The Power of Research and Partnership

Climate Compatible Growth

UKaid
from the British people

Mapping our Journey

April 2021 — March 2024

Foreword

Welcome to this comprehensive overview of CCG's work over the last four years through which we intend to give you a sense of all the facets of our work and to celebrate our collective achievements so far. CCG does not work in isolation but in partnership; with countries, governments, communities, universities and other organisations committed to achieving the transition to clean energy and the creation of sustainable economic growth for countries in the Global South.

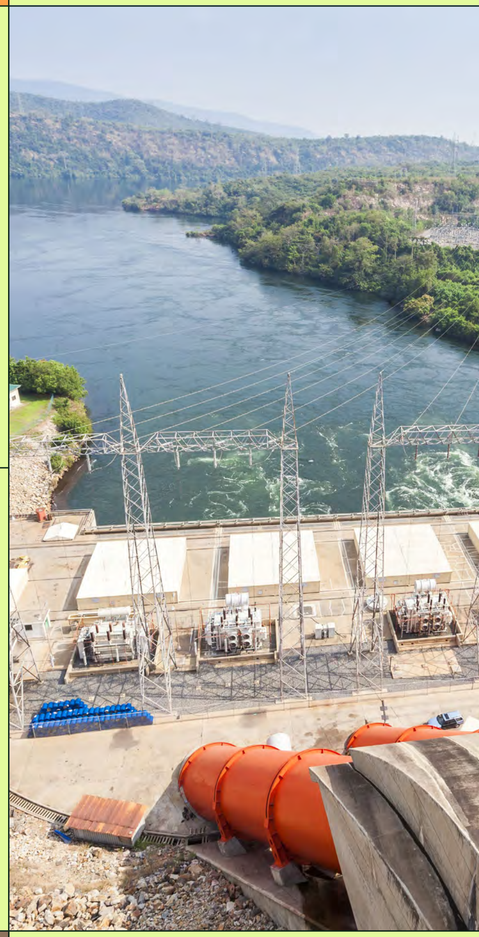
These include banks and investment bodies, energy associations and agencies, and many other organisations in the climate sector who have generously partnered with us. Hence the title of this report — *The Power of Research and Partnership*; over the last four years and, hopefully, in the coming years up to 2030.

At its core CCG draws on the world-leading expertise of university colleagues at *Oxford*, *Cambridge*, *UCL*, *Imperial*, *Loughborough*, *KTH*, the *Open University* and *Strathclyde* alongside the *Centre for Global Equality* and the *Climate Parliament*. This results in ground-breaking research that informs genuine change in our partner countries — Zambia, Kenya, India, Ghana, Vietnam and Lao PDR — and many more countries too. Our partnerships with the *Open University's OpenLearn* project and the *OpTIMUS Community's* energy modelling tools have helped to build a global community of analysts, planners and policy makers. They are empowered to create credible, data-based proposals for their clean-energy projects which now have a much higher chance of securing investment.

We are very grateful for the trust placed in us by the FCDO in extending our work until 2030. They have supported us since we first approached them about creating this programme and their guidance has been invaluable in maintaining the balance between the many elements that make up CCG. We are equally grateful to all of our partners, many of whom are mentioned in these pages. *We could not have achieved so much without you*. We hope to attract other partners of a similar calibre for the next phase of our work up to 2030.

— Prof Mark Howells, Director, CCG
Loughborough University and Imperial College London.

Introduction



While all countries face the pressing challenge of tackling climate change, low- and middle-income countries (LMICs) encounter even greater obstacles. These nations not only struggle with limited access to essential services such as healthcare, education, clean water, energy, and transport but also contend with severe economic and social pressures that require breakthrough levels of investment and finance into new development trajectories.

Often located at the sharp end of global climate change, LMICs are particularly vulnerable to its impacts. To overcome these challenges, innovative, climate-compatible solutions are necessary — solutions that are rooted in rigorous nationally driven and generated research.

Launched in 2021, the UK Foreign, Commonwealth & Development Office's (FCDO) Climate Compatible Growth (CCG) programme aims to enable partnerships which produce cutting edge solutions and knowledge products to tackle these complex problems and help raise the finance needed to direct investment trajectories.

CCG promotes evidence-based decision-making, fosters pioneering research in sustainable energy and transport systems, and builds the strategic partnerships needed to empower LMICs in their climate action efforts.

Who Are We

CCG is a unique consortium that unites world-renowned institutions, including *Imperial College London*, *KTH Royal Institute of Technology*, *Loughborough University*, *The Open University*, the *University of Cambridge*, the *University of Oxford*, the *University of Strathclyde*, and *University College London* (UCL), alongside the *Centre for Global Equality* and the *Climate Parliament*.

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The views expressed in this material do not necessarily reflect the UK government's official policies.

University of Oxford

IMPERIAL

The Open University

University of Strathclyde Glasgow

Centre for Global Equality

UCL

Loughborough University
STEER – Centre for Sustainable Transitions: Energy, Environment and Resilience

KTH Vetenskap och Konst

University of Cambridge

Climate Parliament

Our “Programmed Research”

CCG centres its slow-burn research on three critical areas that support sustainable development. The first area, *System Design*, focuses on developing long-term policies that guide energy and transport planning at local, national, regional, and global levels, using geospatial tools (that analyse and visualise data based on mapped locations) to inform strategic decision-making. The second area, *Sector Interactions*, takes a ‘whole-systems’ approach to infrastructure planning by exploring the how energy, water, food, and land resources depend on each other.

This includes assessing what materials are needed for the low-carbon energy transition and designing integrated infrastructure networks that are resilient to climate impacts. The third area, *Economics and Policy*, investigates economic, fiscal, and innovation policies that promote climate-compatible growth, examining areas such as transport’s role in sustainability and how to create an enabling environment for investment in green infrastructure projects.

Our “Partnerships Engagement”

Committed to fostering climate-compatible growth in LMICs, the CCG programme creates and maintains strategic engagement and research partnerships at national level and with international organisations

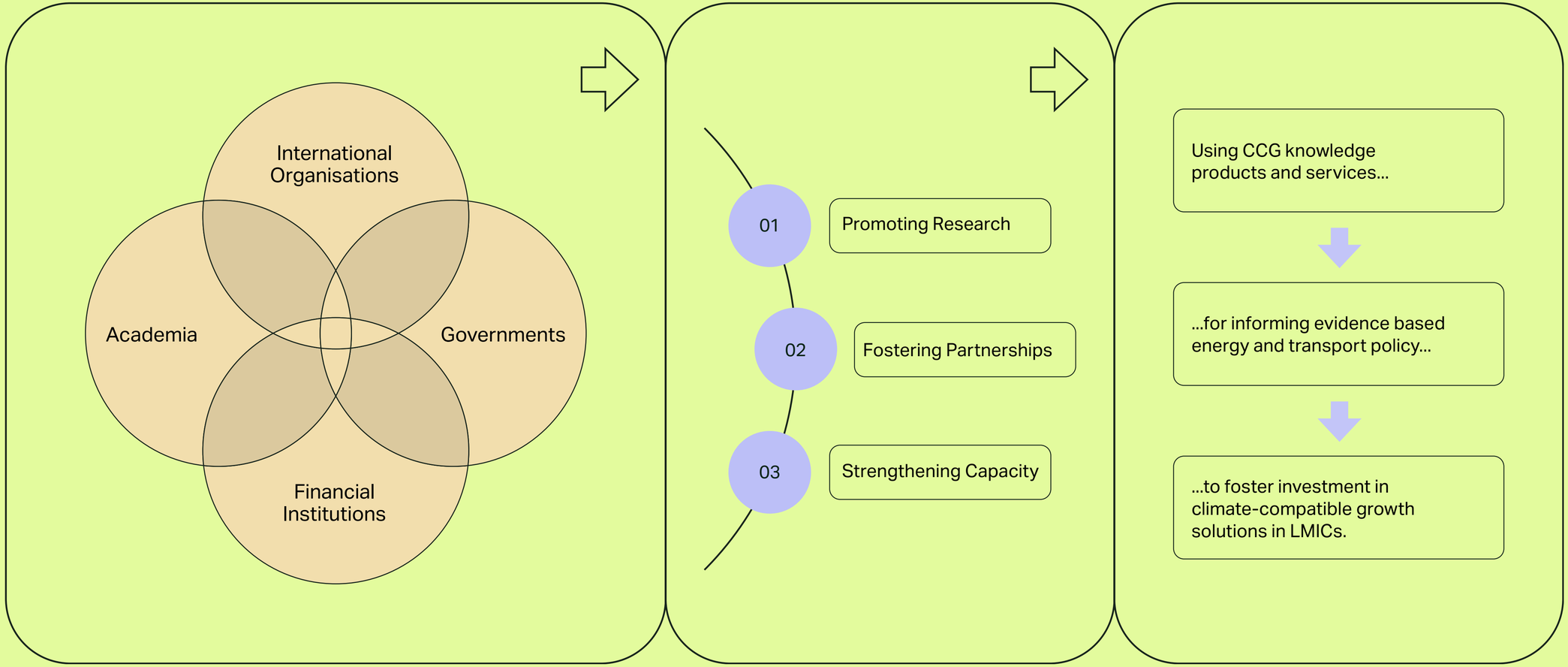
At national level, CCG interfaces with both “Partner Countries,” which are central to its efforts, and “Affiliate Countries,” which benefit from targeted engagement via international partners. It also engages with “Demonstrator Countries,” outside its core regions, to develop and test knowledge products applicable to CCG’s target areas. To do so it responds to requests from governments, NGOs, and leading academic institutions.

“Partner Countries” include Ghana, India, Kenya, Lao PDR, Vietnam, and Zambia. When CCG interfaces with partner countries it focuses on enabling “co-created” research, developed in collaboration with partners in that country; as well as inducing and supporting research, led by partners in that country with support from CCG in the form of accessible data, methods, tools, funding or coaching. A key theme is the production and application of knowledge products — by local analysts — that accelerate the mobilisation of breakthrough levels of finance to speed up lower carbon inclusive economic growth.

CCG also engages with international organisations and financial institutions, including the 2050 Pathways Platform, Asian Development Bank (ADB), Green Grids Initiative (GGI), International Atomic Energy Agency (IAEA), International Energy Agency (IEA), International Renewable Energy Agency (IRENA), OpTIMUS Community of Practice, Sustainable Energy for All (SEforALL), Sustainable Mobility for All (SuM4All), the United Nations Department of Economic and Social Affairs (UNDESA), United Nations Development Programme (UNDP), World Bank Group (WBG) and World Resources Institute (WRI). This engagement results in the co-creation, co-curation and joint deployment of knowledge products at scale, beyond the partner countries with which CCG engages. As with CCG’s country partnerships a key theme is building deep capacity and agency in analysts from the south and enabling the development of southern-led analysis.

Underlying CCG’s Country and International Partnership activities is the belief that analysis that directs development trajectories must be driven by analysts in those countries. Empowering them to enable best practice — through the privilege of partnership — is a critical motivation of the programme.

Figure 1: CCG's collaborative structure at a glance.



Our approach

At CCG, our work is demand-led, with our programmed research and partnership engagement working closely together with LMICs and international partners. Our programmed and engagement research helps create the tools and deep knowledge base to strengthen our partners, ensuring they are equipped with the latest research and empowered to deploy these in local contexts. Partnerships, particularly with LMIC governments and international organisations, provide essential real-world insights that shape and refine our research efforts to address pressing challenges on the ground. (Noting that many International Organisations are constituted by and represent LMIC member states and their needs).

Our goal is not just to co-generate knowledge, to enable organisations and empower analysts, but also — through that — to make a tangible impact. Part of CCG's ever-evolving approach includes adopting and advancing the Data-to-Deal framework, which turns data-driven insights into actionable strategies that help mobilise funding for climate-compatible growth *(See the next page for more details)*.

In addition, CCG follows U4RIA principles — Ubuntu (Community), Retrievability, Reusability, Repeatability, Reconstructability, Interoperability, and Auditability

— to ensure transparency, accessibility, and collaboration in our energy modelling work and data practices.

Central to the work of CCG is also a commitment to Gender Equality and Social Inclusion (GESI). This ensures that all solutions and strategies aim to be inclusive, equitable, and of benefit to marginalised groups, such as women, youth, people with disabilities, and rural populations. By embedding GESI principles, CCG will help create pathways that are part of a just transition, where no one is left behind.

Data-to-Deal (D2D): An Effective Approach to Supporting Countries in Climate Transition

Data-to-Deal (D2D) is a pioneering approach developed to mobilise financial resources for climate-compatible growth. At its core, D2D leverages open data and informed policymaking to facilitate the transition to sustainable, low-carbon economies, enabling billions of dollars to be released by crafting national visions that guide the development of tailored climate finance strategies.

Initially documented in Costa Rica, D2D's success is highlighted by the launch of the National Decarbonization Plan (the country's Long-Term Strategy, or LTS) in 2019, which has mobilised at least US$2.4 billion from international concessional finance sources by the end of 2022. This achievement stemmed from a collaborative and data-driven process, engaging stakeholders to create a nationally owned LTS study that cost less than US$200,000.

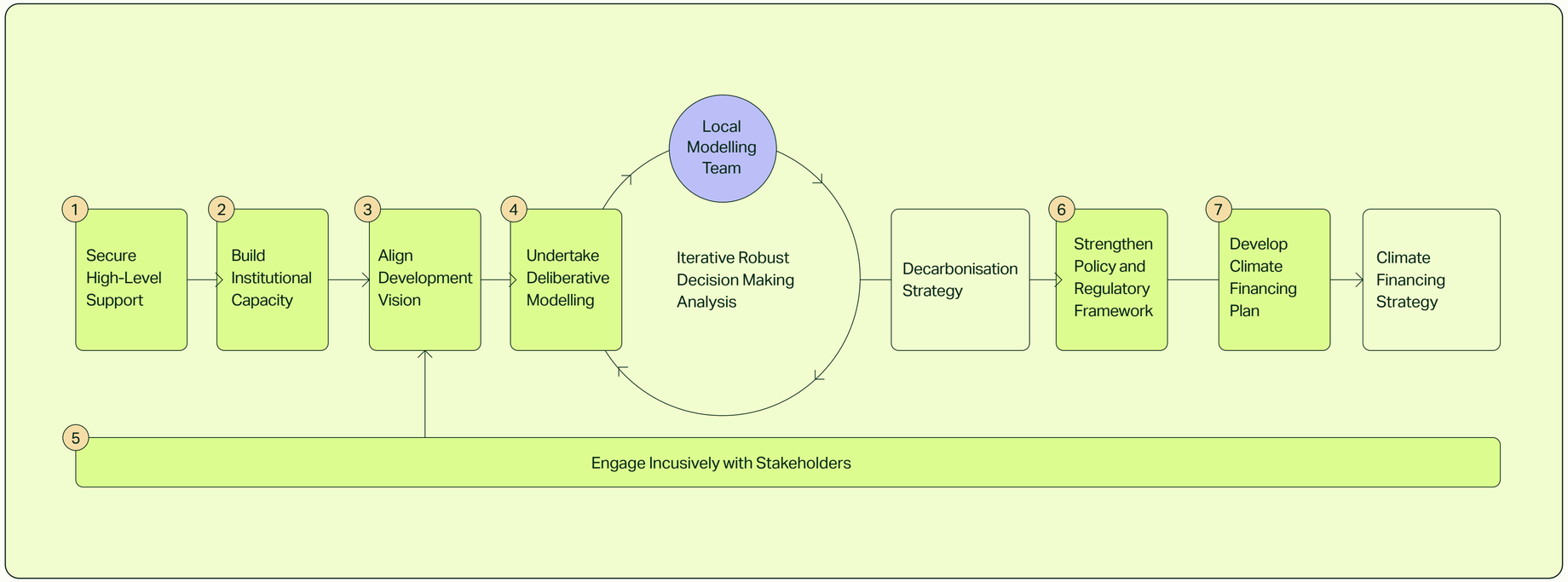


Figure 2:
An info-graphic giving an overview of the seven key elements of Data-to-Deal, from securing political support through to generating finance.

Data-to-Deal (D2D): An Effective Approach to Supporting Countries in Climate Transition

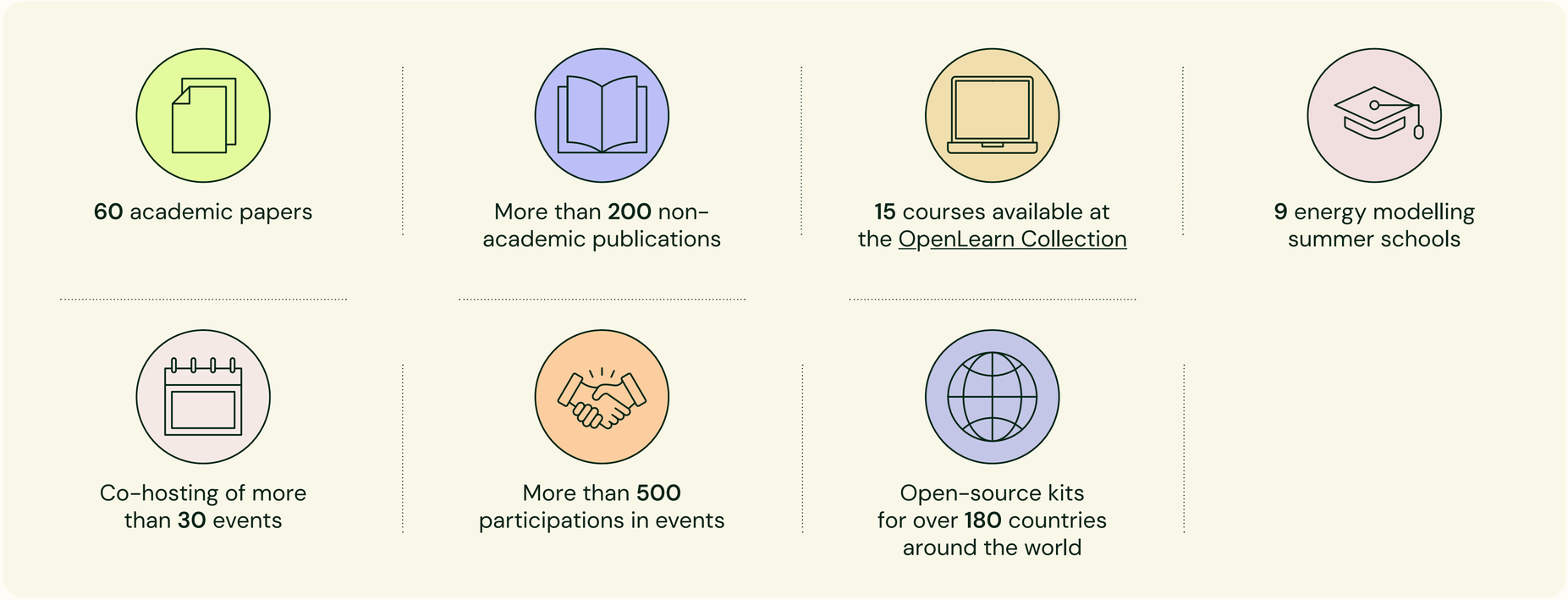
The D2D methodology has also been successfully applied in Uruguay, Chile, and the Dominican Republic, each revealing valuable insights into its implementation and effectiveness in varying national contexts.

- **Uruguay** aims to achieve carbon neutrality by 2050 while safeguarding its crucial agricultural sector. By 2022, it had secured approximately US$300 million in international funding for renewable energy projects, demonstrating a tailored approach to balancing economic growth with environmental sustainability. Web Link.
- **Chile** has made significant strides through its Climate Change Framework Law, enacted in 2022, which codifies its climate commitments. The law supports a target to reduce greenhouse gas emissions by 30% by 2030 compared to 2007 levels, with a projected investment of around US$35 billion needed to meet these goals. Web Link.
- **The Dominican Republic** emphasises the energy sector's critical role in reducing greenhouse gas emissions, having established an LTS that targets a 25% reduction in emissions by 2030. This strategy has attracted an estimated US$150 million in international financing for renewable energy initiatives and energy efficiency programmes. Web Link.

The development of an LTS that aligns with each country's broader development goals ensures that climate action is integrated into national priorities. Furthermore, each case highlights the importance of multisectoral collaboration and partnership, involving government, private sector, academia, and civil society in the development and implementation of the LTS.

Our Results

To date, CCG's efforts — with the support of our partners — are yielding tangible results **(Figure 3)**, with countries and international organisations adopting climate-compatible policies and practices as a direct result of this work.



"By helping countries develop investment cases for climate finance, CCG is contributing to a sustainable development movement that prioritises both economic growth and environmental resilience."

Figure 3:
CCG in numbers.

This report gives an overview of CCG's accomplishments from April 2021 to March 2024, demonstrating how its multifaceted and collaborative approach has empowered stakeholders to pursue climate-compatible growth. Organised to guide readers through the programme's research (*Section 1*) and strategic partnerships (*Section 2*), the report highlights key projects that have influenced policy decisions and investment strategies.

Additionally, it presents a section on capacity-building efforts (*Section 3*) and looks ahead to future initiatives (*Section 4*). An archive of all materials and outputs produced by the consortium is included, offering a comprehensive resource for multiple stakeholders (*Section 5*).

We invite you to explore this report and discover the impactful work of the CCG programme.

1.0

Undertaking Research

This section outlines CCG's programmed and engagement research initiatives and their outcomes. It showcases the evidence, models, and tools developed to inform decision-making across public, private, and civil sectors. By collaborating closely with local stakeholders, CCG not only addresses immediate needs but also empowers communities to pursue their development goals with resilience and adaptability.

Undertaking Research

Since 2021, CCG has significantly expanded its research output. By March 2024, the programme had produced 60 academic papers demonstrating the growing influence of CCG in the field of sustainable development **(Figure 4).**

Year	Academic papers
2021 - 2022	13
2022 - 2023	16
2023 - 2024	31

CCG is also committed to fostering inclusivity and diversity in research, with a notable increase in the number of academic publications led by women authors. Its focus on gender balance, for instance, ensures that diverse perspectives are incorporated into the development of sustainable solutions, enriching the programme's research and enhancing its real-world relevance **(Figure 5).**

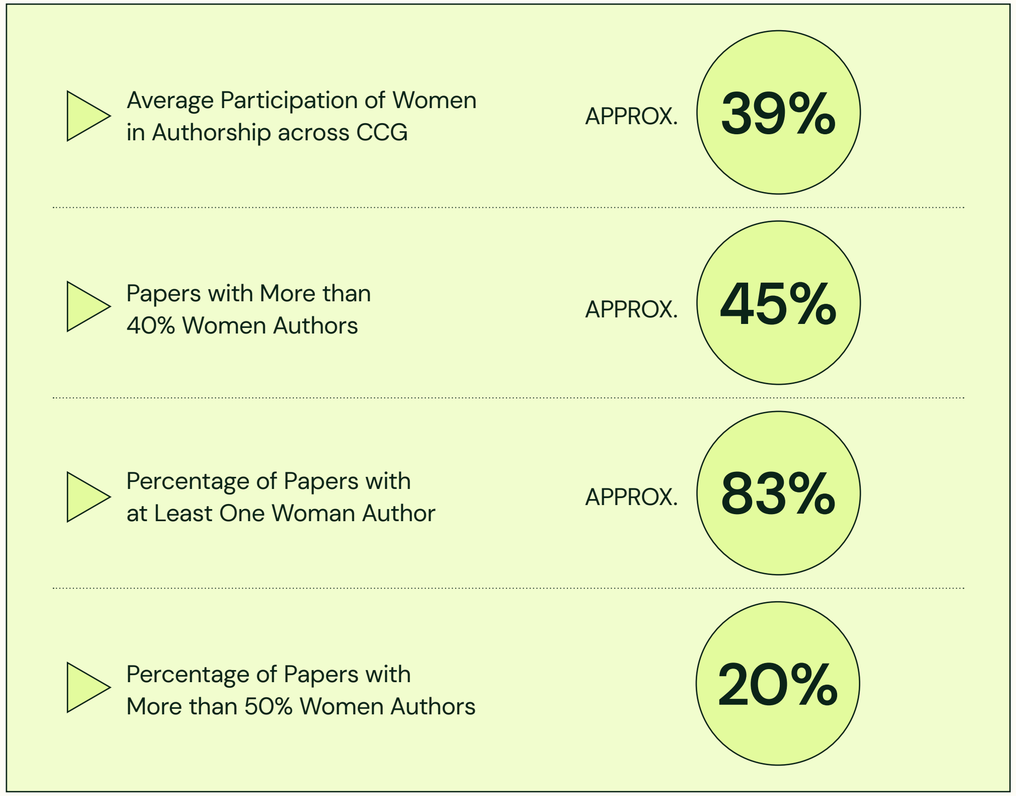


Figure 4 (Table):
CCG academic papers by year.

Figure 5 (Graphic):
Academic papers with contributions from women authors.

CCG research focuses on the most important challenges facing clean, resilient energy and transport systems in LMICs.

These include:

- What energy and transport priorities and investments are required to underpin climate-compatible development in LMICs?

- How can energy and transport systems contribute to wider sustainable development, and how can risks and trade-offs across resource systems be managed?

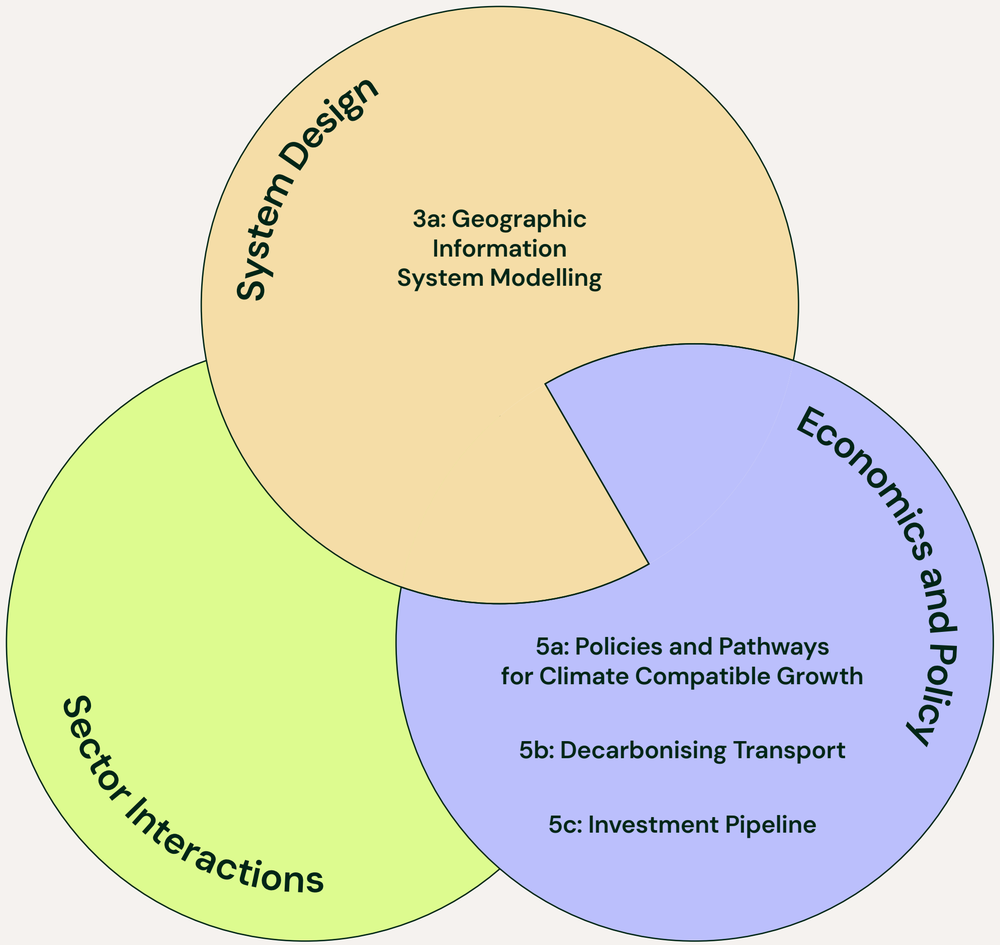
- What policies are required to make investments in clean energy and transport systems economically, financially, and politically attractive?

To answer these overarching questions CCG centres its research on three critical areas that support sustainable development.

- **System Design**
  This area focuses on developing long-term policies that guide energy and transport planning at local, national, regional, and global levels, using geospatial tools to inform strategic decision-making.

- **Sector Interactions**
  Taking a 'whole systems' approach, this area explores the interdependencies between energy, water, food, and land resources. It assesses material requirements for the low-carbon energy transition and designs integrated infrastructure networks that are resilient to climate impacts.

- **Economics and Policy**
  This area investigates economic, fiscal, and innovation policies that promote climate-compatible growth. It examines aspects such as the role of transport in sustainability and the creation of investment pipelines for green infrastructure projects.



Through our research, we aim to foster climate-compatible growth and build resilience in developing countries, promoting equitable access to resources and opportunities while at the same time increasing the agency of Southern researchers to initiate and lead ground-breaking analysis.

More detail and selected examples are given about CCG's programmed research overleaf, and **Table 1** (next page) lists some high-impact papers. Outside the core research programme, CCG has several other mechanisms to promote high-impact projects, such as the Flexible Research Fund and Southern Partner Fund.

Figure 6 (Graphic):
CCG research areas and sub-areas.

Table 1: High-impact academic papers

Authors / Year	Title of paper	Citations*
Collett et al. (2021)	Can electric vehicles be good for Sub-Saharan Africa? Website Link.	76
Niet et al. (2021)	Developing a community of practice around an open-source energy modelling tool. Website Link.	61
Mulugetta et al. (2022)	Africa needs context-relevant evidence to shape its clean energy future. Website Link.	55
Leonard et al. (2022)	The resource curse in renewable energy: A framework for risk assessment. Website Link.	46
Collett et al. (2021)	Data needed to decarbonize paratransit in Sub-Saharan Africa. Website Link.	44
Pappis et al. (2021)	Influence of Electrification Pathways in the Electricity Sector of Ethiopia—Policy Implications Linking Spatial Electrification Analysis and Medium to Long-Term Energy Planning. Website Link.	43
Muller et al. (2023)	Green hydrogen production and use in low- and middle-income countries: A least-cost geospatial modelling approach applied to Kenya. Website Link.	37
Zachariadis et al. (2023)	Science policy frameworks for a post-pandemic green economic recovery. Website Link.	32
Pereira Ramos et al. (2022)	Climate, Land, Energy and Water systems interactions – From key concepts to model implementation with OSeMOSYS. Webstite Link.	31
O'Callaghan et al. (2022)	How Stimulating Is a Green Stimulus? The Economic Attributes of Green Fiscal Spending. Website Link.	30
Trotter & Brophy (2022)	Policy mixes for business model innovation: The case of off-grid energy for sustainable development in sub-Saharan Africa. Website Link.	30
Sahlberg et al. (2021)	A scenario discovery approach to least-cost electrification modelling in Burkina Faso. Website Link.	17

*Citations on Google Scholar (Last checked on 6 October 2024).

1.1

System Design

System Design focuses on developing long-term policies that guide energy and transport planning at local, national, regional, and global levels, using geospatial tools to inform strategic decision-making.

Effective planning of energy and transport infrastructure is crucial for fostering climate-compatible growth in LMICs. CCG works closely with local partner stakeholders, taking a demand-led approach to co-develop modelling tools and data that guide investment decisions and policy design.

Gender Equality and Social Inclusion (GESI) is integrated into all efforts, ensuring energy access benefits marginalised groups. By March 2024, CCG had delivered over 30 publications, 40 open-source products, and 15 workshops to support sustainable energy policies.

> *"This collaborative process strengthens national capacity, training modellers and equipping policymakers with the skills needed for long-term system planning."*

Exploring the Potential of Green Hydrogen in Kenya

The quest for sustainable energy solutions is taking an exciting turn with the rise of green hydrogen — a clean, versatile energy carrier that can help power everything from homes to heavy industries. A recent study by CCG academics, titled "*Green hydrogen production and use in low- and middle-income countries: A least-cost geospatial modelling approach applied to Kenya*" demonstrated how a Geographic Information System method can identify the best locations for its production.

Using advanced mapping techniques, the study indicates where green hydrogen can be produced most cost-effectively. By analysing various factors, such as the availability of renewable resources (like sunlight and wind), transportation routes, and existing infrastructure, the researchers could pinpoint areas that are ideal for production and economically viable. This means they can show which locations could produce green hydrogen at the lowest cost, making it more accessible and affordable.

The research explores various scenarios, indicating that if Kenya leverages its abundant renewable resources, it could significantly lower production costs and enhance energy security. For example, the findings suggest that by 2030, Kenya could potentially produce over one million tonnes of green hydrogen annually, contributing significantly to its energy mix. This not only positions Kenya to meet its domestic energy needs but also opens avenues for exporting green hydrogen to international markets, driving economic growth.

A critical part of System Design is *Geographic Information System* (GIS) modelling studies. These provide high-resolution tools to identify economic opportunities that can drive growth in LMICs.

By March 2024, this research had produced over 13 publications, alongside training courses like the "OnSSET/Global Electrification Platform" to build capacity in GIS-based energy modelling (*see Section 3*).

Contributing to the launch of the new Kenya National Cooking Transition Strategy

The partnership between the Kenyan Ministry of Energy and Petroleum (MoEP), CCG (*through the Kenya CCG Network: see Section 2.1*), and other stakeholders, has led to a significant advancement in clean cooking solutions through the launch of the *Kenyan National Cooking Transition Strategy 2024–2028* (KNCTS). This strategy serves as a roadmap for achieving universal access to clean cooking solutions by 2028, reflecting a strong commitment to improving energy access and sustainability in Kenya.

The KNCTS emerges as a crucial update to the previous Kenya National Cooking Sector Strategy, which guided national policy in clean cooking. The collaborative efforts of CCG were instrumental in the development of the new strategy, providing valuable knowledge products that informed decision-making and aligned with CCG's strategic objectives.

The KNCTS lays out the pathways necessary to meet the ambitious goal of universal access to clean cooking while contributing to Kenya's Nationally Determined Contribution (NDC). The strategy aims to reduce greenhouse gas emissions, which demonstrates a clear commitment to sustainable energy practices.

The acknowledgment of CCG's contribution in KNCTS underscores the collaborative spirit that drives this initiative. This strategic document not only reflects a commitment to clean cooking but also embodies a shared vision for a sustainable energy future in Kenya.

Image:
'Kenya National Cooking Transition Strategy (KNCTS) 2024–2028'.

1.2

Sector Interactions

The transformation of energy and transport systems for climate-compatible development requires an understanding of their interactions with society, the economy, and the environment. CCG's work on Sector Interactions assesses how changes in these systems contribute to Sustainable Development Goals while managing risks and trade-offs across resource systems.

This includes analysing material flows, industrial capacity, and the interplay between infrastructure development and sustainable practices. CCG also examines the interconnections among sectors such as energy, water, food, and land, ensuring infrastructure networks are resilient to climate change impacts. Significant academic contributions include publications like "*Material Requirements for Future Low-Carbon Electricity Projections in Africa*", alongside over 80 *online lectures* in courses like "*The Climate, Land-Use, Energy, and Water Systems (CLEWs)*".

Exploring Low-Carbon Electricity Systems in Africa

Shifting to low-carbon electricity systems is essential for meeting climate goals and improving wellbeing in developing countries. While emissions from running traditional power plants are well known, the emissions associated with the materials used to build these systems—called embodied emissions—are often overlooked.

A study in the paper "Material Requirements for Future Low-Carbon Electricity Projections in Africa" uses a model called Mat-dp to estimate the material needs and embodied emissions for electricity systems in 47 African countries by 2065. Key findings include:

Material Needs and Emissions: The need for construction materials like concrete, steel, and aluminium is projected to increase 20-fold from 2015 to 2065, with embodied emissions potentially reaching 47 million tonnes of CO2 by 2065 in a 2.0 °C warming scenario.

Material Breakdown: By 2065, concrete, steel, and aluminium will account for 64–66% of total material needs and 59–61% of embodied emissions, with an increased demand for specialised materials.

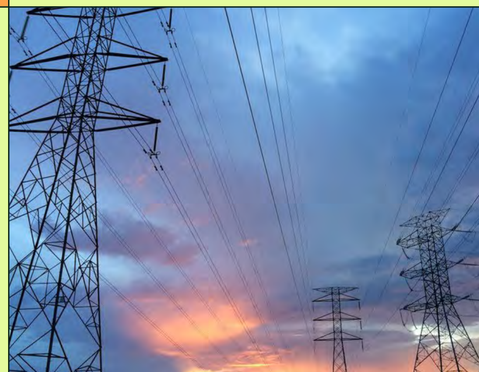
Impact on jobs: Transitioning to low-carbon electricity could create about 1.6 million new jobs annually, primarily in the solar sector.

This research underscores the importance of addressing embodied emissions and improving material efficiency to reduce overall emissions and achieve climate targets.

1.3

Economics and Policy

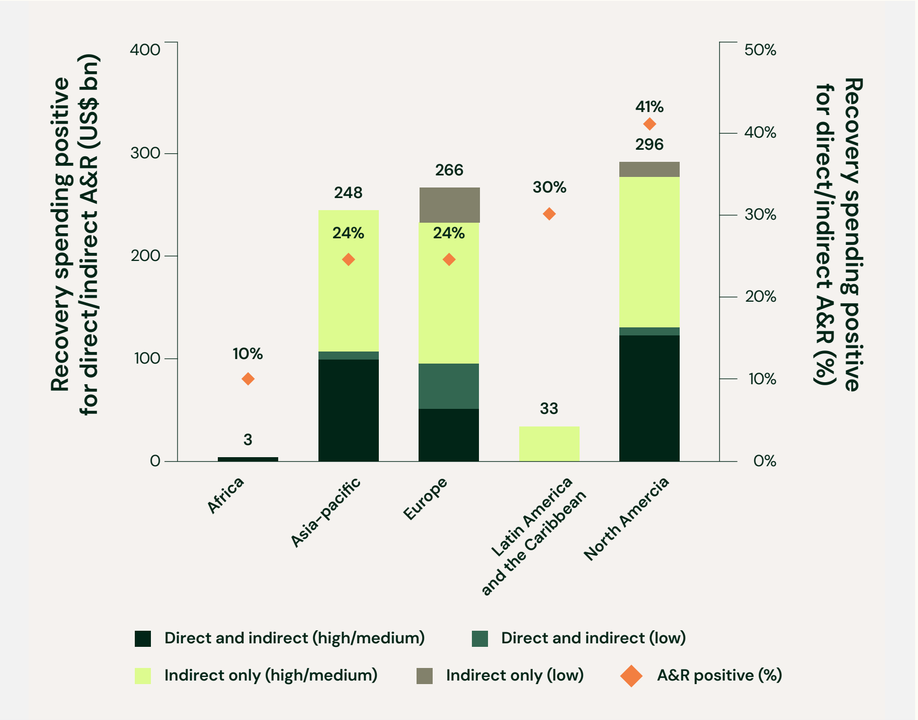
Economics and Policy examines strategies for climate-compatible and resilient growth in LMICs, addressing several critical areas. The focus includes developing tailored climate and energy policies that promote clean investment, investigating fiscal interventions that achieve climate-compatible growth while ensuring the resilience of public finances, and business innovations that allow entrepreneurs and start-ups to adopt the technologies needed for sustainable economic development. CCG has published over 20 *research papers* and organised more than 30 *events* on these topics.



Identifying Regional Variations in Climate Adaptation and Resilience Spending During the COVID-19 Pandemic.

The COVID-19 pandemic highlighted the critical importance of preparedness for systemic risks, revealing significant vulnerabilities in global systems. In this context, a study entitled "The impact of COVID-19 fiscal spending on climate change adaptation and resilience", published in *Nature*, examined the fiscal responses to the pandemic and their implications for climate change adaptation and resilience (A&R). The research emphasised that government spending during this period varied significantly across different regions and countries.

The findings show that recovery spending on A&R was notably higher in North America, which allocated the largest absolute volume and proportion of funds to policies with positive A&R impacts. This spending focused on initiatives such as broadband investment, disaster preparedness, resilient infrastructure, and education. In the Asia-Pacific region, priorities included disaster preparedness and natural infrastructure, alongside broadband investments. Meanwhile, Latin America and the Caribbean concentrated their efforts on education, broadband, and social care, while A&R spending in Africa was primarily directed towards disaster preparedness and education.



The study also noted variations in the confidence levels of A&R spending across regions. For instance, Europe exhibited a higher proportion of low-confidence spending, particularly in areas like green retrofitting and research and development, which were deemed less certain in terms of their impact. This variation underscores the complex landscape of fiscal policy responses to climate challenges and highlights the need for tailored approaches to ensure effective investment in resilience and adaptation across diverse contents.

Figure 7:
Recovery spending by region on policies that positively impact climate adaptation and resilience

This research area also considers *Policies and Pathways for Climate-Compatible Growth*, using a political economy lens to identify opportunities and barriers for just transitions. This work outlines pathways for transitioning to climate-compatible energy and transport systems, emphasising social justice by assessing the distributional impacts across sectors to ensure no one is left behind. Collaborative efforts with academics and governments in LMICs have focused on projects like land access for solar PV in Ghana, transition pathways for climate-compatible growth in Zambia, how to support a circular economy in Zambia, place-based transitions, and energy planning in Kenya.

CCG also conducts research on the transport–energy nexus which informs decision-makers in their efforts towards Decarbonising Transport. Improved and accessible data, suitable transport-energy modelling, innovative research, and robust partnerships are core components of this work.

By March 2024, CCG had produced over 15 publications on electrifying transport, such as "*Plugging into Green Growth: Towards E-Mobility and Renewable Energy Integration in Lao PDR*". These works offer valuable frameworks to aid the transition to sustainable transport systems in LMICs.

Image:
'The Political Economy of Land Access for Large-scale solar Photovolataic Projects in Ghana' and 'From Waste to Resource'.

Can electric vehicles be good for sub-Saharan Africa?

The world is steadily transitioning towards cleaner transportation, replacing polluting internal combustion engine vehicles with low-emission electric vehicles (EVs). In sub-Saharan Africa (SSA), however, despite the growing demand for transport driven by population growth and economic development, the region has been slower to embrace this global shift. For example, by 2019, there were only 500 electric vehicles on the roads in South Africa, one of the most advanced economies in the region. This starkly illustrates the lag in EV adoption in SSA compared to other parts of the world.

The article argues that while the transition to EVs may seem challenging in SSA, it is certainly possible. The strategy for adoption in SSA countries must differ, due to their unique conditions, from that of wealthier nations, where EVs are primarily private cars supported by government subsidies and reliable electricity.

In SSA, mobility patterns are quite different. The transport system is dominated by paratransit vehicles like minibuses, motorbike taxis, and auto-rickshaws. Although unreliable electricity and limited financial resources pose challenges, tailored EV solutions could provide significant benefits.

Focusing on smaller public transport EVs, like motorbike taxis, could reduce emissions by over 90%, save governments money on fossil fuel subsidies (up to $200 per person in some countries), and generate up to $14 billion in annual revenue for electricity providers. Paratransit vehicle owners could also benefit from lower operating costs, potentially saving up to $0.15 per kilometer.

To make this transition successful, SSA countries need to adopt solutions suited to their unique, local conditions. These might include options like battery swapping, plug-in charging stations powered by solar energy, or vehicles equipped with solar panels. The key is to develop technologies and business models specifically for the region, rather than copying what has been done in wealthier countries.

Finally, this research area also examines **Investment Pipelines**, assessing emerging trends in sustainable finance and the reality of implementing projects in developing countries. This research identifies challenges and opportunities in areas such as blended finance, impact capital, decentralised development, south–south aid, loss and damage, and climate finance, particularly for marginalised groups like rural populations, women, and youth.

Notable outcomes include the collaboration with the International Energy Agency on Model for Financial Analysis of Electric Sector Expansion (FINPLAN), which provides insights into global financing in the power sector, particularly in developing countries **(See Section 3)**, and analysis of Zambia's Constituency Development Fund.

Lower Image:
'Mobilising Investment for Climate-compatible Growth Through Zambia's Constituency Development Fund'.

Flexible Research Fund (FRF) and Southern Partners Fund

To promote meaningful collaboration between researchers in partner countries and the long-term research programme, two funding mechanisms have been established:

Flexible Research Fund: This fund aims to increase the diversity of researchers and institutions engaged in the CCG programme. It supports a broad range of research topics and questions that fall within the programme's scope. Research is commissioned through open calls for proposals, with a requirement that at least 40% of project budgets be allocated to researchers from LMICs. To date, three open calls have been launched. In 2023, eight projects were awarded funding across four countries — India, Ghana, Lao PDR, and Vietnam — most of which are currently in development. Notably, six of these projects involve teams based in LMICs, and three are led by female researchers.
The funded projects include studies on green hydrogen and effective energy efficiency measures.

Southern Partners Fund: This fund is intended to facilitate collaboration between researchers in partner countries and CCG researchers in the UK. Projects funded through this initiative are co-developed and predominantly carried out by research teams in the partner countries.
To date, several projects have been implemented, encompassing a diverse array of topics, from decentralised energy planning in Zambia to data-driven low-carbon transport scenarios in Lao PDR.

2.0
Fostering Partnerships

CCG is committed to fostering climate-compatible growth in LMICs through strategic partnerships with academia, governments, international organisations and financial institutions. By leveraging the strengths of these diverse stakeholders, CCG ensures that its initiatives are well-rounded, contextually relevant, and designed for long-term impact. These partnerships enable CCG to align its strategies with national priorities, secure necessary funding, and benefit from a wide range of expertise.

At national level, CCG has effectively engaged with institutions in countries such as India, Ghana, Kenya, Lao PDR, Vietnam, and Zambia. These collaborations have facilitated the development of tailored energy transition pathways and informed policy making processes that reflect local contexts and needs. For instance, workshops in Kenya and Zambia have highlighted the importance of stakeholder engagement in advancing climate goals, while data-driven modelling exercises in Vietnam have provided critical insights for long-term energy planning.

On the international stage, CCG collaborates with prominent partners, including the 2050 Pathways Platform, Asian Development Bank (ADB), Green Grids Initiative (GGI), International Atomic Energy Agency (IAEA), International Energy Agency (IEA), International Renewable Energy Agency (IRENA), OpTIMUS Community of Practice, Sustainable Energy for All (SEforALL), Sustainable Mobility for All (SuM4All), the United Nations Department of Economic and Social Affairs (UNDESA), United Nations Development Programme (UNDP), World Bank Group (WBG) and World Resources Institute (WRI).

Through these partnerships, CCG not only shares best practices but also gains access to cutting-edge research and innovative solutions that enhance the capacity of LMICs to navigate their unique challenges. CCG's involvement in high-level events, such as COP28, has further amplified its impact on a global scale.

In the following pages, we will delve deeper into the specific successes of CCG's collaborations.

2.1

Partnerships at National Level

CCG adopts a demand-led approach, engaging with a diverse array of stakeholders in LMICs. A key aspect of this strategy involves collaboration with leading academic institutions within these nations.

CCG currently partners with six countries:

- Ghana
- India
- Kenya
- Lao PDR
- Vietnam
- Zambia

These SIGS and their corresponding networks are coordinated by local Country Coordinators, who serve as CCG representatives in their respective countries. This ensures that initiatives are firmly rooted in local contexts and demands.

Country Coordinators play a pivotal role in organising a variety of local workshops and events, fostering engagement and collaboration among stakeholders to address the unique challenges and opportunities present in each nation.

As of March 2024, CCG had established partnerships with esteemed institutions in each of the six countries (**see Figure 8**). Within each Country CCG Network, CCG is regarded as a trusted broker of interdisciplinary, policy-facing research, providing policymakers with valuable resources for developing financeable plans for climate-compatible infrastructure projects.

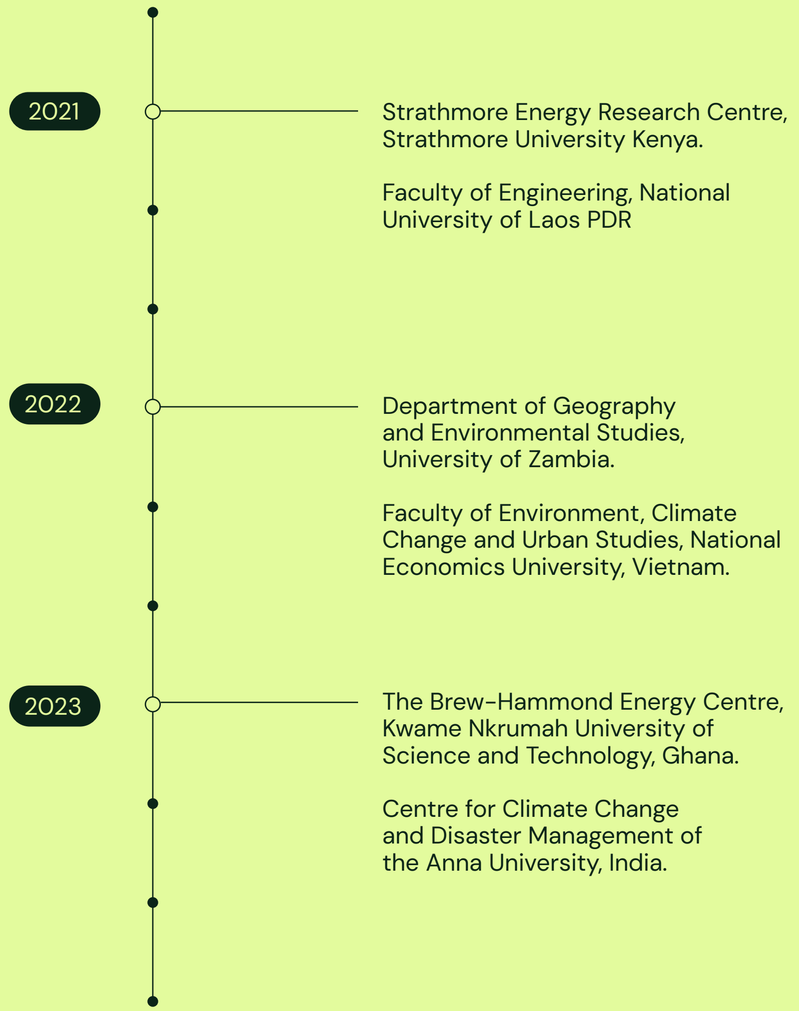


Figure 8:
CCG partner institutions overseas as of March 2024

Partner Institutions

- **Strathmore Energy Research Centre, Kenya**

In Kenya, CCG's climate-compatible initiatives are anchored at the Strathmore Energy Research Centre within Strathmore University. This institution is at the heart of a vibrant network that includes government bodies like the Ministry of Energy and academic institutions such as Nairobi University. Through its leadership in the Kenya CCG Network, Strathmore University plays a pivotal role in addressing national energy challenges by coordinating Special Interest Groups (SIGs) that focus on areas including National and County Energy Planning, Low-Emission Transport, and Clean Cooking.

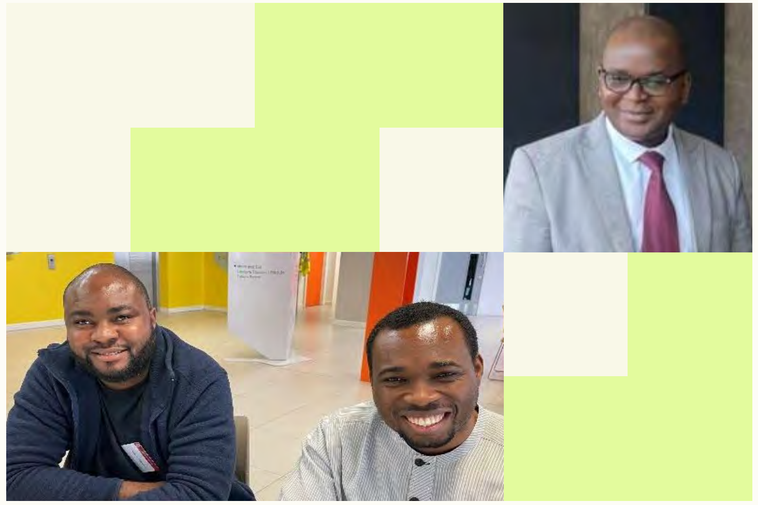
- **Faculty of Engineering, National University of Laos**

In Lao PDR, CCG coordinates with the Faculty of Engineering within the National University of Laos. This institution has become a key facilitator of sustainable energy initiatives, collaborating with the Ministry of Energy and Mines and other local stakeholders. The university leads SIGs focusing on Energy Systems Modelling, Resource Efficiency in Industry, and Low-Emission Transport. By fostering these collaborations, the university helps ensure that Lao PDR's energy transition is both inclusive and well-informed by local expertise.

Partner Institutions

- **Department of Geography and Environmental Studies, University of Zambia**

The University of Zambia, through its Department of Geography and Environmental Studies, serves as the focal point for CCG's initiatives in Zambia. This department coordinates the Zambia CCG Network, which includes SIGs dedicated to Financing Low-Emission Futures, Energy System Scenarios, Decentralised Energy Planning, and Clean Cooking. The University's leadership ensures that these initiatives are deeply integrated into Zambia's development strategy, fostering local ownership and sustainability.



- **Faculty of Environment, Climate Change and Urban Studies, National Economics University, Vietnam**

In Vietnam, CCG has established a strong partnership with the National Economics University (NEU) in Hanoi. NEU serves as the central institution for the Vietnam CCG Network, coordinating the establishment of SIGs that will address key areas like Green Finance, Energy Transition Strategies, and Climate Resilience in Urban Planning. By leveraging its academic and research capabilities, NEU is helping to shape Vietnam's approach to sustainable development, ensuring that growth remains inclusive and environmentally sound.

Partner Institutions

- **The Brew-Hammond Energy Centre, Kwame Nkrumah University of Science and Technology, Ghana**

In Ghana, CCG's activities are based at The Brew-Hammond Energy Centre within Kwame Nkrumah University of Science and Technology (KNUST). This centre is instrumental in driving forward Ghana's energy transition, and it will coordinate SIGs that focus on areas such as Renewable Energy Integration, Sustainable Urban Development, and Capacity-Building in Energy Policy. Through these efforts, KNUST plays a critical role in ensuring that Ghana's energy policies are informed by robust research and tailored to local needs.

- **Anna University, India**

In India, CCG's initiatives are anchored at Anna University in Chennai. Established in early 2024, the partnership with the Centre for Climate Change and Disaster Management coordinates the South India CCG Network.

Diving Deeper: CCG Partner —The Kenyan Case

Overview

The Kenya CCG Network has been active since early 2021, and Kenya was CCG's first partner country. Our institutional partners are based at the Strathmore Energy Research Centre of Strathmore University. Through this network, CCG collaborates with a wide range of Kenyan institutions, including the Ministry of Energy and Nairobi University.

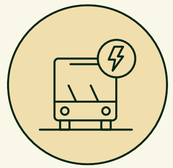
The Kenya CCG Network is supporting the Government of Kenya's implementation of evidence-based, inclusive, and low-emission development policies to mobilise finance for climate-compatible infrastructure that drives resilient economic growth.

Figure 9: The seven Special Interest Groups of the Kenya CCG Network

KENYA

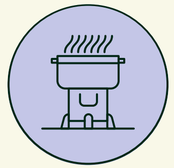
SIG 1
NATIONAL ENERGY PLANNING

SIG 2
COUNTRY ENERGY PLANNING



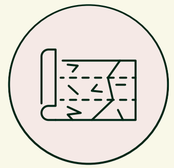
SIG 3
LOW-EMISSION TRANSPORT

SIG 4
POLICY PATHWAYS



SIG 5
CLEAN COOKING

SIG 6
CLIMATE ENTREPRENEURSHIP



SIG 7
CLIMATE LAND, ENERGY, WATER

SIG 1
National Energy Planning: In 2021, the Ministry of Energy and Petroleum requested support for their least-cost power development planning (LCPDP). CCG has been supporting them by co-creating a Kenya-specific power system model using OSeMOSYS and FlexTool, which are CCG-supported energy modelling tools that are open source *(see Section 3)*.

SIG 2
County Energy Planning: This SIG coordinates and standardises County Energy Plans across Kenya's 47 counties to support the County Integrated Development Plans process, linking to national planning activities.

SIG 3
Low-Emission Transport: Kenya is working towards a target of electrifying its transport system, with a focus on electric vehicles and charging stations. This SIG supports these efforts by addressing Kenya's potential to become an electric two-wheeler assembly hub for East Africa.

SIG 4
Policy Pathways: This SIG focuses on research outputs related to gender equality, social inclusion, and the political economy of power planning, providing policy-making capacity support.

SIG 5
Clean Cooking: In 2021, the Ministry of Energy and Petroleum requested assistance to develop clean cooking strategies. CCG coordinates this SIG, liaising with other organisations that provide research expertise.

SIG 6
Climate Entrepreneur: This SIG aims to support climate adaptation entrepreneurs in Kenya, who are vital for addressing climate impacts in sectors like agriculture and energy. By enhancing access to finance and building technical capacity, it seeks to enable these entrepreneurs to scale their innovative solutions while advocating for tailored regulations that minimise friction in emerging climate sectors.

SIG 7
Climate, Land-use, Energy, and Water Systems (CLEWs): By assessing how the production and use of these resources contribute to climate change and vice versa, this SIG aims to identify pressure points, synergies, and trade-offs for sustainable development. The CLEWs approach will inform policy decisions related to clean energy promotion, water competition, and agricultural modernisation.

Kenya CCG Network Annual Workshop 2024

As part of CCG's engagement with partner countries, it holds annual workshops to strengthen collaboration and advance shared goals for climate-compatible growth.

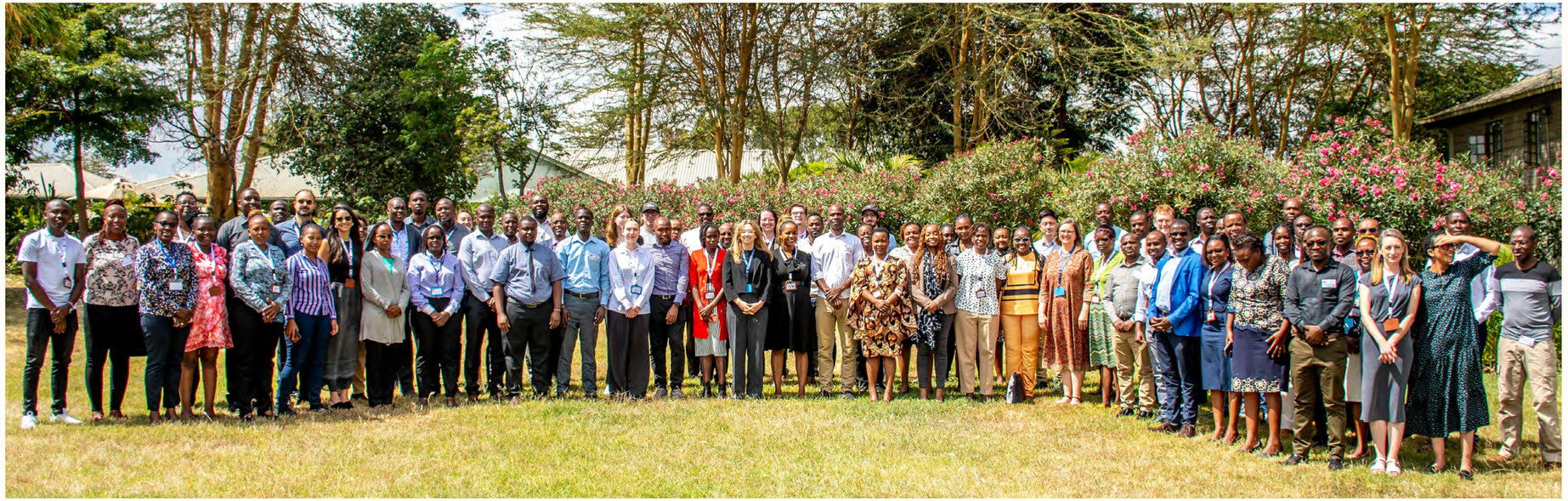


Photo:
A group photo of delegates who attended the Kenya CCG Annual workshop in 2024.

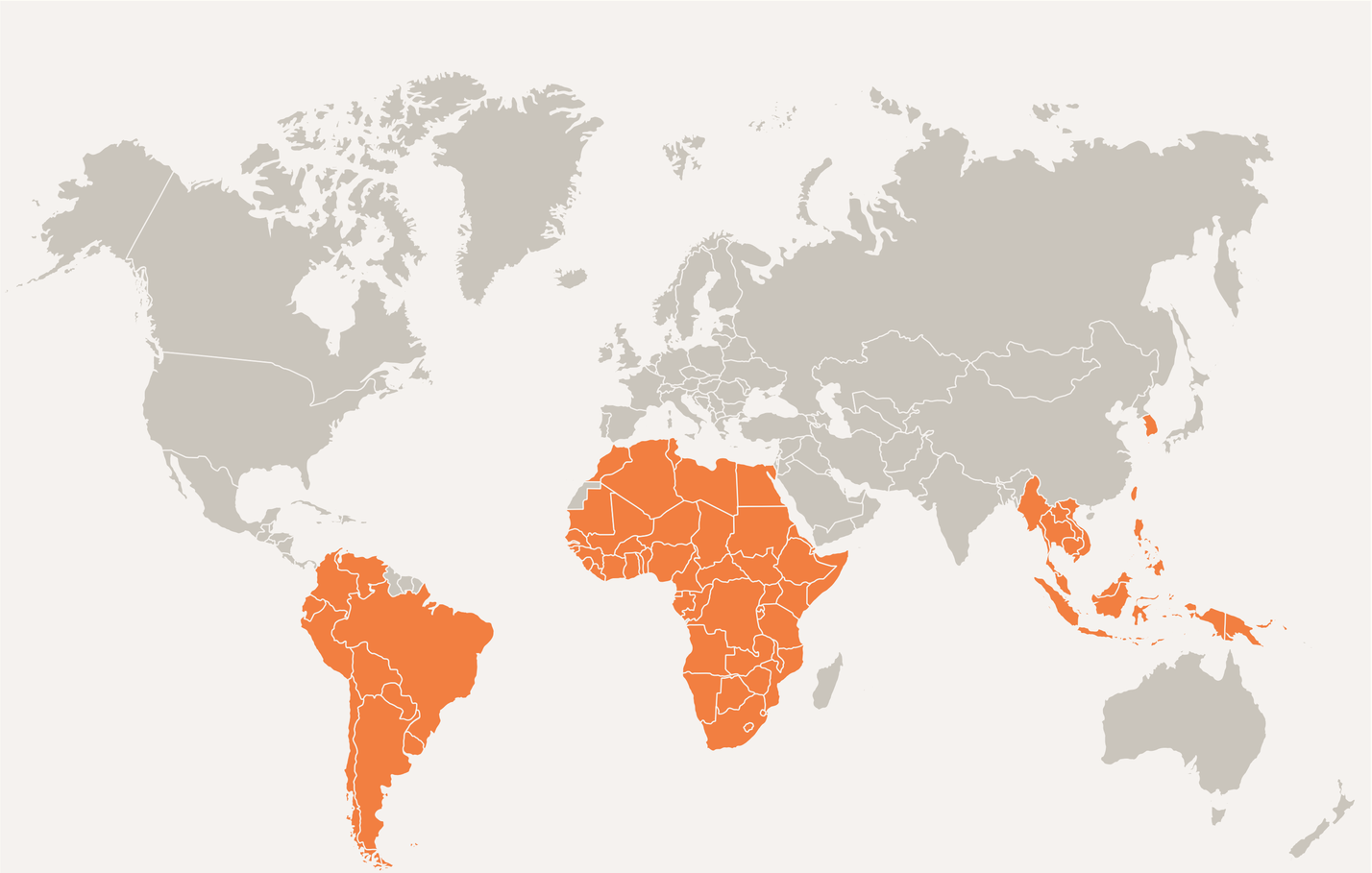
On 20–21 February 2024, the Kenya CCG Network held its fourth annual workshop at Maanzoni Lodge, bringing together 87 delegates from government, academia, international organisations, NGOs, and industry. The event focused on fostering cross-sector connections, celebrating the past year's achievements, and setting priorities for the SIGs for the coming year.

Key sessions included updates on Kenya's National Cooking Transition Strategy, the newly launched Green Hydrogen Strategy, collaborative energy initiatives, and continued development of workplans for SIGs. The workshop featured a poster session showcasing notable research, on topics such as green hydrogen and climate-friendly cooking. These contributions highlighted key advancements in clean energy and sustainable transport. Awards were presented for best posters and group presentations, recognising outstanding contributions from the network.

2.2

Partnerships at International Level

The success of CCG's initiatives has been driven by partnerships with esteemed international organisations, such as, the 2050 Pathways Platform, Asian Development Bank (ADB), Green Grids Initiative (GGI), International Atomic Energy Agency (IAEA), International Energy Agency (IEA), International Renewable Energy Agency (IRENA), OpTIMUS Community of Practice, Sustainable Energy for All (SEforALL), Sustainable Mobility for All (SuM4All), the United Nations Department of Economic and Social Affairs (UNDESA), United Nations Development Programme (UNDP), World Bank Group (WBG) and World Resources Institute (WRI).



Africa
Algeria
Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
CAR
Chad
Cote d'Ivoire
DROC
Djibouti
Egypt
Equatorial Guinea
Eritrea
Eswatini
Ethiopia
Gabon
The Gambia
Ghana
Guinea
Guinea-Bissau
Kenya
Lesotho
Liberia
Libya
Malawi
Libya
Malawi
Mali
Mauritania
Morocco
Mozambique
Namibia
Niger
Nigeria
CG
Rwanda
Lesotho
Senegal
Sierra Leone
Somalia
South Africa
South Sudan
Sudan
TZA
Togo
Tunisia
Uganda
Zambia
Zimbabwe

Asia & Oceania
Cambodia
Indonesia
Lao PDR
Malaysia
Myanmar
Papua New Guinea
Philippines
South Korea
Taiwan
Thailand
Viet Nam

South America
Argentina
Bolivia
Brazil
Chile
Colombia
Ecuador
Paraguay
Peru
Uruguay
Venezuela

Through these partnerships, CCG has been delivering a variety of impactful outputs for empowering global stakeholders with the knowledge and tools necessary for effective and sustainable climate-compatible growth. These include the publication of more than **80 policy briefs and working papers**. CCG has also launched more than **180 Starter Data Kits (SDK)** for energy systems and transport modelling.

These kits serve as valuable resources for further model development and scenario analysis across more than 60 countries **(Figure 10)**. CCG has organised numerous events at key international fora, including COP26, COP27, and COP28, as well as **nine Energy Modelling Platform (EMP) events across Africa, Europe, and Latin America**. Additionally, CCG has curated hundreds of teaching materials available through the OpenLearn Collection (OLC), developed in collaboration with the Open University (**see Section 3**).

Figure 10:
CCG starter data kits by country.

Examples of CCG International Partnerships

International Atomic Energy Agency (IAEA)
The IAEA and CCG have forged a pioneering partnership by collaborating to share three energy modelling tools as open resources. This initiative aligns with the IAEA's mission to assist countries in using nuclear science for sustainable development.

CCG's role in this collaboration includes the provision of training to enhance the capacity of energy professionals, promoting a technology-neutral approach to energy planning. The modelling tools released—MAED, FINPLAN, and EBS—enable countries to assess energy demand, evaluate financial implications of sector expansion, and construct energy balances, respectively. Training courses for these tools are freely accessible on the OpenLearn Collection webpage, and additional in-depth training is offered during the Energy Modelling Platform events co-organised by CCG as part of the OpTIMUS Community.

International Energy Agency (IEA)
The collaboration between CCG and IEA has already yielded substantial results. Through its engagement with the IEA, CCG has significantly contributed to improving the IEA's Technical Assistance Programme for sub-Saharan Africa, which is funded by the European Union. This programme aims to enhance energy data management and long-term planning across selected countries in the region, promoting sustainable and inclusive economic growth through a transition to low-carbon energy systems.

CCG has provided valuable resources and expertise, facilitating the integration of effective capacity-building activities within the programme. By offering online learning courses and comprehensive data frameworks, CCG has equipped government officials across ten participating countries with essential skills and practical knowledge vital for advancing energy transition objectives.

A key example of the positive outcomes from this collaboration is Uganda's Energy Transition Plan (ETP), which was developed with support from CCG as part of the IEA's enhanced Technical Assistance Programme. The ETP serves as a strategic roadmap for the modernisation of Uganda's energy sector, aiming to achieve universal access to modern energy by 2028 and support the country's sustainable economic transformation.

Examples of CCG International Partnerships

Green Grids Initiative (GGI)

CCG fosters global collaboration on research focused on green grids, supporting the Green Grids Initiative (GGI).

Launched by world leaders during COP26 in Glasgow, the GGI and the One Sun, One World, One Grid partnership created the largest global political coalition for clean energy. The initiative aims to accelerate the development of the infrastructure required for a world powered by clean energy, having gained support from 90 countries through the One Sun Declaration.

This declaration identifies three key types of infrastructure that, if constructed promptly, could significantly enhance humanity's ability to confront the climate crisis:

- Clean energy superhighways
- Renewable energy mini-grids
- Smart charging infrastructure for electric vehicles

Energy Transition Council (ETC)

- Launched in April 2021, the Rapid Response Facility (RRF) of the Energy Transition Council (ETC) serves as a technical assistance initiative aimed at supporting countries in their energy transitions. It focuses on providing diverse forms of assistance, such as strategic planning, capacity-building, and technical expertise to streamline decision-making processes for developing nations.

- CCG has been instrumental in providing technical expertise to support several projects under the RRF, enhancing sustainable energy efforts across various countries. Key initiatives include:

- Helping the Ministry of Energy of Kenya in the modern energy planning process.

- Supporting the Ministry of Energy of Kenya in developing the Kenya National Cooking Transition Strategy.

- Conducting a techno-economic (pre)feasibility study for the Ministry of Energy and Mines in Lao PDR.

- Implementing training programmes in energy demand, integrated resource planning, and resilience planning for the Department of Energy Policy and Planning in Lao PDR.

- Providing generation planning tools to the Department of Energy Policy and Planning in Lao PDR.

- Conducting a feasibility study for green energy parks in collaboration with the Carbon Trust for the Lagos State Government Ministry of Energy and Mineral Resources in Nigeria.

Examples of CCG International Partnerships

Transport Data Commons Initiative (TDCI)
CCG is partnering with the Transport Data Commons Initiative (TDCI) to enhance sustainable transportation through effective data sharing and analysis.

Launched in May 2022, TDCI is a coalition of over 30 organisations committed to establishing a common platform for transport-related data, enabling stakeholders to make informed decisions and develop sustainable transportation solutions. To fast-track delivery, TDCI has established three working groups focused on strategy matters, data architecture, and user perspectives, while regularly convening as a full group.

Photo:
Holger Dalkmann at COP 28.

NB: The engagement that characterises CCG's partnerships is far more than "Research Uptake," it co-creates and induces research which it also supports where induced research is driven by international organisations and analysts from the South. This is a critical outcome of CCG's work.

3.0
Building Capacity

A key barrier to the clean energy transition in the Global South is the lack of in-country expertise in energy modelling for policy and planning. Reliance on external consultants can be costly and fails to create lasting knowledge. CCG addresses this by providing free training and support to government teams, ensuring they develop and sustain expertise in energy modelling. Through tailored capacity-building initiatives, policymakers, advisors, and academics — both mid-career professionals and students — gain the skills needed to apply these tools effectively. This approach embeds knowledge within institutions, enabling long-term impact.

3.1 OpenLearn Courses

In collaboration with various international partners and universities, CCG has developed the OpenLearn Collection (OLC), an Open University web portal that provides open access to a varied suite of training courses. These build foundational skills in a wide range of modelling techniques and analytical tools. The OLC aims to equip individuals with the materials necessary to learn how to use various tools and enhance capacity in partner countries.

To date, the OLC has achieved significant engagement metrics, with over 100k downloads and more than 1,500 certificates awarded globally, reflecting its impact across diverse regions. The courses are available in two languages, ensuring accessibility for a broad audience.

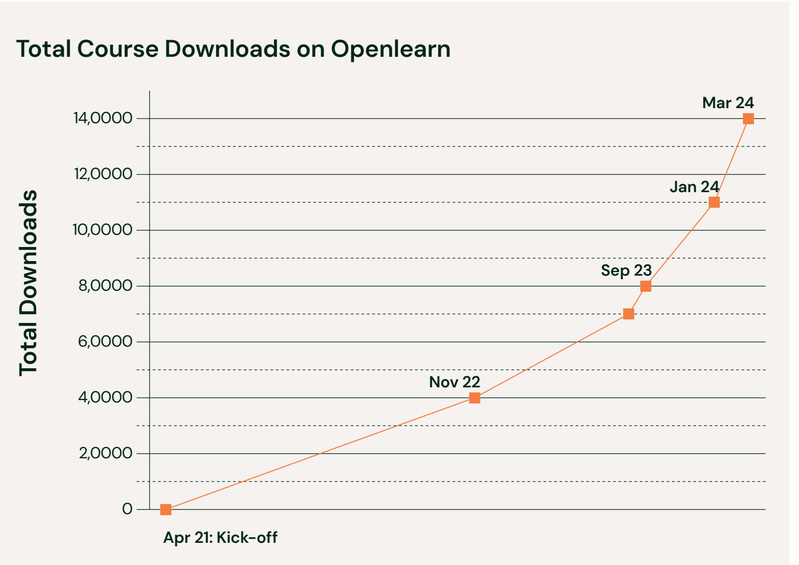
The OLC in numbers:

15
Available courses

134,525
Total course downloads

1,500
Total certificates awarded in five continents

2
Languages



3.1 OpenLearn Courses

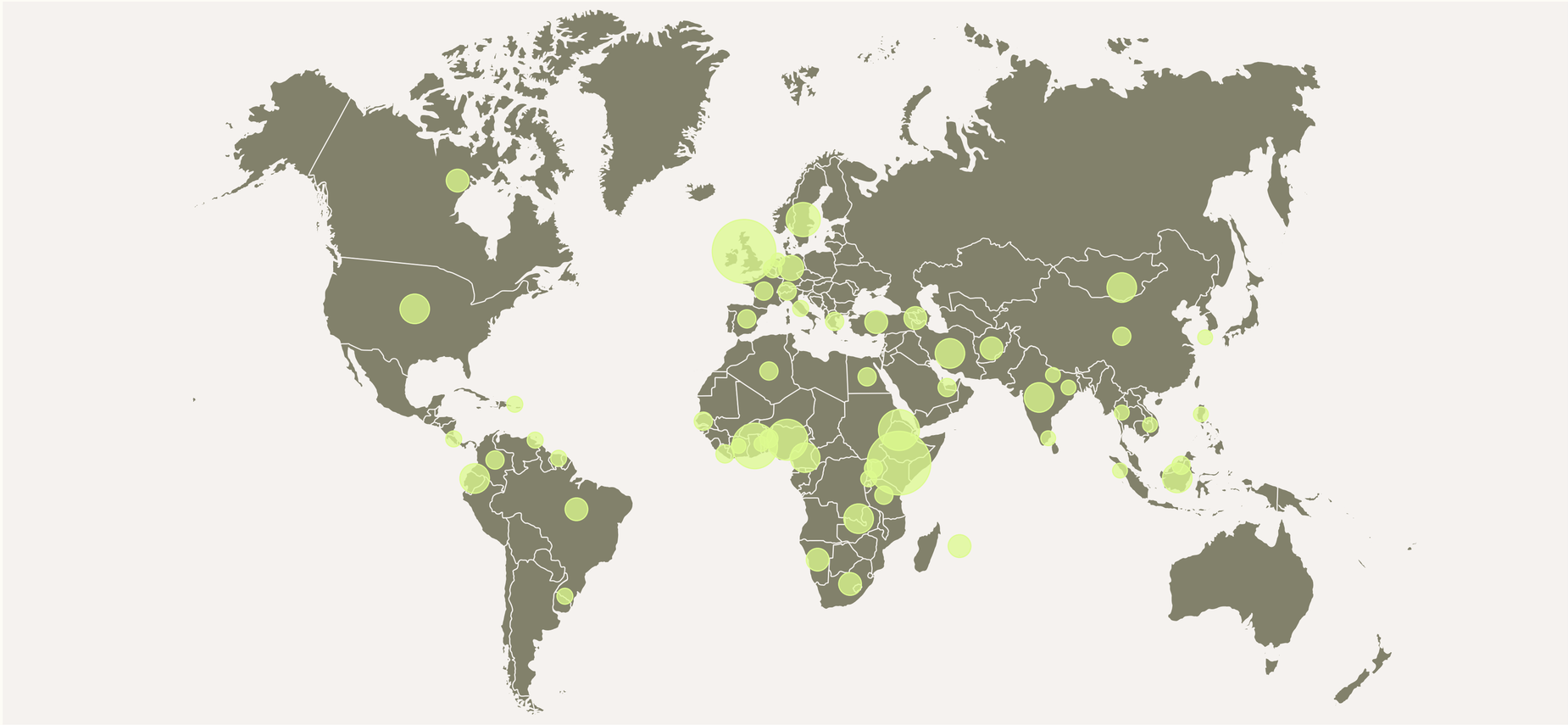


Figure 11:
The geographic spread of certificates awarded through CCG's OpenLearn Collection

The map above illustrates the global impact of the OLC courses, showing how widely participants from across five continents have engaged with the training. With certificates awarded in regions spanning Africa, Europe, Asia, North America, and South America, the OLC's reach demonstrates its effectiveness in building capacity and fostering knowledge exchange on a truly global scale **(Figure 11)**.

3.1 OpenLearn Courses

Introduction to CLEWs Website Link
The Electricity Transition Playbook Website Link
Energy Access Explorer: Data-driven, Integrated & Inclusive Energy Planning Website Link
Creating and Assessing an Energy Balance with EBS (Energy Balance Studio) Website Link
Financial Analysis of Power Sector Projects Using the FinPlan Model Website Link
Geospatial Data Management for Energy Access Modelling & Planning Website Link
Infrastructure and Climate Resilience Website Link
Model for Analysis of Energy Demand Website Link
Input-Output analysis & modelling with MARIO Website Link
Off-Grid Energy Systems Modelling with MicroGridsPy Website Link
Modelling, Policy & Political economy Website Link
Agent-based energy systems modelling: MUSE Website Link
OnSSET/The Global Electrification Platform Website Link
Geospatial clean cooking access modelling using OnStove Website Link
Energy and Flexibility Modelling: OSeMOSYS & FlexTool Website Link

3.1 OpenLearn Courses

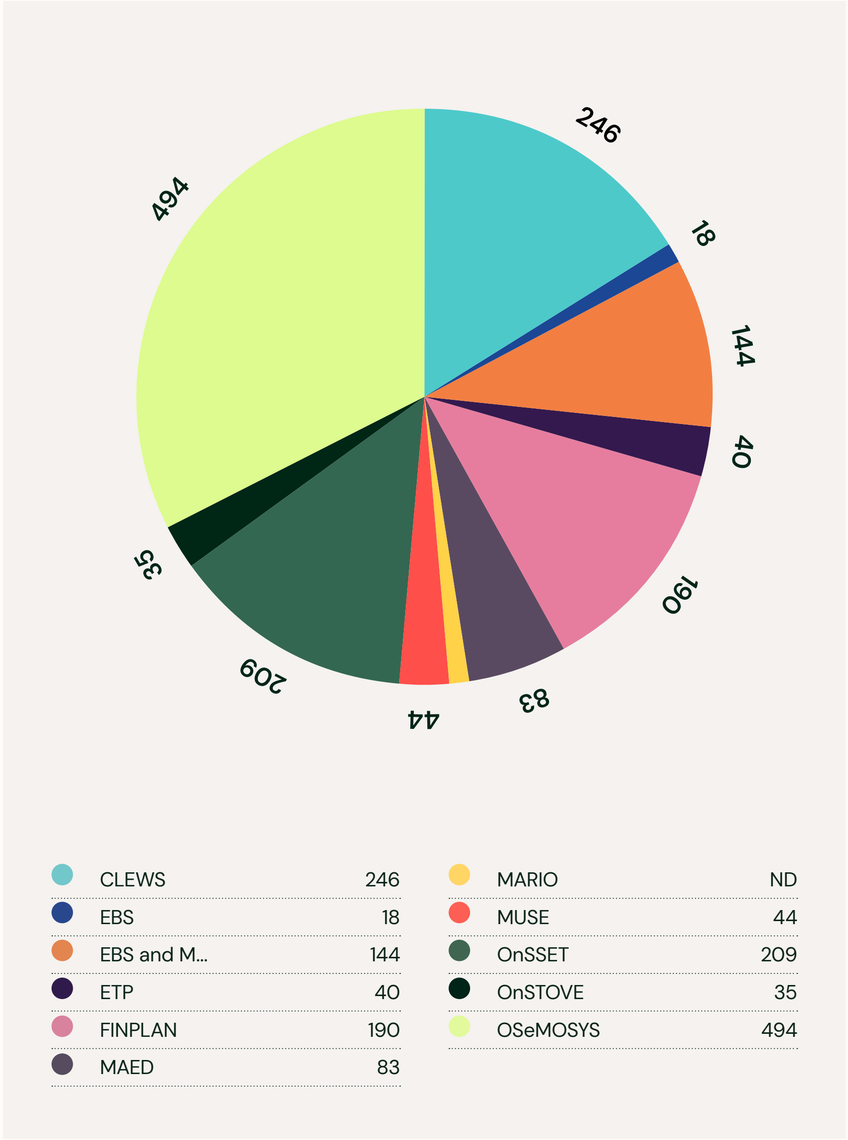


Figure 12:
Certificates awarded for each of CCG's OpenLearn Collection courses*

*NB:
Some of the courses are not yet listed in this data, as they have only recently been added to the OpenLearn Collection.

Figure 12 provides an overview of the distribution of certificates awarded for each course within the OLC from April 2021 to March 2024. Highlights include:

The OSeMOSYS and FlexTool course has issued 494 certificates, reflecting strong engagement in energy systems optimisation and modelling.

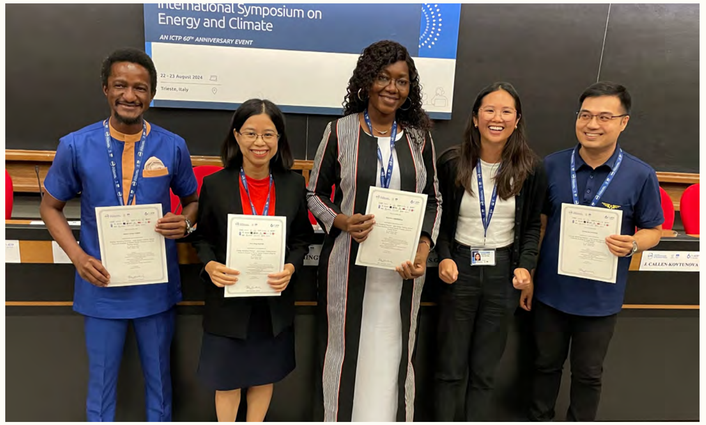
The CLEWs course has led to 246 certificates, demonstrating significant interest in integrated modelling of Climate, Land, Energy, and Water systems.

Other popular courses include OnSSET with 209 certificates, FinPlan with 190 certificates, and EBS and MAED with 245 certificates combined, highlighting the demand for courses related to geospatial energy planning and financial analysis for sustainable energy projects.

These courses can be supplemented by a Joint Summer School on Modelling Tools for Sustainable Development and the Energy Modelling Platform for Africa, Latin America, Europe, and Asia. More information can be found here.

3.2 Energy Modelling Platforms

The Energy Modelling Platform (EMP) is a global initiative designed to support a collaborative, open-source community dedicated to advancing sustainable development and climate-compatible growth. This initiative brings together governments, financial institutions, universities, consultants, and professionals to get free training in open-source tools and share knowledge regarding their energy and climate challenges.

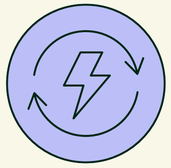


3.2 Energy Modelling Platforms

Objectives

Foster Collaboration

Bring together the energy planning and modelling community to share experiences, models, and data in climate, land, energy, and water systems.



Build Capacity

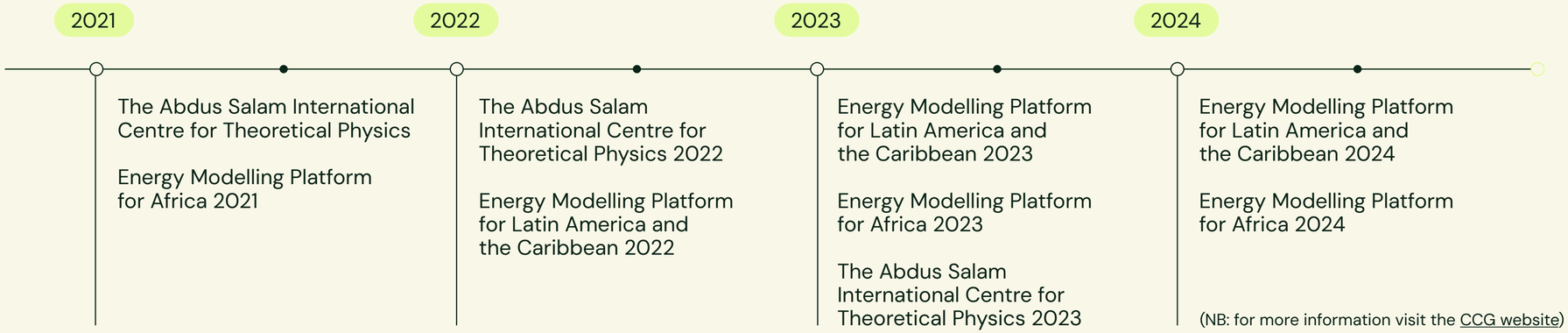
Enhance human and institutional capabilities for integrated energy modelling and investment planning.

Develop Centres of Excellence

Support the creation of centres of excellence for energy planning in various regions.

Promote Open-Source Tools

Encourage the use of open-source modelling tools to advance the implementation of the Sustainable Development Goals and the Paris Agreement.



(NB: for more information visit the CCG website)

3.3 Results

The EMPs have achieved substantial progress since their launch, as evidenced by key metrics in participation, geographic reach, and gender diversity.

1. Participation Trends

The increase in participation, particularly in 2023, reflects the growing interest and engagement in energy modelling and planning.

Year	Total Participants
2021	137
2022	84
2023	233
2024	51 (with more events scheduled)

2. Geographic Reach

Africa has shown the highest level of engagement, indicating the platform's significant impact in the region.

Continent	Number of Participants
Africa	350
Latin America	106
Asia	25
Europe	22
North America	2

3. Top Participating Countries

These figures demonstrate the EMP's strong presence in key regions.

Country	No. of Participants
Nigeria	53
Kenya	46
Ethiopia	40
Ghana	29
Rwanda	15
Brazil	18
Ecuador	18
Uganda	19
South Africa	11
Dominican Republic	11

4. Gender Diversity

Gender diversity has varied over the years, with a notable peak in female participation in 2022.

Year	Percentage of Female Participants
2021	27%
2022	36%
2023	29%
2024	24%
Overall	29%

5. Gender Diversity

Over 99% of participants have expressed a willingness to recommend the EMPs to others, underscoring the high quality and value of the training provided.

99%

would recommend.

3.4 Testimonials

"I applied the knowledge I gained [during a CCG capacity building event] by mapping all primary schools in the country without electricity and analysing the type of energy needed using the energy demand index formula".

Richard Bakubiye
President's Office – Regional Administration and Local Government of Tanzania.

"The training from ICTP helped in revising our National Electrification Plan [of Rwanda], considering grid extension, mini-grids, and standalone systems for energy distribution in various sectors".

Mankuebe Nkuebe
Department of Energy, Lesotho.

"I am happy to let you know that thanks to the (CCG) Summer School held in Trieste (...) I am now working as project lead for the World Resources Institute (WRI) on the "Energy Access Explorer customization project for Democratic Republic of the Congo (DRC)".

Frederic Abondance Famba
World Resources Institute.

"Using the OnSSET tool learned during the capacity-building event, I have published two research papers in the Elsevier journal (here and here). These papers focus on methodologies and tools taught at the event and have contributed to the academic and professional discourse on energy transition and rural electrification".

Salisu Isihak
Rural Electrification Agency of Nigeria.

"I have applied knowledge gained during the Energy Modelling Platform for Africa 2023 in developing Nigeria's energy transition plan, using a model tailored for Nigeria, called the Nigeria Energy Calculator 'NECAL2060'".

Nathan Awuapila
Energy Commission of Nigeria.

"After participating in EMP-Africa 2023, where I took part in the CLEWs track, I have been active in developing curricula at Strathmore University. The training gave me the skills to review the MSc. Sustainable Energy Transition, where we have included FINPLAN, CLEWs, OSeMOSYS & FlexTool, MAED & EBS, and OnSSET tools".

Joseph Obbo
Strathmore University, Kenya.

"I am incorporating the knowledge acquired to develop a methodology based on MARIO to determine water and carbon footprints in the building and construction sector at a country scale".

Pedro Maximiliano Cortez Lara
Monterrey Institute of Technology and Higher Education, Mexico.

4.0

Looking Ahead — Progress through Research and Partnership

CCG is set for significant advancements in the coming months and years, following confirmation from the UK Foreign, Commonwealth & Development Office (FCDO), its most important donor that the programme will continue until 2030. This five-year extension allows time for projects to mature, generating lasting impacts in low- and middle-income countries in the Global South.

In the coming years, CCG will expand to eight partner countries, adding Nepal and Malawi to India, Ghana, Kenya, Lao PDR, Vietnam, and Zambia. The programme will continue to establish collaborative networks or Special Interest Groups (SIGs), to unite researchers, policymakers, and practitioners in crafting tailored, climate-compatible solutions. In Ghana, for example, five SIGs will address areas such as sustainable transport, net-zero emissions, hydrogen systems, energy transition financing, and clean cooking.

CCG is forging partnerships with organisations like the European Commission (EC), ICTP-UNESCO, and IRENA to enhance its research and development capacity. The Energy Modelling Community (EMC) will continue to encourage knowledge exchange among energy modelling experts, supplementing the Energy Modelling Platform by offering more training opportunities. These efforts aim to drive transformative energy and transport investments while improving access to healthcare and education for millions across the Global South.

CCG is preparing to contribute to COP29 and COP30 and will launch an Asia-Pacific version of the Energy Modelling Platform (EMP) to build capacity in energy planning and management.

Post-2025, a revised research strategy will enhance collaboration between research and implementation partners, translating initiatives into practical solutions. Alongside themes like governance, energy systems, and transport economics, CCG will tackle cross-cutting topics such as “Data-to-Deal,” critical minerals, green hydrogen, and resilience. New research topics for the 2024 Flexible Research Fund (FRF) include examples such as the electrification of two- and three-wheelers in Ghana, addressing climate risks in India’s energy systems, county-level energy financing in Kenya, equitable transitions in Lao PDR, and advancing a circular economy in Vietnam. Similarly, the Southern Partner Fund (SPF) encompasses diverse projects, such as scaling solar PV adoption in Ghana, integrating informal settlements into Kenya’s energy models, and critical minerals governance in Zambia, among others.

Complementing these, the new Engagement Fund will support partner-led initiatives like the Transport Data Commons Initiative, Climate Finance Upskilling, and the African Institute for Sustainable Energy in Cape Town. CCG’s research programme spans six key areas, including GESI-transformative approaches, innovative energy modelling in LMICs, and applying AI for sustainable development.

The core work of CCG is funded by UK aid and its operating territory is clearly defined. However, our work over the past four years has created and fine-tuned a proven range of knowledge products (particularly training courses, energy modelling tools and ready-made curriculum materials) which can be adopted by any organisation with the appropriate funds, for use in any country.

These CCG products are rooted in two major themes — achieving an inclusive net-zero future AND empowering a country to use this as an opportunity to grow its economy and address the many societal issues that have remained outstanding because of a lack of funds: education, health, empowering marginal communities and so on. As such, they offer a way in to tackling these challenges; a way to connect rural communities, to empower women, to create sustainable income-generating industries for each country, to educate young people and to realise the full potential of their rich human and material resources, at last.

We plan to approach potential partners this year — particularly philanthropic organisations — to discuss this potential and how our knowledge products could help them achieve their goals for their partners in the global south.

If you would like to discuss this, please get in touch: ccg@lboro.ac.uk

5.0

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Financial Analysis of Power sector Project Using the FinPlan Model

Introduction to CLEWs

Agent-based energy systems modelling: MUSE

Infrastructure and Climate Resilience

Modelling, Policy and Political economy

Energy demand Projections with MAED (Model for Analysis of Energy Demand)

Creating and Assessing and Energy Balance with EBS (Energy Balance Studio)

Input-Output analysis and modelling with MARIO

Geospatial clean cooking access modelling OnStove

Geospatial Data Management for Energy Access Modelling Planning

Energy Access Explorer: Data-driven, Integrated and Inclusive Energy Planning

The Electricity Transition Playbook

Off-Grid Energy Systems Modelling with MicroGridsPy

Open Learn Collection (Online Courses — Spanish)

OnSSET/Plataforma Global de Electrificación

Modelización de la energía y la flexibilidad: OSeMOSYS & FlexTool (Windows)

Modelización de la energía y la flexibilidad: OSeMOSYS & FlexTool (MAC)

Análisis financiero de proyectos del sector eléctrico mediante el modelo FINPLAN

Evaluación de la demanda de energía y escenarios: MAED y EBS

Introducción a los CLEWs

Tools

OnStove – Open Source Spatial Clean Cooking Tool

OnSSET and http://www.onsset.org/

OSeMOSYS – Open Source Energy Modelling System

FlexTool – peroms power system flexibility assessments

CLEWs – Climate, Land, Energy, and Water Systems

FINPLAN – Model for Financial Analysis of Electric Sector Expansion Plans

MAED – Model for Analysis of Energy Demand

MinFin – Model for Informed National Financing (in development)

PathCalc – Pathways Calculator (in development)

OSeMobility (in development)

Teaching Materials

Teaching Kits (Resources for lectures and trainers to use in their own courses/events to be downloaded)

Teaching Kits Curriculum

Introduction to Clews (11 lectures)

Energy and Flexibility Modelling OSeMOSYS and FlexToo

Demonstration Videos

Video: HO1	Installation software SANDxOSeMOSYS
Video: HO2	Energy and Flexibility Modelling “First steps in building a OSeMOSYS model”
Video: HO3	Energy and Flexibility Modelling “Running simple model”
Video: HO4	Energy and Flexibility Modelling “Define domestic and external commodities”
Video: HO5	Energy and Flexibility Modelling “Define main technologies for electricity transmission”
Video: HO6	Energy and Flexibility Modelling “Define main energy production technologies”
Video: HO7	Energy and Flexibility Modelling “Define renewable technologies”
Video: HO8	Energy and Flexibility Modelling “Define emissions and reserve margin”
Video: HO9	Energy and Flexibility Modelling “Define electricity demand sectors”
Video: HO10	Energy and Flexibility Modelling “Define three main scenarios”

Video:	Starter Kit Download
Video:	Reduce Modelling Period
Video:	Reduce Timeslices
Video:	How to run a SAND Text File on the OSeMOSYS Cloud using Windows
Video:	Adding constraints to a model
Video:	Installing and using ClicSAND 3.0 on Windows
Video:	Installing and using ClicSAND 3.0 on Mac
Demonstration Video:	Visualisation Template for OSeMOSYS Scenarios

Open Data Sets

CCG 'Energy and Transport Starter Data Kits' currently cover all countries in mainland Africa, as well as countries across Asia, Oceania, and South America.

All are available from the links below and also from an Interactive Map on the CCG website.

Region	Continent	Energy Dataset	Energy Data Note	Transport Dataset
All Countries	Global	—	—	TR- Data
Algeria	Africa	EN- Data	EN- Pre-print	TR- Data
Angola	Africa	EN- Data	EN- Pre-print	TR- Data
Benin	Africa	EN- Data	EN- Pre-print	TR- Data
Botswana	Africa	EN- Data	EN- Pre-print	TR- Data
Burkina Faso	Africa	EN- Data	EN- Pre-print	TR- Data
Burundi	Africa	EN- Data	EN- Pre-print	TR- Data
Cameroon	Africa	EN- Data	EN- Pre-print	TR- Data
CAR	Africa	EN- Data	EN- Pre-print	TR- Data
Chad	Africa	EN- Data	EN- Pre-print	TR- Data
Cote d'Ivoire	Africa	EN- Data	EN- Pre-print	TR- Data
DRC	Africa	EN- Data	EN- Pre-print	TR- Data
Djibouti	Africa	EN- Data	EN- Pre-print	TR- Data
Egypt	Africa	EN- Data	EN- Pre-print	TR- Data
Equatorial Guinea	Africa	EN- Data	EN- Pre-print	TR- Data
Eritrea	Africa	EN- Data	EN- Pre-print	TR- Data
Eswatini	Africa	EN- Data	EN- Pre-print	TR- Data
Ethiopia	Africa	EN- Data	EN- Pre-print	TR- Data
Gabon	Africa	EN- Data	EN- Pre-print	TR- Data
The Gambia	Africa	EN- Data	EN- Pre-print	TR- Data
Ghana	Africa	EN- Data	EN- Pre-print	TR- Data
Guinea	Africa	EN- Data	EN- Pre-print	TR- Data
Guinea-Bissau	Africa	EN- Data	EN- Pre-print	TR- Data
Kenya	Africa	EN- Data	EN- Pre-print	TR- Data
Lesotho	Africa	EN- Data	EN- Pre-print	TR- Data
Liberia	Africa	EN- Data	EN- Pre-print	TR- Data
Libya	Africa	EN- Data	EN- Pre-print	TR- Data
Malawi	Africa	EN- Data	EN- Pre-print	TR- Data
Mali	Africa	EN- Data	EN- Pre-print	TR- Data
Mauritania	Africa	EN- Data	EN- Pre-print	TR- Data
Morocco	Africa	EN- Data	EN- Pre-print	TR- Data
Mozambique	Africa	EN- Data	EN- Pre-print	TR- Data
Namibia	Africa	EN- Data	EN- Pre-print	TR- Data
Niger	Africa	EN- Data	EN- Pre-print	TR- Data
Nigeria	Africa	EN- Data	EN- Pre-print	TR- Data
Republic of Congo	Africa	EN- Data	EN- Pre-print	TR- Data
Rwanda	Africa	EN- Data	EN- Pre-print	TR- Data
Senegal	Africa	EN- Data	EN- Pre-print	TR- Data
Sierra Leone	Africa	EN- Data	EN- Pre-print	TR- Data
Somalia	Africa	EN- Data	EN- Pre-print	TR- Data
South Africa	Africa	EN- Data	EN- Pre-print	TR- Data
South Sudan	Africa	EN- Data	EN- Pre-print	TR- Data
Sudan	Africa	EN- Data	EN- Pre-print	TR- Data
TZA	Africa	EN- Data	EN- Pre-print	TR- Data
Togo	Africa	EN- Data	EN- Pre-print	TR- Data
Tunisia	Africa	EN- Data	EN- Pre-print	TR- Data
Uganda	Africa	EN- Data	EN- Pre-print	TR- Data
Zambia	Africa	EN- Data	EN- Pre-print	TR- Data
Zimbabwe	Africa	EN- Data	EN- Pre-print	TR- Data
Cambodia	Asia	EN- Data	EN- Pre-print	TR- Data
Indonesia	Asia	EN- Data	EN- Pre-print	TR- Data
Lao PDR	Asia	EN- Data	EN- Pre-print	TR- Data
Malaysia	Asia	EN- Data	EN- Pre-print	TR- Data
Myanmar	Asia	EN- Data	EN- Pre-print	TR- Data
Philippines	Asia	EN- Data	EN- Pre-print	TR- Data
South Korea	Asia	EN- Data	EN- Pre-print	TR- Data
Taiwan	Asia	EN- Data	EN- Pre-print	TR- Data
Thailand	Asia	EN- Data	EN- Pre-print	TR- Data
Viet Nam	Asia	EN- Data	EN- Pre-print	TR- Data
Papua New Guinea	Oceania	EN- Data	EN- Pre-print	—
Argentina	South America	EN- Data	EN- Pre-print	—
Bolivia	South America	EN- Data	EN- Pre-print	—
Brazil	South America	EN- Data	EN- Pre-print	TR- Data
Chile	South America	EN- Data	EN- Pre-print	—
Colombia	South America	EN- Data	EN- Pre-print	TR- Data
Ecuador	South America	EN- Data	EN- Pre-print	—
Paraguay	South America	EN- Data	EN- Pre-print	—
Peru	South America	EN- Data	EN- Pre-print	—
Uruguay	South America	EN- Data	EN- Pre-print	—
Venezuela	South America	EN- Data	EN- Pre-print	—

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Annexes

Abbreviations

A&R	Adaptation and resilience
ADB	Asian Development Bank
CCG	Climate Compatible Growth
CLEWs	Climate, Land, Energy and Water systems
COP	Conference of the Parties of the United Nations Framework Convention on Climate Change
EAE	Energy Access Explorer
EBS	Energy Balance Studio
ETC	Energy Transition Council
ETP	Energy Transition Plan (Uganda)
ETP	Energy Transition Playbook (CCG OpenLearn Course)
EV	Electric Vehicle
FinPlan	Model for Financial Analysis of Electric Sector Expansion Plans
GGI	Green Grids Initiative
IAEA	International Atomic Energy Agency
ICTP	Abdus Salam International Centre for Theoretical Physics
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
KNCTS	Kenya National Cooking Transition Strategy 2024–2028
KNUST	Kwame Nkrumah University of Science and Technology
MAED	Model for Analysis of Energy Demand
MARIO	Multi-Regional Analysis of Regions through Input-Output
MoEP	Ministry of Energy and Petroleum (Kenya)
MUSE	ModUlar energy system Simulation Environment
NEU	National Economics University (Vietnam)
NGO	Non Governmental Organisation
OLC	OpenLearn Create
OnSSET	Open Source Spatial Electrification Tool
OSeMOSYS	Open Source Energy Modelling System
RRF	Rapid Response Facility
SEforALL	Sustainable Energy for All
SIG	Special Interest Group (CCG)
SSA	Sub-Saharan Africa
SuM4ALL	Sustainable Mobility for All
TDCI	Transport Data Commons Initiative
UCL	University College London
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
WBG	World Bank Group

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Climate Compatible Growth

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