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A Brief Bibliometric Analysis of GHGT Abstract Submissions

International Energy Agency

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This report provides an insight into how the focus of research in the field of Carbon Capture, Utilisation and Storage (CCUS) has evolved across a decade, from 2012–2022.

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A BRIEF BIBLIOMETRIC ANALYSIS OF GHGT ABSTRACT SUBMISSIONS

Executive Summary

This technical review provides an insight into how the focus of research in the field of Carbon Capture, Utilisation and Storage (CCUS) has evolved across a decade, from 2012–2022. It is designed to help understand where the most research has been conducted, and to see where CCUS research is going.

This document achieves this through analysis of abstracts submitted to the Greenhouse Gas Control Technologies (GHGT) conference series as a quantitative analogue for the focus of research within the year it was submitted. GHGT is the largest international conference for CCUS, following the merging of earlier conference series in 1997: the International Conference on Carbon Dioxide Removal (ICCDR), and Greenhouse Gas: Mitigation options.

This review finds that there has been a definite shift in research focus across the decade. The greatest percentage increase of abstracts submitted belong to the following topics: “Legal & Regulatory Aspects of CCS & long-term liability of CO₂ storage” (+287.5%), “Towards negative CO₂ emissions” (+252.9%), and finally to “CCS for industrial sources (non-power) & Hydrogen” (+240.9%).

The greatest percentage decrease of abstracts submitted belong to the following topics: “CCS technology assessment, cost, and system integration” (-72.0%), “CO₂ utilisation for GHG mitigation” (-62.3%), and finally to “Demonstration projects and major national and international demonstrations” (-47.4%).

The conclusion of this review discusses the results to help understand the evolution of CCUS research along its observed trajectory in the last decade.



Contents

Executive Summary	1
Contents	2
1 Introduction	3
2 Background	3
3 Detail of Study	4
4 Discussion	7
5 Bibliography	8



1 Introduction

The Greenhouse Gas Control Technologies (GHGT) conference series was formed in 1997 following the merger of the International Conference on Carbon Dioxide Removal (ICCDR) and the Greenhouse Gas: Mitigation Options conferences. The GHGT conference series is the principal international conference on greenhouse gas mitigation technologies, focusing on carbon capture, utilisation, and storage (CCUS). This conference is held every two years in IEAGHG's member countries. The conference series rotates between North America, Europe, and Asia. Each conference is a forum for technical discussions related to the field of greenhouse gas control technology.

The aim of this informational paper is to assess how the focus of this biennial conference has shifted within the field of CCUS through the last decade. Specifically, from GHGT-11 in late 2012, to the upcoming GHGT-16 which took place in late 2022, to identify and quantify any notable changes in the dominant themes of the conferences.

2 Background

To limit global warming to well below 2°C, preferably 1.5°C, compared to pre-industrial levels, as called for in the Paris Agreement, and to reach net zero by 2050, is virtually impossible without rapid development and deployment of CCUS. As researchers and scientific bodies aim to push the frontier of CCUS, they are encouraged to submit abstracts of relevant research to IEAGHG, the guardian of the GHGT conference series. The abstracts are then reviewed by a pool of around 150 expert reviewers. Typically, around a thousand abstracts are submitted to a single GHGT conference. The abstracts are submitted to one of twelve specified themes within CCUS:

1. Advances in Capture technology development
2. Advances in CO₂ geological storage
3. Developments in other storage options for CO₂
4. CCS for industrial sources (non-power) & hydrogen
5. Transport and infrastructure development
6. Towards negative CO₂ emissions
7. CO₂ utilisation for GHG mitigation
8. Demonstration projects and major national and international CCS research
9. CCS technology assessment, cost, and system integration
10. Public perception and acceptance of CCS and communication on CCS
11. Energy, climate change policies and CCS
12. Legal & Regulatory Aspects of CCS & long-term liability of CO₂ storage

GHGT-11 had fourteen themes which abstracts could be submitted to, these additional themes were "Commercial issues" and "Energy, training, and capacity building", GHGT-12 also contained the latter of these two. Later, these themes were merged into "CCS technology assessment, cost, and system integration" and "Public perception and acceptance of CCS and communication on CCS" respectively. To keep this analysis consistent the extra themes in GHGT-11 and GHGT-12 have been merged accordingly, conforming them to the subsequent GHGT format.

Each of these themes has subthemes, allowing for any relevant progress in CCUS to be featured at GHGT. IEAGHG has no influence over the numbers of abstracts submitted under each theme and



subtheme, therefore, the ratios between each theme and the total number of submitted abstracts may be seen as representative of the current focal points of CCUS research, development, demonstration and deployment. We can therefore use abstract themes to identify trends across the last decade of research.

Though GHGT is a biennial conference, GHGT-15 was postponed from 2020 to 2021 because of the COVID-19 pandemic. The result of this is GHGT-16 taking place only one year after GHGT-15. However, this does not skew the results, as the submission process remained as if GHGT-15 were held in 2020, the research was simply presented a year later.

The analysis presented in this report covers only the last decade of GHGT conferences and the position of CCUS within that timeframe.

3 *Detail of Study*

In total, 5781 abstracts were submitted across the six conferences, with an average of 963 abstracts per conference. Figure 1 shows the numbers of abstracts submitted at each conference. The highest number of abstracts submitted to a conference was 1220 at GHGT-11 (2012), and the lowest number of abstracts submitted to a conference was 759 at GHGT-15 (2021).

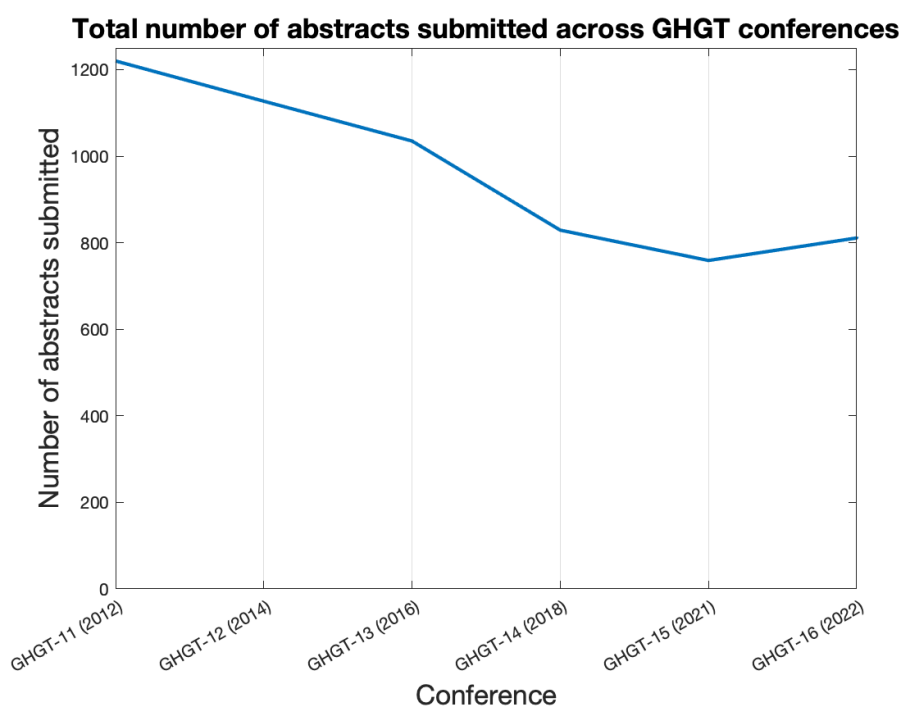


Figure 1: Number of abstracts submitted to each GHGT conference from GHGT-11 (2012) to GHGT-16 (2022).

When analysing the number of abstracts relating to each theme submitted to each conference, it is important to consider that the total number of submitted abstracts varies at each conference. For this



reason, we consider each theme as a percentage of the total abstracts to that conference. Figure 2 shows the percentage of abstracts relating to each theme.

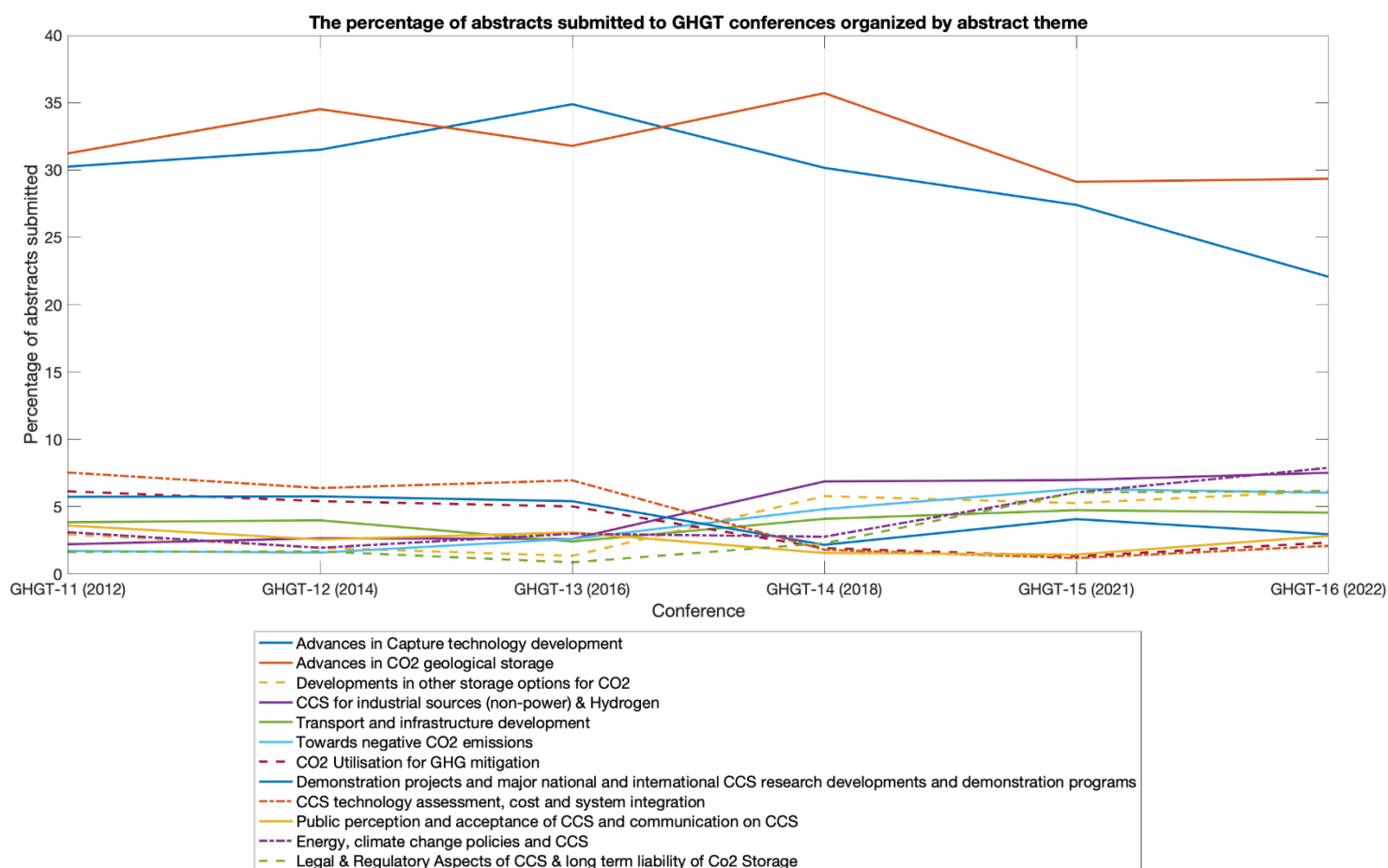


Figure 2: A graph showing the abstracts submitted to GHGT conferences as a percentage of the total number of abstracts submitted that year, from GHGT-11 (2012) through to GHGT-16 (2022).

The CCUS themes with the most abstracts submitted are “Advances in capture technology development” and “Advances in CO₂ geological storage”; these accounted for over half of the total submissions at each conference. The proportion of “Advances in CO₂ geological storage” abstracts has remained at relatively constant, between 29–36%. However, the proportion of “Advances in capture technology development” abstracts has been steadily decreasing since GHGT-13. At GHGT-13 it reached its all-time peak share of submissions of 34%, but since has seen a relative decline in share of submissions to its now lowest point of 22% at GHGT-16 (37% decrease).

Most themes have a relatively steady trajectory across the decade. The exception for this is between GHGT-13 (2016) and GHGT-14 (2018), where there was an apparent shift in the CCUS research community. In addition to the decrease in “Advances in capture technology development” abstracts, there was also a decrease in the following themes:

- CCS technology assessment, cost, and system integration;
- Demonstration projects and major national and international CCS research; and



- CO₂ Utilisation for GHG mitigation.

These three themes also saw a large percentage decrease of greater than 61% after GHGT-13.

Conversely, the themes:

- Transport and infrastructure development;
- Energy, climate change policies and CCS;
- CCS for industrial source (non-power) & hydrogen;
- Towards negative CO₂ emissions;
- Developments in other storage options for CO₂; and
- Legal & Regulatory Aspects of CCS & long-term liability of CO₂ storage

were less prominent during GHGT-13, collectively representing 12.8% percent of the total abstracts submitted to that conference. However, since GHGT-13 all six of these themes have seen a sustained increase in the relative number of submissions through to GHGT-16, where they now collectively represent 38.4%, a collective 200% increase. The increase in the relative share of submissions of these themes helps quantify the shift of research focus in the field of CCUS in the last decade.

The largest percentage increase of a single theme from the beginning of the decade was in abstracts regarding “Legal & Regulatory Aspects of CCS & long-term liability of CO₂ storage, increasing in popularity by 288% from GHGT-11 (2012) to GHGT-16 (2022). This was closely followed by “Towards negative CO₂ emissions” and “CCS for industrial source (non-power) & hydrogen”, which increased by 253% and 241%, respectively, in the last decade. Table 1 shows the percentage of abstracts by theme featured at GHGT conferences in both 2012 and 2022, and the percentage difference across that decade.

Table 1: A table showing the percentage difference of themes across the decade, from 2012 (GHGT-11) to 2022 (GHGT-16).

Theme	% of abstracts in 2012	% of abstracts in 2022	% difference
Advances in Capture technology development	30.2	22.1	-26.8
Advances in CO ₂ geological storage	31.2	29.3	-6.1
Developments in other storage options for CO ₂	3.0	6.2	106.7
CCS for industrial sources (non-power) & hydrogen	2.2	7.5	240.9
Transport and infrastructure development	3.9	4.6	17.9
Towards negative CO ₂ emissions	1.7	6.0	252.9
CO ₂ utilisation for GHG mitigation	6.1	2.3	-62.3



Demonstration projects and major national and international demonstrations	5.7	3.0	-47.4
CCS technology assessment, cost, and system integration	7.5	2.1	-72.0
Public perception and acceptance of CCS and communication on CCS	3.6	2.8	-22.2
Energy, climate change policies and CCS	3.1	7.9	154.8
Legal & Regulatory Aspects of CCS & long-term liability of CO ₂ storage	1.6	6.2	287.5

4 Discussion

The reason why the themes of the abstracts submitted to GHGT conferences have followed the trajectories they have is complex and multi-factorial, including the influence of increasing technology maturity and commercialisation.

The idea of capturing CO₂ and preventing it from reaching the atmosphere was first suggested in 1977 (IEAGHG, 2013). Since the 1970s, the world has opened its eyes to the global climate crisis and in 2015 the Paris Agreement was adopted by 196 parties at COP21 in Paris, with the aim of reducing the effects of global warming. The signing of this treaty bolstered CCUS projects, accelerating research and development within this field.

In additions to the reduction of GHG emissions and the capture of carbon from large emission point sources, the direct capture of CO₂ from the atmosphere may become a necessary measure to combat climate change. These technologies are known as negative emissions technologies (NETs), as they aim to accomplish a negative flux of carbon in the atmosphere. The growing realisation of the necessity for these technologies (e.g. from IPCC SR1.5 (2018) and IPCC AR6 (2022)) explains the increase in percentage share of abstracts across the decade, as the theme “Towards negative CO₂ emissions” was the second largest increaser of +252.9%.

Technology readiness level (TRL) is a qualitative scale, which defines the maturity of technologies within an increasing scale of commercial deployment. The TRL scale ranges from one to nine, where: one to three represents the research phase, four to six represents the developmental phase, and seven to nine represents demonstration. The lower end of the TRL scale is concerned with the possibility that a technology might work, whereas the upper end of the TRL scale is more focussed on commercial viability. CCUS technologies span the full range of TRL, from virgin technologies in fundamental research and developmental stages, through to mature systems which are operating commercially (Kearns, et al., 2021).

As CCUS projects progress past TRL six or seven, the necessary funding required to keep progressing increases exponentially, and intellectual property aspects increase towards commercialisation. Figure



2 shows clearly a decline in abstracts submitted regarding the theme “Advances in Capture technology development”, this perhaps is in response to projects regarding this theme entering high TRLs.

The post GHGT-13 (2016) fluctuations may be as the result of the signing of the Paris Agreement, as more CCUS projects are initiated along their development track and more innovative and commercial research is being conducted. GHGT-13 (2016) took place only one year after COP21, so research catalysed by the Paris Agreement would likely not yet have been ready to be presented, instead being presented from GHGT-14 (2018) onwards. The increase in Legal and Regulatory abstracts may reflect an increasing need to give attention to these deployment issues that are also not commercially-sensitive.

This brief report is intended to make available the bibliometric data from ten years of GHGT conferences, so it can be used and cited by those undertaking meta-analysis of CCUS research, development, demonstration and deployment.

5 Bibliography

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