Climate change and carbon neutrality in Academy of Finland funding applications in 2020

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The Academy of Finland grants funding for research on climate change and carbon neutrality

- As the climate crisis advances, there is a need for more diverse and wide-ranging research on climate change and carbon neutrality, whether it is monitoring, mitigating or adapting to change.
- Interdisciplinary research is especially important in research on climate change. The most crucial sustainability challenge of our time requires interdisciplinary collaboration.
- As the field of climate change research expands, we need new tools to monitor the research and developments — both to understand the current situation and to anticipate the future.
- The need to address issues concerning climate change is part of the Academy of Finland's strategy. Research on climate change and carbon neutrality will be funded both in the September call and in the thematic calls of the Academy and the Strategic Research Council, as well as in international joint calls. (See e.g. www.aka.fi/en/climate)

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Background for the analysis

- In 2020, the Academy of Finland was responsible for more than 20 separate calls, with a total of approximately €400m channelled to research.
- Climate change and carbon neutrality are increasingly central as research subjects.
- The aim of the analysis was to examine:
  - Based on funding applications for the Academy, how much research on climate change and carbon neutrality is conducted?
  - Which issues and research questions the studies in the field cover?

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The aim of the analysis

- We studied the amount of research on climate change and carbon neutrality in applications and granted funding at the Academy of Finland.
- The aim was to gain an overall view of climate change research covered in the applications and to identify themes and issues emerging from them.
- We analysed the applications sent to both the September call and the specific thematic calls relevant to the climate change and carbon neutrality theme during 2020 (see the list of calls on page 7).
  - Research subjects are not restricted to a certain theme in the September call.
  - Special calls, including those of the Strategic Research Council (SRC), provide funding specifically targeted by the Government on a pre-defined theme, such as research on climate change.

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Identifying applications concerning climate change and carbon neutrality

- We identified the applications submitted to the Academy concerning climate change and carbon neutrality using automated methods.
- We compiled a **110-term search term list** (Appendix 1) covering climate change and carbon neutrality topics that we used to identify the relevant applications. Only applications with a sufficient number of search hits were selected for the analysis.
- A typical application relevant to the theme included a large number of search terms: on average, ten different search terms and 67 hits in total. The minimum number of hits in an application concerning climate change was two search terms and 14 hits in total.
- Using automated methods enabled us to analyse a wide dataset with thousands of applications.
- The method is limited with regard to defining the content and extent of the word list.

Search term list

- The list was created by experts, who utilised existing terminologies on the theme.
- The aim was to make the list comprehensive but also unambiguous.
- We included only words that refer to climate change and its study as specifically as possible.
- Climate change and carbon neutrality cover a wide and constantly changing field, which is why some terms, especially those that are currently trending, are underrepresented.

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Findings

- Up to one-fifth (20%) of the applications analysed related to climate change and carbon neutrality research.
- In addition to special calls with a climate change theme, also the September 2020 call had a large number of applications concerning climate change and carbon neutrality.
- The applications ranged from microbiology to communication sciences.
- Especially geosciences and environmental science emerged as individual fields in the analysis.
- Research topics that came up most often included the progress of climate change, its effects and the means to combat it.
- The Academy of Finland and the Strategic Research Council (SRC) funded research directly or indirectly linked to climate change and carbon neutrality for a total amount of approximately **€68m** in 2020.
- The results are presented in futher detail on pages 7–17.

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The number of applications concerning climate change in the analysed calls

Call	All applications (number)	Applications concerning climate change (number)	Applications concerning climate change (%)
All calls included in the analysis	**3,148**	**620**	**20%**
September call total	**2,887**	**498**	**17%**
Research Council for Biosciences, Health and the Environment*	901*	139	15%
Research Council for Culture and Society*	889*	79	9%
Research Council for Natural Sciences and Engineering*	1,097*	280	26%
Other calls total Includes the following calls:** BiodivERsA call on "Biodiversity and climate change“ Antarctic research 2020 Special funding for system-level research into climate change mitigation and adaptation* JPI Climate SOLSTICE Special funding for research into crisis preparedness and security of supply SRC: Strategic research programme: Environmental and Social Links to Biodiversity Loss (BIOD), call for letters of intent SRC: Climate change and humans (CLIMATE), follow-up call SRC: Pandemics as a Challenge for Society (PANDEMICS), call for letters of intent SRC: Information literacy and evidence-informed decision-making (LITERACY), follow-up call SRC: Demographic Changes – Causes, Consequences and Solutions (DEMOGRAPHY), call for letters of intent	**261**	**122**	**47%**

* The call included applications that could not be automatically processed due to file format problems. There were 12 of these applications in total and they have been removed from the analysis.
** For data protection reasons, the number of applications for special calls is not indicated per call. The highest percentage of applications concerning climate change is found in calls directly linked to the climate change theme, while lower percentage in other special calls analysed.
NB. Consortium applications, such as all SRC applications in the analysis have been calculated by consortium, not by subproject. For SRC calls, the number of consortium applications sent to the call for letters of intent or the number of consortia selected was analysed for the calls that were open during the period covered by the analysis in 2020. Only applications sent to the Academy of Finland have been included in the analysis of applications for international joint calls.

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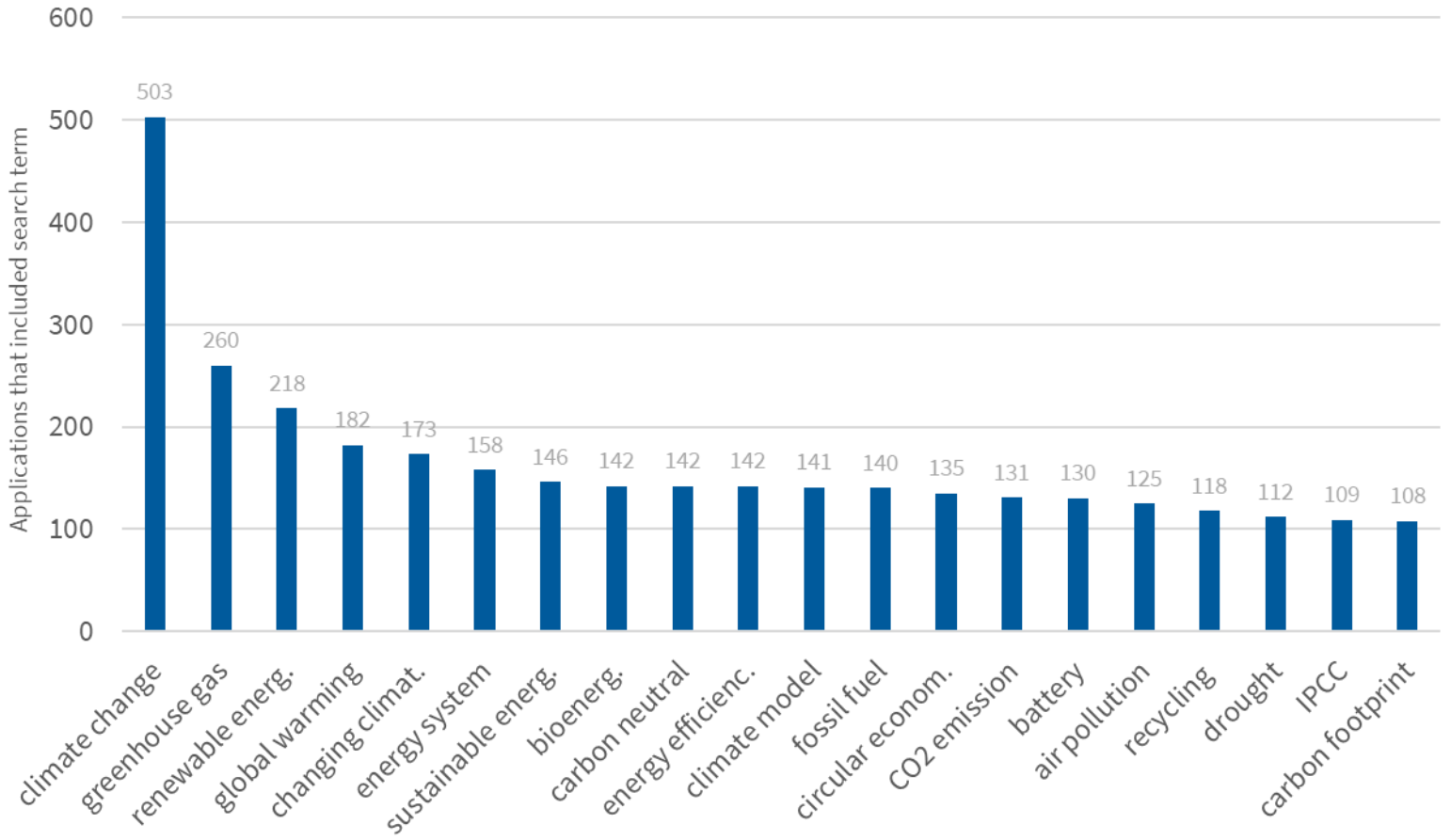
The search terms that were most frequent in the analysis



- The most common search term* for applications concerning climate change is *climate change*. This term was found in 503 applications.
- The most frequent search terms illustrate the wide spectrum of research on climate change. For example, the terms *energy efficiency* and *battery* were related to developing energy efficient technology, while the terms *circular economy* and *recycling* could be related to both climate firendly solutions and studies on human behaviour.

*All search terms used in the analysis can be found in Appendix 1.

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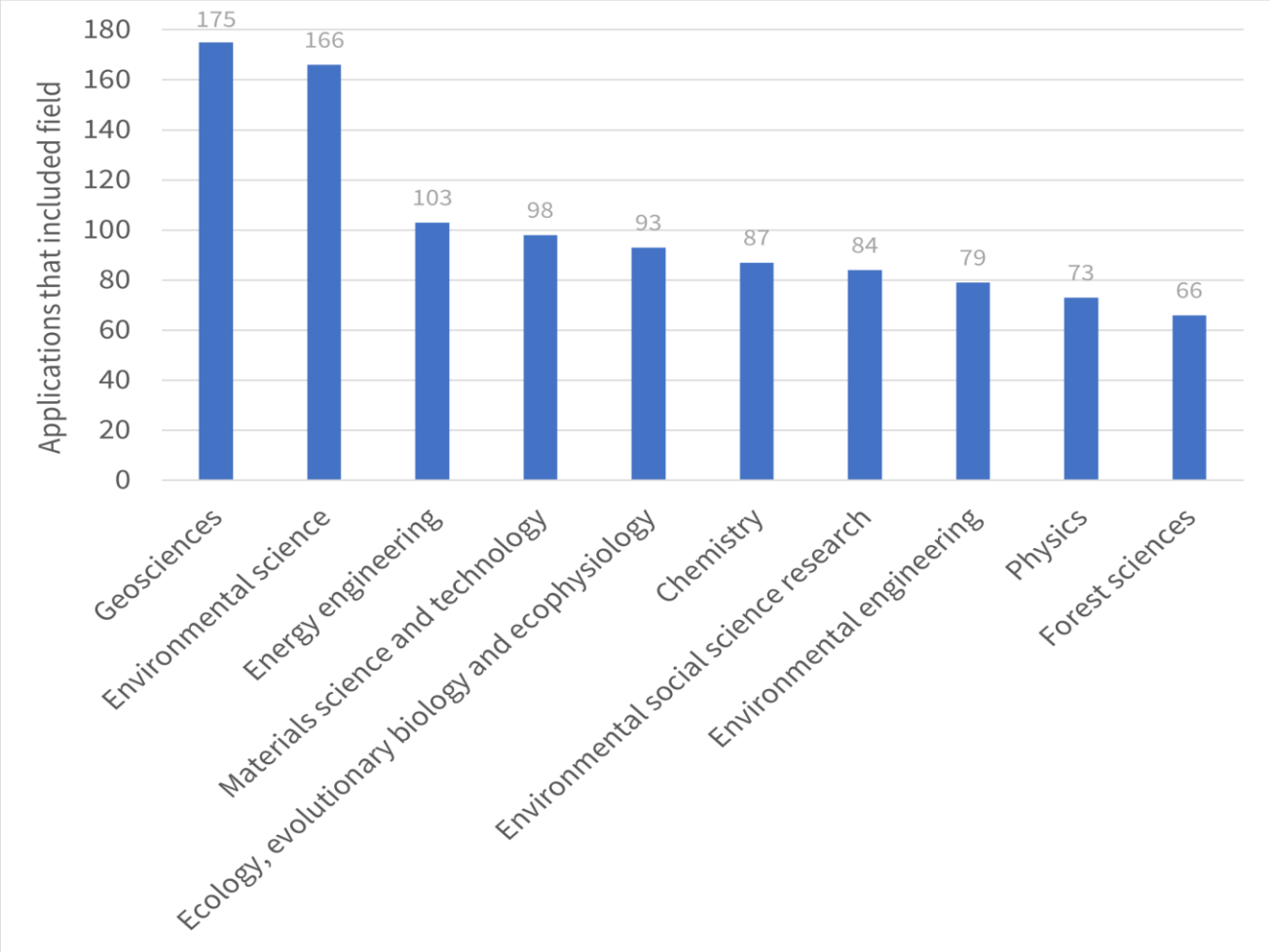
Most common research fields in applications concerning climate change



- The most common research fields in the analysed applications concerning climate change and carbon neutrality were geosciences and environmental science.
- The spectrum of research fields is wide, ranging from physics to environmental social science to geosciences.
- The applications were also interdisciplinary: the applications included 3.4 research fields on average.

The research fields are based on the Academy of Finland research field classification. The applicant can choose 1–5 research fields in the application. The research fields in the chart have been included into wider categories of fields. NB. For some thematic calls that require multidisciplinarity, such as the SRC programme call, a consortium can apply only if they enter a certain number of research fields.

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Themes emerging from the applications

- We wanted to investigate which themes the applications concerning climate change and carbon neutrality represent.
- To this end, applications were automatically divided into thematic clusters*.
  - A network of applications was automatically created based on how their research fields were linked, in which the applications with the closest research fields form a cluster.
- We identified a total of **six clusters*** that will be presented on pages 11–17.
  - The clusters will provide a thematic cross section on climate change and carbon neutrality research in our application data.
  - Research themes could also be clustered differently. The results of our analysis illustrate one aspect of a complex phenomenon, which stems from the methods we use.

*The clusters were divided based on the research fields indicated in the application by the applicant. They were named according to their dominant research fields or main research topics. The research fields are based on the Academy of Finland research field classification. The applicant can choose 1–5 research fields in the application. NB. For some thematic calls that require multidisciplinarity, such as the SRC programme call, a consortium can apply only if they enter a certain number of research fields.

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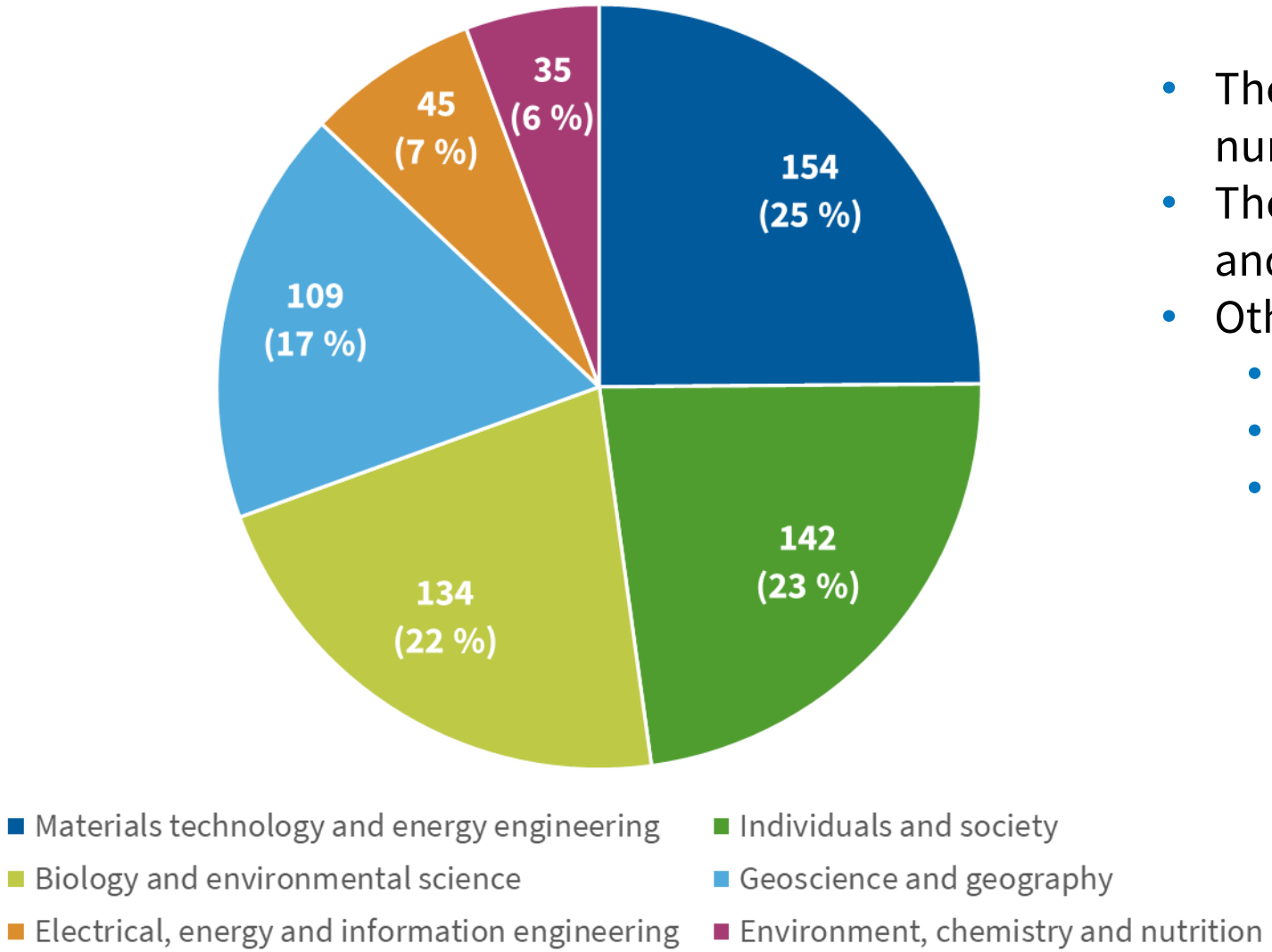
Thematic clusters of research on climate change and carbon neutrality



- The sectors in the pie chart indicate the number of applications in each cluster.
- The largest cluster is materials technology and energy engineering.
- Other large clusters include
  - individuals and society,
  - biology and environmental science, and
  - geosciences and geography.

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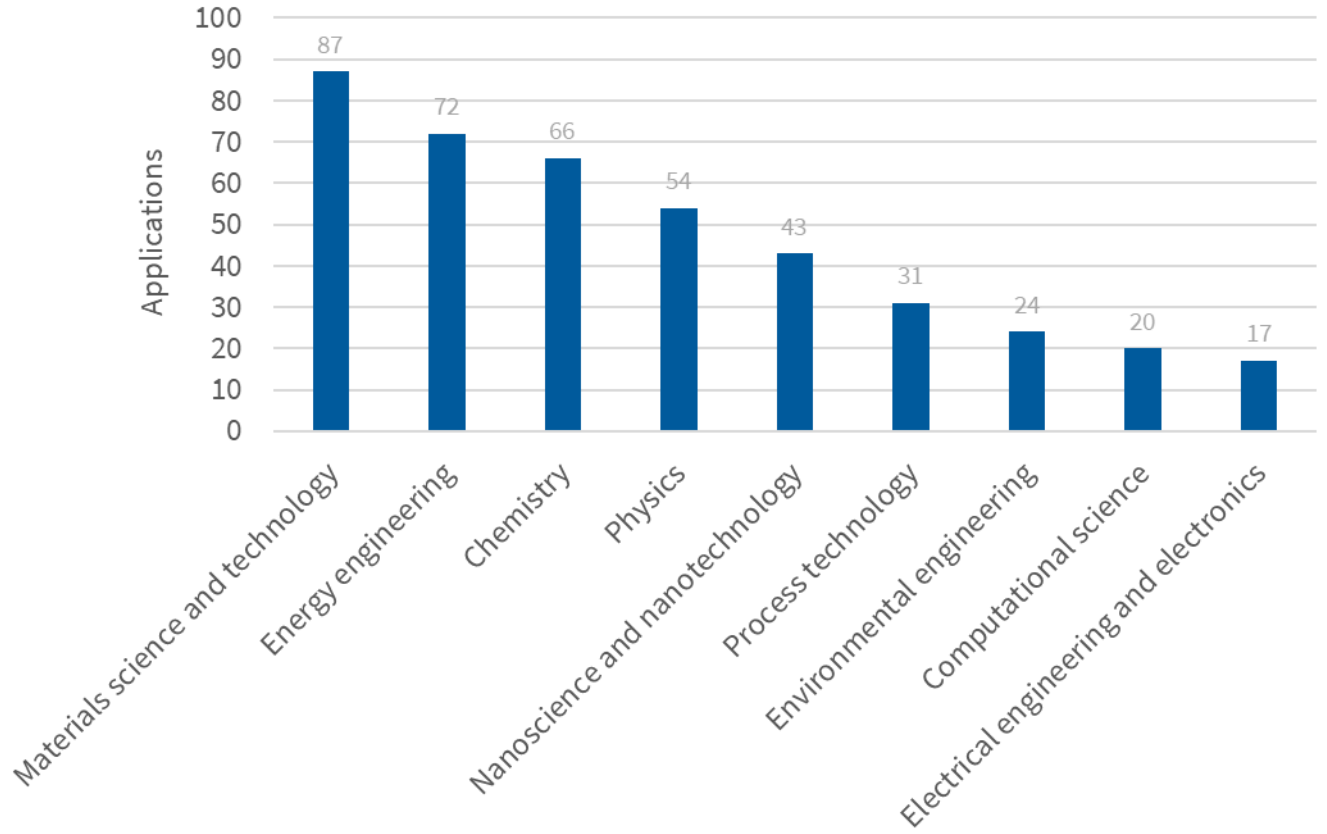
Cluster 1: Materials technology and energy engineering

- 154 applications in total
- Emerging search terms
  - Renewable energy
  - Solar energy, photovolt., solar cell
  - Sustainable energy, clean energy
  - Energy storage
  - Fossil fuel
  - CO2 emission
  - Carbon capture

Most common research fields in applications*



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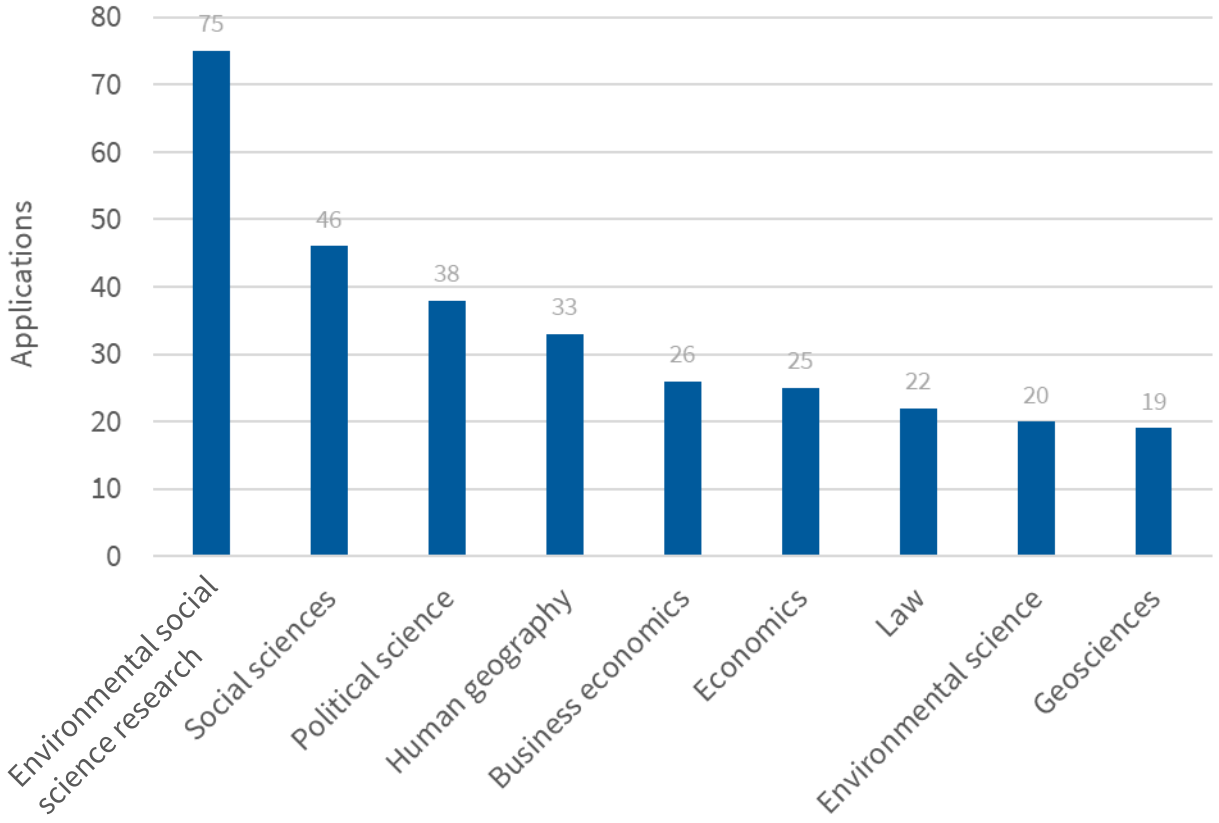
Cluster 2: Individuals and society

- 142 applications in total
- Emerging search terms
  - Circular economy
  - Carbon neutral
  - Climate polic.
  - Sustainable energy
  - Carbon footprint
  - Sustainable consumption
  - Sustainable cit., sustainable urban
  - Climate mitigation

Most common research fields in applications*



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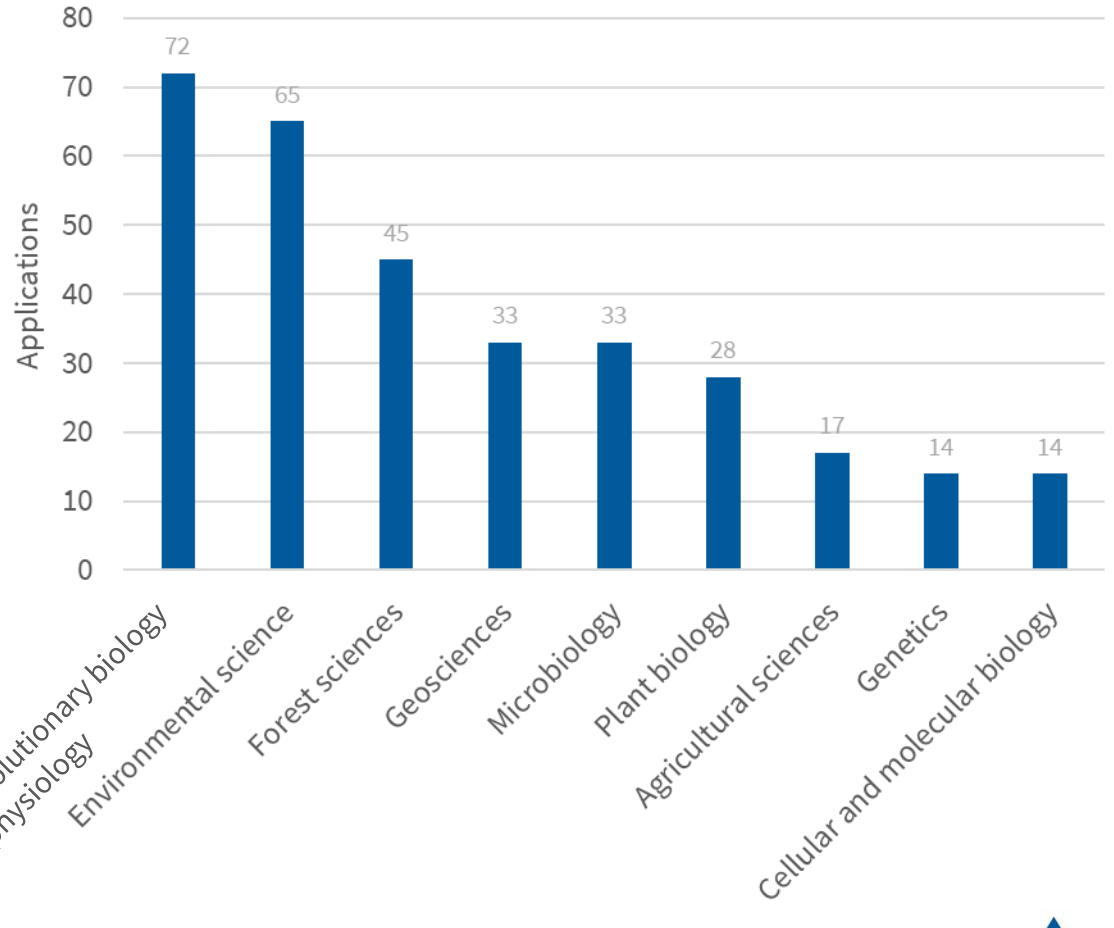
Cluster 3: Biology and environmental science

- 134 applications in total
- Emerging search terms
  - Drought
  - Carbon sink, carbon storage
  - Permafrost
  - Climate model
  - Methane emission
  - Sustainable agriculture

Most common research fields in applications*



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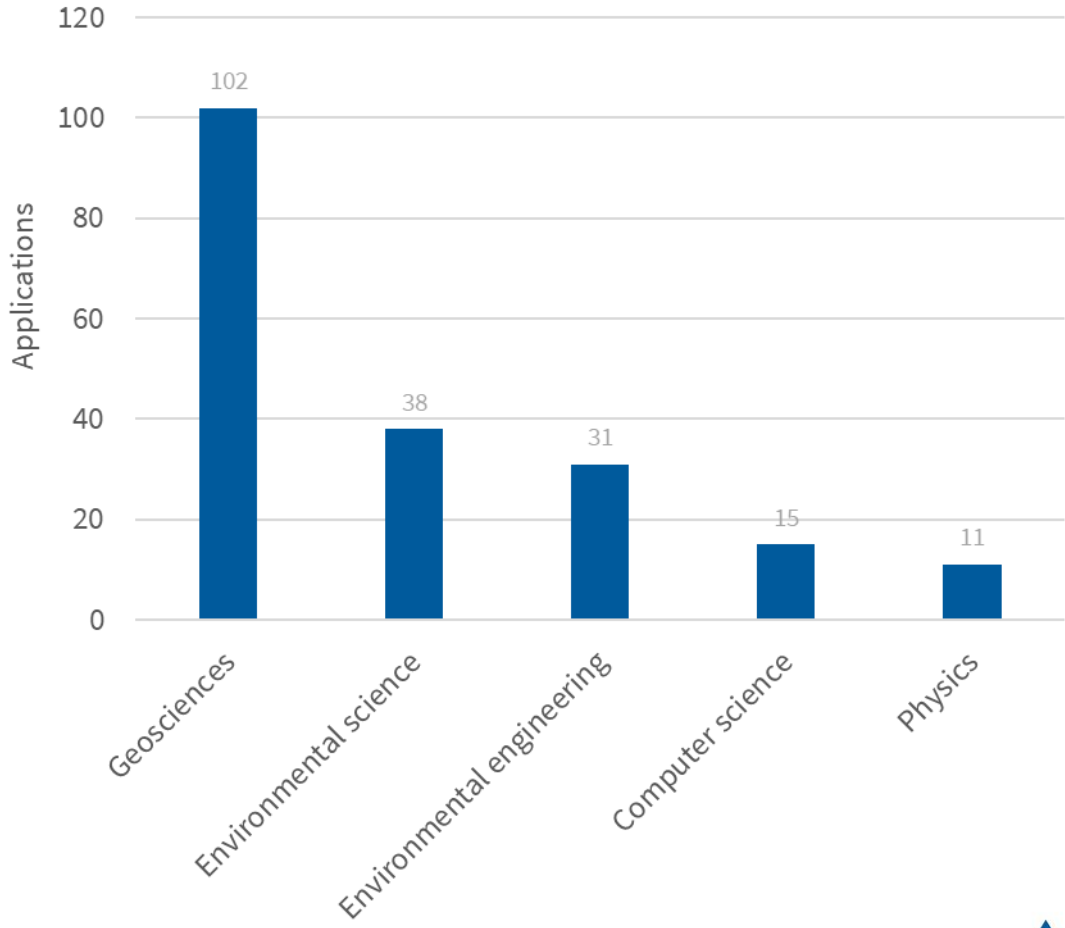
Cluster 4: Geosciences and geography

- 109 applications in total
- Emerging search terms
  - Climate model
  - Air pollution
  - IPCC
  - Black carbon
  - Permafrost
  - Anthropogenic emission
  - Volatile organic compound
  - Secondary organic aerosol

Most common research fields in applications*



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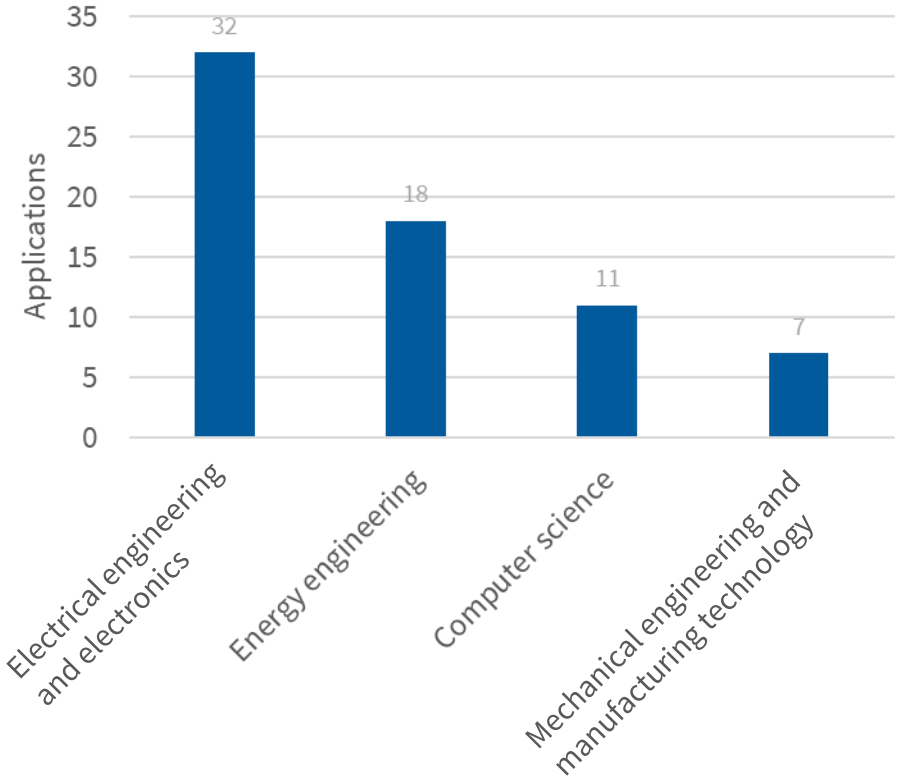
Cluster 5: Electrical, energy and information engineering

- 45 applications in total
- Emerging search terms
  - Energy system
  - Renewable energy
  - Energy efficiency
  - Battery, batteries
  - Smart grid
  - Sustainable energy
  - Energy storage
  - Photovolt.
  - Electrification
  - Wind energy

Most common research fields in applications*



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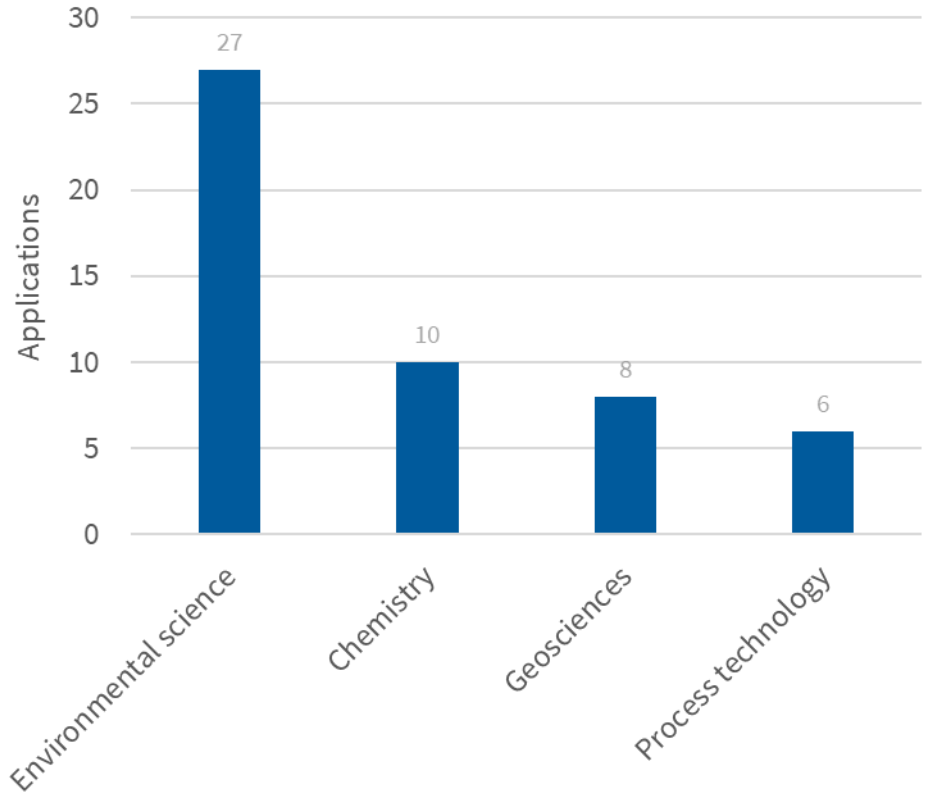
Cluster 6: Environment, chemistry and nutrition

- 35 applications in total
- Emerging search terms
  - Bioenergy
  - Air pollution
  - Carbon sequestration
  - Carbon footprint
  - Recycling
  - Biofuel
  - Volatile organic compound
  - Climate variability

Most common research fields in applications*



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Summary

- Climate change and carbon neutrality is widely researched in different fields, also as interdisciplinary collaboration.
- While the early stages of climate change research focused more on climate change as a phenomenon, now in the 2020s the theme covers a wide range of research fields, ranging from environmental sciences to technology to social and human sciences.
- The applications analysed proposed issues such as greener battery technologies, health impacts of air pollution, food waste reduction, climate change observation technology, and decision-making to be researched.
- The aim of the analysis was also to develop automated analysis methods for the examination of applications. As the research questions change, we need new methods to analyse data.
- Mapping the range of research topics and monitoring changes in it will not only improve understanding of ongoing climate change research, but also provide tools for preparing for the future.
- More information on the analysis: tietoaineistot@aka.fi.

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Appendix 1. List of search terms used in the analysis.

1. air pollution
2. anthropogenic emission
3. atmospheric methane
4. batteries
5. battery
6. biobased solution
7. bio-based solution
8. bioenerg.
9. biofuel
10. bio-fuel
11. black carbon
12. carbon capture
13. carbon footprint
14. carbon free
15. carbon neutral
16. carbon offset
17. carbon sequestration
18. carbon sink
19. carbon storage
20. carbon-free
21. changing climat.
22. circular econom.
23. clean energ.
24. climate adaptati.
25. climate change
26. climate compensation
27. climate denial.
28. climate mitigation
29. climate model
30. climate polic.
31. climate scepti.
32. climate variability
33. climate change
34. CO2 emission
35. CO2 mineralisation
36. CO2 neutral
37. coastal energ.
38. combustion emission
39. decarbonisation
40. decarbonization
41. drought
42. electric transport
43. electrification
44. energy efficienc.
45. energy storag.
46. energy system
47. fair transition
48. fossil fuel
49. fusion energ.
50. GHG
51. global warming
52. greenhouse effect
53. greenhouse gas
54. hydrogen econom.
55. hydrogen fuel
56. IPCC
57. low carbon
58. low-carbon
59. material consumption
60. material footprint
61. methane emission
62. methane fluxes
63. negative emission
64. nitrogen emission
65. nutrient recycling
66. ocean acidification
67. offset energ.
68. overextraction of natural resource
69. overextraction of resource
70. Paris Agreement
71. particle emission
72. photovolt.
73. recycling
74. reduce waste
75. reducing emission
76. reduce waste
77. reliable energ.
78. renewable energ.
79. resilient infrastructure
80. responsible consumption
81. responsible product
82. secondary organic aerosol
83. smart built environment
84. smart grid
85. solar cell
86. solar energ.
87. solar panel
88. sustainable agricultur.
89. sustainable cit.
90. sustainable communit.
91. sustainable consumption
92. sustainable energ.
93. sustainable industr.
94. sustainable manufactur.
95. sustainable product
96. sustainable settlement
97. sustainable textile
98. sustainable traffic
99. sustainable transport
100. sustainable urban
101. thawing permafrost
102. permafrost
103. urban sustainabilit.
104. warming climat.
105. waste reduction
106. water security
107. wave energ.
108. wind energ.
109. volatile organic compound
110. zero emission

In some search terms, letters have been omitted at the end in order to cover all inflections of the word.

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