EngineeringX

Universidad de los Andes

UNIVERSIDAD DE ANTIOQUIA

UK Science & Innovation Network

British Embassy Colombia

Colombia energy sector workshop report

26 April 2024

Royal Academy of Engineering

LR Foundation

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Executive summary

This report summarises a workshop held by Colombian and UK partners on 26 April 2024 in Bogotá, Colombia. The workshop aimed to understand the barriers and opportunities to increasing access to sustainable energy in Colombia, focusing on including marginalised voices and adopting a systems approach to enhance outcomes. The event followed a three-day global Frontiers symposium on systems approaches in a just energy transition and was chaired by Professor Franklin Jaramillo from Universidad de Antioquia.

Colombia and the just energy transition

Colombia's energy mix includes 23% renewables, surpassing the global average of 14%. Despite strong political will to mitigate climate change, though energy is not the focus, challenges persist in transitioning to renewable sources due to infrastructure needs, climate variability, and economic dependency on fossil fuel exports. Energy access is uneven, with 97% connected to the grid but 20% of the population considered energy poor. This includes the northern region of La Guajira which has high levels of poverty despite high renewable energy potential. Communities – 50% of which are Indigenous – have historically been marginalised with little or no relationship with the government and have been excluded from economic benefits of development in the region, for example from coal plants. Colombia has a history of self-organisation, as reflected by the emergence of 'energy communities', a public policy still under construction, in which citizens seek to provide energy for their community and local economic benefits.

Systems approaches

A systems approach, which emphasises the interconnections within socio-technical systems, was highlighted as essential for addressing Colombia's energy challenges. Such an approach can facilitate better decision-making and innovation by aligning technology, processes, and policy to achieve more effective outcomes.

Systems approach

A *systems approach* is a holistic and interdisciplinary way of understanding and solving complex problems. It views the world as a collection of interconnected and interdependent elements or people and emphasises the relationships and interactions between them.

Who was at the workshop?

The workshop gathered representatives from academia, government, industry, civil society, and financial institutions, who discussed their roles in the energy transition. Participants identified key stakeholders in Colombia's energy system, including government, academia, industry, and civil society. However, significant gaps were noted, particularly the exclusion of consumers, Indigenous and Afro-Colombian communities, financial institutions, and miners and fossil fuel companies.

Key findings

Lack of coordination and shared direction:
There is significant activity within the energy system, but efforts are often uncoordinated and communication between actors poor, leading to less impactful outcomes. A central connecting mechanism, potentially led by the government, is needed.

Academia's untapped potential:
Academia's role in knowledge generation and innovation is underutilised, particularly in informing policy. Improved engagement with policymakers is necessary.

Exclusion of communities:
Marginalised communities, especially in remote areas, are excluded from energy discussions and lack trust in government and industry initiatives.

Building trust and involving these communities from the project inception is crucial, whilst ensuring their autonomy. Energy communities could be a solution.

Passive consumer role:
Consumers currently have a passive role in the energy system. Public education and training are needed to empower consumers and integrate their needs into energy decisions.

Financial feasibility and innovation:
Understanding the financial feasibility of the energy transition is critical, requiring greater involvement from financial institutions and innovation in financing mechanisms, including how to derisk initial investments. There is a tension between building cooperation in the system and developing economic competitiveness.

Inclusion of industry:
Companies are crucial to the transition but often feel excluded from discussions. Their role and contributions must be recognised, and their involvement strengthened, including working with academia on how to connect the 'market pull' and science push' to develop new technologies to support the transition.

Need for agile regulation:
Current regulation is slow and not context specific. Agile, evidence-based regulation is needed to keep pace with the transition and support decentralisation of the system.

Systems approach:
A systems approach is vital but challenging to implement. It requires training, time, and resources to deliver and effectively engage all stakeholders. Key questions were asked on who is responsible for resolving tensions in the system? How can it be effectively governed to achieve a shared goal?

Calls to action

- **Develop a network which prioritises collaboration:** Create a multidisciplinary energy network that fosters collaboration and knowledge exchange, directly influences policy, and drives towards a common goal. Include all sectors, especially industry and fossil fuel companies.
- **Government must set achievable targets with clear pathways:** Government should set achievable targets with clear pathways supported by cross-sector leaders, recognising energy as both a development and environmental issue.
- **Better connect academia with other stakeholders:** Academia must strengthen ties with government and industry, promoting research that informs policy and supports innovation.
- **Include and educate communities:** Ensure consumer and community inclusion in energy projects. Government should enhance public education on energy efficiency.
- **Innovate governance to support the transition:** Develop new governance structures, such as regulatory sandboxes, to support agile and decentralised energy regulation.
- **Map the system and financial resources:** Conduct a comprehensive mapping of the Colombian energy system, including available financial resources.
- **Develop pilot projects:** Implement small-scale, high-impact pilot projects to test systems approaches, share results, and refine transition plans.
- **Identify systems champions:** Support ongoing projects that adopt systems approaches, led by individuals driving systemic change.

Introduction

This report summarises a workshop held by Colombian and UK partners on 26 April 2024 in Bogotá, Colombia, which brought together 40 stakeholders from across the Colombian energy sector to gather perspectives and build understanding of the barriers and opportunities to increase access to sustainable energy in Colombia. The workshop sought to understand different motivations within the system, and particularly consider whose voices were not being included and what barriers this could cause. Participants considered whether taking a systems approach to this challenge could improve outcomes. The event followed a three-day global Frontiers symposium on systems approaches in a just energy transition and was chaired by Professor Franklin Jaramillo from Universidad de Antioquia.

Colombia and the just energy transition

Colombia's primary energy comes from a mix of fossil and renewable sources. 23% is from renewables, which is higher than the global average of 14%. There is strong political will to mitigate climate change, though the main focus of emissions mitigation is agriculture, forestry, and land use, rather than energy. There is potential to transition to more renewable sources but there are major challenges. Several regions, for instance, are rich in hydropower resources and others in solar and wind, but transporting this energy to other areas requires further development of grid infrastructure, both within the country and with neighbouring countries. Additionally, renewables are highly variable as they depend on the weather. For example, droughts recently affected the hydropower generation as part of multi-annual phenomena such as El Niño and La Niña. Another major challenge is that Colombia's exports are currently 50-65% dependent on fossil resource exports, so there is a need to transform the country's economy.

Energy access is divided: around 97% of the population have access through the national grid, but almost 20% are energy poor. This means around 800,000 people do not have access to electricity. This includes the northern region, La Guajira, where communities do not have access despite there being high potential for renewable energy, as solar radiation levels are significantly higher than the national average and wind speeds reach up to 10 metres per second. However, the region has some of the highest levels of poverty in the country, with high rates of malnutrition and drought. In the past, local communities – 50% of which are Indigenous – were marginalised, with little or no relationship with the government, and have been excluded from economic benefits of development in the region, for example from coal plants.

Colombia also has a history of community self-organisation and mobilisation, and this is apparent in the creation of 'energy communities', a public policy still under construction. These are groups of citizens that seek to cooperate to provide energy for their community, optimise energy efficiency and simultaneously create economic benefits and provide local employment and community ownership of the distributed energy system.

Systems approaches

A systems approach is a holistic and interdisciplinary way of understanding and solving complex problems. It views the world as a collection of interconnected and interdependent elements or people and emphasises the relationships and interactions between them. A true systems approach does not deliver solely technical solutions. It ensures the appropriate alignment of technology, processes, interactions and policy to deliver innovative responses to today's most complex and pressing challenges.

The energy system is complex and consists of many socio-technical systems that are highly interconnected and interdependent on one another. Therefore, it is important to implement solutions that acknowledge those interconnections, uncertainty, and complexity. Taking a systems approach to the just energy

transition could help actors think differently and enable decision-makers and actors in the system to design, create, and maintain interventions that produce better outcomes.

Who was at the workshop?

40 key actors in the Colombian energy sector from across different stakeholder groups attended the workshop. First, each actor described their perceived role in the transition. This helped to build an understanding of how different stakeholders view their role in the system, and as the conversation progressed, identify if their role was viewed differently by others.

The stakeholder groups were as follows:

Academia

Stakeholders
Universidad de los Andes, Universidad de Antioquia, Universidad del Rosario, Universidad Nacional de Colombia, University of Exeter

Perceived role
Build knowledge and train leaders, providing a source of innovation, as well as supporting its development.

Government

Stakeholders
Ministry of Mines and Energy, British Embassy Colombia

Perceived role
National government focuses on regulation development and building a knowledge network to connect stakeholders.

The British Embassy, Colombia focuses on technical support and looking for financial solutions.

Industry

Stakeholders
Transmilenio, ACOSOL, EPM, Ecopetrol, Glu Energy

Perceived role
Generate, deliver, and use energy and have objectives around decarbonisation/carbon neutral operations, as well as responding to consumer needs, delivering access, training, and finding new sources of energy to support operations. Companies raised concerns on the cost of funding the transition, but also the potential for new business models.

Civil society and international organisations

Stakeholders
GIZ, Governance Action Hub, Transforma, C40 cities, Global Green Growth Institute

Perceived role
Bring in forgotten stakeholders, particularly of communities, and create spaces for these conversations. Innovate new programmes/ways of working to support the transition, including international cooperation.

Financial institutions

Stakeholder
Inter-American Development Bank

Perceived role
Wants to understand financial feasibility (how much will the transition cost?) and look for mechanisms to finance different solutions, as well as new business models.

The interest of all the parties involved, and from such a variety of stakeholder groups, was remarkable, as participants engaged fully in the dialogue and looked for concrete ways forward to define and achieve the transition's goals.

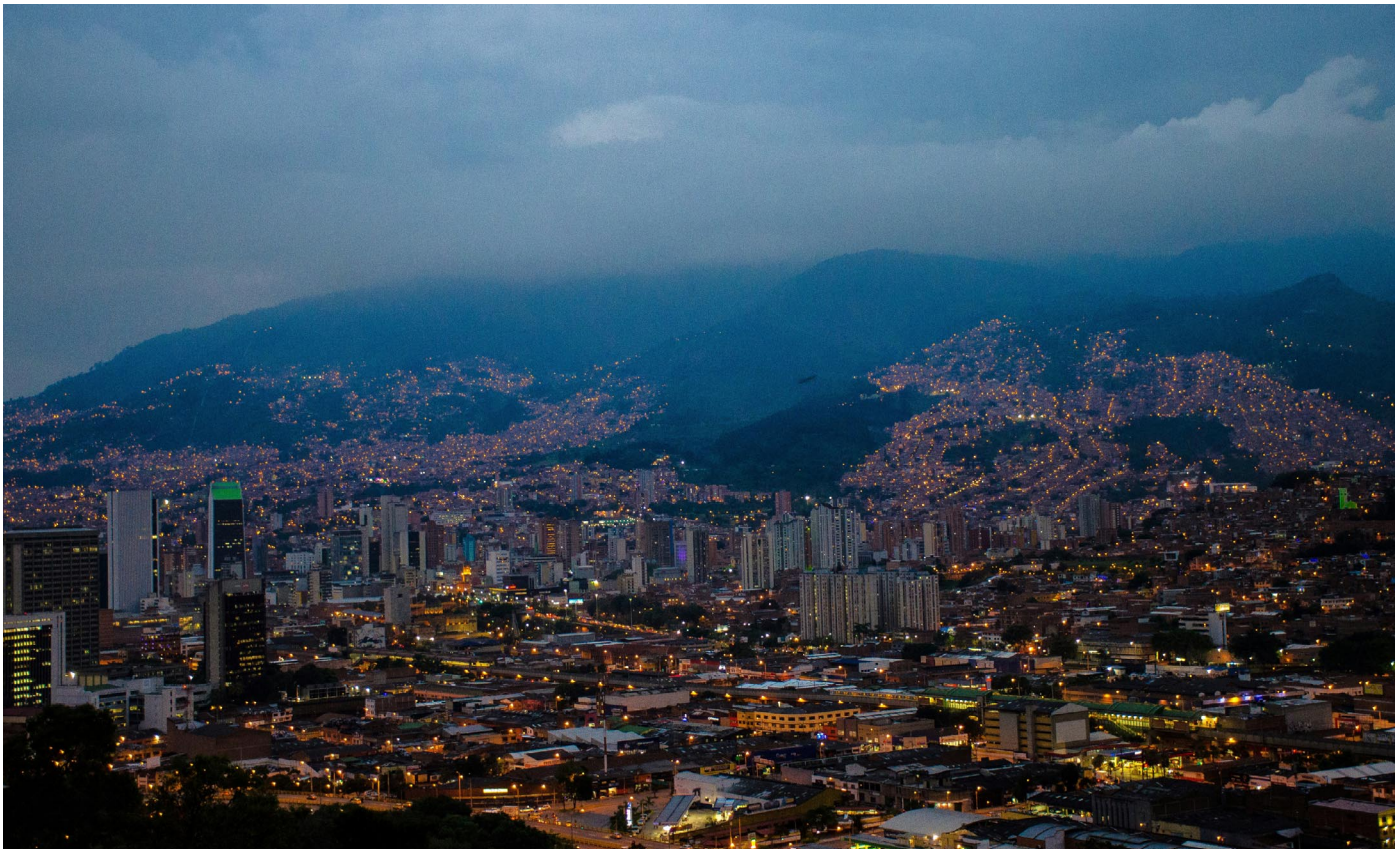
Some key stakeholders were invited but did not attend due to availability. This included less representation from financial institutions, parts of government (IPSE, Departamento Nacional de Planeación (DNP)), and the energy and gas regulatory body CREG.

Key stakeholders in the transition

The discussion began by identifying who were the key stakeholders in the energy system and who has historically been left out of the conversation:

Who is included?	Who is missing?
• **Government**	• **Consumers and citizens**
• **Local political classes**	• **Communities in hard-to-reach areas**
• **Academia**	• **Indigenous and Afro-Colombian communities**
• **Industry: energy companies, transport sector**	• **Financial institutions**
• **Communities**	• **Miners and fossil fuel companies**
• **Civil society**	• **Regional entities / cities**
	• **Trade union organisations**

These are broad stakeholder categories, and it was emphasised that more granular stakeholder categories are needed regionally. For example, there are fishing communities in Santa Marta who fish at night to support their livelihoods using battery-powered light, but there is no safe recycling for these batteries.



Medellín, Colombia. Photo by Juan Saravia on Unsplash

Key findings

After mapping the key actors in the energy system and identifying missing stakeholders, participants explored relationships between different parts of the system. The aims were particularly to understand what is and is not working, what conversations are already happening, and what needs to change to achieve better outcomes. Participants also considered how a systems approach could be applied to the just energy transition in Colombia. These have been summarised into eight key findings.

Lack of coordination and shared direction

There is action, with many actors working in the energy system and different interventions taking place. However, they are not always joined up, aware of each other, or driving towards the same goal. There is an urgent need for better communication between different actors. Actors do not have clear and achievable priorities to work towards, resulting in efforts that are not coordinated and therefore are not as impactful as they could be. The system is missing a way to connect all the elements and participants raised questions on who should be doing this connection. Some participants called for government to take on this direction-setting and leadership role, informed by stakeholders in the system, as well as encouraging longer term plans for collaboration. Participants from companies in particular reported feeling a lack of involvement from the state.

Academia's untapped potential

Academia's role in generating and transferring knowledge and innovation has not been fully realised, particularly to inform government policy. Academia views its role as the builder of knowledge and trainer of new leaders. Many universities are developing research and innovation programmes or projects, and there are some examples of them working with industry. However, academia often holds knowledge in ways that are not accessible to other actors, particularly government, which means that it does not inform policy, regulation, or practice. For example, some academics focus on journal publication rather than engaging with policymakers. As academia plays a critical role in knowledge generation (which should not be overlooked) participants underlined the need to improve engagement, particularly working more closely with policymakers so that they can contribute valuable evidence and reflections. The public regards academics as trusted stakeholders. Academics should therefore play a more active role in connecting different stakeholders within the system, whilst transferring knowledge and innovation, including influencing regulation and policy, to accelerate the transition.

Exclusion of communities

Communities are being excluded, particularly in hard to reach, Indigenous or Afro-Colombian areas that have historically been left out of national dialogue and action. There are many regions, including La Guajira, where there are high levels of poverty, low access to energy, and little relationship or trust between communities and the government. Communities could benefit from the high renewable energy potential, but trust must be built first before energy infrastructure projects can be developed. Communities need to understand how energy could help solve their problems and have assurance that government and industry are working with their best interest in mind, and that they will feel the benefits. They must be involved early, and there must be deep planning to understand potential negative impacts and how they would be mitigated. Without this, communities have shown how they can stop projects. Their autonomy must be protected, and the formation of more energy communities could be a solution, supported by mechanisms of decentralised governance. Energy communities form voluntarily and are given the freedom to develop new models that work in their contexts. Concern was also raised for communities dependent on mining as coal phase-out plans advance. Government, industry, and academia must work together to diversify the economy in those regions and support the labour reconversion.

Passive consumer role

Consumers currently have a passive role in the system when they need to have an active one. It is not only remote or Indigenous communities that are not included in the system, but also citizens, and by that we mean consumers more generally. The consumer does not currently have a voice in the system and their needs do not inform the decisions of energy producers. More should be done to listen to their needs, as well as moving from a passive role to an active one. By this, participants meant that the consumer does not generally have an informed viewpoint on energy consumption, efficiency, or access. Public education and more training should support them to understand their role and influence how they behave in the system.

Financial feasibility and innovation

There is a missing piece for all stakeholders to understand the cost of the transition, as well as the financial feasibility of new technologies. Financial institutions need to play a more prominent role in the system. Participants called for greater understanding of how to integrate capital, financing components, and the necessary implementation mechanisms within the energy transition process. Financial sources are available, including from national government, but it is not clear how to access these and resources must be more efficiently organised. There is also a need to identify concessional funds (public or from international cooperation) that reduce the risk of initial investments that can be catalytic. There is also a tension between building cooperation in the system, so that actors can move towards a common goal, and developing economic competitiveness. Actors, including industry, need to be incentivised to innovate their models and work collectively to progress the transition, whilst also bringing economic competitiveness that drives improvements. This could also attract foreign investment.

Inclusion of industry

Stakeholders from industry, both private sector and public sector companies, in the workshop reported that they are focused on decarbonising their operations, as well as looking for new business models to progress the transition and deliver access. They are pushing to accelerate and support the transition; however, they are often left out of the conversation. There are also reports of both being represented negatively, when they could be seen as allies. Industry must be brought in more strongly, as they are fundamental to realising the transition and must be central in next steps. There are some examples of universities working well with them, and this should be pushed further, particularly identifying how to connect the 'market pull' and 'science push' to develop technologies related to the energy transition. There are examples of industry energy projects that have been very impactful. Lessons and case studies should be shared more widely. Companies working in mining or fossil fuels also need to be more strongly brought in as a central actor in the transition whose actions and agenda will have a huge impact on the sector.

Need for agile regulation

More regulation is needed that is context-appropriate, evidence-based, agile, and bottom-up to support innovation and the decentralisation of the energy system. The transition is moving more quickly than regulation, and participants underlined the need to find ways of accelerating regulatory adjustments to keep pace. Companies need regulation that allows new technologies to enter the market under conditions that allow them to compete with traditional energy sources that are often cheaper but more polluting. Regulation must also be context specific – the regulatory body CREG currently mirrors regulations of other LATAM countries when they should be developed for the Colombian context and according to the needs of the new decentralised energy system. Policies must be evidence-based, including academic research, but also listen to Indigenous community and consumer needs. This could be achieved by developing agile mechanisms for prior consultation processes with Indigenous communities and environmental licences for energy projects to support faster but more holistic interventions. Government must set overall direction and realistic goals that are nationally achievable, but then local governments, municipalities, and communities must be able to drive bottom-up regulation that supports their local contexts. This will support the decentralisation of the energy system and minimise confusion for local governments when having to translate national policies into local action.

Systems approach

Taking a systems approach is an obligation, not an option, but requires support as it comes with implementation challenges. It helps to articulate different stakeholders and tensions within the system, supporting us to understand their different drivers and motivations. It can also help identify stakeholders who are being left out of the conversation. Miners and fossil fuel producers were noted as key to the just energy transition but are not normally engaged in the dialogue – how can we change this? Systems approaches can help us to think through potential unintended consequences and better understand critical points in the future to support longer term thinking.

Training is needed to support this approach, with project implementers and decision-makers, and at universities so that it is embedded within the education system. More time and resources are also needed within projects and programmes to effectively understand the system and connect with all the different actors. Participants also raised issues on how to develop a common language that different stakeholders across the system can speak. Others raised key questions on who is responsible for resolving tensions in the system once these have been identified. How can the system be effectively governed to achieve a shared goal and vision?

Windpower turbines in La Guajira, Colombia. Photo by Omri D. Cohen on Unsplash

Calls to action

Participants suggested the following actions to progress the just energy transition in Colombia.

Develop a network which prioritises collaboration.

All actors in the energy system must be brought together in a network that prioritises collaboration, enables knowledge exchange, and drives towards a common goal. It should be multidisciplinary and cross sector, ensuring participation of industry. It should combine the technical and social and have a direct line to government to inform policy and action. Efforts must also be made to involve miners and fossil fuel companies who are not usually part of the conversation.

Government must set achievable targets with clear pathways supported by cross-sector leaders, encourage long-term collaborations, and recognise energy as a development issue.

Informed by the wider system (through a collaborative network), government must set achievable targets with clear pathways that actors can rally behind. This must be supported by leaders from across the system who are equipped with the right skills and expertise and can lead in their sectors. Government must also recognise the energy transition as a societal and development issue, not only an environmental one, but that could also improve the lives of many Colombians.

Academia needs to be better connected to other stakeholders, particularly government, and find new ways to engage stakeholders with research and knowledge.

Academia needs to better communicate and engage with other actors in the system to share knowledge and take on a more connecting role. It needs stronger ties with Colombian government to feed research into policy and practice, as well as developing links with industry to support innovation and inform project implementation. Prioritising local technology development and implementation should be mandatory, for example on more efficient and sustainable energy technologies depending on the regional energy sources. Gradual decarbonisation of transport and industry is a priority.

Consumers and communities need to be included and educated on energy efficiency.

All actors working on the transition, particularly government and industry, must consult consumers and communities before beginning projects or interventions. Government should implement more public training to improve education on energy consumption for consumers and communities to improve efficiency.

Innovation is needed in governance to support the transition.

Governance is central to successfully bringing about the transition and this can only be achieved through new governance structures that allow for agile and bottom-up regulation that support the decentralisation of the system. Regulatory sandboxes, such as implementing living laboratories for the transition across the country, could be developed. Conversations must take place on how new governance models can be implemented in a complex system and where not all actors have the same goal and motivations.

Map the system and financial resources available.

Participants called to map the Colombian energy system to understand different actors and motivations. This should include assessing available financial sources, including from the state.

Develop pilot projects that put systems approaches into practice.

These should be high-impact, small-scale projects that identify and articulate key actors, evaluate impact, and share results so that others can learn. Projects would prove concepts and the suitability/feasibility of the transition plans and objectives in communities. They would ideally be situated across the country, not only in the usual locations for projects of this kind.

Identify systems champions already working on projects that could implement and share learnings on systems approaches.

Projects that are already underway or about to start should be encouraged to implement a systems approach to assess whether they are considering all the key stakeholders (especially communities and consumers) and anticipating unintended consequences. These could be led by excellent individuals already powering systems change.

Artificially created lake for hydroelectric energy production in Guatapé Colombia. Image: Shutterstock

Closing remarks and next steps

The workshop closed with an address from Juan Felipe Gutiérrez from the Ministry of Mines and Energy.

First, he affirmed that the government is trying to facilitate greater collaboration and shared that the government is developing a network that consists of civil society, academia, industry, international actors, and the government. It is a space for participation – not just a government initiative – to give a voice to different actors which links very closely to the key sentiment of the workshop.

He emphasised that it is important to enable more effective sharing, including sharing knowledge from academia and using this to inform implementation, as well as the importance of sharing success stories about policy and projects that have worked to inspire more action and progress.

The partners who convened this workshop are now developing next steps, along with participants and other key stakeholders in the energy Colombian system, to consider how these calls to action can be taken forward.

The message came through strongly throughout the workshop that energy brings development and crosscuts the Sustainable Development Goals.

The just energy transition is critical and urgent. With the many conversations taking place and political will in Colombia during the current administration, how can we all pull together to realise it so that it benefits everyone, particularly those who have traditionally been left behind?

Bogotá energy workshop stakeholder roundtable. Image: Engineering X

Acknowledgements

This workshop and report were developed and delivered by Universidad de Antioquia, Universidad de los Andes, the British Embassy, Colombia, and Engineering X, an international collaboration founded by the Royal Academy of Engineering and Lloyd's Register Foundation. We are very grateful to all partners for their collaboration, and to all the facilitators, notetakers, and organisers.

With special thanks to our advisers and organising team:

Professor Franklin Jaramillo, Universidad de Antioquia

Professor Juan Felipe Botero, Universidad de Antioquia

María Alejandra Wilches Mogollon, Universidad de los Andes

Dr Pablo Medina, Universidad de los Andes

Professor Sergio Cristancho Marulanda, Universidad del Rosario

Professor Alexánder Gómez, Universidad Nacional de Colombia

Nicolás Meléndez Álvarez, British Embassy, Colombia

Luis Calzadilla, British Embassy, Colombia

Chabelly Medina, British Embassy, Colombia

Pedro Eusse, EPM

Jorge Hernán Flórez Herrera, Governance Action Hub

Professor Pedro Pablo Cardoso Castro, University of Exeter

Hazel Ingham, Engineering X, Royal Academy of Engineering

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We are particularly grateful to everyone who participated in this workshop and their valuable contributions.

The partners

Universidad de Antioquia

Universidad de Antioquia is an autonomous public university committed – based on criteria of excellence – to the comprehensive education of human beings, the generation and dissemination of knowledge in different fields, and the preservation and revitalisation of cultural heritage. Its main campus is located in the city of Medellín, Colombia; additionally, it has other campuses and facilities in the nine regions of the department of Antioquia, Colombia. In 2027, Universidad de Antioquia, as a public institution, will be recognised nationally and internationally for its academic excellence and its innovation in support of the community, the territories, and environmental sustainability.

Universidad de los Andes

Universidad de los Andes was founded in 1948 and was the first private university in Colombia that was independent from political or religious movements or parties. It was conceived as a study centre, a research centre, and a place where truth could be upheld. Ever since the university was founded, its activities have focused on excellence, and this is affirmed in the Comprehensive Development Plan (CDP). It is currently the only private university in the country that has been awarded a ten-year institutional accreditation for quality by the National Ministry of Education through Resolution 582 of 9 January 2015.

British Embassy, Colombia

The British Embassy in Colombia is part of the Foreign and Commonwealth Development Office, and though its main office is in Bogotá, there are other hired local and British staff working in Medellín, Barranquilla and other intermediate cities. The Embassy's efforts are mainly centred on climate action cooperation, peace security and development cooperation matters, supporting commercial relations between British companies in Colombia and Foreign Direct Investment from Colombia towards UK, defence and stability support for the Colombian army, among others. The Embassy has a team of about 17 people working on climate cooperation matters, which includes the just energy transition side.

Engineering X

Engineering X tackles global safety and sustainability challenges and promotes the contribution of engineering to solve global challenges. Using the expertise and networks of our founders, the Royal Academy of Engineering and Lloyd's Register Foundation, we connect and give a platform to people working on these challenges across disciplines, countries, and systems. We champion local leadership of solutions and the importance of taking a systems approach to improve safety and sustainability into the future. We convene, fund collaboration and innovation, and raise awareness of often overlooked challenges.

Royal Academy of Engineering

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Lloyd's Register Foundation

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