REFLEXIONS CONFERENCE

Theme • Energy Transition

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REFLEXIONS
Together for climate action

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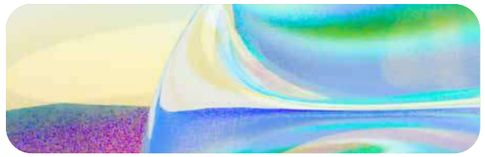

CONTENTS

REFLEXIONS 2026 CONFERENCE ENERGY TRANSITION

The 2026 edition of REFLEXIONS is dedicated to the theme of the “energy transition”, explored through the lenses of sustainability, security, and justice. Organized by Institut Polytechnique de Paris (IP Paris), the event brought together researchers, industry players, policymakers, and members of civil society to examine the technological, economic, environmental, and societal dimensions of the energy transition.

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THE CONFERENCE

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WELCOME SPEECH

LAURA CHAUBARD
Director General of the École polytechnique

Dedicated to the energy transition, the third edition of the REFLEXIONS Conference, organised by the Energy4Climate Interdisciplinary Center (E4C) of Institut Polytechnique de Paris, at École Polytechnique, one of its school member, is based on two major convictions.

First, in the face of environmental challenges, science is essential for an informed debate and to guide collective action. Yet, although climate knowledge is extremely solid, it is contested. This situation reinforces our responsibility to convey to students the keys to understanding a climate crisis that concerns them directly.

Then, the environmental transition requires a collective effort involving researchers, public decision-makers, economic actors and citizens. The Ecole polytechnique and the Energy4Climate center are part of this dynamic by bringing together multiple expertises at the heart of the unique ecosystem of the Saclay plateau. The campus of the Ecole polytechnique, which is celebrating its fiftieth anniversary, is an open-air laboratory with demonstrators for energy storage, grid management, agrivoltaism and carbon capture. This commitment is also reflected in the historical contributions of the Laboratoire de Météorologie Dynamique to IPCC assessment reports.

Science alone will not bring all the solutions, but it remains a compass to simultaneously apprehend the technological, economic, social and political dimensions of transition. Higher education institutions thus assume three fundamental missions: to produce rigorous research, to train the future actors of transition and to transform themselves.

THIERRY COULHON

President of Institut polytechnique de Paris (IP Paris)

The programming of the 3rd edition of the REFLEXIONS conference is based on three pillars: the search for rupture to invent new solutions, the articulation with public policies to inform the decision, and the close cooperation with the companies responsible for concretely deploying the solutions. The speakers thus mix researchers, public officials and economic actors in order to think long-term in an unstable international context where the climate issue tends to take second place.

The energy transition is a challenge that, beyond technology, affects sovereignty, energy security and geopolitical balances, but also justice between territories, generations. It is based on two complementary dimensions. The first concerns the uses and organization of societies: lifestyles, prioritization of investments and distribution of efforts. Without deciding in the place of society, science sheds light on arbitrations by objectifying the costs and consequences of decisions. It allows to think the transition in terms of efficiency, social acceptability and justice.

The second pillar is technological. According to the International Energy Agency, nearly 40% of the necessary technologies are not yet mature: the transition therefore depends on innovative solutions to be invented, tested and then industrialised quickly. Institut Polytechnique de Paris acts in this direction through its numerous experimental start-ups and demonstrators, and by its ever more numerous doctoral students. Created in 2019 and strengthened by the integration of the École nationale des ponts et chaussées in 2024, Institut Polytechnique de Paris aims to strengthen scientific synergies and the impact of research. The Energy4Climate Interdisciplinary Center (E4C) is at the heart of energy-climate research, complemented by other initiatives on energy sovereignty such as CIEDS and on oceans (CIMO).

The transition is also a human challenge, that of training skills, from nuclear to AI, to meet increasing energy needs while satisfying the requirement for sustainability.

OPENING KEYNOTE SPEECH

LAURENT FABIUS

President of COP21 (the Paris Agreement) and President of the Circle of COP Presidents

Climate change requires public policies to reconcile three objectives: ecological sustainability, economic sustainability, and social justice. However, these objectives are often in tension, as shown for example by the yellow vests crisis, which illustrates the conflict between economic sustainability and social justice.

To be effective and accepted, climate policies must integrate social justice, both nationally and internationally, with in this latter area the need to apply the principle of common but differentiated responsibilities and to mobilize financial resources that are differentiated and adapted to the particular situation of different groups of countries.

Faced with a turbulent geopolitical context, awareness of the strategic role of energy is reinforced. Europe must avoid three pitfalls: energy dependence on Russia, the decline in nuclear power and lagging behind China in innovation. Despite the American policies in favor of fossil fuels and the pressures on science, it is necessary to welcome the efforts made, particularly in renewable energies. The results, admittedly insufficient, should make it possible to avoid the +4 °C announced before the Paris Agreement without managing to limit the increase to 1.5 °C. Moreover, a recent decision by the International Court of Justice now considers the application of this agreement as a legal obligation for states and economic actors.

The success of COP21 leading to the Paris Agreement was based on a now fragile alliance between science, civil society and governments around the world. COPs remain useful but need to evolve: ensure implementation of decisions, strengthen inclusion, especially at the local level, including businesses, prioritize adaptation and provide more funding to developing countries.

SESSION 1

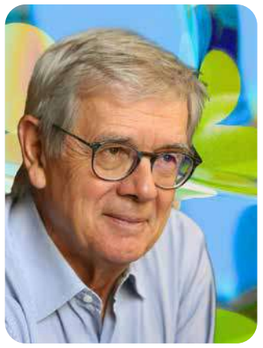
Energy sustainability

Energy sustainability refers to the capacity of an energy system to persist over time while minimizing its impact on the environment. Beyond technical considerations, it is a societal challenge that requires collaboration and dialogue between all actors and stakeholders.

Addressing the challenges of climate change, resource depletion, as well as air, water and soil pollution, this session brings together diverse perspectives on how policy, research and industry contribute to a more sustainable energy future.

WATCH THE REPLAY OF THE SESSION

KEYNOTE



PHILIPPE VARIN

Chair International Chamber of Commerce

Today, climate change is scientifically established, the main technologies of the energy transition exist, and the cost of inaction is documented. The central challenge lies in coordination: without collective action, the energy transition will be slower, more costly and less robust.

Indeed, energy systems are complex. A high share of intermittent renewable energies modifies the behavior of electricity grids, due to their volatility and reduced inertia, inducing new congestion patterns. Cooperation is needed to improve network stability, prevent outages, and limit network access costs. This requires flexible markets, strengthened networks equipped with storage solutions and adapted control systems. The sharing and interoperability of data between actors allows for the development of integrated modelling and planning. In addition, public action is essential to align supply scenarios with the demand roadmaps of decarbonised energy, for example in sustainable mobility.

The transition raises not only political and social questions but also financing problems. According to a report by the International Energy Agency, only 14% of projects reach emerging countries and 2% to sub-Saharan Africa. The problem is neither demand nor global financial resources, but risk assessment and Basel III rules on debt coverage, which penalize countries rated unfavorably. To reduce the cost of capital, development banks and global banks need to deploy collateral to catalyze blended finance. The solution should involve investment platforms aggregating projects at the regional level.

Finally, export restrictions that violate WTO rules undermine supply chains for critical raw materials and raise serious doubts about the feasibility of transition in many countries. The transparency of data on these material flows is an imperative.

Energy sustainability

ROUND TABLE

Chaired by **Philippe Drobinski,** *Director of the Energy4Climate Interdisciplinary Center (E4C) – Institut Polytechnique de Paris*

Paul Leadley, *Emeritus Professor of Ecology at Paris-Saclay University*

Laura Cozzi, *Director of Sustainability, Technology and Outlooks at International Energy Agency*

Jean-Marie Tarascon, *Chair of Solide-State Chemistry and Energy at Collège de France*

Yun Luo, *Co-founder and CEO, ROSI Solar*

PHILIPPE DROBINSKI

Director of the Energy4Climate Interdisciplinary Center (E4C) – Institut Polytechnique de Paris

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The energy transition aims to reduce CO2 emissions to limit global warming. But its implementation consumes raw materials and water (for power plant cooling, hydropower and mining) and interacts with ecosystems and human activities. Achieving a sustainable energy transition therefore means decarbonizing energy while taking into account the impacts, synergies and best trade-offs to be found for issues of water, food systems, biodiversity and resources.

Decarbonation rests on three inseparable pillars:

- rapid deployment of low-carbon energies, with a strengthening of networks, and long-term planning in a context of climate uncertainty;
- electrification of energy uses with decarbonized electricity;
- energy sobriety – one major mitigation lever according to the IPCC.

Renewable energies, despite their intermittency, are essential for reducing dependence on fossil fuels: they are quick to deploy and inexpensive in terms of capital investment and operational costs. However, their massive deployment raises issues of social acceptance, land use, biodiversity and energy justice. Development requires better territorial planning, early stakeholder engagement and solutions that are adapted to the local environment and social context.

In addition, the energy transition requires more flexibility, storage and smart grids that allow for active demand management. To be sustainable, solutions must be designed in terms of systems rather than technologies and they must be financially and socially acceptable, allowing for a fair distribution of costs, benefits and risks.

Another major challenge is climate resilience: this is about ensuring that energy systems can function reliably in future climate conditions marked by higher average temperatures and extreme weather events such as floods, more frequent droughts and storms.

PAUL LEADLEY

Emeritus Professor of Ecology at Paris-Saclay University

One of the key points to consider is the relationship between energy, human health, biodiversity and social justice. For instance, it is essential to mitigate the adverse effects that energy decarbonization may impose on ecosystems' own capacity to regulate greenhouse gas emissions. We must not to lose sight of the urgency of rapid transformation, especially since climate change itself has negative effects on carbon sinks such as forests.

The impacts of carbon energies on ecosystems require a systemic approach and the search for synergies. Nitrogen fertilizers (1% of global energy) could thus be partially replaced by nitrogen fixation by legumes, which would have a dual advantage of reducing oil consumption and pollution.

The environmental and social impacts of decarbonation also need to be systemically assessed. For example, biomass is considered essential to achieve carbon neutrality, but it has negative effects on biodiversity and water. However, the effects that we observe, in particular for solar and wind energy, are much lower than the potential major damages that climate change will inflict on ecosystems.

Public policies must also avoid operating in silos. Climate, biodiversity, water and food systems are interdependent. Addressing these issues requires a coordinated policy across departments and sectors.

LAURA COZZI

Director of Sustainability, Technology and Outlooks at International Energy Agency

According to the International Energy Agency, the expected warming by 2100 has decreased from 3.5–4 °C at the time of the Paris Agreement in 2015 to 2.5–3 °C today. Last year, 70% of new global power generation capacity was renewable, mostly solar; nuclear is also experiencing a revival. Electric cars represent 25% of the global market, and nearly 50% in China. On the other hand, industry decarbonization and hydrogen are advancing slowly. In Europe, 60 GW of renewables have been installed, but more than 400 GW are still waiting to be connected.

The key issue is no longer production, but the flexibility and adaptation of networks. Electricity demand remained stable in advanced economies until the recent rise of artificial intelligence, whose largest data centers now consume as much as 5 million households. AI has the potential to contribute to reducing emissions, especially by promoting intelligent management of electrical networks and their flexibility. However, the overall impact of AI will depend on its adoption and the ability to provide the necessary decarbonized electricity. Europe, which is lagging the United States and China, will have to take energy and digital sovereignty decisions quickly to transform AI into a positive lever, particularly for the climate.

Policies need to be adapted to meet local realities. In Europe, sobriety can be promoted by adopting a change in behavior, but this model is not universal. In India, frugality is valued as an asset. In Africa, access to energy remains a challenge. Replacing wood or other inefficient fuels used for cooking with cleaner alternatives such as LPG would reduce consumption and improve health.

In Europe, we currently import most of the critical materials needed for battery production. Of the 20 critical raw materials, 19 are mainly extracted and refined in a single country. We have taken some time to recognize the geopolitical risks associated with this dependence. Recycling must be part of the solution, alongside diversification of supply and strengthening partnerships with resource-rich regions, including African countries. These partnerships should also contribute to advancing value creation in the supply chain for the benefit of producer countries.

A global vision is essential to be coherent. Energy sustainability is intimately linked to the storage of renewable energies. The main issue that we have today is adapting the grids to the intermittency of renewables. In France, we have nuclear energy providing a stable baseload, but in Germany, for example, they rely on coal fired power plants to balance fluctuations in the daily output of wind turbines or solar PV, which makes no sense from a sustainable energy perspective.

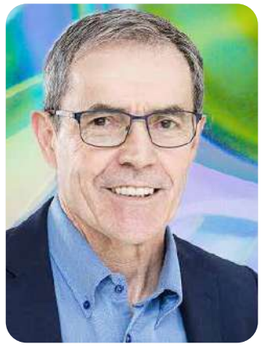
How about the following:

The share of hydraulic pumping (between two reservoirs at different elevations), which has traditionally been used for energy storage (making up over 75% ten years ago) is being rapidly outpaced by the growth of batteries. By 2030, it will represent 20% of capacity with growth in battery energy storage systems (BESS) making up the remaining 80%.

However, batteries have risks associated with their ability to concentrate a lot of energy in a small volume. The answer lies in innovation: the development of “smart” batteries incorporating tracking sensors, or even the future European electronic passport to improve traceability.

Industrially, Europe depends on China for materials, but also for equipment and industrial skills. To meet this challenge, alternatives such as sodium-ion batteries are being studied. To overcome the scarcity of materials, new chemistries are being developed: replacing cobalt with iron or manganese, using dry processes rather than in solution, and modifying synthesis processes to be less energy intensive. Above all, we are focusing on recycling, which is evolving towards direct methods allowing the recovery and renovation of electrodes without destroying the battery structure. Modular batteries, for example, would allow for individual component replacement and recycling.

Climate action requires a long-term vision and sustained strategic commitment to research and innovation.



JEAN-MARIE TARASCON

Chair of Solide-State Chemistry and Energy at Collège de France

YUN LUO,

Co-founder and CEO, ROSI Solar

The massive installation of photovoltaic energy provides Europe with a very significant capacity for producing decarbonized energy. This success translates into a real tsunami of PV modules reaching their end of life. Manufacturing this electronic equipment requires high-purity critical raw materials. And so, the mission of ROSI, an innovative start-up, is to exploit this industrial waste using a proprietary technology to extract silicon, copper, glass, aluminum and silver from end-of-life PV modules. Thanks to recycling, we turn this industrial waste into a huge opportunity for the European electronics industry.

In the long run, ethics and sustainability go hand in hand. The challenge is to harmonize human development, economic systems and sustainable practices.

Technology, combined with operational excellence and artificial intelligence, must make it possible to respond more sustainably to human needs. It can thus transform sectors such as waste treatment and recycling.

TAKEAWAYS

- **Without collective action, the energy transition will be slower, more costly and less robust.**
- **New provisions (guarantees) are needed to facilitate the financing of energy transition projects in emerging countries and sub-Saharan Africa.**
- **Renewable energies are quick to deploy and inexpensive in terms of investment and operational cost – essential for a successful energy transition.**
- **Adapting to the specificities of each region and involving citizens in decision-making are prerequisite for a successful transition.**
- **Energy systems must be resilient to future climate conditions.**
- **Decarbonization must take into account the systemic impacts and necessary trade-offs on water, food, biodiversity, and resources.**
- **The environmental and social impacts of decarbonization need to be systemically assessed.**
- **The key issue is not just decarbonized production, but the flexibility and adaptation of networks.**
- **Energy storage is crucial for the flexibility and resilience of networks and will be mainly provided by batteries.**
- **The recycling of photovoltaic modules is an opportunity for the industry and a necessity to address critical raw material dependencies.**

SESSION 2

Energy security

Energy security covers the stability of supply, infrastructure resilience, and the ability to withstand geopolitical, climatic, or technical crises. It involves key issues such as power outage risks, energy sovereignty, and control of strategic technologies. This roundtable will examine the growing complexity of global energy interdependence, discuss strategies to secure critical resources, and explore how governments, researchers, and industry can collaborate to enhance resilience and ensure reliable, affordable energy access.

WATCH THE REPLAY OF THE SESSION

PIERRE-FRANCK CHEVET

Chairman and CEO of IFP Energies Nouvelles

KEYNOTE

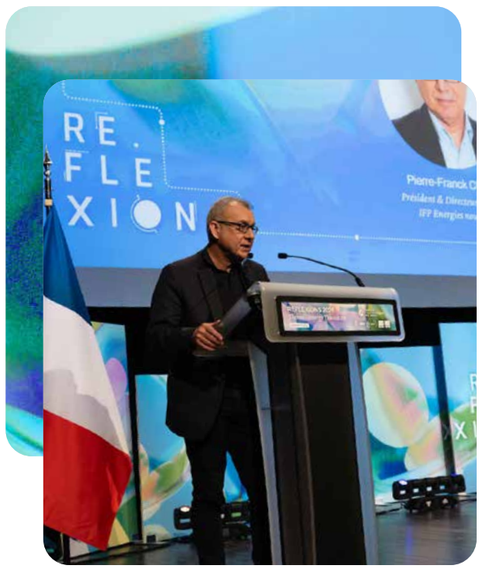
Energy is a key issue for economic and geopolitical sovereignty. France still remains heavily dependent on hydrocarbons and must rapidly reduce their share of its energy mix to meet its climate targets (from 57% today to 42% by 2030).

The Russia-Ukraine war has exposed Europe's vulnerability: soaring gas and electricity prices are driving inflation, high public spending and a loss of industrial competitiveness vis-à-vis the United States and China. However, since then, dependence on Russian gas has been replaced by dependence on American LNG (Liquified Natural Gas). Energy remains a geopolitical weapon, as do rising trade restrictions.

Energy security no longer rests solely on the supply of hydrocarbons but also on the availability of critical raw materials and technologies, and on the resilience of systems. The transition is creating new dependencies on lithium, cobalt, nickel and rare earths, which are mined in a few regions and above all, refined in China. Without local industrial production, Europe is losing both its technological sovereignty and jobs.

The key levers are local production, managing demand through energy efficiency and moderation, and developing low-carbon technologies, including recycling. A European approach is essential to address these challenges.

Despite lagging behind China in innovation overall, French research remains very well positioned in low-carbon technologies and hydrogen. It is crucial to continue investing in research and development, experimentation and the industrialisation of technologies for the energy transition.



ROUND TABLE

Energy security

Chaired by **Mathieu Xémard**, *Project Officer at the Interdisciplinary Center for Defence and Security (CIEDS) – IP Paris*

Agnès Pannier-Runacher, *Renaissance MP for Pas-deCalais EJ Former cabinet minister (2018-2025),*

Luc Rémont, *Honorary President of EDF*

Jean-Christophe Taret, *Director of Impact & Development at Veolia*

Emmanuelle Wargon, *Chairwoman of CRE (French Energy Regulation Commission)*

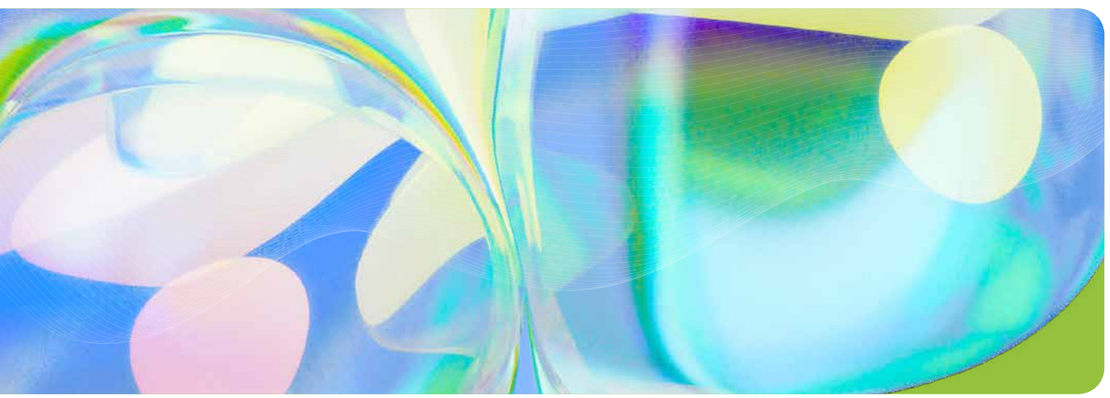
MATHIEU XÉMARD

Project Officer at the lnterdisciplinary Center for Defence and Security (CIEDS) - IP Paris

Uninterrupted access to energy requires suitable infrastructure, alongside the challenges relating to the physical security of power stations and cybersecurity. Dependence on foreign supply chains also creates geopolitical tensions. In this regard, the law on critical raw materials aims to safeguard the green transition by striking a balance between domestic production, potential mining in Europe and the development of “resource diplomacy”.

The resilience of value chains also depends on mastery of certain technologies. To strengthen regional energy security, innovation should be planned for the medium term and local resources better utilised.

Furthermore, it is essential to understand the systemic consequences of dependencies by linking lifestyles and geopolitical dynamics. Past energy choices have, for example, contributed to US military engagements in the Gulf. Taking an approach that combines history, engineering and social sciences promotes informed decision-making.



JEAN-CHRISTOPHE TARET

Director of Impact & Development at Veolia
Emeritus professor of ecology
at the University Paris-Saclay

Heating lies at the heart of the energy transition challenge in Europe: it accounts for 50% of energy consumption and relies on imported fossil fuels for 56% of its supply.

Connections to district heating networks and the conversion of power stations from coal to biomass, geothermal energy and gas have the potential to reduce emissions by 60% whilst limiting external energy dependence.

According to Veolia, Europe has a reserve of 400 GW of untapped local energy sources: recovery of waste heat (from industry, data centres, wastewater, etc.), organic waste and biomass, optimisation of urban heating and cooling networks, as well as energy efficiency in buildings and industry. Independent of international supply chains and shielded from market volatility, this local potential could reduce fossil fuel imports by 30% and provide strategic security. In France and elsewhere, energy-positive wastewater treatment plants and landfills transformed into energy hubs illustrate this trend, driven by strong local political will.

Energy competitiveness requires clear political will and stable regulations. The development of local resources must be prioritised, particularly for the recovery of waste heat from data centres. For geothermal energy, which has high potential but is held back by exploration risks, tailored mechanisms could mobilise more private capital. Speeding up authorisation procedures, which are still too lengthy in France, as well as regulatory stability is also key to securing investment. For the roll-out of district heating networks, existing funding schemes, such as the Fonds Chaleur, are effective.

Finally, artificial intelligence and machine learning are transforming network operations by enabling real-time optimisation based on demand, weather and market prices.

France has no major electricity security issues: it exported 90 TWh of electricity in 2025. However, it relies entirely on imports for fossil fuels, with the exception of local biogas (5%). The challenge, in the long term, is to reduce dependence on imported fossil fuels by developing local carbon-free sources, including district heating produced from waste and waste heat.

Political will and regulation are two complementary drivers of the energy transition. The former sets the medium- and long-term vision at both national and local levels: without the commitment of elected representatives, there can be no sustainable change. Regulation, for its part, ensures stability, market transparency and consumer protection once the rules of the game have been established.

In practical terms, electricity networks must be developed to support rising demand whilst prioritising flexibility to optimise investments. Conversely, gas, which is undergoing a transition towards sustainability, will see its consumption fall by 2050; the question then becomes one of the financing and tariffs for a network serving fewer customers. The success of these transitions depends on a strong political vision and a robust, predictable and fair regulator.

EMMANUELLE WARGON

Chairwoman of CRE (French Energy Regulation Commission)

The decoupling in France of electricity prices from gas prices is a major step forward for competitiveness. To capitalise on this, electrification must be accelerated. However, Europe lacks agility: administrative red tape, lengthy approval processes and legal disputes are holding back projects, due to a lack of a clear and shared political vision.

Energy security is now a European issue: it requires consensus on joint investments and an industry capable of producing the tools for the transition: solar panels, wind turbines, etc.

In many countries, intermittent electricity and baseload electricity operate together, but only up to a certain threshold. The stability of the system may be threatened if technical rules are unclear. And the balance between production and consumption must be promoted through public policies, incentives and a shared vision combining energy sovereignty with the fight against climate change.

AGNÈS PANNIER-RUNACHER

Renaissance MP for Pas-deCalais EJ Former cabinet minister (2018-2025)

Europe's 60% dependence on imported fossil fuels (mainly from Russia, the United States and the Middle East) poses a problem. The priority is to accelerate the transition to renewables, 80% of whose value is created locally. However, we must avoid creating new dependencies, particularly on critical raw materials, hence the need for diversification of supplies, recycling and refining within Europe.

The Climate 2040 Act provides a relevant framework: it sets a decarbonisation target whilst addressing the issue of the competitiveness of industrial supply chains. To remain credible and competitive, Europe must view the energy mix as an integrated system (generation, networks, storage) and fully embrace technology neutrality to control costs and strengthen cohesion. However, the excessive development of interconnections could drive up the cost of electricity in Europe, hence the need to rigorously assess the benefits in order to preserve energy competitiveness.

The surge in electricity prices in 2022, due to low levels of nuclear and hydroelectric generation in France, has shown that Europe is dependent on French generation. Securing the European system comes at a cost that must be recognised in market reforms.

France has unique assets to ensure the success of the energy transition: carbon-free electricity generation thanks to alternatives to fossil fuels. However, the transformation is progressing too slowly, even though "no-regrets" decisions could be taken regarding energy savings or market efficiency. Reducing administrative constraints on renewables and nuclear power is essential: political obstacles drive up costs and slow down projects.

In the market, two levers exist: increasing supply and managing demand. Nuclear generation has grown significantly, but consumption remains insufficient, to the point of making the system sub-optimal. Hence the need for a massive electrification plan.

The energy scenarios developed by RTE to inform public policy decisions show that it is possible to combine nuclear power and renewables if appropriate regulations are put in place. The aim is to support low-carbon, affordable projects capable of supplying electricity on demand, without favouring any specific technology (biomass, geothermal, waste, etc.). Storage and grid connection must also be considered, as these factors drive up costs. Price targets (of €50–70/MWh compared with nuclear power currently costing around €60/MWh) can be used to guide projects..

Moreover, Europe must go beyond research and development to master industrialisation and build green and competitive industrial chains - such as the "European Electric Battery Valley" in northern France - which aims for an integrated supply chain ranging from extraction to recycling. Despite high costs and a lack of industrial experience, the challenge is to make sustainable investments in the face of foreign competition, backed by public funding, as in China.

Another key challenge is the essential training of engineers and technicians, at a time when the industry is facing a skills shortage. Mining and industrial projects take years to complete and require specialist expertise, which is why educational institutions play a crucial role in this long-term strategy.

LUC RÉMONT

Honorary President of EDF

To help businesses remain competitive, it is not enough simply to produce reliable, affordable, low-carbon electricity; industrial processes must be optimised, energy and heat management adapted, and locally generated electricity utilised. This improves both performance and energy security.

When it comes to electricity, Europe is capable of meeting its future needs, provided it remains pragmatic and bases decisions on rational calculations. The main challenge is not so much to generate more electricity as to connect new consumers to the grid quickly, particularly for energy-intensive industrial sites and data centres. In this area, Europe risks falling behind as excessive delays are hampering economic development.

Installed electricity generation capacity provides a secure energy supply. The real risk lies in grid disruptions, which are rare in Europe but costly, particularly in the event of a blackout. To avoid these, controllable sources and inertia are required; hydroelectricity and nuclear power are the only carbon-free energy sources that offer these guarantees.

We must also respect the laws of economics. Increasing intermittent capacity in a system that is already in surplus – for example, adding solar power when prices are zero every other day – undermines the system's overall efficiency. Consequently, continuing to subsidise these additions with public money can no longer be rationally justified; investment should be a matter for private risk-taking.

Electrification does not cover all uses, particularly heating, which accounts for a significant proportion of energy consumption. Renewable thermal sources can enhance competitiveness.

Optimising an electricity system is complex, as demand remains uncertain, even though public policy can influence it. The integration of renewables is also a challenge, particularly when it comes to helping decision-makers assess the real impact of their choices on the system and on the total cost of electricity for users, which also includes taxes and network tariffs. Optimising the operation of networks and investment decisions is, moreover, a complex mathematical problem. The challenge for European policymakers therefore is to solve this equation to deliver energy that is cheap, low-carbon, available and resilient.

TAKEAWAYS

France must reduce its energy dependence on hydrocarbons (from 57% of current consumption to 42% by 2030).

Developing new dependencies on certain critical raw materials leads to a loss of technological sovereignty and jobs.

Heating accounts for 50% of energy consumption in Europe and is dependent on imported fossil fuels for 56%.

Europe has a reserve of 400 GW of untapped local energy sources (waste heat, organic waste and biomass, energy efficiency) which could reduce fossil fuel imports by 30%.

Energy policies must ensure that grid development keeps pace with changing demand in the interests of energy sovereignty and climate change mitigation.

Training of engineers and technicians is essential for industry, which faces a skills shortage, and requires a long-term strategy.

Business competitiveness depends on access to reliable, affordable and low-carbon energy.

The ability to connect energy-intensive customers to the grid is a major industrial and administrative challenge, as well as a factor in competitiveness.

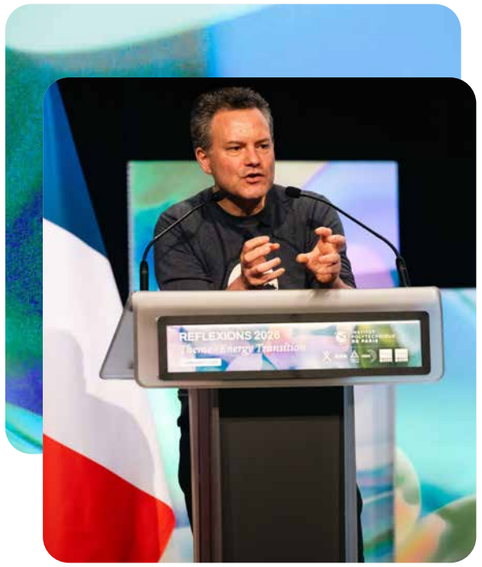
The integration of intermittent renewable energy sources is a scientific and technical challenge for grid operators requiring clear targets from policy makers.

SESSION 3

Energy justice

Energy justice broadens the debate beyond technological considerations by integrating fundamental social dimensions. It raises key questions of distributive justice (who benefits from energy systems and who bears their costs), procedural justice (how and by whom decisions are made), and recognition justice (which addresses past inequities particularly in the context of climate finance negotiations), inviting REFLEXIONS on how to design energy transitions that are sustainable, secure, fair and inclusive.

WATCH THE REPLAY OF THE SESSION



KEYNOTE

ELOI LAURENT

Senior Economist at Sciences Po

Energy justice addresses the social dimension of energy policies and centres on the concept of energy sufficiency, and more broadly, the economics of well-being. At the intersection of environmental justice and the just transition, energy justice is an academic field that informs public policy.

Environmental justice emerged in the 1980s in the United States, after various studies showed that minorities and poor populations were more exposed to environmental risks. In the 1990s, the concept of a just transition emerged around the idea of compensating workers affected by the decline of fossil fuel industries and providing social support for the energy and ecological transition.

Energy justice aims to ensure fair treatment for all social groups in matters relating to energy. Another definition sees it as a prerequisite, or even a measure of the success of the energy transition, going beyond mere compensation strategies.

Various dimensions of justice come into play in the development of policies that integrate social and ecological aspects, notably:

- Intergenerational justice, which comes into play, for example, if future generations are deprived of resources due to our current excessive consumption, such as that linked to AI.

- Earth system justice, which seeks to take into account the challenges posed by planetary boundaries.

- Multispecies justice, which aims to include non-humans in the circle of human decision-making.

Combining sustainability, efficiency and energy justice requires a “post-growth” vision of the economy, such as the wellbeing economy. This approach is largely based on the concept of energy sufficiency, which describes the contrasting situation where some consume too much and others too little, unlike the concept of energy frugality, which focuses on excessive energy consumption. It therefore reflects the idea that energy sufficiency is truly essential for energy justice, cooperation and health. Indeed, today in Europe, a significant proportion of the population lives in energy insecurity.

Energy justice

ROUND TABLE

Chaired by **Céline Guivarch**, *Climate Change Economy Professor at École nationale des ponts et chaussées (ENPC)-IP Paris*

Amy Dahan, *Emeritus Research Director at CNRS, Alexandre Koyré Center*

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CÉLINE GUIVARCH

economist, professor at the École nationale des ponts et chaussées (ENPC)

Energy justice comprises four dimensions: distributive (the distribution of costs, benefits and nuisances), procedural (citizen participation in decision-making processes), recognition-based (taking into account diverse values and viewpoints) and reparative (correcting past injustices). Climate justice draws on these principles to ensure that the fight against climate change involves a just transition.

However, the populations least responsible for climate change are those who suffer its effects the most, whilst historical responsibility lies with the richest and most powerful. Climate change thus exacerbates inequalities between countries and within societies. Inequalities in vulnerability mean that for the same level of exposure, the impact differs based on factors such as age, working conditions or social situation.

The energy transition is not merely a technical challenge. It is not a matter of devising an optimal solution and then “getting it accepted”, but of considering from the outset who stands to benefit and under what conditions.

This means giving citizens a voice and listening to what they have to say. A transition that reduces inequalities and energy poverty is possible, provided that public policies are designed to incorporate issues of eligibility, funding and equity between and within regions from the outset.

AMY DAHAN

Emeritus Research Director at the CNRS Albert Koyré Centre

The concept of climate justice has emerged over the course of the COPs as developing countries have taken ownership of climate issues. This growing awareness has been accompanied by a desire to hold historically industrialised countries morally responsible and to impose obligations on them to reduce emissions.

Between the Kyoto Protocol (1997) and the Paris Agreement (2015), developing countries gained influence. The most vulnerable, such as small island states, imposed the target of a maximum 1.5°C rise in temperature as a requirement of justice, beyond which certain territories would be threatened with extinction.

The Citizens’Climate Convention (2018–2020) revealed an unexpected dynamic: citizens selected randomly, with no particular prior interest, quickly embraced the climate cause after a few scientific presentations. They put forward proposals that were at times bold, with one constant concern: that climate policies should not exacerbate social inequalities. Every binding measure was immediately accompanied by proposals to protect the most vulnerable. Some strong ideas, such as a ban on car advertising, met with unanimous public support, before being dismissed by the political establishment. The Climate and Resilience Act retained a watered-down version of their work.

The work of Chancel, Piketty, Zucman and Stiglitz reveals a major climate divide: emissions from the wealthiest have risen sharply over the past twenty years, whilst those from the poorest half have stagnated or fallen. This divide now runs through countries themselves — not just between the Global North and South. The figures are striking: the 70 million richest people pollute more than the 3.5 billion poorest. Without a fundamental rebalancing of the global financial system, a just transition away from fossil fuels will remain impossible.

The principle of “common but differentiated responsibilities” (CBDR) was established as early as the 1992 Earth Summit in Rio. It recognises that all states share a responsibility towards the climate, a global common good, but that this responsibility varies according to their level of development and historical contribution to emissions.

The asymmetry in exposure to the effects of climate change, often linked to inequalities in development, raises the question of technology transfer and the funding needed to help the most vulnerable countries adapt to climate change. Added to this is the debate on “loss and damages” linked to the irreversible effects of climate change, such as the flooding of territories or desertification: should these losses be compensated, and does this imply an acknowledgement of responsibility?

Furthermore, climate justice also encompasses intergenerational justice, since current inaction will weigh heavily on future generations, as well as inequalities within countries in the face of the energy transition. Do these issues fall within the remit of national sovereignty, or should they be incorporated into international negotiations?

Since the Climate Convention, the main donors have remained the OECD countries of 1992 (Annex 2), even though the global economy has changed profoundly. Rich countries, which accounted for 70% of global GDP in 1990, now account for only 40%. China now emits more CO2 per capita than Europe, whilst still being classified as a “developing country” and a recipient of climate finance.

Furthermore, many countries consider it legitimate to exploit their resources, including fossil fuels, since industrialised nations developed in this way. But this claim conflicts with the objectives of mitigating global warming.

SYLVIE LEMMET

former French Ambassador for the Environment and President of Santé publique France

Europe, for its part, has achieved a remarkable decoupling: a 40% reduction in emissions alongside a 60% increase in GDP since 1990. It has funded the global technological transition, particularly in solar energy, which has led to a fall in costs that benefits all countries.

However, with the US withdrawal, it is shouldering the bulk of climate finance. By constantly being the “unrewarded model pupil”, Europe risks a shift in public opinion — “why should we pay for everyone?” A complete review of contributions, taking into account new economic realities, seems essential.

Similarly, when it comes to climate finance, a question of fairness arises: it is the major emerging economies (BRICS) that capture the lion’s share of funding, whilst the most vulnerable countries — particularly in Africa — struggle to access funds due to a lack of institutional capacity.

MARC PAPINUTTI

Chair of the National Commission for Public Debate, France

The issue of fairness runs through the debates on the energy transition in France, raising practical questions: who pays for the transition, who benefits from it, and how will the cost be shared across different social groups? These concerns were voiced during the Yellow Vests movement.

Regional inequalities also exist, particularly regarding the distribution of energy infrastructure (wind, nuclear, solar). Local debate is essential to enable citizens to take ownership of these issues, participate in decision-making and develop locally driven solutions for a truly fair and accepted transition. Particular attention must be paid to young people, who have integrated environmental constraints into their way of thinking and often propose solutions that are more ambitious than those of decision-makers.

Industrial decarbonisation is fostering the emergence of new industrial ecosystems. But this dynamic raises concrete regional tensions. The “Green Industry” Act provides for coordination between the State and local authorities through comprehensive regional consultation. The challenge now is to ensure that the same regions do not systematically bear the costs of the transition, to treat different situations differently, and to guarantee that this industrial future is truly shared.

Ultimately, it is a question of reconciling democracy and ecology.

ILARIA CASILLA

Executive Director of Foresight and Research at ADEME

ADEME's approach to energy justice is grounded first and foremost in the analysis and measurement of phenomena such as energy poverty. The challenge is to define reliable, harmonised and consistent indicators in order to design public policies that protect the climate without worsening inequalities or penalising already vulnerable populations. This is an essential condition for building a genuinely just energy transition.

Several research programmes illustrate this approach. The Just COP (Conference of the parties) project examines energy justice through a legal and governance lens: who decides, who pays, and how decisions can be debated collectively. Real COP analyses energy justice within local self-consumption collectives, particularly in disadvantaged urban neighbourhoods, by observing decision-making processes and their social effects. COPED (Cooperative Program on Energy and Development), finally, takes a European perspective by looking at the territorial distribution of energy infrastructure: rural areas often host renewable energy installations while cities concentrate consumption and economic value.

ADEME also hosts the National Observatory on Energy Poverty. Three major challenges arise: the absence of a fully integrated definition of energy poverty, the difficulty of measuring it, and significant territorial inequalities. The current definition refers to difficulties in accessing energy in the home. But it remains limited: it does not specify essential needs, overlooks the issue of heatwaves, and neglects the dimension of mobility. Measurement currently relies on several indicators, such as "energy burden" (where more than 8% of income is spent on energy for low-income households) or the subjective experience of feeling cold in winter. However, these indicators remain partial and heterogeneous. The aim is therefore to harmonise them in order to better understand real-life situations and guide the development of appropriate public policies. Measuring energy poverty accurately thus emerges as an essential condition for building a genuinely just energy transition.

In the first place, climate justice requires that policies do not worsen existing inequalities. This calls for structural measures — providing lasting support for energy renovation— rather than one-off schemes such as the energy price shield. The second dimension is that of governance. Environmental democracy, enshrined in the Aarhus Convention and the French Environmental Code, rests on a simple principle: a collectively made decision is a better decision for the environment and for future generations. To believe that genuine climate justice can be achieved without rebuilding our decision-making processes would be an illusion.

TAKEAWAYS

The richest 1% of the world's population are responsible for more than twice as much carbon pollution as the 3.1 billion people who made up the poorest half of humanity (source Oxfam)**.**

The 70 million wealthiest people pollute more than the 3.5 billion poorest.

The populations least responsible for climate change are those who suffer its effects the most.

Climate justice aims to ensure that the fight against climate change proceeds through a just transition.

The energy transition is not merely a technical challenge. Its success requires thinking from the outset about who benefits from it and under what conditions.

A just transition is possible, provided that public policies integrate questions of eligibility, financing and equity between territories.

Genuine climate justice demands that we rebuild our decision-making processes.

Coordination between the State and local authorities, as well as among all stakeholders within a given territory, is essential to achieving a just transition.

TESTIMONIALS

FROM IDEAS TO IMPACT

AURÉLIE PICART

General Delegate of the New Energy Systems Industry Council

French industry reduced its emissions by 46% between 1990 and 2019. But going further is difficult: 85% of industrial emissions remain concentrated in five sectors (chemicals, cement, steel, etc.) where processes require very high temperatures and generate emissions that are structurally hard to eliminate. Solutions exist — hydrogen, biomass, electrification — but remain costly.

Three arguments make the case for action. First, the cost of inaction: difficult to quantify, but real. Second, decarbonising the highest-emitting sectors requires public support — €5 billion has been mobilised in France for the 50 most polluting sites. It also requires stable rules over a 30-year horizon and protections against relocation, through mechanisms such as the European carbon border adjustment.

Finally, the good news: energy efficiency and sobriety are immediate competitive levers, with gains of 10 to 20% achievable quickly, particularly in industrial heating.

Flexibility is also becoming a major lever: during off-peak hours, electricity can carry a negative price — adapting to these fluctuations significantly reduces costs. Meanwhile, equipment prices have plummeted — divided by ten over the past decade for batteries and solar panels. Europe, which structured demand but allowed China to industrialise production, is thus forgoing the benefits of this transformation.

The electric vehicle crystallises Europe's challenges. Transport is the leading emitting sector, and the automotive industry is strategically central: losing it would bring down entire swathes of industry with it — chemicals, steel, SMEs, aerospace, defence. Awareness is growing: it is not enough to want the transition; it must be produced on home soil. Energy transition and industrial policy must now advance hand in hand.

The energy transition urgently needs the hardest-to-decarbonise sectors, precisely to produce the required infrastructure. To continue deindustrialising Europe is to deprive ourselves of the means to build the new energy system. We must set realistic objectives and meet them, choose the segments of the value chain where we can excel, reduce critical dependencies, and draw on scientific and technical expertise.

EUGENIA GUSILOV

Director of the Romania Energy Center (ROEC)

ROEC (Romania Energy Center) is an independent think tank founded in 2010, bringing together academics, policymakers, businesses and civil society to shed light on how energy markets function and to support the energy transition in Romania. We contribute to energy transition regulation in Romania and help the government develop its policies. We also work with the private sector to help companies navigate the many regulatory frameworks and access financing.

Romania's evolving energy landscape has been shaped by contradictory developments. Under pressure from Brussels, Romania has closed 5 GW of coal capacity since 2020, while the war in Ukraine slowed the replacement of these plants. The transition is therefore imposed, not chosen.

Individuals have responded by developing solar energy production capacity, which grew from 400 MW at the start of 2023 to over 3,000 MW by 2025 — twice the planned output of two nuclear reactors that have been on the drawing board for 19 years.

Romania is still a developing country, and a country of contrasts. On the one hand, we aspire to be the first country in Europe to build and commission SMRs (small modular reactors). On the other, more than 40% of the population, mainly in rural areas, still relies on wood for heating. Above all, Romania is suffering from an urban heating crisis stemming from 30 years of neglect: of 350 cities once connected to district heating networks, only 40 remain. In Bucharest, the network — which loses up to 38% of the energy it carries — is too degraded to repair, even with €250 million in European funding.

In January 2026, 3,500 buildings in the capital were left without heating or hot water. No bombardments, but conditions close to those Ukraine endures under strikes. Residents are making do with electric heaters or reversible air conditioning units, with little visible sign of the crisis from the outside.

Romania maintained an energy price shield well beyond the 2022 crisis, unlike other European countries. The return to the free market in July 2025 immediately doubled electricity bills. On gas, price regulation — initially planned until April 2026 — is expected to be extended to 2027, the date when offshore gas production in the Black Sea is due to begin, out of fear of another price surge. Ensuring security of supply or infrastructure is not enough. Prices must also be affordable, and consumers must have the means to pay for their energy. For if energy exists but is unaffordable, who does it serve?

CHIHEB BOUDEN

Professor at the National School of Engineers of Tunis

Tunisia aims for 35% renewable electricity by 2030, driven primarily by the private sector. However, the programme, launched in 2008, has fallen behind schedule. The main obstacle is the electricity grid, which was designed to carry energy from coastal power plants in the east to the west. It is not suited to transmitting electricity generated in the desert south — where solar and wind potential is greatest — northward to where demand is concentrated.

Tunisia, once a hydrocarbon exporter, now meets only 40% of its energy needs domestically. Its electricity production depends heavily on Algerian gas delivered through a single pipeline. This creates a major strategic vulnerability. Reducing this dependency is one of the central motivations behind its energy transition.

Energy subsidies account for 8% of the Tunisian budget — a legacy of the 1980s, originally designed to encourage households to move away from wood and towards LPG (Liquid petroleum gas). They represent a significant financial burden and constrain investment in renewables, yet removing them would be socially unacceptable.

A new approach is being considered: the distribution of free solar panels to low-income households would cost less than maintaining gas subsidies, while also meeting the energy justice demands voiced by part of Tunisian society.

While 98% of Tunisians have access to electricity, western regions suffer from failing infrastructure. The solar transition offers an opportunity to rebalance this distribution — but faces local resistance: communities do not perceive any tangible benefit from renewable installations on their territory.

The challenge is to shift the narrative: the energy transition is not merely a technical matter, but a lever for local development — jobs, infrastructure, reduction of regional inequalities. The task is to communicate this effectively and make it a tangible reality for the communities concerned.

Tunisia's transition suffers from a communication deficit: citizens are unaware of the objectives and benefits of the energy strategy. Strengthened dialogue with local populations is essential.

Despite all this, there are grounds for optimism: investments in public services and new power plants are coming online. The 35% renewables target for 2030 is likely be missed, but reaching 20% would already represent significant progress.

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CONFERENCE 2026
HIGHLIGHTS VIDEO

CONCLUSION

ACCELERATING CLIMATE ACTION: THE AGENDA FOR COP 28

Whilst the scientific basis for the energy transition is indisputable and its technological framework is broadly understood, the main challenges lie elsewhere: in our ability to ensure that this transition is sustainable, safe and just.

Sustainable, first and foremost, because decarbonisation must not simply shift the burden of impacts elsewhere. The large-scale deployment of renewable energies is essential for the success of the energy transition. It must be accompanied by a systemic assessment of its environmental and social effects, even though the impacts of these energies are incomparable to the profound disruptions that climate change is already imposing on ecosystems.

Secondly, safe, because replacing one dependency with another has harmful economic and social consequences. The energy transition relies on critical raw materials — rare metals, specific components — which create new vulnerabilities. Reducing this exposure requires resolute investment in the circular economy, particularly in the recycling of equipment such as photovoltaic modules. This is both an ecological imperative and a major industrial opportunity, particularly for Europe, where sovereignty and sustainability must now go hand in hand.

And finally, it needs to be just, because the current imbalances are unsustainable. The populations least responsible for greenhouse gas emissions are also the most exposed.

Rectifying this imbalance requires mechanisms of solidarity, but also a new approach to governance. The success of the transition depends on close coordination between states, local authorities, economic actors and citizens, at all levels – from local to international.

The energy transition is not merely a matter of technological choices. It depends on our collective ability to balance performance, resilience and equity. Only then can it deliver on its promises: not only to reduce emissions, but also to sustainably reshape our development models.

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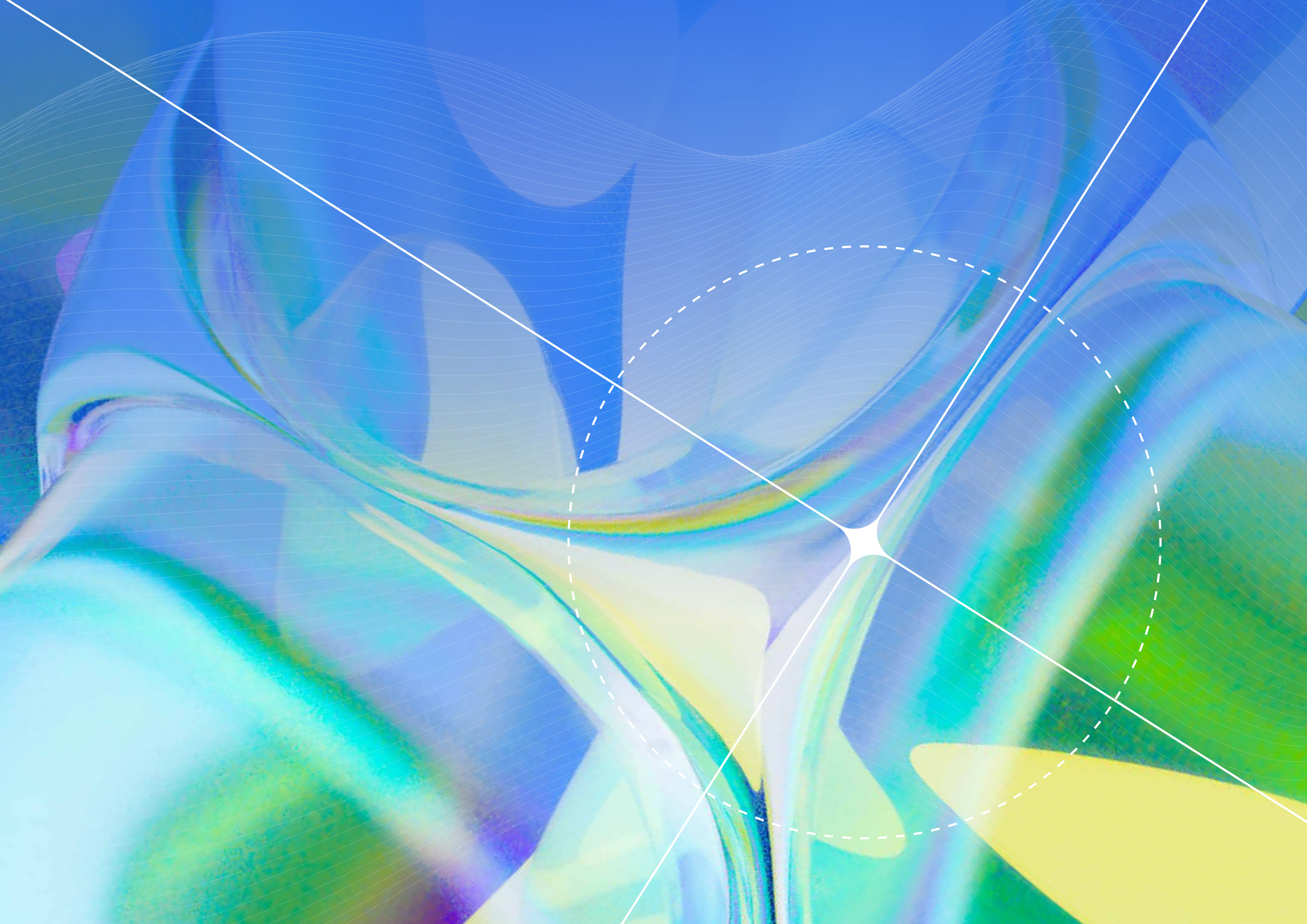

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