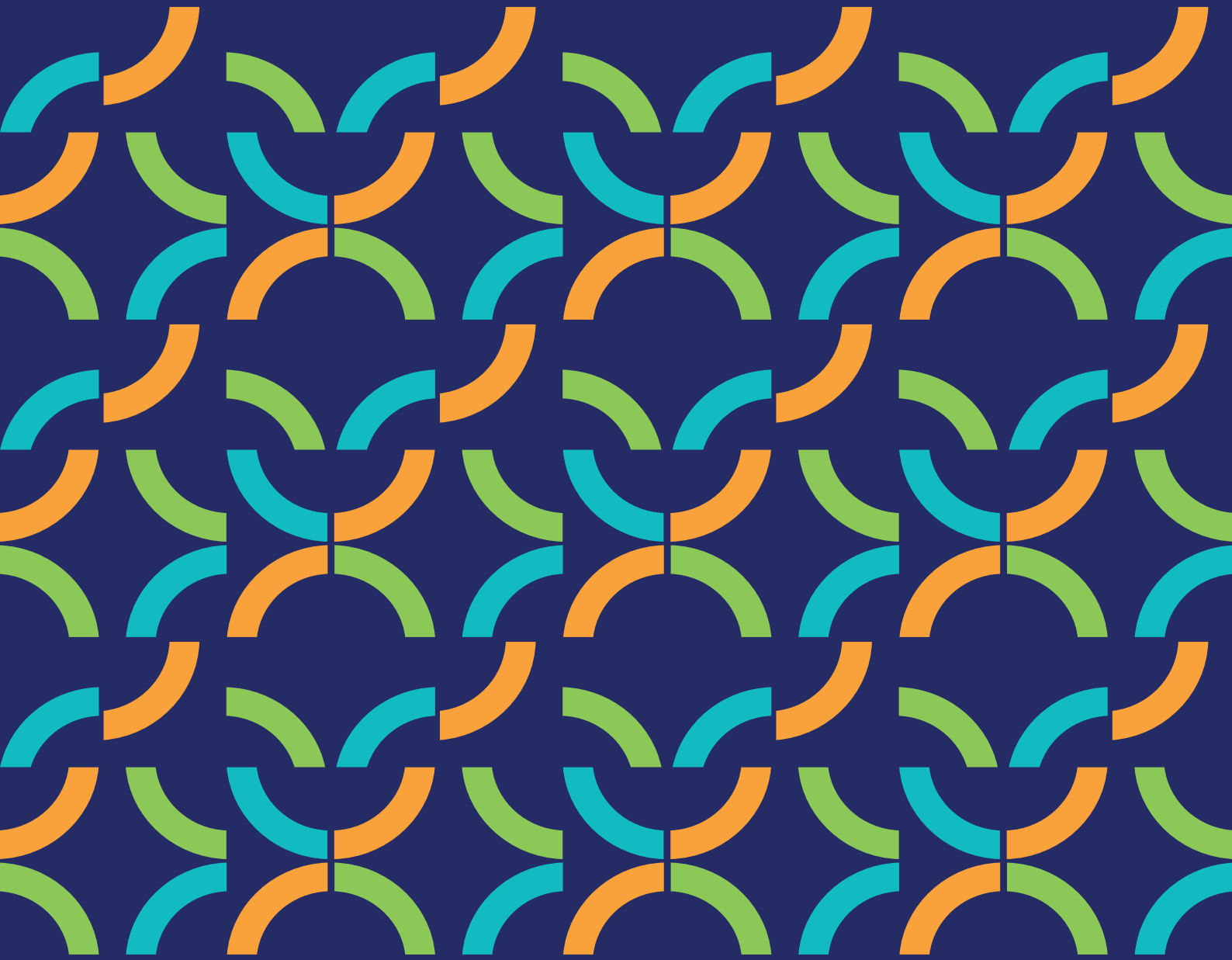
IRENA
International Renewable Energy Agency

IRENA INNOVATION WEEK 2025

Renewables and Digitalisation for a Sustainable Energy Future



Summary report 2025

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IRENA INNOVATION WEEK 2025

Renewables and Digitalisation for a Sustainable Energy Future

Summary report 2025

Contents

List of abbreviations

ADMS	advanced distribution management system
AFID	Alliance for Industry Decarbonisation
AI	artificial intelligence
APUA	African Power Utilities Association
AUDA-NEPAD	African Union Development Agency-New Partnership for Africa's Development
AWAC	L'Agence wallonne de l'Air et du Climat (Walloon Air and Climate Agency)
BECCUS	bioenergy with carbon capture, utilisation and storage
CAPEX	capital expenditure
CATL	Contemporary Amperex Technology Company, Limited
CCS	carbon capture and storage
CEER	Council of European Energy Regulators
CEPRI	China Electric Power Research Institute
CO_2	carbon dioxide
COMET	Community Energy Toolkit
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CREEI	China Renewable Energy Engineering Institute
DER	distributed energy resource
DERMS	distributed energy resource management system
DFI	development finance institution
DG Ener	Directorate-General Energy (European Commission)
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Centre)
DSO	distribution system operator
EASA	European Union Aviation Safety Agency
EBRD	European Bank for Reconstruction and Development
ECLAC	Economic Commission for Latin America and The Caribbean (United Nations)
ECOWAS	Economic Community of West African States
ELES	Elektro-Slovenija d.o.o. (Slovenia Electric Ltd.)
EMDE	emerging and developing economies
EMS	energy management system
ENTSO-E	European Network of Transmission System Operators for Electricity
EPRI	Electric Power Research Institute
ESG	environmental, social and governance

ETAF	Energy Transition Accelerator Financing
EU	European Union
EUR	euro
EV	electric vehicle
FAO	Food and Agriculture Organisation
FCS	fragile and conflict afflicted states
FID	final investment decision
GCEP	Global Coalition on Energy Planning
GHG	greenhouse gas
GIZ	Gesellschaft für Internationale Zusammenarbeit (German Society for International Co-operation)
GO	guarantee of origin
GOGLA	Global Association for the Off-Grid Solar Energy Industry
GW	gigawatt
GX	Green Transformation policy (Japan)
IFC	International Finance Corporation
IKI JET	Internationale Klimaschutzinitiative (International Climate Initiative) Just Energy Transition
ILO	International Labour Organisation
IMO	International Maritime Organisation
IoT	internet of things
IRENA	International Renewable Energy Agency
JIRCAS	Japan International Research Centre for Agricultural Sciences
km	kilometres
kW	kilowatt
kWh	kilowatt hour
LNG	liquefied natural gas
LTES	Long-Term Energy Scenarios network (IRENA)
MED-GEM	Mediterranean Green Electrons and Molecules
MEPC 83	83rd Marine Environment Protection Committee
METI	Ministry of Economy, Trade and Industry (Japan)
MIGA	Multilateral Investment Guarantee Agency
MoU	memorandum of understanding
MW	megawatt
NEA	National Energy Administration (China)
NEDO	New Energy and Industrial Technology Development Organisation (Japan)
NWA	non-wire alternative

NZTC	Net-Zero Technology Centre
O&M	operations and maintenance
PEWA	Palau Energy and Water Administration
POME	palm oil mill effluent
PPA	power purchase agreement
PPP	public-private partnership
PUE	productive uses of energy
PV	photovoltaic
R&D	research and development
SAF	sustainable aviation fuel
SDG	Sustainable Development Goal
SEforAll	Sustainable Energy for All
SEI	Stockholm Environment Institute
SGCC-CEPRI	State Grid Corporation of China-China Electric Power Research Institute
SGERI	State Grid Energy Research Institute (China)
SME	small- or medium-sized enterprise
STEM	science, technology, engineering and mathematics
SURE	Support for Ukraine's Reconstruction and Economy fund
TRL	technology readiness level
TSO	transmission system operator
TW	terawatt
UHV	ultra-high voltage
UNEP	United Nations Environment Programme
UNEZA	Utilities for Net Zero Alliance
USD	United States dollar
WBA	World Bioenergy Association
WWEA	World Wind Energy Association

Introduction: IRENA Innovation Week 2025

The International Renewable Energy Agency (IRENA) Innovation Week is a biennial IRENA flagship event that aims to bring together a broad range of leaders, experts, industry representatives, academics, policy makers and youth to discuss cutting-edge innovations that can accelerate the global energy transition.

The fifth edition, IRENA Innovation Week 2025, was held in Bonn from 10 June to 13 June 2025. It built upon the previous 2020 and 2023 editions and two events held in 2016 and 2018.

Those former editions had explored innovation in the context of end-use sector decarbonisation. The latter events had focused on innovation in integrating higher shares of renewable energy into power systems, along with those systems' decarbonisation.

IRENA Innovation Week 2025, entitled "Renewables and Digitalisation for a Sustainable Energy Future", looked at how innovation could catalyse the tripling of renewables for sustainable growth.

Happening back-to-back with the United Nations' June Climate Meetings (SB 62)[1], IRENA Innovation Week 2025 was an opportunity to collaborate in driving innovation as a necessity in meeting global climate goals and ensuring a sustainable future.

IRENA Innovation Week 2025 started with site visits to leading local institutions in renewable energy innovation. These enabled participants to experience new ideas that were being put into practice locally, including those at the thyssenkrupp Steel facilities in Duisburg and the renewable energy-powered data centres at Kraftwerke Mainz Wiesbaden AG and CyrusOne. There then followed three days of sessions and discussions.

IRENA Innovation Week 2025 explored two pivotal tracks:

Track 1: Innovation in infrastructure for tripling renewables
This focused on closing infrastructure gaps, leveraging digitalisation and securing supply chains to scale renewable energy deployment, worldwide.

Track 2: Renewable-based solutions for sustainable development
This showcased innovations in resilient power systems, productive uses of energy and local value creation. It also highlighted energy communities and bioenergy's role in sustainable economic growth, in alignment with country priorities.

[1] This refers to the 62nd session of the Subsidiary Bodies of the United Nations Framework Convention on Climate Change (UNFCC), held in Bonn on 27 June 2025. See https://unfccc.int/sb62 for details.

During the week, discussions highlighted how innovation transcends technological advances to encompass new perspectives on reality. These include diverse business models, adaptive regulation, strategic planning and system operation. These new perspectives also include innovative financial instruments and social innovations that establish new ways of engaging with communities and consumers.

A recurring thread during the week was that of digitalisation and artificial intelligence (AI) as powerful enablers in enhancing efficiency, reducing costs and optimising energy system management. This thread recurred across all contexts, from grid modernisation in industrialised nations to expanding energy access in developing countries.

During the high level opening session, IRENA's Director-General Francesco La Camera stressed that "the energy transition is unstoppable" and that at its heart lay the urgent need to align renewable energy deployment with inclusive development, social equity and local value creation. Indeed, during the week's discussions there was consistent advocacy for collective responsibility in establishing affordable, secure and low-carbon energy systems that fostered sustainable development and improved livelihoods, worldwide.

A crucial, transformative perspective also emerged from attendees from the Global South. They asserted that the climate crisis was an opportunity for sustainable development. This was because integrating climate action within a transformative development framework enabled issues within existing economic and geopolitical hierarchies to be addressed. True decarbonisation required more than technological change, they said; it also called for confronting and transforming the structural and economic inequalities embedded in our current systems.

Ultimately, the week concluded that innovation was a systemic and continuous process, essential for a resilient, inclusive and fair energy future – one in which international co-operation and knowledge exchange were also strongly emphasised.

IRENA Innovation Week 2025 highlights

*MoU = memorandum of understanding.

Partner organisations

Individuel sessions were organised in partnership with the following organisations:

Five key takeaways

1. **Innovation is more than just technology**
   Innovation in the energy transition must be approached from a systemic perspective. Systemic innovation goes beyond technology to also involve policy, regulation, market design and system operation. There is a need to innovate in financing mechanisms and in engagement with communities and consumers. Innovating holistically and across sectors is key, as there is no "one-size-fits-all" solution in innovation for the energy transition.

2. **No digitalisation without energy and no energy transition without digitalisation**
   Digital technologies and AI are becoming essential tools in managing variable renewable electricity. Their use stretches from demand and price forecasting to flexibility and smart grid management. These tools can also inform predictive maintenance of energy infrastructure. Rising electricity demand from the data centres that support AI introduces both challenges and opportunities, however, for grid planning and expansion.

3. **People and communities are at the centre of the energy transition**
   Digitalisation and renewable energy infrastructure benefit communities in multiple ways, from boosting rural agriculture in China to building energy communities in Colombia and Malaysia. Emerging and developing economies (EMDEs) face an urgent need to modernise their power grids, however, due to rapidly growing demand and a persistent lack of energy access. Therefore, innovation must be leveraged to go beyond technical upgrades and include efficient planning and investment frameworks. Grid modernisation is not only about access to technology, but also about social justice and not leaving anyone behind.

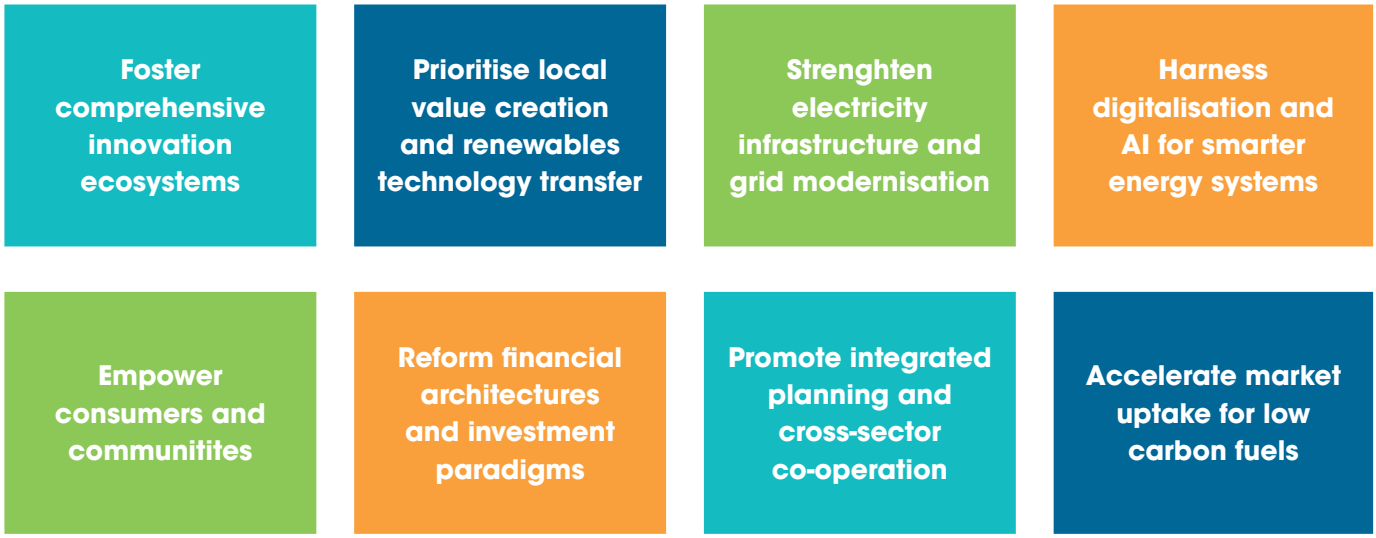
4. **Local value-chain development is a priority for the Global South**
   Renewable-based energy transitions in the Global South must prioritise local manufacturing, skills development, job creation and building economic resilience, all supported by a range of enabling policies. Prioritising local value creation not only accelerates industrialisation, but also strengthens supply chains and fosters energy independence. True progress requires moving beyond just installing gigawatts (GWs). It also requires investment in people, industries and policies that empower communities and nations alike.

5. **Energy is a catalyst for inclusive growth and economic development**
   Advancing sustainable development, especially in rural and remote contexts, requires more than simply delivering electricity. Energy access needs to be integrated with local economic activity, powering agriculture, healthcare, small businesses and value chains that uplift communities.

   Scaling productive uses requires a shift in perspective, however, from focusing on energy access to enabling long-term, reliable energy use. That use must also align with community-defined development goals. Energy can be transformed from being a service into becoming a catalyst for inclusive growth.

Key actions for policy makers

Discussions at IRENA Innovation Week 2025 converged on a list of eight key actions that policy makers can take to enable and accelerate a global just energy transition.



1. **Foster comprehensive innovation ecosystems**
   Policy makers must view innovation in terms of systemic innovation. This extends beyond technology and infrastructure to include policy, business models, system operation, regulation and finance. This ensures that the energy transition is just and serves the people. This requires investing in national innovation infrastructure, including skills and education, to enable active technology learning and to develop a skilled workforce.

2. **Prioritise local value creation and renewables technology transfer**
   To build economic resilience and decrease dependencies – particularly in the Global South – policies should actively support local manufacturing, skills development, job creation and the localisation of value chains within the renewable energy sector. This action demands genuine and equitable technology transfer, moving away from any extractive dynamics that reinforce historical economic imbalances.

3. **Strengthen electricity infrastructure and grid modernisation**
   Significant investment is needed in modern, flexible and smart grids to handle high shares of variable renewables and support electrification of end uses. This involves maximising the use of existing grid infrastructure through non-wire alternatives (NWAs) and digitalisation, in addition to adopting adaptive regulatory frameworks and streamlining permitting processes. In EMDEs, this also means building institutional capacity and ensuring a socially-just distribution of modernisation costs.

   Fundamentally, grid modernisation and energy access efforts must be about social justice and ensuring "no one is left behind". They should also be about prioritising access, affordability and the inclusion of vulnerable populations. Investing in renewables in fragile and conflict-affected states (FCS) should be seen as a peacebuilding strategy, enhancing socio-economic development and state legitimacy.

4. **Harness digitalisation and AI for smarter systems**
   Accelerate the deployment of digital technologies, including AI, to optimise renewable integration, enhance grid efficiency and boost grid resilience. This includes accelerating digital infrastructure roll-out (such as smart meters and data platforms), fostering access and the exchange of energy data with clear governance. It also includes mitigating risks, such as by enhancing cybersecurity and addressing the escalating energy consumption of digital solutions.

5. **Empower consumers and communities**
   The energy transition must be people-centric, empowering consumers through digital tools and skill-building initiatives. It is crucial to reshape the narrative around energy communities, emphasising their role in local development and ensuring genuine ownership, control and the retention of benefits. This involves fostering bottom-up and community-led narratives and approaches, such as integrating diverse local realities and ancestral knowledge into decision making.

6. **Reform financial architectures and investment paradigms**
   There is a critical need to shift the investment paradigm from solely profit-driven to impact-driven, redefining risk to include the failure to meet Sustainable Development Goals (SDGs) and "leaving people behind". This requires mobilising significant investment and rethinking the global financial architecture to prioritise debt cancellation and grant-based climate finance over conditional loans that create debt traps. Patient capital, de-risking mechanisms and innovative financing models tailored to local contexts are essential, especially for productive uses of energy (PUEs) and projects in FCS.

7. **Promote integrated planning and cross-sector co-operation**
   Enhancing cross-ministerial co-ordination, such as between departments of energy, agriculture and industry, enables integrated planning approaches for electricity demand and its productive uses. This includes adopting regional joint-industrial strategies to leverage shared resources and economies of scale across the Global South.

8. **Accelerate market uptake of low-carbon fuels**
   Policy makers must establish clear, harmonised regulatory frameworks and certification schemes, implement strategic carbon pricing, and reinvest revenues to unlock investment in low-carbon fuels, such as green hydrogen and sustainable aviation fuels (SAFs). At the same time, they should stimulate demand through mandates and alliances, while ensuring infrastructure adaptability. This includes repurposing existing assets and developing dedicated facilities for the production, storage and distribution of new fuels to enable scalable and just energy transitions.

Navigating the energy transition is akin to rewriting the operating manual for a global machine. It is not just about installing new parts (technologies), but fundamentally redesigning the blueprints (policies, markets, finance), retraining the operators (skills development), and ensuring everyone on the assembly line (communities, nations) has a voice and benefits from the final product – a truly sustainable, just and inclusive energy future.

The following section of the report will present the key takeaways and highlights of each of the sessions at IRENA Innovation Week 2025.

Two parallel tracks

1.
Innovation in infrastructure for tripling renewables

2.
Renewable-based solutions for sustainable development

Opening session

High level dialogue:
Innovation catalysing the tripling of renewables for sustainable growth

Planning for the future:
Demand side narratives and scenarios

Organised with the Stockholm Environment Institute (SEI) and supported by IRENA's Long-term Energy Scenarios (LTES) network.

Modernising power grids for a renewable future in EMDEs

Organised with the Electric Power Research Institute (EPRI) and supported by Utilities for Net Zero Alliance (UNEZA).

Connecting the dots:
Bridging infrastructure gaps for renewable powered systems

Organised with the State Grid Corporation of China-China Electric Power Research Institute (SGCC-CEPRI).

Bottom-up solutions:
Energy communities

Organised with the World Wind Energy Association (WWEA) and supported by the IRENA Coalition for Action

Plenary session
Digitalisation for the energy transition

Organised with the European Commission Directorate-General Energy (DG Ener).

Productive uses of energy:
Rethinking perspectives and drivers for innovation

Organised with the Global Association for the Off-Grid Solar Energy Industry (GOGLA).

RESourcing AI

Organised with iMasons Climate Accord.

Creating value locally:
Supply chains and skills

Organised with the International Labour Organisation (ILO) and Sustainable Energy for All (SEforALL).

Digitalisation for energy transition: Case studies Organised with the Ministry of Economy, Trade and Industry (METI), Japan.	**Innovative business models for bioenergy in the Global South** Organised with the World Bioenergy Association (WBA).
Enabling next generation trade in renewable energy value chains Organised with the Organisation for Economic Co-operation and Development (OECD).	**Project facilitation in fragile countries: Navigating political risks, enabling renewable energy investments** Organised with the United Nations Environment Programme (UNEP).
Infrastructure for sustainable fuels in shipping and aviation Organised with Future Cleantech Architects.	
Technology innovation showcase Organised with the Net Zero Technology Centre and supported by IRENA's Alliance for Industry Decarbonisation (AFID).	
Closing session **The way forward: Structural change and innovation for sustainable development**	

High-level opening

Innovation catalysing the tripling of renewables for sustainable growth

Session overview

The opening plenary of IRENA Innovation Week 2025 highlighted innovation as an indispensable driver of the global energy transition. It also stressed innovation's key role in achieving SDG7 – access to affordable, reliable, sustainable and modern energy for all – and the COP28 pledge of tripling renewable capacity to 11.2 terawatts (TW) by 2030.

It was emphasised in discussions that the energy transition presented significant opportunities to modernise energy systems worldwide. It was also stressed that innovation extended beyond technology to include business models, regulation and financial instruments – all of which were crucial for the commercialisation and scale-up of existing technologies. Digitalisation, including AI, was consistently presented as a powerful enabler of efficiency gains, cost reductions and optimised system management across diverse contexts. These ranged from developed economies modernising grids to emerging economies expanding energy access and building resilient systems.

Speakers from Germany, the UAE, China, Japan, the Wallonia region of Belgium and the Economic Community of West African States (ECOWAS) – along with a young entrepreneur from Ethiopia – showcased regional, national, sub-national and community-level experiences. This underscored the varying challenges and tailored solutions required, while also stressing our collective responsibility in securing affordable, secure and low-carbon energy systems that foster sustainable development and improve livelihoods, globally.

Key actions

for policy makers

- **Foster comprehensive innovation ecosystems**
  Consider energy transition innovation as reaching beyond technology and infrastructure to include innovation in policy, business models, system operation, regulation and finance. Ultimately, the energy transition needs to serve the people and be delivered in a just way.

- **Engage in international co-operation while building up local value chains**
  Against the backdrop of geopolitical tensions, strategic international co-operation is still needed to unleash the full potential of renewables. At the same time, building up local capabilities and value chains can decrease dependencies.

- **Ensure affordable electricity to maintain industrial competitiveness and prevent delays in electrification and decarbonisation**
  This includes targeted support for energy-intensive sectors and reforms in electricity markets and grid investment planning.

- **Strengthen energy infrastructure**
  Invest in modern, flexible and digital grids to handle variable renewables, support electrification, and improve regional co-operation

- **Harness digitalisation and AI to enable smarter energy systems**
  Accelerate the deployment of digital technologies – including AI, smart grids and predictive analytics – to optimise renewable integration, enhance grid efficiency, improve demand management, and boost disaster resilience. Support policies should enable data access, protect cybersecurity and promote skills development to nsure inclusive digital transformation across regions.

Highlights of the session

Welcome
Norela Constantinescu, Acting Director, Innovation and Technology Centre, IRENA

Opening speech
Francesco La Camera, Director-General, IRENA

Keynotes
Michael Hackethal, Head of Division, Federal Ministry of Economic Affairs and Energy, Germany
Nawal Al-Hosany, Permanent representative of the UAE to IRENA
Li Sheng, Director-General, China Renewable Energy Engineering Institute (CREEI)

Innovator keynote
Yohannes Bimrew, IRENA Youth Delegation and chief executive officer (CEO) of HuluSolar

High-level dialogue
Moderator: Gauri Singh, Deputy Director-General, IRENA

Yoshiomi Yoshino, Director, METI, Japan
Sédiko Douka, Commissioner for Infrastructure, Energy and Digitalisation, ECOWAS
Stephane Cools, President, L'Agence wallonne de l'Air et du Climat (Walloon Air and Climate Agency – AwAC)
Francesco La Camera, Director-General, IRENA

Opening remarks

Norela Constantinescu opened IRENA Innovation Week 2025 by introducing the theme of the conference, "Renewables and Digitalisation for a Sustainable Energy Future". Highlighting innovation's crucial role in achieving an effective and equitable energy transition, she noted that all regions could benefit from resilient, secure and affordable low-carbon energy systems providing universal access to electricity. Advancing renewable energy fosters a fair and just transition for all, she said, while also supporting sustainable economic development.

Francesco La Camera then underscored the point that innovation is vital in meeting global energy commitments while creating opportunities – especially amidst geopolitical fragmentation. He gave emphasis to the idea that successful innovation must be context-specific, addressing local challenges and driven by ambition. In industrialised nations, this often involves upgrading existing systems, while in developing countries, it might mean bypassing outdated infrastructure and building resilient, inclusive energy systems. Ultimately, the aim is to empower local communities to produce and manage their energy effectively.

Keynote speeches

Michael Hackethal said that Germany`s energy policy was guided by the insight that a flexible, renewable, and efficient energy system was key to meeting decarbonisation targets and to reaching net zero by 2045. For Germany, he said, it was equally central to strengthen energy security, build a strong basis for a competitive economy and to create good, future-proof jobs.

He then said that countries around the world were trying to achieve their energy transition while ensuring energy security and maintaining a strong position in future energy equipment markets. This was also being done while navigating geopolitical tensions. As a result, countries were increasingly emphasising the importance of strengthening their energy independence, including technological sovereignty for the energy transition.

Despite this, Hackethal stressed that Germany firmly believed that markets should remain as open as possible to trade and investment. He then described the current phase of the global energy transition as "strategic co-operation within competitive frameworks".

In her remarks, Nawal Al-Hosany highlighted the historic UAE Consensus achieved at COP28. That placed renewable energy at the centre of global climate action, with a goal of tripling global renewables capacity by 2030. As the custodian of this ambition, she said, IRENA was committed to leading with clarity and urgency. However, she added, ambition must be matched with innovation and smart solutions. She called for bold leadership and integrated systems, citing the UAE's progress from 10 megawatts (MW) of renewable power capacity to over 6 GW today, while aiming for 14 GW by 2030. Yet, the energy transition was no longer limited to simply generating clean power, she said. It was also about how swiftly, reliably and equitably clean energy can be delivered to the places where it was needed most.

Li Sheng then pointed out that in 2024, renewables had made up 56% of China's total power generation capacity. China's renewable energy innovation was driven by four key pillars, he said: strong legal and policy support; targeted research and development; corporate-led innovation; and the integration of technology with industry. Li Sheng added that unilateralism and anti-globalisation were on the rise and the global energy transition faced many challenges. China remained firmly convinced, however, that the transition to clean energy was unstoppable.

Innovator keynote

Yohannes Bimrew highlighted the need for the energy transition to support the work of young people in rural communities. These people are creating real impact on the ground, he said, despite limited access to electricity, education and opportunity.

Growing up in a remote farming village in northern Ethiopia without electricity, Yohannes studied by firelight, watched his mother suffer from indoor smoke pollution and saw entire communities held back by energy poverty. Through self-taught innovation, however, he began building simple energy solutions from local materials, eventually founding Hulu Solar, a community-based initiative delivering solar energy to rural villages. By electrifying homes, Hulu Solar is extending study hours for students, improving health for families, and unlocking economic potential for farmers – proving that access to energy is access to a better future.

Panel discussion

The panel discussion, moderated by Gauri Singh, focused on how innovation can catalyse the tripling of renewables for sustainable growth. Participants explored insights from national, regional and subnational perspectives. Overall, the panellists agreed that innovation was a systemic and continuous process encompassing technology, market design, regulation, finance and policy. They also emphasised that it was essential for a resilient, inclusive and fair energy future, while underscoring the importance of international co-operation and knowledge exchange.

The discussion was structured around the following topics:

Driving renewable energy innovation at the regional, national and sub-national level

Francesco La Camera emphasised that innovation went beyond technology – it was also about rethinking how we plan and perceive the changing energy landscape. The Global Coalition on Energy Planning (GCEP), launched under Brazil's G20 presidency with IRENA as secretariat, is a key example of this broader innovation, promoting inclusive, adaptive long-term planning to better align energy systems with evolving societal needs.

Yoshiomi Yoshino said that significant emissions reductions in Japan since 2013 were the result of a combined effort. Factors such as technology innovation, effective policies, improved energy efficiency and changes in societal behaviour were all involved. He highlighted Japan's diversification of energy sources, its notable progress in solar power and energy efficiency, and the recent launch of the Green Transformation (GX) policy. This policy included the world's first sovereign GX transition bonds, which, in US dollar (USD) terms, mobilised USD 130 billion for decarbonisation innovation. This was part of a broader strategy, he said, which aimed to unlock over USD 1 trillion in public and private investment and help towards a balanced, secure and clean energy future.

Sédiko Douka highlighted the progress and the challenges in building a regional electricity market in West Africa.

Since 2018, he said, 14 continental ECOWAS countries had been interconnected, while the region had also been testing cross-border energy trading. Key challenges remained in infrastructure, regulation and digitalisation, however. Only about 10% of electricity was currently traded across borders, despite a regional master plan that aimed to construct 23 000 kilometres (km) of transmission lines and add 16 GW of generation – 30% of which would come from solar and wind. He emphasised that while digital tools like smart grids existed in some areas, broader digitalisation was limited by low telecom penetration, implementation gaps and cybersecurity concerns.

Stephane Cools then pointed out that despite geographical limitations – such as no North Sea access, low solar potential and no major hydro resources – over the last 25 years, the Wallonia region of Belgium had built a strong ecosystem for renewable energy. He said that a cornerstone of this success had been the green certificate mechanism, which helped scale electricity generation from renewables.

Today, he added, new challenges had emerged, such as permitting and project acceptance. Grid capacity and investment planning were not keeping pace with the speed of renewable deployment. The green certificate model was under pressure, as decreasing technology costs have led to windfalls in profits and rising financial burdens for the regional government, prompting reforms. Financing had become more complex due to volatile energy prices, he said, with Wallonia exploring new mechanisms, such as contracts for difference, to support investment. He then stressed the importance of grid investment, but warned

that rising electricity prices could discourage electrification, which remains central to decarbonisation. He concluded by underlining the need for deeper European interconnection and co-operation to meet the 2050 climate targets.

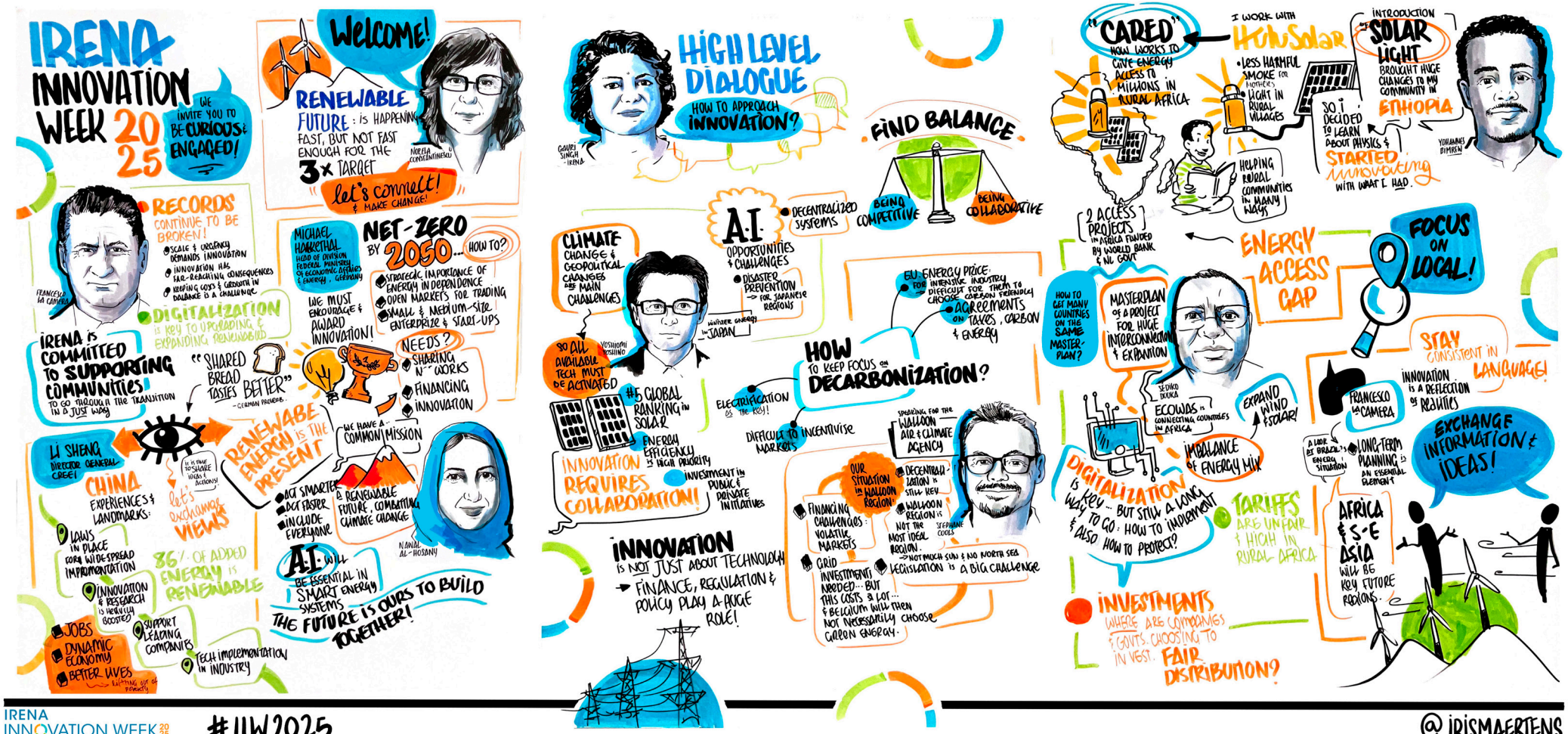
Renewables as catalysers for sustainable growth

Yoshiomi Yoshino said that digital technologies, including AI, were accelerating Japan's efforts to ensure stable energy supply and reduce emissions by improving efficiency, optimising renewable energy generation, and enhancing disaster resilience. Japan had updated its energy efficiency policy, he said, to optimise entire systems using AI. This technology was also being used to improve weather forecasts, manage energy use and maximise the performance of storage and decentralised systems.

Sédiko Douka highlighted the significant challenge of energy access in West Africa. Across ECOWAS, the average access rate was just 52%, he said. Only four or five countries in the region had achieved an electrification rate exceeding 60%, while in some countries energy access was as low as 15%, in others even less. To address this, he added, ECOWAS was implementing two regional projects focused on decentralised renewable solutions, with off-grid solar a particular target. The projects included grants for small and medium-sized enterprises (SMEs) and loans through local banks to enhance rural electrification and generate local value and jobs. The aim of this was to solve the issue of high electricity tariffs. These averaged US cents 0.24 per kilowatt hour (kWh) in rural areas, he said, a level that created a significant barrier, considering the population's relatively low purchasing power. The other big barrier was attracting investors – particularly for energy access projects in rural areas. Douka added that energy access, like education or health, should be treated as a public service, requiring government support to avoid deepening inequality.

Stephane Cools said that the key challenge for European industry was high electricity prices, especially when compared to global levels. This put pressure on energy-intensive sectors as they tried to stay competitive while decarbonising. The new European Union (EU) Campus for Competitiveness initiative aimed to address this by focusing on affordable energy, but geopolitical instability was making investment decisions more difficult, he said. The new Carbon Convention agreement now targeted emissions reductions more directly, encouraging electrification through technologies such as electric pumps and furnaces. Yet for sectors like cement and lime, he added, decarbonisation depended on carbon capture and storage (CCS), which significantly increased electricity demand. This made the transition expensive, with costs in euro (EUR) terms sometimes exceeding EUR 500 million per plant. This highlighted the urgent need, he said, for targeted support and stable market incentives.

Francesco La Camera then concluded by emphasising IRENA's continued role as a global convener and enabler of the energy transition. He highlighted the importance of facilitating knowledge exchange and fostering collaboration across regions, while stressing that regional realities must shape how solutions were designed and implemented. He reiterated IRENA's identification of three, key structural barriers to the energy transition: infrastructure, legal frameworks and skills gaps. He then affirmed the agency's commitment to helping countries overcome these barriers through practical tools, guidance and project support. Acknowledging a growing fragmentation in global co-operation, he also advocated for a model of collaboration, where innovation and competition serve shared progress, rather than division.



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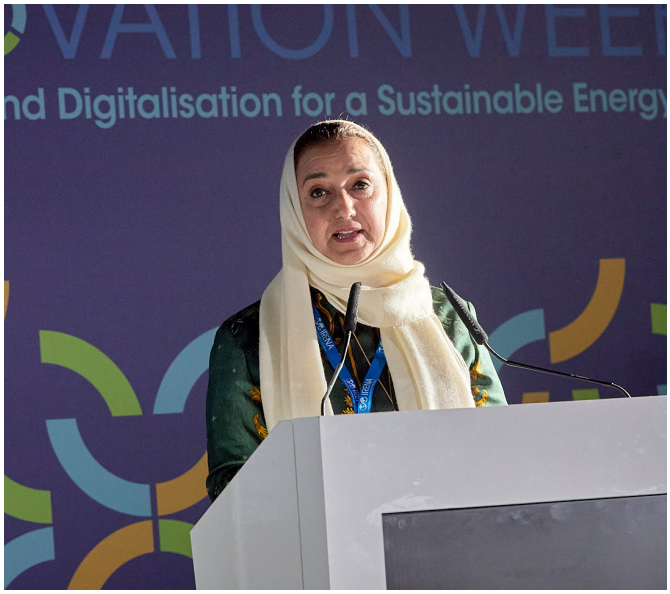
nd Digitalisation for a Sustainable Energy


IRENA
INNOVAT
WEEK 2025


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TRACK 1:

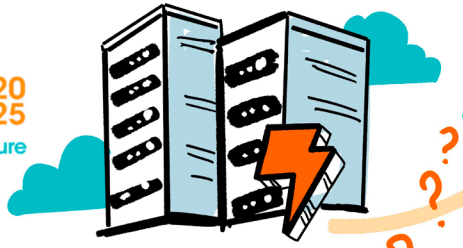
Innovation in infrastructure for tripling renewables

The "Innovation in infrastructure for tripling renewables" track focused on the urgent need for robust, flexible, digitalised and future-ready grid infrastructure to support the global ambition of tripling renewable energy capacity by 2030.

HERE ARE SOME OF THE HIGHLIGHTS FROM THIS YEARS'

IRENA INNOVATION WEEK 2025

Renewables and Digitalisation for a Sustainable Energy Future



POWER DEMAND FOR DATA CENTRES WILL GROW RAPIDLY IN THE COMING YEARS.

HOW?
WHEN?
PLANNING IS DIFFICULT!

"DATA CENTRES ARE ACCELERATING THE RECOGNITION FROM REGULATORS AND ASSET OWNERS OF THE NEED TO SCALE UP POWER SYSTEM INFRASTRUCTURE AND INPUTS, AND THIS IS A GOOD THING. BUT THERE MAY BE A TIPPING POINT!"

INFRASTRUCTURE TRACK

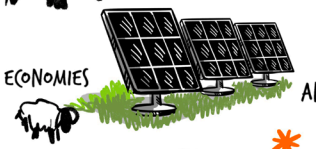
INNOVATION IS OUR COMPASS!

WE LOOK AT NOVEL SOLUTIONS WHICH CUT ACROSS TECHNOLOGY, POLICY, REGULATION, MARKET DESIGN, BUSINESS MODELS, AND SYSTEM OPERATION.

PEOPLE & THEIR COMMUNITIES

MORE GROWTH OF GRASS DUE TO SHADE FROM PV PANELS RURAL, WATER-SCARCE AREAS: THIS FEEDS SHEEP AND ENHANCES LOCAL ECONOMIES

– CHINA

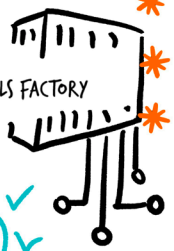


RENEWABLY-POWERED DATA CENTRE INSTALLATION FORMERLY HOSTED A POLLUTING CHEMICALS FACTORY WITH BEE HIVES INSTALLED ON THE ROOF.

– FRANKFURT

DIGITALISATION

"THERE IS NO DIGITAL TRANSITION WITHOUT ENERGY, AND THERE IS NO ENERGY TRANSITION WITHOUT DIGITAL SOLUTIONS".



- DIGITAL AND AI DRIVEN SOLUTIONS FOR FORECASTING EXPECTED RENEWABLE GENERATION, DIGITAL TWIN MODELS FOR ANTICIPATING MAINTENANCE NEEDS ACROSS GENERATORS AND NETWORKS.
- CONTROL SYSTEMS UNDERPINNED BY AI, WHICH ARE ENABLING OPERATORS TO PREVENT THE CURTAILMENT OF RENEWABLE GENERATORS,

"NON-WIRE SOLUTIONS" TO ADDRESSING CAPACITY CONSTRAINTS ON NETWORKS:

- VECTOR OR SYSTEM COUPLING
- ROLE OF HYDROGEN AND DERIVATIVE COMMODITIES

THIS WEEK INCLUDED INNOVATIVE SOLUTIONS FOR ENHANCING BIODIVERSITY

VIRTUOUS CYCLE BETWEEN INTERNATIONAL MARKET OPPORTUNITIES, AND THE ENERGY TRANSITION.

- NEW TRADE PATTERNS
- OPPORTUNITIES TO TRADE GREEN COMMODITIES WILL HELP TO SUPPORT FURTHER AND FASTER DEPLOYMENT OF PRODUCTION FACILITIES FOR THESE COMMODITIES.
- INFRASTRUCTURES NEEDED TO DEPLOY ALTERNATIVE AND SUSTAINABLE FUELS IN HEAVY DUTY TRANSPORT SECTORS, INCLUDING SHIPPING AND AVIATION.

OTHER THEMES:

- DIFFERENT VISIONS FOR THE ADOPTION OF NOVEL AND SUSTAINABLE FUELS IN BOTH SECTORS,
- AND INNOVATION IN REGULATORY FRAMEWORKS TO ENCOURAGE THE DEVELOPMENT OF THE INFRASTRUCTURE THAT IS NEEDED.

INTERNATIONAL MARKETS FOR GREEN COMMODITIES,

- INCLUDING RENEWABLY-PRODUCED HYDROGEN
- AMMONIA AND METHANOL
- ENABLING TRADE IN THE TECHNOLOGIES,
- SYSTEMS AND SERVICES WHICH WILL UNDERPIN THESE SECTORS.

EXCITING NEW TOOLS WILL BE KEY!

NO ONE SIZE FITS ALL SOLUTION

SYNERGIES

Planning for the future

Demand side narratives and scenarios

Session organised in partnership with Stockholm Environment Institute (SEI)

Session overview

This session focused on demand-side energy planning. The narrative around this has recently changed, shifting from a static view of demand and planning to a broader, more engaging and dynamic perspective. In addition, understanding the future of energy demand cannot be solely a top-down approach. It should also be a participatory and inclusive process requiring an engagement with people.

At the same time, while AI will likely be an unpredictable factor influencing demand, it could play a role in forecasting future demand. Such innovative solutions are essential, but we must also consider how to improve energy planning to ensure it is part of a fair, people-centred transition. Improved co-ordination among various stakeholders – such as the different ministries addressing specific demand groups, such a transport – is crucial for enhancing energy planning.

Key actions
for policy makers

- **Enhance cross-ministerial co-ordination**
  Promote collaboration between energy planners and demand-intensive sectors, such as transport, agriculture and industry, to enable integrated planning approaches.

- **Build institutional capacity for participatory planning**
  Strengthen the ability of institutions to engage stakeholders meaningfully from the early stages and throughout the planning process.

- **Prioritise early stakeholder engagement**
  Involve communities and end-users early in the process in order to understand real energy needs, co-design systems and ensure diverse perspectives help shape the policy.

- **Emphasise demand planning as a driver of the energy transition**
  Recognise that proactive demand-side planning – such as identifying and addressing infrastructure gaps – can accelerate market transformation and enhance system resilience.

- **Invest in data infrastructure and advanced modelling tools**
  Support the development of reliable, transparent data and modern analytical tools to better capture evolving demand trends and support scenario building.

Highlights of the session

Scene setting presentation
Nadeem Goussous, Associate Programme Officer, IRENA
Charles Heaps, LEAP Developer and Senior Scientist, SEI

Panel discussion
Moderator: Charles Heaps, LEAP Developer and Senior Scientist, SEI

Marina Gil Sevilla, Energy Specialist, United Nations Economic Commission for Latin America and The Caribbean (ECLAC)
Fiona Lambe, Senior Research Fellow, SEI
Yichun Gong, Researcher, Energy Strategy and Planning Institute, State Grid Energy Research Institute (SGERI) China
Li Xiang, Division Director of the International Co-operation Department of the National Energy Administration (NEA), China

The scene setting presentation from IRENA described how the perception of demand had evolved within IRENA's LTES network. Governments were now prioritising demand-side considerations, ranking them second in recent LTES member surveys, after energy security.

Nadeem Goussous then emphasised that planning today was characterised by integrated system thinking and growing attention to behaviour, choices, and social patterns. Demand was increasingly shaped by technological shifts, changing behaviour and deeper analysis of sectoral dynamics. He explained that planning now involved systems thinking, sector coupling and more detailed engagement with end-use behaviour. While features such as demand response and peer-to-peer systems reflected changes in how energy was used and exchanged, the role of planning was to account for and adapt to these evolving realities. As a result, the field had become more interdisciplinary, requiring further co-ordination and interaction across sectors.

"The narrative around energy planning has changed," Nadeem said. "We went from a static view of demand and planning to a more broader engaging and dynamic view."

Charlie Heaps then started his scene setting presentation by reflecting on how long-term demand-side planning was moving away from stable and predictive models toward more dynamic and uncertain outlooks. He explained that new drivers such as AI, electric vehicles (EVs) and climate imperatives were reshaping the relationship between demand and supply, prompting planners to rethink traditional assumptions.

To guide the discussion, Heaps then raised questions in several areas, including: the extent to which new forms of demand were reflected in national plans; what kinds of methods were being used to model future demand; and whether AI could play a meaningful role in anticipating future needs. He also highlighted persistent gaps in data, modelling and financial alignment, particularly as demand-side measures

remained capital intensive and often underrepresented in planning processes. He then emphasised the importance of integrated approaches that considered social and environmental outcomes, especially as decentralised systems and smart technologies come to play a larger role in energy transitions.

Summarising, he said, "The best way to predict the future is to invent it."

Fiona Lambe then stressed the importance of involving communities early in the design of energy services in order to ensure systems reflect real needs, behaviours and usage patterns.

"People often do not understand the connection between energy and everything else," she said.

Drawing on over a decade of work in household energy and mini-grids, she noted that planning often failed when behavioural and socio-economic factors such as household use, cost and gender were overlooked.

"What matters is how you design and tailor services to people," she said, stressing that early engagement helped embed communities in the energy system, rather than keeping them passive. Her service design approach mapped the full user experience in order to inform more equitable planning.

She also noted that when systems aligned with local livelihoods, communities could benefit financially. In mini-grid projects across Africa, productive use of energy by small enterprises had boosted local demand and income, she said, showing the potential for energy access to support resilience and inclusion.

"Demand side is about people, it is about development," Charles concluded.

Li Xiang from China's NEA then shared China's approach to integrating a long-term vision with short-term implementation. He described how his country used five-year plans to align national priorities with local and sectoral objectives through continuous feedback, annual reviews and evaluations.

As an example, he explained how early consultations had identified the lack of EV charging infrastructure as a key barrier to adoption.

"We have five-year plans," he said, "but top down is not enough. We need to listen to the people."

In response, the next plan prioritised targeted infrastructure deployment in residential areas, workplaces and highways. This directly addressed user concerns, reduced charging anxiety and helped drive rapid EV market growth. By the end of April 2025, over 14 million charging points had been installed. This illustrated how planning could not only respond to demand, but also shape it through structured consultation and timely implementation.

Next, Marina Gil Sevilla from ECLAC highlighted how the growing focus on demand-side planning had made participatory approaches more relevant than ever.

"Latin America and the Caribbean countries have made a lot of progress in energy planning, but most still focus on the supply side," she said.

As planning increasingly considered how people use energy, their behaviour and their social contexts, it became essential to involve communities and stakeholders in shaping scenarios, she said, not just in reacting to them. However, she noted that in much of Latin America and the Caribbean, participatory planning often occurred late in the process and was focused more on information sharing than meaningful

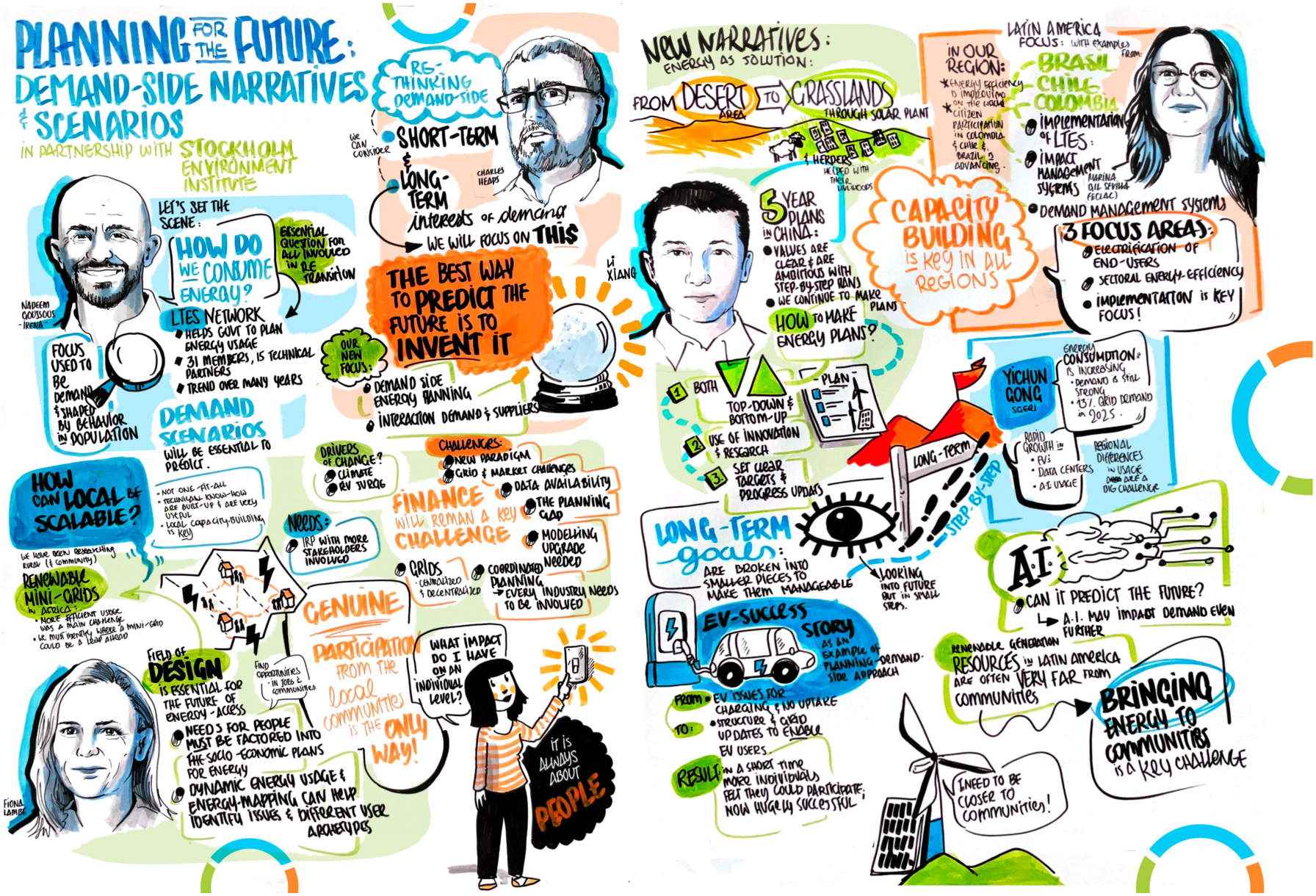
input. Countries such as Brazil, Chile and Colombia had taken steps to embed demand-side priorities into national planning, she noted, particularly in areas such as energy efficiency, electrification and community energy models. Yet, limited institutional capacity remained a key barrier to wider adoption of these practices across the region.

Yichun Gong from SGERI highlighted the challenges of forecasting electricity demand in China, where consumption grew 7% per year from 2022 to 2024. This was driven mainly by industry, EVs and battery use. Electrification was expected to reach 13% annual growth by 2025, with data centres and hydrogen production adding new pressures. To respond, SGERI was using sector-specific and regionally-tailored forecasting tools. Gong emphasised that demand side planning now required an understanding of changing consumption patterns, rather than a reliance on past trends. He called this development foundational in building a low carbon energy system.

During the following question and answer session with the audience, Li Xiang explained that while AI data centres were driving new electricity demand, their load patterns were complex and sensitive to climate, making them hard to forecast. To address this, China introduced policies to improve data centre siting and balance demand across regions.

On mainstreaming justice in energy planning, speakers emphasised that communities must see tangible benefits from their participation in order to stay engaged. Marina Gil Sevilla noted that in Latin America, a key challenge is that renewable resources are often far from consumption centres, making investment in transmission essential. Li Xiang also shared how distributed solar in northwest China supported both local ecosystems and sheep farming, showing how energy projects can enhance livelihoods and restore the environment.

The session concluded with a shared understanding that demand-side narratives must become central to planning processes. Inclusive methods, cross-sectoral co-ordination and stronger data systems were essential in developing long-term energy strategies that were resilient, fair, and actionable. Rather than simply forecasting future demand, the task ahead was to shape demand through planning that was adaptive, participatory and aligned with national goals.



BY @IRIS MAERTENS FOR VISUAL HARVESTING


IRENA INNOVATION WEEK 2025
Panel discussion
Moderator
Panelists
Charlie Heaps
Stockholm Environment Institute
Marina Gil Sevilla
Economic Commission for Latin America and the Caribbean
Fiona Lambe
Stockholm Environment Institute
Yichun Gong
State Grid Energy Research Institute (SGERI)
Li Xiang
National Energy Administration, China
#IIW2025

Connecting the dots

Bridging infrastructure gaps for renewable-powered systems

Session organised in partnership with SGCC-CEPRI

Session overview

As the global energy transition accelerates, the need for robust, flexible and future-ready grid infrastructure has never been more urgent. This session brought together global experts – including industry stakeholders, regulators, utilities and innovators – to explore how infrastructure can evolve to support the tripling of renewable energy capacity. With electricity demand projected to more than double by 2050 (in a 1.5°C aligned scenario) and 91% of supply expected to come from renewables, the session addressed the critical question: can our grid infrastructure keep pace without becoming a bottleneck?

The discussion focused on innovative approaches to infrastructure planning and deployment, including anticipatory investments, NWAs, energy storage, digitalisation and regulatory innovation. Participants emphasised the importance of systemic innovation and the integration of technology, policy and business models in order to unlock untapped grid capacity and ensure secure, affordable, and sustainable energy systems. The session also highlighted the need for international collaboration, data sharing and smarter investment strategies to bridge the infrastructure gap and enable a resilient power system transformation.

Key actions
for policy makers

- **Accelerate infrastructure development through regulatory and permitting innovation**
  Streamline permitting processes and adopt adaptive regulatory frameworks that enable faster grid expansion and integration of renewables. Mechanisms such as Germany's "overriding public interest" clause and anticipatory investments can significantly reduce delays that result in connection queues, aligning infrastructure development with renewable deployment timelines.

- **Aim for maximised use of existing grid infrastructure through NWAs and digitalisation**
  Promote the deployment of grid-enhancing technologies, such as dynamic line rating, battery storage and power flow controllers. Support digital tools such as digital twins, AI-driven analytics and internet-of-things (IoT)-enabled assets to improve grid visibility, forecasting and operational efficiency. This will unlock untapped capacity without major physical expansion.

- **Strengthen markets for flexibility and encourage storage and co-location of assets**
  Develop robust market mechanisms for ancillary services, balancing and capacity in order to integrate variable renewables. Provide clear policy direction and incentives for energy storage deployment and facilitate hybrid projects (e.g. solar photovoltaic (PV) and storage) in order to maximise grid connection capacity and reduce curtailment.

- **Foster integrated planning and cross-sector collaboration**
  Encourage data sharing and co-ordinated planning among transmission system operators (TSOs), distribution system operators (DSOs), regulators and industry stakeholders. Establish collaborative platforms and governance structures to align infrastructure planning with industrial growth, electrification trends, and regional development.

- **Enable smart, inclusive and future-proof investment strategies**
  Prioritise investments that optimise existing infrastructure. Harmonise regulatory frameworks and mechanisms to ensure equitable cost-sharing in cross-border interconnector projects. Incentivise innovation and make infrastructure investments that are both cost-effective and resilient to future energy system needs in order to facilitate an affordable and secure energy transition.

Highlights of the session

Scene setting presentation
Francisco Gafaro, Team-lead, Power Sector Transformation Team, IRENA
Uroš Salobir, Director of the Strategic Innovation Department, Elektro-Slovenija d.o.o. (Slovenia Electric Ltd. – ELES) and Chair, European Network of TSOs for Electricity (ENTSO-E) Research, Development and Innovation Committee
Huang Yuehui, Senior Expert of Department of Renewable Energy, SGCC-CEPRI

Panel discussion
Moderator: Emanuele Taibi, General Manager, Field Italia

Annegret Groebel, Director of International Relations, BNetzA and President, Council of European Energy Regulators (CEER)
Arnis Daugulis, Management board member, Augstprieguma Tīkls AS (AST – High Voltage Network)
Stefan Kilb, Director Industrial Affairs, Schneider
Kangqiao Huang, Senior Director, Policy Research and Public Affairs, Contemporary Amperex Technology Co., Limited (CATL)
Rafael San Juan Moya, Global Innovation Manager, Iberdrola

Closing remarks
Gao Keli, CEO and President, CEPRI, SGCC-CEPRI
Danial Saleem, Associate Programme Officer, IRENA

The session opened with Francisco Gafaro outlining the scale of the challenge in a 1.5°C scenario. In this, electricity needed to supply over 50% of total energy demand by 2050, with 91% of that electricity coming from renewables.

"The grid must not become the bottleneck," he said, highlighting the need for innovation in infrastructure planning and deployment.

He pointed out IRENA's systemic innovation approach, which integrates technology, regulation and business models to enable the energy transition.

Uroš Salobir then presented Europe's ambitious targets of 224 GW of interconnection and 540 GW of storage by 2050. He stressed the importance of "qualitative innovation" – something that aligns with core business processes, such as balancing and stability.

"We do not only need quantitative innovations," he said. "As much as possible, they need to be qualitative… We must not just install technology – we must embed it into operations."

He also emphasised the importance of anticipatory investments, strategic grid planning and transparent communication with regulators and vendors.

"We shouldn't plan to the last decimetre," he noted.

Huang Yuehui then showcased China's multi-pronged strategy. This includes 42 ultra-high voltage (UHV) projects, 73 GW of battery storage and advanced forecasting systems.

"We try our best to use existing infrastructure to accommodate renewables," she said, highlighting flexible interconnections, multi-energy systems and real-time weather-based dispatching tools.

The panel discussion, moderated by Emanuele Taibi (Field Italia), then brought together some diverse perspectives.

Annegret Groebel stressed the need to enable demand-side flexibility and mentioned Germany's regulatory innovations, including "Grid Booster" battery pilots.

"It's not just about grid expansion – it's about enabling flexibility and reducing redispatch costs," she noted.

She also highlighted the introduction of the 'overriding public interest' clause at the EU level as a key enabler that significantly accelerated permitting and construction of grid infrastructure. In addition, she advocated for dynamic regulation and tariff reform to incentivise flexibility.

"We must enable solutions, not stand in their way. Regulation should be adaptive, but predictable," she concluded.

Arnis Daugulis then shared Latvia's experience with grid synchronisation and market balancing. He highlighted regulatory changes that allowed hybrid generation in solar-dedicated grids and the use of dynamic line rating to manage congestion.

"We see renewables not just as a challenge, but as part of the solution," he said.

In his comments, Stefan Kilb presented digital tools such as advanced distribution management systems (ADMS), distributed energy resource management systems (DERMS) and digital twins.

"Interoperability is a must for comprehensive digitalisation," he said, advocating standardised data sets and IoT-enabled infrastructure.

Kangqiao Huang then introduced the concept of "Energy Storage Plus," advocating for national storage targets, safety standards and innovative insurance products.

"Storage must be safe, reliable, and digitally integrated," she said, citing CATL's sodium-ion and dual-chemistry battery innovations.

Rafael San Juan Moya emphasised the importance of co-location of storage and renewables, along with the need for anticipatory investments. "The power grid has been the forgotten element in the energy transition," he said.

He also highlighted the role of hydro-pumped storage and the challenges of underground cabling in urban areas.

The session also discussed complex topics, such as cross-border cost allocation and 24/7 renewable power purchase agreements (PPAs). It was noted that grid enhancing technologies, such as grid boosters (virtual power lines using battery storage), dynamic line rating and grid-forming batteries, had also emerged as promising solutions to congestion and stability issues.

Groebel proposed harmonising regulatory mechanisms to support offshore and interconnector investments. Moya also noted that smart metering and digital platforms were essential in matching real time generation and consumption.

The consensus was clear: to enable a just and sustainable energy transition, future grids must be agile, inclusive and built on a foundation of innovation, co-ordination and regulatory adaptability. In addition, participants agreed there was no single solution to the challenges of an evolving power system. The future had to be one in which power systems were implemented via a collaborative approach, implementing a variety of solutions. Among these, maximising the use of existing infrastructure emerged as a key priority for the short to medium term. This could be achieved in a variety of ways, including: the deployment of NWAs, such as dynamic line rating, grid boosters and grid-forming batteries; leveraging digital tools, such as AI-driven analytics and digital twins; and enabling flexible interconnections and co-location of assets to unlock latent grid capacity.

In closing, the panellists shared some forward-looking insights:

- **Short-term innovations**: Digital twins, AI-based planning and smart metering.
- **Transformative shifts by 2030**: Expanding interconnector capacity, industrial electrification and advanced battery chemistries.
- **Regulatory evolution**: Adaptive, incentive-based frameworks that enable innovation while ensuring predictability.

Danial Saleem concluded by noting that, "Renewable deployment is outpacing grid development. We need a flexible, agile and future-proof grid – and we must invest smarter, not just more."

Gao Keli then echoed the call for international collaboration. "None of us can solve this alone," he said. "Let's strengthen communication and co-operation to bridge infrastructure gaps and accelerate the global energy transition."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Renewables and Dig

Plenary session

Digitalisation for the energy transition

Session organised in partnership with the European Commission Directorate-General for Energy

Session overview

Digital solutions are transforming the energy sector and serving as a key enabler for energy transitions across industries. This session brought together policy makers and industry experts to explore cutting-edge innovations, including AI, smart grids and other transformative technologies that enhance energy system efficiency and adaptability.

The discussion explored recent initiatives, disruptive technologies and the role of AI in accelerating renewable energy deployment and integration across a variety of applications. A key insight was the characterisation of a two-way interaction between AI and the energy system – digitalisation and AI can support the energy transition, while conversely, renewables can meet the growing electricity demand of AI and data centres.

The session aimed to provide actionable insights for governments and stakeholders in managing the increasing complexity and decentralisation of energy systems, while enhancing efficiency and reducing costs.

Key actions
for policy makers

- **Accelerate digital infrastructure roll-out**
  Ensure access to digital infrastructure, such as smart meters and digital platforms. Support digitalisation efforts across the three most relevant layers: the technology layer (smart meters, telemetry, sensors); the data layer (with a focus on interoperability); and the regulatory layer (to enable innovative business models and market integration).

- **Empower energy consumers and foster their engagement in energy transition through digital tools and skills-building initiatives**
  This can be achieved through launching initiatives that enable consumers to become active participants ("prosumers") and raise their energy and digital skills. Also, funding hands-on training at the intersection of digital and energy sectors, and support upskilling when expertise is urgently needed.

- **Unlock finance in smart grid technologies and digital infrastructure through de-risking and impact investment**
  There is a recognised lack of investment in smart grid technology, so policy makers should step up efforts to fund this area. Development banks and funds should specifically invest in data networks, cloud platforms and edge computing nodes in vulnerable regions, including the Global South. Digital grids should be treated as essential climate infrastructure, akin to poles and wires. It is important to develop blended finance models and early-stage support to attract capital for digital energy solutions – particularly in rural and underserved regions.

- **Foster access and exchange of energy data, ensuring interoperability and proper data governance**
  Policy makers should prioritise initiatives that address the lack of interoperability between energy-related data, as this hinders digitalisation. This includes establishing clear data governance, protection and regulatory frameworks for data owners when digital solutions are deployed. Legislation, such as the EU's directive on the energy performance of buildings, can introduce specific obligations for data sharing to facilitate energy reduction.

- **Address and mitigate the risks associated with digitalisation, notably cybersecurity vulnerabilities and the escalating energy consumption of digital solutions**
  Policy makers must manage inherent risks, such as cyber vulnerabilities, particularly in critical infrastructure. Specific measures are needed to reduce the energy used by digital solutions. These measures could include: minimum energy performance standards for data centres; the implementation of reporting obligations; and energy labels.

Highlights of the session

Keynotes
Norela Constantinescu, Acting Director, IRENA Innovation and Technology Centre
Vincent Berrutto, Head of Unit, Research, Innovation, Competitiveness and Digitalisation, European Commission Directorate-General for Energy

Scene setting presentation
Maxime Souvignet, Team Lead, Climate Risk Analytics, United Nations University
Marcia Poletti, Head of European System Change, Octopus Energy
Márcio Venício Pilar Alcântara, Co-ordinator of Innovation and Market Engagement at the Secretariat of Energy Innovation and Energy Transition, Agência Nacional de Energia Elétrica (ANEEL – National Agency for Electrical Energy)

Panel discussion
Moderator: Maher Chebo, Managing Director Europe, Universe
Vincent Berrutto, Head of Unit, Research, Innovation, Competitiveness and Digitalisation, European Commission DG Ener
Márcio Venício Pilar Alcântara, Co-ordinator of Innovation and Market Engagement at the Secretariat of Energy Innovation and Energy transition, ANEEL
Marcia Poletti, Head of European System Change, Octopus
Guilherme Castro, Senior Manager, Faculty AI and IRENA Youth Delegate
Arnoud Kamerbeek, CEO, Jungle AI

Norela Constantinescu introduced the session's theme by pointing out that digitalisation was crucial in enabling energy transitions, especially in managing the variability of renewable electricity generation. As electricity systems became more decentralised and complex, due to increasing electrification, digital tools could enhance planning, forecasting and system operation, she said. Technologies such as AI, smart meters and digital twins were improving grid efficiency, flexibility and cost-effectiveness. However, growing electricity demand from digital infrastructure – particularly from data centres and AI model training – was substantial and rising rapidly.

Vincent Berrutto then said that the European Commission saw digitalisation as key to the energy transition, as energy systems became increasingly decentralised, renewables-based and complex.

"There is no digital transition without energy and there is no energy transition without digital solutions," he said.

Maxime Souvignet highlighted the essential roles of digitalisation and AI in enhancing climate resilience within energy systems. He illustrated this by outlining how integrating AI-driven forecasting tools – such as high-resolution weather data and smart meter inputs – could help utilities anticipate and respond in real time to climate impacts, such as floods or heatwaves. Smart grids, IoT sensors and digital twins enabled predictive maintenance and adaptation, while edge AI allowed for localised, off-grid solutions in vulnerable areas. He called for treating digital grids as climate infrastructure and embedding resilience into

every kilowatt, policy and community.

Marcia Poletti then explained that as energy systems became more complex and volatile, the company she works for – Octopus Energy – had applied AI in three main areas:

- **Grid optimisation:** AI forecasts network congestion to enable dynamic pricing. This allows smart devices like EVs or heaters to shift usage to off-peak times, improving grid efficiency and avoiding costly infrastructure upgrades.

- **Smart device management:** By directly integrating with manufacturers, Octopus manages devices such as EV chargers and heat pumps. AI clusters of devices are based on flexibility and optimised charging, delivering significant savings to consumers. This can be up to 70% for EV charging.

- **Customer interaction:** Generative AI drafts personalised responses that often outperform human agents in customer satisfaction.

"The disruption is going to come from individual consumers, who are going to change the way they are interacting with the energy system", she said.

Márcio Alcântara then highlighted how Brazil already sourced over 87% of its electricity from renewables (mostly from hydro). Now, the focus was on layering digitalisation over this foundation to enable a smarter, more flexible system. Brazil had over 91 million consumer units and over 100 distribution companies and was moving from a historically centralised, hydropower-heavy system to a decentralised, interactive model that included distributed generation, storage and demand-side flexibility.

"No transition without transmission – and no transition without digitalisation," he said.

The panel discussion, moderated by Maher Chebo, emphasised that digitalisation was a foundational element in the energy transition, intertwined with the goal of achieving resilient, decentralised, and decarbonised energy systems.

In the discussion on transformative digital technologies, Arnoud Kamerbeek highlighted predictive maintenance as a high-impact AI application. He explained that Jungle AI's system helped prevent critical failures, reducing carbon dioxide (CO_2) emissions by 30 000 tonnes annually and increasing earnings before interest, taxes, depreciation and amortisation (EBITDA) margins by up to 25% for typical solar or wind farms.

Guilherme Castro then highlighted smart meters as an essential enabling hardware, critical for flexibility, changing consumer behaviour and integrating assets such as EVs into the energy system. He pointed out a significant challenge: the low penetration of smart meters in the Global South. This meant a large portion of the population there would not directly participate in digitalisation for the energy transition. As an example, Brazil had a penetration rate of just 5.6% in 2023, with this expected to rise to 20% by 2030.

Berrutto echoed this, noting the underuse of smart meters even in Europe and the need for indicators assessing how smart the grid really was. Poletti added that while smart meters were vital, many EVs and heat pumps already provided usable telemetry. She underscored the power of bottom-up change, citing Pakistan's installation of 19 GW of solar PV in 2024 as a grassroots system transformation.

When asked about the most high-impact AI use-cases that have been developed in the energy transition space and how their success was being measured, Castro pointed to three core applications: edge

flexibility through granular control of industrial and household assets, such as heat pumps, batteries and freezers; predictive maintenance to prevent failures and ensure operational efficiency; and advanced forecasting to manage the variability of renewable energy. He explained that as energy markets become more complex – with growing risks like price cannibalisation – AI is increasingly vital for large-scale asset owners to determine when and where to sell or store energy in order to maximise value.

On regulations that support or hinder the energy transition, Berrutto highlighted digital-friendly laws such as the EU Energy Performance of Buildings Directive, which ensures tenants can access their energy data – a key enabler for AI-driven efficiency.

"Data is the fuel of AI," he said, emphasising the importance of both sector-specific rules and broader legislation, such as the EU Data Act, to foster data sharing.

Berrutto also underscored the need for proper implementation of regulations across member states and advocated for open-source tools to ensure accessible, scalable digital solutions.

"Regulators are not only enforcers," Alcântara added. "[They] are enablers of change."

Castro then advocated for open-source AI models. This was because they could democratise access, increase transparency and build trust, especially for companies and countries in the Global South. They could do this by allowing on-premise usage and reducing dependence on private, costly, foundational models.

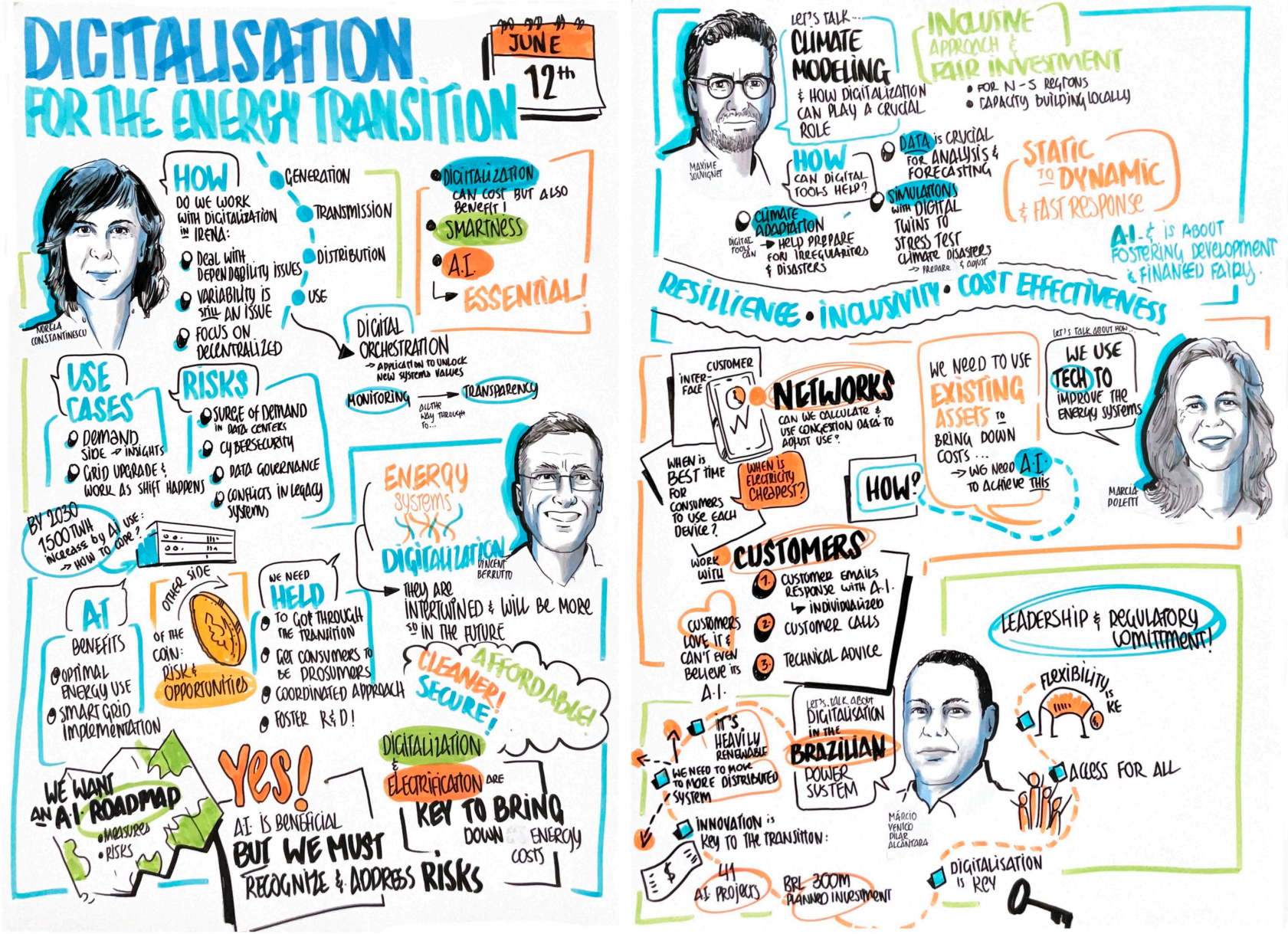
When talking about talent and capacity building, he noted that by automating simple tasks, generative AI would reduce entry-level jobs. He suggested that young professionals should focus on leveraging AI tools through open courses and augmenting their skills.

Poletti added that there was an urgent need for upskilling where skills were desperately needed. "Where the skills are desperately needed, you create ways of enabling this to make it happen," she said.

Kamerbeek then highlighted motivation, saying most people join companies because they want to make an impact and contribute tangibly to the energy transition.

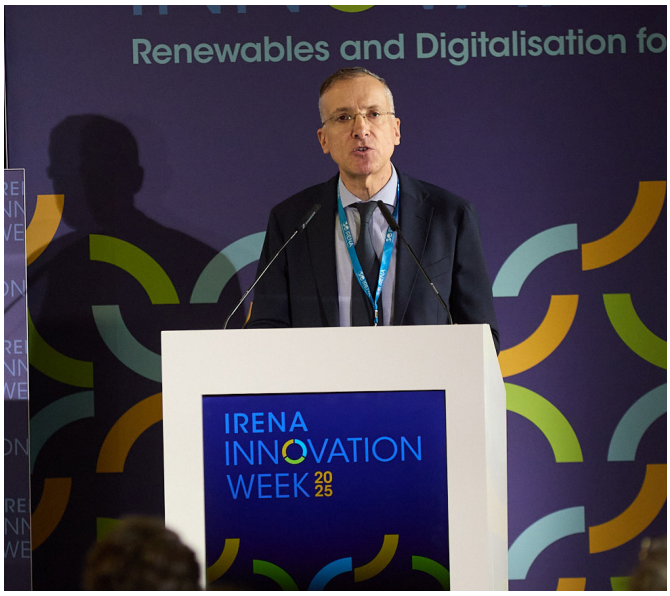
Today's innovations in digitalisation and the energy transition demanded substantial investment, he added, yet there was a recognised lack of investments in smart grid technology. Various funding mechanisms had been mentioned to address this. These included the European Commission's Horizon Europe programme for research and innovation, Brazil's research and development (R&D) and innovation programme for AI-related projects, and the Innovation Fund, which targets larger demonstration projects closer to market through the emissions trading system. For vulnerable regions, especially in the Global South, it was suggested that development banks' funds should invest in digital infrastructure. Attracting private finance for energy access often requires de-risking support and initial subsidies, Kamerbeek then added. The overall goal was to make energy more affordable for consumers, as electrification and digitalisation were seen as solutions to bring down current high energy prices.

Three layers were identified as essential in driving digitalisation in the energy transition: the technology layer, which included smart meters, telemetry and sensors that gathered critical system data; the data layer, which focused on ensuring interoperability to unlock value across planning, operations, flexibility and market functions; and finally, the regulatory layer, which required forward-looking policies to support innovative business models and the integration of digital solutions, with examples of this highlighted from the United Kingdom and Brazil.


DIGITALISATION FOR THE ENERGY TRANSITION
JUNE 12th
NORELA CONSTANTINESCU
HOW
DO WE WORK WITH DIGITALIZATION IN IRENA:
Deal with dependability issues
Variability is still an issue
Focus on decentralized
GENERATION
TRANSMISSION
DISTRIBUTION
USE
DIGITALIZATION CAN COST BUT ALSO BENEFIT!
SMARTNESS
A.I.
ESSENTIAL!
DIGITAL ORCHESTRATION
→ APPLICATION TO UNLOCK NEW SYSTEMS VALUES
MONITORING → TRANSPARENCY
OTHER WAY THROUGH TO...
USE CASES
Demand side → insights
Grid upgrade & work as shift happens
RISKS
Surge of demand in data centers
Cybersecurity
Data governance
Conflicts in legacy systems
BY 2030 1500 TWH increase by AI use: → how to cope?
ENERGY systems
DIGITALIZATION
VINCENT BERRUTO
THEY ARE INTERTWINED & WILL BE MORE SO IN THE FUTURE
AI
BENEFITS
Optimal energy use
Smart grid implementation
OTHER SIDE OF THE COIN: RISK & OPPORTUNITIES
WE NEED HELP
TO GO THROUGH THE TRANSITION
GET CONSUMERS TO BE PROSUMERS
COORDINATED APPROACH
FOSTER R&D!
CLEANER! AFFORDABLE! SECURE!
DIGITALIZATION & ELECTRIFICATION ARE KEY TO BRING DOWN ENERGY COSTS
WE WANT AN AI ROADMAP
Measures
Risks
YES!
AI IS BENEFICIAL
BUT WE MUST RECOGNIZE & ADDRESS RISKS
MAXIME SOUMIGNET
LET'S TALK... CLIMATE MODELING & HOW DIGITALIZATION CAN PLAY A CRUCIAL ROLE
INCLUSIVE APPROACH & FAIR INVESTMENT
FOR N-S REGIONS
CAPACITY BUILDING LOCALLY
HOW CAN DIGITAL TOOLS HELP?
DATA IS CRUCIAL FOR ANALYSIS & FORECASTING
SIMULATIONS WITH DIGITAL TWINS TO STRESS TEST CLIMATE DISASTERS & ADJUST
CLIMATE ADAPTATION → HELP PREPARE FOR IRREGULARITIES & DISASTERS
STATIC TO DYNAMIC & FAST RESPONSE
AI & IS ABOUT FOSTERING DEVELOPMENT & FINANCED FAIRLY.
RESILIENCE • INCLUSIVITY • COST EFFECTIVENESS
MARCIA DOLEFFI
LET'S TALK ABOUT HOW?
WE USE TECH TO IMPROVE THE ENERGY SYSTEMS
WE NEED TO USE EXISTING ASSETS TO BRING DOWN COSTS... → WE NEED AI TO ACHIEVE THIS
HOW?
CUSTOMER INTERFACE
NETWORKS
CAN WE CALCULATE & USE CONGESTION DATA TO ADJUST USE?
WHEN IS BEST TIME FOR CONSUMERS TO USE EACH DEVICE?
WHEN IS ELECTRICITY CHEAPEST?
WORK WITH CUSTOMERS
1. CUSTOMER EMAILS RESPONSE WITH A.I. → INDIVIDUALIZED
2. CUSTOMER CALLS
3. TECHNICAL ADVICE
CUSTOMERS LOVE IT & CAN'T EVEN BELIEVE ITS A.I.
LEADERSHIP & REGULATORY COMMITMENT!
FLEXIBILITY IS KE
ACCESS FOR ALL
LET'S TALK ABOUT DIGITALISATION IN THE BRAZILIAN POWER SYSTEM
IT'S HEAVILY RENEWABLE
WE NEED TO MOVE TO MORE DISTRIBUTED SYSTEM
INNOVATION IS KEY TO THE TRANSITION:
41 AI PROJECTS
BRL 300M PLANNED INVESTMENT
DIGITALISATION IS KEY
MÁRCIO VENICO PILAR ALCANTARA
BY @IRIS MAERTENS FOR VISUAL HARVESTING

BY @IRIS MAERTENS FOR VISUAL HARVESTING


IRENA
INNOVATION


Renewables and Digitalisation fo
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WEEK 2025


Commission
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IRENA Youth
Delegation & Faculty
AI
Jungle AI
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Renewables and Digitalisation for a Sustainable Ene


IIW2025

RESourcing AI

Session organised in partnership with iMasons Climate Accord

Session overview

This session delved into the profound impact on electricity grids, energy prices and global decarbonisation targets made by growing data loads – a process driven by AI, in particular. The session explored critical measures and best practices to enhance the sustainability of data centres, emphasising the imperative of aligning AI energy sourcing with the broader energy transition.

The discussion highlighted diverse approaches in positioning data centres as frontrunners in renewable energy adoption. It also addressed key challenges, such as grid stability, escalating energy consumption and the need for policy coherence. It also uncovered significant opportunities in demand flexibility and waste heat recovery.

Key actions

for policy makers

- **Reinforce regulatory mechanisms for flexibility**
  Policy makers must strengthen regulatory frameworks to enable data centres to actively participate in demand response and flexibility markets. This will transform them into valuable assets for the future energy system, ensuring grid stability and efficient energy use.

- **Promote policy coherence**
  It is crucial to ensure that policies promoting digital infrastructure growth (e.g. the EU Cloud and AI Development Act) are harmonised with those focused on affordable energy and sustainability. This alignment is essential to prevent unintended consequences, such as increased emissions or delayed decarbonisation efforts in other sectors.

- **Establish clear standards and transparency**
  Develop specific standards and regulatory advances for reporting data centre emissions, energy consumption and load projections. This transparency is vital for gaining a true understanding of their environmental impact and for effective planning within the energy transition.

- **Incentivise hourly matching and storage integration**
  Encourage data centres to transition towards 24/7 carbon-free energy matching, ideally achieving up to 90% hourly matching. This can be facilitated by embedding storage solutions into PPAs and making this a criterion for priority grid access.

- **Support the principles of the circular economy and waste heat recovery**
  Create incentives and address existing legal hurdles to promote the utilisation of data centre waste heat for district heating and other beneficial uses. This fosters more circular economic principles in data centre operations, maximising resource efficiency.

Highlights of the session

Scene setting presentations
Adrian Gonzalez, Programme Officer, IRENA
Jill McArdle, International Corporate Campaigner, Beyond Fossil Fuels

Panel discussion
Moderator: Romain Tranchant, Chair of the Innovation Committee, iMasons Climate Accord

Sylvie Tarnay, Chief Strategist Office, Energy Pool
Jill McArdle, International Corporate Campaigner, Beyond Fossil Fuels
Trigya Singh, Head of Corporate Sourcing, Global Renewable Alliance
Gema Del Rio, Energy Transition and International Affairs, Institute for the Diversification of Saving of Energy (Spanish government)
Andrés Acosta, Director of Innovation Europe, LevelTen Energy

Closing presentation
Michael Barth, Senior Corporate Counsel Europe, CyrusOne

The session commenced with an urgent call to address the escalating electricity demand from digital infrastructure, particularly with the advent of AI.

Adrian Gonzalez set the scene by illustrating the surprising energy footprint of digital services. He then highlighted some alarming projections. Global data centre consumption would potentially double in five years, reaching 30% of Ireland's total electricity demand by 2030.

He then stressed, however, that the source of energy was more important than the amount, advocating that power be sourced from renewable energy, rather than fossil fuels. He acknowledged that major data centre operators were leaders in renewables, pushing the deployment of new renewable energy sources through PPAs. Challenges, however, included a mismatch between solar production and data centre consumption, leading to market volatility. Solutions included diversified portfolios of renewables being matched with storage and flexible grid connection agreements to overcome delays caused by congested grids.

Jill McArdle then underscored the critical need for renewables to displace fossil fuels and push them out of the economy. Projections showed significant data centre growth in Europe, raising the concern of increased fossil fuel use to power them. If around half of this new demand was to be powered by fossil fuels, this would lead to 121 million tonnes of emissions, equivalent to all the gas plants in the United Kingdom, Germany and Italy in one year.

Ireland, she said, served as a stark example, as there, data centres were "the only new source of electricity demand, adding significant emissions up until 2030". They had already "peaked past the total wind energy available," she added.

McArdle went on to criticise the current annual matching of renewable energy certificates, which allows data centres to claim to be running on solar power at night. She advocated for hourly matching. She also debunked speculative claims about AI offsetting emissions, stating such numbers lacked any scientific basis. Transparency in emissions and energy consumption data was paramount for sustainable planning, she said.

"Data centres are accelerating the recognition from regulators and asset owners of the need to scale up power system infrastructure and inputs, and this is a good thing," McArdle added. "But there may be a tipping point," she warned.

Romain Tranchant, who was moderating the panel, also highlighted how the digital infrastructure economy – including data centres – was experiencing immense growth. Currently, 55 GW of data centre capacity was under construction globally, he said, with another 135 GW planned, potentially quadrupling their demand. Data centres currently used between 1% and 2% of global energy, with this projected to climb to between 3% and 4% by 2030 – a figure equivalent to the total current annual energy use of Japan.

Sylvie Tarnay then talked about the importance of flexibility. Data centres were traditionally difficult for demand response, due to reliability constraints. Yet they were now poised for change with new typologies and power systems embedding more intermittent renewables. Flexibility was key to bridging the gap between new load and grid constraints, she said. There was tremendous potential for accommodating additional data centre load if they could curtail power consumption for small periods. As an example, in Texas, if centres cut consumption by 0.25% to 1% of the time, or 20 to 80 hours annually, it would create 15 GW of additional capacity. Flexibility could also be temporal – rescheduling tasks such as training, for example – or spatial, such as via shifting load between locations. It could also involve reducing process speed. This contribution to grid services could prevent dramatically increased system costs.

Trigya Singh advocated for "matchmaking" demand and supply for renewable energy projects, though she acknowledged this was challenging due to information gaps. Nonetheless, she emphasised the importance of credible, matched renewable energy procurement by data centres, advocating against weakening accountability systems such as the greenhouse gas (GHG) protocol. She then called for political consensus and collaboration between stakeholders to address these challenges.

Gema Del Rio then explained that Spain viewed data centres as an opportunity to drive more demand for renewables. The country had the aim of sourcing 81% of its electricity demand from renewables by 2030, she said. She also stressed the need for regulatory mechanisms to enable flexibility and make data centres an asset to the energy system. She then highlighted uncertainties due to fragmented markets and the need for specific standards and transparency on emissions to truly understand the sector's impact.

Andrés Acosta explained that the differences between data centre business models – either owner-operated or rental – could affect their ability to procure long-term PPAs. He added that AI workloads could also change consumption profiles. A significant uncertainty was "time to power", or grid connection delays, which could overshadow energy source discussions. Data centres had been pioneers in incentivising renewable energy development through PPAs, setting an example for other industries, he said. Their long-term PPAs helped finance new projects, which in turn drove down average energy costs by displacing fossil fuels.

Michael Barth then presented CyrusOne's Frankfurt 7 project as a lighthouse example of sustainable data centre development. This facility aimed for climate neutrality by 2030, used 100% renewable energy, and

– importantly – would provide 40 MW of waste heat to heat 70 new buildings and 500 000 square metres of campus. CyrusOne prioritised water-free cooling, he aid, which constituted 81% of its portfolio, while also achieving high energy efficiency. Legal and tax hurdles, such as avoiding being a utility provider or paying value added tax on free waste heat, had to be overcome to implement the waste heat reuse, he added. This project demonstrated that data centres, if developed with the right infrastructure and collaboration, could be part of the energy transition.

Tranchant's closing remarks summarised the session's key takeaways:

- There was a consensus on the growth of the data centre industry, though the exact scale remained uncertain.
- The industry needed to shift to a "renewables or nothing" approach for energy sourcing.
- The primary challenges were not technological; instead, deeper changes in the data centre industry were required to fully embrace the available technologies.
- There was significant untapped potential for accommodating new data centre load on existing grids, if flexibility – such as even minor curtailment for a few hours a year – was adopted.
- Projects like CyrusOne's Frankfurt 7 provided a practical, ideal example of a sustainable data centre, showcasing the integration of renewable energy, heat reuse, low/no water usage, and high efficiency.

The session highlighted that while data centres, particularly those supporting AI, presented significant energy demand challenges, they also offered immense opportunities for driving renewable energy adoption and grid innovation, if strategic planning, policy coherence and commitment to flexible, transparent, and sustainable practices were embraced.

Digitalisation for the energy transition

Case studies

Session organised in partnership with METI, Japan

Session overview

This session showcased cutting-edge uses of digital technology in the energy system. The studies came from multiple sources, including utilities, aggregators, digital technology providers, energy infrastructure suppliers and innovation accelerators.

The first part of the session explored how digital technologies optimise grid operations. The second part addressed how digital technologies and demand-side flexibility can contribute to the development of an efficient energy system with renewable energy integration.

Key actions
for policy makers

- **Unlock untapped capacity in the existing energy infrastructure and energy assets by using digital technologies**
  Digital technology can create new potential in energy systems with complex and diverse assets. It can do this through optimised forecasting and operation and maintenance (O&M). This is expected to lead to more efficient, resilient and stable energy systems.

- **Urge international collaboration among energy stakeholders to develop solid demand side management programmes**
  This includes activities such as developing standards and certification schemes for communication protocols and the inter-operability of distributed energy resources (DERs). It is essential to have cross-sector co-operation that includes DERs, suppliers and utilities in order to ensure affordable demand-side management programmes.

- **Facilitate the acquisition and compatibility of energy data**
  Appropriate and large volumes of data are fundamental elements in digitalisation. These data should come from a variety of segments and market players across the energy system.

- **Raise awareness of demand-side management programmes among consumers**
  Scaling up the number of end-users who participate leads to stable and high performing programmes.

Highlights of the session

Opening remarks
Yoshiomi Yoshino, Director, METI, Japan
Moderator: Yasuhiro Sakuma, Programme Officer, IRENA

Presentation: Digitalisation for grid optimisation
Fernando Llaver, CEO, SPLIGHT
Rafael San Juan Moya, Global Innovation Manager, Iberdrola
Kosuke Yamamoto, Chief Officer, New Energy and Industrial Technology Development Organisation (NEDO)

Presentation: Digitalisation for demand-side management and effective renewables integration
Serge Subiron, CEO, Jedlix, and President, Mercury consortium
Tarvo Ong, Founder and CEO, Fusebox
Tomoyuki Chinuki, Senior Engineer, Mitsubishi Electric

Closing remarks
Yasuhiro Sakuma, Programme Officer, IRENA

Yoshiomi Yoshino opened the session by saying that Japan's National Strategic Energy Plan had been updated recently. The plan aimed for a well-balanced electricity mix, he said, with maximum use of decarbonised power sources. He added that the share of renewable energy in the country's mix was expected to expand to between 40% and 50% by 2040. In this, solar PV would play a central role. He then stressed that to achieve higher shares of variable renewable energy, energy systems needed to address stable grid operation and optimal demand side management, and digital technologies could facilitate efficient energy systems.

Fernando Llaver, whose company, SPLIGHT, has had commercial partnerships mainly in Latin America and northern Spain, then began his presentation.

He first provided examples of how digital solutions could increase the potential capacity of transmission lines. In the United States, he said, the typical utilisation rate of transmission grid capacity was 50%, with the construction of transmission lines typically taking 10 years. This meant that, on average, only about half of the total technical transfer capacity of transmission lines was actively used over the course of a year. Renewable energy, he continued, had often been in a long queue for interconnection. In addition, queues for interconnection approval on the demand side for data centres had also been observed.

SPLIGHT, meanwhile, had deployed digital systems that could collect grid data and control renewables in real time, Llaver said. Since this process – which used algorithms – was very fast, SPLIGHT could turn assets such as solar PV, wind, storage batteries and sources of high demand such as data centres into fast-responding, reliable assets.

"Transmission lines are the missing link between renewable energy and the large data centre loads of the future", he concluded.

Rafael San Juan Moya's presentation focused on grid maintenance optimisation via predictive maintenance using digital technology. Spanish utility Iberdrola had adapted machine learning based models to perform preventive maintenance on energy assets in the network, he said. These were of different specifications, models, types and manufacturers. Optimisation models allowed timely maintenance schedules or procurements that could respond to Spanish regulations. The digital technologies improved decisions in maintenance operations and fed into different business processes around logistics, inspections or procurement.

However, **"Challenges exist around data consistency and data availability,"** he said, since hundreds of energy assets in the supply chain had been procured. Data integration was therefore necessary.

Kosuke Yamamoto then explained that when grid congestion was anticipated, renewable energy operators could not immediately connect to the grid. Grid facilities must be expanded for the longer term, he said. In this regard, Japan had launched a "non-firm connection" scheme in 2021 which focused on the fact that grid congestions did not occur all the time, but happened only on limited occasions. The scheme allowed renewable energy operators to connect to the grid without grid reinforcement under the condition of curtailment when congestion was expected to occur.

Japan was different, Yamamoto added, in that it used a permanent system, rather than the temporal systems adopted by some markets in the EU or the United States. As a result, Japan's system was capable of exercising meticulous control – even over power sources as small as 10 kilowatts (kW) – in order to minimise the curtailment of renewables.

"Japan's system for non-firm connection and management can control even small-scale power sources," he said.

He then added that NEDO was working on a project to develop a DER flexibility system. This would aim to use DERs to mitigate congestion in distribution lines caused by renewable energy.

Serge Subiron then said that, **"Only 5% of end-users' devices participate in demand response programmes."** That was around 200 million devices, worldwide, while the number of demand side flexible assets was certain to increase exponentially.

"There is complexity in communication protocols," he added, with a lot of variability in DER suppliers. The cost of integrating these into the aggregation platform was high. In addition, energy markets were very fragmented globally, with as many different products as markets.

To tackle these challenges, Subiron advocated global outreach. This was necessary, he said, if there was to be a universal scaling up of demand-side resource participation. This could not be achieved at the global level, he added, without cross-sector co-operation from utilities, DER suppliers, research institutes and policy makers. The Mercury certification programme tested devices to make sure they performed the way they are supposed to, he said. Once they passed through this process, they were qualified for those markets ultimately able to deliver outputs to consumers. Finally, he stressed that moving the share of flexible devices from 5% to 95% needed strong policy support.

In his presentation, Tarvo Ong explained that Fusebox operated virtual power plants using behind-the-meter commercial/industrial scale devices. They also shared their business models, software and technology with local energy asset owners in different countries.

"Energy traders will not connect with smart devices," he said, "as there are so many and they are very different. So we connect with them, so that they can trade the portfolio into different energy markets."

Local asset owners use Fusebox to lower their costs and increase revenue.

Ong then said that the process of unlocking new ancillary markets was composed of four stages: 1) connecting energy assets; 2) optimising energy with Fusebox's energy management system; 3) entering ancillary markets; and 4) scaling up the energy asset portfolio.

One of the main challenges, he said, was that energy traders were wary of connecting with demand-side resources because of their high complexity. Fusebox's interface therefore made it easy for energy traders to interface with them. Since Fusebox was neutral, DER suppliers could use it to access energy markets, while energy traders could use it to access DER markets. He then added that Fusebox had operations now in both Mexico and Finland.

Tomoyuki Chinuki started his presentation by providing two examples of battery energy management systems (EMS). These had used DERMS for reliable grid operation and flexible connectivity.

The first example referenced Japan's Hokkaido area – a region with great potential for wind energy. There have been several challenges in developing this, however, such as small grid capacity and low power demand. Project developers were still able to install large amounts of wind power and battery storage systems, however, by using EMS. By using this system, the project could reduce curtailment and imbalance costs, while at the same time improving grid stability.

The second example referred to the United Kingdom, where the DSO had a large volume of connection applications for renewable energy generation. The cost of the grid reinforcement necessary to fully accommodate these connections was high and resulted in long queues. DERMS, however, was able to monitor grid capacity and control DERs in real time to comply with grid capacity. The system reduced costs and made renewable energy interconnection faster.

"Our DERMS realises lower costs and faster interconnections for renewable energy," he concluded.







Enabling next generation trade in renewable energy value chains

Session organised in partnership with the OECD

Session overview

Speakers and panellists discussed innovative approaches to driving the development of international markets across the full renewable energy value chain.

Many of the contributions focused on renewably-produced hydrogen and its derivatives, including ammonia and methanol, and the measures needed to support emergent trade in these commodities.

Speakers also discussed the value of aligning international standards and certification schemes, as well as underpinning regulatory frameworks, in building market confidence.

Key actions

for policy makers

- **Clarify regulatory expectations, standards and certification schemes for green commodity markets**
  For international hydrogen projects, regulatory uncertainty is a key barrier to investment and secure off-take. Regulatory clarity is also a requirement for the development of robust and inter-operable certification.

- **To give confidence to producers, provide clear demand signals for green commodities**
  Panellists agreed that off-take risk – and its associated demand and price uncertainties – was the critical factor preventing the deployment of export-orientated green commodity projects.

- **Support research, development and commercialisation of novel technologies across the full energy value chain, and identify opportunities for their export**
  Trade in enabling technologies, components and systems is expected to facilitate cost efficiencies and enhance the broad benefits of renewable energy projects.

- **Work together with partners**
  International co-operation is integral to reducing risks, promoting trust and building markets as it brings producers and consumers together. Supporting initiatives for international harmonisation will help to unlock trade.

Highlights of the session

Scene-setting presentation
Ann-Kathrin Lipponer, Associate Programme Officer, IRENA
Deger Saygin, Industry Programme Lead, OECD

Panel discussion
Moderator: Deger Saygin, Industry Programme Lead, OECD

Dolf Gielen, Hydrogen Programme Lead, World Bank
Eleanor Webster, Head of Secretariat, Mission Innovation
Frank Wouters, Director, Mediterranean Green Electrons and Molecules (MED-GEM)

Fireside chat: Case studies and insights from first-mover projects
Moderator: James Walker, Team Lead, Renewable Gases, IRENA

Ryan (Chenjiang) Xiao, Deputy General Manager, China Hydrogen Alliance
Luca Corradi, Chief Technology Officer, Net Zero Technology Centre

In her scene-setting presentation, Ann-Kathrin Lipponer pointed out that while the energy transition would influence how countries traded energy and commodities in the future, trade patterns in energy value chains would also shape the direction of the energy transition. This relationship might be synergistic – whereby trade might accelerate the transition, or enhance cost effectiveness. This perspective would also apply across the full energy system. Lipponer highlighted the opportunity for trade to reduce costs and enhance the resilience of supply chains in key components and technologies. Trade could also provide new markets and boost off-take security in the export of energy resources, such as renewable power, green hydrogen and its derivatives.

Deger Saygin then provided an overview of recent studies highlighting ways to de-risk investment in renewable and low-emissions hydrogen projects. These projects included some with international markets as target off-takers. He noted that a range of de-risking instruments should be used in combination in order to enhance project success. This could be done, for example, by reducing production costs while also providing demand guarantees through public-private partnerships (PPPs) in key sectors.

Saygin then moderated the first panel discussion. This considered progress in the evolution of market conditions in the international trade of renewable energy – and in commodities derived from green hydrogen in particular. The discussion also considered the role of multilateral initiatives in facilitating this trade.

For green commodities, including renewably-produced hydrogen, ammonia and methanol, the panellists agreed that international markets for these would be "buyer's markets". There were relatively few countries signalling an intention to import these commodities in large volumes, the panellists agreed, yet there were many potential producers.

During the panel discussion, Frank Wouters highlighted the degree to which many production project developers were following developments in Germany in order to understand how the market there might evolve. Producers would need to meet the regulatory and standardisation requirements of importing countries, he said. The panellists then discussed the need for knowledge exchange in order to bring about a shared understanding of these requirements as they were being defined.

Uncertainty in demand and an absence of clear signals for off-take, or signed agreements, were the most critical barriers to trade in renewably-produced hydrogen and derived commodities, Dolf Gielen noted. That off-take risk is – at its core – all about price, he said. In the absence long-term price guarantees, price uncertainty curtails demand, as would-be consumers cannot plan accordingly.

Trade is also a vital consideration when attempting to address insecurity, or limited resilience, in critical material value chains, Gielen added. The same is true when considering other technology and equipment supply chains across the whole energy system. These vital inputs are crucial energy transition enablers and dialogue will be needed to keep international markets open and to ensure trade is kept stable, reliable and predictable.

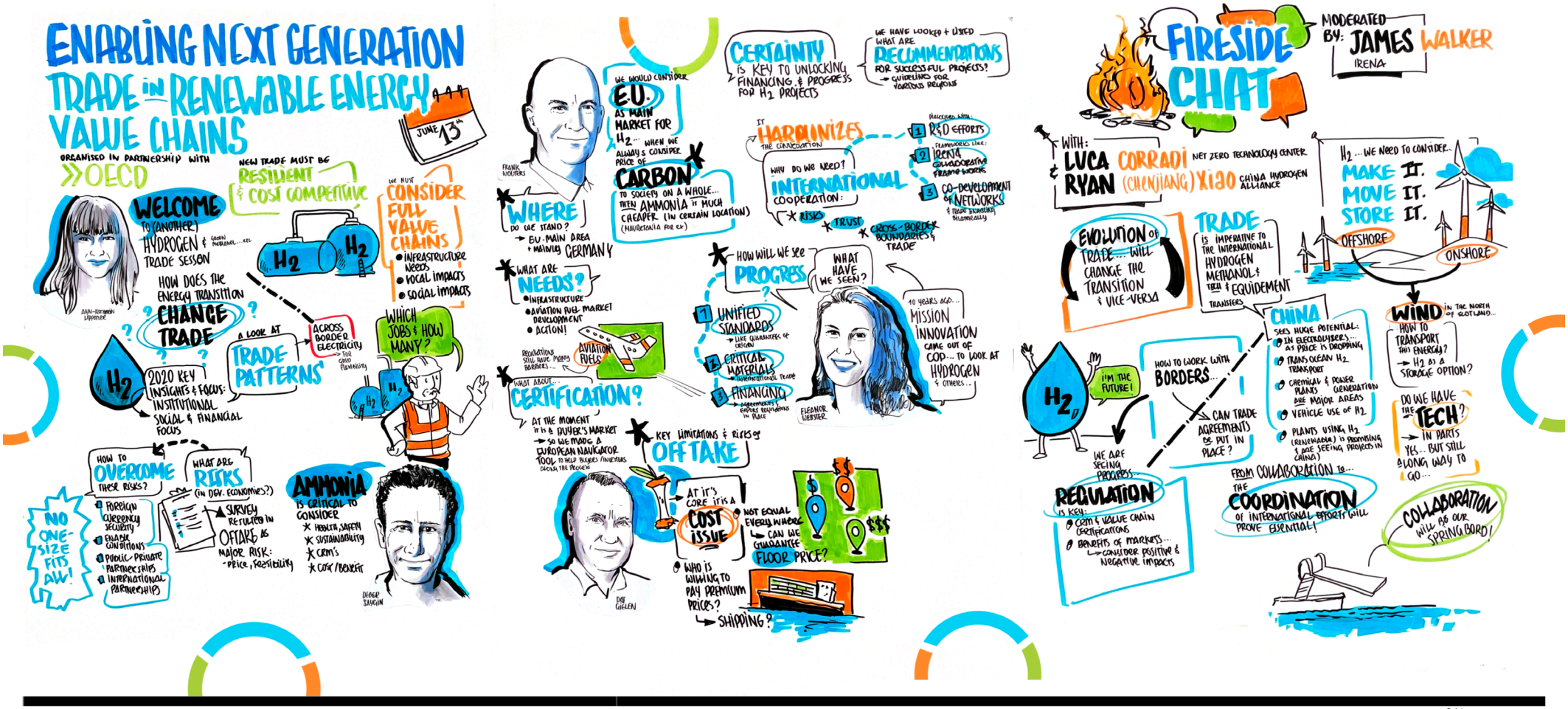
The panellists then agreed that price premiums for green products might help to unlock investment. These would facilitate the production of volumes of renewably-produced hydrogen and derived commodities, and also have an impact across the wider renewable energy value chain. Such premiums might help to address off-take risk in some commodity markets, although carbon pricing was likely a requirement for this to occur.

There was consensus amongst all of the panellists that international co-operation was vital to de-risking investment and unlocking markets by building confidence in producers and consumers alike. Eleanor Webster highlighted the critical role played by collaborative efforts in harmonising international standards, with these also a means to increase confidence in international markets. Those markets depended on a good understanding between different players, which could be facilitated through co-operation and the harmonisation of standardisation requirements.

In the second half of the session, James Walker was joined on the stage by Ryan (Chenjiang) Xiao and Luca Corradi for a "fireside chat". This focussed on what had been learnt from near-to-market hydrogen production and export projects in China and Europe.

Ryan Xiao highlighted the huge current project pipeline in China, along with the very ambitious and promising near-term opportunities for low-cost hydrogen production in the country.

Luca Corradi then described various feasibility studies undertaken to evaluate the prospect of exporting hydrogen from Scotland to Germany. He also spotlighted recent work in Scotland on demonstrating the feasibility of producing hydrogen offshore, in order to ease its export. There, the hope was that to reduce costs, offshore oil and gas infrastructure could be re-purposed.



BY @IRIS MAERTENS FOR VISUAL HARVESTING


#IIW2025

Infrastructure for sustainable fuels

in shipping and aviation

Session organised in partnership with Future Cleantech Architects

Session overview

Currently, the global aviation and maritime sectors together represent between 5% and 6% of anthropogenic GHGs. Their combined activity could also double by 2050.

To reach net-zero emissions, both sectors need to transition to low carbon energy sources, such as biofuels, green e-fuels and renewable electricity. These sectors also need to take a variety of energy efficiency and new operational measures. This represents a major challenge for fuel producers, ports, airports and ship and aircraft operators. They need to adapt existing infrastructure and develop new ways to store, transport, handle and bunker these low carbon fuels for ships and aircraft.

In this session, presenters and panellists considered the infrastructure necessary to produce sustainable aviation and shipping fuels and to deliver these to ports and airports. They also highlighted the challenges in producing, bunkering, blending and certifying sustainable fuels, while also discussing potential ways forward.

Key actions

for policy makers

- **Implement strategic carbon pricing and innovative funding mechanisms**
  Governments should leverage carbon pricing as a key tool, ensuring that the revenues generated are strategically reinvested to stimulate technological progress and facilitate final investment decisions (FIDs) for new projects. The creation of a fund specifically to finance low-carbon fuels is an important aspect of this.

- **Establish robust regulatory frameworks and global standards with clear incentives**
  Policy makers must develop strong, streamlined and well-designed regulations to guide the transition. This includes setting clear global standards, such as those developed under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) by the International Civil Aviation Organisation (ICAO) and its member states, to avoid carbon leakage across the lifecycle of fuels. It is also crucial to address ongoing challenges in sustainability certification. Regulatory requirements, combined with carbon pricing, are seen as the path to acceleration.

- **Incentivise sustainable fuel production and optimise infrastructure deployment**
  Policy makers must actively boost investment in renewable energy and SAF plants. This includes developing strategies and regulations to create transparent and sustainable markets for biogenic carbon dioxide (CO_2). A significant opportunity lies in repurposing existing infrastructure, such as fossil fuel refineries, for SAF production. This can lead to substantial savings in capital expenditure (CAPEX). While aviation has largely opted for "drop-in" fuels, there will need to be an evolution toward renewable fuel options that are not necessarily as homogeneously compatible with the petroleum-based value chain – potentially by adapting the fossil fuel chain to renewables. Indeed, recognising

that existing infrastructure is optimised for fossil fuels, there is a clear need for adaptation and investment in separate storage, transport and distribution facilities for new fuels such as ammonia and methanol.

- **Stimulate and aggregate demand for low-carbon fuels and technologies**
  It is vital for policy makers to create an environment that encourages stronger demand-side leadership from the private sector. This could be done, for instance, by aggregating demand through alliances. Policies should also support buyers of environmental attributes that can be monetised, as these play an essential role in the economic feasibility of sustainable supply chains. Implementing specific SAF targets (as seen in China) and fostering initiatives such as green shipping corridors – pairs of ports that guarantee the availability of low-carbon fuels – can help drive market creation and the uptake of sustainable alternatives, especially for long-distance shipping.

- **Promote strategic port development, grid integration and infrastructure adaptability**
  Policy makers need to ensure that the necessary energy infrastructure is in place and that strategic decisions by ports support the transition. Maritime ports face critical strategic decisions as to which low-carbon fuels they offer, as these choices will affect their competitiveness. This involves decisions on whether to produce fuels on-site, requiring large power capacities, or bring them in by ship or pipeline, which has other cost implications. Finally, ensuring energy infrastructure is in place involves encouraging the coupling of hydrogen production with the power grid, while also supporting the electrification of short-distance shipping and all port operations.

Highlights of the session

Scene setting presentation
Peter Schniering, Co-founder and CEO, Future Cleantech Architects
Arno van den Bos, Analyst, Green Hydrogen Energy and Power-to-X, IRENA

Panel discussion
Moderator: Peter Schniering, Co-founder and CEO, Future Cleantech Architects.

Panellists
Arno van den Bos, Analyst, Green Hydrogen Energy and Power to X, IRENA
Ralph-Uwe Dietrich, Manager Techno Economic Assessment, Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Centre – DLR)
Zhang Chang, Chief engineer of the hydrogen energy technology department, Huaneng Clean Energy Research Institute
Pierpaolo Cazzola, Director, European Transport and Energy Research Centre
Santiago Haya-Leiva, International Co-operation Officer – Sustainability, European Union Aviation Safety Agency (EASA)

Peter Schniering opened the session with a scene-setting presentation that gave a bird's eye perspective of the aviation and shipping sector decarbonisation challenge.

Two key points were that almost 40% of the cargo transported by international shipping consisted of fossil fuels, while the total annual emissions of the global maritime transport sector represented about 1.3 times the total annual emissions of Germany. In addition, the long lifespans of ships made technological transitions very slow, so we should get started as soon as possible.

In the aviation sector, over 80% of the world's population had never boarded a flight, Schniering said. Today, electrification of planes could take us on flights out to a range of around 500 km, while hydrogen could perhaps extend that to 4 000 km. For longer distances, however, we needed drop-in sustainable fuels.

Arno van den Bos then followed these comments up with a second scene-setting presentation. This showcased IRENA's decarbonisation scenarios for shipping and aviation. Some key messages from these were that while energy efficiency measures could play a role, he said, the bulk of decarbonisation would come from biofuels and synthetic fuels. In the shipping sector, IRENA foresaw a larger role for ammonia, as it did not require biogenic CO_2, which is a scarce resource. Ships powered by liquefied natural gas (LNG) which were currently being built, or on the order books could use bio-LNG in the future.

Zhang Chang then proceeded to present China's approach to decarbonisation and the role of hydrogen and green fuels. The Chinese government, she said, had implemented dual carbon goals with carbon pricing and SAF targets. Methanol was to play a major role in transportation, while ammonia would mostly be used in industry. She also highlighted the importance of coupling hydrogen production to the power grid, a procedure on which the Huaneng Clean Energy Research Institute had done extensive work.

Schniering then moderated the panel discussion, which touched on the following topics:

Challenges in shipping and ports

Pierpaolo Cazzola said that ammonia and methanol required separate storage, transport and distribution facilities. These were important for ports because of their cost and the amount of investment they required. Potentially, they also came with competitiveness challenges, since ports that had access to lower cost e-fuels could attract more traffic.

Biofuels, meanwhile, were not only lower cost than e-fuels, but were also compatible with existing infrastructure. Because ammonia is toxic, however, urban ports were considering moving parts of their infrastructure to other areas, with Cazzola referencing examples of this from Nordic ports. This shift involved major changes and challenges that were not well covered in energy transition scenarios.

Van den Bos then said that getting an FID and the production of low carbon fuels started were major challenges. Ports – and smaller ones in particular – had to make strategic decisions, since they would not always be able to provide every type of fuel. Governments needed to develop strategies and regulations to create transparent and sustainable markets for biogenic CO_2, which was a scarce resource. He added that to get investments going, we needed stronger policies and leadership from private sector demand, something that could be achieved, for instance, by aggregating demand through alliances.

Zhang Chang then added that ports had to make strategic decisions as to whether they produced the fuels on site – which required large power capacity – or ship or pipe the fuels from another site, which had other cost implications, while also depending on the availability and cost of land, along with other factors.

Aviation fuel

Santiago Haya-Leiva then said that EASA was supporting countries in scaling up SAF. In terms of raising the volume of production, it was important to start tapping into the possibility of repurposing existing infrastructure such as refineries, he said. This could save large amounts of CAPEX. He then added that together with the German development agency GIZ and colleagues from the Netherlands, EASA was supporting this with techno-economic analysis.

Haya-Leiva then pointed out that the economic feasibility of developing sustainable SAF supply chains depended not only on the existing infrastructure, but also on the creation of market demand. Enablers that played an essential role in this included government policies, certification bodies, investment ecosystems and buyers of environmental attributes that could be monetised, he said. This latter process could occur either through government programmes, or via company commitments.

He then added that the extent of the challenge depended on the pathway chosen. The least challenging was blending bio-crude in existing refineries, as this required only minor blending adjustments, together with certification. The most challenging were the power-to-X pathways in which the infrastructure did not exist and required significant investment. All pathways, however, were necessary, he concluded.

Cazzola then added that the aviation sector had strongly opted for drop-in options. This meant renewables had to be adapted to the petroleum based value chain, which could be more expensive than adapting the fossil chain to renewables. While this approach also had advantages, he said, there would need to be an evolution toward some renewable fuel options that were not necessarily going to fit as homogeneously into the petroleum-based value chain.

Ralph-Uwe Dietrich then made the comment that the task of infrastructure was to connect the source of

aviation fuels with the customer. This had been optimised for fossil fuels, so when governments required the blending in of renewable sources, this was a challenge. Uncertainties lay in the quantity of feedstock available and how to build a plant near them, he said. Competition between refiners would be strong as the resources were limited.

Creating adequate markets for both shipping and aviation fuels

On this topic, Haya-Leiva said there had to be clear global standards which could avoid carbon leakages in the life cycle of the fuels. Together with its member states, ICAO had developed such a system with the CORSIA standard, he said.

Cazzola then added that there were still issues in sustainability certification that needed to be addressed. The International Maritime Organisation (IMO) 83rd Marine Environment Protection Committee (MEPC 83) decision that needed to be finalised in October was also a compromise that brought interesting dynamics, he said. The creation of a fund to finance low carbon fuels – and potentially other things as well – still faced big questions about how that fund would work

Electric shipping and zero carbon aviation in the next 20 years

Cazzola then turned to future prospects by saying that he thought it was reasonable to expect short-distance shipping to be electrified in the next 20 years, along with all port operations. He pointed out that the EU's alternative fuel infrastructure regulations went in that direction. The distance these ships travel would depend on a cost-benefit analysis. Some options for containerised battery-swapping were being considered. If long-distance shipping happened with sustainable fuels, he then said, it would happen via green shipping corridors – pairs of ports that guaranteed the availability of low carbon fuels – and via buyers' alliances.

Regarding pathways, Dietrich then said that SAF would win out where carbon and hydrogen were the cheapest. If we used woody biomass – which was very green and had no need for fertiliser – with green hydrogen, Europe could produce large quantities of SAF, he said . Other pathways might also be successful in other regions, such as the use of bio-ethanol in Brazil.

When asked what were their main wishes when it came to accelerating the transition, Zhang Chang said the development of efficient and flexible electrolytic technologies would help a lot. Haya-Leiva added that partnerships were important, not only among different types of organisations, but also across sectors and through well-designed policies.

For his part, Cazzola answered that on policy, a combination of regulatory requirements and carbon pricing was required, with the revenues from carbon pricing used to stimulate technological progress and to more FIDs. Dietrich, meanwhile, said that he wished for strong, streamlined regulation and boosted investment in renewables and SAF plants. This would potentially redirect profits from fossil fuel companies into renewable alternatives.

Finally, van den Bos warned that the improvements in battery technologies that could make a difference in hybrid systems should not be underestimated. Regarding financing, he said that an initiative that could work well in this area was IRENA's collaboration with the ICAO and EASA to expand the Energy Transition Accelerator Financing (ETAF) platform for aviation fuels. He concluded by saying that port incentives could also boost the adoption of clean fuels.


Future
eantech
Architects


IRENA INNOVATION WEEK 2025
Panel discussion
Moderator
Panellists
Peter Schniering
Future Cleantech Architects
Arno van den Bos
IRENA
Ralph-Uwe Dietrich
German Aerospace Center (DLR)
Pierpaolo Cazzola
European Transport and Energy Research Centre
Santiago Haya-Leiva
European Union Aviation Safety Agency (EASA)

Technology innovation showcase

Session organised in partnership with the Net Zero Technology Centre (NZTC)

Session supported by AFID

Session overview

The Technology innovation showcase spotlighted breakthrough decarbonisation solutions that target hard-to-abate industrial sectors. Responsible for a third of global CO_2 emissions, these sectors urgently require systemic shifts. The showcase presented innovative decarbonisation and net-zero technologies to industry end users, highlighting those solutions with high impact potential. The session also aimed to foster partnerships and sustain further collaboration among AFID members and partners.

The session introduced and demonstrated cutting-edge innovations in the following areas: bioenergy with carbon capture, utilisation and storage (BECCUS); hydrogen; and circularity. The session underscored the fact that scalable, real-world solutions for industrial decarbonisation are already emerging. Continued collaboration across sectors and geographies remains essential, however, in accelerating deployment and driving the systemic change needed for a net-zero industrial future.

Key actions

for policy makers

- **Prioritise the deployment and scale-up of high technology readiness level (TRL) decarbonisation technologies in industry**
  This should be achieved through targeted support and public-private collaboration.

- **Incentivise partnerships between technology developers, industrial users, and investors**
  This should accelerate the adoption of innovation in hard-to-abate sectors.

- **Integrate circularity, digitalisation and green hydrogen-based innovations**
  These should be integrated into national industrial decarbonisation strategies.

- **Build capacity across industrial sectors**
  This can be achieved by supporting knowledge-sharing platforms such as AFID and innovation showcases.

- **Develop policies that facilitate investment in emerging decarbonisation technologies**
  This should be achieved while also ensuring just and inclusive transitions.

Highlights of the session

Panel discussion
Master of ceremonies: Begonia Gutierrez, Associate Professional, IRENA

Opening remarks
Francesco La Camera, IRENA Director-General
Urban Peyker, Mission Director, Mission Innovation, Net Zero Industries

Technology showcase: Pitches
Moderator: Luca Corradi, Chief Technology Officer, Net Zero Technology Centre (NZTC)

Technology showcase
BECCUS technology: Giovanna Massobrio, Decarbonisation R&D unit, Società Nazionale Metanodotti (SNAM – National Gas Pipeline Company)
Circularity technology: Pietrogiovanni Cerchier, CEO and Founder, 9-Tech
Green hydrogen technology: Frazer Ely, Founder, Latent Drive

Live voting session and award ceremony: AFID Technology Innovator 2025

Francesco La Camera opened the session by saying that "decarbonising in hard-to-abate industries is no longer optional" and calling for systemic shifts and innovation.

Urban Peyker then reinforced the urgency of rethinking industrial operations.

"Reaching net zero by 2050 will not be possible without transforming industrial operations at their core," he said.

Technology showcase: Pitches

Giovanna Massobrio then presented SNAM's BECCUS innovation. This integrates heat electrification in the conversion of biogas or biomethane into hydrogen. Pietrogiovanni Cerchier then showcased a circularity solution from 9-Tech that features new equipment and processes for recycling solar PV panels. Finally, Frazer Ely introduced Latent Drive's green hydrogen innovation, which is a direct seawater-to-hydrogen electrolyser stack.

Live voting session: Audience Award – IRENA Innovation Week 2025

The audience then voted for the "Most Promising Technology" among the three pitches. The competition was won by 9-Tech and its solar PV recycling solution.

Award ceremony: AFID Technology Innovator 2025

The AFID Circularity Award was presented by Nawal Al-Hosany, Permanent Representative of the UAE to IRENA. In her remarks, she highlighted the fact that "the AFID Technology Showcase includes areas of technology that are also part of the technological pathway of the UAE's Industrial Decarbonisation Roadmap".

She then stressed that it was "critically important" that the industrial companies of the UAE advanced their decarbonisation efforts in close co-operation with international partners.

She also noted that the winning technology promoted "sustainable resource recovery in the solar industry", recognising 9-Tech's solution for recycling solar PV panels.

The AFID BECCUS Award was presented to SNAM by Begonia Gutierrez, Associate Professional, IRENA.

The AFID Green Hydrogen Award was presented to Latent Drive by Hassan Al Ali, Environmental, Social and Governance (ESG) and Sustainability Engineer, EMSTEEL and AFID Co-Chair.

In his opening remarks, he said, "I am proud to highlight that EMSTEEL is operating the region's first green hydrogen pilot project for low-carbon steel production."

Presenting the award, he commended on Latent Drive's "breakthrough" SeaStack technology – a direct seawater electrolysis system designed to produce green hydrogen offshore without the need for desalination. He closed by affirming that, "Industrial transformation cannot happen in isolation. It requires strong collaboration between governments, technology developers and industry leaders – exactly the type of partnerships we are proud to build through AFID."

BY @IRIS MAERTENS FOR VISUAL HARVESTING


#IIW2025


Thank you!

TRACK 2:

Renewable-based solutions for sustainable development

The "Renewable-based solutions for sustainable development" track of IRENA Innovation Week 2025 underscored the necessity of a holistic and people-centred approach to the energy transition. This is particularly the case in EMDEs and fragile contexts. Overall, discussions in this track stressed that successful solutions had to be context-specific and deliver broad socio-economic benefits, fostering true sustainable development.

HERE ARE SOME OF THE HIGHLIGHTS FROM THIS YEARS'

IRENA INNOVATION WEEK 2025

Renewables and Digitalisation for a Sustainable Energy Future

STORIES FROM TANZANIA, SOUTH AFRICA, NIGERIA, ETHIOPIA , COLOMBIA, CHINA, JAPAN, INDIA, MALAYASIA, THE PHILIPPINES... JUST TO NAME A FEW!

EXPERIENCES AND STORIES FROM ALL OVER THE WORLD.

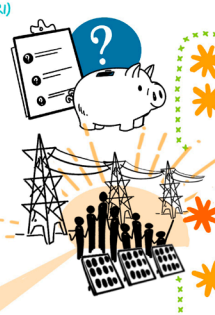
RICH DISCUSSIONS, DIVERSITY OF SPEAKERS: PUBLIC SECTOR, PRIVATE SECTOR, INNOVATORS, ACADEMIA, CIVIL SOCIETIES, BANKS.

HIGHLIGHTS FROM DAY 1

MODERNISING POWER GRIDS OR A RENEWABLE FUTURE IN EMDES

ORGANIZED WITH: ELECTRIC POWER RESEARCH INSTITUTE (EPRI)
SUPPORTED BY UTILITIES FOR NET ZERO ALLIANCE (UNEZA)

- LACK OF INVESTMENT COMES FROM A LACK OF PLANNING
- "GRID MODERNIZATION NOT ONLY ABOUT TECHNOLOGY ACCESS, BUT ALSO ABOUT SOCIAL JUSTICE AND NOT LEAVING ANYONE BEHIND."
  – PEMY UNFCCC



BOTTOM-UP SOLUTIONS:

ENERGY COMMUNITIES
SESSION ORGANIZED IN PARTNERSHIP WITH: WORLD WIND ENERGY ASSOCIATION (WWEA)
SUPPORTED BY IRENA COALITION FOR ACTION

- WE MUST INNOVATE NOT ONLY IN TECHNOLOGY, NOT ONLY IN BUSINESS MODEL, BUT ALSO IN TERMS OF ENGAGEMENT

HOW?

- NARRATIVE CHANGE
  ALSO IN TERMS OF GOALS
- BUY-IN – FROM CLIMATE CHANGE
  TO DEVELOPMENT AND LOCAL BENEFITS, INCLUDING THOSE FOR WOMEN.
- "IF THE COMMUNITY STARTS USING THE ENERGY PROJECT FOR ECONOMIC DEVELOPMENT, ALL OTHER ELEMENTS FALL INTO PLACE; IF NOT, THE PROJECT FALLS APART"
  – MANOJ GUPTA, TATA –>PVE SESSION

HIGHLIGHTS FROM DAY 2

PRODUCTIVE USES OF ENERGY: RETHINKING PERSPECTIVES AND DRIVERS FOR INNOVATION

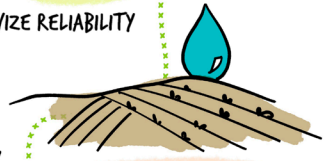
ORGANIZED WITH: GOGLA

FINANCING

- "SLOWER, PATIENT" CAPITAL IS NEEDED!
- "BORING IS GOOD, BECAUSE BORING MEANS INVESTORS AND COMPANIES COME IN – LET'S MAKE PRODUCTIVE USE BORING"
  – BARBARA RICHARD, GIZ

SOLUTIONS

- A CALL TO ACTION WAS TO TRY TO INCENTIVIZE RELIABILITY OVER JUST LOWERING COSTS
- "WE ARE WITNESSING A NEW PHASE FOR THE ENERGY ACCESS SECTOR IN WHICH WE HAVE TO TALK TO OTHERS IN THE AGRICULTURE AND WATER SECTORS"
  – CARLOS SORDO, GOGLA
- "IN MANY VALUE CHAINS, IT IS WOMEN WHO ARE RUNNING BUSINESSES
  – COUPLING PRODUCTIVE USE WITH WOMEN'S EMPOWERMENT IS PARTICULARLY IMPACTFUL."
  – BARBARA RICHARD, GIZ



CREATING VALUE LOCALLY: SUPPLY CHAINS AND SKILLS

SESSION ORGANIZED IN PARTNERSHIP WITH: INTERNATIONAL LABOUR ORGANIZATION (ILO) AND SUSTAINABLE ENERGY FOR ALL (SEFORALL)

SOLUTIONS

- COLLABORATION!
- CHANGE THE COLONIAL ROLES THAT GLOBAL SOUTH COUNTRIES

LARGE-SCALE PROJECTS CAN OFTEN FORGET TO CONSULT OR SHARE BENEFITS WITH THE LOCAL COMMUNITIES LIVING NEAR THE PROJECTS – STORY FORM THE PHILIPPINES

- "YOU CAN'T DECARBONIZE A SYSTEM WHICH HASN'T BEEN DECOLONIZED"
  – FADHEL KABOUB, GLOBAL INSTITUTE FOR SUSTAINABLE PROSPERITY

HIGHLIGHTS FROM DAY 3

INNOVATIVE BUSINESS MODELS FOR BIOENERGY IN THE GLOBAL SOUTH

ORGANIZED WITH: WORLD BIOENERGY ASSOCIATION (WBA)

SUCCESS FACTORS

- LOCAL SUPPLY CHAINS FOR END-USE TECHNOLOGIES, TO UPGRADE THE ASSETS OF SMALL LOCAL PRODUCERS AND BUSINESSES.
- "WE WERE NEVER AT THE POINT WE ARE TODAY IN TERMS OF COMMITMENT IN AFRICA FOR CLEAN COOKING"
  – VERENA BRINKMANN, GIZ

PROJECT FACILITATION IN FRAGILE COUNTRIES: NAVIGATING POLITICAL RISKS, ENABLING RE INVESTMENTS

SESSION ORGANIZED IN PARTNERSHIP WITH: UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

- "THERE IS A DISCONNECT BETWEEN PERCEIVED RISK AND REAL RISK ON THE GROUND"
  – KRISTEN PETILLON, PEACENEXUS/KUBE ENERGY
- "PERCEPTION OF RISK IS OFTEN EXAGGERATED IN THE AFRICAN CONTEXT"
  – REDA SOUINI, AFRICASO
- "INVESTING IN FRAGILE SETTINGS IS POSSIBLE, IT JUST TAKES THE RIGHT MINDSET"
  – KRISTEN PETILLON, PEACENEXUS/KUBE ENERGY

Modernising power grids

for a renewable future in EMDEs

Session organised in partnership with EPRI

Supported by UNEZA

This session emphasised the critical role grid modernisation plays in supporting the energy transition in EMDEs by bringing together experiences from Africa, India, Palau and other countries.

In particular, participants outlined how in Africa current challenges include rising demand, unreliable access, underinvestment, weak planning, outdated infrastructure and limited skilled labour. The rapid growth of distributed renewables, such as rooftop solar PV, also added complexity for grid operators. A major challenge was a lack of investment. This often stemmed from a lack of planning for African contexts, alongside insufficient policy and regulation. Aging infrastructure that needed replacement, not just expansion, was also a significant challenge.

The solutions highlighted included: strategic planning to support resource allocation; ensuring a socially-just distribution of modernisation costs; and enhancing grid resilience through combining different resources, such as hydro and geothermal with solar and wind. Digital technologies such as AI could also support pro-active operations, while batteries were valuable for providing reliability in island grids. Renewable mini-grids were considered a key innovation in expanding and enhancing access in isolated areas. Ultimately, grid modernisation was not just about technology, but also about social justice and ensuring "no one was left behind".

Key actions
for policy makers

- **Address specialised labour shortages and build institutional capacity**
  The unavailability of specialised labour is a significant bottleneck in grid modernisation. Furthermore, capacity must be built for grid operators, regulators and planners to effectively manage increasingly complex systems.

- **Integrate diverse technologies for grid resilience**
  Policy makers should encourage the adoption and integration of a variety of technologies that enhance grid resilience. These include the use of digital technologies, such as IoT or AI, for pro-active operations, accurate forecasting, real-time demand response and enhanced integration of distributed energy resources. In addition, enabling the deployment of batteries – particularly for island grids – can provide more reliability. Additionally, renewable mini-grids are a key innovation in expanding and enhancing access in isolated areas, which policy makers should support. Different resources, such as hydro, geothermal, solar and wind, should be combined for complementary production profiles, especially in Africa.

- **Include climate resilience in power system planning**
  Modernisation efforts should go hand-in-hand with resilience building. This should be achieved through: infrastructure upgrades; the use of protective equipment; climate-proofing design; and the integration of decentralised systems, such as mini-grids, for remote areas.

- **Prioritise social justice and a customer-centred approach**
  Grid modernisation is not solely about access to technology. It is also fundamentally about social justice and ensuring "no one is left behind". Policy makers should prioritise access, affordability and inclusion – particularly for vulnerable populations. Also, policy makers should foster a customer-centred approach for utilities and grid operators to ensure that reliability remains central to modernisation efforts. Such an approach ensures that grid improvements translate into reliable access for all populations, especially those currently lacking provision.

- **Mobilise and ensure equitable distribution of investment**
  Lack of investment is a primary challenge in modernising grids in EMDEs. Policy makers need to facilitate significant investment while – critically – ensuring a socially-just distribution of the costs of grid modernisation. This equitable distribution is essential in ensuring that investments are politically acceptable and that "no one is left behind".

Highlights of the session

Scene setting presentation
Gayathri Nair, Programme Officer, IRENA
Mark McGranaghan, Fellow, Electric Power Research Institute (EPRI) Europe
Leonard Hulsmann, Renewable Energy Engineer, R&D, Energynautics

Panel discussion
Moderator: Mark McGranaghan, EPRI Fellow, EPRI Europe

Abel Didier Tella, Director General, African Power Utilities Association (APUA)
Götz von Stumpfeldt, Advisor, Innovation Regions for a Just Energy Transition, Internationale Klimaschutzinitiative (International Climate Initiative – IKI) Just Energy Transition (IKI JET)/Deutsche Gesellschaft für Internationale Zusammenarbeit (German Society for International Co-operation – GIZ)
Eden R Uchel, Director, Palau Energy and Water Administration (PEWA)
Pemy Gasela, Director International Climate Change Department of Environmental Affairs, Republic of South Africa
Manoj Gupta, CEO, Tata Power Renewable Microgrid Limited (TPRMG)

Gayathri Nair opened the session by introducing the importance of grid modernisation. Strengthening the grid was key to climate resilience and security and reliability enhancement, she said.

She then presented IRENA's upcoming innovation landscape report, which includes 40 innovations for resilient power systems across four innovation dimensions for systemic innovation. Those dimensions were: technology and infrastructure; business models and key change agents; market design and regulation; and system planning and operation. Together, these formed a cohesive framework that supported the design of tailored solutions reflecting each region's technical, economic and socio-cultural conditions.

Two upcoming IRENA publications were also presented: The Grid modernisation toolkit for Small Island Developing States (SIDS), and Enhancing resilience: Climate-proofing power infrastructure.

Mark McGranaghan then showcased grid modernisation challenges in grid development. These included regulatory, market and partnership challenges. He stressed how innovation was key to decarbonising the grid, highlighting the fact that grid flexibility and efficient electrification were crucial to achieving this goal. Grid modernisation was a synonym for having an integrated grid, he said. Such a network would encompass the integration of electricity, telecommunications and customer local energy networks.

"If every local community and customer is optimising their energy use," he said, "and is able to provide flexibility as part of that optimisation, we can achieve a much more efficient global energy system. That's really what the integrated grid is all about."

In his remarks, Leonard Hulsmann highlighted the challenges that EMDEs face, such as rapid DER growth alongside a weak grid infrastructure. EMDEs could leapfrog such challenges, however, arriving at solutions that stretched across transmission and distribution networks and across two levels: planning and regulation, and operation, he said.

At the transmission level, under planning and regulation, solutions such as storage, sector coupling, and market and ancillary services could be key supports. In terms of moving towards operational flexibility, grid enhancing technologies, dynamic line rating (DLR) and advanced transmission management could all support such a move. At the distribution level, digitalisation – including the development of grid codes to help standardise deployment – and the fast tracking of permitting processes were also highlighted. Distribution grids could benefit from increased integration of flexible resources, he added. These could include: demand response; time of use tariffs; DER controllability and monitoring; and automation of the grid.

Summing up, Hulsmann said that grid expansion would need to happen. The critical question was how much digitalisation, smart controls and automation could save, in terms of infrastructure expansion.

The panellists then discussed how grid modernisation was key to sustainability and renewable energy integration.

Abel Didier Tella pointed out that not all countries in Africa were at the same level of development. While some had grid infrastructure and the current challenge was grid modernisation, others were still dealing with lack of access, thus needing grid expansion. He then addressed how planning could support the allocation of resources for grid modernisation.

"Lack of investment comes from a lack of planning in many African contexts," he said.

Manoj Gupta then described how in India one of the most critical challenges was dealing with blackouts. This had been addressed in the past with islanding systems. He then said that the core priorities for customers remained reliable power, quick restoration after outages and affordable energy bills. To address these needs, TataPower was innovating with technologies such as signature-based smart meters that gave users real-time insights into appliance-level energy consumption. This empowered them to optimise usage and costs, he said. Operationally, the grid was becoming smarter, with AI and IoT enabling pro-active outage detection and rapid response, while self-healing grids and intelligent underground substations enhanced reliability in dense urban areas. These cutting-edge solutions were now being extended to rural India, he pointed out, including the deployment of decentralised microgrid-based distribution systems, further broadening the impact of these advances. India could be the proving ground for some of these technologies, he said, adding that these had worldwide application in terms of grid resilience.

Eden Uchel then introduced Palau's main challenge – aging infrastructure. She said that grid modernisation was therefore absolutely essential in order to integrate more renewable energy and reach the national goal of 70% renewables in the grid by 2030.

"In some ways, we have put the cart before the horse by adding renewables before planning the modernisation of aging grid infrastructure," she said.

Götz von Stumpfeldt then talked about the shortage of skilled labour. He gave the example of Colombia, where one important lesson learnt had been the importance of local recruitment. There, the people who were being trained had been recruited from the same region as where the infrastructure was being

developed. This ensured that communities benefitted not just from electricity, but also from job creation and the acquisition of long-term skills.

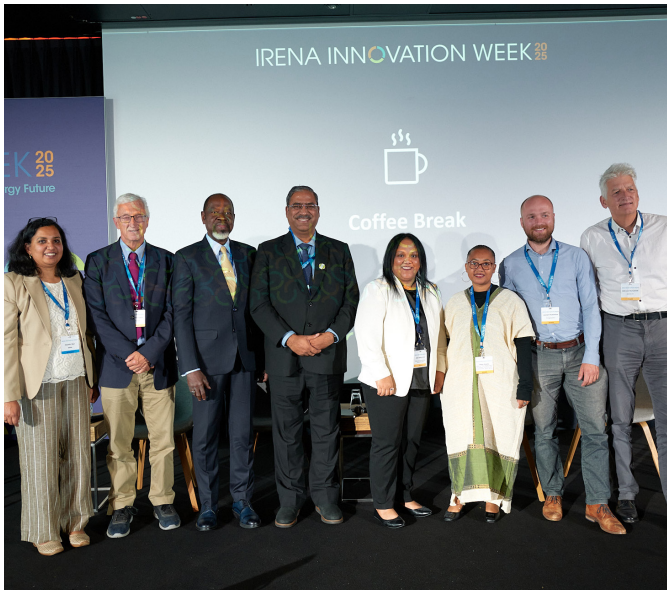
"Renewables are competitive," he said, "but we need finance to accelerate the investment in infrastructure."

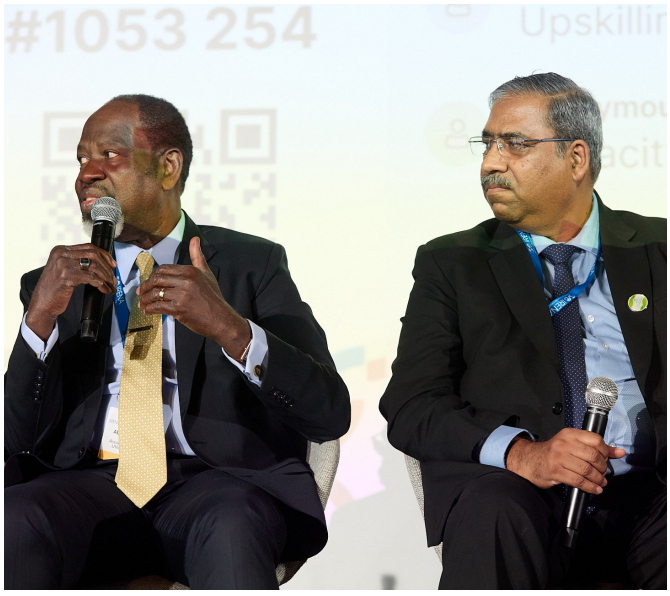
In her comments, Pemy Gasela emphasised that the energy transition was fundamental to climate mitigation. It must also prioritise social equity, she said, by ensuring that vulnerable and historically underserved communities were fully included in grid modernisation efforts. This approach involved strengthening centralised systems, creating inclusive job opportunities through workforce development and enhancing affordability for low-income households. It also involved advancing grid expansion, digitalisation and the integration of smart grid technologies.

"Grid modernisation is not only about technology access," she said, "but also about social justice and not leaving anyone behind. We need to approach grid modernisation in a way that ensures that vulnerable and historically underserved communities are not left behind."


IRENA


Digitalisation for a Sustainable Energy Future
Abel Didier Tella
Director General
Association of
Power Utilities of
Manoj Gupta
CEO
TATA Power Microgrid
India
Eden R Uchel
Director
Palau Energy &
Water
Administrat
(PEW


IRENA INNOVATION WEEK 2025
Coffee Break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Upskillin


Panel discussion
IRENA
INNOVA
Renewables and Digitalis
Abel Didier Tella
Director General
Association of
Power Utilities of
Manoj Gupta
CEO
TATA Power Microgrid
Eden R Uchel
Director
Palau Energy &
Water
Administration
(PEWA)
Götz von Stumpfeldt
Advisor
IKI JET, GIZ
Pemy Gasela
UNFCCC TEC Member
& Chief Director of

Bottom-up solutions

Energy communities

Session organised in partnership with the World Wind Energy Association (WWEA) and supported by IRENA Coalition for Action

This session provided an understanding of how energy communities function. It also highlighted their different models and the benefits they could bring to the energy transition, both globally and locally. Focusing on innovations in Africa, Colombia, China, India and Malaysia that enable the formation of energy communities, the session also showcased how innovative bottom-up approaches could deliver the kind of shared benefits that are essential in advancing the energy transition.

Key actions
for policy makers

- **Reshape the narrative around energy communities as a means to sustainable development**
  It is crucial to shift the narrative around renewables from one solely concerned with climate change mitigation to one that emphasises the benefits to local development and the productive use of energy for communities. Similarly, energy communities are not simply a means of providing energy, but also a means of reaching development goals defined by the local community. In this way, energy becomes a platform though which communities can achieve their development goals. Setting the right narrative guides policy – and setting the right policy guides funding.

- **Empower communities through genuine ownership and participation**
  It is critical to the success of effective energy community projects that there be community engagement, ownership, control and the retention and sharing of benefits and profits. We must innovate not only in technology or business models, but also in terms of engagement. This involves creating structures to embed ownership and agency within communities, especially in developing world, or off-grid contexts.

- **Innovate financing and business models for local contexts**
  To make energy communities viable, there is a need for innovative financial mechanisms that are accessible and tailored to local contexts. This includes initiatives such as: exploring local bonds – financial instruments that communities can buy, even by potentially selling assets such as livestock; the implementation of outcome-based financing; and designing revenue-sharing models to

incentivise local maintenance operators and ensure healthy system operation. Furthermore, enabling policies that allow for bi-directional power flow (from community to grid) and direct sales to creditworthy off-takers (like mines or data centres) can ensure economic viability.

- **Invest in local capacity building and peer learning**
  Building local capacity is crucial in enabling communities to understand, operate and benefit from energy projects. This includes providing technical training in O&M and guiding communities on productive uses of energy for income generation. Facilitating the exchange of experiences and learning among communities is also vital, allowing them to learn from each other's governance models, negotiate effectively with developers and incorporate diverse perspectives, such as gender.

- **Leverage digital technologies for efficiency and engagement**
  Digitalisation is a crucial component of successful energy community projects. It is essential to develop and deploy digital tools for community engagement, demand assessment and energy planning. Furthermore, for efficient O&M in remote locations, integrating digital technologies for remote control and monitoring is vital. To ensure cost-effective management, particularly for payment collection, establishing digital payment systems is necessary. This also requires the development of low-cost, reliable metering technology suitable for measuring small-scale energy consumption.

Highlights of the session

Scene setting presentation
Arina Anisie, Analyst, Renewable Energy Innovation, IRENA
Ayu Abdullah, Managing Director, Community Energy Toolkit (COMET)

Panel discussion
Moderator: Stefan Gsänger, Secretary General, WWEA

Simbini Tichakunda, Principal Programme Officer Energy, The African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD)
Manoj Gupta, CEO, TPRMG, India
Jose Vega, Research Fellow, SEI, Colombia
Ayu Abdullah, Managing Director, COMET, Malaysia
Peng Zhang, Staff Member of the Qinghai Provincial Energy Bureau, China

IRENA's scene-setting presentation drew from its upcoming report, Innovation landscape for sustainable growth powered by renewables. Arina Anisie began by setting the scene for the broader energy transition. She noted that renewable energy deployment was at the core of this, with ambitious targets being set to increase the share of renewables in energy systems. This transition, she stressed, extended beyond climate goals to the driving of sustainable growth, the modernisation of energy systems, and the provision of universal access to electricity.

Anisie went on to say that IRENA's innovation landscape reports provided a toolbox for policy makers. The reports therefore acknowledged that there was no "one-size-fits-all" solution.

At the same time, IRENA's definition of community energy was based on three principles, she said. These were: ownership by the local community; control and decision making by the local community; and profit staying with the local community. For successful energy community projects, multiple innovations had to come together. These included: innovations in technology, such as mini-grids, small-scale batteries and digitalisation; innovations in business models, such as peer-to-peer trading; and innovations in finance, such crowdfunding and pay-as-you-go.

The following panel discussion was moderated by Stefan Gsänger. He opened the dialogue by explaining what was meant by "energy community" and "community energy". He said that while "community energy" referred to the principle of local ownership, control and participation, the term "energy community" defined a concrete entity.

Ayu Abdullah's presentation emphasised that while technology, tariffs and business models were relevant to off-grid systems, they were not the whole story.

"After years of deploying off-grid solutions," she said, in an energy project, "we now know that the critical success factor is the community – their engagement, participation and endorsement."

Abdullah then detailed a spectrum of community engagement. This ranged from one-way consultation – in which external parties gathered information for system design – to a higher level of two-way capacity building and co-development, culminating in the highest level: complete community ownership, self-mobilisation and control over decision making. She explained that effective engagement not only reduced costs and improved implementation, but also ensured alignment with community aspirations, thereby activating the desired development outcomes.

She then added that digitalisation was a crucial component in successful energy community projects. It was essential, she said, to develop and deploy digital tools for community engagement, demand assessment and energy planning. An example of this was the Comet simulation platform. This facilitated community workshops to help local populations understand scenarios such as mini-grid systems, costs, demand profiles and tariff setting. It thereby amplifyied human interaction and enabled more nuanced system designs based on community expectations. The tool has been deployed in over 110 communities globally. Her call to action included a call for the rethinking of community energy, advocating for innovation not solely in technology and business models, but also in engagement approaches.

Simbini Tichakunda then said that with 600 million people lacking electricity access, the focus needed to shift from "access" to "productive use" in order to empower communities to afford power. AUDA-NEPAD was piloting models for off-grid communities with existing transmission infrastructure, he said, allowing power to flow from the community back into the national grid. His organisation aimed to design financing mechanisms, such as local bonds. Communities could buy these, financing the transaction by selling assets such as cows or chickens, if necessary, in order to foster ownership. The goal was to stimulate broad-based socio-economic development by attracting downstream industries, once power was readily available.

In his remarks, Manoj Gupta described two models: serving un-electrified areas and underserved areas with unreliable supply. In underserved areas, micro-grids complemented the national grid, providing reliable power that reduced production costs for micro-enterprises and boosted their businesses. For unelectrified areas, Tata Power employed a "partner in success" model where local operators earned a percentage of revenue, incentivising system maintenance. Key challenges included safety awareness among people new to electricity, he said. They also included the challenge of guiding communities on productive uses for income generation, such as agri-based processing and biogas from agri-waste for cooking and electricity.

"If the community starts using the energy project for economic development," he said, "all the other elements fall into place; if not, the project falls apart."

Digital technology for remote control and digital payments, along with low-cost, reliable meters, were also critical, he added. There was also a need for outcome-based financing and incentives for end-user customers to adopt energy-efficient equipment.

Jose Vega then emphasised the need for a profound change in the narrative. This should focus on the benefits energy communities bring to local development, rather than solely on climate change mitigation. Building local capacities was crucial for communities to understand projects, he said, as well as for them to build their own energy companies and negotiate effectively with developers – often without an intermediary. The exchange of experiences and perspectives among communities – including gender perspectives – was vital.

At the same time, he said, while the Colombian government had an ambitious target of 20 000 energy communities by 2026, there was a lack of deep understanding among communities about their planning, maintenance and governance implications. Indigenous communities showed strong interest,

but required more detailed understanding. Policies should also consider renewable energy auctions with specific quotas for energy communities in order to avoid direct competition with large companies, he added.

Peng Zhang then detailed the extensive government support available in China. This included property rights reform, in which village collectives held the rights to power stations and benefits were shared. As an example, some 1 622 villages were now operating solar plants, he said. Qinghai province had implemented a "special energy co-operation zone" where solar generation in sun-rich areas funded development in high-altitude, low-sunlight regions, ensuring clean energy reached remote areas. The programme also balanced energy for economy with environmental protection, setting up solar stations in deserts to increase vegetation and fix sand, generating income while improving the environment.

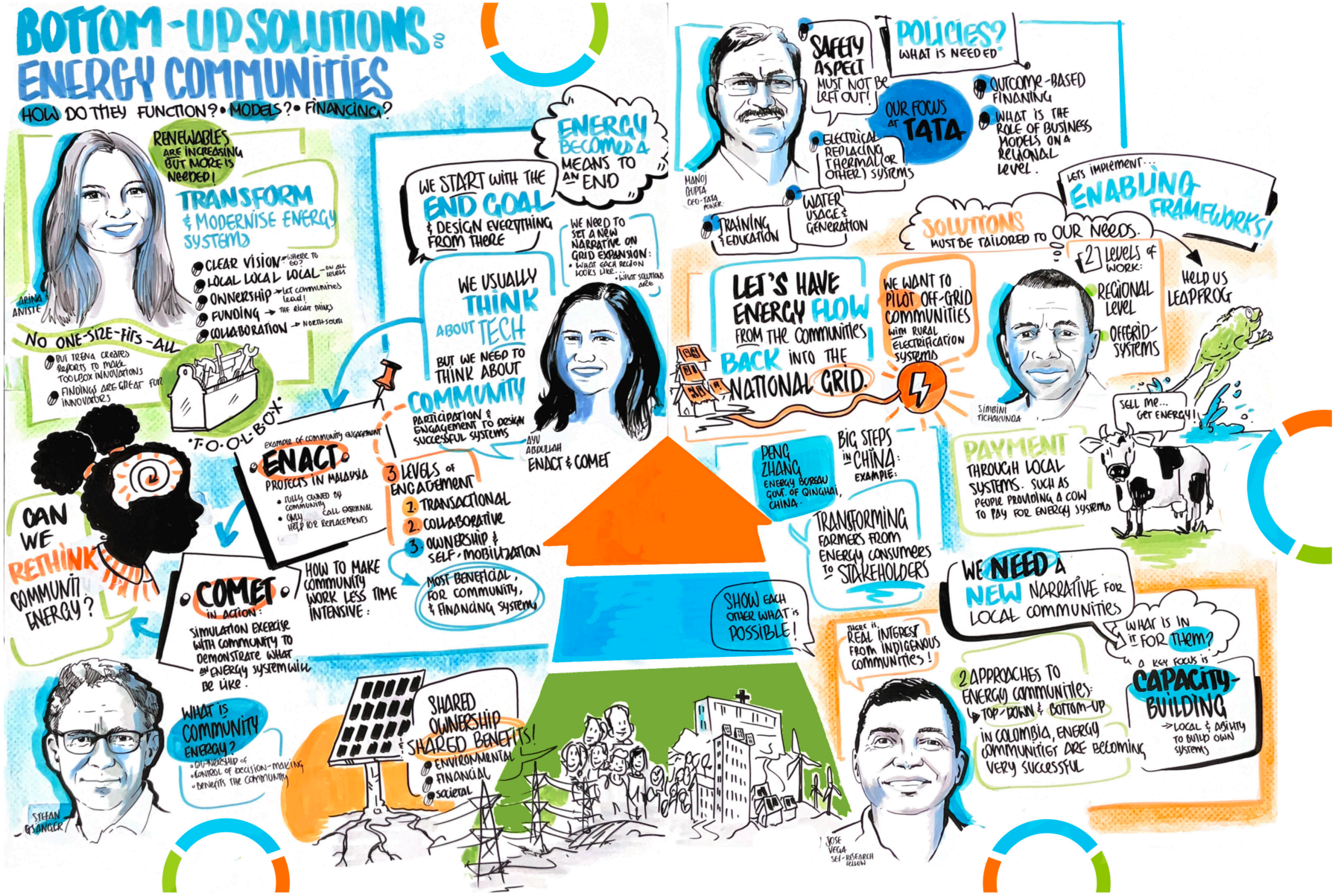
Abdullah then said that the overall goal should be to help communities build their capabilities to meet their defined development outcomes, with energy serving as a platform, or means to an end. She argued that setting the right narrative was critical, as it guided policy and funding.

"Setting the right narrative guides policy, and setting the right policy guides finance," she said.

In regions such as Southeast Asia, correcting the narrative – such as by acknowledging that ongoing energy access issues went beyond simple grid extension – and fitting energy access into current government priorities, such as energy transition and climate resilience, were vital for effective policy, she added.

After this, Tichakunda approached the concept of energy communities on two distinct levels. The first level focused on communities on a regional scale, where member states within different regional economic communities were empowered to trade power among themselves. This trade aimed to foster interconnectedness and power exchange across national borders. In contrast, he said, the second level delved down into off-grid systems, recognising their crucial role even as efforts were made to create interconnected national grids through regional power pools. This dual approach acknowledged the necessity of both large-scale, cross-border energy solutions and localised, decentralised systems in addressing the continent's energy access challenges.

The consensus was that both top-down solutions and innovative bottom-up approaches were needed for a successful energy transition. The panel concluded by emphasising the importance of continuing the discussion and mainstreaming community energy, while understanding that solutions always had to consider the national and cultural context.


BOTTOM-UP SOLUTIONS ∞ ENERGY COMMUNITIES
HOW DO THEY FUNCTION? • MODELS? • FINANCING?
RENEWABLES ARE INCREASING BUT MORE IS NEEDED!
ARINA ANISTE
TRANSFORM & MODERNISE ENERGY SYSTEMS
CLEAR VISION → WHERE TO GO?
LOCAL LOCAL LOCAL → ON ALL LEVELS
OWNERSHIP → LET COMMUNITIES LEAD!
FUNDING → THE RIGHT THING
COLLABORATION → NORTH-SOUTH
NO ONE-SIZE-FITS-ALL
BUT IRENA CREATED REPORTS TO MAKE TOOLBOX INNOVATIONS
FINDINGS ARE GREAT FOR INNOVATORS
T.O.O.L.B.O.X.
CAN WE RETHINK COMMUNITY ENERGY?
ENERGY BECOMES A MEANS TO AN END
WE START WITH THE END GOAL & DESIGN EVERYTHING FROM THERE
WE USUALLY THINK ABOUT TECH
BUT WE NEED TO THINK ABOUT COMMUNITY
PARTICIPATION & ENGAGEMENT TO DESIGN SUCCESSFUL SYSTEMS
WE NEED TO SET A NEW NARRATIVE ON GRID EXPANSION:
• WHAT EACH REGION LOOKS LIKE...
• WHAT SOLUTIONS ARE...
AYU ABDULLAH
ENACT & COMET
EXAMPLE OF COMMUNITY ENGAGEMENT
ENACT
PROJECTS IN MALAYSIA
• FULLY OWNED BY COMMUNITY
• ONLY HELP FOR REPLACEMENTS
3 LEVELS OF ENGAGEMENT
1. TRANSACTIONAL
2. COLLABORATIVE
3. OWNERSHIP & SELF-MOBILIZATION
MOST BENEFICIAL FOR COMMUNITY, & FINANCING SYSTEMS
COMET
IN ACTION:
SIMULATION EXERCISE WITH COMMUNITY TO DEMONSTRATE WHAT AN ENERGY SYSTEM WILL BE LIKE.
HOW TO MAKE COMMUNITY WORK LESS TIME INTENSIVE:
STEFAN GSÄNGER
WHAT IS COMMUNITY ENERGY?
• OWNERSHIP OF
• CONTROL OF DECISION-MAKING
• BENEFITS THE COMMUNITY
SHARED OWNERSHIP SHARED BENEFITS!
• ENVIRONMENTAL
• FINANCIAL
• SOCIETAL
MANOJ GUPTA CEO TATA POWER
SAFETY ASPECT MUST NOT BE LEFT OUT!
POLICIES? WHAT IS NEEDED
OUTCOME-BASED FINANCING
WHAT IS THE ROLE OF BUSINESS MODELS ON A REGIONAL LEVEL.
OUR FOCUS AT TATA
ELECTRICAL REPLACING THERMAL (OR OTHER) SYSTEMS
TRAINING & EDUCATION
WATER USAGE & GENERATION
SOLUTIONS MUST BE TAILORED TO OUR NEEDS.
LETS IMPLEMENT... ENABLING FRAMEWORKS!
HELP US LEAPFROG
2 LEVELS OF WORK:
REGIONAL LEVEL
OFFGRID-SYSTEMS
SIMBINI TICHAKUNDA
LET'S HAVE ENERGY FLOW FROM THE COMMUNITIES BACK INTO THE NATIONAL GRID.
WE WANT TO PILOT OFF-GRID COMMUNITIES WITH RURAL ELECTRIFICATION SYSTEMS
SELL ME... GET ENERGY!
PAYMENT THROUGH LOCAL SYSTEMS. SUCH AS PEOPLE PROVIDING A COW TO PAY FOR ENERGY SYSTEMS
PENG ZHANG ENERGY BUREAU GOVT. OF QINGHAI, CHINA.
BIG STEPS IN CHINA: EXAMPLE:
TRANSFORMING FARMERS FROM ENERGY CONSUMERS TO STAKEHOLDERS
WE NEED A NEW NARRATIVE FOR LOCAL COMMUNITIES
WHAT IS IN IT FOR THEM?
A KEY FOCUS IS CAPACITY BUILDING
→ LOCAL & ABILITY TO BUILD OWN SYSTEMS
SHOW EACH OTHER WHAT IS POSSIBLE!
THERE IS REAL INTEREST FROM INDIGENOUS COMMUNITIES!
2 APPROACHES TO ENERGY COMMUNITIES:
→ TOP-DOWN & BOTTOM-UP
IN COLOMBIA, ENERGY COMMUNITIES ARE BECOMING VERY SUCCESSFUL
JOSE VEGA SET-RESEARCH FELLOW
BY @IRIS MAERTENS FOR VISUAL HARVESTING


IRENA INNOVATION WEEK 2025
Panel discussion
Moderator
Panellists
Manoj Gupta
Ayu Abdullah
Jose Vega
Peng Zhang


IRENA INNOVATION WEEK 2025
Panel discussion

Productive uses of energy

Rethinking perspectives and drivers for innovation

Session organised in partnership with GOGLA

"Productive uses of energy" (PUE) refers to the ways energy (often renewable) is used to create economic value, enhance productivity and improve livelihoods. This utilisation goes beyond basic household needs and encompasses activities that generate income, create jobs or improve existing livelihoods.

PUE have never taken centre stage in energy project and programme design and implementation. There is a growing recognition, however, that PUE need to be integrated within a broader ecosystem approach to be truly successful.

The session held on this topic at IRENA Innovation Week 2025 saw participants conclude that their primary focus should not be on technology alone. It should also be on the forward and backward market linkages that many PUE enterprises require, in addition to the enhancement of capacities, access to financial resources, and enabling policy and regulatory frameworks.

Success stories and lessons learnt were then highlighted by panellists from the private sector and practitioners with long standing experience. These examples looked especially at ways to mainstream PUE as an enabler of wider livelihood development, both in discourse and practice.

Key actions
for policy makers

- **Shift policy focus from minimal access to intentional PUE planning**
  Instead of merely aiming for minimal electricity or energy access, policies in many countries need to be reformed to intentionally plan for more productive uses. This also means that ministries of energy should broaden their perspective beyond the consideration of larger projects to consider the diverse and complex needs for PUE that exist across different value chains and local contexts.

- **Foster cross-ministerial co-operation and stable policies**
  Ministries of energy, agriculture and other sectors need close co-ordination to enable PUE to gain maximum impact on livelihoods. Policy makers are also responsible for establishing stable policies that build trust between ministries and the business community, which is key to supporting PUE projects. Better co-ordination among support partners, such as donors and international agencies, can also reduce overlapping efforts for ministries. Governments should develop and enforce enabling regulatory frameworks to incentivise PUE solutions – in technology and finance and in research – and in emerging technological solutions, such as agricultural cooling and e-mobility.

- **Reform financing practices and attract patient capital**
  Policy makers should work to reform practices for suppliers of finance and donors to help them better understand the particularities of lending for PUE. This is especially so in last-mile contexts, where issues such as a limited appetite for debt among smaller businesses, foreign exchange risks, and informal activities are prevalent. Encouraging the availability of slower, patient capital, such as more equity rather than debt, is also beneficial, given the long-term nature of local economic development that PUE fosters.

- **Incentivise reliability and promote standardisation**
  Policies and regulations need to incentivise easier access to finance, as well as equipment reliability over lower costs of equipment. Both governments and donors should better co-ordinate grant funding (payable and non-repayable) to enable sector growth and maturity. Furthermore, standardisation will be a critical component of scaling up solutions across various PUE sectors.

- **Design holistic, socially-inclusive programmes**
  Systemic innovation is crucial in supporting PUE. Such innovation in technology, business models, market design and system planning are crucial pillars to be addressed. Thus, policy and planning need to ensure the interconnectedness of these pillars. A particularly impactful approach involves coupling productive use with women's empowerment, given that in many value chains, women are often running the business.

Highlights of the session

Keynote
Gauri Singh, Deputy Director-General, IRENA

Scene-setting presentation
Kavita Rai, Senior Programme Officer, IRENA

Panel discussion
Moderator: Carlos Sordo, Senior Project Manager, Productive Uses of Renewable Energy, GOGLA

Matthew Matimbwi, Executive Secretary, Tanzania Renewable Energy Association
Divya Balakrishnan, Senior Advisor. GET.Invest, GIZ
Ulrich Zimmermann, COO, Zimpertec GmbH & Co
Barbara Richard, Team Leader, Energising Development (EnDev), GIZ

Gauri Singh opened the session by saying that at IRENA, innovation was not just about breakthrough technologies, but also about new and efficient ways of doing things. This included rethinking how we plan, design, finance and deploy programmes on the ground.

"Access to clean energy is not an end goal," she said. "It is what people do with this energy that needs to be explored."

Whether the issue was powering an irrigation pump on a small farm, running a fridge to store products to sell, or supporting a woman-led tailoring business, PUEs were the link between energy and livelihoods, she added. IRENA wanted to explore how innovation could help us unlock the full development potential of energy access initiatives.

She then pointed out that innovation needed to be inclusive in addition to being productive – especially from an end user perspective.

In addition, "South-south co-operation is a very powerful tool for countries going through a similar stage of the energy transition," she concluded.

Kavita Rai then highlighted that, "Innovation has to be looked at with an ecosystem approach – a systemic view".

PUE had not moved as rapidly as it should have, with more work needing to be done. Innovation needed to be looked at using a systemic approach that encompassed enabling technologies, policy and institutional approaches, financing, business models, system planning and operation. Programmes needed to take a bundled approach with end-to-end value chain design and aggregation, while simultaneously ensuring social and gender inclusiveness to enable livelihood outcomes, she said.

She then highlighted the IRENA initiative entitled "Empowering Lives and Livelihoods: Renewables for Climate Action". This was launched during COP28 in 2023 and supported IRENA member states and a range of partners in working across sectors, such as in agriculture and health. IRENA analysis of productive sectors such as agriculture, fisheries and dairy farming had shown that in many countries, each step of an agri-food value chain contained huge potential for the integration of renewables and thus the promotion of sustainability. Establishing cross-programmatic partnerships in different areas, such as policy, finance and skills development, was necessary to facilitate PUE.

IRENA, she said, was part of an agri-energy coalition led by GOGLA. This included stakeholders from both the agriculture and energy sectors. A report, entitled Beyond Silos: Powering Food Systems with Off-Grid Solar: Strengthening the Nexus Collaboration, called for governments and stakeholders across sectors to promote and demonstrate cross-sector partnerships and programmes and build a body of evidence.

Carlos Sordo then moderated the panel discussion. He noted the importance of engaging with a wider network of expert stakeholders from agriculture, water, fisheries and health to enable PUEs. He informed participants that GOGLA was an industry association representing over 200 private companies in the Asian and African energy sectors. In recent years, over 40 million people had gained access to electricity as a result of GOGLA companies distributing solar home systems. He added that the panel members all appreciated the importance of PUE and of taking a systemic approach to energy matters.

"Working in silos will not solve the energy access problem," he stressed. "We are witnessing a new phase for the energy access sector in which we have to talk to others in the agriculture and water sectors."

Ulrich Zimmerman then described his company's line of solar technologies. This included a new, under-development innovation that supported cooling and freezing. The company's experience, he added, also showed that reliability was more important than a low price , and minimising cost was not always possible.

"My call to action would be to try to incentivise reliability over just lowering costs", he said.

In addition, off-grid assets companies, especially distributors, needed to have access to finance to ensure they could support availability in remote areas. In the long run, standardisation was also necessary and would ensure better maintenance, he said. Patient capital was required to maintain business activities of productive-use enterprises as well. It was also necessary to focus on scaling up, instead of reinventing the wheel.

In his comments, Matthew Matimbwi highlighted how investments in energy required robust policies to ensure that they materialised. Energy was also not just about electricity, but came in different forms, such as heat and mechanical energy, especially for productive uses. As an example, he described how renewables such as solar-powered lighting supported fishermen in their livelihoods, in addition to promoting sustainability and safety by disincentivising the use of kerosene lamps. Technology transfer, emerging technology and public research environments were also key areas where action needed to be taken, he said. There was a need to establish trust between public and private sectors, while it was vital for governments to develop strong regulatory frameworks.

Divya Balakrishnan then drew lessons from GIZ's portfolio of 91 clients in the PUE sector. The main challenges in the field, she said, included: small financing tickets; a mismatch between end-user and investor requirements; shortages of local currency that made local debt highly unattractive; and currency fluctuations. Currently, productive use enterprises are treated as equivalent to commercial and industrial businesses, which is not correct, she added. Entities were not thinking in terms of nexuses which prevent

investments and support going to productive uses. In contrast, business development, investment strategy support, financial structuring support and post investment activities were pillars that GET.invest looked into when working with PUE entities. "Patient equity capital" was crucial, she concluded, in the development of PUE solutions to counter the large debts that were usually found in PUE projects.

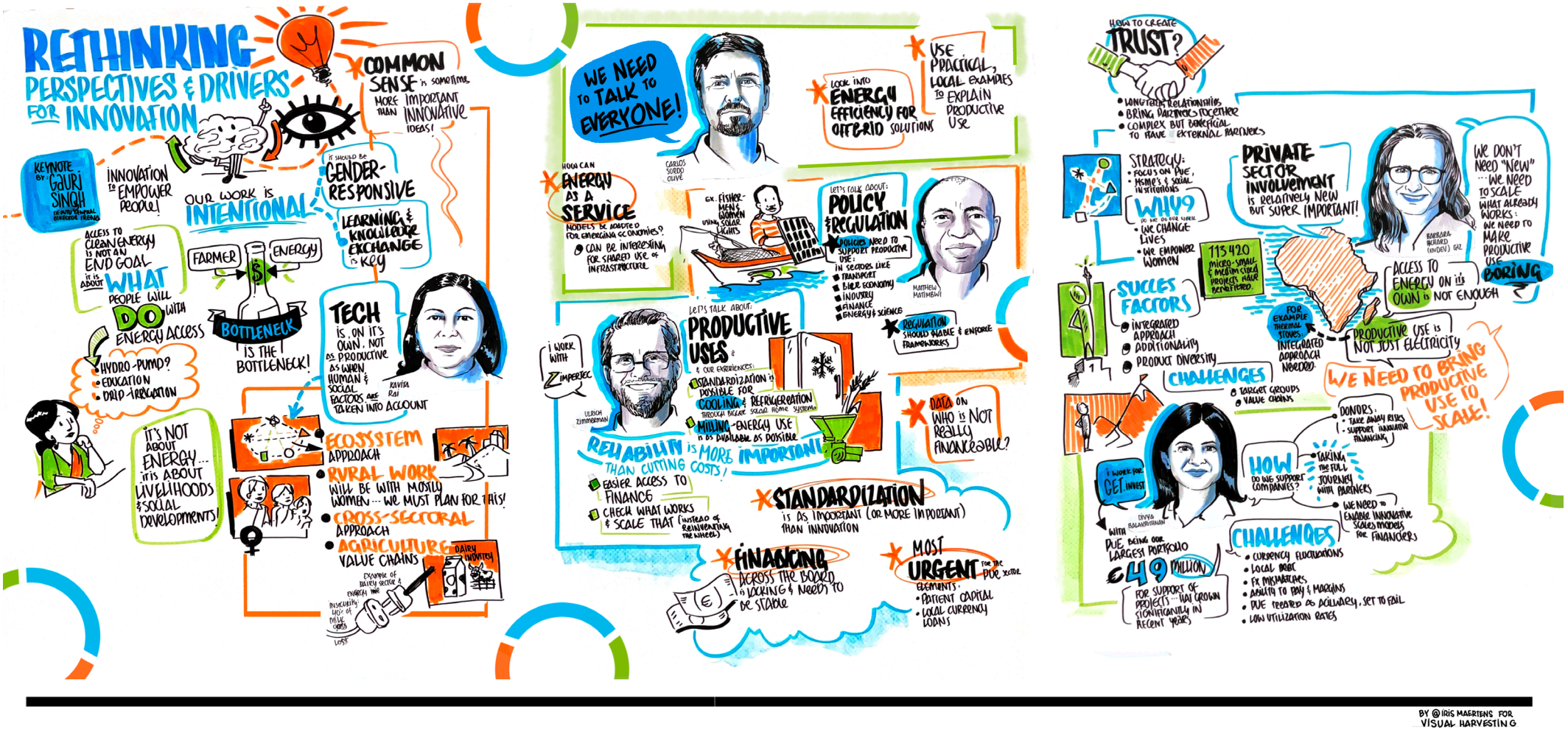
Barbara Richard then shared lessons from the programmatic support GIZ had provided since 2005 to 110 000 enterprises with a productive use focus.

Fostering productive uses was an integral pillar of the approach taken by GIZ, she said. This integrated approach combined access for households, enterprises and social institutions. Success factors included: an integrated approach to energy and beyond, throughout the value chain; additionality; product diversity; and working with cross-sectoral stakeholders.

"I think the biggest challenge for productive use is the complexity and diversity of needs across different value chains, and the need to manage that complexity," she said.

Complex processes required different steps and solutions to make products or services, with this entailing a range of different "energy" requirements. For example, she said, in the production of shea butter, manufacturers needed both electricity and heat. Other crucial factors for success included: the standardisation of products; an understanding of market dynamics; research on hard data to support renewables for off-grid solutions; and research on reliable indicators to determine the creditworthiness of people requesting financial loans.

"Boring is good," she said, **"because boring means investors and companies come in. Let's make productive use boring."**



BY @IRIS MAERTENS FOR VISUAL HARVESTING

Creating value locally

Supply chains and skills

Session organised in partnership with the ILO and SEforALL

Session overview

With a particular focus on emerging economies and developing countries, this session discussed innovative policies and strategies that could enhance local value creation across the renewable energy value chain.

The session highlighted the fact innovation's role in creating efficient and resilient local value chains was key. At the same time, however, this needed to be accompanied by measures to address skills shortages in critical sectors. It also needed to go hand-in-hand with policies to develop the capabilities that were essential to support the transition, while driving local economic growth.

Key actions

for policy makers

- **Prioritise local value chain development**
  Policy makers and financial institutions need to fundamentally rethink the structure in which finance is provided and received in developing countries. Their focus should extend beyond simply blending or de-risking finance to ensuring it actively supports the creation of local value, job creation and the localisation of value chains within the renewable energy sector.

- **Prioritise a people-planet centred energy transition**
  Policy makers must ensure that large-scale renewable energy projects share their benefits and consult with the local communities living near them. Renewable-based energy transitions must prioritise local manufacturing, skills development and job creation, while building economic resilience and equitable benefit sharing. All of this must also be supported by a range of enabling policies. True progress requires moving beyond just installing gigawatts to investing in people, industries and policies that empower communities and nations.

- **Build economic resilience through diversified local renewable energy value chains**
  Prioritising local value creation not only accelerates industrialisation, but also strengthens supply chains and fosters energy independence. Policy makers must design industrial policies that bring countries – particularly on the African continent – to the higher end of the renewable energy value chain, rather than remaining at the bottom. This involves transforming the historically imbalanced global economic dynamics in which many countries in the Global South have been positioned mainly as suppliers of low-cost raw materials, consumers of industrial goods

from highly industrialised nations, or recipients of outdated technologies. Instead, policies should focus on building value chains for intermediate manufactured products, such as green steel. These provide much greater added value to the domestic economy than simply exporting raw materials.

- **Adopt regional, joint-green industrial strategies**
  It is critical to implement regional, joint-green industrial policies to leverage shared resources and create economies of scale. This will enable the building of sustainable, homegrown solutions for renewable energy sectors across the Global South.

- **Invest in skills development and build local capabilities**
  To address significant skills shortages and labour market misalignments in critical sectors, policy makers should implement policies that can develop the essential capabilities necessary to support the energy transition and drive local economic growth. This includes addressing limited access to curricula and educational infrastructure. With Global South countries possessing the youngest labour force on the planet, there is immense potential to grow renewable energy jobs, provided there are policies to ensure decent work and diverse workforces.

Highlights of the session

Scene setting presentation
Celia García-Baños, Programme Officer, IRENA
Pavel Tereshchenko, Energy Analyst, SEforALL

Panel discussion
Moderator: Ute Collier, Acting Director, IRENA Knowledge, Policy and Finance Centre (KPFC)

Fabian Barrera, Project Lead PtX, Agora Energiewende
Fadhel Kaboub, Associate Professor, Denison University and President, Global Institute for Sustainable Prosperity
Lanz Gabriel Jabla, Project Manager of the Renewable and Sustainable Energy Technologies (ReSET) Centre, Yamog Renewable Energy Development Group, Inc.
Omobola Omofaiye, General Manager, Renewable Energies Division, Levene Energy

Opening the session, Celia García-Baños declared that, "The energy transition is not just about gigawatts, it is about people and the benefits they receive."

She then showed how employment in the renewable-energy sector was still concentrated in a handful of countries. Yet, given the right deployment, integration and "just-transition" policies, a 1.5°C pathway could double the number of jobs in renewables and distribute them far more evenly.

To avoid crippling skill shortages, she urged governments to rethink technical and university education, expand apprenticeships and insist on decent-work standards. These include fair pay, safe conditions, collective bargaining and full workforce diversity. Structural barriers inherited from fossil-fuel systems had to be dismantled, she added, so that supply-chain growth truly served communities and the climate together.

Pavel Tereshchenko then quantified Africa's "resource paradox". In 2023, he said, the continent imported USD 2 billion in fully-assembled solar modules and USD 2.5 billion in lithium-ion batteries. This was despite the fact that Africa was the source of several of the minerals those products required. Using Nigeria as a case study, he presented an SEforALL independent analysis that showed how expanding Nigeria's domestic module assembly to 2.5 GW (half of projected demand) could generate 2.7 million person-days of employment, add USD 560 million in local value and attract USD 250 million in fresh investment by 2035.

He then outlined how SEforALL's Green Industrialisation Hub[2] tackled bottlenecks through the Renewable Energy Manufacturing Initiative[3] and the Council for Critical Minerals Development in the Global South.[4] These three supported governments in industrial policy design, addressing data and skills gaps, investment facilitation and supporting collaboration and partnerships between governments, industry and financiers.

[2] See https://www.seforall.org/programmes/un-energy/green-industrialization-hub
[3] See https://www.seforall.org/programmes/un-energy/green-industrialization-hub/aremi
[4] See https://www.seforall.org/programmes/un-energy/South-South-Cooperation/Council-Critical-Minerals

For localisation to stick, he argued, countries needed long-term partnerships, cohesive industrial policy and the hard and soft infrastructure that lets regional trade flow.

"We need better information to design localisation pathways, as these present a transformational socio-economic opportunity for the Global South," he concluded.

Fadhel Kaboub then argued that Africa had to pursue energy sovereignty and justice by re-imagining its own renewable energy systems. He noted that the continent held unparalleled solar, wind and critical-mineral resources, yet attracted under 2% of global renewables finance and lacked large-scale manufacturing capacity. National policies were too small to copy entire supply-chain segments, he said, so he called for joint regional, or continental industrial strategies that pooled Africa's scale, youthful labour force and complementary resources.

"We in the Global South are the global majority," he said. "Our collective economic and geopolitical weight matters, but it can only be leveraged as a bloc, not as individual countries. A full bargaining chip can achieve change, while a single slice can't."

He then went on to say that, "You can't decarbonise a system that hasn't been 'decolonised'." Kaboub therefore urged the "decolonising" of finance. Instead of export-oriented plants funded by investors chasing dollar returns, he proposed patient joint ventures in which partners from the Global North provided technology in kind, output was shared between local deployment and export, and Africa gained long-term market leverage.

"Before we blend the finance or de-risk the finance, we should think about the structure in which the finance is provided and received in developing countries," he said.

He also argued that the recent growth in trade barriers could be challenging, but could also offer opportunities. This was because national governments could use this development to diversify their supply chains and promote domestic, green industrialisation.

Omobola Omofaiye then described how Levene Energy , was one of only three Nigerian solar PV manufacturers, and was embedding sustainability across the solar value chain. Blended finance – which combined resources from development finance institutions (DFIs), concessional loans and private capital – now de-risked mini-grid projects and public-institution PPAs, while public-private deals accelerated the deployment of solar PV at schools and hospitals. Her company was localising technology and up-skilling a workforce that was 60% new to solar. Levene Energy was also creating internships for science, technology, engineering and mathematics (STEM) graduates, and youth.

Omofaiye then urged regional co-ordination. Nigeria might specialise in solar PV, for example, while its neighbours specialised in batteries or inverters. All would also be supported by pan-African R&D hubs so that intellectual-property dependency shrank and domestic content rules aligned across borders.

"There must be regional manufacturing collaboration," she said. "Solar PV localisation in one area, batteries in another, inverters elsewhere – with cross-trade among all the regions."

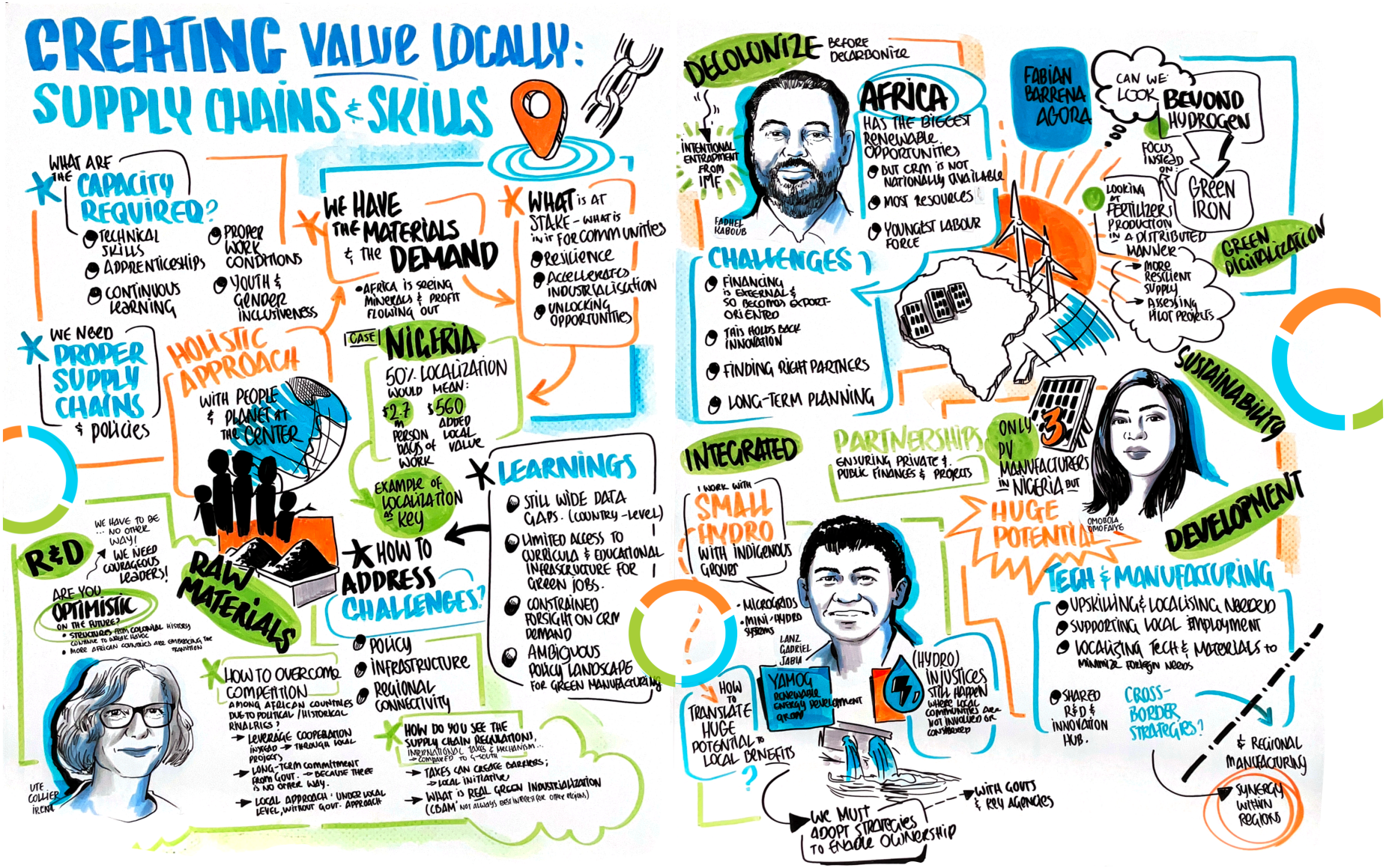
Lance Gabriel Jabla followed this by recounting how the Yamog Renewable Energy Development Group helped rural and Indigenous communities in Mindanao build and own micro-hydro systems.

"A key success factor is that communities own not just the physical assets but also the outcomes, responsibilities and accountabilities," he said.

Yamog was founded after local protests against a large power plant left villages still unelectrified, two decades after the plant opened. The group works through co-design, ensuring communities hold the physical assets, as well as the responsibility and political voice to defend those assets. Legal instruments agreed with local governments and intensive skills-training anchor this integrated approach. Yamog's work has already scaled service to more than 4 300 households, he said, while spawning a federation of grassroots renewable-energy users. This network now lobbies utilities and swaps technical know-how across Mindanao.

Fabian Barrena then argued for green industrialisation in the Global South via green hydrogen and downstream value chains. Many economies in the Global South had slipped into raw-material export dependency, he said. Cheap renewables let them capture energy intensive segments of the value chain and manufacture higher-value intermediate products, such as green iron. As an example, he pointed to Brazil. There, if iron-ore exports were replaced by green iron production powered by renewable hydrogen, the satisfaction of just 5% of global demand could triple export revenues while creating 41 000 local jobs. It could also cut green steel costs for importers such as Germany by 20%.

Barrera also highlighted small, decentralised, renewable-based fertiliser plants of a type already piloted in Kenya and the United States. These "show how innovation can disrupt the classic fossil-fuel-intensive model and build local resilience", he said.



BY @IRIS MAERTENS FOR VISUAL HARVESTING


IRENA INNOVATION WEEK 2025
Panel discussion
Moderator
Panellists


ON WEEK 2025
for a Sustainable Energy Future


Fadhel Kaboub
Global Institute
Sustainable
Prosperity


CREATING VALUE LOCALLY:
SUPPLY CHAINS & SKILLS
DECOLONIZE
AFRICA
CHALLENGES
PARTNERSHIPS
INTEGRATED
NIGERIA
LEARNINGS
HUGE POTENTIAL
TECH + MANUFACTURING

Innovative business models

for bioenergy in the Global South

Session organised in partnership with the World Bioenergy Association (WBA)

Session overview

This session explored how sustainable bioenergy can support clean energy transitions in developing countries. Speakers emphasised the need for context-specific solutions and integration with agriculture and waste systems. They also urged policy and investment support to scale up bioenergy in a way that ensured sustainability and local benefits.

Key actions
for policy makers

- **Develop tailored national bioenergy strategies that align with local resources, land use and energy needs**
  Policy makers must integrate bioenergy into national energy plans. This requires a systemic approach involving stakeholders across the entire value chain.

- **Invest in full bioenergy value chain infrastructure, including supply chains, technology deployment and digital platforms**
  Policy makers need to create an enabling environment to attract the significant investment required. This is estimated by IRENA at roughly USD 200 billion per year, globally, for the bioenergy sector to reach the 1.5°C target. There is a need for policy makers to reform practices for suppliers of finance and donors, encouraging slower, patient capital, such as equity.

- **Ensure sustainability through clear standards and land-use safeguards, balancing energy goals with food security and environmental protection**
  It is crucial for policy makers to ensure that sustainability assessments should be at the beginning of the investment process for bioenergy projects. A primary element of these assessments must be to avoid competition between bioenergy crops and food crops or food production. This ensures that the pursuit of bioenergy does not compromise food security in developing nations.

Highlights of the session

Scene setting presentation
Ricardo Gorini, Team Lead, REmap and Bioenergy, IRENA

Presentations and panel discussion
Moderator: Bharadwaj Kummamuru, Executive Director, WBA

Michela Morese, Energy Team Leader and Senior Natural Resources Officer, United Nations Food and Agriculture Organisation (FAO)
Uke Ayaka, Energy Team Lead, Japan International Research Centre for Agricultural Sciences (JIRCAS)
Gabriele Giannini, Head of Africa Agri-business, Eni
Verena Brinkmann, GIZ EnDev

In the session, participants highlighted the significance, challenges and opportunities presented by bioenergy. This was also seen as a key component in the global clean energy transition for developing regions in particular.

Ricardo Gorini opened the session by emphasising the importance of integrating biomass into energy transition strategies, particularly for meeting the 1.5°C climate goal.

"To reach the 1.5°C target, bioenergy is a must," he said.

He referenced Brazil's ethanol programme, noting how combining sugar and ethanol production fostered ecosystem development and social impact. The session stressed that while electrification is vital, sustainable fuels and biomass are equally necessary to decarbonise multiple sectors.

Bharadwaj Kummamuru then highlighted India's significant, yet underutilised biomass potential, particularly from agriculture. Although India faced challenges – such as cost aggregation, quality control and supply chain standardisation – initiatives such as government-supported pellet mills and the development of bioenergy hubs and digital marketplaces were promising steps forward.

Next, Michela Morese from the FAO emphasised the nexus between energy, agri-food systems and climate. She introduced the FAO's sustainability assessments for Africa. These had revealed substantial potential in biogas production, particularly in countries such as Rwanda and Zambia.

"First and foremost," she said, "sustainability assessments should be put in place at the beginning of the investment process."

SIDS also present strong biogas opportunities due to the high organic waste produced by tourism. Morese noted that sustainability must be assessed across the full bioenergy value chain using both before and after evaluations.

Gabriele Giannini then presented a vertically integrated bioenergy model centred on Africa. This utilised agricultural waste and residues to produce bio-feedstock and other by-products through agri-hubs. This model ensured that the value chain actively involved local farmers and avoided food-versus-fuel competition by promoting crop rotation.

In her remarks, Verena Brinkmann focused on clean cooking solutions in countries like Kenya and Senegal.

"We have never been at the point we are today in terms of commitment in Africa to clean cooking," she said.

She highlighted the importance of investing in infrastructure, quality standards and user awareness to grow the bioenergy sector. She also called for integrated energy policies to unify fragmented strategies and ensure that bioenergy contributed meaningfully to Sustainable Development Goal 7 (SDG7) and national climate goals.

"We can't reach SDG7 without biomass energy, and we can't do that without efficient technologies," she added .

Uke Ayaka then outlined some innovative bioenergy solutions. These included flexible pellet production, biogas from wastewater and converting biomass to liquid fuels. She stressed the need for integrated renewable energy approaches in Asia in particular, as there, decentralised energy models could be highly effective due to smaller-scale agricultural systems.

During the panel discussion, speakers reiterated the importance of context-specific policies and sustainability assessments. Land use emerged as a key concern, with no universal tool available to quantify its impact on food security. The need for financing and scaling up bioenergy infrastructure was also emphasised as crucial in attracting investments and achieving long-term sustainability.

Closing the session, Chun Sheng Goh reinforced two key takeaways: 1) context matters deeply in bioenergy strategies; and 2) demand creation is as essential as supply. Without enabling market mechanisms and regional adaptation, bioenergy systems cannot flourish. The session concluded with a call to build inclusive, scalable and sustainable models tailored to local conditions.

Project facilitation in fragile countries

Navigating political risks, enabling renewable energy investments

Session organised in partnership with UNEP

Session overview

This session had two aims. The first was to explore innovative approaches to project facilitation and risk-mitigation. The second was to inform participants of the financing mechanisms that are available for coping with multi-faceted political risks in FCS. By engaging key stakeholders – including those who mitigate risk, financiers and developers – the session shed light on the lessons learnt for financing renewable energy projects in such contexts. Numerous investment opportunities that were crucial for local resilience and peacebuilding were also identified.

Key actions

for policy makers

- **Correct misconceptions about investment risk**
  Investment risks in fragile states are often exaggerated or misunderstood. Investors need confidence in governance, transparency and stability before committing capital. Structured de-risking tools, such as credit guarantees, upfront capital facilities, and blended finance, are critical in attracting private investment at scale.

- **Deploy collaborative financing and risk-sharing mechanisms**
  The key is to address technical and financial gaps through collaborative financing and risk-sharing mechanisms. Financiers must scale-up early-stage de-risking instruments, such as credit enhancement and guarantee schemes. They must also bundle technical and financial support to lower transaction costs. This accelerates the bankability of renewable energy and infrastructure projects in FCS settings.

- **Adopt conflict-sensitive approaches**
  Proximity and context awareness are key in FCS settings. International organisations, financiers and developers must adopt conflict sensitive approaches when implementing clean energy programmes. This means systematically analysing the context and integrating peace building considerations.

- **Engage with local governments and stakeholders**
  Building trust and legitimacy with shareholders and local stakeholders is essential in unlocking investment in FCS. Involved actors should work closely with local governments to address regulatory barriers. They should also work closely with communities to build trust and ownership.

- **Position renewable energy investment as a peacebuilding strategy**
  Investing in renewable energy in FCS is not just about climate goals. It is also a strategy for resilience and peacebuilding. The conditions behind fragility and access to energy services are intertwined. Clean energy access can bolster socioeconomic development and state legitimacy, helping countries escape the trap of fragility. Renewables can deliver tangible peace dividends by improving daily life and reducing conflict pressures.

- **Recognise and promote energy access as a basic human need, while driving structural and paradigm shifts**
  Structural and paradigm shifts are also necessary to accommodate the unique challenges faced by FCS. It should be recognised that energy is a basic human need, which should serve as the motivating force for investors to channel investments into FCS.

Highlights of the session

Scene setting presentation
Luis Munuera, Senior Energy Expert – Urban Energy, UNEP

Panel discussion
Moderator: Ahmed Badr, Director, IRENA Project Facilitation and Support

Linda Wamune, Project Director, Energy Peace Partners
Kristen Petillon, Business Engagement Lead, PeaceNexus Foundation/Kube Energy
Nadiia Petruchenko, Co-founder and Chief Business Officer, SPP Development Ukraine
Jisong Won, Senior underwriter, Multilateral Investment Guarantee Agency (MIGA)
Reda Souini, Associate Investment Director, Africa50
Anja Werntges, Clean Cooking Component Lead, GIZ

The opening of the session saw participants emphasise that investing in FCS not only presented challenges, but opportunities as well. Clean energy investments in these countries were also crucial, speakers said, as roughly 80% of the world's population without electricity lived in an FCS – a condition exacerbating humanitarian crises.

At the same time, renewable energy offered a highly resilient and flexible pathway to electrify fragile states. Solar and wind resources were very abundant in many of these countries, while the modularity of renewable energy systems meant that they could be deployed at any scale and expanded, incrementally, as conditions improved. Clean energy access could also bolster socio-economic development and state legitimacy, resulting in positive impacts on peacebuilding.

Some examples were then provided of successful renewable energy projects being implemented in FCS. Sudan's solar-powered water pumps and Mali's 50 MW solar farm were presented, along with Ukraine's assessments of 30 MW solar plants. All these projects effectively benefitted communities.

The scene-setting presentation also tackled the main challenges commonly faced in FCS. These included: weak institutions, unclear regulatory frameworks, poor governance enforcement, currency fluctuations, poor revenue reliability, security risks and threats to infrastructure. In conclusion, adaptability and conflict-sensitive approaches were identified as crucial elements for all stakeholders working in these contexts.

Linda Wamune then described how Energy Peace Partners were driving clean energy investment in FCS through Peace Renewable Energy Credits (P-RECs). This was an innovative financing tool that addressed energy poverty, fragility and climate vulnerability. Her organisation developed, verified and promoted P-RECs while engaging governments and corporate buyers. It was also launching a USD 11 million aggregation facility to boost market activity.

To ensure context-specific impact, Energy Peace Partners built multi-stakeholder partnerships, she said. It also used remote technologies for on-the-ground data collection and project monitoring. It then shared these findings publicly in order to promote transparency and collaboration.

Kristen Petillon then talked about how Kube Energy leveraged deep expertise in humanitarian, development and World Bank sectors to design conflict-sensitive, locally tailored energy interventions in fragile regions. In these, prioritised proximity, stakeholder engagement and adaptability over one-size-fits-all models, he said. The company had developed medium-scale renewable energy infrastructure in FCS such as Somalia, South Sudan, Mali and the Central African Republic. There, it had collaborated with local governments to enhance bankability and investor confidence.

At the same time, Kobe Energy's Peace Nexus Foundation supported blended financing and peace-positive investment frameworks in order to help developers manage not just financial risk, but also social, political and reputational challenges. In this, the foundation emphasised trust-building, local legitimacy and long-term community benefit, such as early asset transfer models.

"There is a disconnect between perceived risk and real risk on the ground," he said. "Navigating complex settings is not only about avoiding the risks, but understanding the risks."

His organisation advocated for investment in local capacity, he said. It also supported businesses that were not yet investment-ready and stressed the importance of patient, committed capital in FCS, along with a holistic, long-term support model.

"Investing in fragile settings is possible, it just takes the right mindset," he said. "Investments in fragile contexts require patient capital due to longer timelines and greater complexity."

Nadiia Petruchenko then outlined how in Ukraine, despite the extreme challenges of war – such as damaged infrastructure, supply disruption and investor hesitation – Ukrainian renewable energy developers had maintained progress. They had done this by leveraging international partnerships and risk mitigation tools – such as MIGA – while maintaining a resilient, adaptive mindset.

Building on strong pre-war capabilities and institutional backing from the European Bank for Reconstruction and Development (EBRD) and International Finance Corporation (IFC), Ukraine had added 2 GW of new generating capacity during the war, she said, half of which had come from renewables. This signalled the country's long-term potential, she added. Continued success depended on reducing political and financial risk through trust-based partnerships, establishing co-development platforms that enabled shared decision-making and accountability, and on expanded access to de-risking mechanisms.

"During the war, we don't stop, we adapt," she concluded.

In her remarks, JiSung Won then said that MIGA provided three core guarantee products: 1) political risk insurance; 2) credit enhancement guarantees; and 3) trade finance guarantees. These were now integrated with IFC and World Bank instruments under a unified platform to streamline and scale up investment, she said, enabling de-risking through pooled resources and expertise.

In Ukraine, MIGA used the Support for Ukraine's Reconstruction and Economy (SURE) Trust Fund to sustain guarantees during wartime. In Africa, it provided credit enhancement guarantees to support climate and renewable energy lending through regional banks and risk-sharing facilities, such as the Sustainable Renewable Mitigation Initiative and M3-100 Initiative, expanding coverage for private sector electrification projects in fragile and low-income contexts.

Reda Souini, then described how Africa50 supported infrastructure development across Africa through two vehicles: project development (for early-stage structuring); and project finance (providing equity

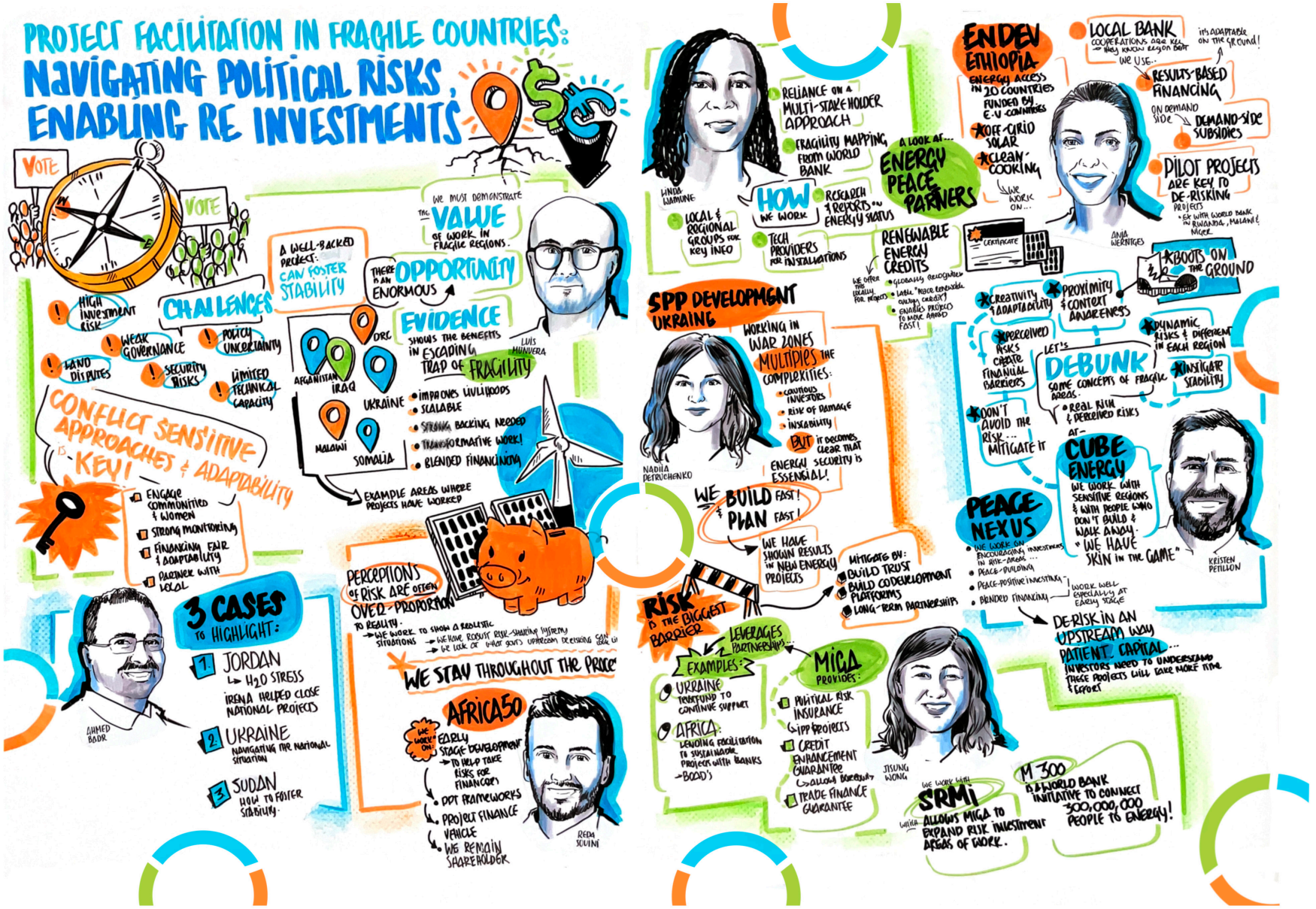
at financial close). In this way, they co-developed projects with governments to ensure bankability and crowd-in private capital through long-term equity stakes.

Leveraging local knowledge, early government engagement and partnerships with DFIs, Africa50 mitigated risks and maintained continuity across political cycles, while enforcing strong ESG strategies and compliance to enhance investor confidence and project viability.

"Perception of risk is often exaggerated in the African context," she said.

Anja Werntges then turned to EnDev and how it used results-based financing to stimulate both supply and demand in fragile contexts. In this way, her organisation supported local solar distributors, subsidised end-user prices and piloted adaptable, scalable approaches to generate evidence, build trust, and unlock larger-scale investments. An example of this was in Rwanda with the World Bank, she said.

By investing in local skills, supply chains and institutional capacity – including training technicians and creating stove production groups – EnDev promoted sustainable energy access. At the same time, it also strengthened local bank capacity for energy lending and advocated for supportive national policies and regulatory frameworks.



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Closing session

The way forward – structural change and innovation for sustainable development

Session overview

IRENA Innovation Week 2025 concluded its three days of discussion with a thought-provoking session on the structural challenges faced by the Global South as it tries to achieve just energy transitions. In this, participants discussed how to address obstacles to such transitions in ways that could unlock the Global South's potential for sustainable socio-economic development.

The session also highlighted the importance of industrial policy in strengthening local capacities, with this supported by strategic investments, long-term planning and effective partnerships.

Subsequent remarks then sought to explore what was needed to advance the energy transition equitably. Participants were encouraged to question prevailing paradigms and consider structural changes beyond their technological aspects. The session also emphasised the need for systemic innovation – not only in policy, regulation, market design, business models and system operation, but also in the social dimensions of the transition. Such aspects included shifting narratives and mindsets.

The discussion also examined the potential role that the upcoming COP30 conference in Brazil could play in advancing the global, just transition agenda.

Key actions

for policy makers

- **Shift the investment paradigm from profit-driven to impact-driven**
  There should be a move away from renewable energy being viewed as solely a profit-making enterprise. Risk should be redefined to encompass not just investor returns, but also the risks of failing to meet the SDGs and "leaving people behind". In developing economies, this requires a scaling-up of impact-driven investments, such as concessional loans and grants, to complement profit-driven investments.

- **Prioritise local value creation and technology transfer**
  Implement policies that foster local manufacturing and value chains for the industrial development of renewable energy infrastructure, reducing import dependency. This requires genuine and equitable technology transfer and a move away from extractive dynamics. It would also avoid the reinforcement of economic imbalances.

- **Invest in national innovation infrastructure, including skills and education**
  Enhance national innovation capabilities through continuous public investment in research institutions, technical education and local knowledge systems. This will further enable active technological learning, allowing countries to absorb, adapt, and innovate beyond imported technologies. It will also enable the development of a skilled workforce capable of leading countries' energy transitions.

- **Foster bottom-up and community-led narratives and approaches**
  Empower communities as active co-designers of the energy transition by integrating diverse local narratives into decision making. This would entail moving beyond top-down policy prescriptions and involve setting-up inclusive channels for effective conversations with marginalised local communities. This ensures that energy transition aligns with local priorities and delivers real social value, leveraging existing knowledge.

- **Rethink the global financial architecture**
  Advocate for structural reforms that measures that call for debt cancellation – not just rescheduling – and the prioritisation of grant-based climate finance, instead of conditional loans. Creating fiscal space is essential for developing countries to pursue transformative pathways, such as scaling renewable energy and a just energy transition.

Highlights of the session

Rapporteurs
Innovation in infrastructure for tripling renewables: Key messages
James Walker, Team-lead, Renewable Gases, IRENA
Renewable-based solutions for sustainable development: Key messages
Arina Anisie, Analyst, Renewable Energy Innovation, IRENA

Scene-setting presentation
Diala Hawila, Programme Officer, Policy Advice, IRENA

Panel discussion
Moderator: Felicia Jackson, Co-founder and co-host, Shaken Not Burned

Pedro Ivo Ferraz da Silva, Co-ordinator, Scientific and Technological Affairs, Climate Department, Ministry of Foreign Affairs of Brazil
Beatrice Coda, Head of Unit of the Clean Energy Transition Unit, Directorate General for Research and Innovation, European Commission
Fadhel Kaboub, Associate Professor, Denison University, and President, Global Institute for Sustainable Prosperity
Yacob Mulugetta, Professor of Energy and Development Policy, University College London and Climate Compatible Growth (CCG)
Zeeshan Ashfaq, CEO, Renewables First, Pakistan

Youth speech on behalf of future generations
Ana Ramrez Tovar, IRENA Youth Delegation, Sustainable Director, RIOT Green Hydrogen

Closing remarks
Gauri Singh, Deputy Director-General, IRENA

IRENA's scene-setting presentation used investment data to underscore the prevailing challenges faced by the energy transition.

The data revealed that 2023 had seen a record global high of USD 2.1 trillion of investment in the energy transition. Yet, these investments had been heavily concentrated in a few technologies, such as solar PV and wind. In addition, these investments had also predominantly flowed to the advanced economies and China, with Africa, for example, receiving a mere 1% of the global total. This was a figure that had also declined from 2% a couple of years before that, highlighting increasing geographical disparities.

This pattern of concentration had also extended to supply chains, the data showed. In 2023 , some 88% of solar PV supply chain investments and 65% of solar PV jobs had been located in China, demonstrating how the rest of the world – and particularly developing economies – had not been benefiting equitably from the energy transition.

The presenter then argued that under the current paradigm, renewable energy was viewed primarily as a profit-making sector. In this, public funds were often serving to cushion private investor returns, leading to a situation where the lowest income population paid the most for energy.

A critical shift in perspective was then proposed:

"When we talk about risk mitigation," Diala Hawila said , "we shouldn't just focus on the risk of investors not getting their money back. We should look at the risk of falling behind on so many Sustainable Development Goals. How about the risk of leaving people behind?"

She then proposed a "parallel narrative" for financing renewables – one that is more inclusive and adopts a systemic approach, integrating finance, industry, education and skills into a cohesive and innovative system.

The subsequent panel discussion elaborated on these structural issues and proposed solutions. Fadhel Kaboub said that the current global economic architecture was still rooted in the oast, and in ongoing structural dependencies. These kept the Global South countries at the bottom of the global value chain. These countries, and Africa in particular, remained: 1) a source of cheap raw materials; 2) consumers of industrialised output from the Global North (including renewable technology); and 3) places where obsolete technology and assembly line manufacturing were outsourced. He then stressed the need for "real industrial development" in Africa, particularly in renewable energy infrastructure manufacturing, which demanded a genuine transfer of technology and sharing of technology through "win-win joint ventures", rather than charity.

Yacob Mulugetta then highlighted the systemic challenge of global inequality. Some 95% of the world's population was denied decent living standards, he said, yet just 30% of current global resource and energy use could achieve such standards for all. He pointed to successful examples, such as Uruguay and Costa Rica, where strong public institutions and domestic long-term planning, rather than reliance solely on the private sector, were key to scaling up renewable energy. He also argued that the high risk perception in Africa was often "manufactured" by the existing global financial architecture. He also emphasised the importance of robust government investment in national innovation infrastructure. This was necessary, he said, in order to build local capabilities and control knowledge systems within Africa, reducing dependence on private sector investments and funding from the Global North.

Pakistan's solar development was then described by Zeeshan Ashfaq as a remarkable "bottom-up, people-led and market-driven" energy transition. In this, 20 GW of solar panels had been installed in less than three years, driven by soaring electricity prices, grid unreliability and falling solar panel costs.

This demonstrated that, "When the grid fails to provide reliable and affordable electricity, people can drive energy transition faster than any policy mandate," he said.

Ashfaq also noted that one advantage for Pakistan was proximity to China, which was the main exporter of solar panels. However, he noted that the affluent classes had adopted solar first, leaving others behind. This underscored the need for additional support – assistance that would combine private sector dynamism with philanthropic capital and multilateral development support – in order to ensure an inclusive transition. He then added that local manufacturing required specific fiscal and financial incentives and a supportive policy framework.

Pedro Ivo Ferraz da Silva then introduced the concept of innovation economics in what he termed "active technological learning". In this, countries build national institutions to absorb knowledge, then adapt and innovate the technology beyond what is imported. Brazil's aviation sector was an example of this, he said, as national institutions had been created to support this industry.

He then explained that Brazil, through its G20 presidency and its hosting of COP 30, aimed to influence the global discussion. His country would emphasise the need for a radical shift in the world economic order, particularly in regards to the financial sector. This was because "capital costs more for those who have less," he said. Proposed solutions included partnerships with regional development banks to mitigate currency volatility for investors and country platforms that would align national development plans with technological and financial providers, moving away from project-based approaches.

In his comments, Pedro Ivo Ferraz da Silva also stressed the importance of integrating local narratives and bottom-up approaches. This meant recognising the diverse local realities within countries – such as differences between Brazil's north and south – and building channels for meaningful conversations with marginalised communities. These included Indigenous peoples, whose ancestral knowledge could inform climate solutions. In conclusion, COP30 could be a platform to build new channels of communication with these communities, he said.

Kaboub then said that reframing the global narrative on climate finance was essential to addressing systemic inequalities and fostering genuine sustainable development. He said that countries that had historically contributed disproportionately to carbon emissions carried a "climate debt" toward nations in the Global South, whose emissions had been comparatively minimal. Currently, however, the prevailing climate finance framework often reflected and reinforced long-standing global economic asymmetries. Kaboub argued that rather than facilitating fair compensation, current financing models frequently relied on limited, conditional grants and concessional loans that could create debt dependency, while such models also prioritised the interests of wealthier nations over the development needs of recipient countries.

He then argued that the global approach must shift away from extractive financial mechanisms toward genuine debt cancellation – not merely rescheduling. This, he said, should be coupled with substantial grants and the unconditional sharing of critical, life-saving technologies. Such transformative action was necessary, he said, to enable countries in the Global South to build the fiscal capacity and industrial foundations needed to lead their own energy transitions and achieve true economic sovereignty.

"If we don't have radical solutions that go to the roots of the problem, then we end up with superficial solutions that reproduce the status quo," he concluded .

Beatrice Coda then argued that some Global South challenges also existed in Europe. The continent was committed to global co-operation and technology co-creation on an equal basis through initiatives such as Mission Innovation, while Europe also co-funded projects with African countries and India. These efforts aimed to strengthen innovative systems and develop tailored solutions, acknowledging that many challenges – such as skills, financing, value chains and energy poverty – were global.

Following up on this, Yacob Mulugetta then challenged the conventional North–South dichotomy.

"Within the Global North, you have a Global South as well," he said.

The Global North was internally divided, he continued, with people across its countries experiencing grievances "equal to or similar" to those in the Global South. Mulugetta argued that the crucial question was how the Global North could create a narrative and implement policies that unified its population and enabled it to move forward. He therefore suggested that interventions and concessions were needed within the Global North, rather than solely between the Global North and South. Global disparities which were often characterised as rich versus poor, he said, were also significantly present within northern countries themselves. This culminated in him asking a provocative question: **"How do you save the Global North from itself?"**

In their concluding remarks, panellists then identified the key shifts they considered necessary.

Kaboub reiterated the demand for real technology transfer to enable large-scale manufacturing in the Global South, as a block. Mulugetta urged Brazil to use its COP30 presidency to advance the Global South agenda. Coda highlighted the shift towards technology co-creation on an equal basis. Ashfaq then emphasised the need for bottom-up solutions to drive the energy transition. Lastly, da Silva called for a shift in mindset towards the Brazilian ancestral concept of 'mutirão' – a collective effort towards a common goal and to overcome polarisation.

"It is quite important that one of the shifts that happens is a shift in mindset," he said, **"towards the ancestral concept of mutirão, which is a local, indigenous concept of collective effort – of everybody coming together to achieve a common goal."**

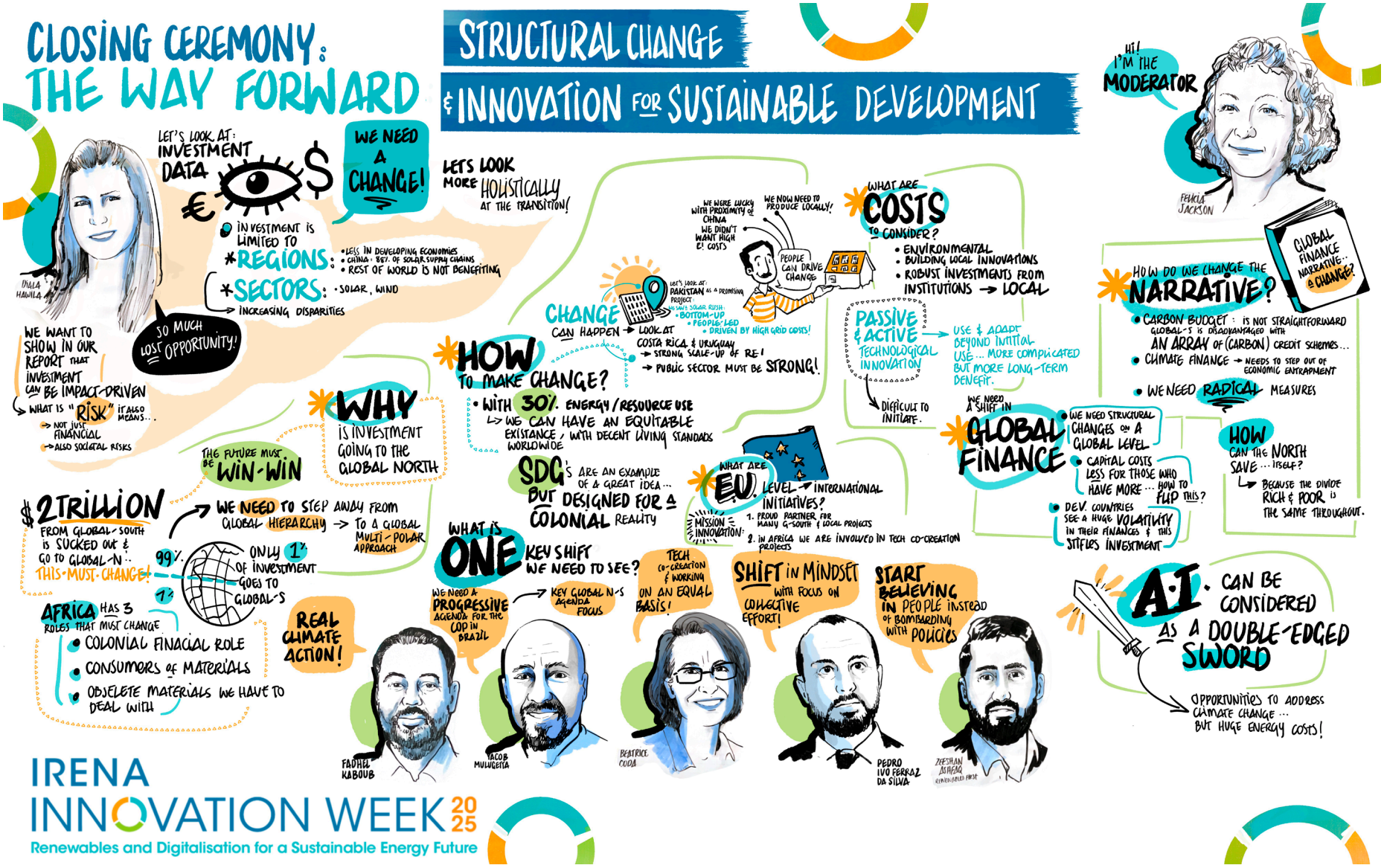
In her speech on behalf of future generations, Ana Ramirez Tovar spoke powerfully.

"The energy transition is not merely technical," she said. **"It is deeply human."**

She then emphasised the fact that "communities are not passive recipients, but are active co-creators of the energy system". The energy transition had to be "collaborative and built from the ground up," she added, saying that it should embrace diverse visions of development and move beyond 'paternalistic' or 'extractive' approaches.

She then underscored the need for a just transition that reskilled and reinvested in communities historically reliant on fossil fuels, ensuring the transition was regenerative, decentralising, dignified and elevated traditional knowledge.

The overall message was: **"Think big, act together and lead with purpose,"** she said. **"Let's ensure this transition is not only just in intention, but just in practice. Let's ensure it delivers not only energy, but hope, dignity and opportunity for every generation to come."**



IRENA INNOVATION WEEK 2025

Renewables and Digitalisation for a Sustainable Energy Future


Digitalisation for a Sustainable Ene


and Digitalisation for a Sustainable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Site visits

As part of IRENA Innovation Week 2025, a day of site visits was organised. Participants could choose between three options:

- **Site visit 1: Innovating steel at thyssenkrupp and the Carbon2Chem® Transformation Project[5]**
  This focused on innovation in steelmaking, beginning with the Carbon2Chem initiative that captures CO_2 from production and converts it into valuable chemicals.

- **Site Visit 2: Sustainable energy solutions for cities and data centres with KMW AG[6]**
  This visit showcased the development of a next-generation data centre that prioritised sustainability at every level.

- **Site visit 3: Meeting AI demand with renewables at CyrusOne[7]**
  CyrusOne is a leading global data centre developer and operator with 55+ data centres across the US and Europe. The tour showcased CyrusOne's sustainability initiatives, including waste heat recovery, energy-efficient designs and the technologies driving its 2030 climate neutrality target.

Site visit 1: Innovating steel at thyssenkrupp Steel and the Carbon2Chem® Transformation Project

In this site visit, IRENA Innovation Week 2025 participants travelled to thyssenkrupp's facilities in Duisburg, Germany. The visit was structured in two parts, with the Carbon2Chem® project site visited first, followed by a tour of thyssenkrupp Steel Europe.

Part 1: Carbon2Chem® visit

Carbon2Chem® is a flagship project that transforms CO_2 captured from steel production into chemicals such as methanol and ammonia. During the site visit, participants were given an introduction to thyssenkrupp's decarbonisation strategy that highlighted the company's plans and efforts to reduce CO_2 emissions. A question and answer session followed the presentation, allowing participants to engage with experts from thyssenkrupp on the challenges faced in decarbonising heavy industries.

The German government's carbon emissions reduction goals are a major driver behind switching to green hydrogen. Participants were then given a guided view of the construction of a pilot electrolyser. The electrolyser aims to produce renewable hydrogen to support the production of low-carbon chemicals and fuels.

[5] See https://www.thyssenkrupp-carbon2chem.com

[6] See https://www.greenmountain-kmw.com/en/ or https://www.kmw-ag.de/rechenzentrum/ (in German)

[7] See https://www.cyrusone.com/data-centers

Part 2: thyssenkrupp Steel Europe

Participants were then taken on a guided tour of the steel plant, observing the following key stages of production:

- **Raw material handling**
  This included the sourcing and processing of coal and iron ore, delivered to the site.

- **Steelmaking**
  Participants observed large containers filled with liquid crude iron and the transformation processes that followed. These included the charging of scrap and molten iron into the converter steel mill. This is a crucial step in the production of crude steel.

- **Rolling and finishing**
  The group was then taken to the final process of crude steel formation, where steel slabs from the previous steel were rolled through a rolling mill. These steps prepare the steel for a wide range of industrial applications, ensuring the desired thickness, strength and surface properties.

- **Low-carbon production**
  The tour also included a glimpse into thyssenkrupp's construction at the site of a direct reduction furnace that would allow a switch to low-carbon methods of production.

Site visit 2: Sustainable energy solutions for cities and data centres at Kraftwerke Mainz Wiesbaden AG

IRENA Innovation Week 2025 participants also visited the Kraftwerke Mainz Wiesbaden (KMW) AG Data Centre in Mainz, Germany. KMW is the municipal and regional energy producer there, with several production plants in the Rhine-Main area.

The visit included the following highlights:

- **Innovative heat recovery for urban sustainability**
  Once operational, the Green Rock data centre will feature a cutting-edge heat recovery system that channels excess server heat into Mainz's district heating grid. This enhances the grid's overall energy efficiency and boosts its share of renewable and low-carbon energy.

- **Exceptional energy efficiency with future-ready design**
  Through its integration with the district heating network and other advanced technologies, the data centre is designed to achieve a power usage effectiveness (PUE) value below 1.3. This would place it among the most energy-efficient facilities globally, setting a benchmark for next-generation data centres.

- **Smart cooling and resilient power for sustainable operations**
  Important aspects of the project include its brown field nature – it is being constructed on the site of an old coal power plant. It also has a tri-modal cooling approach involving district heating, water from the River Rhine river and rooftop ventilation. In addition, back-up power is provided by existing gas generation infrastructure close-by. This enables the Green Rock data centre to operate with high energy efficiency, economic viability and minimal environmental impact.

Site visit 3:
Meeting AI demand with renewables at CyrusOne

The third site visit on offer at IRENA Innovation Week 2025 was to the CyrusOne FRA1 Facility in Frankfurt, Germany. CyrusOne is a data centre owner and operator with seven data centres currently running in Germany and multiple others globally. Currently, CyrusOne relies on electricity from the Frankfurt city grid, although there are also plans in place to build a data centre that relies on hydrogen to meet 100% of its energy needs.

Participants toured FRA1, a data centre with 9.1 MW of IT capacity. The tour included a visit to the transformer facility, the backup generator room, the data centre halls, the battery room and the chiller room. The visit offered participants an in-depth view of the operation of data centres and insights into the role they play in the energy transition.

After the visit, representatives from CyrusOne made a presentation on the functionality of the data centre. They also said that and annual growth in data centres of between 15% and 20% was expected over the next few years.

The visit included the following highlights:

- **Renewable energy for data centres**
  CyrusOne FRA1 uses electricity from the city grid and relies on guarantees of origin (GOs) to determine that the data centre is utilising electricity generated from renewable energy sources. While the Frankfurt city grid is not 100% renewable energy, obtaining a GO incentivises the increase in renewable energy generation. Currently, data centres are responsible for an estimated 3% of Europe's electricity consumption. In the current legislation, however, there is no clear definition of "data centre", with only sites with a capacity over 100 kW considered to qualify.

- **Energy and water security for data centres**
  Data centres are impacted by extreme climatic events as they rely on electricity and water for key operations. In 2020, FRA1 relied on its emergency generators and battery storage when a storm impacted the district grid. Furthermore, data centres that rely on water for cooling may be impacted by extreme droughts. Newer data centres are therefore designed to rely on innovative cooling solutions, including closed-system hydro cooling.

- **Technological innovation using hydrogen to power data centres**
  CyrusOne is developing FRA7 as a data centre that will pilot the use of hydrogen to power operations. It will therefore reduce its emissions from electricity generation. FRA7 will rely on an onsite gas-fired power plant and initially run on a 25% hydrogen blend, although with the potential to upgrade to 100% hydrogen in the future.

- **Industry engagement in market design and regulation**
  CyrusOne is a member of the Climate Neutral Data Centre Pact,[8] together with over 100 other data centre operators and trade associations working towards climate neutrality. Data centres are working with regulators nationally and at the EU level to develop regulations and policy for climate neutrality

[8] See https://www.climateneutraldatacentre.net

and positivity for the industry. CyrusOne plans to achieve climate neutrality and positivity by 2030. This innovative approach to policy and regulation ensures that policy makers and industry stakeholders collaborate to design robust and implementable climate and energy regulations.

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Summary report 2025

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