Contribution ID: **112** Type: **not specified**

DIRECT AIR CAPTURE DEPLOYMENT –WHERE AND WHY?

Friday, March 27, 2026 5:10 PM (20 minutes)

Introduction and Motivation
Direct Air Capture (DAC) technologies are increasingly discussed as a key component of global net-zero and long-term decarbonization strategies, particularly for offsetting emissions in hard-to-decarbonize sectors (Erans et al., 2022).
Existing research on DAC and engineered carbon dioxide removal is dominated by cost- and energy modelling, life cycle assessments, and system-level analysis (Deutz and Bardow, 2021; International Energy Agency 2023). While these studies offer valuable insights into technical feasibility, they remain weakly connected to empirical evidence on real-world deployment patterns.
Parallel policy-oriented work emphasizes governance challenges, innovation policy, and the role of targeted incentives, and recent tracking efforts document rapid growth and strong geographic concentration (Meckling et al., 2021; Sovacool et al., 2022; Smith et al., 2024).
However, these studies do not explain why DAC projects emerge in specific countries. This study addresses this gap by leveraging newly unique dataset on global DAC activities. The integrated structure enables a comparative globally descriptive analysis between DAC-active countries and others. The study provides first empirical evidence on how country –level conditions differ between DAC host and non-host countries, empirically linking insights from the existing literature to real-world DAC deployment patterns.

Method and Data
The analysis is based on a newly compiled dataset that combines project-level information on DAC activities with country-level economic, environmental, energy-related, and institutional indicators. The data pertaining to the DAC projects cover the period from 2009 to 2024. The dataset includes information on host countries, locations, and project status.
To examine country-level characteristics associated with DAC activity, the project data is merged with a country–year panel dataset. This includes country data such as Gross Domestic Product (GDP) and income classification, CO_2 emissions, energy system characteristics, including fossil and renewable energy shares and energy prices, as well as institutional quality (Rule of Law, and the participation of these countries in the Paris Agreement. The resulting country–year panel covers the period from 2009 to 2024 and includes both DAC-active countries and a global comparison sample constructed using the same data sources and preparation steps. To account for potential scale effects, all analyses are conducted both including and excluding China, due to its economic size and emission levels.
Building on the descriptive findings, the project is designed to move towards a quasi-experimental difference-in-differences (DiD) framework that exploits cross-country and temporal variation in policy and energy-system factors, such as policy incentives, participation in emissions trading schemes, fossil fuel dependence, or energy prices. This approach allows for distinguishing between host-country and origin-country determinants of DAC deployment, consistent with a push–pull perspective, and for investigating whether participation in emissions trading schemes or a high reliance on fossil fuels are key drivers of DAC project deployment.

Results
The descriptive results are ambiguous and do not show clear and systematic differences between DAC-active countries and the wider global sample. DAC-active countries are characterized, on average, by substantially higher CO_2 emissions and higher levels of economic development, as measured by GDP. Additionally, DAC countries demonstrate stronger institutional quality, as reflected in higher Rule of Law indicators, and are more deeply embedded in international climate policy frameworks, with universal participation in the Paris Agreement and widespread adoption of net-zero targets. In terms of energy systems, DAC-active countries

tend to combine relatively high shares of renewable energy with continued reliance on fossil energy sources, indicating diversified yet still carbon-intensive energy structures.

A first inspection of the available project-level information suggests that DAC activity has increased over time and remains concentrated in a limited number of host countries. The dynamics of the energy system are clear: fossil energy shares decline consistently while renewable energy shares increased markedly throughout the sample period. By contrast, average CO2 emissions show no clear downward trend, remaining stable at high levels. This suggests that DAC deployment occurs in countries undergoing energy transitions but still facing significant emission challenges.

To assess robustness, descriptive analyses of country-level outcomes are conducted both including and excluding China. Excluding China substantially lowers average emission levels but does not alter qualitative temporal patterns or the relative differences between DAC-active countries and the global sample. This indicates that China primarily affects the scale of aggregate emission measures, without driving the main descriptive relationships observed at the country level.

Project-level evidence provides valuable insights into the salient features of the nascent DAC sector. The sector is undergoing rapid expansion, with 54.5% of DAC firms founded after 2020, indicating strong recent market entry. At the same time, DAC deployment is highly geographically concentrated: most installations are in the United States (28 sites) and Canada (13 sites). Despite this concentration, the development of DAC is not dominated by incumbent fossil fuel firms. Only 26.8% of DAC companies are associated with the energy, oil, and gas sector, while the majority originate from research, infrastructure, and other non-traditional energy-related fields.

Author: DÜZ, Berivan

Co-authors: STEIGERWALD, Björn (Fachgebiet Wirtschafts- und Infrastrukturpolitik (WIP), TU Berlin); Prof. HOLZ, Franziska (DIW Berlin und NTNU); MENGE, Philipp (Fachgebiet Wirtschafts- und Infrastrukturpolitik (WIP), TU Berlin); Prof. VON HIRSCHHAUSEN, Christian (Fachgebiet Wirtschafts- und Infrastrukturpolitik (WIP), TU Berlin und DIW Berlin)

Presenter: DÜZ, Berivan

Session Classification: Carbon Removal & Transition Pathways