this is why other levers should be used first to reduce the conventional fuel demand (electrification for example) before addressing the remaining fuel demand with biofuels. A warning is raised by the agriculture and land use module if the bioenergy demand is too high regarding the available sustainably sourced potential.
Yes, the levers seem to cover most ranges of credible future.	NO ACTION NEEDED.

Q10. Do the intermediate levels of ambition (levels 2 and 3) provided for each mitigation option ("lever") illustrate a useful set of choices, or should they be moved up or down?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
For freight transport levels 2 and 3 don't really differ significantly. You could convert the current level 3 to level 2 and then have an extra ambitious level that reflects where things really need to get to.	NO, I do not agree with the statement as the level 2 ambition represents a 22% increase in freight demand while level 3 represents a status quo.
The level of ambition 2-3 illustrates a useful set of choices.	NO ACTION NEEDED.

Q11. Are the modelling dynamics (e.g. sector interactions and feedback loops) covered correctly and sufficiently or is any important feedback/interaction missing?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Transportation modelling often relies on socio-economic data. Thus, I believe that the model could provide more precise forecasts of demand if it could use the data of previous years from modules (for example using the industrial activity of year t-1 to compute the demand for haulage at year t). However, this would induce two major problems. First, it would increase computation time by introducing retroaction loops and also require changing EUCalc's computation structure. Second, it would require more precise levers than the one currently used for transport.	NO ACTION NEEDED.
Good that the initial driver is total ton.km to allow manual adjustment of GDP decoupling. No other comment	NO ACTION NEEDED
For the lever "fuel mix" in the transport sector, interlinkage between so-called "e-fuels" and the electricity sector should be made clear. In case only	YES, Clarification to be brought with other partners.

renewable excess electricity would be used to produce "e-fuels", economic viability needs to be assessed.	
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Q12. Did you search for any technical documentation for the sector(s)/module(s) you are reviewing? Is it sufficiently comprehensive?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Yes, I have used WP2_transport, the figures illustrate the architecture of the module in a very clear way. I could easily find all the data I searched for.	NO ACTION NEEDED
Very comprehensive (at least for transport)	NO ACTION NEEDED
<p>Yes. Level of detail is OK, although disagree with some of the assumptions within...</p> <ul style="list-style-type: none"> • No mention of ammonia as a potential marine fuel, although it is generating quite a bit of interest. • It is incorrect to refer to ton as the unit of mass if you mean 1000kg; you should write tonne or metric ton, not ton on its own as that is something different (and also different on either side of the Atlantic). • Don't ignore air freight in case of increase – a small increase in modal share could have a big impact on emissions due to the extremely high emission intensity • Do you really mean 50% electric aviation on page 79 of tech doc? • Vehicle lifetime increases, whereas in practice scrappage of the existing vehicle stock may be necessary to accelerate turnover and bring in new technologies in time to meet required impacts 	YES, the 50% electrification is a typo and has been corrected in the input data.

Comments provided in other sections:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Just wondering about aviation. It seems to be in the mode of transport, but is it also in the distance travelled? I presume then the car dominance of 78% of travel km is lower? What is the justification for not having a separate aviation section?	YES, Aviation is treated differently as it can't be shifted to other modes for most of the trips concerned. Only short-haul trips can be shifted to rail, bus or car, but they represent a really small part of the total trips. The car dominance is expressed on inland transport demand, hence excluding aviation.
Behaviour (Transport) - Description of 'Car own or hire' include something about heating and residential floor space. Are they belong to this sector? The description/levels for occupancy and car own or hire are very similar (concerning the behaviour in car sharing)	YES, the car ownership or hire is part of consumption patterns, on the same level as heating and residential space. The definition between both indicators is not the same: occupancy represents the amount of people in a car during the same trip while the utilization rate represents the km travelled by a single car in a year.
Freight technology: what do the % mean?	YES, it represents the share of a particular technology in the total demand for this particular mode.
Freight mode looks a bit unambitious in shift from trucks to rail and water, no?	YES, Rail and IWW have a high but limited potential due to spatial constraints. Lever settings account for

	these constraints.
It took me some time to find passenger transport behavioural levers since transport is separated between key behaviours and technology and fuel. Especially since freight modal share is classified under technology. It is also confusing that technical information concerning those levers are given in the transport module document (WP2_Transport).	YES, Regarding the confusion on where to find the documentation of the levers. We will now directly link the one-pager description of the lever directly to the respective documentation instead of pointing out to a general page with all the documents of the module.
How come not too much changes when you select the ambitious target for transport? Wouldn't an ambitious climate policy (i.e. huge investments in public transport and taxes on flying/using cars) enable a bigger shift away from cars/flying?	YES. The ambition range has been defined to encompass Business-as-usual situation as well as disruptive but realistic scenarios, and the corresponding levels have been validated in workshops with transport experts.
The freight transport levers are all there, although we wouldn't necessarily group them or express them in the same way.	NO ACTION NEEDED
As an example, aviation and marine segments are missing in GHG emissions in transport	YES. They are present in the graphs, e.g. here http://tool.european-calculator.eu/app/transport/freight-emissions-mode/?levers=1111122ff112112221211ffffffff11f41111122111121112122212
The unit of Passenger distance per mode is unclear to me. From what I can read on the diagram, in 1990, the passenger.distance/mode was 6T? i.e. 6 tones? 6 trillion?	YES. This is the same for all graphs in the TPE: T is the symbol for Tera, hence 10^{12} . See https://en.wikipedia.org/wiki/Metric_prefix
(Comment on TPE outputs) It's missing an assessment of emissions per tonne kilometre as the best KPI for freight transport efficiency improvement	YES. The choice of indicators shown on the TPE has been made so that the user does not get lost in too many details. The proposed indicator is indeed interesting, but it can be calculated quickly from the emissions and tkm graphs
There is a disconnect between the measures under 'Manufacturing' and those under the end use products 'Transport' and 'Buildings'. E.g., material switch will have an impact on building energy use. Is this interplay modelled? Also, embodied emissions seem to be missing in these end use products. It seems some parts of the life cycles of these products are captured (e.g., the use phase in freight efficiency and material switch in production), but not all. Maybe some are also overlapping. What is the scope of this assessment?	<p>YES. Indeed</p> <ul style="list-style-type: none"> - the transport module covers the energy use of the transport vehicles. - the manufacturing module covers the product manufacturing <p>This means the end of life of the products and how the materials can be recycled is not covered. Furthermore, the energy use to recycle some materials is not covered either.</p> <p>There is however no overlap in the emissions calculation</p>
the average km travelled don't include the possibility that this value decreases heavily. why not?	YES, Given the general feedback pointing towards a higher level of ambition for level 4 also in other comments, we decided to further reduce the amount of distance travelled in this lever. This is done by alleviating the "rebound effect" of increasing travel for the purposes due to a reduction from the need to travel to work/study and access to services. In the original version of the EUCalc, all countries converge to the current level of travel for leisure as in rich EU countries by 2050. This assumption is alleviated so that the travel for leisure drops in 2050 to 70% of the value typically found in rich countries today. This would represent a shift in preferences for people to commute smaller distances for the purposes of leisure. This change is noted in the Lifestyle documentation, together with the remark that the change has been undertaken following the consultation feedback.

<p>Is international aviation and shipping part of the emissions?</p>	<p>YES. Marine is always international, and aviation is domestic and international, and both categories of aviation are grouped in a single one.</p>
<p>LDV? When I google this, I get a former UK car company Leyland?!</p>	<p>NO ACTION NEEDED Google? The user is advised to use Wikipedia instead.</p>
<p>This LDV sector has also three folded in the 1990s?</p>	<p>NO ACTION NEEDED. There is no "threefold" factor in the TPE for LDV related variables, be it pkm, TWh, GtCO₂,...</p>
<p>Freight emissions appear to be going negative in the 1990s.</p>	<p>NO ACTION NEEDED. Not the case for the current version of the model</p>
<p>First and foremost, on bioenergy across the tool</p> <ul style="list-style-type: none"> • In "biofuels" for transport you say using more biofuels is more ambitious. Do you apply a maximum potential of biofuels (a cap)? I cannot imagine 100% biofuels is climate friendly if passenger km's don't reduce drastically. • I think it is important to apply a cap of what biofuels and biomass can be sourced domestically and sustainably. This has to relate to land-use carbon sinks (which will be negatively impacted with more bioenergy use). The moment the users cross the EU-internal sustainable bioenergy potential, it should receive a warning sign. The additional bioenergy use (biofuels and biomass) is then assumed to be unsustainable or imported and, therefore, cannot be considered zero-carbon anymore. The model should then either stop offering that solution or add a value on emissions from imported bioenergy. • Please note these scientific papers underpinning the above points: <ul style="list-style-type: none"> ◦ EASAC, 2018: https://easac.eu/publications/details/commentary-on-forest-bioenergy-and-carbon-neutrality/ ◦ Trinomics/NRDC, 2019: https://www.nrdc.org/sites/default/files/burnout-eu-clean-energy-policies-forest-destruction-ip.pdf 	<p>YES. The potential for sustainable bioenergy is determined in the agriculture and land-use module and a warning is sent to the TPE user when the amount of required bioenergy is too high regarding this potential.</p>
<p>For many sub-levers, the detailed descriptive text has a blank space where the user expects a graph.</p> <p>The user expects to see something in this white space. Can you easily remove the white space when it is not needed? Or maybe you can provide some simple graphic representation of the different ambition levels. For example, this should be possible for the occupancy lever.</p>	<p>YES, this has been fixed.</p>
<p>"Car own or hire" lever. This lever seems to me to be redundant. Don't you have enough information to generate emissions from travel if you know km/person/yr, occupancy, and transport mode? Isn't sharing of cars implicit in occupancy?</p>	<p>YES. The more a car is used, the faster it is replaced with a new one, possibly with higher efficiency or different technology. This lever thus influences the technology share and efficiency of the vehicle fleet.</p>
<p>Car own or hire text. This text seems wrong. It talks about floor space per person</p>	<p>NO ACTION NEEDED This comment might refer to a late version of the TPE. In the current version online the description of Car owned or hired is correct.</p>

Freight distance. This is really annual freight transport demand, isn't it? If yes, name of lever should be more descriptive. And why is this in "consumption" and not in "transport?"	NO ACTION NEEDED All extensive quantities are expressed for a year, which is implicit given the way they are presented in graphs.
Passenger efficiency text. Ambition levels should be described as efficiency not energy consumption (which reflects efficiency and miles travelled/yr!)	NO ACTION NEEDED The lever is called efficiency, but it eventually sets the consumption level of vehicles, hence it makes sense to refer to the decreasing energy consumption in the lever description.
Passenger technology. Is there a vehicle stock model that underlies this lever? What are the assumptions around vehicle mortality and total vehicle sales? These seem important, and maybe should be available to the user?	YES, there is a stock model underlying the calculations. All assumptions can be found in the Transport module documentation available online .
Freight technology. Same comment as with passenger technology (above)	NO ACTION NEEDED Same answer as above.
Freight efficiency. Might be helpful to provide a bit more description around the type of truck that is represented here. Light-duty—which is suggested by the descriptive paragraph? Or medium and heavy-duty? And maybe it would be helpful to put a bit more text around the total energy consumed by those different types of trucks?	NO ACTION NEEDED All assumptions in freight efficiency and representation of trucks can be found in the Transport module documentation available online .
Freight mode: Typo	NO ACTION NEEDED
Graphs with errors (first round of Call for Evidence) https://drive.google.com/drive/u/1/folders/1EIRCJ3VMkcRoCydI6jqL9YGBp1W1jHmL	NO ACTION NEEDED Outdated
The Y axis' unit in the "Passenger distance per mode" graph may look confusing for a non-expert user. Also, two-wheelers legend is not shown within the graph as for the other transport modes. Similar problems with the legend were noted in other graphs in this same tab, too, namely: "Passenger energy demand per mode", and "Passenger energy demand per fuel".	YES. This is a general comment for all graphs in the TPE.
Where are biofuels (ethanol, biodiesel, HVO etc.) in the graph on "Passenger energy demand per fuel"? Also, the unit in the Y axis would work better in Tera Joules or MTOE, rather than TWh, which is more used for electricity rather than liquid fuels. Moreover, there is no biofuels in the graphs about "Cars Tech Share" and "Freight energy demand per fuel".	YES. The technology share only indicated the share of internal combustion engines vs other technologies, e.g. BEV. The fuel, whether conventional, biofuel or synthetic, does not change the fact that a car has an internal combustion engine. The missing categories in the graphs will be added.
Some graphs are not opening in the Transport tab. Unit in Y axis in the "Passenger GHG emissions per mode" should be MtCO ₂ eq y ⁻¹ , specially to clarify that it is in CO ₂ eq and that it is per year (rather than cumulative) - the same issue occurs for the "Freight GHG emissions per mode" graph and some other graphs in different tabs. The costs graph in the Transport tab is not opening, although there is a dedicated tab for costs (not operational yet).	YES. Outdated issue for missing graphs. The question of indicating that values are yearly values has already been treated above.

Comments provided at the 2050 Calc Conference in Windsor:

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Passenger Efficiency <ul style="list-style-type: none"> Not splitting it per technology reduces the 	YES. The levers, their number and scope and their design were approved in the stakeholder review

<ul style="list-style-type: none"> credibility This level is not seen as entirely useful; better to talk about technology Most were neutral about the levers Some disagree with lever 3&4 	process in mid-2018. Much more specific input is needed to address this comment.
Passenger Technology <ul style="list-style-type: none"> Ambition is not high enough on level 1 and 2 Even having no effort on level 1 then the baseline could still be 100% electric Level 1 and 4 were primarily disagreed with, whilst level 2 and 3 were neutrally received. 	YES. The levers, their number and scope and their design were approved in the stakeholder review process in mid-2018. Much more specific input is needed to address this comment.
Freight Efficiency <ul style="list-style-type: none"> Not splitting it per technology reduces the credibility Majority of levels were neutral, some disagreed with level 4 stating it was too ambitious 	YES. The levers, their number and scope and their design were approved in the stakeholder review process in mid-2018. Much more specific input is needed to address this comment.
Freight Technology <ul style="list-style-type: none"> Ambition is not high enough on level 1 and 2 Mostly neutral, mild disagreement on level 1 and 4; full electrification on trucks is a push by 2050, whilst the baseline is not ambitious enough 	YES. The levers, their number and scope and their design were approved in the stakeholder review process in mid-2018. Much more specific input is needed to address this comment.
Fuel Mix Regret the fact that the biofuels lever is not segmented from the e-fuels and hydrogen levers	YES. The model allows it, but it has been decided for the sake of ease of use that these would be grouped on the TPE.

5.2.2.6 Manufacturing

Q7. Do the sector(s)/module(s) you are reviewing answer the right questions, with the appropriate depth and modelling logic?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Industry - yes, good.	NO ACTION NEEDED
Answering based on the manufacturing module: The model architecture seems strange or a bit ad hoc. To me it seems like a (life) cycle approach would be more systematic and holistic, and simpler. It could be that it is just difficult to understand the model architecture completely.	NO ACTION NEEDED

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
They look OK for construction materials (material switch technical details).	NO ACTION NEEDED
Manufacturing (Technology and Fuels): the assumption that timber-based buildings being more climate-friendly can be controversial as the source of timber is not mentioned to be from a sustainable source, thus this could mean an import of timber from	NO ACTION NEEDED It is out of scope if the timber/wood demand is met by a sustainable source.

deforestation in other countries, shifting emissions out of Europe to other countries instead.	
Material switch: I would suggest making clearer the advantage of material switch - is it to use a lower emission material, to achieve emissions reduction elsewhere, to use less material overall? It should also be noted that the relative emissions of the two materials need to be taken into account - for example, the emissions intensity of aluminium per unit of material may be higher than that of steel, but overall there may be savings due to using less material, savings in vehicle fuel efficiency, etc.	YES, this is part of the modifications in Jan2020 showing the material switch impact in buildings.
Material switch: I think the 60% substitution of concrete for timber in the ambitious scenario seems too high - where will the wood come from (will it be sustainable, will it compete with other uses like biomass), and its use will be limited in taller buildings.	NO ACTION NEEDED Out of scope if wood is coming from sustainable sources, and if then in agriculture. Substitution rate is high, yes, but it is the assumption we made based on literature. No differentiation in small/high-rise buildings made.
Technology efficiency: I would rename this to something more like 'deployment of very low carbon technology' or 'deployment of innovative technology'. This is a better descriptor of what you are describing here. These are not just more energy efficient technologies; they are fundamentally different technologies/process routes with substantially lower emissions. You already have energy efficiency covered in another lever.	YES, this is a minor mistake which will be clarified. Should be technology share/deployment
HIIsarna process should have a short descriptor (maybe in brackets) after its mentioned. The average user would likely not be familiar with it.	YES, Will be adjusted.
It should be made clear whether or not the industry emissions include process emissions (ex. with a footnote on the figure)	YES, Will be mentioned additionally.

Q9. Does the scope of mitigation options ("levers") and the range of levels of ambition presented for sector(s)/module(s) you are reviewing cover the full range of credible futures? If not, what evidence suggests that the scope of levers and/or range of levels should be broader than those presented?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
I am unsure. It is hard to tell without the levers being presented along (life) cycles of products.	NO ACTION NEEDED

Q12. Did you search for any technical documentation for the sector(s)/module(s) you are reviewing? Is it sufficiently comprehensive?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Documentation for materials efficiency and materials switch seem good/appropriate. 'Geopolymers' (the more scientific term is 'alkali-activated materials') do not have zero GHG emissions, but this is fair enough high-level assumption. https://letters.rilem.net/index.php/rilem/article/view/6	NO ACTION NEEDED

<p>Yes, it's good and comprehensive. Note that the report you cite and discuss as unpublished in the material efficiency section "OECD/IEA (2019, upcoming), Exploring different clean energy pathways: the case of material efficiency, IEA Publishing" has been released. It can be found here: www.iea.org/publications/reports/MaterialEfficiencyinCleanEnergyTransitions/ and cited as IEA (2019), "Material Efficiency in Clean Energy Transitions", IEA, Paris, www.iea.org/publications/reports/MaterialEfficiencyinCleanEnergyTransitions/.</p>	<p>YES, Will be revised</p>
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Comments provided in other sections:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Manufacturing (Carbon Capture to fuel) - Confusing graphs with different ambition levels (are they telling the same story?)</p>	<p>NO ACTION NEEDED The lever settings are explained in the one-page description and the model documentation, carbon capture to fuel describes a technology switch.</p>
<p>In "Product manufacturing" and "material production" you say that pushing these outside of Europe is more ambitious. What is the impact of that on global emissions? One could argue we need to be more self-sustained and produce closer to consumption for global climate goals. Currently, we are shifting the hot potato of production to rest of world.</p>	<p>NO ACTION NEEDED, out of scope</p>
<p>There is a disconnect between the measures under 'Manufacturing' and those under the end use products 'Transport' and 'Buildings'. E.g., material switch will have an impact on building energy use. Is this interplay modelled? Also, embodied emissions seem to be missing in these end use products. It seems some parts of the life cycles of these products are captured (e.g., the use phase in freight efficiency and material switch in production), but not all. Maybe some are also overlapping. What is the scope of this assessment?</p>	<p>NO ACTION NEEDED, out of scope embodied energy.</p>
<p>Just to note some graphs appear to be missing (ex. Chemicals material demand and energy, graphs for some of the industry levers)</p>	<p>YES, will be updated and shown in the final version of TPE. The reason was due to a different naming convention or non-reliable results at this stage.</p>
<p>Material efficiency: Why do levels start in 2020 at different points? Do we have no idea about today's figures? Same for material switch</p>	<p>NO ACTION NEEDED It was generally agreed to start ambition in 2020, since we move on in 5 yrs. Although there is data available for 2017 or even 2018, the model allows it to start in 2020.</p>
<p>Industry section – I like the separation of sectors, overview as well as having energy and emissions.</p>	<p>NO ACTION NEEDED Thanks!</p>
<p>Product manufacturing: Ambition level 3 label is missing from my screen.</p>	<p>YES, this issue has been fixed.</p>
<p>In the "Material production" graph, pathways for cement scenarios do not seem to be accurately calibrated, showing some very abrupt changes overtime. There is also a strong variation in the historical data for cement – I would suggest having a double check of these values just for confirmation. Different figures, for instance, are presented in some related literature. See at:</p>	<p>NO ACTION NEEDED Calibration of historical data by JRC IDEES. This source was used for all materials shown in TPE. Data quality and reliability lies within this data source.</p>

https://setis.ec.europa.eu/system/files/Technology_Information_Sheet_Energy_Efficiency_and_CO2_Reduction_in_the_Cement_Industry.pdf	
Historical data for 1990-2000 in all graphs in Industry tab are constant, which is possibly wrong. I would recommend either to delete this historical data and start the series from 2000 or to update the historical data accordingly. The graph on "Energy Demand per Material" is also flat in the same period.	NO Due to missing historical data for the time period of 1990 and 2000 it has been decided to use the latest available data (starting 2000) and to fill missing data gaps.
Pathways for both "aluminium production techs" and "energy demand for aluminium production" appear very volatile, usually with a sharp peak in 2035. Are these credible transitions?	NO, the material production relies on activities and product demand coming from demand sectors (such as buildings, transport). Projections are based on increasing and decreasing demand and therefore dependent on these sectors. Transition pathways in each sector have been discussed and checked with sector experts in consultation phase.
Energy demand for lime production is extremely volatile in 2020 and 2025 according to different available example pathways, either increasing or sharply decreasing followed by an abrupt increase.	Same as above.

Comments provided at the 2050 Calc Conference in Windsor:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
Material Efficiency <ul style="list-style-type: none"> All agreed with lever 1 Lever 2-4 was a mix of agreed, neutral and disagreed 	NO ACTION NEEDED
Material Switch <ul style="list-style-type: none"> All agreed with lever 1 Majority were neutral for lever 2; 20% is too high All disagreed with lever 3 & 4 40% is too high for timber and 60% is also too high; level 3 & 4 are too ambitious 	NO ACTION NEEDED at this point
Energy Efficiency <ul style="list-style-type: none"> The majority agreed with lever 1 & 2, although lever 1 was considered too low for business as usual There was an equal spread between agree, neutral and disagree for lever 3 The majority disagreed with lever 4; it is too ambitious 	NO ACTION NEEDED at this point. Additional literature required
Fuel Mix <ul style="list-style-type: none"> All agreed with lever 1 & 2 Almost all were neutral with lever 3, with one disagreeing, whilst opinions were mixed for lever 4 Biomass seemed problematic because there wasn't enough Lever 4 is too idealistic 	NO ACTION NEEDED at this point
Carbon Capture in Manufacturing <ul style="list-style-type: none"> All agreed with lever 1 The majority disagreed with lever 2, whilst all disagreed with lever 3 & 4 20% is too ambitious in lever 2, whilst level 3 should be level 4 	NO, this lever and associated levels descriptions are available in the Manufacturing documentation (section 4.3.6). The levels' ambitions were selected based on the literature. They vary depending on the industrial sector and technology used. The "too ambitious" level (20% for lever 2, in 2050) only corresponds to the cement dry- and wet-kiln technologies, while the

	ambition is much lower in other sectors (e.g. 0% until L3 for paper, aluminium, glass).
<p>Carbon Capture to Fuel</p> <ul style="list-style-type: none"> Opinion on level 1 was mixed All disagreed with lever 2-4 Level 4 is unrealistic; level 3 should be 4 instead Cost should be addressed on the lever 	<p>NO What was maybe not fully clear: the carbon to fuel lever is used as a technology switch. It allows you to switch from carbon storage (level 1) to carbon utilisation (level 4) with two combined levels in between. As is discussed in the CCUS documentation this is not perfectly aligned with the ambition level definition, but it is also not required since all CCUS technologies quasi equally aid in CO2 emission reduction. Cost is addressed on the lever description.</p>

5.2.2.7 Minerals

Comments provided via email

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
The title of this tab (Minerals) may be inaccurate. Oil and gas for example are not minerals technically speaking, although they may be extracted from mineral sources. The term "Mines" may be a better option.	YES, this was changed to "Raw Materials"
Some graphs in this tab (e.g. aluminium demand) have some missing data. In addition, as observed in some other tabs, all graphs have a warning message regardless of the selected example pathway, even under the "ambitious" example pathway. This may be confusing for an ordinary user.	YES, the missing data are sent to the pathway explorer; they are not yet processed for visualisation. The warning messages are linked to 2015 mineral reserves allocated to Europe and are constantly turned on, especially with ambitious pathways because they require rare elements. The warning exact definition needs to be added somewhere in order to explicitly represent what they mean.
In the European aluminium demands per sector, why the energy sector dominates that? Although the production of aluminium is energy intensive, this graph is about aluminium demand. The energy sector demands it to produce parts of pipes and ducts, towers, generators etc. but it looks too high against other sectors. Is this because of the growing construction of wind generators across Europe? Are car manufacturing and buildings included in "others"?	YES, it is related to my previous comment and I have attached the results I obtained from my module. Energy concerns construction for energy infrastructure and represents 14% in OTS.
In Phosphate demand, the graph shows "... iron demands..." (rather than phosphate demand). In addition, there is an abrupt peak of phosphate demand around 2002 that deserves a double checking to see if this was not a typo in the basic data sheets. Idem for the graph on potash demand.	YES, this typo comes from my original google doc, which has been corrected since. Now, the titles are in line with what it should show in the appropriate google doc. The translation into the tool should be done soon hopefully.

5.2.2.8 Land use and Agriculture

Q7. Do the sector(s)/module(s) you are reviewing answer the right questions, with the appropriate depth and modelling logic?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)

<p>I would suggest the Legend for the land-use sector to be better organised, it is not that clear as the graph of other sectors.</p>	<p>YES, A major update of agriculture/food/land-use is under development, which will be updated by the end of January 2020.</p>
<p>Agricultural sector. See my previous comments which are applicable here too (if I am looking for something specific, for e.g. development of livestock units in Sweden under certain assumptions etc, I find the information that I want. It is not clear though what input and references are used. Observe that in "climate smart crops" and "climate smart livestock" the graph uses numeric, but the description uses letters.). But apart from that, I find the interface with the sectors useful and easily read. It would be useful to be able to click on the graph and see the references or what input is used</p>	<p>NO ACTION NEEDED All the data used is referenced explicitly in the technical documentation, available by clicking on the levers' names pagers (see the bottom of the page). FAO's data is used as input regarding livestock yields and slaughter-rates (Section 4.1.2.3.). NO ACTION NEEDED GHG mitigation effort cannot be ranked through a 1-4 scale as it is highly correlated to other levers such as the diet, bioenergy or biomaterial demand. Thus, a A-D scale has been used to avoid ranking the 4 possible scenarios.</p>
<p>No. They seem too polemical in tone and sources. This is unfortunate in that the results they support are usually fine, but the modules themselves support a lot of false premises</p>	<p>NO ACTION NEEDED The agriculture and land-use modules are mostly based on FAOSTAT, EUROSTAT and IDDRI's database which are considered robust. If any polemical sources, please mention the exact reference(s).</p>

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>On biofuels no. Looking at 2015 data is highly misleading. More recent data shows a different biofuel mix. Saying "food biofuels" is like calling a tax on estates a death tax. It is a loaded and entirely indefensible term that leads to a set of incorrect assumptions. Effectively nothing used to make biofuels is headed towards a human mouth and then diverted. These are crop biofuels. Using low quality crops for transport is nothing new. The reason why Europe had more land under wheat cultivation 120 years ago than it does today is because that the worst part of that crop was what horses ate for energy. There is really no need to use loaded terms. The focus on advanced biofuels is not tenable. If 95% of what exists is not advanced but 95% of sources are people who are fanatic believers in advanced, then that is a problem if their predictions will fail. Since their predictions from 5 years ago failed, this is a salient concern. Same with predictions from 10, 15, 20 and 75 years ago. These are not experts in biofuels; these are experts in biofuels rhetoric, and this situation is now ridiculous. I think we had our meeting a year ago. What success and movement has there been since then? Zero. Just like every year. There are still 30 bold announcements every year, just like every year, and no actual projects. Once in a while something is built and then goes bankrupt. In the face of this objective trend, it is just indefensible to give credence to an argument that is being made for the 25th year in a row and is always wrong. I say this as the company that in six months will bring online a large advanced biofuel plant and so as someone who can actually walk the advanced biofuels walk. Not despite, but because of that credential, I say that the talk and tone in your background papers about</p>	<p>NO ACTION NEEDED We could not find any mention of "food biofuels" neither in the tool nor in the documentation. The model keeps track of each kcal consumed, including human food, animal feed, bioenergy and biomaterials. Both advanced and conventional biofuels data and assumption are mostly based on EUROSTAT and Capros, P., De Vita, A., Höglund Isaksson, L., Winiwarter, W., Purohit, P., Bottcher, H., 2013. EU energy, transport and GHG emissions trends to 2050. Please back-up any statements / numbers with some literature and remind that Calculators are exploratory tools that aim at exploring what is technically possible, not what is probable.</p>

<p>advanced biofuels is just rubbish. It reflects something like consensus, but that is a dumb consensus based on decades of the fundamental assumptions behind that consensus being so consistently disproven by reality. If the aspirational consensus was right, we'd have every possible financial incentive to support that vision, but that vision rests on objectively false technology and agricultural premises. And also, with another passing year, the empirical data shows that yield intensification and not land expansion is what absorbs the bulk of demand support coming from crop biofuels. All the 2010-2020 econometric models predicting high crop prices, so ILUC from biofuels are now only of historic interests. The crop price increases just never happened. Of course, at some level the elasticity of the sector and actual physical limits will be reached and so the 25% cap is an excellent part of the calculator.</p>	
<p>Domestic supply (Food Production): European countries becoming net exporters of food. Do emissions from transportation still occur as when Europe was a net importer?</p>	<p>YES, this is not modelled in the tool. The 'tonne km' lever models the demand for freight transport economy-wide, irrespective of the sector. There is no link between the import ratio and the tonne km lever. To model this effect, the user has to reflect it by an adequate setting of the tonne km lever representing an increase/decrease of the freight transport demand depending on the import/export profile in various profiles.</p>

Q9. Does the scope of mitigation options ("levers") and the range of levels of ambition presented for sector(s)/module(s) you are reviewing cover the full range of credible futures? If not, what evidence suggests that the scope of levers and/or range of levels should be broader than those presented?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>No, but what is presented is good for its purpose.</p>	<p>NO ACTION NEEDED in the absence of a more concrete suggestion there was no action undertaken.</p>
<p>As an example, level 4 of ambition in the fuel mix (100% of biofuels providing the total transport demand) seems pretty optimistic</p>	<p>YES, this is indeed optimistic, and this should be reflected by a warning in the agriculture/land use sectors regarding a too high use of bioenergy compared to its sustainable potential.</p>

Q10. Do the intermediate levels of ambition (levels 2 and 3) provided for each mitigation option ("lever") illustrate a useful set of choices, or should they be moved up or down?

- Overall, useful and thoughtful

Q11. Are the modelling dynamics (e.g. sector interactions and feedback loops) covered correctly and sufficiently or is any important feedback/interaction missing?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>In the ambitious scenario the % of land used to grow timber is very high, and the amount of cropland is</p>	<p>NO ACTION NEEDED Cropland demand is associated with the diet, bioenergy and biomaterial demand.</p>

<p>very low. Where does the EU get its food in this scenario? I can't find the answer to this question.</p>	<p>Depending on what you call the ambitious scenario, lower use of crops may come from diet shift (decrease of meat consumption), bioenergy and biomaterial (crop-based) lower demands, or a decrease of the self-sufficiency ratio (lever input). Forests are not necessarily used to grow timber depending on the lever setting, one may use it for biodiversity for example, or else to increase the forest carbon stock (biodiversity / land-management levers).</p>
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Q12. Did you search for any technical documentation for the sector(s)/module(s) you are reviewing? Is it sufficiently comprehensive?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>On biofuels it is all from authors with no actual knowledge of biofuels-- just of models. Actual industrial realities are not reflected</p>	<p>NO ACTION NEEDED The model includes all possible settings in between the use of dedicated crops to only residues and wastes feedstock (biomass hierarchy lever) / and in between the current levels of production (2015 level) to the maximum potential identified in the literature (see technical documentation).</p>
<p>Detailed comments about the supplementary technical document on agriculture and land use were already sent by email long time ago by email, respectively on 8 July 2019 and 17 July 2019. However, only the original draft⁸ of the technical document released on 28 May 2019 is currently available online i.e. only the old version, apparently without any change or update. I guess this file will be updated soon based on the comments earlier sent and other possible updates, which is very important for improving the original draft.</p>	<p>YES, Technical documentation has been updated by November 2019, but it seems that it is not available online. The new version will be updated.</p>

Comments provided in other sections

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Climate smart crop production. Use of "production" is a bit confusing given that graphs are declining over time. Consider renaming as something like "losses from crop production"</p>	<p>YES, Production is short for the production system, which explains the confusion. We will update the lever name to avoid confusion. The production level is set through the food self-sufficiency lever, not by the climate smart crop system lever.</p>
<p>Climate smart livestock. Consider renaming "losses from livestock production"</p>	<p>YES, Same as above</p>
<p>Forestry practice. I'm not sure what the graph is trying to show.</p>	<p>YES, Forestry tab were not available at that time. It will be added in later version of the tool (January 2020)</p>
<p>Land management. I am not sure what this graph is trying to convey.</p>	<p>NOT SURE Possibly the lever name is also confusing and should be renamed land dynamics.</p>

⁸ See [at: http://www.european-calculator.eu/wp-content/uploads/2019/09/EUCalc_Agriculture_land-use_documentation.pdf](http://www.european-calculator.eu/wp-content/uploads/2019/09/EUCalc_Agriculture_land-use_documentation.pdf)

<p>It would be helpful to better understand the relationship between forestry practices, land management, and biodiversity levers.</p>	<p>YES, the interlinkages are the results of distinguished practices that can be seen in the land-allocation graph. Forestry Practice lever is working the same way as climate-smart agriculture and set the production system practices (e.g. harvest rate). The name will also be updated</p>
<p>Food production. Suggest using a different word than "cakes" as this may not be well-understood by casual users.</p>	<p>"Cake" is the most proper name, but I acknowledge that casual users may be confused. Nevertheless, I would rather add a definition than changing the name as the cake-biofuel-meat nexus is critical for expert audiences.</p>
<p>It is not clear to me how bioenergy is being treated in this exercise and this is quite an essential feature: (1) "bioenergy capacity" under land-use is not specified or explained, (2) "hierarchy for biomass end-uses is hard to understand. I think we should show a clear "cascade use for biomass", starting with (a) its primary purpose for biodiversity and the related natural carbon sinks, then (b) I guess as fertiliser or as construction material to replace carbon-intensive steel, and (c) at the very end for energy use. That cascade is an essential feature across the calculator but doesn't come out well. Could we add a cross-cutting lever where people can play with the cascade principle? Does "other possible uses" mean other than for energy? That would be good to spell out. Note that I see biomass in the fuel mix for manufacturing but not for power. But again, this should only be added on the condition that the cascade is clarified.</p>	<p>Crop-based bioenergy falls into cropland category, and wood-based bioenergy falls into forest category. Other industrial wastes and residues are not pictured in the land allocation but in the bioenergy feedstock mix.</p> <p>The biomass hierarchy follows the waste hierarchy set by the European Commission and considers the lifespan of wastes (most ambitious being direct use and the least one being disposal). The point of the lever is to let the user choose how biomass residues and wastes are used, not to set a hierarchy that would impose the user a choice. Effort will be made to clarify the lever description.</p> <p>Other-uses indeed means non-energy-uses, which will be clarified in the technical document.</p>
<p>In "biofuels" for transport you say using more biofuels is more ambitious. Do you apply a maximum potential of biofuels (a cap)? I cannot imagine 100% biofuels is climate friendly if passenger km's don't reduce drastically.</p>	<p>NO ACTION NEEDED Given the mentioned issues, we chose an A-D scale that enables us to remove the ranking of ambitions. Indeed, some settings are not sustainable which can be reflected in the land-use type. For example, large amounts of crop-based biofuels will imply deforestation and/or a decrease of the self-sufficiency level (depending on the lever setting). Such a scenario triggers a warning to inform the user about this issue.</p>
<p>I think it is important to apply a cap of what biofuels and biomass can be sourced domestically and sustainably. This has to relate to land-use carbon sinks (which will be negatively impacted with more bioenergy use). The moment the users cross the EU-internal sustainable bioenergy potential, it should receive a warning sign. The additional bioenergy use (biofuels and biomass) is then assumed to be unsustainable or imported and, therefore, cannot be considered zero-carbon anymore. The model should then either stop offering that solution or add a value on emissions from imported bioenergy.</p>	<p>NO ACTION NEEDED A cap is set but not through a lever setting, as it depends on the combination of a wide range of levers. For example, a decrease of meat consumption can free lands for bioenergy. Thus, a warning is displayed when wastes and residues are not sustainably available, and when deforestation occurs because of cropland demand increase. Nevertheless, import/export is a choice of the user, thus there is no warning for this feature.</p>
<p>Please note these scientific papers underpinning the above points: EASAC, 2018: https://easac.eu/publications/details/commentary-on-forest-bioenergy-and-carbon-neutrality/Trinomics/NRDC, Trinomics/NRDC, 2019: https://www.nrdc.org/sites/default/files/burnout-eu-clean-energy-policies-forest-destruction-ip.pdf</p>	<p>Thank you for your inputs</p>
<p>From Agriculture to forestry: should A and B not be the other way around? Ambition means more forestry, right?</p>	<p>A-D scales means that there is no ranking. For agriculture, A means highly intensified production systems, whereas D means intensified (agroecology) production system.</p>

<p>If we take for example the agriculture tab: The Y-axis name doesn't make sense to the non-expert. I guess "LSU" refers to something like "Livestock units", but I'm not sure. Please spell it out. When you hover over the chart with your mouse, the tooltip should indicate the total for all categories. Also, in the tooltips, show the figures rounded and as millions (e.g. instead of "Lying hens: 7478723.26", show "Lying hens: 7.5M", it would be infinitely clearer. Also, animals units should always be integers. Finally, it is spelled "Laying hens", unless you're referring to mythomaniac fowl)</p>	<p>(To discuss with Bernd before answering) We will update the tool as you suggested.</p>
<p>Small description of countries specificities could be helpful (e.g. why such a large land use change for Bulgaria). I found no answer about this.</p>	<p>NO Linking all settings (billions of them) with text is not humanly feasible. Automatizing such features would also possibly lead to wrong interpretation.</p>
<p>Something wrong on forestry practices as all levels the same? If so, what is the point of the sector?</p>	<p>YES, to be updated, this is a glitch.</p>
<p>The second issue is that the results seem to be a bit odd. For example if I choose the EU LTS 1.5LIFE pathway the graph shows the EU reaching zero net emissions in 2025 (thanks to a truly staggering amount of carbon dioxide removal in the land use sector) and then returning to net positive emissions in 2050 (see screenshot below). Is this a glitch? There is a similar pattern in the EU reference scenario (and possibly others – I haven't checked all of them).</p>	<p>YES, the glitch has been corrected.</p>
<p>Finally, it seems that the bioenergy lever isn't yet operational, but this is one the issues that is of most interest to us in WWF (and I imagine to other environmental NGOs).</p>	<p>YES, the bioenergy lever is now operational</p>
<p>In particular it would be interesting to know: How the model addresses the issue of dedicated energy or biofuel crops. Based on the studies we've seen (e.g. the examples included below) we would expect reforestation – or even simply land abandonment followed by natural succession – to deliver greater net emissions benefits than using land for bioenergy or biofuel crops, even taking account of the displacement of fossil fuels. Do you know how this is dealt with in the model?</p>	<p>YES, Online version of TPE reviewed had some glitches in several sectors, causing errors in overall results/graphs. FYI, LULUCF module has just been implemented and it still remains to be adjusted. The bioenergy flow is under implementation, bioenergy demand will be driven by the end-user, such as the biomass you want to consider or to exclude (e.g. food-crop-based). Whenever the demand is too ambitious compared with the supply, the model will provide a warning for land-use scarcity. The buffer can either be trade or deforestation, which is/will be clearly mentioned as a drawback. Nevertheless, the availability of sustainable feedstock will result from the multiple biomass demands, including food, feed, non-food and bioenergy. The model is being agnostic, the land scarcity will be pointed out, but not directly biofuel overconsumption. As long as food requirement is fulfilled, land scarcity can stem from meat overconsumption, or alcoholic beverages for example, not just biofuels. Thus, through the warning, the user will know s/he can explore, diet shifts, and/or bioenergy and biomaterial reduction to avoid land scarcity issues.</p>
<p>It would be interesting to know whether the model allows the user to choose to increase the level of forest biomass use and if so, what feedstocks are involved and how carbon debt is dealt with.</p>	<p>Although not fully updated, the technical document of Land use and Agriculture should provide a preview about the methodology for addressing biomass feedstock availability in the model. Please know that demand for biomass (either bioenergy or e.g. timber for construction) is controlled by a user depending on her/his choices and settings in demand-side sectors (e.g. buildings, transport, energy supply, industry), mainly through levers linked to technology/fuel switch and material switch. We bring to your attention land use module levers such as Land management and</p>

	<p>Climate smart forestry allowing users to control the extent of freed/occupied land and reforestation, as well as rate of forestry harvesting. We'd be happy to receive your comments on the document.</p>
<p>What assumptions are made on the percentage of harvested wood that ends up in products and what the lifetimes of those products are</p>	<p>This information is not a direct assumption but the results of various levers that set the switch for biomaterial (e.g. building insulation), and the lifetime of products set through lifestyles and technology lever settings.</p> <p>For agriculture, the scenarios include maximum intensification, current trends continuation, sustainable intensification and agroecology. The first version of the model followed the approach that you suggested, enabling the user to choose the extent of each practice deployment. Nevertheless, this approach has been redesign given the stakeholder workshop's feedback. The stakeholders suggested to limit complexity for the user and to provide such trajectory rather than a specified deployment pattern for each practice.</p> <p>[kcal, to update] kcal is more suited to compare food-feed requirements and to allocate the burden of crop production towards different-uses. Nevertheless, for the yields it may be more user-friendly to actually show the values expressed in tonnes, which will be updated.</p>
<p>Another point (reg Climate smart crop production) is what is climate smart agriculture? To use more agricultural inputs is not necessarily a bad strategy in terms of climate change mitigation, because the total GHG emissions per ton of grains produced, for example, may be lower in conventional intensification than in agroecology systems, although possibly not in terms of harvested area. Some users may note that while running the webtool, but some users may think there is a mistake in the</p>	<p>YES, this setting is available in the climate smart production setting. Moreover, the A-D scale has been chosen (no ambition ranking between scenarios) over the 1-4 scales for this exact reason.</p>
<p>On the lever's pager for Climate smart livestock, pathways for levels 3 and 4 look the same in the graph. The first paragraph of this pager is almost a repetition of the "climate smart crop production" pager. Similar comments for the previous lever are applicable here as well. Moreover, the rationale between levels 1-2 and levels 3-4 is confusing, e.g. livestock intensification decreases from level 1 to 2, but it increases from level 2 to 3. I presume it was firstly referring to conventional intensification and then to sustainable intensification, but this issue is not clear on the pager.</p>	<p>YES, A glitch has been removed that was effectively affecting the level D.</p>
<p>There is neither a graph nor a diagram available on the lever's pager Bioenergy capacity. In addition, the pager says, "The European Union biofuel (biogas and solid biofuel) based electricity generation capacity was 28 TWh in 2015, with an average increase of 13% per year since 2005...". Is this calculation correct? 13% a year leads to an exponential increase (compound rate vs simple rate). Please also note that the first part of the second paragraph below the blank part is the same as the previous paragraph.</p>	<p>NO ACTION NEEDED Data comes directly from Eurostat data and analysis.</p>
<p>What do you mean by biogasoline? FT gasoline? Is bioethanol included? Is HVO included in biodiesel? What are the amounts of liquid biofuels in levels 2, 3 and 4? It is also not clear on the pager if bioenergy</p>	<p>NO ACTION NEEDED Biogasoline refers to the Eurostat definition: Biogasoline includes bioethanol (ethanol produced from biomass and/or the biodegradable fraction of waste), biomethanol (methanol produced</p>

<p>may (or may not) be imported to meet the projected demands, and if it will come partially from wastes (the user may be confused while looking at the lever on the hierarchy for biomass end-uses, which is about wastes). A clarification note on the pager may be helpful.</p>	<p>from biomass and/or the biodegradable fraction of waste), bioetbe (ethyl-tertio-butyl-ether produced on the basis of bioethanol; the percentage by volume of bioetbe that is calculated as biofuel is 47%) and biomtbe (methyl-tertio-butyl-ether produced on the basis of biomethanol: the percentage by volume of biomtbe that is calculated as biofuel is 36%). Bioethanol (code 55461r) is a subcategory of biogasoline. Biogasoline is the sum of pure biogasoline (code 5546r) and blended biogasoline (code 5546o).</p>
<p>On the pager Alternative protein source, the graph shows a unit in percentage, but the value is not, it is like 0.1, 0.2, 0.3, rather than 10%, 20%, 30%. Thus, a user may not understand if it is 0.2% or 20%. Moreover, the graph is an illustrative figure for poultry, but it does not match with the descriptions for poultry feed in the levels below the figure. Level 4 for poultry fed by insect meals would reach 30% for example, whereas the graph shows a maximum of 15%. Also, what about a higher use of yeasts (a common by-product from the beverage and bioethanol industry) that are probably more viable than algae as an alternative protein source for animal feeding?</p>	<p>YES, Alternative protein source is a separate lever given the uncertainty of its deployment. Yeast use is also considered (as well as other by-products from the agri-food industry) through the biomass-hierarchy lever that drives industrial by-products towards different markets. The one pager of the lever is wrong in its description, and it will be updated to remove the inconsistency between the text and the graph.</p>
<p>Another issue about the lever (Alternative protein source) is the idea of "spare lands". While microalgae may be produced in coast or in natural lakes, it may occupy land space when produced in artificial ponds or in plastic bags/structures. In the case of producing algae in reactors with artificial lightening, there is also an energy penalty and relevant costs associated with. Regarding insects, how are they supposed to be fed? Only with crop residues? Is it included in the calculations the trade-off of using food residues for insect feeding rather than using it directly as an animal feed, a bioenergy source or an organic fertilizer increasing soil C? If so, the user should be informed about that; otherwise, only the modeller will be aware of these dynamics. It is important to highlight that (as observed for the Global Calculator) only very few users are likely to access the supplementary technical documents and read them carefully.</p>	<p>YES, Sapre lands come from better yields, but the actual land-use for these alternatives are considered. Insects are assumed to be fed by wastes only. The biomass hierarchy enables the wastes/residues/by-products to be sent towards different markets. When the setting is not consistent with biomass availability against biomass demand, a warning will be displayed (not implemented in the version you had). Fertilizer dynamics is also considered for both synthetic and organic using UNFCCC inventories and FAO factors. The interface is being updated to display extra graphs regarding input uses and emissions by sources.</p>
<p>On the pager Forestry practices, the graph shows an example pathway with a same projection curve for all levels. In level 1, what do you mean by "current trends"? Historical trends? Level 4 is extremely ambitions (possibly incredible), although still in line with the calculator's rationale, but is the trade-off with biodiversity conservation also included in this trajectory? Large trees are part of a balanced ecosystem. If the periodic harvest is kept to a minimum, the impact is low, depending on the forest resilience level and its succession stages. However, if the harvest rate is not that low, significant impacts on biodiversity may occur. Besides, managed forests (apart from their several benefits) may affect landscapes and require infrastructure e.g. internal roads for machinery, transport of harvested woods etc., generating several turbulences. In high-slope areas for example it is not easy to harvest selected trees sparsely distributed in natural forests, although level 4 considers 100% of all public and private forestlands being managed as a technically possible scenario. The point is: how to restore (at least partially) some pristine natural forestlands in Europe in such a case? Are protected parks also included here? Is there any interaction of this lever with the</p>	<p>YES, Forestry features were not displayed in the current version of the TPE, but it will be for the next version (January 2020). Current trends mean historical trends. Harvest rates depend on the country's historical trends and are set for the future depending on the lever setting. The sustainable harvest rate is set based on literature. Biodiversity is included through land-sparing but not land sharing. The latter part is already investigated but not in the context of the EUCalc project. Level 4 is supposed to be technically achievable even though this is not probable. 100% may be exceeding the technical limit, and we may investigate if level 3 should be considered the level 4.</p>

<p>lever for “area set aside for nature...” in the Biodiversity set? These interactions are not clear.</p>	
<p>The term “land management” is probably not intuitive, given that it can mean many other things e.g. how farmers cultivate their croplands etc.</p>	<p>YES, the term is not representative and will be updated for land dynamics.</p>
<p>Similar to pager on Forestry practices, the graph on “land management” shows the unit in percentage, but the value is not in percentage. Moreover, the graph, although illustrative, shows a situation in which all pathways remain flat from 2025 to 2050, which sounds confusing for an ordinary user, although they are connected to the availability of freed-up lands.</p>	<p>YES, we will update the interface to ensure there is no confusion between a 0.X and X% for the end-users. The graph may not be a line graph, but it has been done this way to align with the other modules.</p>
<p>Pager Land management, in the second paragraph right below the graph, what do you mean by “e.g. the extent of settlements cropping on forest lands”? Do you mean peripheral agriculture (e.g. horticulture) around urban areas being expanded on surrounding forestlands?</p>	<p>It refers to the land-dynamics patterns, for example, when settlements are extended it will crop on other lands such as forest, cropland and so on. In other words, it represents the UNFCCC land-use transition matrix and how it may evolve.</p>
<p>Also, linked to Land management lever, a brief definition of “freed-up lands” would be useful on this pager, because as already mentioned only very few users may access the supplementary technical document and read it entirely. In the lever’s levels, the term “free lands” is also used, which may sound confusing. Also, what do you mean by forests here? Planted forests, natural regeneration, commercial forests, natural forests? The same for prairies, do you mean natural grasslands (without livestock)? In addition, why not expanding some energy crops in part of these potential surplus lands?</p>	<p>YES, Definition will be added</p>
<p>Hierarchy for biomass end-uses. The lever’s title may be counterintuitive, given that it is about the organic wastes and residues, rather than biomass as a whole. Also, as noted for other pagers, the percentage unit vs values should be corrected in the main graph. The graph shows an illustrative scenario that sounds unrealistic, with 100% of biomass to liquid fuel in level 4 and, besides, this not connected to the textual description shown for the levels below it. Information about the “deployment of advanced bioenergy” in levels 3 and 4 is missing.</p>	<p>YES, Lever name will be updated. Values issues have already been discussed in the previous comments.</p>
<p>Land use Tab. Graph on land share per type. It might be useful clarifying what types of area are included in this graph. Is this only about productive land plus settlements? I might also be good splitting “others” into subcategories, given that its total amount is too large to remain as a single category. Where are ice cover and sheets, and arid lands? Otherwise, “others” should be followed by a brief description in brackets, e.g. “others (xxx, xxx, xxx)”. Also, the EU total territory has about 447 million ha (incl. about 3% of inland waters, but excluding overseas territories such as the Denmark’s Greenland, French Guiana, etc.), but the graph shows approximately 680 million ha, exceeding by far this total. Is that correct?</p>	<p>NO ACTION NEEDED The land-use data is based on the UNFCCC official inventory that is the only available dataset for land-use and land-use change that is available for each country and each year since 1990, enabling to track the carbon stock dynamics. “Other” lands are not available with subdivisions for all-countries and will add a lot of complexity in the model as the carbon dynamics already relies on 180 factors per country per year with only 36 land transition possibilities. In other words, the additional complexity is not worth the value added of including more details for others. The overall European surface is including non-metropolitan areas (UNFCCC inventories) which explains the gap you mention (e.g. Denmark).</p>
<p>Still about the graph on land-share per type, while selecting some example pathways, e.g. “key behaviour”, the total land area in 2050 is significantly smaller than in 2020, but what happens with this land excluded from the graph? Has it become an abandoned land? Note that even an abandoned land</p>	<p>YES, A glitch in the overall framework has been spotted and corrected. The dynamics of unmanaged lands follows the UNFCCC patterns for such lands.</p>

<p>has something (incl. carbon and biodiversity dynamics), for instance, it may become a forestland or a grassland under natural regeneration overtime, or even an area under desertification process.</p>	
<p>Land use Tab. Graph on LULUCF emissions. For clarification, I would suggest including the term "equivalent" in the Y axis' unit, i.e. MtCO₂eq, given that it also includes N₂O and CH₄, and not only CO₂, right? It is also per year and not cumulative, so the unit should be MtCO₂eq y⁻¹. Legend of this graph is confusing and not very didactic for an ordinary user. In addition, while hovering the mouse on the graph, it shows less categories than the number of categories described below the graph, and it is difficult to identify what is each category in the graph.</p>	<p>YES</p>
<p>Graph Forestry production. This graph was unavailable in the assessed version.</p>	
<p>Agriculture Tab. Livestock production. All example pathways available in the draft tool shows a significant reduction in total livestock populations. Is an increase in total livestock also a credible example pathway? Furthermore, for clarity, the curve for lying hens should be close to poultry, rather than above dairy cattle.</p>	<p>NO ACTION NEEDED The livestock patterns are closely linked to dietary changes and self-sufficiency ratio. Moreover, the current trend is negative since decades, which explains that only a few scenarios will lead to an increase of livestock (e.g. no diet shift and an increase of self-sufficiency ratios)</p>
<p>Animal-based food production. An alternative version of this graph in weight terms would be useful, too, given that "animal fat" for example is very energy intensive, but in weight terms it would not be that high. This additional graph could be shown right below the current graph. On the other hand, milk may distort the graph in weight terms, because it has a lot of water content and therefore weight.</p>	<p>NO ACTION NEEDED Kcal approach has been kept limiting computation time. The option of having both tonnes and kcal will depend on speed trades-off but is not at all a technical challenge.</p>
<p>Animal-based food production. The energy unit in kcal should be reconsidered, because the Y axis is in fact in T kcal (idem for other graphs in this same tab), so the unit it could be written in tera kcal directly.</p>	<p>YES, we will discuss the opportunity to change units</p>
<p>Crop consumption per use. The example pathway "past trends" is not consistent with the scenario shown in the graph by 2050. Bioenergy for example tends to zero. Apart from new EU regulations, this is not a historical trend, right?</p>	<p>YES, A glitch was spotted and corrected.</p>
<p>Crop production per type. Apparently, there is an error in this graph. Also, while hovering the mouse, some categories described in the legend below it is not showing up (e.g. starchy roots). In addition, "pulses" is a very common term in British English, but users from other nations may find it confusing. In the U.S. for example they usually say "legumes" for beans, lentils etc. (rather than pulses), although legumes can also mean different things in other countries and languages. Maybe "pulses (leguminous crops)" would avoid any misunderstanding.</p>	<p>NO, the food groups follow the aggregation and names of FAOSTAT, which will be kept to be consistent with the key database and state of the art scenarios (usually based on FAOSTAT too).</p>
<p>Typical livestock ration. Apparently, this graph is also trying to find an unavailable data, showing an error message. The graph title is unclear, perhaps "Average livestock feed ratio". Again, some categories are not visible while moving the mouse over the graph. Besides, is</p>	<p>YES, Sugar crop issue has been spotted and will be corrected in the next version of the model.</p>

imported feed (e.g. soybean) also included in this graph?	
Bioenergy. No graph was available for this section in this EUCalc version.	YES, Not presented in the graph in this evaluation period. It will be available at the end of January 2020

Email (similar to online/table above): I have followed the instructions and provided feedback via the online sheet. Notwithstanding that I wanted to raise my main point per email as well which relates to the question **how biomass is treated in the tool**. As it stands, I'm not sure whether and what cap the tool sets on available sustainable biomass for use in the economy. Such a cap is quite important as it avoids over-optimism about the potential of these resources. This piece from [ECF and ICCT](#) finds around 220MT per year of dry biomass available in Europe (domestically) from wastes and residues. If converted to liquid fuel, this equates to roughly 30 Mtoe, but it can be converted to other energy uses as well of course or used in construction sector. As a stretch scenario, one could add winter crops as per this [Gas4Climate](#) study which adds about 50% to the total, although we believe this is really a stretch scenario. The ICCT argues, rightfully we believe, that in a world with growing population and a need to increase land-based carbon removals, there is not much land available for winter cropping. Generally, and given the importance of land-use and biomass in the Net Zero debate, it may be worth making it more visible to the user what end-uses it allocates these biomass sources to and how that impacts natural carbon sink potential. Lastly, it is also not immediately clear whether a difference is made between domestic biomass for energy and imported biomass for energy. We believe the latter should not just be considered zero-carbon at point of combustion. There is quite a large consensus on this point as this piece from EASAC and this piece from Trinomics/NRDC exemplify. Also this piece of Forest Research is worth considering. In table 5.1 it shows that, in terms of the difference between GHG savings from domestic bioenergy vs savings from imported wood pellets, imported bioenergy pathways offer around 120 MT pa less savings than delivered by domestic energy crops (and about 150 MT less savings than doing zero-carbon RES instead).

Comments provided at the 2050 Calc Conference in Windsor:

Food & Land

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Climate Smart Crop Production <ul style="list-style-type: none"> Levers were a bit technical Agriculture lever ambitions are all fine, but diets should be extended to include insects, lab-meat etc. 	<p>NO ACTION NEEDED Technical documentation has been updated. Insects are included for livestock but both insects and lab-meat have not been considered because of cultural acceptance uncertainty.</p> <p>The case for a substantial shift in preference for insect-based food was not accounted in diets. Various consumer surveys focusing on European preferences point to a low willingness to consume insects as a meat substitute. In Belgium only 19% of people surveyed stated that they would be prepared to eat insects as a meat substitute (Verbeke et al 2015), similar levels of acceptance have been reported in Germany (Hartmann et al 2015). Given the choice, the survey respondents preferred products not containing insects to products containing insects (Schosler et al 2012, Tan et al, 2016). For example, in a survey for the Netherlands only 4% of the interviews chose a snack containing insects (Boer et al 2015). Because there seems to be still an early resistance to accept insect-base products, and because there are other easier dietary shifts to explore, it was decided not to account for this food item for the diets in Lifestyles.</p> <p>Regarding the laboratory meat. Novel technologies for production of lab-grown meat have been labelled as TRL between 2 and 3, similarly algae meat substitute has been classified as TRL 3 and 4 (Smetana et al, 2015). These levels of technology are below the</p>

	<p>indicative TRL 5 (Component and/or Breadboard Validated in Simulated or Realspace Environment) as threshold for a technology to be considered in the EUCalc model and hence not considered. Given the</p> <p>Verbeke W, 2015, Profiling consumers who are ready to adopt insects as a meat substitute in a western society. Food Qual Prefer 39: 147–155</p> <p>Hartmann C, Shi J, Giusto A et al. 2015, The psychology of eating insects: a cross-cultural comparison between Germany and China. Food Qual Prefer 44: 148–156</p> <p>Boer J, Schösler H, Boersema JJ, 2013, Motivational differences in food orientation and the choice of snacks made from lentils, locusts, seaweed or “hybrid” meat. Food Qual Prefer 28: 32–35</p> <p>Schosler H, de Boer J, Boersema JJ, 2012, Can we cut out the meat of the dish? Constructing consumer-oriented pathways to-wards meat substitution. Appetite 58: 39–47</p> <p>Tan, Hui Shan Grace, Eva van den Berg, and Markus Stieger. "The influence of product preparation, familiarity and individual traits on the consumer acceptance of insects as food." Food quality and preference 52, 2016: 222-231.</p> <p>Smetana, Sergiy, Alexander Mathys, Achim Knoch, and Volker Heinz. "Meat alternatives: life cycle assessment of most known meat substitutes." The International Journal of Life Cycle Assessment 20, no. 9 2015: 1254-1267.</p>
Climate Smart livestock <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated
Bioenergy Capacity <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated
Alternative Protein Source <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated
Forestry Practices <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated
Land Management <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated
Hierarchy for Biomass End-Uses <ul style="list-style-type: none"> Levers were considered fine, but slightly too technical for a lay users 	YES, Technical documentation has been updated

5.2.2.9 Power / balancing / CCUS

Q7. Do the sector(s)/module(s) you are reviewing answer the right questions, with the appropriate depth and modelling logic?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
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Sector wind: yes, it does.	NO ACTION NEEDED
No. Refineries do not appear as part of the industrial sectors. It seems that refineries are modelled as an "energy" module, only processing fossil oil, and not taking into account the possibility of processing low-carbon feedstocks (progressively replacing fossil oil, and therefore, being able to achieve significant GHG reductions).	<p>NO This would need significant revision of the calculation. Considering that the refinery sector is only responsible for around 3% of the EU GHG emissions plus the cited Concawe studies are very recent (dated to July and September of 2019), I would avoid the significant rework of the calculation. Additionally, this would involve other modules such as transport, industry and agriculture that may result in total rework of interfaces and potential feedback loop. Apart from the above we don't have time and cannot dedicate anymore efforts.</p> <p>I would thank for the suggestion and would open up the opportunity for a new project/cooperation to do this but would not in the framework of the current project. In our input to Jürgen to the new deliverable I noted the oil refinery as a research gap with further research needs.</p>
It was not clear to what extent system adequacy and grid congestion was integrated into the module design of the electricity sector. If demand side management is integrated into the storage module, potential competition between different flexibility options (e.g. batteries vs. power to gas technologies vs. demand side management) should be analysed. Depending on the progress of infrastructure upgrades such as the extension of electricity grids, the use of the aforementioned flexibility options might remain limited.	NO ACTION NEEDED The modelling of flexibility options at hourly granularity is a new feature in the calculator family, thus the concept can be further matured and developed. At the moment, the bottlenecks between trading zones are considered but system adequacy and grid congestion are not explicitly at the moment. As one needs to consider also the complexity of the modelling and the need to provide real time outputs by changing the levers, these further developments need further research and coding, that is outside of the scope of the current project. The demand side management values can come from the demand side modules (but DSM is not integrated in the model as we did never receive input for this from the relevant modules...) Additionally, for further development of the storage module, one needs to consider how to keep the flexibility of the calculator without including optimization measures.

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
sector wind: no time to review this.	NO ACTION NEEDED.
Assumptions, methodology and data for Refining sector are not clear. Concawe is willing to contribute with available evidence (see reports attached recently published on the Refinery 2050 concept)	NO ACTION NEEDED Documentation is available online. Plus, see response above.

Q9. Does the scope of mitigation options ("levers") and the range of levels of ambition presented for sector(s)/module(s) you are reviewing cover the full range of credible futures? If not, what evidence suggests that the scope of levers and/or range of levels should be broader than those presented?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>

sector wind: yes, maximum installed power is in agreement with our own estimates. Seems realistic.	NO ACTION NEEDED.
Differentiation of renewable energy potentials is very difficult with the aggregation of hydropower, geothermal and tidal energies in one single lever. The four aggregated levels of ambition lead to imprecision with regard to the specific pace of renewable energy growth rates. In addition, it is apparently not possible to opt for any ambition level that assumes a complete phase-out of nuclear capacities. Assessing a 100 % renewable energy pathway seems to be impossible with the current arrangement of ambition levels. Ideally, users would be allowed to enter precisely the installed capacities of distinct renewable and non-renewable energy units in the electricity and heating sector.	<p>NO Regarding the aggregation of hydro, geo and tidal, we have chosen to keep them together. We already have far too many levers and need no more.</p> <p>NO, we opted not to have a “zero nuclear” trajectory imposed but keep Level 1 as before. The trajectories were created based on a bottom-up assessment by checking each nuclear power plant and their future prospects based on the country database of the World Nuclear Association. These assumptions for each country are detailed in the annex of the content document available on the project website. Additionally, nuclear power policies of each country were considered when creating the trajectories. In this sense, level 1 DOES mean phase-out for many countries, as only committed new builds and lifetime maintenance is considered for a few countries sticking to nuclear power. Level 4 assumes slow phase-out and in case of countries committed to nuclear long-term maintenance, as well as timely and expanded new builds.</p> <p>NO, the model is based on the selection of pre-defined levels and therefore we do not opt for entering “precisely the installed capacities”.</p>

Q10. Do the intermediate levels of ambition (levels 2 and 3) provided for each mitigation option (“lever”) illustrate a useful set of choices, or should they be moved up or down?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
sector wind: lever 1 is a bit unambitious compared to lever 2, or the other way around.	NO ACTION NEEDED. Meanwhile levers have been revised.
(See answer to questions no. 2) A tiered scale (e.g. 100 - 150 - 200 GW installed capacity) would not allow precise comparisons of distinct national or EU-wide targets with users specific assumptions or scenarios.	NOT SURE. It’s a technical matter for TPE, we have the numerical data.

Q11. Are the modelling dynamics (e.g. sector interactions and feedback loops) covered correctly and sufficiently or is any important feedback/interaction missing?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
For the lever “fuel mix” in the transport sector, interlinkage between so-called “e-fuels” and the electricity sector should be made clear. In case only renewable excess electricity would be used to produce “e-fuels”, economic viability needs to be assessed.	<p>NO, the only e-fuels we produce are hydrogen (detailed in the Storage content doc) and synthetic natural gas (detailed in the CCUS content doc, produced using H2 from excess electricity). We cannot produce any other e-fuel in the current model. That’s why we agreed not to mention e-fuel.</p> <p>EUCalc is not an economic and optimisation model, economic viability is not assessed at all.</p>

As an example, interaction between the refineries and the petrochemical & bitumen production is missing	NO. See the first answer on the refineries. This would need a significant rework of the interfaces.
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Q12. Did you search for any technical documentation for the sector(s)/module(s) you are reviewing? Is it sufficiently comprehensive?

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
<p>Yes, please refer to these two Concaawe reports: https://www.concaawe.eu/publication/co2-reduction-technologies-opportunities-within-the-eu-refining-system-2030-2050-qualitative-quantitative-assessment-for-the-production-of-conventional-fossil-fuels-scope-1-2/ https://www.concaawe.eu/publication/refinery-2050-conceptual-assessment-exploring-opportunities-and-challenges-for-the-eu-refining-industry-to-transition-towards-a-low-co2-intensive-economy/Very-comprehensive-(at-least-for-transport)</p> <p>See also uploaded report (file Rpt_19-9) on this link https://drive.google.com/drive/u/1/folders/1EIRCJ3VMkcRoCydI6jqL9YGBp1W1jHmL</p>	NO ACTION NEEDED. These studies are referred to in my above replies.
For replying to this questionnaire, the following documents were briefly reviewed: Storage requirements module, WP5–Energy supply module documentation, Expert consultation workshop on electricity and fossil fuels.	NO ACTION NEEDED.
Yes. Level of detail is OK, although disagree with some of the assumptions within...No mention of ammonia as a potential marine fuel, although it is generating quite a bit of interest. (Transport module)	NO ACTION NEEDED

Other comments:

Call for Evidence Comments	Feedback by EUCalc team <i>(Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)</i>
The use of fossil gas is very relevant for the electricity, heating and potentially even for the transport sector. Surprisingly, neither the power sector levers, nor the other levers do refer to fossil gas or gaseous energy carriers at all. Providing a lever to explicitly analyse any fossil gas phase-out pathway would enrich the online tool and add transparency with regard to the fuel mixes. Differentiating hard coal and lignite use also matters for a consistent analysis of a number of countries' energy scenarios.	<p>NO ACTION NEEDED. Lack of lever controlling the natural gas capacities: due to the flexible nature and user oriented scenario setting of the model, in order to match electricity supply and demand, a technology option needs to be left open (i.e. not governed by a lever but controlled by the gap between supply and demand). If all the available electricity production technologies would be bound by the lever setting, then gaps between supply and demand cannot be filled without overwriting the lever setting by the user. Currently, in the EUCalc natural gas-based power generation fills the gap between supply and demand, therefore natural gas-based electricity generation is not controlled by a lever directly.</p> <p>The emission factor used for coal is an average of lignite and hard coal. We use this averaged value to calculate emissions as we don't know how the quality of the coal used in the future will change</p>

(There is no) explanations of weird behaviour of the curves (especially for France), electricity related emissions are expected to increase rapidly around 2040? why?	NO ACTION NEEDED. I believe all the weird graphs have been spotted and corrected.
I like your coal phase out levels, as one can tell a story with them.	NO ACTION NEEDED.
Do not understand by in Power you can only reach a 30% rate of ccus in 2050, whereas in industry you go up to 70%. This seems non-sensical as power CCUS is deemed to be easier than industry. Also, more likely to be more cost effective. I believe your level 4 for power CCUS should go to at least to 70% to match that of industry or go even higher. The UK could cover them all by 2050.... but not sure about the others.	YES, I was already addressed. Level 4 is now at 80%.
Regarding the graph on CCUS per sector, under the EU Reference pathway, the "capture CO2 from coal power" has a sharp decrease from 2045, which looks inaccurate, abruptly affecting the total trend as well. Apparently, this is also affecting the storage in "depleted oil/gas" in the "CCUS per technology graph". A better calibration of related levels' trajectories may help resolve these abrupt variations.	
If I have one wish for the EU Calc, then please have level 1 of nuclear go to zero . You need to have a no nuclear scenario, otherwise you lose a whole stakeholder base. It is also excellent to compare a no nuclear pathway next to a high nuclear pathway. Your current level 1 dives up to 2025 and then maintains very low levels of nuclear for ever...11GW. If European population drastically goes against nuclear, these 11 can be phased out. God forbid, but another Fukushima could end the nuclear debate forever. As Japan has shown is it possible to switch off nuclear very quickly and nobody can tell me that 11 GW of nuclear would/could need to linger on forever. Have it his zero in the 2040s. The other levels are fine, although at level 4 one could have even more as it is physically clearly possible.	NO, the aim of the consultation is to refine the EUCalc assumptions based on robust evidence, not to grant individual wishes. Accordingly, we opted not to have a "zero nuclear" trajectory imposed but keep Level 1 as before. The trajectories were created based on a bottom-up assessment by checking each nuclear power plant and their future prospects based on the country database of the World Nuclear Association. These assumptions for each country are detailed in the annex of the content document available on the project website. Additionally, nuclear power policies of each country were considered when creating the trajectories. In this sense, level 1 DOES mean phase-out for many countries, as only committed new builds and lifetime maintenance is considered for a few countries sticking to nuclear power. Level 4 assumes slow phase-out and in case of countries committed to nuclear long-term maintenance, as well as timely and expanded new builds.
In balancing, I'd suspect pumped storage to play a much more significant role. Seems to be barely mentioned....	NO ACTION NEEDED. PHS provides a significant part of balancing as described in the documentation.
There are two balancing strategies levers?	NO ACTION NEEDED. There is only one such a lever.
Instead of 'CC ratio in power', I would call is 'CCS in power'.	NO Not possible, since CC encompasses both utilisation and sequestration
Why does the one pager start in 2020 and level four already has roughly 10%?	YES Fixed
Are there Greenhouse Gas Removal technologies? I presume BECCS, but no DACS?	NO ACTION NEEDED BECCS included DACS not included See the CCUS documentation
Does the EU Reference Scenario project a phase out of power coal? I would check.	NO ACTION NEEDED. The EU ref scenario does not predict a complete coal phaseout by 2050.
Really looking forward to the energy flow chart. Also, the king of all energy flow chat is the one from the Indian tool, as you can see it going through the years, starting today and in five-year steps all towards 2050! http://iess2047.gov.in/pathways/2220222222	NO ACTION NEEDED. The energy flow chart is under implementation by Bernd.

2222202222222201222202222221120222022022222/sankey#	
Coal Phase out. Do you need to describe what the coal is replaced with?	NO ACTION NEEDED. It's up to the user depending on the lever settings. If there are not enough capacities by lever settings, then natural gas will fill the gap between supply and demand.
Ambition level descriptions for charging profiles seem a bit vague. How much is "penetrating more" for level C?	NO ACTION NEEDED. See documentation for figures.
Carbon capture chart looks a bit weird. Is there DACS?	NO ACTION NEEDED Why does it look weird? No action needed since we do not have more details... DACS not included. See the CCUS documentation.
Carbon capture to fuel. Show as a set of bars not as time series?	NO ACTION NEEDED In theory possible. However, the current representation was selected with care to agree with the other representations of the EUCalc and changing it would hence create graphical inconsistencies without a clear reason. Final judgment: No action needed
Energy tab: In the Electricity generation per tech graph, the curves for nuclear power and hydropower look the same.	NO ACTION NEEDED. Though I don't understand the comment but meanwhile the levers have been revised, so I don't think there is a relevance of this comment.

Comments provided at the 2050 Calc Conference in Windsor:

Power

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Nuclear (In the graphs, talking about demand for nuclear fuel is weird, it should be nuclear energy. In Belgium, in the ambitious scenario, the nuclear is kept longer than nationally desired. This is not appreciated by the Belgian government.)	NO ACTION NEEDED; this is a personal opinion from Belgium. It will not be considered otherwise we are bound to a precedent and should not talk about coal phase-out for coal in Poland and nuclear phase-out in Hungary (just two examples from the many where the trajectories may include very different routes than governmental strategies).

5.2.2.10 Water

Q6 When you look at the outputs displayed on the Transition Pathways Explorer. Do they reflect the main impacts for assessing the relative attractiveness of pathways? Is there anything missing?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Do not see water impact on land/costs of defending against water. and water level	NO Not in the water module, but there was discussion to have it in the Climate tab, displaying the environmental impacts of CC in 2100.

Q7. Do the sector(s)/module(s) you are reviewing answer the right questions, with the appropriate depth and modelling logic?

- My area of expertise in water, and there is not much info about it yet. :/

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
<p>I do research on water in Belgium and the Netherlands. In so doing, I observe increased calls for water reuse after two very dry summers. In Belgium, these calls were translated into a ban on watering plants/gardens and using water for swimming pools. Moreover, farmers were using effluent for irrigation. In that sense, I don't understand why both countries are framed as 'low water scarce region'.</p>	<p>NO, the indicator we could compute (Water Exploitation Index) is the total water consumption divided by the water resources (for each semester & regions). Hence, this granularity hides local issues happening in a short period of time.</p> <p>In addition, extreme events (such as droughts) are not modelled in the Water module, but would be displayed in the Climate tab.</p> <p>Finally, the Water module does not model the different water supply options (due to loop issues) and trade-off between water management practices (there was discussion about adding such a lever but it was left out of the EUCalc scope for this version of the calculator).</p>

Comments provided elsewhere

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
<p>Water" tab. When you hover your mouse over the map, the tooltip should indicate what the WEI value is for the region selected, and what water exploitation category that relates to</p>	<p>NOT SURE Would it be possible in the TPE? We do send the information, so it is more about how to display it.</p>
<p>Water in resources? It should have a heading/title by the way, as it is not very intuitive at the moment.</p>	<p>YES, not sure what this comment refers to? If it is about the levers (there used to be a water lever displayed), we removed it. If it is about the graph, there are titles.</p>
<p>Water section – I do not really understand how you linked it with the levers, but very much like the visual and interesting messages!</p>	<p>NOT SURE It feels like it is a general comment that some reviewers failed to understand all the interactions / integrated perspective. We do discuss it in the technical documentation but maybe it might help to create a "one-pager" not only for the levers but also for the results, to explain what the graph means and how it relates to levers / other sectors.</p>
<p>In the water stress map, although the summer map may be affected according to different example pathways (at least some Mediterranean nations), no change seems to occur in the winter map. This may not be necessarily wrong, but it may worth double checking it for confirming if the calculations are properly linked with the graph. Furthermore, a warning message is always on, even while selecting the "ambitious" example pathway. Apparently, this is occurring because water stress is expected in some regions by 2050 anyway (e.g. due to potential climate change effects in the Mediterranean region, aggravating its dry season), but the user may think that s/he is doing something wrong in the levers' choice.</p>	<p>YES Indeed, no changes occur in the winter map (it is not an error). To better visualize the changes in water stress, we will add a map of the changes with respect to 2050.</p> <p>Regarding the warning, it should not be always on. This error was identified and will be solved.</p>

5.2.2.11 Climate

Q6. When you look at the outputs displayed on the Transition Pathways Explorer. Do they reflect the main impacts for assessing the relative attractiveness of pathways? Is there anything missing?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
Do not see water impact on land/costs of defending against water. and water level	NO Not in the water module, but there was discussion to have it in the Climate tab, displaying the environmental impacts of CC in 2100.

Q8. Are the input assumptions, methodology and data underpinning the sector(s)/module(s) you are reviewing sound, robust and based on the best available evidence? Can you provide a source(s) to underpin your concerns, if any?

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
I do research on water in Belgium and the Netherlands. In so doing, I observe increased calls for water reuse after two very dry summers. In Belgium, these calls were translated into a ban on watering plants/gardens and using water for swimming pools. Moreover, farmers were using effluent for irrigation. In that sense, I don't understand why both countries are framed as 'low water scarce region'.	NO ACTION NEEDED The indicator we could compute (Water Exploitation Index) is the total water consumption divided by the water resources (for each semester & regions). Hence, this granularity hides local issues happening in a short period of time. In addition, extreme events (such as droughts) are not modelled in the Water module, but would be displayed in the Climate tab. Finally, the Water module does not model the different water supply options (due to loop issues) and trade-off between water management practices (there was discussion about adding such a lever but it was left out of the EUCalc scope for this version of the calculator).

Other comments:

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
For the "Temperature" chart, I think that what's shown is the Global mean temperature anomaly, not the Global mean temperature	YES, this was fixed.
Climate – Still believe you should ask yourself what is the message here? Is it that you just want to show that any action in EU is pointless for the global climate?	NO ACTION NEEDED It's not a matter of message, it's a matter of being scientifically accurate. The question can be turned around: what we need to show is that without international cooperation the isolated efforts of the EU will not account for much.
This tab is still very incomplete. The temperature change forecasted by 2100 depends on the type of scenario used for the rest of the world, of course; hence, it might be good showing it against two or three global reference scenarios (or maybe the IPCC's RPCs) rather than just a single choice. GHG emissions for ROW, and impacts were not visible in the current assessed version. The Global Calculator could be used as a reference.	
Moreover, as already known the global impacts are related to the imports vs exports coming in and out of	NO. Imports and exports are evaluated in monetary terms. Land use, afforestation/ reforestation/

<p>the EU, including not only carbon, but also land use, afforestation/reforestation/deforestation etc., although a tab dedicated to these dynamics is apparently supposed to be implemented in updated versions of the EUCalc. Therefore, it is important to make sure that the comparison between EU and Global changes are consistent and transparent in the graphs; otherwise, it may be misleading.</p>	<p>deforestation is not easily detailed on a global scale, especially within a CGE framework. However, this proposed extension to the model might be interesting for eventual future work. The methodology used to calculate imports and exports is detailed in the Transboundary module's description.</p>
<p>As also occurring in some other tabs (e.g. water), there is always a warning message in this tab regardless of the selected example pathway. The user may think that s/he is doing something wrong in the levers' choice.</p>	<p>YES, we did notice the issue and thanks for comment. The issue has now been fixed. In addition, the user is now prompted by the interface to make changes in the levers most likely to fix the warning.</p>

5.2.2.12 Biodiversity

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
<p>In Biodiversity, the component of ecosystem services can be discussed where the priority levels given to climate mitigation can be selected by the user, for example, level 1 - priority given to provisional goods and services (e.g. clean air & water) ranges to level 4 - priority given to climate mitigation. This will then inform policy in terms of land-use change to fit with prioritised ecosystem services.</p>	<p>NO the biodiversity lever only looks at the amount of area in a country that is subject to protection without detailing what type of ecosystem service that that area should focus on.</p>
<p>I never heard of biodiversity emissions. What are they?</p>	<p>NO ACTION NEEDED</p>

5.2.2.13 Health

Call for Evidence Comments	Feedback by EUCalc team (Please suggest YES/ NO/ NOT SURE /NO ACTION NEEDED at the top of the cell to indicate if the comment has/is/will be addressed and provide a short explanation if needed)
<p>I think it can be improved by being more specific on the different environmental issues. E.g., rather than "high heat-related morbidity..." actually state the number of DALYs for the scenario.</p>	<p>NOT SURE what is meant here. we show increased mortality as a result of each scenario setting.</p>
<p>Air – always the same line only the vertical numbers change?!</p>	<p>NO ACTION NEEDED</p>
<p>Air tab: The Y axis is movable according to the example pathway. This is not a problem per se, but the calculator may be used in open presentations and the audience may not realise that, leading to a possible misunderstand of the projected dynamics.</p>	<p>YES, this is indeed visually confusing. Hope this can be adapted in the TPE.</p>

5.3 Workshop feedback

5.3.1 Workshop audience

Moderators

Gino Baudry (Imperial)
Michel Cornet (Climact)
Luis Costa (PIK)
Katja Firus (T6)
Bernd Hezel (CMF)
Victoria Hoare (Imperial)
Garret Patrick Kelly (SEECN)
Jérôme Meessen (Climact)

Onesmus Mwabonje (Imperial)
Patricia Osseweijer (TUDelft)
Ana Rankovic (SEECN)
Morgan Raffray (Imperial)
Alexandre Strapasson (Imperial)
Paisan Sukpanit (Imperial)
Jeremy Woods (Imperial)

Participants

Aakriti Kapoor
Benti Firdissa
Clare Wildfire
Fekadu Beyene
John Watterson
Madeleine Rawlins
Nicky Austin
Ramesh MacKay
Shoimzoda Jamshed
Yann Briand
Abdullah Al Mamun
Bernadette Ballantyne
Claudio Pregagnoli
Fernando Olea
Jordan Poncet
Koen Meeus
Malvina Bondy
Nicola Terry
Reena Bhandari
Sian Evans
Yufeng Yang
Abdulwaheed Suleiman Ahmed
Bevan Freake
David Cox
Garegin Baghramyan
Joseph Olayande
Komathi Mariyappan
Maria King
Nicola Webb
Richard Millar
Supit Kamklad
Adina Popa
Boris Thurm
Dearbhla Hone

Alex Doyle
Carlo Papa
Ed Hogg
Imam Usman
Khairun Nisa Zabidi
Laura Aylett
Michael Doust
Ogunfowora Segun
Sam Clemmens
Uladzimir Rak
Anna Stephenson
Caroline Quitaleg
Elene Goksadze
Jacqueline T. Miel
Keith Kline
Lavanya Kadirvelarasan
Michael Wawire
Oleksandr Martyniuk
Sam Friggens
Upik Jamil
Archil Kokhtashvili
Cathy Johnson
Elisabeth Ellegaard
Jan Kiso
Kellee Hosking
Le Thi Ngoc Bich
Nadya Kelly
Olga Buslavets
Sandra Milena Bravo Cordoba
Viviana Bohórquez
Auchareeya Chotikadachanarong
Catur Kurniadi
Emma Owens
Javid Abdullayev

Guy Doyle
 Kate Downen
 Korakot Phupaiboon
 Mark Howells
 Nicolae Magdil
 Ross MacPherson
 Talant Beishembaev
 Aimi Hazwanie binti Nordin
 Canecia Seepane
 Duncan Millard
 Hoang Van Tam
 Katerina Maneva Mitrovikj
 Lāsma Līvzeniece
 Martha Elliott
 Norzarifah Ismail
 Sam Carter

Kemal Sarica
 Lindiwe Olga Chauke
 Nguyen Quoc Khanh
 Olzhas Agabekov
 Sapna Sanghvi
 Volkan Polat
 Bahrom Umarbekov
 Chris Dodwell
 Eva Botez
 Jenny McInnes
 Kenneth Oduol Esau
 Līza Leimane
 Nguyen Thi Lam Giang
 Pulkit Kapoor
 Saule Sabieva
 William Wilson

5.3.2 Workshop General feedback

The raw feedback provided by the Windsor workshop participant is listed below, segmented by topic.

Topic	Feedback
Overall look and feel and accessibility	<ul style="list-style-type: none"> The visuals of the TPE are good. A short run through of how to use the calculator (on the page itself) would be helpful. Explanation for how to use it (Indian Calculator looks more user-friendly in terms for the users who are new to the Calculator) The level of each lever would be clearer to understand if the numbers were inside the circles
Overall coverage of key questions	<ul style="list-style-type: none"> The calculator covers most of what you'd expect Some of the levers are very big so should be quite comprehensive. Water is a good feature. Jobs addition is important. Feature on the TPE that reflect the level of investments in Europe. Net zero was more understandable with all the choices.
Responsiveness to user input	<ul style="list-style-type: none"> the calculation speed is a bit too slow to be as useful for policy makers.
Country level information:	<ul style="list-style-type: none"> Getting into a country's calculator is not intuitive; it takes too long to figure out how, maybe adding a 'pick a country' sign would help. One stakeholder requested to see the details of each country in the 1-pagers rather than having the EU overall picture.
Carbon budget notion in the TPE	<ul style="list-style-type: none"> The notion of target emissions needs to be better explained The link between cumulative emissions and carbon budget needs to be better explained The fairness approach needs to be better explained, the current explanation is phrased too vaguely. Not just GDP counts but also needs/requirements. The cumulative budget idea is important but slightly faded
Other	<ul style="list-style-type: none"> Air should be renamed to air quality/Highlighting the affected sections based on the levers perhaps.

In addition, the voting preferences to the two questions are provided below:

Question 1:	Please rank, in order of importance to you, the following levers unique to the EU Calculator			
Number of Respondents:	53			
Lever Options	1st Place	2nd Place	3rd Place	4th Place
Air Quality	20	12	12	3
Water	16	18	8	5
Biodiversity	8	4	15	16
Jobs	9	10	7	18

Question 2:	Please rank, in order of importance to you, the following types of 'security':			
Number of Respondents:	53			
'Security' Options	1st Place	2nd Place	3rd Place	4th Place
Environmental Security	15	16	10	8
Food Security	19	18	11	3
Energy Security	10	9	14	15
Human Development Security	9	7	14	20

5.3.3 Workshop Lever discussions

The raw feedback provided by the Windsor workshop participant is listed below, segmented by lever.

5.3.3.1 Key Behaviours

a. Travel

Lever	Key Discussion Points
Passenger Distance	<ul style="list-style-type: none"> - Generally agree, ambition could be increased - More scenarios could see a decrease in travel distance - Primarily agree on the middle two levers - Mode choice will determine the distance to a large extent - There should be a greater ambition for level 4
Mode of Transport	<ul style="list-style-type: none"> - Not flying to leisure should be reflected in the model - Levels 1-3, all participants were neutral - Level 4 was all neutral, all bar one disagree where they felt ambition could be greater
Occupancy	<ul style="list-style-type: none"> - Should it be about getting more people onto trains, or getting more trains - Needs to account for rural/urban setting - Almost all levels were received neutrally, level 4 was spread across all three, with majority disagreeing
Car own or Hire	<ul style="list-style-type: none"> - Rural and Urban needs to be reflected - 75% of car travel can be via automation

b. Consumption

Lever	Key Discussion Points
Use of Paper and Packaging	<ul style="list-style-type: none"> - Majority agree with level 1 - Level 2 should show an increase in glass consumption; most disagreed - Level 3 the majority disagreed with, stating that they disagreed with the stagnation of plastic consumption by 2050
Product Substitution Rate	<ul style="list-style-type: none"> - Table primarily agreed with level 1, however not with level 2-4. - Level 2 was because they disagreed with the reason changing phones regularly due to trend dictated by retail sales - Level 3, the point was raised that the culture of repair has disappeared in Europe so the 155% needs to be changed as this indicator seems wrong. How about communal laundry use?
Food Waste at Consumption Level	<ul style="list-style-type: none"> - All levels had majority disagreeing - Level 1 should be set as level 2 is due to the new policies about climate change. This then should be cascaded through the levels. - Level 4 should be set at 90% to be ambitious enough
Freight Distance	<ul style="list-style-type: none"> - Level 1 was thought to be too high a percentage use. The group was split between agree and disagree - The group agreed with level 2, but not 3 or 4 - Level 3 was because of behavioural change and the group felt level 3 should have been used for level 4

c. Home

Lever	Key Discussion Points
Living Space per Person	<ul style="list-style-type: none"> - All agreed with level 1 - All disagreed with level 2-4 - Level 2 is not very ambitious, should be constant, as it is easier to understand than a relatively slow decrease - Level 3 showed very precise fractions, when they shouldn't be. - Level 4 could be more ambitious, as it is already a reality in some European countries (e.g. Bosnia)
% of Cooled Living Space	<ul style="list-style-type: none"> - All agreed with level 1 - All disagreed with level 2-4 - Some lack of clarity in the description specifically regarding the '21.7%' - Level 4 should be better explained; Level 3 and 4 seem very similar
Space Cooling and Heating	<ul style="list-style-type: none"> - All agreed with levels 1-3, with only one person disagreeing with level 4

	<ul style="list-style-type: none"> - Relationship between indoor and outdoor climate does need to be better explained- it is hard to contextualise 'room temperature' - Gender portion should be mentioned; this was the main common argument that there is a gender issue here
Appliances Owned	<ul style="list-style-type: none"> - All agreed with level 1-3 - All disagreed with level 4 - Level 4 is very ambitious, in particular for computers; no info on any other electronic devices (e.g. smartphones)
Appliances Used	<ul style="list-style-type: none"> - All agreed with levels 1-4 - The term "computer" should be specified

d. Diet

Lever	Key Discussion Points
Calories Consumed	<ul style="list-style-type: none"> - Level 1, 2 & 4 had a mix of agreed, neutral and disagreed responses. - The majority were neutral for level 3 - For level 4, obesity can be caused by other factors
Type of Diet	<ul style="list-style-type: none"> - 80% of the group agreed for levels 1-4, with 20% being neutral - The group agreed that WHO's recommendations are good for health and the environment - The group were not convinced about the assumptions on meat consumption

5.3.3.2 Technology & Fuel

e. Transport

Lever	Key Discussion Points
Passenger Efficiency	<ul style="list-style-type: none"> - Not splitting it per technology reduces the credibility - This level is not seen as entirely useful; better to talk about technology - Most were neutral about the levers - Some disagree with lever 3&4
Passenger Technology	<ul style="list-style-type: none"> - Ambition is not high enough on level 1 and 2 - Even having no effort on level 1 then the baseline could still be 100% electric - Level 1 and 4 were primarily disagreed with, whilst level 2 and 3 were neutrally received.
Freight Efficiency	<ul style="list-style-type: none"> - Not splitting it per technology reduces the credibility - Majority of levels were neutral, some disagreed with level 4 stating it was too ambitious
Freight Technology	<ul style="list-style-type: none"> - Ambition is not high enough on level 1 and 2 - Mostly neutral, mild disagreement on level 1 and 4; full electrification on trucks is a push by 2050, whilst the baseline is not ambitious enough
Freight Mode	NA

Freight Utilisation Rate	NA
Fuel Mix	- Regret the fact that the biofuels lever is not segmented from the e-fuels and hydrogen levers

f. Buildings

Lever	Key Discussion Points
Building Envelope	<ul style="list-style-type: none"> - Level 1 was mostly neutral, with one disagree- decided that windows will get replaced by 2050 - Level 4 was split equally between neutral and agree- if entire budget for Net zero would go to buildings, it was considered possible
District Heating Share	NA
Technology and Fuel Share	<ul style="list-style-type: none"> - Majority were neutral for levels 1-4, with one person on each level disagreeing - Level 4; too much biomass, the mix should be more complicated, and more choice needed for the user to fine tune the mix of heat pumps and biomass. - Phase out of fossil fuels should be a separate lever
Heating and Cooling Efficiency	NA
Appliances Efficiency	<ul style="list-style-type: none"> - Majority were neutral for levels 1-4, with one person on each level disagreeing - For level 1, may be interesting to show no change and even less than 38% improvement i.e. level 1 is too ambitious - Descriptions and units need to be clearer

g. Manufacturing

Lever	Key Discussion Points
Material Efficiency	<ul style="list-style-type: none"> - All agreed with lever 1 - Lever 2-4 was a mix of agreed, neutral and disagreed
Material Switch	<ul style="list-style-type: none"> - All agreed with lever 1 - Majority were neutral for lever 2; 20% is too high - All disagreed with lever 3 & 4 - 40% is too high for timber and 60% is also too high; level 3 & 4 are too ambitious
Technology Efficiency	<ul style="list-style-type: none"> - All agreed with lever 1 & 2 - All disagreed with lever 3 & 4 - 65% is too high, as is 90%; lever 3 & 4 is too ambitious
Energy Efficiency	<ul style="list-style-type: none"> - The majority agreed with lever 1 & 2, although lever 1 was considered too low for business as usual - There was an equal spread between agree, neutral and disagree for lever 3 - The majority disagreed with lever 4; it is too ambitious
Fuel Mix	- All agreed with lever 1 & 2

	<ul style="list-style-type: none"> - Almost all were neutral with lever 3, with one disagreeing, whilst opinions were mixed for lever 4 - Biomass seemed problematic because there wasn't enough - Lever 4 is too idealistic
Carbon Capture in Manufacturing	<ul style="list-style-type: none"> - All agreed with lever 1 - The majority disagreed with lever 2, whilst all disagreed with lever 3 & 4 - 20% is too ambitious in lever 2, whilst level 3 should be level 4
Carbon Capture to Fuel	<ul style="list-style-type: none"> - Opinion on level 1 was mixed - All disagreed with lever 2-4 - Level 4 is unrealistic; level 3 should be 4 instead - Cost should be addressed on the lever

5.3.3.3 Resource & Land Use

h. Water & Biodiversity

Lever	Key Discussion Points
Area set aside for nature [...]	<ul style="list-style-type: none"> - Level 1 seems ambitious as there's a large assumption that the standards can be maintained - Level 2 is not ambitious enough; the narrative between level 1 and 2 doesn't flow and the two levels seem similar - All disagreed with level 3, whilst 1, 2& 4 were primarily disagreeing, with several neutral and agrees.
[...] From Agriculture or Forestry	<ul style="list-style-type: none"> - This level is not clear on what is meant by intensified forest; this could mean several things - Primarily disagree with both scenarios, although opinion was split across all three.

i. Food & Land

Lever	Key Discussion Points
Climate Smart Crop Production	<ul style="list-style-type: none"> - Levers were a bit technical - Agriculture lever ambitions are all fine, but diets should be extended to include insects, lab-meat etc.
Climate Smart livestock	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users
Bioenergy Capacity	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users
Alternative Protein Source	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users
Forestry Practices	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users
Land Management	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users
Hierarchy for Biomass End-Uses	<ul style="list-style-type: none"> - Levers were considered fine, but slightly too technical for a lay users

5.3.4 Workshop agenda

Introduction: [10.30-11.00]

- 30 minutes total

1st: Michel Cornet & Jerome Meessen [Climact] with a *~7-minute talk*

2nd: Bernd Hezel [CMF] with a *~7-minute talk*

3rd: Mentimeter questions by Jeremy Woods [Imperial], Q&A and explanation of group session, *~10-15 minutes*

Group Session: [11.00-12.10]

- 70 minutes total
- Facilitators to know what their table number is and the two levers they are discussing
- Facilitators to have the excel spreadsheet up on their devices to fill in

1st: Lever 1 discussion and fill in the excel spreadsheet, *20-minutes*

2nd: Lever 2 discussion and fill in the excel spreadsheet, *20-minutes*

3rd: Open discussion prompted by the facilitators (example questions available), *20-minutes*

4th: Patricia Osseweijer [TU Delft] to collate key points from each table to present to group in plenary, *10-minutes*

Plenary: [12.10-12.30]

- 20 minutes total

1st: Patricia Osseweijer [TU Delft] with a *~10-15 minutes* of letting the room know the key points from the session

2nd: Last two questions on Mentimeter and final words, *5-10 minutes by Jeremy Woods [Imperial]*