STUDY PROTOCOL

Carbon pricing, health co-benefits and trade-offs: protocol for a systematic framework synthesis [version 1; peer review: awaiting peer review]

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Abstract

Carbon pricing is considered an important instrument in the fight against climate change (World Bank, 2022). In particular, many experts and stakeholders have called for the implementation of carbon pricing as a part of ambitious climate policy agendas (Hepburn et al., 2020). This requires consideration of the interactions of carbon pricing with other policies, as well as of the societal outcomes of carbon pricing. In particular, carbon pricing has been found to have potentially large health impacts, leading to important co-benefits as well as potentially some trade-offs (Parry et al., 2014), (Hasegawa et al., 2018). Information on health impacts of carbon pricing, their distribution and how they are affected by policy design is necessary in order to progress towards more socially sustainable and politically feasible policy design.

Recent reviews have focussed on various aspects of carbon pricing design and outcomes, synthesizing evidence on its effectiveness, equity impacts or societal perception (Boyce, 2018), (Green, 2021), (Maestre-Andrés et al., 2019). Others have reviewed the evidence on health co-benefits of mitigation, but do not analyse specific policies or issues of policy design Gao et al.(2018).

This review will narratively synthesize the evidence on the health impacts of carbon pricing between 2010 and 2021 and identify gaps in the literature. We will use a framework synthesis approach to analyse different categories of policy-relevant information in contexts where carbon pricing is implemented as part of wider, coordinated policy agendas or complex policy mixes. This includes for example impacts on health inequalities and how health co-benefits are affected by

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issues of policy design and policy interactions.

Keywords
carbon pricing, climate, health co-benefits, evidence synthesis, framework synthesis

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Background

When referring to carbon pricing in this document we include both direct carbon pricing interventions (mainly carbon taxes, emissions trading schemes or ETS and carbon crediting); as well as indirect carbon pricing (fuel taxes) (World Bank, 2022).

International institutions and experts have increasingly called for the implementation of carbon pricing mechanisms as part of society-wide agendas to promote fair, equitable transitions to a green economy (Hepburn *et al.*, 2020). This involves implementing carbon pricing in combination with other policies and regulations, as well as considering the broader societal impacts of carbon pricing, beyond GHG emission reduction (Klenert *et al.*, 2018), (Parry *et al.*, 2014).

In particular, multiple studies have analysed the potential impacts of carbon pricing on health, suggesting in some cases that these can be considerable. However, there is a lack of agreement on how and under what circumstances carbon pricing interventions can be designed and implemented as part of a transformative policy agenda in order to reduce CO_2 emissions while improving human health and wellbeing. More specifically, true integration of health and wellbeing considerations in carbon pricing policy agendas and processes has been limited (Nemet *et al.*, 2010), (Workman *et al.*, 2018).

There are several recent reviews on the co-benefits of climate change mitigation, but they do not focus on separately synthesizing evidence for specific policies or issues of policy design (for example, Gao *et al.* (2018), Karlsson *et al.* (2020). Reviews specific to carbon pricing have covered a range of topics including effectiveness (Boyce, 2018), (Green, 2021), equity (Boyce, 2018) and public perception (Maestre-Andrés *et al.*, 2019). Boyce (2018) find that carbon pricing can in theory be used as an effective instrument to drive decarbonization throughout society, while revenues collected can be used to compensate households for higher energy prices. On the other hand, Green (2021) find little ex-post evidence of carbon pricing driving sufficient decarbonization, while Maestre-Andrés *et al.* (2019) find that negative public perceptions can constitute significant barriers to political feasibility. However, no one has so far systematically reviewed the evidence on carbon pricing and health, including complex issues of policy design, policy mixes and comparisons or health inequities and distribution of impacts.

This study aims to map the evidence around the health impacts of carbon pricing and develop a narrative and, if possible, graphical synthesis, based on framework analysis (Brunton *et al.*, 2020). We will conclude by highlighting the main insights from the literature as well as the main gaps and their relevance for future research and policy.

Objectives and research questions

We will aim to answer the following research questions

1. What are the main health outcomes analysed in connection with carbon pricing policies, and do particular types of policies tend to relate to particular health outcomes?
2. What is the geographical and sectoral coverage of carbon pricing policies where co-benefits have been identified, and where are the gaps?
3. What are the main methods and study designs(?) used to analyse health co-benefits of carbon pricing policies?
4. Can we extract insights relevant for the practical design of carbon pricing as part of transformative policy approaches (ie. Coordinated policy mixes that are deliberately designed to drive ambitious decarbonization in a societally sustainable and equitable manner)?

Search strategy

A draft search strategy was compiled in the Clarivate Analytics Web of Science Core Collection databases by an experienced information specialist (JF). The search strategy includes strings of terms and synonyms to reflect two concepts:

Concept 1: Carbon pricing. This included the three most important greenhouse gases (carbon dioxide, methane, nitrous oxide)

Concept 2: Health. This included general health terms as well as socioeconomic and health risk factors

We include studies published after 2010. This cut-off has been used previously in the context of evidence synthesis on climate mitigation co-benefits (Chang *et al.*, 2017) and is designed to include the most up-to-date and relevant information informed by current understandings on health co-benefits. In November and December 2009 the Lancet published the Lancet Commission on Managing the Effects of Climate Change (Costello *et al.*, 2009), and a series of seminal studies on the health co-benefits of mitigation in various sectors (Haines *et al.*, 2009), including food and agriculture, urban land transportation. This series informed a broader understanding of health co-benefits, which had until then been limited to air pollution. In the field of air pollution, a high quality review was published in 2010 which synthesized the evidence to that date (Nemet *et al.*, 2010). Therefore, our choice to focus on the literature from 2010 allows us to build on existing reviews, and carry out a broader search which can capture a wide range of co-benefits and trade-offs. Only studies published in English were included. No other filters or limits were added.

The search strategy was refined with the project team until the retrieved results reflected the scope of the project and contained relevant papers already known to the team. The agreed draft searches were adapted for each database to incorporate database-specific syntax and controlled vocabularies. Full details of the search strings used for each database can be found in the appendix.

In a second step, we will carry out snowballing, searching the reference lists of included articles.

Databases

The databases were designed to provide wide thematic and geographical coverage, avoiding geographical bias. Table 1 lists

Table 1. Databases, supporting platform, database and coverage dates.

Supporting platform	Database name	Database coverage dates*
OvidSP	Medline ALL	From 1946
	Embase	From 1974
	Global Health	From 1910
	Econlit	From 1886
Clarivate analytics Web of Science Core Collection	Science Citation Index-Expanded;	From 1970
	Social Sciences Citation Index,;	From 1970
	Arts & Humanities Citation Index, 1975-present;	From 1975
	Conference Proceedings Citation Index-Science, 1990-present;	From 1990
	Conference Proceedings Citation Index-Social Science & Humanities, 1990-present;	From 1990
	Emerging Sources Citation Index, 2015-present.	From 2015
Clarivate Analytics Web of Science Korean Journal Database, 1980-present		From 1980
Clarivate Analytics Web of Science SciELO Citation Index, 2002-present.		From 2002
Ebsco	Africa-Wide Information, complete database.	
	GreenFILE, complete database	

* Note that searches were restricted to 2010 in each database as describe in the above sub-section

databases along with their supporting platforms and coverage dates.

- OvidSP Medline ALL, 1946 to 22 June 2021.
- OvidSP Embase, 1974 to 22 June 2021.
- OvidSP Global Health, 1910 to 2021 week 25.
- OvidSP Econlit, 1886 to 17 June 2021.
- Clarivate Analytics Web of Science Core Collection.

  This collection contains the following databases which were searched simultaneously:

  - Science Citation Index-Expanded, 1970-present;
  - Social Sciences Citation Index, 1970-present;
  - Arts & Humanities Citation Index, 1975-present;
  - Conference Proceedings Citation Index-Science, 1990-present;
  - Conference Proceedings Citation Index-Social Science & Humanities, 1990-present;
  - Emerging Sources Citation Index, 2015-present.
- Clarivate Analytics Web of Science Korean Journal Database, 1980-present. Data last updated 22 June 2021.
- Clarivate Analytics Web of Science SciELO Citation Index, 2002-present. Data last updated 10 June 2021.
- Ebsco Africa-Wide Information, complete database.
- Ebsco GreenFILE, complete database.

Information management

All citations identified by our searches will be imported into EndNote X9 software. Duplicates will be identified and removed using the method described on the London School of Hygiene & Tropical Medicine Library & Archives Service blog (Falconer, 2018).

Screening

All titles and abstracts, as well as preliminarily included full texts will be screened by two team members. Disagreements that cannot be resolved after discussion will be resolved by a third team member.

Inclusion and exclusion criteria

The same inclusion and exclusion criteria will be applied at the title and abstract stage and the full text stage (Table 2). In the title and abstract stage, records will be included if there is any uncertainty about whether or not the criteria are met. A specific reason for exclusion will be recorded for all of those papers excluded after full text screening. Two co-authors will

Table 2. Inclusion and exclusion criteria.

	Included	Excluded
Population	Studies analysing impacts at a local, sub-national, national or international level	None
Intervention	Direct and indirect carbon pricing interventions: Carbon taxes, emissions trading schemes, carbon crediting. Indirect: Taxes on fuels, subsidy removal	Other climate change mitigation policy, where separate results are not provided for carbon pricing
Comparator	Affected versus unaffected geographical areas, before and after, intervention scenario versus counterfactual without carbon pricing intervention. This can include comparators where there is a mitigation intervention in place as long as this is *also* present in the intervention scenario, meaning that the impact of carbon pricing can be isolated.	Studies with no comparator
Outcomes	GHG emissions AND Impacts on health outcomes. (See explanation earlier in this section. This is in order to assess links between effectiveness and health outcomes, as well as to be able to include indirect carbon pricing measures) Health outcome indicators would include any general morbidity or mortality outcome, including burden of disease, QUALYs, DALY, monetized estimates of health outcomes	Studies that only estimate exposures or health risk factors, or impacts on social and economic outcomes that are indirectly related to health such as GDP growth, job creation, income levels
Study design	Ex-post quantitative studies, ex-ante applied modelling studies. Empirical qualitative studies. (for relevant related reviews we will obtain the full text and screen their included articles as part of snowballing)	Theoretical studies
Year of publication	2010 or after	Before 2010
Language	English language	Other

independently record the main reason for exclusion and disagreements about the main reason for exclusion will be addressed through discussion for those articles where both co-authors agree to exclude. Any disagreements persisting would also be consulted with a third co-author.

Only studies including both GHG emissions outcomes and health outcomes will be included. This allows us to discuss synergies or trade-offs between effectiveness and health outcomes, as well as allowing the inclusion of indirect carbon pricing policies (eg. gasoline taxes or subsidy removal). These play an important role in the carbon pricing policy mix but, if not assessed in terms of their mitigation potential they are hard to compare with direct carbon pricing policies.

Information extraction and management

The full texts of the included articles will be examined by one of the co-authors to identify additional references of interest and these will be screened using the same inclusion and exclusion criteria applied to all the previous studies.

Key reviews that do not meet our inclusion criteria (for example they focus generally on the co-benefits of mitigation strategies) will also be downloaded and their included articles searched for any additional relevant references.

Information from each included article will be extracted by either SC or DN. Key information for mapping and framework analysis will be entered into an excel spreadsheet. More detailed coding will be carried out in NVivo, in order to allow for the iterative stages of coding required for framework analysis. Summarized information from the final coding in NVivo will be extracted onto the excel sheet, in addition to the main mapping variables. 20% of the articles will be independently extracted by another co-author in order to avoid reviewer bias. Any disagreements would be sorted out by discussing and, if necessary, through the intervention of a third co-author.

Evidence synthesis

Mapping

We will map the evidence in order to support the identification of gaps in the literature and identify relevant patterns in terms of impacts. Information will be displayed graphically where this is appropriate and summarized in tables or narratively otherwise.

We will extract information on the following concepts (see Table 3 for a more detailed description)

- **Scope of the intervention**: We will extract information on both geographical and sectoral scope of the intervention.

Table 3. Information extraction for mapping and framework analysis.

Main categories	Information extraction for mapping and framework analysis
Article identifying information	1. Authors, year of publication, full citation information)
Scope of intervention	2. Scale (national, multi-country, sub-national) 3. Specific country or countries/region; Detail, if sub-national scope 4. Sectoral coverage
Type of Intervention	5. Type of intervention (carbon tax, cap and trade, fuel and energy taxes, subsidy removal); Detail, compulsory if more than one carbon pricing intervention, Includes a brief description of any additional details of intervention design that might not be covered in the other fields
Outcomes	6. Direction of impacts (whether the study finds synergies, trade-offs or both) 7. Risk factor category/pathway (initial classification based on previous literature on health co-benefits (Haines *et al.*, 2009), (Gao *et al.*, 2018). This would be updated if necessary to add any additional categories) 8. Type of health outcome (whether health outcomes are monetized or not); detail, specific health endpoints
	9. Health outcomes, detail (Health indicator, specific risk factors, causes of mortality/morbidity)
Methods	10. Ex-ante vs. ex-post 11. Detail: Type of model or if ex-post, detail on approach (natural experiment, time series analysis, intervention study)
Scenario design and health outcome disaggregation or distribution: Assessing CP as a transformational policy:	Data extraction for this section will be based on an iterative process for framework analysis. Framework analysis section below provides methodological details. Is carbon pricing considered as part of a wider policy package or are policy interactions analysed? (details) 12. Are alternative uses of carbon pricing revenues considered? (details) 13. Does the study consider distribution of outcomes? (details) 14. Are the most relevant health outcomes systematically identified and are potential trade-offs considered? (details)

- **Type of intervention**: We will identify what type of direct or indirect carbon pricing intervention or interventions are being analysed, differentiating between carbon taxes, cap and trade, fuel and energy taxes and subsidy removal.
- **Methods**: We will classify studies into ex-post and ex-ante and extract details on the method or model used.
- **Health outcomes of the intervention**: We will classify studies according to whether or not health outcomes are monetized and the main risk factor category they belong to, and extract details about the specific health outcomes reported. We will record the direction of impact (whether synergies, trade-offs or both are identified).
- **Scenario design and outcome distribution or disaggregation.** This will be extracted following an iterative framework analysis methodology (see evidence synthesis section)

Framework analysis

We will use a qualitative framework analysis methodology (Brunton *et al.*, 2020) (Ritchie & Spencer, 2002) to identify and analyse the role that health co-benefits played in each study from the point of view of transformational policy-making.

This methodology was developed originally for qualitative research in applied policy analysis (Ritchie & Spencer, 2002), and has increasingly been applied as a method for evidence synthesis in literature reviews (Brunton *et al.*, 2020).

Data analysis will involve several steps, which are based on the analytical steps described by Ritchie and Spencer (Ritchie & Spencer, 2002).

Familiarisation: Familiarisation with the studies, which will be carried out by SC, will involve identifying and coding relevant segments which describe scenarios, health-related outcome variables and results in a clear, objective way. Relevant author interpretations of their own findings will be separately identified for context in some cases but will not be included in the main analysis.

Preliminary framework: A preliminary framework will be identified, informed by the familiarisation step and by existing theories and frameworks. In this case, this step will be informed by insights from several strands of literature: Firstly, we will aim to incorporate insights from the literature transformative

policy approaches, (Schot & Steinmueller, 2018) and its recent applications to areas relevant to environmental or health policy (Naito *et al.*, 2022), (OECD, 2021), (Lee *et al.*, 2020). Secondly, we will also incorporate insights from the literature on the political economy of carbon pricing (Rosenbloom *et al.*, 2020), (Jenkins, 2014), and the role of health co-benefits in climate mitigation policy (Nemet *et al.*, 2010), (Remais *et al.*, 2014), (Chang *et al.*, 2017).

Indexing: The previously identified relevant segments and any additional necessary sections will be coded in NVivo and analysed based on the preliminary framework.

Charting: Coded segments will be lifted and analysed in order to get a perspective of the data as a whole. This step will be carried out in NVivo, where all the text coded to an index category can be viewed together and analysed as a whole.

Mapping and interpretation: This step will involve identifying emerging themes, patterns in the data, relationships between concepts and emerging typologies. This will result in a final framework of analysis.

The most relevant information corresponding to different categories in the final framework will be entered into the excel sheet. Other types of visualization will be elaborated if possible including heat maps of the main themes in the literature, charts or mind maps.

Risk of bias appraisal

Quality assessment will be based on the STROBE categories for any ex-post studies identified. We anticipate that most, or perhaps all studies will be ex-ante, however. A quality appraisal checklist modelling tool has been adapted from (Van Voorn *et al.*, 2016). A similar checklist, also adapted from the same tool, was used by (Jarmul *et al.*, 2019). The tool is kept brief and as simple as possible, because the diversity of models and applications (from air pollution to diet or physical activity and from multi-country macroeconomic models to local, bottom-up models) would make it difficult to apply a more detailed checklist consistently and meaningfully. The proposed checklist is described in Table 4.

Table 4. Quality appraisal for modelling studies.

Q1. Is the model described clearly (either in the study itself or separately published model documentation that the reader is explicitly referred to)?	Yes/No/Unclear
Q2. Is the model choice discussed in relation to the literature	Yes/No/Unclear
Q3. If YES to Q2, is model choice in accordance to well-established knowledge or practice?	Yes/No/Unclear
Q4. Does the article provide a clear discussion of assumptions and limitations?	Yes/No/Unclear
Q5. Are model inputs clearly described and their limitations explained?	Yes/No/Unclear
Q6. Is scenario design clearly explained and justified?	Yes/No/Unclear
Q7. Is the model subject to sensitivity analysis?	None/Key parameters/ Parameters and model choice

Risk of bias

Risk of researcher bias will be addressed by independent double screening and consultation with a third party in case of disagreement. Input will be sought from a variety of experts.

Risk of publication bias: We will identify studies that provide insights on trade-offs or mixed impacts, and assess any systematic differences these might have with respect to studies reporting co-benefits. Some risk of publication bias can remain and this will be identified as a study limitation. Unlike other reviews, we do not limit our searches to studies that estimate co-benefits but search for studies that estimate any potential health outcomes (positive, or negative).

Study status

Searches have been completed and analysis is under way.

Data availability

No data are associated with this article.

1 Appendix: Search syntax

This appendix provides full details of all search strings used for bibliographic databases, with dates and number of references returned and notes explaining any unusual search techniques or syntax. The EndNote X9 import order is provided, as the deduplication technique keeps the first uploaded copy of the reference by default. Searches are all carried out by JF.

1.1 Medline ALL

Database name	Medline ALL
Database platform	OvidSP
Dates of database coverage	1946 to 22 June 2021
Search strategy notes	Search lines ending in a '/' are subject heading searches. Search lines beginning 'exp' are exploded subject heading searches. Two-letter codes at the end of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract adj*n* searches for words within *n* words of each other. or/*x-y* combines search sets in the range *x-y* with Boolean operator OR. * is used for truncation of words.

#	Search terms	Results
1	climate change/ or global warming/	22467
2	Greenhouse Gases/ or Greenhouse Effect/	6674
3	Carbon Dioxide/ or carbon/	144296
4	Methane/	19028
5	Nitrous Oxide/	14609
6	exp fossil fuels/ or exp particulate matter/	91022
7	Vehicle Emissions/	10455
8	or/1-7	286740
9	"Costs and Cost Analysis"/	49682
10	Taxes/	6951
11	Commerce/	26118
12	Financing, Government/	21118
13	or/9-12	100768
14	8 and 13	1252
15	((greenhouse gas* or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or co2 or ch4 or methane or n2o or nitro* oxide* or emission*) adj3 (price* or prici* or tax or taxes or taxation or trade* or trading or credit* or fiscal or subsid*)).ti,ab.	2431
16	("cap and trade" or "cap and invest").ti,ab.	92
17	or/14-16	3553
18	exp Health/	388688
19	"Quality of Life"/	214008
20	exp morbidity/ or exp mortality/	951370
21	Disease/	68780
22	quality-adjusted life years/	13402
23	"cost of illness"/	28990

#	Search terms	Results
24	exp Exercise/	211495
25	exp Diet/	296000
26	cold-shock response/ or exp heat-shock response/	9429
27	Sedentary Behavior/	10996
28	Noise/	21157
29	Crowding/	3473
30	Air Pollution/	33366
31	Accidents, Traffic/	44738
32	exp Food Supply/	14241
33	((health* or well-being or wellbeing or morbidity or mortality or disease* or illness* or DALY* or life year* or burden of disease* or QALY* or death* or (life adj2 satisf*) or wellness or "quality of life" or QOL) not "soil").ti,ab.	7480196
34	(physical exercise or physical activity or diet* or nutrition* or (thermal adj1 (comfort or stress)) or (exposure adj2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or air-quality or clean air or traffic accident*).ti,ab.	1245540
35	(energy poverty or food poverty or food security or food insecurity).ti,ab.	11007
36	(climate adj4 (benefit* or co-benefit*)).ti,ab.	439
37	or/18-36	9030312
38	17 and 37	1139
39	limit 38 to yr="2010 -Current"	786
40	limit 39 to (english or spanish)	773
41	remove duplicates from 40	771

1.2 Embase

Database name	Embase
Database platform	OvidSP
Dates of database coverage	1974 to 22 June 2021
Search strategy notes	Search lines ending in a '/' are subject heading searches. Search lines beginning 'exp' are exploded subject heading searches. Two-letter codes at the end of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract adj*n* searches for words within *n* words of each other. or/*x-y* combines search sets in the range *x-y* with Boolean operator OR. * is used for truncation of words.

#	Search terms	Results
1	exp climate change/ or climate resilience/ or greenhouse effect/ or greenhouse gas/ or carbon footprint/	62867
2	carbon/	130102
3	carbon dioxide/	103176
4	methane/	30060
5	nitrous oxide/	33851

#	Search terms	Results
6	charcoal/ or coal/ or coke/ or diesel fuel/ or fossil fuel/ or fuel oil/ or gasoline/ or kerosene/ or liquefied natural gas/ or liquefied petroleum gas/ or natural gas/ or petroleum/	54644
7	exp atmospheric particulate matter/	5471
8	nitrous oxide emission/	1116
9	exhaust gas/	19938
10	or/1-9	392132
11	tax/	15261
12	commercial phenomena/ or market/	64878
13	public expenditure/	201
14	"cost"/	59700
15	or/11-14	137079
16	10 and 15	2957
17	((greenhouse gas* or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or co2 or ch4 or methane or n2o or nitro* oxide* or emission*) adj3 (price* or prici* or tax or taxes or taxation or trade* or trading or credit* or fiscal or subsid*)).ti,ab.	2792
18	("cap and trade" or "cap and invest").ti,ab.	107
19	or/16-18	5463
20	exp health/	745419
21	wellbeing/ or physical well-being/ or psychological well-being/	94014
22	exp morbidity/	384047
23	exp mortality/	1163905
24	exp diseases/	23032142
25	exp disease burden/	56391
26	exp death/	747209
27	exp "quality of life"/	536790
28	exp exercise/	365883
29	exp diet/	345503
30	nutrition/	110226
31	thermal exposure/	5055
32	sedentary lifestyle/	15990
33	exp noise/	118772
34	"crowding (area)"/	4032
35	exp air quality/	33220
36	traffic accident/	61535
37	food security/	5836
38	((health* or well-being or wellbeing or morbidity or mortality or disease* or illness* or DALY* or life year* or burden of disease* or QALY* or death* or (life adj2 satisf*) or wellness or "quality of life" or QOL) not "soil").ti,ab.	10088812
39	(physical exercise or physical activity or diet* or nutrition* or (thermal adj1 (comfort or stress)) or (exposure adj2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or air-quality or clean air or traffic accident*).ti,ab.	1567578

#	Search terms	Results
40	(energy poverty or food poverty or food security or food insecurity).ti,ab.	12462
41	(climate adj4 (benefit* or co-benefit*)).ti,ab.	467
42	or/20-41	24983116
43	19 and 42	1842
44	limit 43 to yr="2010 -Current"	1359
45	limit 44 to (english or spanish)	1346
46	remove duplicates from 45	1335

1.3 Global Health

Database name	Global Health
Database platform	OvidSP
Dates of database coverage	1910 to week 25 2021
Search strategy notes	Search lines ending in a '/' are subject heading searches. Search lines beginning 'exp' are exploded subject heading searches. Two-letter codes at the end of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract adj*n* searches for words within *n* words of each other. or/*x-y* combines search sets in the range *x-y* with Boolean operator OR. * is used for truncation of words.

#	Search terms	Results
1	exp climate change/ or greenhouse gases/ or greenhouse effect/ or carbon footprint/	11486
2	carbon dioxide/ or nitrogen oxides/	9752
3	carbon/	8999
4	methane/	3839
5	coal/ or coke/ or fossil fuels/ or exp fuel oils/ or kerosene/ or liquid petroleum gas/ or natural gas/	7370
6	particulate matter/	5944
7	exp emissions/	5676
8	or/1-7	44663
9	exp prices/	7256
10	taxes/ or direct taxation/ or indirect taxation/ or levies/ or tax credits/ or tax incentives/	1850
11	exp trade/	4769
12	exp credit/	278
13	exp subsidies/	677
14	public expenditure/	210

#	Search terms	Results
15	or/9-14	13917
16	8 and 15	387
17	((greenhouse gas* or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or co2 or ch4 or methane or n2o or nitro* oxide* or emission*) adj3 (price* or prici* or tax or taxes or taxation or trade* or trading or credit* or fiscal or subsid*)).ti,ab.	621
18	("cap and trade" or "cap and invest").ti,ab.	21
19	or/16-18	935
20	exp health/	355982
21	illness/	2058
22	morbidity/	35663
23	exp mortality/	163646
24	exp diseases/	2570215
25	"quality of life"/	21855
26	exp food security/ or food access/	13046
27	physical activity/ or exp exercise/	70619
28	diet/	63636
29	exp nutrition/	98085
30	exposure/	68223
31	noise/ or noise pollution/	3194
32	exp crowding/	532
33	air quality/	10104
34	traffic accidents/	4482
35	((health* or well-being or wellbeing or morbidity or mortality or disease* or illness* or DALY* or life year* or burden of disease* or QALY* or death* or (life adj2 satisf*) or wellness or "quality of life" or QOL) not "soil").ti,ab.	1641746
36	(physical exercise or physical activity or diet* or nutrition* or (thermal adj1 (comfort or stress)) or (exposure adj2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or air-quality or clean air or traffic accident*).ti,ab.	614896
37	(energy poverty or food poverty or food security or food insecurity).ti,ab.	13044
38	(climate adj4 (benefit* or co-benefit*)).ti,ab.	171
39	or/20-38	3313197
40	19 and 39	620
41	limit 40 to yr="2010 -Current"	477
42	limit 41 to (english or spanish)	450
43	remove duplicates from 42	448

1.4 Econlit

Database name	Econlit
Database platform	OvidSP
Dates of database coverage	1886 to 17 June 2021
Search strategy notes	Two-letter codes at the end of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract adj*n* searches for words within *n* words of each other. or/*x-y* combines search sets in the range *x-y* with Boolean operator OR. * is used for truncation of words.

#	Search terms	Results
1	((greenhouse gas* or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or co2 or ch4 or methane or n2o or nitro* oxide* or emission*) adj3 (price* or prici* or tax or taxes or taxation or trade* or trading or credit* or fiscal or subsid*)).ti,ab.	12486
2	("cap and trade" or "cap and invest").ti,ab.	780
3	1 or 2	12737
4	((health* or well-being or wellbeing or morbidity or mortality or disease* or illness* or DALY* or life year* or burden of disease* or QALY* or death* or (life adj2 satisf*) or wellness or "quality of life" or QOL) not "soil").ti,ab.	82304
5	(physical exercise or physical activity or diet* or nutrition* or (thermal adj1 (comfort or stress)) or (exposure adj2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or air-quality or clean air or traffic accident*).ti,ab.	21345
6	(energy poverty or food poverty or food security or food insecurity).ti,ab.	4039
7	(climate adj4 (benefit* or co-benefit*)).ti,ab.	365
8	or/4-7	102588
9	3 and 8	762
10	limit 9 to yr="2010 -Current"	533
11	limit 10 to (english or spanish)	517
12	remove duplicates from 11	516

1.5 Africa-Wide Information

Database name	Africa-Wide Information
Database platform	Ebsco
Search strategy notes	Two-letter codes at the beginning of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract * is used for truncation of words. N*n* searches for terms within *n* words of each other.

#	Query	Results
S1	(TI ((“greenhouse gas*” or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or “co2” or “ch4” or methane or “n2o” or “nitro* oxide*” or emission*) N3 (price* or prici* or tax or taxes or taxation or trade* OR trading or credit* or fiscal or subsid*))) or (AB ((“greenhouse gas*” or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or “co2” or “ch4” or methane or “n2o” or “nitro* oxide*” or emission*) N3 (price* or prici* or tax or taxes or taxation or trade* OR trading or credit* or fiscal or subsid*)))	2,053
S2	(TI (“cap and trade” or “cap and invest”)) or (AB (“cap and trade” or “cap and invest”))	7
S3	S1 OR S2	2,054
S4	(TI ((health* or “well-being” or wellbeing or morbidity or mortality or disease* OR illness* OR DALY* OR “life year*” OR “burden of disease*” OR QALY* OR death* OR (life N2 satisf*) OR wellness OR “quality of life” OR QOL) not “soil”)) or (AB ((health* or “well-being” or wellbeing or morbidity or mortality or disease* OR illness* OR DALY* OR “life year*” OR “burden of disease*” OR QALY* OR death* OR (life N2 satisf*) OR wellness OR “quality of life” OR QOL) not “soil”))	532,756
S5	(TI (“physical exercise” or “physical activity” or diet* or nutrition* or (thermal n1 (comfort or stress)) or (exposure n2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or “air-quality” or “clean air” or “traffic accident*”)) or (AB (“physical exercise” or “physical activity” or diet* or nutrition* or (thermal n1 (comfort or stress)) or (exposure n2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or “air-quality” or “clean air” or “traffic accident*”))	86,992
S6	(TI (“energy poverty” or “food poverty” or “food security” or “food insecurity”)) or (AB (“energy poverty” or “food poverty” or “food security” or “food insecurity”))	8,077
S7	(TI (climate n4 (benefit or “co-benefit”))) or (AB (climate n4 (benefit or “co-benefit”)))	45
S8	S4 OR S5 OR S6 OR S7	593,813
S9	S3 AND S8	143
S10	S9 Limiters - Year Published: 2010-2021	85
S11	S10 Limiters - Language: English, Spanish	82

1.6 GreenFILE

Database name	GreenFILE
Database platform	Ebsco
Dates of database coverage	Complete database as of search date
Search strategy notes	Two-letter codes at the beginning of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract * is used for truncation of words. N*n* searches for terms within *n* words of each other.

#	Query	Results
S1	(TI ((“greenhouse gas*” or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or “co2” or “ch4” or methane or “n2o” or “nitro* oxide*” or emission*) N3 (price* or prici* or tax or taxes or taxation or trade* OR trading or credit* or fiscal or subsid*))) or (AB ((“greenhouse gas*” or ghg or carbon or fuel* or energy or particulate* or decarbon* or climate or “co2” or “ch4” or methane or “n2o” or “nitro* oxide*” or emission*) N3 (price* or prici* or tax or taxes or taxation or trade* OR trading or credit* or fiscal or subsid*)))	11,985
S2	(TI (“cap and trade” or “cap and invest”)) or (AB (“cap and trade” or “cap and invest”))	1,191
S3	S1 OR S2	12,410
S4	(TI ((health* or “well-being” or wellbeing or morbidity or mortality or disease* OR illness* OR DALY* OR “life year*” OR “burden of disease*” OR QALY* OR death* OR (life N2 satisf*) OR wellness OR “quality of life” OR QOL) not “soil”)) or (AB ((health* or “well-being” or wellbeing or morbidity or mortality or disease* OR illness* OR DALY* OR “life year*” OR “burden of disease*” OR QALY* OR death* OR (life N2 satisf*) OR wellness OR “quality of life” OR QOL) not “soil”))	96,419

#	Query	Results
S5	(TI ("physical exercise" or "physical activity" or diet* or nutrition* or (thermal n1 (comfort or stress)) or (exposure n2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or "air-quality" or "clean air" or "traffic accident*")) or (AB ("physical exercise" or "physical activity" or diet* or nutrition* or (thermal n1 (comfort or stress)) or (exposure n2 (cold or heat or temperature*)) or walk* or sedentary or noise or noisy or crowding or overcrowding or "air-quality" or "clean air" or "traffic accident*"))	48,763
S6	(TI ("energy poverty" or "food poverty" or "food security" or "food insecurity")) or (AB ("energy poverty" or "food poverty" or "food security" or "food insecurity"))	3,000
S7	(TI (climate n4 (benefit or "co-benefit"))) or (AB (climate n4 (benefit or "co-benefit")))	896
S8	S4 OR S5 OR S6 OR S7	136,419
S9	S3 AND S8	849
S10	S9 Limiters - Publication Date: 20100101-20211231	487

1.7 Web of Science Core Collection

Database name	Web of Science Core Collection. This contains the following databases which are all searched together: Science Citation Index Expanded (SCI-Expanded) • Social Sciences Citation Index (SSCI) • Arts & Humanities Citation Index (A&HCI) • Conference Proceedings Citation Index – Science (CPCI-S) • Conference Proceedings Citation Index - Social Science & Humanities (CPCI-SSH) • Emerging Sources Citation Index (ESCI)
Database platform	Clarivate Analytics Web of Science
Dates of database coverage	SCI-Expanded, 1970-present SSCI, 1970-present A&HCI, 1975-present CPCI-S, 1990-present CPCI-SSH, 1990-present ESCI, 2015-present Data last updated: 2021-06-22
Search strategy notes	* is used for truncation. Two-letter codes at the beginning of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract NEAR/*n* searches for words within *n* words of each other.

#	Results	Search terms
# 10	2,269	(#9) AND LANGUAGE: (English OR Spanish) Timespan=2010-2021
# 9	2,817	#8 AND #3
# 8	9,244,714	#7 OR #6 OR #5 OR #4
# 7	1,137	TI=("climate" near/4 ("benefit" or "co-benefit*")) or AB=("climate" near/4 ("benefit" or "co-benefit*"))
# 6	30,536	TI=("energy poverty" or "food poverty" or "food security" or "food insecurity") or AB=("energy poverty" or "food poverty" or "food security" or "food insecurity")

#	Results	Search terms
# 5	2,202,663	(TI=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*") or AB=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*"))
# 4	7,519,136	TI=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil") or AB=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil")
# 3	42,553	#2 OR #1
# 2	1,244	TI=("cap and trade" or "cap and invest") or AB=("cap and trade" or "cap and invest")
# 1	42,166	TI=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*")) or AB=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*"))

1.8 Korean Journal Database

Database name	KCI-Korean Journal Database
Database platform	Clarivate Analytics Web of Science
Search strategy notes	* is used for truncation. Two-letter codes at the beginning of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract NEAR/*n* searches for words within *n* words of each other.

#	Results	Search terms
# 10	14	(#9) AND LANGUAGE: (English OR Spanish) Timespan=2010-2021
# 9	98	#8 AND #3
# 8	227,116	#7 OR #6 OR #5 OR #4
# 7	12	TI=("climate" near/4 ("benefit" or "co-benefit*")) or AB=("climate" near/4 ("benefit" or "co-benefit*"))
# 6	445	TI=("energy poverty" or "food poverty" or "food security" or "food insecurity") or AB=("energy poverty" or "food poverty" or "food security" or "food insecurity")
# 5	62,096	(TI=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*") or AB=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*"))
# 4	181,570	TI=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil") or AB=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil")

#	Results	Search terms
# 3	1,662	#2 OR #1
# 2	57	TI=("cap and trade" or "cap and invest") or AB=("cap and trade" or "cap and invest")
# 1	1,648	TI=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*")) or AB=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*"))

1.9 SciELO Citation Index

Database name	SciELO Citation Index
Database platform	Clarivate Analytics Web of Science
Dates of database coverage	2001-present Data last updated 10 June 2021
Search strategy notes	* is used for truncation. Two-letter codes at the beginning of search lines designate the fields to search. Fields codes used are: TI: title AB: abstract NEAR/*n* searches for words within *n* words of each other.

#	Results	Search terms
# 10	11	(#9) AND LANGUAGE: (English OR Spanish) Timespan=2010-2021
# 9	21	#8 AND #3
# 8	211,344	#7 OR #6 OR #5 OR #4
# 7	7	TI=("climate" near/4 ("benefit" or "co-benefit*")) or AB=("climate" near/4 ("benefit" or "co-benefit*"))
# 6	1,024	TI=("energy poverty" or "food poverty" or "food security" or "food insecurity") or AB=("energy poverty" or "food poverty" or "food security" or "food insecurity")
# 5	44,995	(TI=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*") or AB=("physical exercise" or "physical activity" or "diet*" or "nutrition*" or ("thermal" near/1 ("comfort" or "stress")) or ("exposure" near/2 ("cold" or "heat" or "temperature*")) or walk* or "sedentary" or "noise" or "noisy" or "crowding" or "overcrowding" or "air-quality" or "clean air" or "traffic accident*"))
# 4	183,187	TI=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil") or AB=(("health*" or "well-being" or "wellbeing" or "morbidity" or "mortality" or "disease*" OR "illness*" OR "DALY*" OR "life year*" OR "burden of disease*" OR "QALY*" OR "death*" OR ("life" NEAR/2 "satisf*") OR "wellness" OR "quality of life" OR "QOL") not "soil")
# 3	277	#2 OR #1
# 2	1	TI=("cap and trade" or "cap and invest") or AB=("cap and trade" or "cap and invest")
# 1	277	TI=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*")) or AB=(("greenhouse gas*" or "ghg" or "carbon" or "fuel*" or "energy" or "particulate*" or "decarbon*" or "climate" or "co2" or "ch4" or "methane" or "n2o" or "nitro* oxide*" or "emission*") NEAR/3 ("price*" or "prici*" or "tax" or "taxes" or "taxation" or "trade*" OR "trading" or "credit*" or "fiscal" or "subsid*"))

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