Climate Movers Database

- Methodology note

This paper briefly outlines the methodology used to identify leading European researchers within the 12 technology areas included in the Climate Movers Database (see appendix for a short description of the technology areas).

Which institutions are included in the database?

The database is based on a mapping of researchers at fifty European research institutions. The mapping includes 40 universities and 10 research and technology organizations (RTO). The map below provides an overview of the fifty institutions included in the mapping.

Figure 1. European research institutions included in the mapping

Universities included in the mapping were selected partly based on their rankings in two official university rankings[1] and partly based on their publication activities within fields of research relevant to combating the

[1] QS Ranking for Engineering and Technology & Times Higher Education

challenges of climate change. Universities performing well on both university rankings as well as having a high publication activity are included in the mapping.

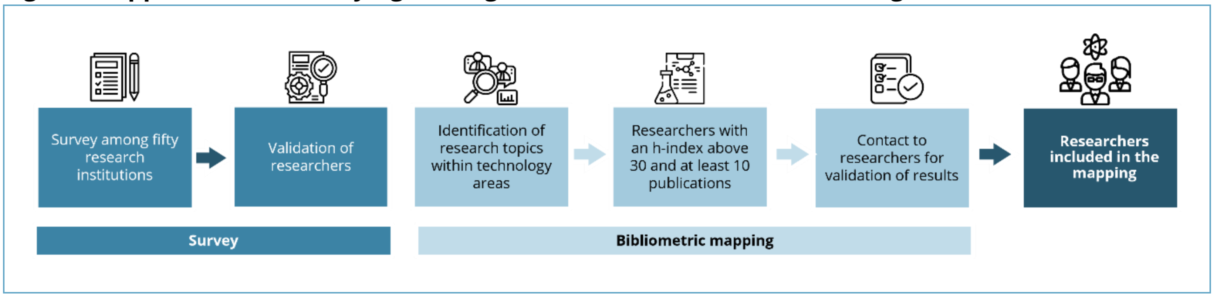
Selection of RTOs for the mapping is also based on publication activity and, additionally, the total number of ERC grants[2] within the field of engineering and technology.

As a final step, the list of institutions was reviewed by experts at The Technical University of Denmark to assess if any leading university or RTO was missing from the list. Based on the review, a few specialized universities within agricultural sciences were added to the database.

How are leading researchers identified?

To identify leading researchers at the fifty European research institutions, we sent out a survey to the institutions and carried out a bibliometric analysis. The approach is illustrated in the figure below. In the following sections, we describe the approach in more detail.

Figure 2. Approach for identifying leading researchers on climate technologies



Survey among research institutions

Initially, we distributed a survey to 50 research institutions, asking them to contribute to the mapping by identifying top researchers within 12 predefined climate technology areas. The survey was distributed to leading employees at the institutions, such as provosts, presidents for research, vice chancellors, etc.

More than 500 potentially relevant researchers were reported. Out of these, we focused on professors who had published at least 10 articles over the last 5 years.

As a final step, experts at The Technical University of Denmark conducted a quality assessment of the proposed researchers to ensure that the researchers are considered leading within their field.

Bibliometric analysis

To identify leading climate technology researchers at institutions that did not answer the survey, a bibliometric analysis was carried out. First, bibliometric research topics were identified based on publications by the researchers reported in the survey. Based on that, a list of research topic clusters[3] was created for each of the 12 technology areas.

Each technology area is constructed around a unique combination of research topics. Using the combination of research topics, we identified researchers at the remaining institutions within each of the 12 technology areas based on their publication activity.

[2] The European Research Council (ERC) provides grants for international, pioneering, and excellent research projects.

[3] A research topic cluster is a grouping of research topics that share a similar research interest. For example, secondary batteries, electric batteries, and lithium alloys constitute a topic cluster, which is used to identify researchers within the technology area "Long duration energy storage".

To ensure that only leading researchers were included in the mapping, the following criteria were applied:

- The researcher must have an h-index of at least 30.
- The researcher must have published at least 10 scientific articles within the technology area (unique combination of research topics) over the last five years.

In total, the bibliometric mapping identified more than 900 potentially leading researchers within climate technologies.

To validate the results from the bibliometric mapping, we reached out to the identified researchers, informing them of the analysis and the results. We asked the researchers to confirm the technology area(s) they have been identified with and requested permission to publish their names in the database. Only researchers who have validated the results from the bibliometric analysis have been included in the database.

Appendix: Technology areas

Table 1. Technology areas included in the Climate Movers Database

	Agricultural innovations encompass various technologies, practices, and approaches aimed at improving efficiency, sustainability, and productivity in farming. These innovations can include precision agriculture, crop and soil monitoring technologies, drought and flood resistant food crops, low-carbon palm oil alternatives, and in-situ (in-field) nitrogen fixing approaches. By adopting agricultural innovations, farmers can optimize resource utilization, minimize environmental impact, and increase crop yields.
	Alternative proteins are food products derived from sources other than traditional animal agriculture, such as plant-based proteins (e.g., soy, peas) and cultivated meat (grown from animal cells in a lab). These proteins offer an alternative to conventional meat and have gained popularity due to their potential environmental benefits, reduced reliance on livestock, and potential to address food security and ethical concerns.
	Carbon Capture Storage & Utilization (CCSU) encompasses technologies and strategies for capturing carbon dioxide (CO_2) emissions from various sources, storing it safely underground, and utilizing it for beneficial purposes. CCSU can help mitigate greenhouse gas emissions by preventing CO_2 from being released into the atmosphere. Utilization of captured CO_2 includes applications such as enhanced oil recovery, carbon mineralization, and the production of synthetic fuels or chemicals.
	E-fuels for heavy transport are synthetic fuels produced from renewable sources that aim to replace traditional fossil fuels in trucks, ships, and airplanes, reducing greenhouse gas emissions and promoting sustainability in the transportation sector.
	Geothermal energy is a renewable energy source derived from the heat of the Earth's interior. It involves harnessing the natural heat stored in the Earth's crust to generate electricity or provide direct heating and cooling for buildings. Geothermal energy offers a reliable and sustainable solution that can reduce reliance on fossil fuels and contribute to a cleaner energy mix.
	Long duration energy storage refers to technologies and systems that can store energy for extended periods, typically from several hours to several days or even weeks. These solutions are crucial for balancing intermittent renewable energy sources and ensuring a stable and reliable energy supply. Examples of long duration energy storage include pumped hydro storage, flywheels, molten salt, advanced batteries, and storage of electrical energy as heat in stones.
	Low-carbon steel production focuses on reducing the carbon emissions associated with steel manufacturing, which is traditionally energy-intensive and emits significant amounts of greenhouse gases. This can involve adopting energy-efficient processes, using renewable energy sources, and exploring

	alternative iron production methods like hydrogen-based direct reduction. Low-carbon steel production is crucial for achieving carbon neutrality targets and decarbonizing the industrial sector.
	Low-carbon plastic production refers to manufacturing processes and technologies that aim to minimize the carbon footprint associated with the production of plastic materials. This can include utilizing renewable feedstocks in pyrolysis processes, conversion of CO_2 and other greenhouse gases into plastics, and improving energy efficiency. Low-carbon plastic production is essential for reducing the environmental impact of plastic manufacturing and addressing the challenges of plastic waste and pollution.
	Next-gen nuclear fission refers to advancements in nuclear fission technology that focus on improving safety, efficiency, and waste management compared to conventional nuclear reactors. These innovations involve new reactor designs, advanced fuel materials, and enhanced control systems, aiming to make nuclear energy cleaner, safer, and more sustainable.
	Nuclear fusion is a process that releases energy by combining atomic nuclei, resulting in a highly efficient and virtually limitless source of clean energy. It involves the fusion of light atomic nuclei, such as hydrogen isotopes, under extreme temperature and pressure conditions. Successful implementation of nuclear fusion has the potential to revolutionize global energy production by providing abundant, carbon-free power.
	Producing green hydrogen from renewable energy sources, such as wind or solar power, to generate hydrogen through electrolysis. This process splits water into hydrogen and oxygen, resulting in a clean and sustainable fuel source. Green hydrogen has the potential to play a significant role in decarbonizing various sectors, including transportation and industry.
	The reduction of fossil fuel use to heat ovens in various industries involves transitioning from traditional fossil fuel-based heating systems to cleaner and more sustainable alternatives. This transformation may include a shift to electric heating systems powered by renewable electricity, or mixing CO_2 into cement production. By reducing reliance on fossil fuels for industrial heating, emissions can be decreased, contributing to climate change mitigation.