EUCALC

Explore sustainable European futures

User demand documentation

D9.1

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Short Description
This report summarises the inputs given by stakeholders at the two user demand workshops organized at the onset of the European Calculator project. The inputs relate mainly to the modelling approach and scope as well as key trends and developments that the European Calculator ought to address to assist stakeholders in their decision making. Further, the report provides responses on how the comments and recommendations from the stakeholders have been taken into consideration in the design of the European Calculator.

Quality check	
Name of reviewer	**Date**
Katja Firus	**31st July 2019**
Bernd Hezel	**31st July 2019**

Statement of originality: This deliverable contains original unpublished work except where clearly indicated otherwise.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

EUCalc policy of personal data protection in regard to the workshops

The EUCalc project defined its personal Data Protection procedures in order to comply with the ethical requirements as stipulated in Deliverable 12.1 (Ethics requirements – procedures and criteria to identify research participants in EUCalc – H – Requirements No. 1). All step by step processes in relation to the co-design of the European Calculator aka EUCalc (content of this report), in particular the stakeholder mapping, the facilitation and implementation of the workshops and the follow-up of the workshops, strictly adhere to these procedures. The informed consent procedure in relation to the workshops is based on D9.2 "Stakeholder mapping" and D9.4 "Method for implementation of EUCalc co-design process". The originals of the signed consent forms are confidentially stored at the coordinators' premises with no possibility of public access of these documents to externals. Scans of each of the informed consent forms are stored on the internal EUCalc file storage system.

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Abbreviation list

CCS - Carbon Capture and Storage

CCU - Carbon Capture and Utilization

COP 21 - Conference of the Parties Twenty-first session

DoA – Description of Action (the project proposal)

EUCalc – European Calculator

EU – European Union

IDDRI - Institute for Sustainable Development and International Relations

LULUCF - Land-Use, Land-Use Change and Forestry

NGOs - Non-Governmental Organisations

GHG – Greenhouse Gases

TPE - Transition Pathways Explorer

GDP – Gross Domestic Product

4sing - ForeSight and Strategy for Security and Sustainability in Governance

1 Executive summary

This report summarises the stakeholders' input received during the two user demand workshops held in Potsdam on 14th December 2016 and in Brussels on 23rd March 2017 within the European Calculator (EUCalc) project. Further, this report also provides responses on how the comments and recommendations from the stakeholders have been taken into consideration in the design of the European Calculator.

The following topics were covered:

- Modelling approach and scope
- Lever choices and range
- Key trends and developments
- Resource availability and conflict of use (e.g. biomass)
- Socio-economic impacts

A selected group of 15 external experts from public institutions, research organisations, think tanks, business organisations and Non-Governmental Organisations (NGOs) participated at the workshops.

2 Introduction

The goal of the European Calculator (EUCalc) project is to test low-carbon transformation pathways on the European and member state scale. The project will develop a novel and transparent open source model combined with a Transition Pathways Explorer (TPE), an online tool providing instant results from the EUCalc model runs.

With the TPE, European and national policy-makers, businesses, NGOs, innovators, and investors will be able to create (online and in real-time) their own pathways and compare them to other integrated pathways. The tool will in this way support the energy, emissions and resources debate on a low carbon transition.

In order to understand key decision points that various stakeholders are facing within their organisations, whilst being able to reflect that back to the outcomes of the EUCalc, it was necessary to organise two user demand workshops at the onset of the project that were held in December 2016 and in March 2017 respectively.

A selected group of key decision/policy maker's active in sustainable low carbon development pathways for Europe, were invited to shape the European Calculator development. A brief policy review was conducted in order to enhance understanding of the potential challenges members of the selected group faced in their strategic decision making. As a beta version of EUCalc was not at that stage available, the Global Calculator was used as a proxy to demonstrate decision making pathways, while explaining that the EUCalc would be more complex with several additional features including a ROW link, trans-boundary effects, a complex LULUCF component and Outputs not just related to Climate Change and Carbon Emissions but also to Jobs, Health and Air Quality etc.

2.1 Policy review

The EU presented in November 2016 the 'Clean Energy for all Europeans' communication package, consisting of 8 legislative acts, commonly referred to as the "Winter Package", designed to keep the European Union competitive as the clean energy transition is changing global energy markets (European Commission, 2016). The proposed policies and legislation are aligned with the 2030 targets agreed by the European Council regarding GHG emissions reduction, renewable energy, energy efficiency and land use, land-use change and forestry (LULUCF) regulation addressed in the Clean Energy for All Europeans package (European Council, 2014). This marked a major milestone in the construction of

a robust Energy Union[1] and setting the EU on the ambitious decarbonisation trajectory that was set out with the Paris Agreement. The Impact Assessments studies, which accompany the submission of the policy package to the EU institutions, mainly use quantitative analysis via the design and elaboration of two core policy scenarios, namely EUCO27 and EUCO30 (Capros, 2018). These two policy scenarios were developed based on the EU Reference Scenario 2016 and are designed to achieve the 2030 targets as agreed by the European Council (Capros, 2016). The analysis of impacts of the two policy scenarios was the input to the Effort Sharing Regulation Impact Assessment communication on low-emission mobility strategy published in July 2016 (European Commission, 2016). The interplay between the set targets is complex, therefore, quantitative analysis that incorporates the calculator modelling approach, can assist in assessing such interactions and synergies (European Commission, 2018).

Analytical models have become increasingly important tools for defining policies for rapidly evolving energy system. They are used in multiple contexts to represent the systems that surround us. There exists an extensive number of models addressing energy and climate issues. However, few can easily be used by the EU Commission and other policy makers. Additionally, their outputs are not always comparable and applicable for policy making. Nonetheless, transparency in these existing tools is limited with differing underlying data and assumptions impairing their comprehension (Climate KIC, 2018). To this end, the EUCalc project aims to develop a novel and transparent open source model, combined with a Transition Pathways Explorer designed with a level of complexity that is adequate for policy makers and lay people, without compromising on scientific rigour.

2.2 Objectives of the user demand consultation

The EUCalc model addresses multi-dimensional and inter-disciplinary issues, which requires a wide range of expertise to develop. Decision-support tools are mostly shaped by highly disciplinary and technically deep scientific debates and have in the past often omitted the input of key stakeholders. Deliberative democracy and public participation in the process of imagining and implementing the future scenarios for individual states is also recognised as critical (Tomei et al., 2015). It is for these reasons, that the EUCalc project embeds a co-design process with key stakeholders and experts. Through this process, stakeholders are involved in shaping the development of the EUCalc TPE by helping co-design the determinants and the scope of the intended performance and output of the tool.

The over-arching objective of the user-demand consultation workshops was to build a more precise knowledge of the challenges members of the target groups were facing and the (political/strategic) levers they could possibly set in motion to meet these challenges.

The stakeholders that were invited to take part in the user-demands workshops had been identified as key decision/policy makers active in developing sustainable low carbon pathways within their organisations. The composition of the stakeholder sample, based on the profiles identified in the DOA, were from public, civil society and private sectors. The EUCalc project team was keen to understand how best to focus the development of the EUCalc Transition Pathways Explorer in order to assist the participants in their work of developing their decarbonisation pathways.

[1] A strategy for guaranteeing accessible, affordable, secure, competitive and sustainable energy for all Europeans

A detailed description of the proposed EUCalc model and its philosophy (Figure 1) was presented to the stakeholders during the workshops, illustrating the pathways concept using the Global Calculator[2], as well as a series of targeted probing questions in aid of stimulating discussion.

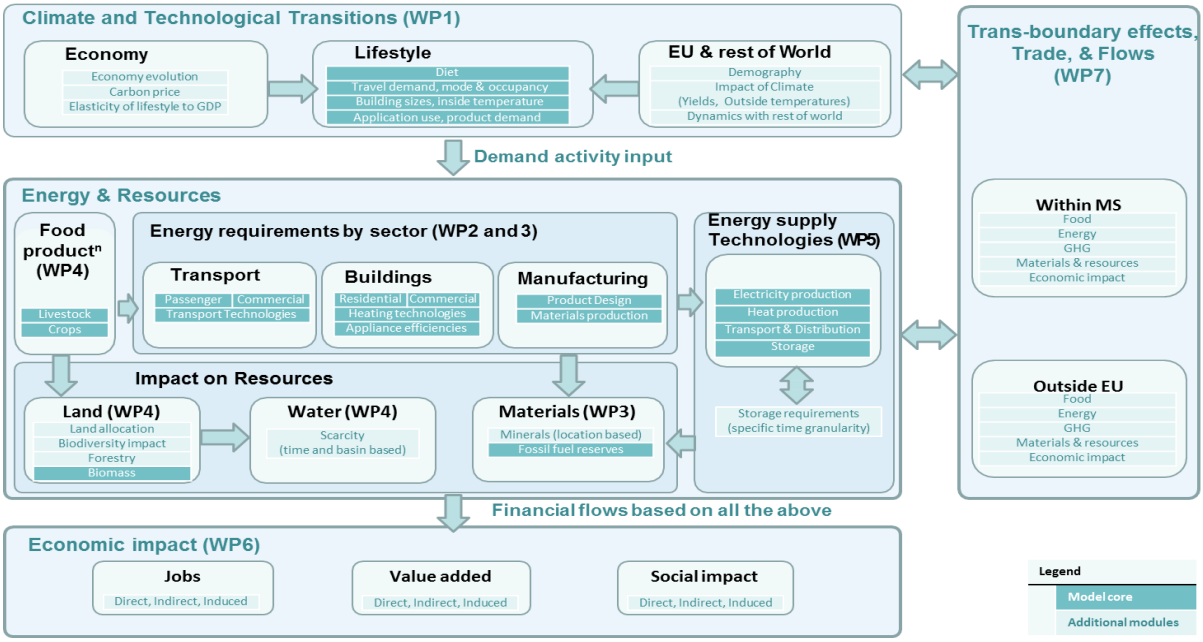

Figure 1 - Overview of the EUCalc structure

2.3 Questions to the stakeholders

Following a discussion around workshop constraints, three questions were deemed to be critical for the co-design process of the Calculator development. An extensive list of all the potential questions which were considered in advance of the workshop can be found in Annex 7.3.

- The first question centred on how each individual stakeholder organisation would utilise the Calculator in decision making related to energy, resource use and climate change.
- The second question explored lifestyle issues anticipated to be modelled within the Calculator and whether there were others which they thought needed to be included.
- The last question focused on the level of choice as opposed to optimisation function having arisen from the internal modelling discussions preceding the workshops.
- In addition, a supplementary question was asked at the end of the session in a way of soliciting the stakeholders for their assistance with data/literature that the EUCalc consortium could use or take into consideration.

3 Setting the scene

Both workshops started with a welcome addresses from the project co-ordinator Juergen Kropp (PIK) and by Jeremy Woods (Imperial College London)presenting the objectives and the scope of the European Calculator project as well as an overview on what the European Calculator is intended for and who are the anticipated target users. Jeremy Woods also

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

emphasised on the importance of the co-design process in the development of the Calculator as it entails both fundamental and applied research.

This was then followed by a presentation and a general overview of the European Calculator, delivered by Bernd Hezel (Climate Media Factory) at the first workshop and Michel Cornet (Climact) at the second workshop, where the Global Calculator was deployed as a proxy. These two presentations focussed attention on the fact that the Calculator is being developed as a visual tool, which will offer users a number of levers to explore the range of viable trajectories, in order to arrive at a desired GHG emission reduction target. Both Bernd Hezel and Michel Cornet attributed the comprehensive/holistic view associated with the development of the Calculator to be an asset, particularly, if the consortium managed to allow for the most important interconnections. They also presented about aspects of the Calculator such as trans-boundary effects among member state countries within the EU and to the rest of the world, stronger socio-economic components and water and biodiversity. The comprehensiveness of the model allows to exposé possible trade-offs and synergies, providing transparent, accessible, dynamic, real time response to the user.

Stakeholders' introductions were led by a professional facilitator from 4sing, who also were instrumental in facilitating the sectorial expert consultation workshops. This involved ice-breaking questions in order to prepare the ground in terms of expected outcomes from both the invited stakeholders and the members of the EUCalc consortium.

4 Discussion and recommendations

This section summarises Potsdam and Brussels workshop discussions based on the questions as described in section 2.2 and Annex 7.3.

4.1 Potsdam Workshop (16th December 2016)

During the Potsdam workshop, one of the stakeholders shared previous Calculator experience by looking at the place of the Global Calculator to national calculators and the lessons learnt from them, whilst giving examples on how they are currently used. This was followed by second presentation that articulated the significant role of the European Calculator towards modelling the EU energy systems. This presentation touched on the current EU energy modelling approach. A reference was made in relation to the main EU energy pathways currently being used to be the Reference Scenario 2016 and EUCO30. The presentation also touched on the possible strengths of the proposed European Calculator and some of the challenges at hand that the developers could experience. The strengths outlined - associated with the European Calculator - were transparency, a holistic approach to energy and land use as well as the ability to identify and showcase uncertainties, among others. Regarding the challenges, the difficulties in acquiring detailed, uniform/comparable data sets from all the 28 member states, obtaining robust cost data and ensuring the Calculator would have the capability to be utilised for legislative policy impact assessment were sighted. The stakeholders suggested key social indicators such as economic growth with respect to income, reduction in consumption, particularly in reference to air travel and freedom from consumption or green growth as some of the issues to be considered in the development of the Calculator. They also wanted the Calculator to address Winter Package targets. The issue of trade unions and gender aspects were also raised in addition to full time and part-time employment and energy efficiency. Other stakeholders suggested making GDP an output of the European Calculator model.

The stakeholders also advocated for a deeper interaction by the consortium with NGOs, public and private sector partners in relation to possible lever diversification on transport, particularly, urban transport in relation to modal shift, aviation and heavy duty transportation. They also stressed the importance of having a meaningful dialogue between sectors that are interested in the burden sharing, rates of change/technological development, implicit cost of carbon for different technologies (particularly for biofuels),

sentiments that were later echoed at the Brussels workshop. There was concern raised on the difficulties of considering carbon beyond borders due to many possible uncertainties. The stakeholders also voiced their concern in relation to the Global Calculator being too complicated for the public use. The stakeholders advised on having a robust data collection initiative such as that outlined in the deep decarbonisation pathway project published by the U Institute for Sustainable Development and International Relations (IDDRI).Another reference suggested for the consortium to look at was the My 2050 pathways. The stakeholders also felt that post Paris COP21 and in order to achieve the level of ambition set, there is need for an open-source and transparent reference tool such as the European Calculator being developed that can facilitate and enable sensible mitigation conversation within various sectors.

Similarly, on levers matching, LULUCF, biomass for heat and power and common agricultural policy were suggested as important aspects that required consideration. The participants also noted the importance of involving experts who were enthusiastic and influential enough during the scheduled sectorial stakeholder workshops (on transport, agriculture, etc.) where the ambition levels setting of the respective levers were to be agreed upon. They observed that the most heavily regulated sectors may be most interested in these workshops. These include oil companies (Total, Statoil, DRAX, Chevron), car companies, solar panel manufacturers, building, insulation, aviation industry among others. The stakeholders also observed that it will be important to achieve the participatory ideals of the European Calculator to reflect the EU regulatory framework that will allow its development.

Finally, the stakeholders during the Potsdam workshop emphasised the importance of including their input and suggestions in the development of the Calculator and the EUCalc consortium agreed to work hard to take these into account when designing the model structure and the TPE. Given the short notice for participation at the Potsdam workshop, it was thought necessary to hold a second workshop in Brussels to which the participants saw as a good strategy. In addition, it was suggested that participation should again be of public, private and civil society sectors.

4.2 Brussels Workshop (23rd March 2017)

In response to the first question "How will you use the Calculator" during the Brussels workshop, the most important aspect for policy makers was the possibility to be able to test impact of existing policies, shadow policy and identify areas with significant impact. More generally, it was felt that after Paris agreement (COP 21), there was a need to constantly test policies, monitor where the gaps are and show which areas can make significant impact by understanding interactions between different sectors and their respective roles in transition. The policy makers also suggested that the European Calculator ought to take into consideration EU long term targets on GHG, renewables, energy efficiency and interconnection.

Civil society organizations considered the tool useful in aid of their advocacy related efforts and activities. Additionally, this group sought to be assured regarding what sort of practical applications there are for accommodating the innovative products and policy currently being developed e.g. practical applications of Carbon Capture and Storage (CCS) which is not necessarily something that some NGOs support. In their opinion, they felt that by capturing the state of knowledge about practical application of innovative products and policies, the European Calculator could help them understand their impacts.

The private sector wanted the Calculator to assist them decision making regarding their costing, trade-offs and technology choices, economic impacts of transition and quantification of their role and contributions (e.g. what meaningful action and contribution private sector can make and in what areas, including the impact of their existing organizational plans and strategies on EU or global level). They also suggested a provision within the European Calculator for allowing people to model their own future prediction

and costs. This category of stakeholders were in favour of building the model with sufficient granularity at country level.

In terms of having confidence in future utilization of the Calculator several Stakeholders strongly emphasised the need for transparency and clarity, particularly, around assumptions, calculation matrix in relation to emissions and energy factors, clarity on definitions and meaning of terminology used e.g. on the list of indicators to be considered in terms of environmental impacts. It was also emphasised that measures around assumptions and estimations involving innovation are needed, especially in terms of cost reduction of certain technologies and how this can contribute to the increased deployment and decarbonisation targets. Stakeholders in several instances highlighted the importance and usefulness of decomposing, translating and adding up different scenarios (databases and assumptions) under the one roof of the European Calculator. They also encouraged having a common platform that allows users to create and compare their preferable visions of the future together with a greater level of transparency that the European Calculator strives to achieve is currently lacking and can significantly aid the dialogue between various stakeholder groups.

In response to the second question, "Which lifestyle issues are important", the stakeholders thought that all the lifestyle choices as identified by the consortium needed to be included in the European Calculator (e.g. Diet, Travel demand, Building sizes and occupancy, Appliance use, Product demand). However, some felt that materials for building should have preference – due to the significance of their impact – as compared to focusing on the size and occupancy rate. In addition, it was suggested that efficiency ought to be included and captured at every stage alongside the happiness index.

The third question, "How much choice do you need", which was intended to focus the stakeholders in providing insight as to which issues should be in the preview of user choice and which should be optimized along a utility function. A set of examples were also provided to the participants to assist them in consolidating their views, but also give them an idea on how the consortium is planning to approach this issue. In reference to the set of examples provided, the stakeholders suggested adding to the list the ability for switching on or off benefits of carbon stock credits since they viewed these to be time limited. The stakeholders wondered whether the functionality of being able to optimise for more than one criteria e.g. on costs versus health versus jobs impacts when comparing pathways ought to be able to be modelled within the calculator. Similarly, they suggested including the functionality of being able to show burden sharing between countries, if possible, and benefits of further EU energy integration. The stakeholders also suggested incorporating human health impacts such as ionising radiation and particulate matters among other environmental impacts as part of the choices on optimization. It was also suggested that affordability versus environmental benefits alongside abatement cost of climate change ought to be considered.

Finally, on the supplementary question on requisition for help on materials/literature that the European Calculator consortium could take into consideration, a number of references were supplied.

The participants were invited to continuously inspire the design of the Calculator that is to be built. It was announced that the consortium may get back to some of the participants and ask them to take part in one of the many sectoral stakeholder workshops (on transport, agriculture, etc.) in which the ambition levels of the respective levers will be agreed upon. Each stakeholder was also requested to spread the word to their colleagues at their various stations regarding the potential of the European Calculator being developed and encouraged to e-mail any further comments.

5 Lessons and conclusions

The EUCalc user demand consultations held at the onset of the project provided some important inputs for the development of the EUCalc Transition Pathways Explorer. The targeted set of stakeholders invited covered a wide range of experience and expertise. Both in the general discussion following the presentations and in the smaller discussion groups we were able to collect a significant number of suggestions and comments. These valuable feedback ranges from the general scope of the EUCalc model to the specific issues such as levers and ambition levels. The findings of the two workshops were discussed with the consortium during the project monthly calls between month 1 and 5 at the inception phase of the project. These findings were summarised in two workshop reports that were circulated to all project partners as part of milestone 1 (Demand analysis workshop).

Table 1 below explains in detail how the EUCalc consortium endeavoured to integrate and use the stakeholders' inputs from the demand workshops in order to improve the modelling approach and the assumptions of the EUCalc model. The table is divided in three columns. The first column contains all the input provided by the stakeholders. The second column gives the EUCalc team responses on how the input given has been taken into consideration in the development of the EUCalc model. The last column contains useful references linked to the EUCalc team responses. The integrations of these inputs will be further enhanced in the light of both the Scientific Call for Evidence and Public Call for Evidence. Additionally, it is anticipated that all the participants would be invited to review the TPE during the Public Call for Evidence. The content of the table is diverse as was the input of the stakeholders ranging from, buildings, agriculture, land-use, sharing economy efficiency across sectors etc.

Table 1 – Stakeholders Feedback and EUCalc consortium responses

Stakeholders input	**EUCalc Consortium Consideration**	**Reference (EUCalc deliverables (sector/module documentation has been produced but not yet published. These will soon be published and made available on the EUCalc website and the TPE))**
The stakeholders suggested that efficiency ought to be captured where possible at every stage of the EUCalc development (diets, products, land use, etc.).	*Each modelled sector includes the most important and known decarbonizing solutions grouped in the different levers[3], including the efficiency as a critical one. E.g. Fuel efficiency, thermal efficiency of buildings, food production processes, technology development and CCS etc.*	*For more details on decarbonizing options included in each module/sectors, please refer to the specific sector documentation lifestyle, building, transport, land-use, supply, manufacturing, etc.).*
The stakeholders suggested the possibility of the EUCalc tool to perform an optimization process along two or more	*The EUCalc model does not perform an optimisation process. However, it is deeply linked to other models that embed on their platforms an*	*For more details, Deliverable 8.2.*

[3] The EUCalc is controlled using a range of levers that represent changes we could make to mitigate climate change from now until 2050. For each lever there are different levels of effort/ambition – for most this will range from level 1 (make minimal effort to tackle climate change), to level 4 (make an extraordinarily ambitious and extreme level of abatement effort).

criteria e.g. costs, jobs, health, etc.	*optimisation process (e.g. GTAP provides EUCalc model several inputs or suggested lever positions). Likewise, the EUCalc model is expected to provide inputs for optimisation models such as TIMES/MARKAL, GTAP, GAINS, etc.*[4] *Nonetheless, if the model calculation time can be significantly reduced below 1 second, the EUCalc team will consider including a multi-criteria optimisation process (e.g. the cheapest possible scenario that can achieve net-zero by 2050).*	
Restrictive policies, such as taxation were mentioned as relevant by several stakeholders; particularly, along the lines of carbon pricing mechanisms.	*The goal of the EUCalc model is to test the long-term implications of the most important decarbonizing options and choices that we can make between now and 2050.The model levers are "engineering based" and not policies. However, the link to policies is assessed in several ways: a) For selected scenarios, specific required policies are assessed. B) where possible, policies are translated into appropriate 'engineering levers'.*	*For more details, Deliverable 6.2.*
Stakeholders suggested that the EUCalc model needs to be politically relevant, and take into consideration essential socio- economic dimension such as people skills, job availability, health and environmental impacts, among other issues that people passionately care about.	*For each pathway, the EUCalc Transition Pathways Explorer displays the implications over time. It computes different types of impacts, such as, the energy consumption and GHG emissions at the EU and country level, key sources of air pollution, resource depletion (water, lands) and other environmental impacts such as biodiversity, alongside socio-economic impacts such as employment and health.*	*For more details about the scope of these impacts calculation and about the methodology used, please check the related sector documentation/deliverables.* *For socio economic impacts, Deliverable 6.3 is particularly relevant.* *For biodiversity and water impacts, Deliverable 4.3.*
The issue of transparency was raised as a critical aspect by most stakeholders, and they wanted to see it reflected adequately in the EUCalc model.	*The EUCalc model is completely open source and complies with the Calculator philosophy of ensuring transparency of the tool to the end user. This can be evidently observed in the documentation of: a) The input data used in the model; b) The rationale of the calculation applied on the input data; c) The ease of use of the tool by the end user. An exhaustive documentation is provided while theonline tool (the Transition Pathways Explorer) helps users understand thelogic of themodel, e.g. by clearly separating input of the*	*For more details about the main assumptions underpinning the modelling choices performed as well as on the stakeholders consulted and inputs provided in their respective areas of expertise, please check the related sector documentation/deliverables 1.6, 2.3, 2.7, 3.4, 4.2, 4.3, 5.4, 6.3, 7.3*

[4] Historically, the 2050 calculators have been complementary to optimisation models. The deepest integration being in the UK with the UCL Times/Markal. The Times/Markal cost are typically an input to the 2050 calculators, while the 2050 calculators remove bugs and challenge the interpretation of Times/markal scenarios.

	model and model results by design, or by aligning user and model workflow. *Furthermore, the model is developed through a co-design process involving expert stakeholders' engagement in each of the sectors being addressed by the tool. This co-design process is fully documented and publicly available as a part of the EUCalc project deliverables.*	
The stakeholders also emphasised the need of defining and providing clarity on terminologies used within the EUCalc tool.	*A Glossary has been made available for all documentation embedded within the EUCalc model, defining all terminologies used in order to make it easier for both experts and non-experts users to navigate the tool with ease.*	*For more details, sector related documentation/ deliverables.*
Stakeholders wondered about the level of flexibility of the model in terms of adjustments and modifications, such as adding up new levers or moving the level 4 to what used to be level 3, as necessitated by new technological innovation aspect within sectors.	*The structure of the EUCalc model is flexible and allows for future changes. The data and the assumptions are not hard-wired, but are represented as input to the model. In this way, these data and assumptions made could easily be modified in the future.* *Incidentally, the co-design process has been crucial and instrumental in terms of capturing the existing knowledge and building the trust in parameterization and calibration of levels. The adjustment and modification has to take the co-design approach into consideration, particularly, when new data and assumptions emerge in the near future.*	*For more details about the stakeholders consulted and inputs provided in their respective areas of expertise, please check the related sector documentation/deliverables.*
The stakeholders also suggested that sharing economy and rebound effects ought to be considered when developing the EUCalc tool.	*While lever and ambition setting is done within each sector, the EUCalc tool allows users to identify and explore some cross-sectoral thematic areas through groups of lever setting. Several levers are linked to the sharing and circular economy. For example car own or hire, share or recycled materials, product life time..* *Choices on the levers, levels and parameters must be made in a coherent manner, since the model itself does not reflect the full complexity of the real world system, and judgments are required to combine various ambition levels or sector trajectories. The users of the model must themselves make these judgements to avoid non-plausible combinations. Similarly, the model does not account for all possible feedbacks between different sectors. Changes in one sector may have a rebound effect in another sector, and*	*For more details, Deliverable 3.4.*

	not all of these may be reflected in the model. The Transition Pathways Explorer will include warnings on some of the key problematic user choices.	
Stakeholders wondered if the EUCalc tool can quantify climate change actions for organisations by following calculations rules and assumptions as in environmental footprint (Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF)).	*The EUCalc Transition Pathways Explorer is not designed for quantifying impact and/or contribution associated with individual organizations or businesses. However, the tool can be used by various businesses and organisations to predict and determine most "meaningful" actions that can be taken through their long-term strategies towards decarbonisation.*	*For more details, Transition Pathway Explorer.*
In several instances, stakeholders highlighted the importance and usefulness of decomposing, translating and adding up different scenarios under the umbrella of EUCalc. Most of them suggested that having a common platform that allows users to create and compare their preferred decarbonisation pathways, whilst incorporating greater levels of transparency that the EUCalc strives to achieve and currently lacking in other similar models, can significantly aid the decarbonisation dialogue between various stakeholder groups.	*The EUCalc Transition Pathways Explorer provides a fair and balanced platform for conversation, owing to its transparency ideals and real time responses. The Calculator does not aim to define an optimal scenario, but rather to simulate and reflect the full scope of what is believed to be possibly achievable by 2050. Underpinned by a robust literature review - and the expert stakeholders' co-design process - the EUCalc team has endeavoured to account for the full range of scientifically credible and balanced opinions when considering a possible decarbonised future by 2050 and beyond. This has taken into account outputs from other modelling projects and scenarios that can be replicated within the EUCalc model. The EUCalc Transition Pathways Explorer, therefore, not only allows for desired pathways to be created and replicated by the end user, but it will also include a set of pre-defined pathways such as scenarios from the EU long-term strategy for climate neutral Europe.*	*For more details, please refer to the Transition Pathway Explorer.*
Some stakeholders suggested that it would be beneficial to some end users if the EUCalc could model loss and damage, e.g. biodiversity loss, impacts on ecosystems, minerals, materials, (e.g. minerals and materials for medicine and building stock) in order to better understand the long-term impacts associated with lifestyle choices for material, diets, products, etc.	*The European Calculator is a tool intended to explore trade-offs and synergies across sectors.; It does so by being complex enough to capture the main decarbonisation paradigms of established models, whilst remaining simple enough to allow experts and non-expert users to explore their various possibilities instantaneously. Instantaneous response features of the EUCalc limits the extent of granularity in each module. This necessitated the EUCalc team to model only what is absolutely essential so as to arrive at scientifically robust results in support of the decarbonisation debate. As long as there are parameters that*	*For more details, please refer to the sector related documentation/ (e.g. Lifestyles, Buildings, Agriculture and land use, Manufacturing, etc.).*

	make a significant impact on results, they will be added, whilst remaining mindful of retaining a good balance between complexity, transparency and simplicity of the tool. The tool has taken into consideration impacts associated with biodiversity, water, material and mineral acquisition for all sectors.	
The stakeholders highlighted the importance of considering different assumptions and estimations involving innovation for the model, especially in terms of cost reduction of certain technologies and how this can contribute to the increased deployment and decarbonisation targets. Additionally, the meaning of "cost-efficient" under various economic circumstances was questioned and the importance of having costs to play with in order to understand the outcomes of different costs assumptions was emphasised as of importance.	*The EUCalc provides a technology matrix. This matrix consolidates technology information such as:* - *specific energy consumption (segmenting feedstocks)* - *specific process emissions* - *capex, non-fuel opex* - *Technology Readiness Level (TRL)* - *actualisation of the costs using the discount factor* *Related to it, the technology matrix also consolidates:* - *the material composition of products* - *the material switch ratios (how much of one material is required to substitute another).* *It is the EUCalc project ambition to make this information more easily accessible to all the energy modelling platforms.*	*For more details, please refer to the WP1 technology documentation.*
Stakeholders highlighted that assumptions on energy cost, discount rates and on primary energy factors must be very transparent, in particular, in the light of the fact that many existing models lack this essential element. It was suggested that perhaps these could become levers/sub-levers that users could play with.	*The EUCalc model has been developed with strict adherence of the transparency Calculator philosophy. In view of this, the energy costs have been modelled as a function of the energy demand and will be clearly specified. It could also become a lever. In addition, the discount rate will also be a lever. However, the conversion rates from primary energy are clearly defined by the supply sector and not user defined.*	*For more details, Deliverable 5.4 and energy supply documentation.*
Some stakeholders questioned the issue of embedded energy/carbon implications of different building sector renovation/new build/demolition ambitions level: "What contribution can the building sector plus others make towards various emission reduction pathways?"	*The EUCalc module on Buildings addresses the impacts of building stock for renovation, new build and demolition, alongside their material and resources requirements.* *To address the GHG emissions related to the construction and renovation of buildings, EUCalc makes a connection between the Buildings and Manufacturing module. Within the latter, an estimated amount of materials is used to assess carbon emissions and energy consumption coming from using different construction materials and performing construction works.*	*For more details, Deliverables 2.5 and 3.4.*

The stakeholders wondered how the EUCalc would deal with direct and indirect components since this is a model for Europe and it differs in this respect from the Global Calculator, and hence the importance of the trans-boundary elements of the EUCalc.	*The EUCalc module on Transboundary Effects and Trade Flows aims precisely at quantifying the transboundary effects of a number of user-defined decarbonisation pathways. These have been defined at sectoral levels and obtained from combinations of levers from EUCalc core modules.*	*For more details, Deliverables 7.3 and 7.4.*
The EUCalc needs to go deeper than the Global Calculator to reflect the regulatory structures and language of the European Union and to facilitate dialogue between regulators, member states, NGOs, etc. especially in sectors where there are no off the shelf solutions available at the moment.	*The deeper level of granularity and flexibility in the EUCalc has been facilitated by the use of KNIME platform for the modelling purposes. The co-design process has helped the project and the tool to capture complexities of Europe and the individual 28 member states + Switzerland as well as the EU as a discrete entity.* *Even though the consultations could not be organized in each member state, the EUCalc team tried to ensure the gathering of views and perspectives from each member state (e.g. literature review, Sustainable Energy Week in Brussels, country of operation in stakeholder consultation process, etc.).*	*For more details, please refer to the Transition Pathways Explorer and sector related documentation.*
The stakeholders also wanted to see more on the application of LULUCF and carbon sequestration with respect to forests, grazing land among others being covered by the EUCalc.	*LULUCF is a key pillar to achieving net-zero emission pathways within EU and at the member state level. To this end, the EUCalc module has incorporated a LULUCF module that includes two levers. One focusing on land management and the other one focusing on forestry. The forestry lever has been developed under a climate-smart approach, with inter-linkage to the crop farming and livestock production systems levers in the agriculture module.*	*For more details, Deliverables 4.1, 8.4 and the documentation for Agriculture and the land use module.*
The stakeholders wondered about the translation of the 'sustainability criteria' across biofuels and biomass for electricity and heat purposes and whether it was possible to see this translated into all other agriculture and forestry activities.	*The EUCalc model has taken into account production of heat and electricity from biofuels/biomass within the EU and individual member states in its agriculture and land-use module. Depending on the lever setting, either energy crops or imports are used as a buffer when the biomass supply from the EU cannot meet the required bioenergy demand (gas, solid or liquid). However, the lever setting does enable end users to explore extreme scenarios for which dedicated energy crops or imports are not plausible. In such a case, a warning signal activates to inform the user that they are approaching or have breached resources limits, and have therefore chosen an inconsistent pathway that ought to be avoided.*	*For more details, Deliverables 4.1, 4.2 and documentation for Agriculture and land use module.*

The stakeholders questioned if the most subsidised sectors have a corresponding public duty to engage.	*The EUCalc does not distinguish subsidies in its cost structure. However, the end users are provided the ability to explore the potential of various sectors, including those most subsidised ones, to act on reducing emissions.*	*For more details, please refer to the Transition Pathways Explorer.*
Stakeholders sought clarity regarding the practical application of the model in terms of innovative products and policies that are currently emerging (e.g. practical applications of CCS which is not necessarily something that some stakeholder groups support). The assumption being that by capturing the state of knowledge regarding emerging practical application of innovative products and policies, the EUCalc tool could ultimately help in understanding their various associated impacts.	*The EUCalc model has endeavoured to capture current product innovation that is emerging within the EU. A good example is the incorporation and implementation of a carbon capture utilization and sequestration (CCUS) module. The CCUS module receives the captured carbon (expressed as Mt CO2-eq.) from the Industry and Power sectors modules. It then quantifies the flow of carbon sent to sequestration or utilization according to the lever definition and setting. The module accounts for the CCS potential of each country and the corresponding utilization and sequestration energy penalty and cost, as well as possibilities associated to carbon capture and utilization (CCU) fuel output.*	*For more details, please refer to the CCUS documentation and Deliverable 3.3.*
The stakeholders suggested to the consortium to trying to gain an understand how much potential time the end users were prepared to invest in terms of learning how to use the various tools before targeting the tool to them for their application. A simplified version of the tool could be targeted at MEP who have limited time, whilst a complex version to parliamentary advisors since they will have more time to interrogate the tool. Some referenced the Belgium Calculator, which they believed to be user friendly. The importance of calculations happening immediately (in real time) was viewed to be of value.	*The EUCalc model will have interfaces of different complexity levels. The Transition Pathways Explorer as a tool of intermediate complexity and the "My Europe 2050" e-learning Tool, which will offer a simplified platform for education and engaging non-expert citizens in conversation.* *The EUCalc team has interacted with members of the European Parliament (seen as the potential users of the tool) to understand better how the EUCalc Transition Pathways Explorer can assist them in their decision making e.g. what is the likely impact at member state level with regard to testing long-term targets plus their impact on effort in member states.*	*For more details please refer to the Transition Pathways Explorer and Deliverable 9.5 and 9.6.*
Some stakeholders suggested that it is questionable whether it would be good or not in terms of climate impact if everyone went organic.	*The EUCalc provides the ability to explore a wide range of agriculture scenarios, ranging from intensification to 100% agroecology within the Agriculture and Land use module as part of "Climate-Smart" crop and livestock production systems within the EU.*	*For more details, please refer to Deliverables 4.1, 4.2 and documentation for Agriculture and land use module.*
Stakeholders mentioned that the European Calculator will be useful in bringing	*For every lever end-users can test resulting emissions and other implications across their respective*	*For more details, please refer to the sector related*

understanding on the impact of fuel switching in terms of emissions and suggested to incorporate the ability for the end users to carry out a sensitivity analysis.	*ambition levels range. Further, implication comparisons can be made at a country level for a given lever and level setting.* *Fuel switch is a commonly used lever across sectors such as transport, buildings, industry, electricity, production, etc. The following switches are modelled in one or more sectors: to gas, to biofuels, to e-fuels, to electricity, to hydrogen).* *It is important to note that there is often also a technology lever, and that changing technology also modifies the fuel mix.* *Also, at present the e-fuel switch is performed by the CCUS module outside the sectoral modules.*	*documentation/deliverables (e.g. Transport, Buildings, Supply, Manufacturing, etc.) and the CCUS documentation for the efuels.*
After the Paris COP21, there is a need to constantly test policies, monitor where the gaps are and show which areas can make a significant impact by understanding interactions between different sectors and their respective roles in transition.	*The EUCalc tool is precisely designed and built to allow an understanding of the interactions and roles/contributions that different sectors can make in low carbon transition.* *The policy related deliverables assesses and provides the link between the policies and levers.* *Moreover, the EUCalc Transition Pathways Explorer will include a number of predefined pathways including EU long-term strategy for climate neutral Europe.*	*For more details, please refer to Deliverable 6.2*
Stakeholders stressed that in regard to bioenergy, one gets different answers depending on which experts are consulted (e.g. climate change, environmental, forestry scientists) and wondered how the EUCalc model will mediate between the different resource demands.	*In terms of biomass, this was discussed again as part of the agenda of the co-design workshop on the Agriculture and Land Use module. As a result, different perspectives that came up during this workshop from the expert stakeholders were taken into consideration in defining a range of ambition levels to a lever setting that enables and allows for different uses and application of biomass.*	*For more details, please refer to Deliverables 4.1, 4.2and the sector related documentation.*
Some stakeholders suggested that the Calculator should address gender aspects.	*The EUCalc module on socio-economic impacts will assess Gender intersections by reviewing relevant lever explanations across different EUCalc modules as well as by providing insights about gender implications of a number of selected EUCalc pathways. These insights will be described in the respective (sub-module) content documents.*	*For more details, please refer to sector related content documentation and Deliverable 6.3.*
Stakeholders also wanted to know if the EUCalc model could address the type of pathways the power sector ought to take for a 2° cost efficient trajectory.	*In the EUCalc model, users can set the composition of the electricity generation capacities, which is then matched against demand. Necessary flexibility solutions are also added to account for intermittency. The impact*	*For more details, please refer to Deliverables 5.1 and 8.5.*

	of emissions is shown against the carbon budget.	
Stakeholders suggested to include in the Transition Pathways Explorer a functionality for showing burden sharing between countries (if possible) and benefits of further EU energy integration.	*The consortium agreed that when the ambition for a lever of one country is changed, the ambition of all the other countries should not be changed automatically to make up for the lacking emission reduction. The argument was to not predefine the "algorithm" of burden sharing since making these rules is a matter of political negotiation.*	*For more details, Transition Pathways Explorer*

5.1 Costs Explained

Further to the comments of the stakeholders (Table 1, page 15), Deliverable 1.5 and Deliverable 5.1 provide detailed explanation on costs calculation and learning rates related to technologies included in the EUCalc model across Transport, Buildings and appliances, Manufacturing and production, Power generation and storage, Agriculture and Carbon Capture Storage and Use (CCUS). Deliverable 5.1 also includes the primary fossil energy emission factors alongside those of Biomass and Biogas in response to the request by the stakeholders. The consortium decided to use predefined technology costs assumptions as documented in Deliverable 1.5 and 5.1 and not to use a lever approach in relation to cost. Nevertheless, end users can explore various technology deployment options and their respective cost implications iteratively using the Transition Pathway Explorer (TPE). Given that the EUCalc is not an optimisation model, the costs are not the result of an optimisation process. Currently, the TPE displays the costs for Transport, Building, Electricity and CCUS sectors. The costs for the remaining sectors are under discussion and refinement and thus are not displayed in the current EUCalc version of the TPE.

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7 Annexes

7.1 Participants list

Participants – Stakeholders:

First Name	Last Name	Organisation	Sector/type
Alessandro	Celestino	The Regulatory Assistance Project (RAP)®	CSO
Alex	Mason	World Widelife Fund for Nature (WWF Europe)	CSO
An	De Schryver	European Commission, DG Environment	Public
Christos	Kolothakis	The Regulatory Assistance Project (RAP)®	CSO
Dimitrios	Sofianopoulos	European Commission, DG Energy	Public
Dries	Acke*	European Climate Foundation (ECF)	CSO
Edit	Konya	European Commission, DG Agriculture	Public
Ivan	Sitár	IKEA	Private
Jan Ole	Kiso*	European Commission, DG Energy	Public
Leia	Achampong	World Widelife Fund for Nature (WWF Europe)	CSO
Olivia	Gippner	European Commission, DG Climate	Public
Stephen	Zimmermann	World Bank	IFIs
Thomas	Nowak	European Heat Pump Association	Business Association
Laura	Aylett*	UK Government, Department for business, energy and industrial strategy	Public
Graham	Buss	Shell Global Solutions	Private

*EUCalc project Advisory Board members

Participants – European Calculator:

First Name	Last Name	Organisation
Michel	Cornet	Climact
Vincent	Matton	Climact
Julien	Pestiaux	Climact
Onesmus	Mwabonje	Imperial College London
Jeremy	Woods	Imperial College London
Lorenzo	di Lucia	Imperial College London
Vincent	Moreau	EPFL
Hannes	Warmuth	ÖGUT
Miklós	Gyalai-Korpos	PANNON Pro Innovations Ltd.
Judit	Kockat	BPIE

Dan	Staniaszek	BPIE
Garret	Kelly	SEE Change Net
Ana	Rankovic	SEE Change Net
Ivana	Rogulj	SEE Change Net
Ines	Bulajić	SEE Change Net
Bernd	Hezel	Climate Media Factory
Jurgen	Kropp	Potsdam Institute for Climate Impact Research (PIK)
Luis	Costa	Potsdam Institute for Climate Impact Research (PIK)
Sandra	Kirchner	Climate Media Factory
Ephraim	Broschkowski	Climate Media Factory
Hannes	Warmuth	ÖGUT
Patricia	Osseweijer	TU Delft
Marc	Vielle	EPFL
Wusheng	Yu	University of Copenhagen (UCPH)
Miklós	Gyalai-Korpos	PANNON
László	Zentkó	PANNON
Katja	Firus	T6 Ecosystems
Alessandra	Prampolini	T6 Ecosystems

Facilitator:

First Name	Last Name	Organisation
Adrian	Taylor	ForeSight and Strategy for Security and Sustainability in Governance (4Sing)

Workshop agenda

7.1.1 Potsdam workshop

Wednesday 14th December 2016 Potsdam Institute for Climate Impact Research, Albert Einstein Research Campus	
13.45–14.00	Arrival, registration; introduction of participants
14.00–14.15	Introduction to the European Calculator project and partners
	Dr Juergen Kropp, Potsdam Institute for Climate Impact Research
14.15–14.35	Presentation about the critical role of the Climate 2050 Pathway Calculators in facilitating robust climate mitigation policy
	Dr Jeremy Woods, Faculty of Natural Sciences, Centre for Environmental Policy, Imperial College London
Dr. Bernd Hazel, Climate Media Factory	
14.35–16.00	Discussion (1)
	What would help to maximise the usefulness of the EUCalc Pathways Explorer from your sector's perspective?
16.00–16.15	Coffee break
16.15–17.30	Discussion (2)
	What are the limitations of our approach to creating the EU Calculator that we should communicate in order to avoid setting wrong, or too high, expectations in terms of our ability to help solve the users' problems?
17.30–17.45	Wrap-up and next steps

7.1.2 Brussels workshop

Thursday 23rd March 2017 DG MOVE, Flamoureux, Rue de Mot 24/28, Brussels	
9.00–9.25	Arrival, registration; introduction of participants
9.25–9.45	Introduction to the European Calculator project and partners
	Dr Jeremy Woods, Faculty of Natural Sciences, Centre for Environmental Policy, Imperial College London
9.45–10.15	Presentation about the critical role of the Climate 2050 Pathway Calculators in facilitating robust climate mitigation policy
	Michel Cornet, Senior Consultant at Climact
10.15–10.45	Discussion (1)
	What do you need for this model to be relevant for your policy/work?
10.45–11.00	Coffee break
11.00–12.10	Discussion (2)
	What do you need for this model to be relevant for your policy/work?
12.10–12.15	Wrap-up and next steps
12.15–13.00	Lunch

7.2 Workshop questions

1. How will you use the Calculator?

A. What are the main energy, resource & climate change decisions you need to take?
B. What challenges/dilemmas do these decisions raise which you want EUCalc to address?
C. What would help to maximise the usefulness of the EUCalc Pathways Explorer from your sector's perspective?

2. Which Lifestyle Issues are important?

The greater the levels of our ambition to decarbonize, the more there will be need for lifestyle issues to be addressed. In the model, it is possible to see the impact of changes in the following lifestyle choices: Diet, Travel demand, Building sizes and occupancy, Appliance use, Product demand.

A. In your opinion, are all these items needed?
B. Are any items missing that we should model?

3. How much choice do you need?

In modelling, it is possible to give users more or less choice, and correspondingly to let the machine simply optimize certain factors by itself.

A. Which of the following would you like to be able to challenge and change and which should be optimized automatically?

   Technology mix & resource use – optimize or choose? Optimize for:
   - Maximal welfare
   - Minimal cost
   - Minimal environmental impact
   - Maximal job creation
   - Minimal water impact
   - Minimal health impact (e.g. air quality)

   Member state level: optimize or choose? Different implications for:
   - equality in welfare distribution (social cohesion)
   - food sovereignty
   - energy sovereignty /security
   - effort in burden sharing

B. Are there any important factors missing here?

C. What are the limitations of our approach to creating the EU Calculator that we should communicate in order to avoid setting wrong, or too high, expectations in terms of our ability to help solve the users' problems?

4. What should we envisage as a reference scenario (e.g. level 1 or least ambitious level) for Europe?

5. Should the European Calculator provide results at the national level (If yes, which ones?)? How should it deal with trans-boundary effects in the EU?

6. Should the European Calculator address the question of emission leakage associated with offshoring intensive production? Please provide suggestions on how these leakages ought to be addressed.

7. What are the plausible future developments outside of Europe (RoW, trans boundary) that should be captured by the European Calculator that might significantly affect climate and energy landscape inside the Europe (e.g. competitiveness)? How does

the global picture impact choices and optimization of resource use and energy technology within Europe?

8. What socio-economic impact issues should be covered by the European Calculator? The consortium has suggested the following: "health", "employment creation", "value added", "standards of living", "energy security" and "GDP". How appropriate are these?

9. How can we best ensure a high standard of transparency in the European Calculator?

10. **A request for Help:** By its very design – levers and levels - the European Calculator is capable of integrating a range of existing scenarios and knowledge. Please suggest pivotal studies/scenarios that you use/rely on in your work and decision making that the European Calculator should consider and include. Write these below on this sheet of paper, and hand it in to us.