Explore sustainable European futures

Expert consultation meeting on Air pollution and health module of the European Calculator

Pre-read document
Tuesday 9th April 2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730459.

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1 Agenda

Expert consultation meeting on Air pollution and health module of the European Calculator

Tuesday, April 9, 2019 from 11:00 AM to 4:00 PM UK time
Room G03, Weeks Building, Centre for Environmental Policy (CEP)
Imperial College London
16-18 Prince's Gardens
South Kensington Campus
London SW7 1NA

Time	Activity	
10.30 - 11.00	Registration and coffee	
11:00 -11.15	1. Opening and welcome 2. Introduction to EUCalc project (slides set I)	Jeremy Woods (ICL) and Patricia Osseweijer (TUDelft)
11.15 - 11.30	3. Introduction to the EUCalc Work Package Social Impact 4. Results and introduction Health Module & questions (slide set II; pre-read Ch. 2)	Patricia Osseweijer (TUDelft)
11:30 - 12:00	5. Model approach Air & Health module 6. Use of IIASA data in EUCalc (pre-read Ch. 3)	Marc Stettler (ICL)
12.00 - 13.00	7. Points of discussion and solutions (pre-read Ch. 3.3 points 1-7)	Expert participants
13.00 - 14:00	Lunch	
14.00 - 15.00	8. Health matrix 9. Points of discussion and solutions (pre-read Ch. 3.3 points 8-9) 10. Model output (costs & health effects) 11. Calibration with GAINS scenario	Expert participants
15:00 -15:30	12. Any other issues	
15:30- 16:00	Conclusions, solutions and next steps	

*Slides sets will be circulated before the meeting

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2 About the European Calculator

2.1 What is a Calculator?

The Calculator approach consists of a multi-sectoral systems model associated with a web-tool that allows users to explore the options for reducing GHG emissions from now to 2050, and to see the consequences of these choices on multiple sustainability issues. To this end, users are enabled to control levers[1], expressing behavior, technology or practice patterns among the different sectors, which affects the GHG emission trajectory, and a range of sustainability impacts. The first Calculator was developed in 2009 (UK 2050 Calculator[2]) to enable the UK Government to develop their greenhouse gases (GHG) emission mitigation strategy, namely the UK Carbon Plan. Since then, more than 30 Calculators[3] have been developed worldwide so far, with a few others already in process. These calculators can be used for informing policy making, designing GHG mitigation strategies, reporting on the Intended Nationally Determined Contributions (INDCs), education and research purposes, disseminating awareness and knowledge, and contributing to the climate change debate more broadly.

Building on the success of some early national 2050 calculators, the Global Calculator[4] was developed, which was led by the former UK Department of Energy and Climate Change (DECC), and co-funded by Climate-KIC, involving several world leading institutions in the project. The Global Calculator enables users to explore the options for reducing global greenhouse gas (GHG) emissions associated with land, food and energy systems in the period to 2050. The Global Calculator also extends the approach used in the country level 2050 calculators by illustrating some of the detrimental impacts of climate change associated with global-level choices.

The EUCalc relies on tried and tested methodology of the Global Calculator, extends it by additional modules and adapts it to the EU context.

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[1]Each 'lever' allows for four different 'levels', based on the ambitions in terms of GHG emissions reduction. **Level 1**: Business as usual; it contains sectoral projections aligned and coherent with the observed trends. **Level 2**: Ambitious but achievable; this level is an intermediate scenario, more ambitious than business as usual but not reaching the full potential of available solutions. **Level 3**: Very ambitious but achievable; this level is considered very ambitious but realistic, given the current technology evolutions and the best practices observed in some geographical areas. **Level 4**: Transformational breakthrough; this level is considered as transformational and requires additional breakthrough and efforts such as a very fast market uptake of deep measures, an extended deployment of infrastructures, major technological advances, or strong societal changes, etc.

[2] The original UK 2050 Calculator is available at: http://classic.2050.org.uk

[3] See the full list of completed calculators with links to access them at: www.2050.org.uk/calculators

[4] The Global Calculator is available at: www.globalcalculator.org

2.2 What is the European Calculator?

The European Calculator (EUCalc)[5] is an ongoing project supported by the EU Horizon 2020 Programme, which builds on the expertise of these existing calculators. The project is led by the Potsdam Institute for Climate Impact Research (PIK-Potsdam, Germany), involving several other European institutions.

The goal of the EUCalc project is to test low-carbon transformation pathways on the European and Member State (MS) scale. By following the modelling philosophy of the Global Calculator, the EUCalc project will develop the existing model core further with several additional modules (e.g. water module, socio-economic module, lifestyle assessment, link to the economy, trade flows, parameterization of the rest of the world, etc.) and downscale it to the Member State level of the EU. Combined with a Transition Pathways Explorer, an online tool providing instant results from the EU Calculator model runs, the ease of use of the model will be guaranteed.

With EUCalc tool levers, 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 results will enable EU policy-makers to support the energy, emissions and resources debate on a low carbon transition.

The development of the EUCalc tool is a module-based process. Each work package of the project produces one or multiple modules that are linked together to form a fully integrated (European) model (Fig.1). This allows each module to work independently, providing the necessary flexibility and integration of the EUCalc tool development..

2.3 The role of co-design in EUCalc

The EUCalc project takes a multi-sectoral and cross-disciplinary approach by drawing on a wide range of energy and land demanding sectors from lifestyle, buildings, markets, trade, manufacturing, agriculture and forestry, etc., in order to model integrated energy pathways. Co-design and stakeholder consultations are a fundamental component of the EUCalc model development, in order to capture and leverage existing work, to clarify and agree on the key assumptions and ambition level ranges to be used in the EUCalc tool on a sector by sector basis as well as to enhance the science-decision making interface. This process is organized through stakeholder co-design workshops and expert meetings for each main module (Fig. 1). In this workshop we invite your input to the design of the module and the scientific rigor of the approach. We will discuss the scientific challenges of relating air pollution to mitigation pathways and its effects on human health.

[5] More information on the EUCalc is available on its project's website at: www.european-calculator.eu

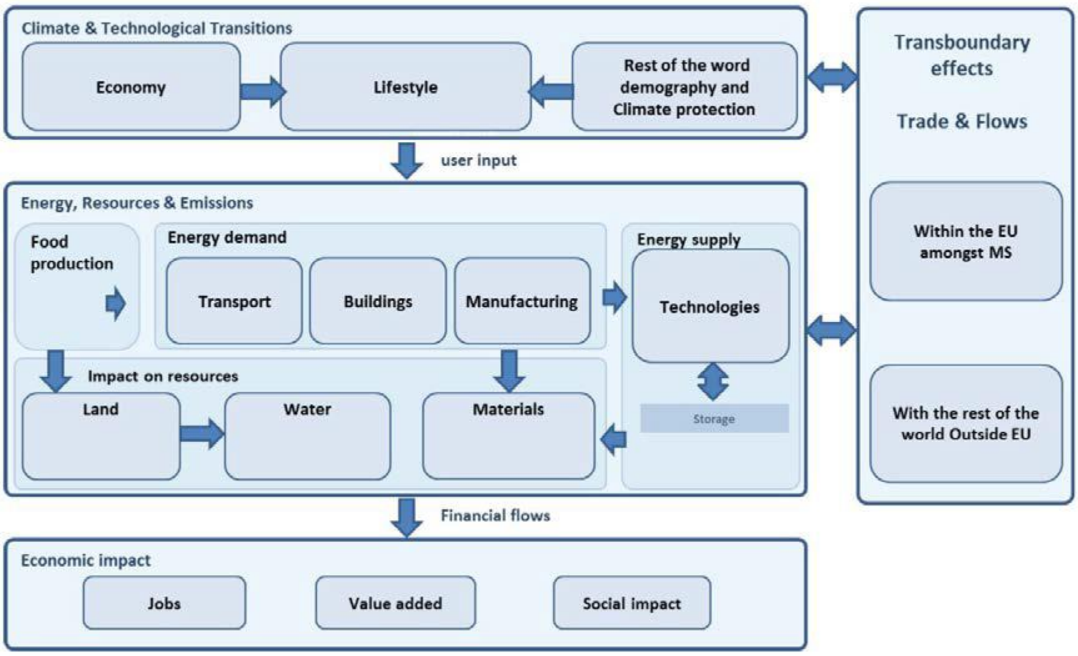


Figure 1: Modular structure of the European Calculator model

2.4 Rationale for including air pollution in EUCalc

EUCalc is the first calculator which aims to include information on social impacts related to climate change mitigation strategies. Work Package on Social Impacts ("WP6" hereafter) aims to assess the socio-economic impacts of the scenarios (pathways) developed by other WPs. In WP6 we follow the following approach:

- **Defining socio-economic issues and indicators** (TU Delft)
  - The issues were defined by stakeholder survey online
  - First (expert) workshop of WP6 to confirm and identify indicators
- *Result: employment and health were selected as prime relevant topics. Gender was defined as a crosscutting issue and perceived as either too complex to be modelled or not feasible due to lack of data. It was therefore decided to include gender aspects in lever explanations instead.(Regarding the health impacts of decarbonization pathways, indicators were validated by the experts based on three criteria namely: conceptual coherence, operational coherence and utility. Experts' discussions showed that there are large uncertainties regarding the applicability of different indicators. In particular, experts had consensus regarding air pollution as this is highly linked to mitigation strategies and it provides a considerable impact on health and related costs. (Pashaei Kamali et al. 2019 working study).*
- **Developing Employment module** (EPFL)
  - An initial version of the employment module in now completed and being integrated in the overall EUCalc model
- **Developing Health module** (Imperial, TU Delft)
  - This expert workshop has the objective to define the scientific approach for the health module
  - Developing health module with Climact
  - Integrating health module in EUCalc
- **Policies task** (EPFL)

    - Review of EU policies in all sectors
    - Qualitative links between levers and policies (discussion initiated with sectoral experts)
    - Assessment of quantitative links between levers and policies, case-study of the transport sector
- **Gender intersections** (OGUT)
    - Review of lever explanations for work packages 1-5 in collaboration with WP leaders and defining entry points for each lever
    - Expert review
    - Final draft gender documentation and implementation

TU Delft is leading the WP6of the EUCalc project, in collaboration with EPFL Lausanne, OGUT Vienna, PIK-Potsdam, Imperial College, Climact, Climate Media Factory, T6ECO, SEE Change Net. The University of Lausanne leads the module on impacts on employment, while Imperial College and Delft University of Technology are developing the module on health impacts.

3 The air pollution and health effects module

Air pollution can lead to a range of serious adverse health outcomes. Epidemiological studies have shown that there are a large number of adverse health effects associated with air pollution. Exposure to air pollution has both long-term and short-term effects. The long-term effect on health relates to premature mortality due to cardiopulmonary (heart and lung) effects. In the short-term, high pollution episodes can trigger increased admissions to hospital and contribute to the premature death of people who are more vulnerable to daily changes in levels of air pollutants.

The human health assessment of WP6 aims to:

i. Provide quantitative estimates of the air pollution impacts of different 2050 calculator pathways across 28+1 EU countries in the EUCalc;

ii. Enable users of EUCalc to interpret the air pollution impacts with policy relevant metrics;

iii. Account for ongoing improvements in emissions control technologies that are not explicitly covered by the EUCalc methodology.

This document describes the methodology underlying the health effects calculations and:

- defines the overall rationale for the health impact assessment, in particular by demonstrating how it builds on the impact pathway approach (IPA);
- identifies a general framework for quantifying impacts of air pollutants on human health, including links to the other EUCalc core modules;
- identifies the assumptions and data that will form the basis of the quantification of benefits;
- highlights outstanding questions for the expert consultation.

3.1 Impact pathway approach

The impact pathway approach (IPA) is a systematic method for identifying and tracing the effects of air pollution, from changes in emissions that result from changes in human activity, through to impacts on outcomes that society values[6].There are six component stages, as shown in Table 1. The IPA can also be represented diagrammatically, as in Figure 2.

Table 1: Stages of the impact pathway approach.

Stage	Description
1	Estimating anthropogenic activity
2	Quantifying the resultant air pollutant emissions
3	Modelling the dispersion of emissions of air pollutants to understand changes in ambient pollutant concentrations in different locations
4	Quantifying the exposure of the population to changes in air pollutant concentrations
5	Estimating how those changes in exposure affect human health
6	Valuing those impacts using a single monetary metric

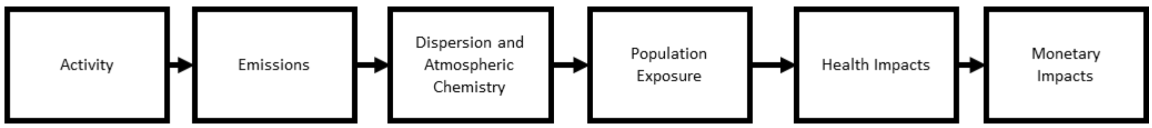


Figure 2: Impact pathway approach.

3.1.1 Limitations of EUCalc approach for air pollution

In the process of developing the methodology to estimate air pollution impacts within EUCalc, we have encountered a number of limitations that mean a full IPA would not be feasible, including:

1. **Emissions factors**. The standard method of conducting an emissions inventory is to multiply an activity value (e.g. PJ, vkm) by an appropriate emissions factor that accurately quantifies the mass of emissions per unit of activity (e.g. kg NOx/PJ or kg NOx/vkm). In Europe, the standard resources for emissions factors is the EMEP/EEA air pollutant emission inventory guidebook[7]. However, it became clear that the technology

[6] Defra (2019) Impact pathways approach: Guidance for air quality appraisal. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770649/impact-pathway-approach-guidance.pdf

[7] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

definitions for each of the core energy conversion sectors within EUCalc (e.g. energy, transport, manufacturing) were not detailed enough to allow us to choose the appropriate emissions factors. Note, that this reflects the fact that the pollutant emissions factor for an energy conversion process can vary by an order of magnitude or more with negligible effect on energy efficiency (and CO2 emissions) owing to the advancement of emissions control technologies (e.g. catalysts, filters and scrubbers). To resolve this, it would be necessary to specify emissions control technologies in each of the 28 + 1 EU countries for different sectors up to 2050.

2. **Spatial distribution of emissions.** To calculate emissions dispersion and resultant changes in concentrations due to pollutant emissions, it is necessary to know the source location of emissions. As EUCalc is a model aggregated to the country-level, there is no spatial information contained within the existing framework. Furthermore, it is therefore also not possible to represent the location of emissions with respect to population.

At this stage of the project it is not possible to remedy the issues highlighted above and couple a full-scale IPA.

3.2 Proposed approach with IIASA-GAINS

To meet the aims of WP6 and to overcome the challenges posed by the aggregate country level of EUCalc, we have collaborated with Markus Amman and Fabian Wagner of IIASA and are proposing to use their pre-existing work with GAINS. This approach enables: (1) quantification of accurate emissions factors for each sector and country, accounting for different technological development pathways, and; (2) incorporating the spatial distribution of emissions in each country and the dispersion and transport of pollution of transport across the EU.

In the following sub-sections we describe GAINS, propose an approach to estimate air pollution exposure resulting from emissions in EUCalc, show an example calculation, and then summarise the outstanding issues.

3.2.1 Introduction to GAINS

The GAINS (Greenhouse gas-Air pollution Interactions and Synergies) model was developed by the International Institute for Applied Systems Analysis (IIASA) and is now employed for the international negotiations among participants under the Convention on Long-range Transboundary Air Pollution[8].

The GAINS model can quantify the full pathway of the DPSIR (demand-pressure-state-impact-response) framework from the driving forces to the effects on human health and ecosystem of six air pollutants (SO_2, NO_x, NH_3, VOC, $PM_{2.5}$ and PM_{10}) and six greenhouse gases (CO_2, CH_4, N_2O the three F-gases). Examples of driving forces include economic activities, energy combustion, and agricultural production[9].

Source-receptor relationships have been developed to consider the atmospheric dispersion process. They quantify the impacts for the EU territory with the 50 km

[8]http://www.iiasa.ac.at/web/home/research/researchPrograms/air/policy/LRTAP_overview.en.html

[9] http://www.ec4macs.eu/content/report/EC4MACS_Publications/MR_Final%20in%20pdf/GAINS_Methodologies_Final.pdf

× 50 km grid resolution of the geographical projection of the EMEP model from changes in emissions of SO_2, NO_x, NH_3, VOC, $PM_{2.5}$ of the 25 Member States of the EU, Romania, Bulgaria, Croatia, Norway and Switzerland, and five sea areas[10].

Particularly for $PM_{2.5}$, the source-receptor relationships developed for GAINS describe the response in annual mean $PM_{2.5}$ levels to changes in the precursor emissions SO_2, NO_x, NH_3 and primary $PM_{2.5}$. In addition, a generalized methodology was developed to describe the urban increments in $PM_{2.5}$ concentrations in urban background air that is emitted from local sources[11].

The size of urban agglomerations and populations are critical to estimate the urban increment of $PM_{2.5}$ concentration and exposure in a given city. This information has been collected for 473 European cities in Europe with more than 100,000 inhabitants. Urban areas and diameters were derived from the JRC European population density data set and the www.citypopulation.de database, thereby linking population density for the individual urban agglomerations considered[12].

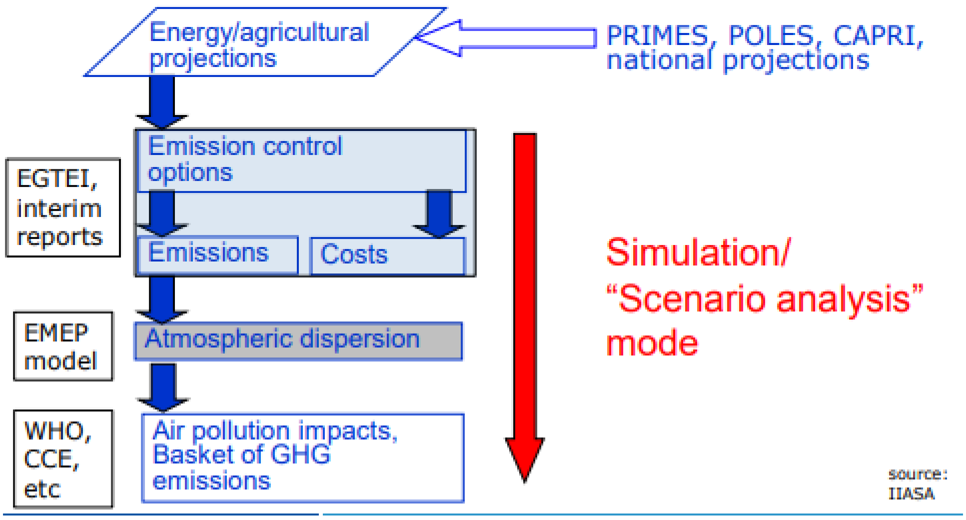


Figure 3: The GAINS model structure[13].

3.2.2 Integration with EUCalc

The EUCalc model will output activity for different sectors in different countries and in different years. This is stage 1 of the IPA.

We are proposing to make use of the work that has already gone into GAINS to use derived 'exposure factors' from GAINS that can be used to quantify population exposure directly by multiplying with the activity. This can be interpreted as combining steps 2-4 of the IPA.

[10] http://www.ec4macs.eu/content/report/EC4MACS_Publications/MR_Final%20in%20pdf/GAINS_Methodologies_Final.pdf
[11] http://www.ec4macs.eu/content/report/EC4MACS_Publications/MR_Final%20in%20pdf/GAINS_Methodologies_Final.pdf
[12] https://www.sciencedirect.com/science/article/pii/S1364815211001733#bib57
[13] http://tftei.citepa.org/images/files/2011-03-18/8-IVL_Astrom_20110317.pdf

Exposure is a function of pollution concentration and population in the receptor country. Concentration is a function of emissions in all EU member states and atmospheric transport. Emissions are a function of fuel mix, energy consumption and emission control technologies. The fuel amount is factored out at the end to get to a per-PJ value.

The units of the '**energy-based exposure factors**' provided by IIASA are:

(1000 people*µg/m³)/PJ ,

and these can be multiplied with the energy consumption of each sector to obtain population exposure results from activity in different energy conversion sectors.

A schematic presentation of how these 'exposure factors' relate to the IPA is shown in Figure 4. The different 'energy-based exposure factors' are provided for each EU member state and for every 5-year increment, as shown in Table 2.

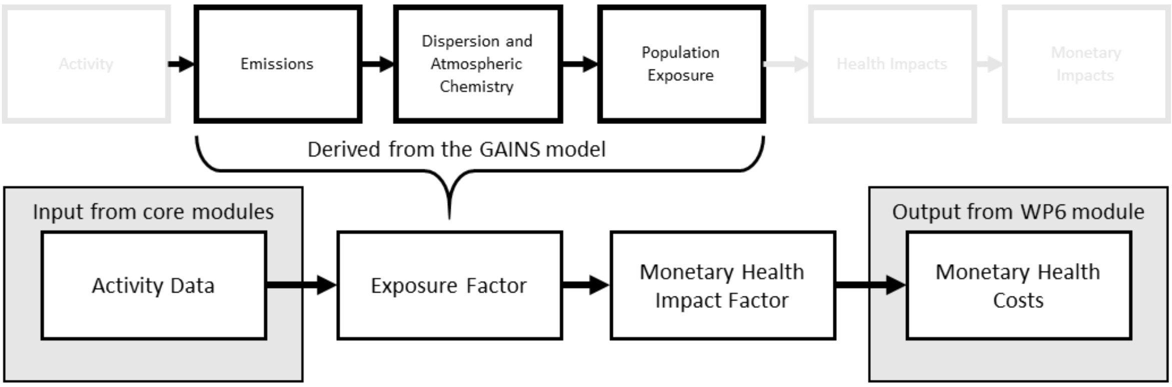


Figure 4: Schematic of the proposed approach in relation to the IPA. GAINS 'exposure factors' account for emissions control technology, pollution dispersion and population exposure.

Table 2: Energy-based exposure factors. These are provided for each of the sectors listed for every 5-year increment and member state.

Country	Year	Sector	Sub-sector	Technology
Austria	2015	Buildings	heating systems	bioenergy_solid
Austria	2015	Buildings	heating systems	coal
Austria	2015	Buildings	heating systems	gas
Austria	2015	Energy	Power	Coal
Austria	2015	Energy	Power	Gas
Austria	2015	Industry	cement	all
Austria	2015	Industry	chemicals	all
Austria	2015	Industry	iron & steel	all
Austria	2015	Industry	pulp & paper	all
Austria	2015	Transport	freight	Bus ICE CNG

Austria	2015	Transport	freight	Bus ICE liquid fuel
Austria	2015	Transport	freight	HDV ICE CNG
Austria	2015	Transport	freight	HDV ICE liquid fuel
Austria	2015	Transport	freight	LDV ICE CNG
Austria	2015	Transport	passenger	LDV ICE liquid fuel
…				

In cases where there is an imperfect alignment of sectors in EUCalc and GAINS, IIASA have also provided '**emissions-based exposure factors**' with units of (1000 people*μg/m^3)/tonne of emissions:

(1000 people*μg/m^3)/(tonne of emissions species) .

This will make it possible to calculate emissions for sectors that are not already included in GAINS, or for sectors that are modelled in greater detail in EUCalc than in GAINS (e.g. buildings heating and agriculture). The different 'emissions-based exposure factors' are shown in Table 3.

Table 3: Emissions-based exposure factors. These are provided for each of the sectors listed for every 5-year increment and member state.

Country	Year	Pollutant	Sector	Note
Austria	2015	PM2.5	Buildings	Accounts for urban increment
Austria	2015	PM2.5	Transport	Accounts for urban increment
Austria	2015	PM2.5	All others	
Austria	2015	NH3	All others	
Austria	2015	NOx	All others	
Austria	2015	SO2	All others	
Austria	2015	VOCs	All others	
…				

The current exposure factors provided by IIASA aggregate all exposure across the EU's population for each individual source. In other words, the factors include exposure caused by emissions in Austria within Austria and in all other EU member states. We are continuing to discuss with IIASA to create country-to-country exposure factors which account for exposure in each EU state due to emissions within each other country.

We have yet to finalise how it is best to interpret and present the exposure values and convert them to relevant health metrics. Feedback on this topic would be appreciated.

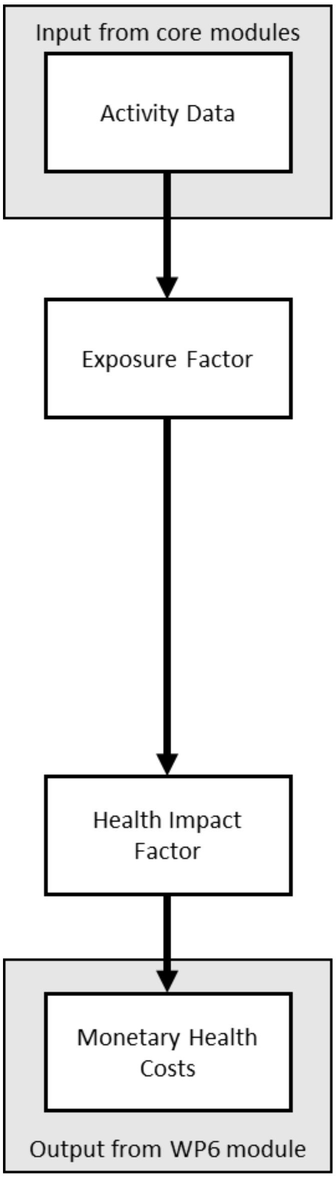
3.2.3 Example calculation

An example calculation is shown in Figure 5. This example was created with the preliminary exposure factors we have received from IIASA to demonstrate the linkages planned with other modules of EUCalc. To populate the example with data we used activity data from GAINS Online, IIASA's webtool.

The example activity data is multiplied by the exposure factor to produce a population weighted exposure (Tables 1-3 of Figure 5), effectively going from step 1 - 4 of the IPA. Once each source's contribution to the population weighted exposure is calculated a total sum can be made to calculate the overall exposure for the EU's population.

In this example, the exposure factor per PJ of energy from Coal in Poland drops from 88.2 to 28.0 1000 people*μg/m^3between 2015 to 2030. This change could result from an improvement in emission control technologies and also a change in the spatial distribution of coal plants relative to populated areas. Both factors would result in lowering population exposure to pollution. Capturing the redistribution of emission sources is not feasible in EUCalc since the model is not geographically defined (as discussed in section 3.1.1), however, this example demonstrates how we can approximate this effect by using the exposure factors from GAINS.

This example also serves to highlight that any technological improvements assumed in the scenario used in GAINS are adopted by EUCalc. It is therefore necessary to define appropriate scenarios within GAINS that align with the assumptions of EUCalc.



1. Activity Data

	Year	Country	Sector	Technology	Unit	Value
Example	2015	Austria	Energy	Coal	PJ	37.0
	2030	Austria	Energy	Coal	PJ	21.1
	2015	Poland	Energy	Coal	PJ	1549.0
	2030	Poland	Energy	Coal	PJ	1183.2
	...	...	...	...		

2. Exposure Factor

	Year	Country	Sector	Technology	Unit	Value
Example	2015	Austria	Energy	Coal	1000 people *µgm ^{3} /PJ	25.4
	2030	Austria	Energy	Coal	1000 people *µgm ^{3} /PJ	24.8
	2015	Poland	Energy	Coal	1000 people *µgm ^{3} /PJ	88.2
	2030	Poland	Energy	Coal	1000 people *µgm ^{3} /PJ	28.0
	...	...	...	...		

3. Population Weighted $PM_{2.5}$ Exposure

	Year	Country	Sector	Technology	Unit	Calculation	Value
Example	2015	Austria	Energy	Coal	1000 people *µgm ^{3}	37.0 x 25.4 =	939.8
	2030	Austria	Energy	Coal	1000 people *µgm ^{3}	21.1 x 24.8 =	523.2
	2015	Poland	Energy	Coal	1000 people *µgm ^{3}	1549.0 x 88.2 =	13662.2
	2030	Poland	Energy	Coal	1000 people *µgm ^{3}	1183.2 x 28.0 =	33129.6
	...	...	...	...			

4. Health Impact Factor

	Year	Country	Unit	Value	Notes
Example	2015	Austria	TBC		Health impact factors can be summed across sectors and countries for each year
	2030	Austria	TBC		
	2015	Poland	TBC		
	2030	Poland	TBC		
	...	...			

5. Health Impact (Monetary Health Costs)

	Year	Country	Unit	Value	Notes
Example	2015	Austria	TBC		Health impact factors can be summed across sectors and countries for each year
	2030	Austria	TBC		
	2015	Poland	TBC		
	2030	Poland	TBC		
	...	...			

Figure 5: An example calculation using the planned methodology. The activity data was taken from IIASA's GAINS Online webtool, specifically using the IEA World Energy Outlook 2017 scenario.

3.3Outstanding questions/issues

The approach presented above overcomes the limitations of the EUCalc model, however it is reliant on a number of assumptions and there are several issues that we would appreciate expert feedback on. These issues are summarized below.

1. **Population distribution**: the exposure factors from the GAINS model are estimated based on population growth projections and spatial distribution assumptions. This therefore potentially conflicts with the EUCalc project on population. It is necessary to understand the population assumptions in GAINS and alignment to EUCalc. It would be possible to apply a linear scaling of the exposure factors to account for relative differences between the population projections of GAINS and EUCalc at the member state level, however we could not change the spatial distribution of population. In order to align data assumptions on population we will compare the basic data sets used by EUCalc and GAINS. If the basic datasets are not comparable, we need to decide how to compensate for this.

2. **Emission control technology improvements**: the GAINS exposure factors account for emissions control technology improvement and these would therefore be assumed by all EUCalc future scenarios. EUCalc core modules do not currently account for emissions control. However, it is necessary to ensure that the GAINS scenario(s) are consistent with the EUCalc scenarios.

3. **Scenario alignment**: GAINS can be run in 'scenario analysis mode' where it follows greenhouse gas emissions pathways from pre-defined scenarios. It is therefore necessary to understand the importance of consistent assumptions and whether there is a need for validation between GAINS and EUCalc. Also whether the exposure factors from GAINS are sensitive to different GHG scenarios, which would be possible under EUCalc.

4. **Transport sector**:
   a. **Light-duty vehicles**: the GAINS exposure factors make implicit assumptions on the fuel split for the light-duty vehicle transport sector (diesel/petrol). We have the assumed relative split, so the assumed values are clear. However, we will need to apply some scaling in order to allow for different fuel type splits under different EUCalc scenarios and make use of the 'emissions-based exposure factors'.
   b. **Plug-in Hybrid vehicle**: GAINS does not include plug-in hybrid vehicles. Using the 'emissions-based exposure factors', it would be possible to include hybrid vehicles if the emissions are calculated separately (e.g. using EMEP/EEA guidebook). The assumption would be that the location of emissions relative to the population would not change.

5. **Agriculture sector**: GAINS does not include Agriculture and therefore there are no exposure factors that can be used directly. As an alternative, it would be possible to estimate agriculture emissions separately (e.g. using EMEP/EEA guidebook) and then assume that agricultural emissions have a similar

distribution relative to the population as another sector to a first order approximation, e.g. the power sector (i.e. mainly in rural areas).

6. **Heating sector**: the classification of heating technologies in the GAINS model is different to that in EUCalc. The 'emissions-based exposure factors' provided by the IIASA could be applied to our own estimation of emissions from this sector.

7. **Industrial sector**: the classification of industrial processes in GAINS is different to that in EUCalc. The 'emissions-based exposure factors' provided by the IIASA could be applied to our own estimation of emissions from this sector.

8. **Transboundary exposure**: the exposure factors provided by IIASA include exposure caused by emissions of one country on all other countries. We are continuing to discuss with IIASA to create country-to-country exposure factors which account for exposure in each EU state due to emissions within each other country, however we will need to ensure that the full extent of health effects are accounted for and also not double-counted.

9. **Health costs**: if we estimated the exposure in every member state as a result of emissions from every other member state, it would be possible to apply country specific damage costs, which accounted for different economic values of lives or life-years lost. In the EUCalc framework, this could lead to sensitive outcomes, such as emissions being shifted to countries with the lowest health damage costs to minimize overall health costs.

4 Practical Information

4.1 Reimbursement Form

Please find attached the Travel Expenses claim forms and a correspondent guide. The accommodation will be arranged in nearby hotel upon confirmation of participation and according to the information provided. Accommodation and travel costs will be covered by organizers (TU Delft) from the project budget.

Completed forms should be sent to:
Anka Montanus (email: A.M.Montanus@tudelft.nl)
cc’d to Farahnaz Pashaei Kamali(email: f.pashaeikamali@tudelft.nl).

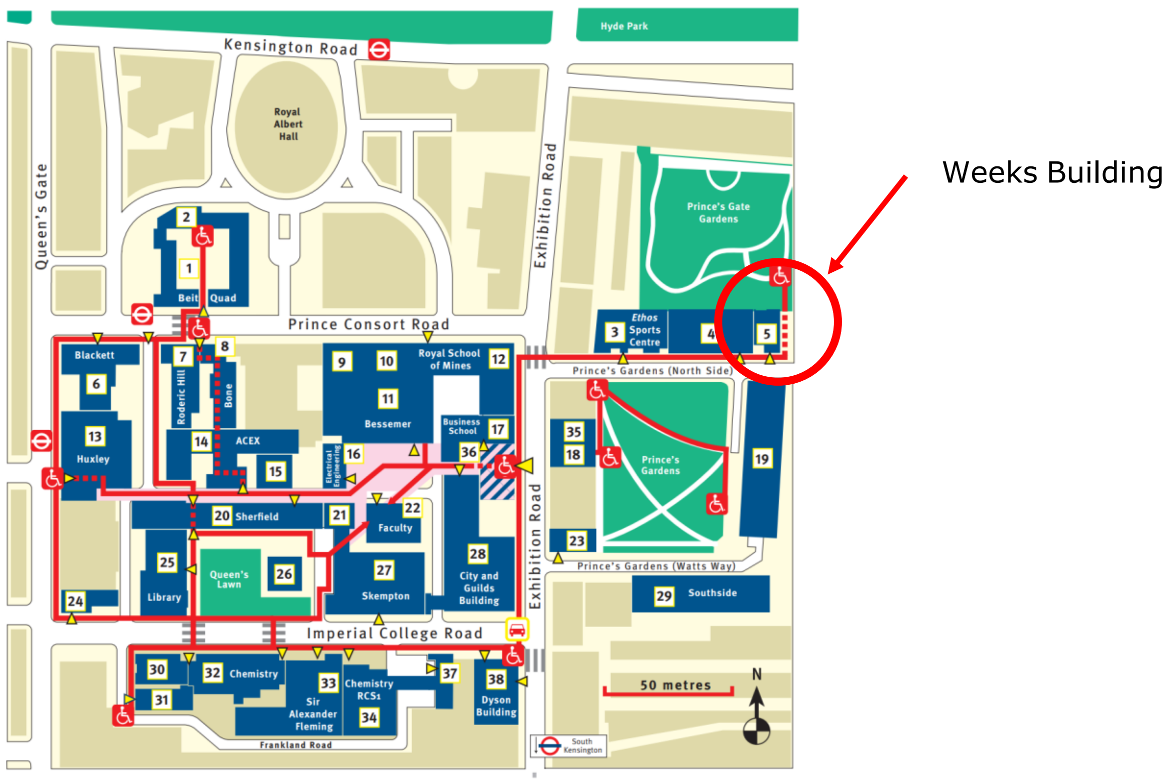
4.2 Information about venue

Address

Room G03, Weeks Building, Centre for Environmental Policy (CEP)
Imperial College London
16-18 Prince’s Gardens
South Kensington Campus
London SW7 1NA

https://www.imperial.ac.uk/visit/campuses/south-kensington/

Map



Remote access

For participants who will take part in the meeting remotely, access link and further information will be circulated soon.

5 Information Sheet

In advance of attending the expert consultation meeting we would like to outline our joint understanding of how the meeting will be conducted and how information from it will be used. We take these issues seriously so please take time to read and understand the following. Please let us know in case of any concern. We will ask you to sign a copy of the consent form (overleaf) at the workshop.

I consent to be a participant in the Expert consultation meeting on Air Pollution and Health module of the European Calculator, to review and co-design a novel air pollution impact model and health impact metrics under the framework of the EUCalc project, London on 9th April 2019 based on the principles outlined below.

During the meeting, a group of approx. 8 frontline experts from private, civil society sectors, the Commission and academia will come together to share their perspectives and discuss air pollution and health module of the European Calculator. The meeting programme (enclosed) is designed to stimulate interactive knowledge exchange and we welcome your active participation and contribution to this group effort.

The EUCalc project team assures you that we will only record information that is necessary to address the central purpose of our research. While your name and organization will be acknowledged on the list of participants, your inputs and contribution will not be attributed and will only appear in de-identified form in the publications/reports arising from this research. Anonymity of your input will at all times be safeguarded, except where you have consented or specified otherwise. This principle will be applied effectively on social media sites such as Twitter. Pictures taken at the workshop may be used inside project reports and could be used for the project website (http://www.european-calculator.eu/) and project presentations.

I understand that if at any time during the Workshop I feel unable or unwilling to continue, I am free to leave without negative consequences. That is, my participation in this Workshop is completely voluntary, and I may withdraw from this project at any time.

Co-design is one of the central components of the EUCalc project and we thank you for your willingness to participate. As a benefit of participating we would like to highlight an opportunity to be involved in a significant piece of research, to make connections with other prominent experts and to shape the EUCalc. The EUCalc team is also committed to the continued collaboration and exchange with participants, including opportunities for subsequent feedback and access to early releases of the EUCalc. On the other hand, collected information will be stored internally and managed by the EUCalc partners under strict rules defined to safeguard anonymity of your inputs and alleviate any potential participation burdens such as harm for misuse of your identifiable information.

I have been informed that if I have any questions seeking further clarification or assurances about the ethical issues relating to the project, I am free to contact Patricia Osseweijer (email:p.osseweijer@tudelft.nl) or Jeremy Woods (email:jeremy.woods@imperial.ac.uk).

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Informed Consent Form

EU CALC - Pathways for a sustainable Europe

Expert consultation Air Pollution and Health module of the European Calculator

Date: 9th April 2019

Venue: Centre for Environmental Policy (CEP)

Imperial College London

I ………………………………………………………………………………………… agree to participate in Expert consultation Air Pollution and Health module of the European Calculator.

The purpose of the consultation meeting has been explained to me in writing.

I am participating voluntarily and understand that I can withdraw from the research project, without repercussions, at any time, before it starts or while I am participating.

I am satisfied that the assurances of responsible and strict data governance, given by the *European Calculator projec*t, will be upheld.

I understand that my name and organizational affiliation will appear as a participant, but that anonymity of participants' contributions will be ensured at each research stage in the project, unless otherwise agreed.

I agree that pictures taken at the meeting may be used inside project reports and could be used for the project website (http://www.european-calculator.eu/) and project presentations.

A copy of the information sheet and (this) signed consent form will be given to the signee.

Signature:……………………………………………………………………………………….

Participant's name:…………………………………………………………………………….

Date:…………………………………………………………………………………………..