Connecting HEALTH & CLIMATE CHANGE

ENHANCING BELMONT RESEARCH ACTION
TO SUPPORT EU POLICY MAKING
ON CLIMATE CHANGE AND HEALTH (ENBEL)

Potential synergies between climate change and health projects funded by the Belmont Forum and Horizon 2020

Connecting HEALTH & CLIMATE CHANGE

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Content

Executive summary

The impacts of climate change on human health pose serious threats on human wellbeing, health and livelihoods in the 21st century and beyond. The aim of this report '**Potential synergies between climate change and health projects funded by the Belmont Forum and Horizons – report summing the commonalities between projects in research methods, measures, populations; and the potential areas where we can perform common activities across projects and generate shared outputs' (D3.1)** is to identify synergies across the research projects on climate change and health that are funded by the Belmont Forum and the EU's Horizon 2020 programme represented in ENBEL[1]. We identify areas where value can be added by the ENBEL consortium, especially pertaining to synthesis of research findings, dissemination and knowledge mobilisation. We present results of an online survey completed by investigators of the Horizon 2020 and Belmont Forum funded projects. The report includes both projects who are members of the ENBEL project as well as other projects on climate change and health supported by these funders. We also compare areas of research activities and discuss potential synergies and collaboration opportunities.

The survey was completed by representatives of twelve of the targeted projects, and data was extracted from project documents on these twelve, as well as three other relevant projects.

The results show that, while there are potential barriers to collaboration, many opportunities exist. There is much enthusiasm for collaboration among the group. Several of project researchers already interact through shared projects, setting the stage for rich collaboration. We identified several topic areas, research methods and study populations which are common to several projects. Having a common theme allows for joint dissemination of findings, cross-learning between projects and data sharing. Many of the projects focus on heat and health, opening up opportunities for a range of joint activities in this critical area. There are also overlaps in research methods used. Of particular note, several projects apply similar geospatial analyses techniques and health economics methods. Social science research is also common among the projects, providing opportunities for cross-learning around understanding the perceptions of communities. Moreover, there may be important lessons to be learnt from co-design and community-based research activities which are common to many projects.

Commonalities between projects provide an opportunity for developing joint conference sessions around a particular cross-cutting theme. Bringing together researchers from different projects who are working in the same discipline in face -to-face meetings may allow for very rich exchanges. Moreover, generating interactions between the different climate scientists in the projects could provide useful insights into work at the interface between climate and health sciences. It will be important to ensure that projects view data sharing as an opportunity, not a threat.

We identified several key barriers to conducting joint activities between ongoing projects and partner organisations. The research topics, the settings and project teams are quite disparate. The projects are

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1 The Horizon 2020 project ENBEL (Enhancing Belmont Research Action to support EU policy making on climate change and health) coordinates a network of international health and climate research projects funded by Belmont Forum and the EU. ENBEL aims to contribute with knowledge and policy advice on climate change and health links to support adaptation and resilience. Six Belmont Forum Climate Environment and Health projects, four Horizon 2020 projects, one other Belmont Forum and one ERA4CS project are represented in ENBEL. Read more www.enbel-project.eu

also in different stages of the project lifecycle, which limits the potential for concurrent activities, such as use of common study tools, cross-project analyses and dissemination activities. In addition, the COVID-19 pandemic has resulted in delays to several projects, further desynchronising activities across projects.

A successful capitalisation of potential synergies will require a robust communication process between ENBEL and the relevant projects. It will be important to find activities that are mutually beneficial. Joint dissemination activities and knowledge mobilisation around common themes or research methods is one such example, and a central aspect of the ENBEL project.

Background

The Intergovernmental Panel on Climate Change (IPCC) provides definitive evidence that humans have drastically altered the global climate and thereby are posing multiple compounding threats to human health and the natural world[2] . Climate change is increasingly recognised as a pre-eminent threat to the natural environment, ecosystems and human health in the 21st century [3]. Although the number of research projects on climate change and health funded by the European Union and the Belmont Forum has increased considerably in recent times, many large gaps in evidence remain. The recently released WHO Regional Office for Europe guidelines on heat and health highlighted many major gaps in evidence on how to respond to the new problems climate change is causing to health[4]. Moreover, the ''headcount'' of researchers working on the topic takes time to grow, especially as the field in complex and requires contributions from a range of disciplines. It is important to carefully consider whether the growing number of researchers, research projects currently underway and research topic being addressed are able to provide the volume of evidence needed to tackle one of the greatest health threats yet faced by humankind. Additionally, the quality of the research methods and geographical spread are also important to assess.

What is clear is that use of available information needs to be optimised. Doing so will require coordinating the existing projects, identifying key gaps in the current research portfolio and supporting joined-up activities among existing projects. While the focus is on work in the European Union, much can be done to optimise the relevant projects being carried out elsewhere, which cover large parts of the globe.

There have been several major initiatives within the European Union to address climate change and health. Research on health impacts of climate change and actions to address impacts emerged as a key priority in the EU's 7th Framework Programmes for Research and Technological Development (FP7). Seven projects on climate change and health were funded under Horizon 2020, receiving around €29 million from the EU.[5] These include the ENBEL project, and HEAT-SHIELD which is included in ENBEL, but also Climate-fit.city, PYROTRACH, GEMCLIME, BLUEHEALTH and BLUEACTION. Several other projects addressed climate change through the lens of co-determinants for health. This includes air quality (EXHAUSTION (included in ENBEL), CLAIR-CITY, ICARUS and iSCAPE, and others), urbanisation (GROW GREEN, URBAN GREENUP, VARCITIES and others) or infectious diseases (MOOD, VEO). The research projects funded through Horizon 2020 are intended to align with policy initiatives and provide critical evidence to guide their actions.

[2] Intergovernmental Panel on Climate Change (IPCC) (2018). "Special report on Global Warming of 1.5 ºC." https://www.ipcc.ch/sr15/.
[3] Watts N, et al. The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises. Lancet 2021; 397(10269):129-170

[4] Heat and health in the WHO European Region: updated evidence for effective prevention (2021) https://www.euro.who.int/en/publications/abstracts/heat-and-health-in-the-who-european-region-updated-evidence-for-effective-prevention-2021
[5] European Commission Directorate-General for Research and InnovationTuomo K (2021). "European Research on Environment and Health: Projects Funded by Horizon 2020 (2014-2020)." https://op.europa.eu/en/publication-detail/-/publication/03a2c022-9c01-11eb-b85c-01aa75ed71a1/language-en/format-PDF/source-199503195#document-info

The European Commission adopted the new EU strategy on adaptation to climate change in 2021[6]. It acknowledges that climate change impacts the health and well-being of Europeans, who increasingly suffer from heat waves among other manifestations of climate change. Furthermore, it calls for a deeper understanding of the climate-related risks for health. Within this context, a new European Climate and Health Observatory has been established under Climate-ADAPT[7], which provides access to a wide range of relevant publications, tools, websites and other resources related to climate change and human health. The Horizon Europe ''Mission area: Adaptation to climate change including societal transformation'', sets out key ambitions on climate change adaptation related to health[8].

Identifying synergies and potential areas of collaboration between existing projects could offer major benefits for the field and optimise use of available resources. These current set of research projects set the stage for future work and collaborations in this area. Moreover, taking advantage of opportunities for collaboration or joint outputs could substantially improve the research outcomes of individual projects, and offer policy makers and other academics more comprehensive knowledge products. Additionally, working across projects offers tremendous possibilities for members of the research teams themselves. These opportunities include knowledge mobilisation, cross-learning, joint dissemination events, including conference sessions, future joint grant applications and assisting with networking with researchers in the field. Additionally, bringing together available resources and optimising academic work and collaborations may help spark new ideas and accelerate the process of generating a critical mass of expertise in this area. Summarising the overall body of work across the projects also enables policy makers to identify key strengths and gaps in the area and assists them to identify which experts they can draw on for inputs in specific topics.

Over the past decade, recognition has grown of the mutually beneficial interactions among policymakers, researchers and the public at large, and how this can galvanise action and hasten efforts to reduce the impacts of climate change on health. Promoting health impact assessments of climate action and inaction is a powerful means of highlighting the potential consequences of climate change and promoting adaptation activities in various sectors.

While there is broad recognition of the potential health consequences of climate change, this has not translated into action at scale. Climate change is a complex issue and is quite rightly framed as being a major threat to the natural world, future generations, and our current way of life. Health is but one part of the whole picture. Nevertheless, viewing climate change through a health lens and as a pressing health issue may assist in bringing the influence and resources of the formidable health sector to bear on the problem. The sector is commonly viewed as being a legitimate source of information and guidance for societal action. The potential for public health to advance climate planning and action is largely untapped at present, though recognition of this potential is gaining in prominence, and the case is being made. One recent article summed this well: "Co-benefits to health help underpin greenhouse gas reduction strategies, while safeguarding health—particularly of the most vulnerable—is a frontline local adaptation goal'' (Fox et al., 2019). This is a key example, where reducing emissions from industry

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[6] New EU Strategy on Adaptation to Climate Change adopted on 24 February 2021 (COM(2021)82) https://climate-adapt.eea.europa.eu/observatory, https://ec.europa.eu/clima/policies/eccp_en
[7] European Climate and Health Observatory. https://climate-adapt.eea.europa.eu/observatory
[8] https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/missions-horizon-europe/adaptation-climate-change-including-societal-transformation_en

and transportation will reduce exposure to fine particulate matter and thereby lung diseases and presents a critical argument to substantiate mitigation efforts and the importance of carbon pricing that matches the burden of disease (Balbus et al., 2014).

One of the obvious strategies is to ensure integration of climate change concerns within all health policies and programme implementation, and vice versa. This may help bring the fields together and compel policy makers and programme in each area to engage with the others. Nevertheless, it appears that the countries in the European Union lag some way behind other global regions in government engagement with 'climate change and health'. Only 28% of EU countries included considerations of public health in their National Determined Contributions (NDC) submissions[3]. This figure was above 90% for most other global regions. Mainstreaming public health into NDCs might enhance the production of integrated evidence-based policy advice on climate change and health (Watts et al., 2019). Bringing together and raising the profile of Belmont Forum and Horizons 2020 projects focused on climate change and health, as well as forming a collective grouping of the leading researchers may help advance policy and programme integration between climate change and health, and secure the place of the health sector among the other stakeholders around which climate change is currently framed from a policy and public perspective (United Nations 2015[9]; European Commission 2019[10]). Firmly centring the place of health in the climate change agenda will increase the ability of the health sector to advocate for more robust mitigation and adaptation initiatives. Strengthening the body of research being done on the topic will go a long way to achieving this aim.

Report aims and methods summary

The ENBEL consortium brings together and includes researchers from six Belmont Forum Climate Environment and Health projects, four Horizon 2020 projects, one other Belmont Forum and one ERA4CS project[11].

As part of the initial ENBEL work package 'Produce research syntheses on key policy-relevant questions and identify how consortia projects can fill knowledge gaps on climate change and health linkages' WP3 activities we administered a survey in March 2021 to each of the relevant Belmont Forum and Horizon 2020 projects and extracted information from relevant project documents. This information provides an updated overview of research being carried out to enhance the dissemination of the research results and to promote awareness and policy on climate change and health. The report is presented in five sections, covering key thematic areas, namely, overall project description; potential synergies based on study populations and research topics; research methods and data analysis; data sharing considerations; and opportunities and barriers to cross-project activities. The report will be disseminated widely, drawing on the large networks of each of the ENBEL partners and the activities of the work package in ENBEL responsible for dissemination (WP5).

This report serves to identify and facilitate synergies between the Belmont Forum Collaborative Research Action (CRA) Climate, Environment and Health (CEH)[12], other relevant previous Belmont CRAs

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[9] United Nations 2015, Paris Agreement. Source: https://unfccc.int/sites/default/files/english_paris_agreement.pdf (Retrieved on 12-06-2021)

[10] European Commission 2019, European Green Deal, Source: https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF (retrieved on 12-06-2021)

[11] https://www.enbel-project.eu/projects

[12] https://www.belmontforum.org/cras#ceh2019

and EU-funded projects. This is done through examining commonalities between project activities, research methodologies and target populations, and noting complementary competencies among the project partners and ways of standardising study measures and analysis across projects, with a focus on health inequalities and gender analysis. The report also informs the activities and priorities of the ENBEL project as a whole. Identifying common thematic areas and methods will help the project team to develop dissemination activities, including conference sessions and joint publications.

A principal focus of the ENBEL project is on synthesising research findings across the Belmont Forum/Horizon 2020 projects, drawing on the wide-ranging research activities, content knowledge and methodological expertise of the consortium members. This deliverable will serve to identify the topics where the Belmont Forum/Horizon 2020 projects have major strengths and then draw on the competitive advantages and skills nested in these projects. Synthesis topics will also reflect the priority research- and policy-gaps in the field and be informed by the networking activities in the ENBEL work package on networking and coordination among researchers and stakeholders within the climate change and health nexus(WP2), the policy-prioritisation workshops and consultations with the European Commission (in particular with the Directorate-General for Research and Innovation policy officer).

A central aspect of the ENBEL project is to enhance the dissemination of the research results of the relevant projects, and knowledge mobilisation.

The report and the recommended actions constitute one of the key ENBEL activities to support the respective projects in their endeavours to generate impact by helping the projects to disseminate their findings to external audiences, spread powerful stories and enhance their long-term visibility.

Scope of the report

The overarching aim of this report is to identify opportunities for fruitful collaboration between the Belmont Forum and Horizon 2020 climate change and health projects, and to highlight ways that the resources within the ENBEL project can be used to optimise the outputs of the individual projects and their collective. Based on a survey in March 2021 and a document review, the report sums the commonalities between projects in research methods, study measures or indicators, target populations; and potential areas where we can perform common activities across projects and generate shared outputs.

We also aim to outline ways that the projects can advance the EU research agenda in climate change and health, drawing on the collaborative opportunities identified.

The report also provides a comprehensive summary of the projects, their characteristics, focal areas and methodologies applied. Gaps in the overall body of research are noted, including in topics and populations covered, as well as in research methodology. Lastly, we provide recommendations on what further steps might be taken to actualise the potential synergies between projects.

Methods

We included information from all projects included in the ENBEL consortium, as well as another three projects funded through the Belmont Forum CRA on Climate, Environment and Health who are not part of the ENBEL consortium.

Online survey

To identify potential synergies between Belmont Forum/Horizon 2020 projects covered in the report, we designed a survey instrument to collect a standardised set of information from the relevant projects[13]. The survey tool was developed by the ENBEL team members of work package 3 in February 2021, piloted in early March 2021 before being refined and finalised. The final version of the survey was distributed to the project leads of the included projects in mid-March 2021. The online questionnaire was prepared using LimeSurvey version 3.26.1 and hosted by the University of Graz, Austria. The tool included an introductory section in which the aims and structure of the survey were outlined, and an explanation provided of how the survey conformed to the principles and regulations of the EU General Data Protection Regulations (GDPR).

The questionnaire consisted of 10 thematic sections and a total of 61 response items. Questions were operationalised in several ways, as appropriate, and included mutually exclusive questions, questions with multiple-response options, free text questions and 'mask questions' which require a specific input such as a date or a file to be uploaded. A summary table of the thematic areas included in the survey is shown in Table 1 and the individual question items are included in the Annex. The large number of survey questions meant that the survey took approximately an hour and a half to complete. To optimise the amount of data available for analysis, survey participants were requested to provide very detailed responses wherever possible and add additional information in free text boxes or as uploaded files.

Table 1. Summary of thematic areas included in the survey and number of questions in each section.

Section	Thematic Area	N. questions
1	Project description and its partners	12
2	Climate hazards and health impacts covered by the project	3
3	Study Population(s) targeted in the study	3
4	Project topics addressed, or outcomes measured.	6
5	Study methods and data analysis	6
6	ENBEL support and collaboration activities	7
7	Project outputs (e.g., conference presentations, journal articles, reports)	11
8	Potential contribution of the project to European, national, regional or local policies	4
9	ENBEL training courses on climate change and health	4
10	Communication, dissemination, and citizen outreach	3

The survey starts with questions on project description and main characteristics of the projects, such as the climate hazards, health impacts and study populations examined in the project. The Intergovernmental Panel on Climate Change (IPCC) definition of a hazard was used in the questions: 'The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods,

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[13] https://survey2.uni-graz.at/778714/lang-en

service provision, and environmental resources'[14], such as heat waves exposure or wildfires, for example. Thereafter, questions covered the research and analysis methods used in the project, and the primary and secondary outcomes of their work. The questionnaire also included sections on data sharing, collaboration opportunities and modes of communication, dissemination, links to current policy and engagement with decision-makers, policy stakeholders and target groups. Finally, participants were asked to advise on how ENBEL could best support their project, especially regarding the dissemination of their findings.

Survey completion and other data sources

The survey was completed by 12 project representatives between 11 March 2021 and 30 April 2021. It was mostly filled in by the project's principal investigator, in some instances by the project's representative in ENBEL or other investigator. We then reviewed the responses for unclear or missing data. Where possible, missing information was extracted from the project documents which we had obtained from some projects or from the project websites. The Belmont Forum has a collection of videos archived on YouTube on each of their projects which provided very useful overviews of the project[15]. Follow-up emails were sent to clarify responses that appeared ambiguous and to explore some responses in more detail.

Three of the relevant projects did not complete the questionnaire (BuildERS, S&CC and MEWAR) mainly because the project leads felt it was still too early in the project's activities for collaborative work. We extracted information on these projects using the documentation on the project that was available to the work package 3 team and the project websites.

We also drew on the discussions and documents from two Belmont Forum workshops that the ENBEL team held (18 February and 23 March). In these workshops, eight of the nine Belmont Forum Climate Environment and Health projects[16] presented their work and discussions were held about potential overlaps, joint interests and opportunities for collaborative work and dissemination.

Data analysis and structure of the report

Interconnections and possible synergies between Belmont Forum CRA CEH and the included EU-funded projects were initially assessed through descriptive analyses of tabulated data. The results were grouped according to the following themes: Project characteristics; project topics, disciplines and activities; research methods and analysis; and inter-project collaboration through data sharing, joint data analysis, and opportunities for joint work, dissemination and support from the ENBEL team. Findings on each of these themes are presented separately in sub-sections of the report.

Binary or other categorical variables were tabulated and free text responses recoded in some instances into additional categories of a variable or grouped with other free text responses and summed in a

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[14] Field et al. 2014. Climate change 2014. Impacts, Adaptation, and Vulnerability. Summary for Policymakers. Cambridge University Press, Cambridge, United Kingdom and NewYork, NY, USA. Source: https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf (Retrieved on 12-06-2021)

[15] https://www.youtube.com/watch?v=u55l1cPW5X8&list=PLq4USJIxTB6Q5O1lUh1HufN0uUGHRGScf&index=1

[16] Out of the nine projects funded under the Belmont Forum CRA Climate Environment and Health (CEH), six are represented in ENBEL. For the workshop principal investigators of all the nine Belmont Forum CEH projects were invited.

narrative. We present selected illustrative responses as quotes. To highlight specific findings of particular interest, we present some results of the analysis in the form of maps.

The analysis offered an opportunity to identify topics on specific priority areas that had received little attention in the projects. Potential barriers to collaboration across projects are also presented. We paid particular attention to activities and opportunities in Africa since this forms an important part of the focus on the overall ENBEL project. Lastly, we draw some overarching conclusions from the analysis in the report and provide some recommendations for how the ENBEL project and the individual project teams could capitalise on commonalities and potential synergies between projects.

Section 1: Commonalities and differences between projects

1.1 Overall description of the projects, partners and study settings

Projects included in this report

The Belmont Forum, in collaboration with Future Earth, announced a new Collaborative Research Action for transdisciplinary research in 2019 (CRA, Climate, Environment and Health; CEH2019), which aimed to improve understanding of the pathways between climate, environment and health, and to protect and promote human health and well-being in the face of climate challenges. Multilateral, interdisciplinary and transdisciplinary research projects were selected that investigate the barriers to action; address complex climate, ecosystem and health pathways to determine processes underlying causal links; and foster the use of scientific information and climate-related decision support tools to better inform planning and enhance resilience.

A total of nine projects were awarded, six of which are represented in the ENBEL project (ACRoBEAR, AWARD-APR, CCCEHN, CHAMNHA, HEATCOST and PREP). This report also includes information about the three projects not included in ENBEL (MEWAR, Micro-Poll and S&CC). One project in the ENBEL consortium, PARSEC, was part of a previous CRA of the Belmont Forum (SEI; Science-driven e-Infrastructure Innovation). Tables 2-4 present the characteristics of the projects.

We also include four Horizon 2020 projects in this report (BuildERS, CASCADES, EXHAUSTION and HEAT-SHIELD), all of whom are partners in the ENBEL project. Two projects were funded through LC-CLA-03-2018: Climate Change Impacts in Europe (RIA) call, societal challenges 5 climate (EXHAUSTION, CASCADES) as well as one project funded under societal challenge 1 health (HEAT-SHIELD) and another funded under societal challenges 7 secure societies. ClimApp, one of the projects in ENBEL, was funded under JPI Climate ERA4CS.

This report covers 15 Belmont Forum/Horizon 2020 projects. Tables 2a, 2b and 2c present an overview of these projects.

Table 2a: Belmont Forum Climate, Environment and Health projects

Project acronym	Project title and website	Aim(s)
ACRoBEAR	Arctic Community Resilience to Boreal Environmental change: Assessing Risks from fire and disease https://bag.leeds.ac.uk/projects/ACRoBEAR/	Aims to predict and understand health risks from wildfire, air pollution and natural-focal disease at high latitudes, under rapid Arctic climate change, and resilience and adaptability of communities across the region to these risks. This will be achieved through integrating health data and knowledge, community knowledge and stakeholder dialogue, with satellite and in-situ observations, and numerical modelling.
AWARD-APR	Addressing Extreme Weather Related Diarrheal Disease Risks in the Asia Pacific Region https://vinnyv28.github.io/AWARD-APR/index.html	Aims to address Extreme Weather-Related Diarrheal Disease Risks in the Asia-Pacific Region and is working to address this issue and enhance community resilience against the threats of climate change through development of an early warning system for diarrheal diseases that are tied to extreme weather events.
CCCEHN	Community collective action to respond to climate change influencing the environment-health nexus https://www.belmontforum.org/projects/community-collective-action-to-respond-to-climate-change-influencing-the-environment-health-nexus/	Aims to contribute to filling in the gap in understanding on how to deal with collective action problems at the community level by investigating approaches and apparent solutions for groups in two case studies, by focusing on two non-profit community groups based in Sitka (Alaska) and Toco (Trinidad).
CHAMNHA	Climate, heat and maternal and neonatal health in Africa https://www.lshtm.ac.uk/research/centres-projects-groups/chamnha	Aims to address key knowledge gaps around heat and Maternal and Neonatal Health in Sub-Saharan Africa in collaboration with stakeholders, employing qualitative and quantitative methods, implementation and evaluation science, and climate impact methods.
HEATCOST	Health effects and associated socio-economic costs of increasing temperatures and wildfires: a global assessment https://cicero.oslo.no/en/posts/projects/heatcost	Aims to quantify health risks attributable to heat and air pollution (with a particular focus on air pollution from wildfires) in main world regions under selected climate scenarios and socioeconomic pathways.
MEWAR^	Mosquito's populations modelling for early warning system and rapid response public by health authorities correlating climate, weather and spatial-temporal mobile surveillance data https://www.ucl.ac.uk/risk-disaster-reduction/research-projects/2020/sep/mosquito-population-modelling-early-warning-system-and-rapid-health	Aims to combine public health, mobile technology and climate modelling to evaluate impacts of environmental changes on water providing breeding habitats for mosquitoes in Northeast Brazil.
Micro-Poll^	The Pollination of Nepal's Micronutrient-rich Crops in a Changing Climate https://www.belmontforum.org/archives/projects/the-pollination-of-nepals-micronutrient-rich-crops-in-a-changing-climate	Aims to protect crop pollinators from climate change and thereby safeguard the micronutrients in people's diet through a case study in the Jumla district in Nepal.
PARSEC*	Building New Tools for Data Sharing and Reuse through a Transnational Investigation of the Socioeconomic Impacts of Protected Areas https://parsecproject.org/	Aims to provide a unique opportunity for data and synthesis scientists to collaborate and exchange in real-time toward the goal of improving research outcomes, data sharing, and data reuse. It will also help pioneer new scientific and data science

		technologies aimed at improving both the management and conservation of global biodiversity.
PREP	Protection Resilience Efficiency and Prevention for workers in industrial agriculture in a changing climate https://www.belmontforum.org/projects/protection-resilience-efficiency-and-prevention-for-workers-in-industrial-agriculture-in-a-changing-climate/	Aims to evaluate the immediate and long-term impact of the Adelante Initiative, a workplace intervention with focus on adequate water, and rest in shade together with improved ergonomics, designed to prevent chronic kidney disease unknown aetiology among workers at a sugarcane mill in Nicaragua, and create tools for implementation in other occupations and geographies.
S&CC^	Integrated risk mapping and targeted snail control to support schistosomiasis elimination in Brazil and Cote d'Ivoire under future climate change https://www.belmontforum.org/archives/projects/integrated-risk-mapping-and-targeted-snail-control-to-support-schistosomiasis-elimination-in-brazil-and-cote-divoire-under-future-climate-change	Aims to investigate the effect of increasing temperatures, temperature variability and shift in precipitation patterns due to climate change on dynamics of snail-born schistosomiasis; conduct initial feasibility and nutritional studies, and market analyses of aquaculture of freshwater prawns; and to track future changes in the distribution and abundance of the snail hosts

*Project awarded in the Belmont Forum CRA SEI, the remainder are the CRA CEH'. ^Projects not included as partners in the ENBEL project

Table 2b: Horizon 2020 projects on climate change and health that are included in the ENBEL consortium

Project acronym	Project title and website	Aim(s)
BuildERS	Building European Communities' Resilience and Social Capital https://BuildERSproject.eu/	Aims to increase understanding of societal resilience to strengthen social capital, risk awareness and preparedness of the vulnerable segments of societies and communities.
CASCADES	Cascading climate risks: towards adaptive and resilient European societies https://www.cascades.eu	Aims to identify how the risks of climate change to countries, economies and peoples beyond Europe might cascade into Europe. It does so by analysing how these risks interact with major challenges facing European societies. The project is working with a diverse range of stakeholders – both within and outside Europe – to support the design of a coherent European policy framework to address these risks.
EXHAUSTION	Exposure to heat and air pollution in Europe – cardiopulmonary impacts and benefits of mitigation and adaptation https://www.exhaustion.eu/	Aims to establish exposure-response functions for cardiopulmonary health outcomes of extreme temperatures and assess potential interactive effects of air pollutants and project the future corresponding health burden for Europe. Identify adaptation strategies that will help avoid premature death and disease among vulnerable groups across Europe and estimate the costs of the increased vulnerability to heart and lung diseases.
HEAT-SHIELD	Integrated inter-sector framework to increase the thermal resilience of European workers https://www.heat-shield.eu/	Aims to address the negative impact of increased workplace heat stress on the health and productivity of five strategic European industries: manufacturing, construction, transportation, tourism, and agriculture.

Table 2c: The EU ERA4CS (JPI Climate) project related to climate change and health that is included in the ENBEL consortium

Project acronym	Project title and website	Aim(s)
ClimApp	Translating climate service information into personalized adaptation strategies to cope with thermal climate stress https://www.lth.se/climapp/	Aimed to combine information from weather forecasts with data from end-users to provide heat and cold stress warnings and to develop a decision support system through an App. The ClimApp provides timely relevant guidelines for individuals and the public and private sectors to take actions to improve thermal resilience when adverse environmental conditions are expected.

Geographical areas covered by the projects

The projects take place in a wide range of geographical areas (Figure 1-3). Eight projects focus all or at least some of their activities on climate change and health in the European Union. Four projects cover the EU as a whole, with the remainder conducting activities in only certain EU countries. Eleven of the fifteen projects include sites in lower- and middle-income countries. Only one Horizon 2020 project does so (CASCADES). HEATCOST activities include data from across the whole world.

Five projects base their study activities in Asia, Australasia and the Middle East, while seven included research in the Americas. Two projects cover the Arctic region (ACRoBEAR, CCCEHN). No projects included activities in the Antarctic region. Three projects have field activities in Africa, though only CHAMNHA has Africa as its principal focus area (Burkina Faso and Kenya). The S&CC project conducts field research in Côte d'Ivoire, but also has a large field site in Brazil. The CASCADES project is conducting a series of research activities in the Western Sahel, covering several countries in that region, mostly centred on Niger and Mali.

Projects either covered whole continents, sub-regions or individual countries. In total there are field activities in fourteen individual countries. Three projects are set in Brazil and the same number in the United States, while two take place in Sweden.

The majority of projects involve considerable desk work activities. These often cover large geographical areas and involving complex geospatial or cost-effectiveness analyses of climate and health databases. In almost all projects, the attention given to desk work far outweighs field activities, such as the collection of primary or raw data form field sites.

Project partners funded through the Belmont Forum or Horizon 2020 projects

Though the majority of partners in the relevant projects are located in the European Union or the United Kingdom, there are partners in all global regions (Table 3, and Figure 2 and 3). The distribution of project partners differs considerably between the Belmont Forum and Horizon 2020 projects. Several institutions are involved in more than one Horizon 2020 or Belmont Forum project. For example, CICERO is a partner on two Belmont Forum grants and one Horizon 2020 projects, and Lund University is partner in one Belmont Forum grant, one Horizon 2020 project, as well as the ERA4CS-project.

Sweden and the United Kingdom each have institutions involved in eight of the 15 projects. Institutions in Finland and Norway both have six projects. In total, 13 EU/EEA countries had one or no institution that were included in the projects reviewed, specifically Bulgaria (0), Croatia (0), Czech Republic (0), Hungary (1), Iceland (0), Ireland (1), Latvia (0), Lithuania (0), Luxemburg (1), Romania (1), Poland (1), Portugal (1), Slovakia (0).   The projects covered includes few partners from the countries that joined the EU in or after 2004.

Institutions included in the Belmont Forum projects

In the Belmont projects, overall, the institutions are spread across the globe, though concentrated in the EU and the United States. Within the EU, the institutions that have received Belmont Forum funding are predominately situated in the Scandinavian countries and the United Kingdom. This distribution is not surprising as it reflects the countries who provided funding for the Belmont Forum

CRA on Climate, Environment and Health[17]. Comparing Figure 1 with Figures 2 and 3 shows that half of the ten projects among the Belmont Forum projects are located within the countries where the study activities take place, while three projects have no partner in the field sites (Micro-Poll, CHAMNHA and PREP) and two have only a partner in some of the field sites (ACRoBEAR and CCCEHN).

Institutions included in the Horizon 2020 projects

The Belmont Forum projects project partners have a wider geographical spread across the EU than the Horizon 2020 projects. In Europe, project partners are concentrated mainly in the 'old' member states, with just a few project partners from Eastern Europe. There are only two Horizon 2020 partners are located outside Europe, namely the George Mason University (Washington, USA) and the University of Indonesia (Jakarta, Indonesia).

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[17] https://www.belmontforum.org/cras#ceh2019

Table 3: The European consortium partners in the projects represented in the report, divided by regions

Region	Country	Partner name (Belmont/H2020)
Northern Europe (19)	Denmark (3)	1. Aarhus University (**EXHAUSTION**) 2. Technical University of Denmark (**ClimApp**) 3. University of Copenhagen (**ClimApp, HEAT-SHIELD**)
	Finland (4)	1. Finnish Meteorological Institute (**EXHAUSTION, *HEATCOST***) 2. Finnish Environment Institute (**CASCADES**) 3. University of Helsinki (***ACRoBEAR**, *Micro-Poll***). 4. VTT Technical Research Centre of Finland (**BuildERS**)
	Iceland (0)	N.A.
	Norway (6)	1. **CICERO Center for International Climate Research (EXHAUSTION, *HEATCOST*, *ACRoBEAR*)** 2. Info Design Lab (**EXHAUSTION**) 3. Norwegian Institute of Public Health (**EXHAUSTION**) 4. Norwegian Centre for Transport research (TOI) (**BuildERS**) 5. University of Stavanger (**BuildERS**) 6. University of Oslo (***CCCEHN, CHAMNHA***)
	Sweden (6)	1. Karolinska Institute (***CHAMNHA, PREP***) 2. **Lund University (HEAT-SHIELD, ClimApp, *PREP, AWARD-APR*)** 3. Stockholm Environmental Institute (**CASCADES, BuildERS**) 4. Sveriges meteorologiska och hydrologiska institut *(**ACRoBEAR**)* 5. Umeå University *(**ACRoBEAR**)* 6. University of Gothenburg (***ACRoBEAR, PREP***)
Western Europe (22)	Belgium (2)	1. European Center for Development Policy Management (**CASCADES**) 2. Health and Environment Alliance
	France (3)	1. Laboratoire Atmosphères, Milieux, Observations Spatiales *(**ACRoBEAR**)* 2. Fondation pour la Recherche sur la Biodiversité *(**PARSEC**)* 3. University of Toulouse *(**PARSEC**)*
	Ireland (1)	1. Royal College of Surgeons in Ireland
	Luxembourg (1)	1. Luxembourg Institute of Socio-Economic Research (**EXHAUSTION**)
	The Netherlands (3)	1. Red Cross and Red Crescent Climate Centre 2. Netherlands Organisation for Applied Scientific Research (**HEAT-SHIELD**) 3. Vrije Universiteit Amsterdam (**ClimApp**)
	United Kingdom (10)	1. Chatman House (**CASCADES**) 2. London School of Hygiene & Tropical Medicine (***CHAMNHA,* EXHAUSTION**) 3. Meteorological office UK *(**ACRoBEAR**)* 4. **PHE (HEAT-SHIELD)** 5. University of Birmingham *(**PREP**)* 6. University of Leeds (***CHAMHNA***) 7. **University of London (*ACRoBEAR, MEWAR*, EXHAUSTION)** 8. University of St. Andrews *(**S&CC**)* 9. University of Wolverhampton (**HEAT-SHIELD**) 10. University of York (**CASCADES**)
	Switzerland (2)	1. Swiss Federal Institute of Technology (**CASCADES, HEAT-SHIELD**) 2. World Health Organization *(**MEWAR**)*
Central Europe (10)	Austria (2)	1. University of Graz (**CASCADES**) 2. University of Vienna (**CASCADES**)
	Czech Republic (0)	N.A.
	Germany (4)	1. Potsdam Institute for Climate Impact Research (**CASCADES**) 2. Adelphi (**CASCADES**) 3. University of Tübingen (**BuildERS**) 4. Helmholtz Institute for Climate Research (**EXHAUSTION**)
	Hungary (1)	1. Geonardo (**BuildERS**)
	Poland (1)	1. Centre of System Solutions (**CASCADES**)
	Slovakia (0)	N.A.
	Slovenia (2)	1. Jožef Stefan Institute (**HEAT-SHIELD**) 2. University of Ljubljana (**HEAT-SHIELD**)
	Portugal (1)	1. University of Porto (**EXHAUSTION, HEAT-SHIELD**)

Southwest Europe (3)	Spain (2)	1. ACCIONA **(HEAT-SHIELD)** 2. Barcelona Centre for International Affairs **(CASCADES)**
Southern Europe (9)	Cyprus (2)	1. Center for Technology Research and Innovation **(HEAT-SHIELD)** 2. University of Nicosia **(HEAT-SHIELD)**
	Greece (3)	1. DRAXIS Environmental SA **(EXHAUSTION)** 2. University of Athens **(EXHAUSTION)** 3. University of Thessaly **(HEAT-SHIELD)**
	Italy (4)	1. Euro-Mediterranean Center for Climate Change **(CASCADES)** 2. Department of Epidemiology **(EXHAUSTION)** 3. Provincia autonoma di Trento **(BuildERS)** 4. University of Florence **(HEAT-SHIELD)**
Southeast Europe (1)	Albania (0)	N.A.
	Bosnia-Herzegovina (0)	N.A.
	Bulgaria (0)	N.A.
	Croatia (0)	N.A.
	Macedonia (0)	N.A.
	Montenegro (0)	N.A.
	Romania (1)	1. Meteo România **(EXHAUSTION)**
	Serbia (0)	-
Eastern Europe (3)	Estonia (3)	1. University of Tartu **(BuildERS)** 2. Estonian Rescue Board **(BuildERS)** 3. Positium **(BuildERS)**
	Latvia (0)	N.A.
	Lithuania (0)	N.A.
	Belarus (0)	N.A.
	Ukraine (0)	N.A.
	Moldavia (0)	N.A.

ENBEL Partners are underlined. The Belmont Forum partners in italics

Time span of projects

Only two projects commenced before 2018 (Table 4). Four began in 2019 and the remaining nine started in 2020. The duration of the projects ranged from three to six years, with three years the most frequent project length. PARSEC and HEAT-SHIELD are among the longest projects. PARSEC is a four-year project with a six-month extension and HEAT-SHIELD, a five year project, with a year's extension due to the pandemic. Most projects (n=6) are expected to be completed in 2023, some are scheduled to end either in 2021 or 2022 (n=6), while it is anticipated that the last projects will end in 2024, depending on delays caused by the COVID-19 pandemic.

Project delays

Many projects reported that their activities had been delayed by the COVID-19 pandemic (ClimApp by 10 months and PARSEC 6-12 months, for example). Micro-Poll has lost one of the planned three years of data collection. In other project, while projects start-up had not been delayed, they had been unable to conduct some activities as planned. Community engagement components of the projects appear to have been worst affected, as well as in-person interviewing. CASCADES, for example, experienced challenges in doing empirical work outside the EU for a period of three months, and had therefore revised their data collection methods, adopting fully online and phone surveys. The ACRoBEAR team also noted that aspects of their intended community engagement activities had been affected. The team then employed alternative engagement methods, but implementation was delayed by more than one year in some instances. These delays will have knock-on effects on other aspects of the project.

The Micro-Poll investigator noted an interesting observation about an unintended consequence of the COVID-19 pandemic: "Because we had to be so much more reliant on staff locally, and hand over responsibility, the capacity [among local staff] that has been built has been much greater, farmers are more self-sustaining in the project".

Many projects had experienced delays in face-to-face project meetings and in planned engagements with policy makers due to the pandemic. Delays in finalisation of funding arrangements between partners and the funders, as well as in sub-contracts between partners were also reported.

A concern is that the delay in the projects means that the ENBEL project may be completed before the other projects and thus limit the opportunities for the ENBEL team to support the final stage of dissemination of the Belmont Forum/Horizon 2020 projects.

Table 4: Overall description of the projects and settings

Var. Cat.	Variable	Categories	N	Project name
Funder	Funding programme	Belmont CEH CRA	9	ACRoBEAR, AWARD-APR, CCCEHN, CHAMNHA, HEATCOST, S&CC, MEWAR, Micro-Poll, PREP
		Belmont SEI CRA	1	PARSEC
		Horizon 2020	4	BuildERS, CASCADES, EXHAUSTION, HEAT-SHIELD
		EU ERA4CS JPI Climate	1	ClimApp
Time span of project	Date of project onset	2016	1	HEAT-SHIELD
		2017	1	ClimApp
		2018	0	-
		2019	4	BuildERS, CASCADES, EXHAUSTION, PARSEC
		2020	9	ACRoBEAR, AWARD-APR, CCCEHN, CHAMNHA, HEATCOST, MEWAR, Micro-Poll, PREP, S&CC
	Duration of project (years)	3	5	BuildERS, CCCEHN, CHAMNHA, Micro-Poll, PREP
		4	6	ACRoBEAR, AWARD-APR, EXHAUSTION, HEATCOST, MEWAR, S&CC
		5	3	ClimApp, CASCADES, PARSEC
		6	1	HEAT-SHIELD
	Anticipated date of project completion	2021	2	ClimApp, HEAT-SHIELD
		2022	4	BuildERS, CCCEHN, CHAMNHA, Micro-Poll
		2023	6	ACRoBEAR, AWARD-APR, CASCADES, EXHAUSTION, HEATCOST, PREP
		2024	3	PARSEC, MEWAR, S&CC
Geographical area	Continent and countries	European Union	8	Across the EU (BuildERS, ClimApp, EXHAUSTION, CASCADES, HEAT-SHIELD), France (PARSEC), Sweden (CHAMNHA, ACRoBEAR)
		United Kingdom	1	United Kingdom (PARSEC)
		Africa	3	Burkina Faso (CHAMNHA), Côte d'Ivoire (S&CC), Kenya (CHAMNHA), Western Sahel (CASCADES)
		Artic	2	ACRoBEAR, CCCEHN
		Antarctic	0	-
		Asia, Australasia, Middle East	6	Asia-Pacific (AWARD-APR), Australia (PARSEC), India (PREP), Japan (PARSEC), Nepal (Micro-Poll), Russia (ACRoBEAR), Tigris-Euphrates Region (CASCADES)
		South America	5	Brazil (PARSEC, MEWAR, S&CC), Nicaragua (PREP), Trinidad (CCCEHN)
		North America	3	United States (PARSEC), Alaska (ACRoBEAR, CCCEHN)
		Global	1	Global (HEATCOST)
	Activities in Africa	Yes	3	CHAMNHA, CASCADES, S&CC

Var. cat. Variable category

1.2 Potential synergies between the climate change and health projects represented in ENBEL

Study population groups

Overall, a wide range of populations groups are being studied (n=13; Table 5). Many projects reported having more than one study population of interest. The focus is strongly on high-risk groups, with only three projects studying the general population.

Children are the most common study population (n=4). Three projects are set in occupational settings and assess the health of employees. The elderly forms the primary target population group in only two projects (ACRoBEAR and ClimApp), whereas the EXHAUSTION project includes high age among the vulnerability factors to be investigated. One project addresses people with chronic kidney disease of unknown aetiology (CKDu), while the EXHAUSTION and HEATCOST projects include a focus on heat and air pollution impacts on people with chronic cardiovascular or respiratory diseases. Only the CHAMNHA project specifically targets pregnant women and neonates. Four projects gather data from policy makers (a larger number include policy makers as the target audience of the study). Only one project examines populations affected by disasters.

Three projects have a specific focus on community organisations (ACRoBEAR, CCCEHN and PREP), while community members are included in CHAMNHA research activities. Three projects focus on vulnerable geographical settings, rather than vulnerable populations *per se*. These include Arctic and small island areas, as well as outdoor work settings in tropical areas.

Disciplines

The projects encompass a very broad range of disciplines. Not surprisingly, most projects are grounded in the disciplines of climate science and public health (n=11 and n=12, respectively). The fields of biostatistics, modelling and computer sciences are also strongly represented (n=9). Five projects reported having team members from the social science fields. Four projects are incorporating health economics or economics within their work.

The discipline of communication was listed by only three projects (BuildERS, EXHAUSTION and PREP), which is concerning given the limited communication expertise on climate change and health globally and the complexity of messaging relating to the climate change and health nexus.

Other disciplines represented in the projects, aside from the above, include thermal physiology, occupational and environmental health, human thermal environments (ClimApp); ecology or natural scientists (Micro-Poll); health policy (CHAMNHA); and atmospheric chemistry; air pollution; and pollution health impact (ACRoBEAR, EXHAUSTION, and HEATCOST). ClimApp, MEWAR and S&CC draw on mobile phone technology experts in their projects. The S&CC team includes people from the discipline of aquaculture who breed freshwater prawns, natural predators of snail hosts of the schistosome. MEWAR also includes civil and biomedical engineering as well as biodiversity disciplines.

Research topics: hazards and health outcomes and impacts assessed

In terms of which climate change hazards (exposures) are tackled, most projects address heat exposure (n=11). Only two projects cover storms or heavy precipitation and one is on droughts.

Five projects cover infectious diseases or vectors, namely diarrheal diseases, mosquito-borne infections, schistosomiasis and 'natural focal diseases', such as tickborne infections. Three addressed both air pollution and wildfires. Cold stress, unsafe water and disasters were the focus of one project only.

Several of the projects use detailed geospatial mapping to assess changes in exposure hazards such as air pollution, temperature and disease vectors. Some of these studies do not assess how these changes translate into health impacts.

Content areas relating to health span a wide range of topics, which can be clustered into five common themes, listed in order of frequency. Firstly, several projects focus on specific health outcomes, such as morbidity, mortality, maternal and child health, infectious diseases, mental health, nutrition and occupational health (n=13). The second category includes themes relating to community involvement, resilience, attitudes, and behaviours (n=6). Thirdly, some projects assess changes in access to health services (n=5). The fourth cluster of themes pertain to the social determinants of health, such as socio-economic status and migration (n=4). Lastly, four projects extended beyond the domain of human health to cover human-nature interactions.

Four infectious diseases are being addressed. Only two projects reported having activities related to climate change mitigation (CCCEHN, EXHAUSTION).

Several priority topics in climate change and health have received little attention in the Belmont Forum/Horizon 2020 projects to date, namely mental health, violence and allergens. Only one of the projects has populations affected by disasters as their primary focus. While many projects assess changes in disease burden and demand for health care due to climate change, far fewer are paying attention to how services need to adapt to meet the increased demand. Only few respondents reported having a major focus on advancing research methodology in the field of climate change and health. There are some exceptions to this. PARSEC, for example, has a focus on improving methods around data sharing and EXHAUSTION is advancing methods for analyses involving 'small-area approaches' to reveal area level vulnerabilities, and is developing methods for including health effects in macro-economic models.

Interventional research

Of the fifteen projects, eight reported doing primary interventional research, in which an intervention is designed, implemented, and evaluated. In Micro-Poll, there is a field experiment planned to test adaptation to climate change through a natural world lens, with a focus on testing the resilience of insect pollinated crops to climate change.

The CHAMNHA, HEAT-SHIELD and PREP projects all evaluate an intervention to reduce impacts of extreme heat on health, and broadly follow a similar study methodology, though in different study populations (workers and pregnant women). The CHAMNHA project implements two pilot interventions to reduce heat impacts in pregnant women, one in community settings in Kenya and another in health facilities Burkina Faso. PREP will evaluate an existing interventional package ('Rest, Water, Shade') to lower heat exposure in occupational settings. HEAT-SHIELD designed and tested several heat-stress mitigation interventions in a range of occupational settings. PREP project team already provided important technical inputs on alternative methods of measuring heat exposure and assessing intervention outcomes for a research proposal developed by members of the CHAMNHA team. The HEAT-SHIELD team and members of the CHAMNHA team brought their knowledge together in a funding proposal for a future project, building on the methods used in these projects.

The AWARD-APR, ClimApp, HEAT-SHIELD and MEWAR projects develop early warning systems, for diarrhoeal diseases, extreme heat and cold events, extreme heat in occupational settings and mosquito intensity respectively.

A respondent from the ACRoBEAR project described their work as: ''In terms of adaptation to wildfire risk we will use a bottom-up analysis where we will go to the communities and ask what measures they are taking, or measures they worry they have to take, to reduce their risk to these fires''.

CASCADES, EXHAUSTION and HEATCOST perform policy simulations, but these are largely based on applying policy scenarios rather than being assessed quantitatively in the field.

Overall, none of the projects tests of the effectiveness of an intervention as its main activity. Where interventional research was done in the projects, it was a relatively small component of the projects assessed, or the lengthy stages of intervention development meant that there were few resources available for a full evaluation of effectiveness. This somewhat limits the ability to draw conclusions about the effectiveness of different adaptation measures that have been tested.

Work packages in each study

We analysed the titles and contents of the work packages in each project, aiming to identify overlaps between them, and to understand the work package structure across the projects.

Although the project with the highest amount of funding (CASCADES) has the largest number of work packages (n=8), in general, the amount of funding or the duration of the project do not appear to be correlated with the number of work packages. Many projects had a dedicated management work package, sometimes referred to as project management and coordination, or leadership and management. The remainder of the work packages appear to follow two kinds of structures. Firstly, projects with a stepwise work package structure – one work package providing the information needed for subsequent ones. This structure was followed by the following projects: HEAT-SHIELD, CHAMHNA, Micro-Poll, CCCEHN and ClimApp. As a clear example, ClimApp WP1-3 follow the development, implementation, and dissemination of the ClimApp Technical Platform in a linear manner. As a further example, CCCEHN WPs 2-4 follow the steps of data collection, data analysis and dissemination of participatory development protocols. This linear structure has implications for joined-up work between projects if there are marked differences in the timing of each stage between the projects. Conversely, the stepwise structure could allow for simultaneous mutual learning if the activities are coterminous.

In the second type of work package structure, the work packages comprise discrete largely standalone activities, rather than linear processes. In this case, each work package has specific outcome(s) which are somewhat disconnected, at least in part, from other work packages (e.g., intervention, technological platform, guidelines and policy inputs). The PARSEC and CASCADES project appears to have broadly adopted this structure.

Table 5: Description of the thematic areas: hazards, impacts and study populations

Variable	Categories	N	Project name
Disciplines	Climate science	11	ACRoBEAR, CASCADES, CHAMNHA, ClimApp, EXHAUSTION, HEAT-SHIELD, HEATCOST, MEWAR, Micro-Poll, PARSEC, S&CC
	Biomedical/clinical sciences	5	CHAMNHA, EXHAUSTION, HEAT-SHIELD, PREP
	Public health	12	AWARD-APR, ACRoBEAR, BuildERS, CHAMNHA, ClimApp, EXHAUSTION, HEAT-SHIELD, HEATCOST, MEWAR, Micro-Poll, PARSEC, PREP
	Communications	3	BuildERS, EXHAUSTION, PREP
	Health economics/Economics	4	EXHAUSTION, HEATCOST, PARSEC, PREP
	Biostatistics, modelling and computer science	10	CHAMNHA, EXHAUSTION, HEAT-SHIELD, HEATCOST, MEWAR, PREP Micro-Poll, PARSEC, PREP, S&CC
	Social sciences	5	ACRoBEAR, CASCADES, CHAMNHA, PARSEC, PREP
	Other	6	ACRoBEAR, CHAMNHA, ClimApp, MEWAR, Micro-Poll, PREP
Study populations	General population	3	EXHAUSTION, HEATCOST, MEWAR
	Arctic communities	2	ACROBEAR, CCEHN
	Small island communities	1	CCCEHN
	Women	2	CHAMNHA, Micro-Poll
	Pregnant women	1	CHAMNHA
	Children	4	AWARD-APR, CHAMNHA, ClimApp, Micro-Poll
	People with chronic conditions	3	EXHAUSTION, HEATCOST, PREP
	Elderly	2	ACRoBEAR, ClimApp
	Community organisations	3	ACRoBEAR, CCCEHN, PREP
	Policy makers	4	CASCADES, CHAMNHA, ClimApp, PREP
	Workers	3	ClimApp, HEAT-SHIELD, PREP
	Vulnerable groups during disasters	1	BuildERS
	Researchers	1	CASCADES
Hazards examined	Air pollution	3	ACRoBEAR, EXHAUSTION, HEATCOST
	Cold stress	1	ClimApp
	Droughts	1	CASCADES
	Heat exposure	11	AWARD-APR, ACRoBEAR, CASCADES, CCCEHN, CHAMNHA, ClimApp, EXHAUSTION, HEAT-SHIELD, HEATCOST, Micro-Poll, PREP
	Infectious diseases or vectors	5	ACRoBEAR, AWARD-APR, CCCEHN, MEWAR, S&CC
	Natural and manmade disasters	1	BuildERS
	Storms or heavy precipitation	2	AWARD-APR, CASCADES
	Unsafe water	1	MEWAR
	Wildfires	3	ACRoBEAR, EXHAUSTION, HEATCOST
	None	1	PARSEC
Focus content areas and outcomes	Occupational health	3	ClimApp, HEAT-SHIELD, PREP
	Mortality	3	ACRoBEAR, EXHAUSTION, HEATCOST
	Morbidity	6	ACRoBEAR, CCCEHN, CHAMNHA, EXHAUSTION, HEATCOST, PREP
	Health service access	5	ACRoBEAR, CHAMNHA, EXHAUSTION, HEATCOST, PREP
	Maternal Child Health	2	AWARD-APR, CHAMNHA
	Infectious diseases or vectors	5	ACRoBEAR, AWARD-APR, CCCEHN, MEWAR, S&CC
	Nutrition and food systems	3	CASCADES, CCCEHN, Micro-Poll
	Community involvement or perceptions	6	ACRoBEAR, BuildERS, CASCADES, CCCEHN, CHAMNHA, PREP
	Migration	1	CCCEHN
	Mental Health	1	HEAT-SHIELD
	Socio-economic status	3	CHAMNHA, EXHAUSTION, PREP
	Social determinants of health	4	CCCEHN, CHAMNHA, EXHAUSTION, PREP
	Attitudes and behaviours	5	ACRoBEAR, BuildERS, CCCEHN, CHAMNHA, PREP
	Resilience	6	ACRoBEAR, BuildERS, CASCADES, CCCEHN, HEAT-SHIELD, PREP
	Human-nature interactions	4	CASCADES, CCCEHN, Micro-Poll, S&CC
	Mitigation	2	CCCEHN, EXHAUSTION
Interventional research	Implements and evaluates an intervention	8	AWARD-APR, BuildERS, CHAMNHA, ClimApp, HEAT-SHIELD, MEWAR, Micro-Poll, PREP
	Assesses existing intervention	2	ACRoBEAR, PREP
	Modelling of different scenarios	4	EXHAUSTION, HEATCOST, HEAT-SHIELD, MEWAR
	Policy simulations	3	CASCADES, EXHAUSTION, HEATCOST

1.3 Research methods and data analysis

In general, we can distinguish between three types of projects, namely 1) those that primarily have adopted quantitative approaches (ClimApp, Micro-Poll, PARSEC, HEATCOST, AWARD-APR, and EXHAUSTION), 2) those based largely around qualitative approaches (CCCEHN, for example) and 3) projects with mixed methods that involve two or more of the following: quantitative biostatistics, qualitative research, and modelling of policy options, cost effectiveness and different climate scenarios (e.g., ACRoBEAR, PREP, HEAT-SHIELD, CHAMNHA and CASCADES (Table 6).

The total amount of funding in a project seems to be correlated with the number of methods used; projects that employ several quantitative methods, including health economics, appears to have larger amounts of funding available, perhaps explaining their use of more expansive approaches.

Quantitative data collection and analyses

Several projects collect primary quantitative data directly from study participants or through measures of vectors of infection, pollinators and food nutrients. Only the CHAMNHA, HEAT-SHIELD and PREP projects gather clinical data from study participants.

The CHAMNHA project collects quantitative data, including heat stress indicators, to assess the outcomes of two pilot projects among pregnant women in Burkina Faso and Kenya. HEAT-SHIELD is gathering quantitative data among workers on heat stress symptoms, perceptions of heat exposure, work productivity and human physical responses to heat exposure in different sectors. PREP collects quantitative data on environmental measurements such as temperature and humidity, physiological measurements of workload, symptoms of heat stress, participants' heart rate and core body temperature, and biobanked serum and urine samples. PREP and HEAT-SHIELD are the only projects that use biological indicators (measurements of dehydration through assessing urine specific gravity, for example) to assess outcomes of an environmental exposure (heat in these instances). The CHAMNHA and HEAT-SHIELD projects also collect data on indoor temperature exposures using temperature monitors placed on the walls of households, workplaces or health facilities.

ACRoBEAR carries out questionnaires and interviews with people to explore their experiences of climate change and what measures have been taken to support them. The CCCEHN collects extensive qualitative data, as discussed below. ClimApp gathers data from people who have used a personalised warning system mobile phone App to evaluate the usability and functionality of the App when users consent to collection of that information. Micro-Poll will collect plant-pollinator data and human diet data from 10 villages in Nepal over one year. The S&CC project collects data on snail hosts of schistosomiasis and freshwater prawns.

Many projects make use of existing data on meteorology and health outcomes, rather than doing primary data collection. Most of these projects combine actual meteorological and health outcome data, with some then stratifying results by socio-economic indicators and other vulnerabilities. These activities largely involve the generation of large geospatially coded databases. The databases bring together data on the weather, the natural world such as vegetation, demographics, the social determinants of health, especially socio-economic status, and health outcomes. Many of these databases encompass information from whole countries, and even from across all the EU. The analyses are mostly time-series modelling of heat and health outcome data, but air pollution exposure is also examined in some projects, or interactions between heat and air pollution. The findings of these analyses are then often complemented by policy scenario analyses, modelling of future impacts, or even

used in work productivity simulations. The health outcomes examined vary from diarrhoeal diseases, worker health, and maternal and neonatal outcomes, to mortality. In some analyses the projects only examine exposure to hazards such as air pollution or extreme heat, without linking those exposures with health outcomes. Some examples of these geospatial analyses and their extensions are provided immediately below. Several projects aim primarily to use the large geospatial datasets they have constructed to identify vulnerable populations and settings. These are detailed in the section below on equity considerations.

The geospatial and health data used by projects is very diverse, but also the aims and types of outputs of analysis vary considerably between projects. The AWARD-APR project integrates measures of diarrheal disease incidence with data from the Global Historical Climatology Network (GHCN) and ERA (hourly estimates of many atmospheric, land and oceanic climate variables) in the Asia Pacific Region. HEAT-SHIELD brings together forecasted weather patterns and workers' future conditions in the manufacturing, construction, transportation, tourism, and agriculture sectors to assess heat vulnerability amongst workers in Europe. Based on these insights, the project will formulate guidelines to promote worker's health and prevent productivity loss. The CHAMNHA project uses data on birth outcomes from across Sweden for more than a decade and merges that with meteorological and other data to identify associations between temperature during pregnancy and birth outcomes such as preterm birth. The project also performs analyses of temperature impacts on birth outcomes in selected sites in Africa, using similar meteorological and air pollution data.

MEWAR will develop an Early Warning System for mosquito vector surveillance in Northeast Brazil by using mosquito surveillance data to calibrate a predictive model in real time through a mobile app and Internet of Things devices. AWARD-APR develops a seasonal or sub-seasonal early warning system for diarrhoeal diseases based on their geospatial analyses. ClimApp combined human heat balance models grounded in human physiology for hot, moderate and cold climates. The project then integrated those data with weather forecast data in Europe. Micro-Poll develops a modelling approach to predict how climate change will affect crop pollination networks in nutrient-rich crops in rural Nepal.

CHAMNHA and PREP are examples of projects that explicitly set out to conduct mixed-methods research. CHAMNHA uses time series analysis of heat exposure and birth outcome data and combines these findings with those of qualitative enquiry into experiences of extreme heat and also with the results of pilot projects on adaptive interventions. All these findings are brought together to provide policy advice and support for National Adaptation Planning for heat-related health risks. The PREP project in Nicaragua, unlike CHAMNHA, does not perform time series modelling, but collects other data types. As with CHAMNHA, advice for policy makers and other stakeholders is its end goal. The project generates this advice through combining environmental and physiological measurements of workers doing physical labour in sugar cane fields with socio-economic data gathered through interviews.

Data science applications

HEAT-SHIELD, MEWAR, PARSEC and S&CC will all employ data science methodologies in their work, including machine learning, artificial intelligence, and the Internet of Things. S&CC, for example, will develop machine learning algorithms that enable computer vision as an environmental diagnosis tool for identifying potential schistosome-host snails and parasites from field-acquired cell phone images, trained on thousands of images that have already been classified by the presence or absence of different snail species. As a further example, Parsec is employing artificial intelligence techniques to use satellite images as a proxy of socio-economic indicators to better predict and mitigate the effects of actions that

potentially threaten the livelihoods and health of local indigenous communities. The ACROBEAR project is working with the University of Helsinki who are using machine learning procedures to examine relationships between wildfires and tickborne infections.

Qualitative data

The CCCEHN project team will gather in-depth qualitative community data on participatory community development. The project begins with a desk review of secondary documentation, academic literature, legislation, policies, and reports from the communities, governments, and the private and non-profit sectors. These data will then be complemented by qualitative interviews, focus groups, and participatory development protocols at a community level in Alaska and Trinidad. The project CHAMHNA gathers qualitative accounts on heat exposure in pregnant women and potential adaptive measures, drawing on a range of informants (pregnant women, male partners, village leaders and health workers) in the Burkina Faso and Kenya study sites. This information then feeds into co-design workshops which involve all relevant stakeholders who are tasked with designing an intervention to reduce the impacts of extreme heat on pregnant women and neonates. The CASCADES project team collects qualitative data during workshops with stakeholders in Europe as well as during workshops and surveys in three regions outside the EU, namely: Western Sahel; the Middle East and Northern Africa, and the Euphrates-Tigris Regions. PREP and HEAT-SHIELD both collect qualitative data through questionnaires, focus group discussions and in-depth interviews with a range of stakeholders about environmental stress during work. The ACRoBEAR project also has a large qualitative component as described above.

Systematic and narrative reviews

Only two projects reported conducting systematic reviews of evidence (CHAMNHA and EXHAUSTION). These both cover heat impacts and related adaptation measures, presenting opportunities for joint work. Many other projects include reviews of evidence but apply narrative methodology. Some projects conduct desk reviews of grey literature.

Health economic analyses

Four projects apply health economics modelling to assess, for example, the costs of an intervention compared to its benefits, or the costs of harms from climate change. EXHAUSTION will estimate the costs of an increased health burden (cardiovascular and respiratory deaths and disease) attributable to changes in exposure to heat and air pollution, and how these costs vary across different scenarios for global warming and assumptions about the implementation of adaptation measures. The HEATCOST project has a similar approach. The PREP project measures the return on industry investment (ROI) of interventions to reduce chronic kidney disease of uncertain aetiology, and assesses the health economic impacts of the condition on the local communities, and on the local health system

Analyses of equity implications of climate change and health

The approach to assessing equity – or differential impacts of an exposure or variations in effectiveness of interventions – varies considerably across projects (Table 6). Considerations around equity can be considered during the design of a project – where a project selectively recruits only especially vulnerable groups or is set in vulnerable areas – or in analysis where groups with different levels of vulnerability are compared in stratified analyses, for example.

While most projects mention they will conduct analyses around equity, it appears that in many cases this is not being done in a pre-specified systematic manner. In the CCCEHN project, for example, the

informant noted that equity analyses have not been pre-specified, but 'will be driven by data, rather than pre-supposing relevance and analyses.' None of the projects reported having based equity analyses on commonly used frameworks for these analyses, such as the PROGRESS-Plus matrix, for example.

Several projects aim primarily to use the large geospatial datasets they have constructed to identify vulnerable populations and settings. EXHAUSTION, for example, will apply time series and other biostatistics techniques to small-area and cohort data sets from several European countries to examine linkages between air pollution, meteorology, and health outcomes across different population groups. The project then performs health impact projection modelling of alternative adaptation scenarios, with a focus on differential impacts across European settings and by socio-economic status. The PARSEC project addresses questions of equity, especially relating to socio-economic conditions and rurality. It uses various indicators for socio-economic status, such as the United Nations Human Development Index (HDI) and the gross national income (GNI) per capita and interconnects these with time-series satellite data from local indigenous communities within protected areas in France, Brazil, the US, Japan, Australia. HEATCOST develops global data on heat stress and air pollution concentrations and links these with population data, income data, vulnerability indicators to quantify and visualize inequalities in population exposure to climate change.

The EXHAUSTION project, in particular, has paid much attention to equity analyses, stating that 'a part of WP2 is to investigate how a range of vulnerability factors may modify the Exposure-Response relationship for heat and health'. The key analyses here cover, e.g., age, sex, socio-economic indicators and vulnerability predicated on geographical area and on urban characteristics, such as population density and the number of green spaces in an area, for example.

Vulnerability is assessed on a number of levels in addition to those outlined above. In the PREP project, for example, analysis of the household consequences of disease burden from physical labour will be stratified by consumption and savings, labour supply and productivity, and education and human capital accumulation. The CHAMNHA team have placed a strong emphasis on understanding differential impacts of climate change, by including rural and urban sites and two regions of Africa. Other vulnerable groups assessed include people living adjacent to protected areas (ACRoBEAR). ClimApp has a focus on a wide range of factors which make a population vulnerable to exposure to extreme heat and cold and have incorporated these factors into their mobile phone App. CASCADES assesses equity concerns using macro level factors such as trade disruption, food shortages or price spikes, conflict and hunger. None of the respondents mentioned assessing differential impacts or intervention effectiveness by ethnicity.

Several projects reported being interested in vulnerability *per se*, but without having a focus on specific populations groups or settings. Interestingly, the PARSEC representative noted that there may be potential risks in doing vulnerability analyses as 'in [the] case of poverty, the target community(ies) may not wish to be spatially identified in case this hinders their future well-being '.

Assessments of gender dimensions of climate change and health

Overall, there appears to be little focus on differential impacts of climate change by gender in the projects. For example, while the PARSEC project as a whole encompasses a strong equity focus, it appears that data are not going to be broken-down by gender. The HEAT-SHIELD project specifies that it will examine the distribution of heat vulnerabilities in the workplace by gender and age. Additionally, two projects purposively selected females as their study group on the basis of gendered vulnerability. The Micro-Poll project chose to recruit women in specific age groups and young children as these are believed to be key determinants of vulnerability to nutritional deficiencies. The groups are adult woman

of child-bearing age (20 to 48 years), adolescent girls (10 to 18 years) and young children (6 to 47 months). The CHAMNHA project focuses on pregnant women based on their specific vulnerabilities to heat exposure and limited resources to protect themselves and their child.

Attribution of climate change impacts, future disease burden assessments

We asked respondents whether their project quantifies the burden of disease attributable to the changes in climate or air pollution that have already taken place or that are projected in the future. The ACRoBEAR respondent noted that they will perform such analyses where they 'utilize health impact assessment methodologies that relate changes in relative risk of cardiovascular and respiratory disease to changes in air pollution exposure [based on model output and population data]'. The EXHAUSTION and HEATCOST projects perform very similar analyses, examining temperature and other heat stress indicators and the modifying effects of air pollution. The CCCEHN informant reported that such analyses had been planned, but that to date, in preliminary analysis, the findings do not indicate major shifts in infectious disease have taken place.

Some projects, such as CHAMNHA and PREP, are gathering data that could be used for calculating such estimates but have not planned to do so. The CASCADES network model could potentially perform analysis and modelling of attribution and forecasts using data from other projects; however, this would require enough health data to successfully complete this work.

Several projects use their findings of exposure-outcomes analyses to make projections of future impacts under different emission and socio-development scenarios, and then link these to policy options. ACRoBEAR focuses on the Arctic region and combines qualitative data from communities and indigenous information and knowledge on climate risks with data on atmospheric circumstances and local extreme events, which is then used to inform modelling of future climate scenarios. The CASCADES project performs integrated assessment modelling using the ISIMIP (Inter-Sectoral Impact Model Intercomparison Project) model. It then brings these together with stakeholder insights in Europe, the Western Sahel, the Middle East and North Africa, and the Euphrates-Tigris Regions. All these findings are then used to consider the risks of cross-border and cascading climate change impacts on each setting and on the EU, and possible mitigation and adaptation efforts.

Research methods on health-mitigation linkages

We also enquired whether the projects consider alternative future emission scenarios. Five projects answered in the affirmative. The ACRoBEAR informant, for example, explained that: 'We will use future emission and climate forcing scenarios to evaluate potential health impacts from projected changes in fire and disease. These will be based on future scenarios from IPCC Sixth Assessment Report (AR6) (SSP scenarios) as well as ECLIPSE scenarios. Several other projects reported having adopted similar approaches, with the participant from EXHAUSTION noting that: 'Health burden estimates will be derived for alternative futures (in terms of RCP/SSP combination)'; and the HEATCOST informant said that: 'We will select RCP/SSP combinations for the scenarios. The future cardio-pulmonary disease burden associated with increasing temperatures and wildfire emissions will be estimated'; and the participant from HEAT-SHIELD noted that: 'different RPE scenarios are analysed'. The Micro-Poll project examines health outcomes indirectly as they will predict the impact of climate change on crop pollination and thereby on diet in rural Nepal. The project will thus model impacts of a range of alternative future climate scenarios on pollinators and then draw conclusions about how this will affect micro-nutrient deficiency in humans.

Research activities in Africa

The CHAMNHA and S&CC projects are set in Africa, and the activities in those projects are described throughout the report.

The ClimApp and PREP projects both have some connection to African climate change and health research. While ClimApp does not include African partners in the project, during their dissemination activities the team involved African researchers and other stakeholders and is actively building research collaborations with African partners in ENBEL. The ClimApp project was recently involved in a United States National Institutes for Health (NIH) proposal on data science with some members of the CHAMNHA project team where they plan to extend use of the ClimApp to several countries in Africa. The PREP project, while primarily set in Nicaragua, will also target its dissemination activities at their network of researchers and health professionals based in Africa, including in Cameroon and Eswatini, as they have successfully done with their previous similar projects, such as the Adelante Initiative.

Though capacity building activities are not a central part of the CASCADES project, the project intends to conduct a few 'benefit sharing' type of trainings in Africa, depending on the needs of local stakeholders and the available resources. These training sessions would focus on climate change and health issues. The Micro-Poll project team has links with the African Academy of Sciences especially around training on climate change and infectious diseases modelling.

Table 6: Study methods, analysis strategies and assessments of equity

Variable	Categories	N	Project name
Analyses disaggregated by socioeconomics or other equity indicators	Plan to disaggregate findings by equity variable	7	BuildERS, CCCEHN, CHAMNHA, EXHAUSTION, HEAT-SHIELD, HEATCOST, PREP
		1	AWARD-APR
	Could potentially do so		
	Not possible to do so	4	CASCADES, ClimApp, Micro-Poll, PARSEC
Analysis disaggregated by gender	Plan to disaggregate findings by gender	9	BuildERS, AWARD-APR, CCCEHN, CHAMNHA, ClimApp, EXHAUSTION, HEAT-SHIELD, Micro-Poll, PREP
	Could potentially disaggregate by gender	2	ACRoBEAR, HEATCOST
	Not possible to do so	2	CASCADES, PARSEC
Quantifies burden of disease due to climate changes present or future	Yes	5	ACRoBEAR, CCCEHN, EXHAUSTION, HEATCOST, PREP
	Could potentially do so	5	AWARD-APR, CHAMNHA, HEAT-SHIELD, MEWAR, S&CC
	Not possible to do	4	CASCADES, ClimApp, Micro-Poll, PARSEC
Takes future emission scenarios into account	Yes	6	ACRoBEAR, CASCADES, EXHAUSTION, HEAT-SHIELD, HEATCOST, Micro-Poll
	No, but is possible to do	3	AWARD-APR, CHAMNHA, PREP
	Not possible to do so	3	CCCEHN, ClimApp, PARSEC

1.4 Sharing of data and study documents

Several projects indicated a willingness to share data with the ENBEL project team and with other Belmont Forum or Horizons 2020 projects (Table 7). Most respondents, however, presented some caveats to data sharing. These may limit the opportunities for some types of common activities.

Two work packages in the PARSEC project are dedicated to advancing topics around data sharing, aiming to develop toolkits and workshops to support data sharing, and to assist researchers to view how the data that they have deposited has been used, cited and reused. The PARSEC investigators are potentially a very useful resource for guiding the ENBEL team through the complexities around data sharing.

The CASCADES team noted an overarching condition that the data to be shared needs to be anonymized or pseudonymized, and to comply with General Data Protection Regulation 2016/679 in EU law (GDPR). None of the project teams reported that a data sharing agreement would be required for data sharing in all instances, varying with the 'sensitivity' of the data. Two respondents felt that a data sharing agreement would be somewhat useful and only for certain types of data, which would be considered on a case-by-case basis (CCCEHN, PREP).

Clearly there would be a series of steps to follow before data sharing was possible. These include developing a working relationship between the partners involved in sharing and analysis, where all those involved understand what is required and the benefits of the joint work. Considerations around data handling safety are central to any plans for sharing data.

The PREP team emphasized the importance of consulting with their team members prior to data sharing, which is likely to be true of all projects. Consistent with this, the CASCADES representative noted that 'Project partners responsible for the data collection would need to agree.' Seemingly this is not a minor concern, especially as different rules may apply with the individual partners in each project. The AWARD-APR noted a related constraint to data sharing: 'we have multiple partners from different countries providing health data. They are the true custodians of the data, and this issue is highly sensitive'. The information in this section thus reflects the views of the respondent to these questions, and the regulations that they need to comply with, which may differ from those of the overall project consortium or individual data holders.

A question was asked about what could be done to make data sharing more attractive for the ENBEL partners. The CCCEHN respondent felt that the key to sharing of data and study documents was "understanding collaborative outputs. NDAs [non-disclosure agreements] are not really relevant.'. The CASCADES representative noted that 'In general, it would be important to create incentives for data sharing and joint work (e.g., working on joint publications). Any work not foreseen in our project deliverables is extra work for partners and the project coordination team. It would be important to clearly define the benefits of the potential collaboration and if the ENBEL team could coordinate the effort". The HEAT-SHIELD response was similar: 'as long as it is co-publication, collaboration is very welcome'. The informant from CCCEHN noted that while data sharing agreements were important, ''benefit sharing'' was critical ('depends on data sharing agreements and specific collaborative outputs. Mutual benefit would facilitate sharing'). These quotes illustrate the importance of a trust relationship, mutually beneficial objectives, and minimizing of the time and costs required from the partner who is contributing data.

Barriers to sharing raw data with the ENBEL team to allow for comparative analyses with other projects were assessed. The ACRoBEAR respondent provided detailed inputs on this question, stating that

barriers might include assuring data quality and accuracy; allowing priority analysis and production of findings for the parent project team; and adhering to existing data protocols around use of health data.' They went on to highlight that it is important to have in place data management procedures agreed upon by the ENBEL consortium of projects.

CCCEHN noted that 'Standard research ethics' may constitute a barrier, reminding the ENBEL team that data sharing requires compliance ethics, legal and other regulatory procedures, which can take considerable periods of time. The PREP respondent reinforced this point, saying that: 'Individual-level sensitive data from the project cannot be shared unless there is IRB [ethics committee] approval.' The CHAMNHA team felt that data sharing procedures can take quite some time to finalise, the legal processes around sharing can be complex, and some data holders expect substantial reimbursement for the time spent preparing a database for sharing. Each of the different field sites may have specific ethics rules about sharing, and some data will not be in English. In the CHAMNHA project, for example, data in Burkina Faso are collected in French only, and costs of translating interview transcripts to English would be considerable.

Some forms of data face fewer barriers to sharing than others. The informant from EXHAUSTION, for example reported that: 'We cannot share health data from registries; all climate data/products can be shared, e.g., heat stress indicator evolvement'. Similarly, the PREP participant noted that: 'Group level data [synthesized data] can be shared, but not individual level data unless approved by IRB'. The CASCADES participant raised important points about how data sharing depends on the type of data, saying: 'The empirical data we collect is to a large extent qualitative (workshop results), however, we run a survey consisting of semi-structured interviews in the Sahel region of Africa, the anonymized data base should be publicly available and could be shared with ENBEL. When it came to sharing of study documentation, the CASCADES and EXHAUSTION projects said that sharing agreements were not necessary as they are willing to share all study documents.

The timing of data sharing in the project lifecycle appears an important concern. The respondents from two projects indicated that, in their view, they were willing to share data as it was collected. Most of the people, however, who completed this question felt that data sharing would only be possible once findings of the project had been submitted for publication or conference presentation. The Micro-Poll project, for example, noted that: 'We have set up data management systems that will allow access to all project data *once the project is complete*''. It is important to note that the views of the respondents may not reflect those of the whole team on the research project. Moreover, there may be major constraints to that stem from the rules of the regulatory authorities in different countries.

Table 7: Data sharing potential in the view of respondents

Variable	Categories	N	Project name
Data sharing possibilities	Yes, as data are collected	2	CASCADES, CHAMNHA
	Yes, once data are cleaned and finalised	2	ACRoBEAR, HEAT-SHIELD
	Yes, once the findings are submitted for a publication or conference presentation	3	HEAT-SHIELD, Micro-Poll, PREP
	Not applicable	2	ClimApp, HEATCOST

1.5 Opportunities and barriers to cross-project synergies

Existing collaborative work between projects

There are many existing collaborations between the projects which provide a platform for future joint activities. Some of the research units, and indeed investigators in these unit, are members of the consortium of more than one of the projects, which facilitates cross-project work. Several projects reported that they are already collaborating with the EXHAUSTION team or have an interest in expanding developing these links with that project (ACRoBEAR and CASCADES). There are many opportunities for joint work between the EXHAUSTION and HEATCOST projects, which have the same principal investigator and the modelling in both projects is being done by the same modeller.

The CCCEHN team reported very positive joint work with related projects: 'We are always interested in collaborations and exchanges. We continually find numerous people with plenty to contribute". They noted, however, the "sometimes collaborations work out (e.g., for publications) and sometimes collaborations do not work out.". It would be interesting to examine what factors determine the success of collaborations.

The ClimApp project developed a mobile phone application for an Early Warning System for heat waves and cold spells. This could potentially be used in several projects. Already, the CHAMNHA team joined with the ClimApp group to prepare a proposal for a US NIH grant on big data, based around the ClimApp warning system.

Potential contribution of the ENBEL team to project outputs and collaborative activities

Respondents were asked whether there were any specific methodological outputs, data analysis, or research tools that the ENBEL team could assist with (Table 8). In general, the project representatives reported being most interested in enlarging their networks and being introduced to new collaboration opportunities which can lead to publishing of the outcomes of the ENBEL work or of the projects that ENBEL supports. The overwhelming response about the potential inputs of ENBEL was around assistance with disseminating the project results (ACRoBEAR, CASCADES, CCCEHN, CHAMHNA, HEAT-SHIELD and HEATCOST).

Overall, levels of interest in collaboration or other outreach, dissemination and communication activities are very high, especially around participating in joint dissemination meetings with policymakers that cover a range of Belmont/Horizon 2020 projects. The CCCEHN team were especially enthusiastic about collaborations: 'We are always delighted to have such collaboration. As we are disseminating our project findings now, we have preliminary results and ideas, which will continue to be refined and updated until the end of the project'. The CASCADES team summed the sentiments of the respondents well: 'It could be useful to organize a meeting for both climate and health types of policy makers and then show them examples how climate change and health issues interact overall, and what kind of trade-offs and co-benefits exist.'. Similarly, the ACRoBEAR team noted that 'Joint dissemination meetings with other ENBEL projects would be interesting, particularly around key themes (e.g., fire, disease, or regional themes).'

The timing of dissemination or policy engagement meetings were raised as a concern as the projects are at very different stages of their work. Additionally, some partners already have a set of outreach, dissemination, and communication activities in place. Therefore, the activities organised by ENBEL would have to demonstrate clear benefits for adding value to their project. The Micro-Poll participant noted that collaborative dissemination meetings may not be useful now, as they already have these

systems in place through their NGO collaborators in Nepal and via planned applications for further funding.

The ENBEL team, through their networks of partners, could potentially assist in securing raw data on health outcomes for exposure-outcome analyses in several projects. The CHAMHNA team, for example, needs to secure health data on pregnancy outcomes for their time series analyses correlating health and weather. Other areas where the ENBEL team might contribute include data analysis in CCCEHN. Several projects reported that, with additional methodological inputs from the ENBEL team, they could convert the narrative reviews they have performed into systematic reviews, namely: AWARD-APR, ACRoBEAR, CCCEHN, ClimApp, HEAT-SHIELD, and PARSEC. The HEATCOST team mentioned that assistance would be especially useful in developing a systematic search strategy, as well as in the stage of meta-analysis.

The CCCEHN team raised an important question, enquiring: 'What resources might be available to ensure the best outcomes feasible?'', implying that additional resources would be important to facilitate such policy or dissemination events. This implies that the resources available in ENBEL for such activities are critical for the success of such initiatives, and without these additional inputs these activities may not be possible. In this vein, the CASCADES team suggested that existing or emerging opportunities could be used to collaborate and support dissemination, but that planning completely new events might be too ambitious.

Some synergies on teaching may be possible, though more work will need to be done to identify overlaps in teaching content, and in how findings of the ENBEL projects can feed into the teaching materials of different partners.

A very useful suggestion was made by the CASCADES team, who noted that following each other's projects on social media would help raise the profile of our respective projects and support the dissemination of the project findings. Another concrete suggestion was to use the ENBEL network of projects to disseminate information on different project webinars. A common ''message board'' system where projects can exchange ideas was also suggested.

Other potential projects to consider in collaborative activities

In addition to the ENBEL project, six projects on climate change and health were funded under Horizon 2020 [18]. Of these, HEAT-SHIELD is included in the ENBEL consortium. The other five projects are called Climate-fit.city, PYROTRACH, GEMCLIME , BLUEHEALTH and BLUEACTION, and efforts could be made to incorporate these projects into the ENBEL network and dissemination activities.

Climate change is also included in several other Horizon projects where climate change is considered as one of the co-determinants for health in many projects described in other parts of this catalogue: for example, in relation to air quality (EXHAUSTION (included in ENBEL), CLAIR-CITY, ICARUS and iSCAPE, and others), urbanisation (GROW GREEN, URBAN GREENUP, VARCITIES and others) or infectious diseases (MOOD, VEO).

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[18] European Commission Directorate-General for Research and InnovationTuomo K (2021). "European Research on Environment and Health: Projects Funded by Horizon 2020 (2014-2020)." https://op.europa.eu/en/publication-detail/-/publication/03a2c022-9c01-11eb-b85c-01aa75ed71a1/language-en/format-PDF/source-199503195#document-info

The team from the project CASCADES noted that: 'We currently cooperate with the RECEIPT Project.' The potential benefits of linkages with the RECEIPT project (REmote Climate Effects and their Impact on European sustainability, Policy and Trade)[19], could be explored.

Barriers to synergies within the ENBEL project

Some of the potential collaborating projects are unclear about the purpose of the ENBEL project and thus potential opportunities within the project. This is especially true of projects that are funded by the Belmont Forum, but not formal partners in ENBEL. The AWARD-APR survey participant, for example, reported that: 'It is unclear what ENBEL is trying to do, so it is bit hard to guess [what synergies might be possible].' Similarly, the contributor from CCCEHN said: '[I] still do not understand what ENBEL does or the resources available to collaborate". Clearly more needs to be done to communicate the purpose and resources available within ENBEL to potential collaborating projects and to promote the benefits of collaboration.

In a similar vein, many of the projects are not familiar with the work of other projects, especially since the Belmont Forum projects are relatively new. The respondent from the Horizon 2020 CASCADES project noted that: 'We do not have direct links to BELMONT Projects, we do not know what the projects are focusing on and who is involved in them'. Projects with an interest in collaborating will struggle to do so if they are not familiar with the other projects. The ENBEL group could assist in leveraging interest in other projects and making similar projects more familiar to others, so that the response from the Micro-Poll participants shifts from one of: 'I'm not aware of any [synergies] as yet' to reporting on strong connections.

Some participants raised important concerns around potential collaborations and indeed in the methods being used to identify collaborative opportunities. The CCCEHN respondents, for example, noted that: 'Please be aware that (i) much of the information requested here is duplicated in other requests or is otherwise available; (ii) many of the questions were hard to respond to due to vagueness and lack of clarity; and (iii) many of the answers must be "it depends on the specific context and situation".

Table 8: Added value of ENBEL

Variable	Categories	N	Project name
How ENBEL could optimise project outputs	Data analysis across projects on common areas or methods	2	ACRoBEAR, CHAMNHA
	Review of research outputs of projects	4	CHAMNHA, EXHAUSTION, ClimApp, HEATCOST
	Incorporate themes such as gender and equity analyses in data collection instruments	2	CHAMNHA, HEAT-SHIELD
	Providing knowledge products, and opportunities for dissemination and communication of research findings	7	ACRoBEAR, CASCADES, CHAMNHA, ClimApp, EXHAUSTION, HEATCOST, PREP
	Securing access to wider network of stakeholders, researchers, and policy makers	9	ACRoBEAR, CASCADES, CHAMNHA, ClimApp, EXHAUSTION, HEAT-SHIELD, HEATCOST, PARSEC, PREP
	Do not yet see how ENBEL can add value to projects	1	Micro-Poll

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[19] https://climatestorylines.eu/

Potential contribution of the project to policies

Survey responses provided information regarding the contribution of the projects to policy on climate change and health and potential engagement with decision makers and stakeholders. Figure 4 shows the number of projects which account for different policies on climate and health. A slightly wider link to national health and climate adaptation policies was found and links with WHO guidance documents. Other policies projects refer to are UNFCCC and thematic policies, such as occupational guidelines (ClimApp and HEATCOST), and the pollinator strategy for Nepal. Over 60 per cent of the projects envisage dissemination activities and sharing of their work via webinars or meetings specifically addressed to stakeholders and expert groups and were positive towards possible joint dissemination events with other ENBEL partners or similar projects. A few projects have already held such events and shared information and web links.

Section 2: Conclusions and recommendations for collaborative synergistic activities across projects

Based on the findings of an online survey, review of documents and direct contact with the project leads, we draw recommendations on a set of actions that could facilitate synergies between the projects and secure the achievement of the objectives of the ENBEL project.

The scale of the current and projected impacts of climate change on health mean that opportunities such as those presented by the ENBEL project are highly valuable and need to be capitalised on. The suite of projects reviewed, and indeed ENBEL itself, have the potential to make a large contribution to protecting health in the Anthropocene era. There is thus clearly an imperative to draw maximum benefits from the current set of research projects funded by the Belmont Forum and the EU's Horizon 2020 programme.

Clearly, there are many potential opportunities for synergistic activities. The ENBEL project and individual partners will need to prioritise which activities to take forwards given limited resources within the individual projects and in ENBEL itself. Criteria for prioritisation may include considerations such as the interest of project teams, the extent to which joint activities are mutually beneficial, feasibility, available resources within the individual projects and ENBEL, and information gaps and policy priorities in the EU.

The cumulative knowledge generated by the projects have tremendous potential to spotlight the climate change impacts on health, the scale of action required and the potential adaptive actions needed. Moreover, taken together, the project teams and the ENBEL collective could bring to bear a large body of evidence to highlight the urgent need for more rigorous mitigation policies and new technologies for reducing greenhouse gas emissions. Some projects are doing pioneering work on the health co-benefits of mitigation initiatives, especially reductions in air pollution, and together with estimates of the health damage from global warming itself these findings could be used to advance mitigation initiatives.

There appears to be limited coherence in the overall body of work done, making the work of ENBEL more challenging, but also especially important. A very wide range of topics, populations, impacts, adaptation interventions and settings are being examined by the projects. This seeming diffusion of attention makes it difficult to discern what the research priorities are for the researchers or for the funding agencies. This is perhaps understandable as the field is relatively new and forming a solid baseline set of knowledge is an important step before a clear set of coherent priorities are identified.

There are limited activities of the ENBEL projects in Africa and any cross-linkages between these projects will need to be optimised to support achievement of the ENBEL goals in Africa. It will be important to draw on the projects that do currently have activities or partners in Africa. Moreover, to achieve the objectives of the ENBEL project which relate to Africa, it will be necessary to draw many of the other projects into this work. One specific opportunity is worth considering. Many of the Belmont Forum/Horizon projects, and indeed the ENBEL project itself, include activities with policy makers in the EU, and those activities could be leveraged to engage with policy makers in Africa.

Opportunities for capitalising on common topic and methods

There are several broad areas of common ground across many projects. Importantly, most projects are firmly centred in the discipline of public health and underscored by climate science. The high priority

given by many projects to social science research, including qualitative research methods, also provides a real opportunity for collaboration between these groups. In particular, there may be opportunities for cross-learning around social science activities in understanding the perceptions of communities, and engagement with community members and organisations, building a body of knowledge on the topic. Unfortunately, community engagement activities and in-person interviewing and especially focus group discussions were heavily affected by the COVID-19 pandemic restrictions. This may limit the amount of data available for cross-learning. Many projects applied co-design methods to intervention development and there likely many important insights could be drawn from discussion among groups who applied these methods.

Three projects assess interventions to reduce impacts of extreme heat on health, and broadly followed a similar approach to intervention design and evaluation. Though these projects covered different geographies and encompassed workers and pregnant women, there may be opportunities for cross-learning between these projects. Key cross-cutting topics may concern intervention co-design, and methods of assessing actual heat exposure and intervention outcomes. Moreover, the synergies between the two projects which assessed heat exposure in the workplace (PREP and HEAT-SHIELD) are clearly evident. For example, the climate scenario forecasting methods developed in HEAT-SHIELD might be applied to the PREP findings.

It is important to capitalize on opportunities to develop a community of researchers with overall common interests. Several examples of this were noted during review of the projects:

1. Health impacts of heat are addressed by many projects, and much could be gained by pooling knowledge generated form these projects
2. As mentioned above, the CHAMNHA, HEAT-SHIELD and PREP projects all evaluate an intervention to reduce impacts of extreme heat on health, and broadly follow a similar study methodology, though in different study populations (workers and pregnant women). There may be opportunities for cross-learning between these projects through, for example, examining the methodological and other factors that may have influenced effectiveness. The PREP project team already provided important technical inputs on alternative methods of measuring heat exposure and assessing intervention outcomes for a research proposal developed by members of the CHAMNHA team.
3. There may be many valuable opportunities within the projects to comment on the strengths and drawbacks of the research methods applied. In particular, the focus on community engagement and co-design in many projects may provide an opportunity for detailed reflection of these methods across the projects, and how to improve the research methods used involving communities. A joint conference session examining research methods with communities might be a means of facilitating such exchanges.
4. Four studies are applying data science techniques, such as machine learning, in their work. These projects set the stage for potential expansion in this critical field, which is expanding rapidly, and highly relevant to the climate change and health field. Making connections between these projects, with pooling of the data from these and other projects with similar datasets, would result in a 'big data' opportunity with the potential to provide many important insights.
5. Two projects are conducting systematic reviews of evidence on heat impacts and related adaptation measures (CHAMNHA and EXHAUSTION). This overlap presents many opportunities for joint reviews

It is important to note that several common areas were identified which may be considered for future conference sessions led by the ENBEL project. Potential conference sessions that could be developed which cut across the projects include community engagement research methods and outcomes; impacts of extreme heat events on health and adaptive measures, modelling of cost-effectiveness; and modelling of adaptation or future emission scenarios.

We identified a limited number of existing collaborations between the projects, suggesting that major opportunities for joined-up work remain untapped. The growing investments in research and programmes on climate change and health may provide a platform for leveraging such opportunities. Several new proposals were written by groups within ENBEL that had become linked up through common activities in the project.

Gaps in the research activities covered in the projects

It is important to carefully assess whether the wide scope of work being done aligns with the knowledge needs in the field, and whether these are clearly defined as yet. One mismatch between knowledge needs and actual research is apparent: only eight of the projects assessed the effectiveness of an actual intervention, and then only in small pilot projects, with weak study designs. The imperative of designing and testing adaptation interventions must surely be an overwhelming priority for the field now. The scale and urgency of the problem of climate change means that it is important that a coherent agenda emerge in the next few years.

Though the projects included a wide range of topics, settings and research methods, some areas have received limited attention. Some key areas noted include:

1. There appears to be little emphasis on the critical topic of health systems' responses to climate change, with far greater emphasis placed on documenting the increased need for services than on how to address the burgeoning need for care.
2. Several priority topics in climate change and health appear to have received little attention in the covered Belmont Forum and Horizon 2020 projects to date, including mental health, violence, and allergens.
3. The projects seem to pay limited attention to advancing research methodology in the field of climate change and health, which is surprising given the relative 'newness' of the emerging field.
4. Only some projects have a strong focus on health co-benefits and trade-offs. These are central themes in the field of climate change, and important ways to build linkages between different sectors involved in climate change.
5. Linked to item four, few projects focus specifically on the role of the health sector in mitigation. This is important both in reducing carbon emissions in the sector, but also in bringing the health sector into the field of mitigation more broadly
6. Few projects have specifically set out to assess different ways of measuring the impacts of climate change on health and then how to track these indicators over time. These population-level measures are important for assessing whether adaptation measures are effective at large scale.
7. There appears that the attention given to population groups does not match the burden of climate-related disease in different groups. It might be a useful exercise to compare the topics and groups covered with the relative burden of disease form climate-sensitive conditions. For example, few studies specifically addressed the elderly or those with non-communicable diseases, who carry a high burden of heat-related conditions.

8. The important field of climate change, migration and health has received little attention to date

Very few projects indicated having strengths in the area of project communication. This is concerning given that many key policy makers are not familiar with the health risks of climate change, messaging relating to the climate change and health nexus is complex, and beyond the projects there is limited communication expertise on this topic. The ENBEL project has a major focus on communication so offers a very good opportunity for building those skills. One particular opportunity bear mention, namely the policy engagement expertise in the ENBEL consortium. Moreover, the limited attention given by the projects to communication highlights the critical role for collaboration and support projects such as ENBEL, who have a major role in optimizing project outputs, especially around communication and dissemination.

Many of the projects include climate scientists, drawing these researchers into the health sphere, and vice versa. There may be value in bringing the climate scientists and the health specialists working with them all together. This meeting could review the lessons learnt at the intersection between climate science and human health, which may be outside the normal sphere of work for both groups.

Barriers to address to optimise ENBEL outputs

On the whole, the willingness of projects to cooperate appears very strong, translating this into actual activities may require concerted efforts, however.

There appears to be a large disconnect between the directives of the Belmont Forum and Horizon 2020 for data sharing and the intentions of partners in this regard. While there are ethical and regulatory barriers to sharing data, many of the barriers appear to relate to a desire of investigators to restrict access to the data generated in their project. Limited sharing of data between projects will constrain the ability of the ENBEL project to attain its stated objectives. The PARSEC project has developed considerable expertise on the principles and mechanisms of data sharing and may be able to assist in resolving this concern. Data sharing arrangements are most likely to be successful if they are underscored by a 'high trust relationship', mutually beneficial objectives, and efforts to minimize of the time and costs required from the partner who is contributing data.

Many projects present very compelling and clearly articulated examples of why major societal changes are needed to curtail the changes in climate we are experiencing. The projects address some of the groups that are being most affected by climate change. However, it appears that little thought has been given on how the body of work done might be used to support climate activism. None of the respondents mentioned advocacy as a key aim of their work. The potential for the projects individually or as a collective to advance advocacy around climate change, especially mitigation, appears limited at present. There could be more thinking about the opportunities that might exist to use of the project findings to advance the 'Green agenda'. On a similar note, projects use the phrase ''climate change'', rather than ''climate crisis''.

Most projects seem to apply a strict definition of human health, rather than a definition that considers human health as inextricably linked with plant and animal life. The Micro-Poll is one example where the health of the natural world or the interface of the human and natural world is examined. It is possible that such links exist in many projects but were not made explicit in project responses or documents.

In projects that have a narrow view of human health, it is this difficult to envision collaboration between these projects and those that extend human health to the natural world. Not surprisingly, therefore,

the Micro-Poll project that studies the natural world as a means of understanding human health, found it hardest to identify entry points for cross-project collaboration.

Many projects place a strong emphasis on assessing equity concerns but have generally not done so in a systematic manner. Promoting a systematic approach and framework to this topic may help optimise the findings in individual projects and allow for more direct comparisons between project findings, or joint analyses. The PROGRESS-Plus framework, with a standardised set of definitions for each sub-population, might be a useful option in this regard[20].

Many of the projects are at different stages in their activities, making it harder to draw conclusions across studies and identify synergies that are actionable in the short-term. Having projects at different stages, however, does provide an opportunity for projects that are in their early stages to learn from the experiences of more advanced projects. Moreover, many of the projects will be completed around 2024, meaning that the main outputs from several projects may be ready for dissemination at that time, allowing for joined-up dissemination activities. It is important to note that the delays in projects caused by the COVID-19 pandemic have meant the some of the relevant projects may only be completed after the ENBEL project is complete. This difference in timing is unfortunate as it may mean that ENBEL is unable to provide support for dissemination for some of the projects in their final stages.

Conclusion

In conclusion, there are multiple opportunities for synergistic collaboration taking advantage of the major strengths in the project teams and resources within the ENBEL project. These pertain, for example, to holding joint conference sessions on common themes, cross-learning between projects that have applied a similar research methodology, and building of skills in new areas, across disciplines.

There are challenges in inspiring and conducting joint activities between partners, however. Firstly, the topics of the research, settings and project teams are mostly disparate. Secondly, the projects are in different stages in the project lifecycle, which limits the potential for joint activities, such as use of common study tools, cross-project analyses and dissemination activities (some projects do not yet have findings for dissemination). The COVID-19 pandemic delayed several projects, further desynchronising activities across projects. Thirdly, projects teams have competing priorities and resource concerns. One of the major barriers to a more intensive inter-project collaboration is related to the fact that the resources and work in the projects have been planned and allocated. Any new and unplanned activities are on the top of what the projects have already committed to deliver. It is essential to create incentives for joint collaboration. Such incentives could be provided, for example, by creating opportunities for collaboration on scientific publications, increasing project outreach and communication, or perhaps forming new consortia and responding to new project calls. This means that the ENBEL team needs to clearly articulate the benefits of collaboration to the projects and try to minimize the amount of time and other resource inputs required from partners. Last, but not least, the successful capitalisation of potential synergies requires a robust communication process between ENBEL and the relevant projects – some projects still remain underinformed regarding the objectives and operation of the ENBEL project.

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[20] Cochrane Methods Equity. PROGRESS-Plus https://methods.cochrane.org/equity/projects/evidence-equity/progress-plus
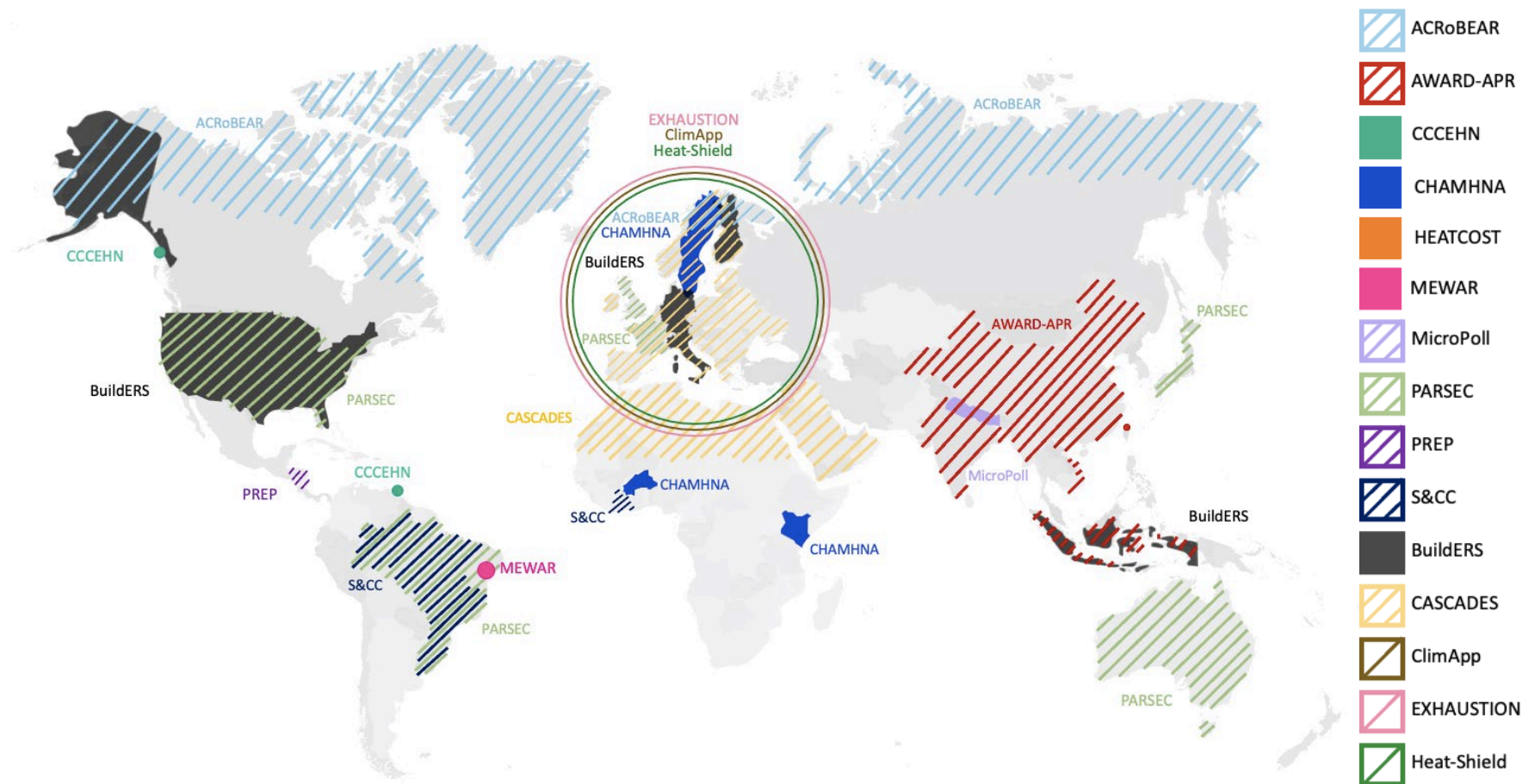
Figure. 1: Location of study sites in the Belmont Forum and Horizon2020 projects
The solid colours indicate the Belmont Forum projects and stripped ones the Horizon projects. The circles around Europe indicate the four projects that focus on the whole of the continent *HEATCOST operates worldwide. Projects are summed in accompanying table below
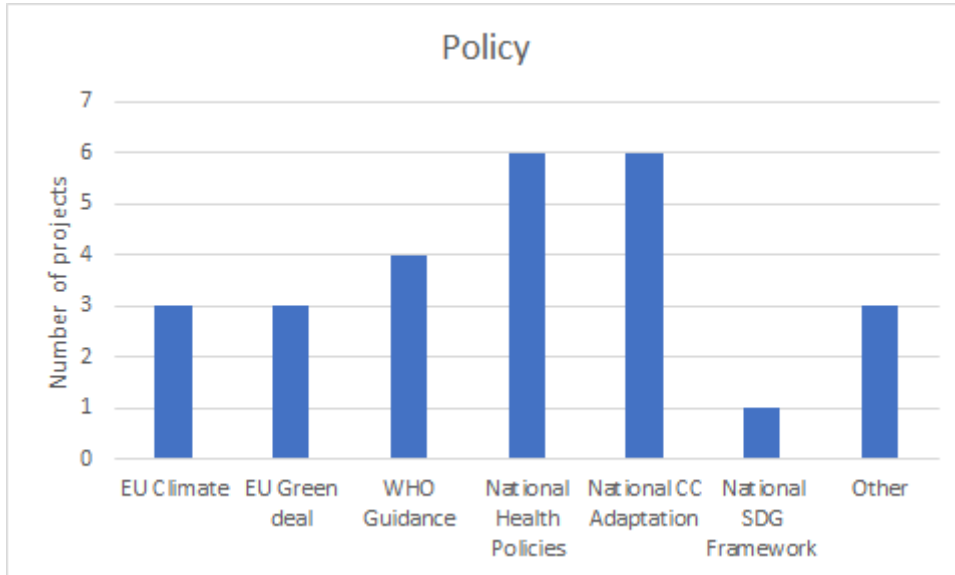
Figure 2: The consortium partners outside Europe in the Belmont Forum and Horizon 2020's projects covered in the report
The circles indicate the Belmont Forum projects and the flags the Horizon projects. ENBEL partners are underlined, some of which are not partners in the Belmont Forum or Horizon projects. Projects are summed in accompanying table below

Figure 3: The European consortium partners in the projects represented in the Belmont Forum and Horizon 2020's projects covered in the report

The circles indicate the Belmont Forum projects and the flags the Horizon projects. ENBEL partners are underlined, some of which are not partners in the Belmont Forum or Horizon projects. Projects are summed in accompanying table below

Summary table of projects presented in figures above

BuildERS
- Improving disaster resilience in society keeping in mind vulnerabilities and analysing how technologies and media could help

EXHAUSTION
- Health effect estimates of temperatures and air pollution and future impacts considering climate change projections
- Forest-fire modelling and biostatistics of health
- ''Costs'' of health impact from extreme heat and air pollution

CHAMHNA
- Explore the risks from heat on maternal and new-born health
- Based on climate exposure data and birth data

ACRoBEAR
- Measuring of community resilience from wildfire air pollution and natural-focal disease
- Based on atmospheric and community data

S&CC
- Modelling of snail-born schistosomiasis
- By looking at snail population data and climate data
- Market analyses of aquaculture of freshwater prawns as biological control

HEATCOST
- Modelling cardiopulmonary health due to extreme heat and air pollution (including from wildfires) under selected climate scenarios
- Assessing adaptation strategies and the associated costs.

Micro-Poll
- Modelling of climate change, crop pollination networks and micronutrient intake

HEAT-SHIELD
- Modelling heat stress from weather forecast data on occupational health
- Weather forecast data and conditions of workers

CCCEHN
- Interviews, focus groups and participatory development exercises
- Qualitative data on community

CASCADES
- Identifying how the risks of climate change beyond Europe might cascade into Europe.
- By analysing how risks interact through integrated assessment modelling of stakeholder insights

ClimApp
- Building a mobile phone application that integrates weather forecast data and human thermal models
- Based on human heat balance models, weather forecast data and personal factors

PREP
- Measuring the impact of chronic kidney disease (non-traditional cause) amongst workers in extreme heat
- Based on environmental measures and physiological measurements of worker productivity

PARSEC
- Building New Tools for Data Sharing and Re-use through investigating of socioeconomic Impacts of Protected Areas
- Indicators for socio-economic status
- Satellite data of protected areas

MEWAR
- Modelling of the mosquito population
- To establish an early warning system and community-based strategies

AWARD-APR
- Measuring community resilience against diarrheal diseases tied to extreme weather events
- Based on atmospheric data and diarrheal disease data

Figure 4. Project contribution to climate change and health international, European and national policies.

Annex

Annex 1: Questionnaire thematic areas and questions

Question category	Questions
A. General Data Protection Regulation	A1 - I have received and understood information about the ENBEL survey and have been given the opportunity to ask questions. I give consent:
B. Description of project and its partners	B1 - Please provide us with your project details (Name, acronym, total funding amount and duration). B2 - Please provide information on the project's website and Instagram, Facebook, etc. B3 - To which type of project call did the project respond? B4 - On which date did the project start and when is it expected to be completed? B5 - Has the project undergone any delay, for how long and due to which cause (E.g., Covid-19)? B6 - Who is/are the overall lead PI(s) of the project? Please provide us with a name(s) and institution(s). B7 - Please provide us with (1) the name and institution of the primary contact(s) the ENBEL team should communicate with, (2) the preferred point of contact for media enquiries, coverage and contributions and (3) the local contacts or staff at project sites where your research is taking place. B8 - What disciplines are represented in the project? B9 - What is/are the geographic focus area(s) of the project? Please specify the countries, provinces and / or local areas. B10 - Are any aspects of your project relevant to climate change and health in Africa, such as any project activities, any partners set in Africa, and any dissemination events involving African platforms or partners? B11 - What are the primary objectives of project? You are welcome to copy and paste from your project documents. B12 - What are the titles of the work packages within the project?
C. Climate hazards and health impacts covered by the project	C1 - Which climate hazard(s) are covered in the project? In case no climate hazards are covered in the project, please continue to section D of this survey. C2 - Which health impact(s) are covered in the project? C3 - What research methods or data sources are being used to describe/quantify the hazards(s)/impact(s) covered in the project? For example, in desk review or by means of a survey.
D. Study Population(s) targeted in the study	D1 - Who is/are the primary study population(s)/target(s) of research in the focus of the project? Comment only when you choose an answer. It is possible to tick multiple boxes when a comment is provided for each choice. D2 - Are there any or secondary target population(s) or groups that are indirectly affected, but not directly included in the focus of the project? Comment only when you choose an answer. It is possible to tick multiple boxes when a comment is provided for each choice. D3 - Are there any factors which make these study population(s)/target group(s) of research especially vulnerable? For example, age extremes, gender disparities, chronic diseases, unsafe working conditions or poverty?
E. Project topics addressed, or outcomes measured.	E1 - Does the project include the assessment of an intervention? E2 - Which of the following are covered in the project, either as the primary or secondary focus? E3 - Please provide us with a brief description of what kind of data will be collected during the project. You are welcome to copy and paste from your project documents. E4 - What date did data collection begin and at what stage of data collection are you in now? E5 - Did the project already find/create specific knowledge products or evidence syntheses that could be useful for other Belmont/H2020 projects? Please include link if published. E6 - Are there any important research or policy gaps that have been discovered after the project started and are not covered in your project, but that should be addressed in future projects?
F. Study methods and data analysis	F1 - Does the project carry out a systematic literature/document review or a narrative review of the project topics? F2 - In case of a narrative review, would it be possible to convert from a narrative review to a systematic review with some methodological input from the ENBEL project? F3 - Will the study data or findings be disaggregated by gender? F4 - Does the project include specific socio-economic or equity analyses? F5 - Does the project quantify the burden of disease attributable to the current or previous climate burden and / or future impacts considering projections of the future? F6 - Does the project consider different future emission scenarios? F7 - Are there any methodological outputs, data analysis, or research tools that the ENBEL team could assist with? For example, developing a search strategy for a systematic review, registration of the review protocol, questionnaire design, publication of study protocol, analysis of qualitative or quantitative data, peer review of project outputs
G. ENBEL support and collaboration activities	G1 - Are there specific Belmont, H2020 or other projects you would like to collaborate with? Please specify... G2 - Are there specific policymakers or organisations that are relevant to your project? Comment only when you choose an answer. G3 - Are there specific policymakers or organisations your project targets and that you think ENBEL should also target? G4 - How can the ENBEL project add value to your project? Please provide us with a detailed comment to your answer.

	G5 - Would your project consider sharing raw primary data collected in the project with the ENBEL team to allow for analyses of data across the Belmont/H2020 projects (provided data sharing agreements have been secured)? We understand that the issue would need to be discussed with the project team and that the response provided might change once the issue has been discussed with the team.
	G6 - Would a Non-Disclosure agreement that stipulates specific procedures for the ENBEL team to follow during comparative analyses and presentation of the findings, facilitate sharing of raw data between projects? Comment only when you choose an answer. We understand that the issue would need to be discussed with the project team and that the response provided might change once the issue has been discussed with the team.
	G7 - What barriers might projects face in sharing raw data with the ENBEL team to allow for comparative analyses with other projects? What could be done to make data sharing more attractive for the ENBEL partners?
H. Project outputs (e.g., conference presentations, journal articles, reports)	H1 - Please kindly provide us with a list of outputs that are already generated within the project. When available, please also add links or documents related to successful press or social media coverage.
	H2 - Please kindly provide us with a (provisional) list of potential research papers which the project intends to deliver.
	H3 - Please kindly provide us with a (provisional) list of reports which the project intends to deliver.
	H4 - Please kindly provide us with a (provisional) list of policy briefs which the project intends to deliver and specify the target audience of the policy brief.
	H5 - Please kindly provide us with a (provisional) list of key communications and outreach plans within the project (events, press releases, campaigns) intends to deliver.
	H6 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
	H7 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
	H8 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
	H9 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
	H10 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
	H11 - Please upload any relevant project outputs relevant to the study methods and data. Please also point us to the relevant page(s) of the document.
I. Potential contribution of the project to EU/WHO/National policies	I1 - Is your project planning to contribute to one or more of the following policies?
	I2 - Are you planning a dissemination meeting(s) with policymakers?
	I3 - Are you interested in a joint dissemination meeting for policymakers with other Belmont/H2020 projects? When would you have findings and / or data to disseminate at such a meeting? If yes, please provide us with ideas or details.
	I4 - Are you interested in collaboration or other outreach, dissemination and communication activities? If possible, please specify... For example, share posts on social media, joint events, joint material, press releases, contribution to newsletters, media, etc...
J. ENBEL training courses on climate change and health	J1 - Does the project or any of its consortium members provide training on climate change and health? If possible, please provide us with details or links...
	J2 - Does the project or any of its consortium members take part in training on climate change and health? If possible, please provide us with details or links...
	J3 - What learning materials or sources does the consortium use to get more information on climate change and health?
	J4 - Are you interested in participating in an additional interview to obtain further information or clarify your responses?
K. Communication, dissemination, and citizen outreach	K1 - Do you have any photo and/or video material that can be used freely by the ENBEL consortium to promote the project efforts? Please include links to galleries if available.
	K2 - Do you have ongoing contacts and relationships with journalists, podcasters or others that have covered your work or are interested in doing so? Please elaborate...
	K3 - Do you have any other comments related to ENBEL or this survey?