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VENICE MANIFESTO

5TH EDITION

BEYOND COP



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Università Ca'Foscari Venezia

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Abstract

Climate change is the most demanding test of our capacity to trust the future. After thirty years of COPs, global emissions have not fallen, fossil fuels still supply about 80% of the world's energy, and Europe has just lived through its hottest summer on record. The backlash of the last couple of years has not made the problem go away. It has exposed how inadequate our tools are: institutions built for another century that cannot reconcile very different interests, and a shrinking stock of trust, in each other and in the future itself, which is what collective action runs on. The costs of acting are certain and immediate, while the benefits are uncertain and distant. The challenge, then, is to find ways to start with those who are willing and to bring the others along.

This is, in a nutshell, the message of the manifesto of the fifth edition of the **Venice Conference on Global Governance of Climate Change and Sustainability,** held on **San Servolo Island** from **15 to 17 October 2026**, a few weeks before COP31 in Antalya.

The manifesto includes:

- The **main findings of the six problem setting/solving groups**, led by students and tutors from Bocconi, Politecnico di Milano, Iuav, the EUI School of Transnational Governance, LUISS and SDA Bocconi. Their topics are "the mobility of the future: the Tiber as Rome's green transport corridor"; "rebuilding Venice"; "beyond differentiation: the future of waste"; "reforming COP"; "managing geoengineering"; and "developing renewables in Africa".
- The **outcomes of the plenary sessions** on mobility, loss and damage, insurance, cloud and AI, small modular reactors, agrifood, and a new Green Deal for a post-2.5 degrees Europe.
- A synthesis, **"From Venice to Antalya"**, setting out what we ask and of whom. It is addressed to the COP31 presidency and the Parties, the European Union, cities and regions, companies, lenders and development banks, and the research community.



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INTRODUCTION: THE CONCEPT OF THE CONFERENCE

How can we turn the worst crisis into our greatest opportunity?

This paper is our stocktaking of where the battle against climate change stands today. It has six parts. The problem has not gone away, whatever the political backlash suggests. The multilateral system created to solve it has not delivered. It has not delivered because its institutions no longer fit the twenty-first century and cannot reconcile very different interests. But institutions are only half of the story: climate action also depends on how much people trust each other and trust the future. The Conference is built around these three failings.

The backlash has not made the problem go away

In the last couple of years, the climate agenda has gone through its most challenging phase since 1995, when the first Conference of the Parties (COP) made it arguably the most interesting and pressing case of global governance. The final agreement at the last COP in Belém, thirty years after the first in Berlin, failed even to mention the necessity of a formal roadmap to phase out fossil fuels. The delegation of the most powerful country in the world, and the one that has historically contributed most to climate change, was not there, although there were plenty of individuals and organizations coming from the US. This should paradoxically have made negotiations easier[1], and yet the usual political deadlock followed. Vision's delegates did not see the pavilions of some of the largest multinationals, especially in tech and management consulting, that had played a role at earlier COPs and saw far fewer global media networks.

And yet the problem has not gone away. If anything, it is closer than ever. Climate change is no longer something that happens elsewhere: almost every country in the world now experiences its direct consequences. Europe is the clearest example: it is the fastest-warming continent on Earth, warming at roughly twice the global average since the 1980s[2]. Figure 1 shows that the temperature in Europe (five-year average) is now more than 2°C above the 1850–1900 level. This summer made it concrete. Italy lived through its hottest summer since records began. According to the National Research Council (CNR), the average temperature was 24.3 °C, which is 0.7 °C above the previous record set in 2003 (23.6 °C)[3]. EuroMOMO, the European mortality monitoring system, recorded more than 36,000 more deaths than expected, from all causes, across Europe over the summer, with the sharpest rise in the week of the late-June heat wave[4]; and the summer of 2022 had been estimated to cause 61,672 heat-related deaths

in Europe[5]. Climate change today is people dying of heat in European summers.

[1]Francesco Grillo, Trump calls climate science a 'con job'. That could make tackling the crisis a whole lot easier, 2025, The Guardian https://www.theguardian.com/commentisfree/2025/oct/13/donald-trump-withdrawal-paris-agreement-tackling-climate-crisis-easier

[2]Copernicus Climate Change Service (C3S) and World Meteorological Organization (WMO), European State of the Climate 2025, 'Why is Europe warming so quickly?', 2026, https://climate.copernicus.eu/esotc/2025/why-europe-warming-so-quickly

[3]The Local Italy (reporting the National Research Council, CNR), "Italy heads for hottest year on record after scorching summer", 8 September 2026, https://www.thelocal.it/20260908/italy-heads-for-hottest-year-on-record-after-scorching-summer

[4]RTÉ, 'Europe's hidden heat toll: what excess mortality tells us about the summer of 2026' (citing EuroMOMO data), 25 September 2026, https://www.rte.ie/news/a-european-perspective/2026/0925/1592920-climate-change-summer-2026/

[5]Joan Ballester et al., 'Heat-related mortality in Europe during the summer of 2022', Nature Medicine, 2023, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10353926/

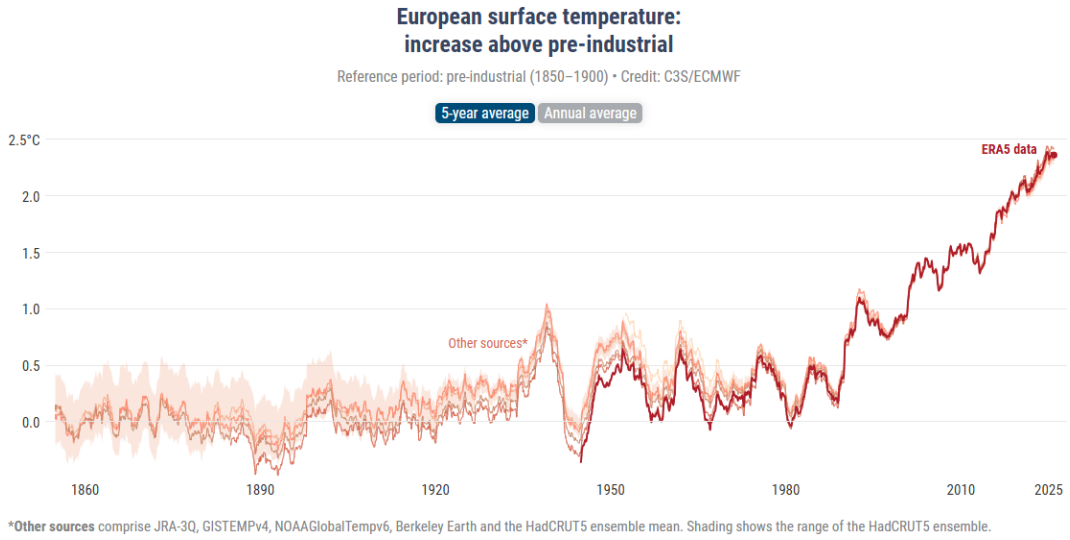


Figure 1. Europe is warming much faster than the world.

Source: ERA5 (C3S/ECMWF), JRA-3Q (JMA), GISTEMPv4 (NASA), HadCRUT5 (Met Office Hadley Centre), NOAAGlobalTempv6 (NOAA) and Berkeley Earth. Credit: C3S/ECMWF.

The evidence is reaching everybody. Rising global temperatures do not just affect our day-to-day lives through heat and extreme weather events, but also what we eat. The heat and drought of the same summer hit European agriculture: according to the Joint Research Centre of the European Commission, September forecasts put EU yields below the 2021–2025 average by 15% for soybeans, 14% for green maize, 11% for sugar beet, 8% for grain maize and 7% for potatoes (Figure 2). In the hardest-hit areas crops were so damaged that harvesting was no longer economically viable and fields were abandoned[6].

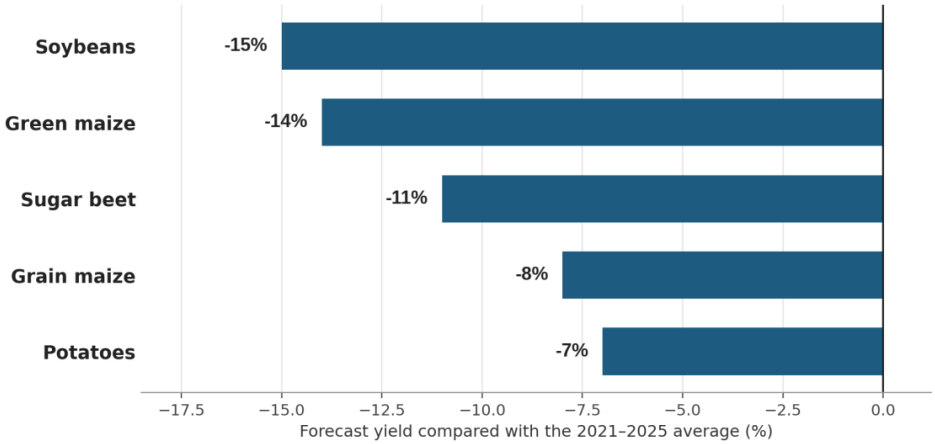


Figure 2. EU yield forecasts, September 2026, compared with the 2021–2025 average (%).

Source: Joint Research Centre of the European Commission, JRC MARS forecasts (28 September 2026).

There is also a reason to fear that change will not be linear. Climate scientists speak of tipping points, thresholds beyond which change becomes self-reinforcing and continues even without further human action. The Amazon is an example: rising temperatures mean more droughts, which feed more (often human-made) fires, and with fewer trees there is less rain, hence more droughts. Figure 3 maps sixteen such tipping points and the warming levels at which they could be triggered[7]. Some of them, including the collapse of the West Antarctic ice sheet, may be dangerously close.

[6]European Commission, Joint Research Centre, 'European agriculture hit hard by exceptionally hot and dry summer', 28 September 2026, https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/european-agriculture-hit-hard-exceptionally-hot-and-dry-summer-2026-09-28_en

[7]David I. Armstrong McKay et al., Exceeding 1.5°C global warming could trigger multiple climate tipping points. Science 377, eabn7950 (2022). DOI: 10.1126/science.abn7950

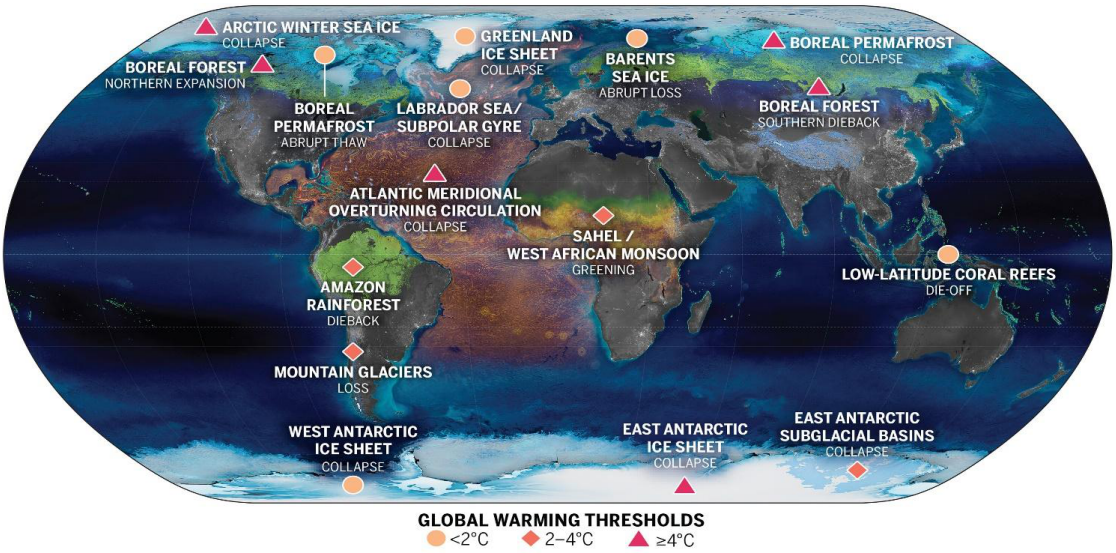


Figure 3. Sixteen climate tipping points and the global warming thresholds at which they could be triggered.

Source: David I. Armstrong McKay et al., Exceeding 1.5°C global warming could trigger multiple climate tipping points, Science (2022).

Nor can we deny that human beings are responsible. The climate of the Earth has always changed, and it has been much warmer than today: by as much as 18°C, as Figure 4 shows[8].

But in its hottest phases the Earth had no polar ice caps and the oceans stood where today we have Shanghai and New York: much of the land on which those cities are built was under water. Life as we know it today will no longer be possible in a warmer world. What is unprecedented is the speed. Past changes unfolded over thousands to millions of years, while the warming of the last 150 years has followed our own emissions of CO_2, and the Intergovernmental Panel on Climate Change has found it unequivocal that human influence has warmed the atmosphere, the ocean and the land[9].

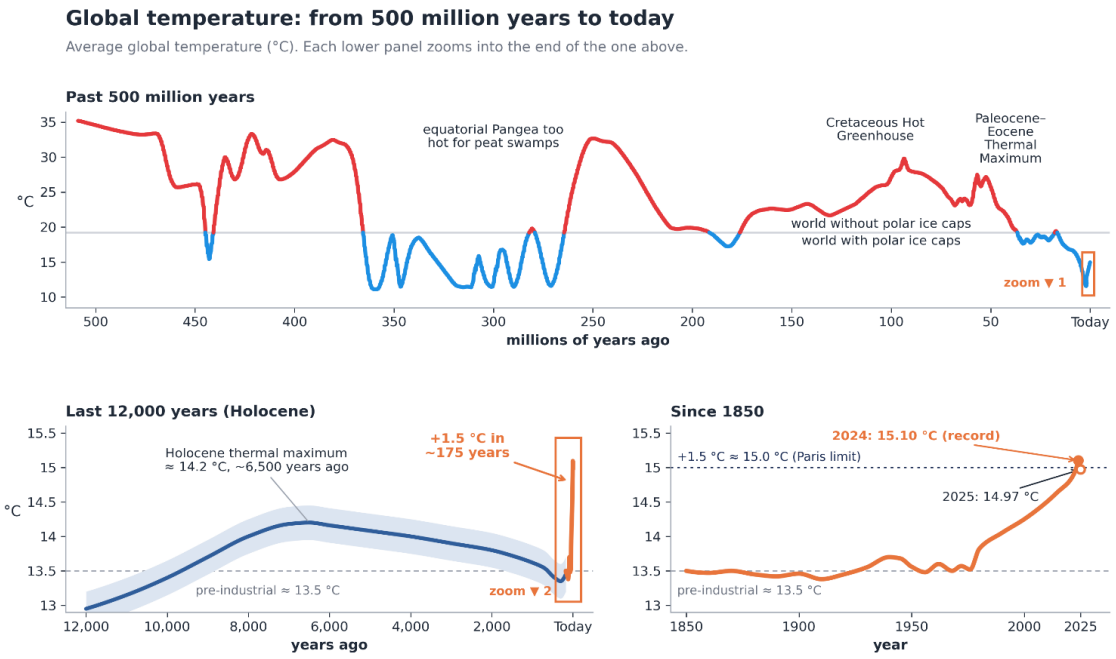


Figure 4. Estimated global temperature over the last 500 million years (°C).

Source: Vision on Emily J. Judd et al. (2024), 'A 485-million-year history of Earth's surface temperature', Science; adapted from the Smithsonian Institution.

[8]Emily J. Judd et al., 'A 485-million-year history of Earth's surface temperature', Science, 2024.

[9]IPCC, Climate Change 2021: The Physical Science Basis, Working Group I contribution to the Sixth Assessment Report, Summary for Policymakers, https://www.ipcc.ch/report/ar6/wg1/

The critics of multilateralism have a point

If the problem is still here, it is partly because the critics of multilateralism are right about one thing: it has not delivered. Since the first COP, global emissions of CO_2 have not fallen. They keep reaching new records, and Figure 5 shows how far they remain from a path consistent with the Paris Agreement: on current trends, emissions in 2030 would be almost twice as high as that path allows[10].

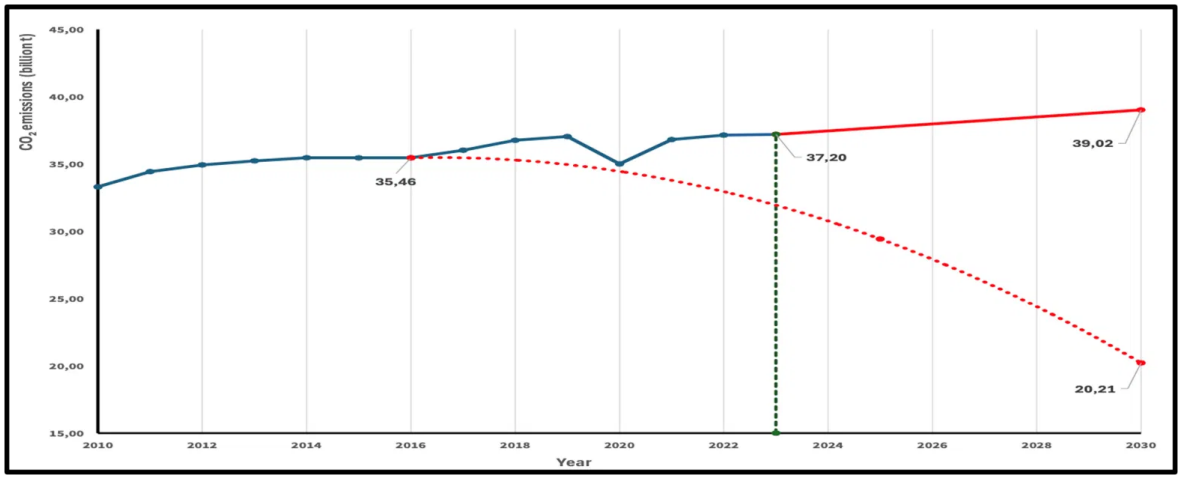


Figure 5. Emissions are still rising while the Paris path requires them to fall: world CO_2 emissions (billion tonnes).
Source: Vision on University of Oxford and IEA data.

Nor has the energy system changed enough: Figure 6 shows that the share of fossil fuels in the world's primary energy consumption has fallen only marginally, from 85.5% in 2000 to 80.0% in 2025. After thirty years of conferences, we are failing the Paris Agreement on both counts: the input, the emissions that cause warming, and the output, the temperatures we are already recording (Figure 1).

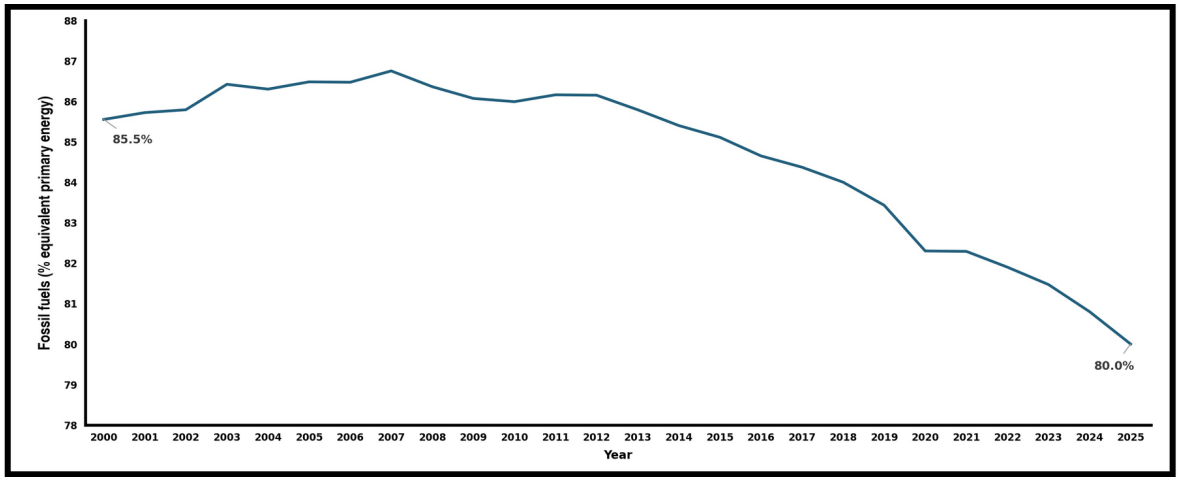


Figure 6. After thirty years of COPs, fossil fuels still supply 80% of the world's energy: share of primary energy consumption from fossil fuels (%).
Source: Vision on University of Oxford data.

[10] International Energy Agency (IEA), Global Energy-Related CO_2 Emissions Report.

Institutions from another century, different interests

Multilateralism is failing because its institutions do not fit the twenty-first century and cannot handle different interests. The COP gives visibility to climate change, creates a sense of urgency for policymakers and works well for networking. But its results are never binding enough, the syndrome of the lowest common denominator; its cost and footprint risk delegitimizing the climate agenda; and its link to local populations is weak. A recent review found that around three-quarters of the decisions of the COP and of the bodies that serve it are procedural[11].

The interests are, indeed, very different. Countries are affected by climate change in very different ways and contribute to it in very different ways (Figure 7). Countries with very low emissions per head, such as Pakistan and Bangladesh, are projected to see the highest increases in temperature-related deaths, while Russia and Canada, among the highest emitters per head, are projected to see net falls, as fewer deaths from cold outweigh additional deaths from heat. Climate change may even have its beneficiaries. It is hard to build a consensus between those who pay and those who suffer, and those who may even gain.

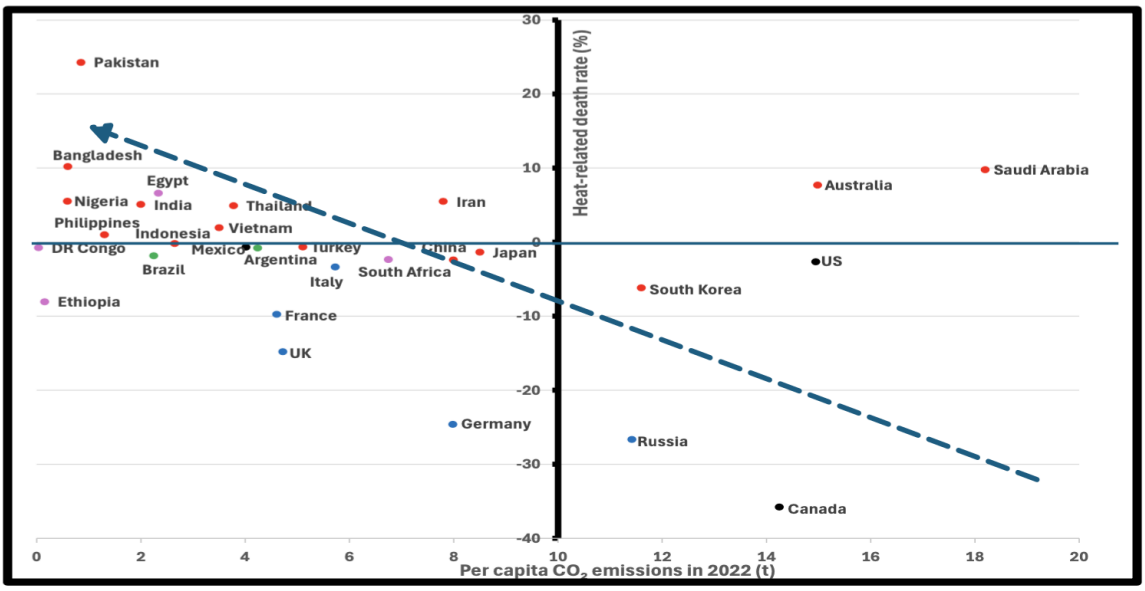


Figure 7. Those who contribute least suffer most: CO_2 emissions per capita (horizontal axis, 2022) and net change in temperature-related deaths, heat and cold combined (vertical axis, 2030), by country (G20 and top 20 by population).

Source: Vision on University of Oxford data.

To this we must add the global economic structure. In global markets countries and companies compete, and those that avoid the burden of becoming sustainable gain an advantage over those that carry it, at least in the short term. Everyone has an incentive to let others do the work, and a system based on consensus among all is the one in which free riders have the most room. China, with its heavy investment in solar power and batteries, may be starting to challenge this logic. For the time being, however, we face a global economic structure that creates climate change and an institutional structure that is not fit to address it.

[11] A. López Carbajal et al., Reforming the UN climate governance system for an implementation context, Transforma, policy brief, 2nd edition, May 2026.

The numbers show how far the institutions are from reality. The COP has 198 Parties, but three of them, the United States, China and India, account for 53% of world CO_2 emissions, 42% of world GDP (in purchasing power parity) and 39% of the world's population; and for 82% of the investments in AI of the last ten years, a proxy for where the capacity to innovate lies. Three Parties are more than half of the problem and more than half of the solution (Figure 8).

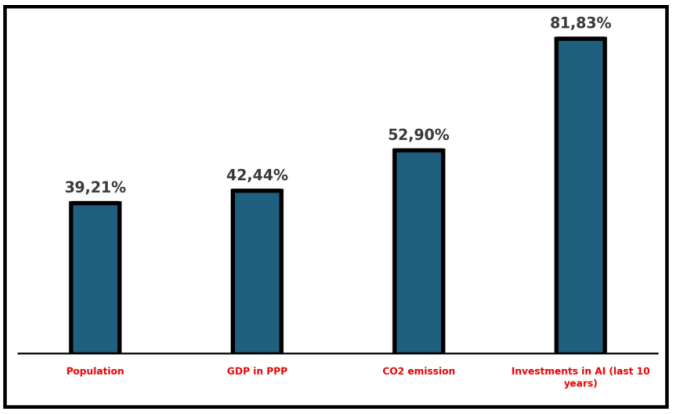


Figure 8. Three of 198 Parties account for more than half of the problem and of the solution: share of the United States, China and India in world totals (%, 2023).
Source: Vision on World Bank, IEA and Stanford University data.

Hence, we need a reform. Vision will put three ideas to the Conference[12]. First, to streamline the map of the financial facilities so that countries receiving help with mitigation or energy transition can more easily gain access to resources for adaptation, loss and damage, and research or vice versa. Standardized application procedures and sharing data between funds would enable countries to enter the system through one door and through it access the other funds if they are eligible. Second, to make decision-making both more inclusive and more efficient, moving gradually from a sub-optimal 198 Parties to about ten regional clusters of states plus non-state parties: roughly 70% of the weight for regional representation, with votes by population and qualified majorities, and roughly 30% for cities, young citizens' assemblies and farmers. Third, a new COP model: semi-permanent hubs, one per continent, that share knowledge and generate communities, separated from policymaking, with footprint and accessibility as criteria. The pathway is incremental: incentives (voting by population and qualified majority), experiments on selected policies that combine high relevance and low complexity, and leadership by example, starting from the EU.

It is not only about institutions: trust

Institutions are only part of the problem. It is also about how people expect others to behave. Climate action is a collective action problem: it works only if enough people believe that others will do their part. And that depends on trust, in two forms: trust in each other and trust in the future.

Trust in each other is where we are weakest. Figure 9 compares the share of people who say they would give 1% of their income to fight climate change with their perception of the share of their fellow citizens who would do the same. In every country in the sample the second is lower than the first: people systematically underestimate the willingness of others. In China about 80% say they would pay, but they think only a little more than half of their compatriots would; in the United States about half say they would, and they believe that only a third of others would; in Japan about half, against a perceived

[12]Vision, A reform of COP: three ideas to kickstart the debate, https://www.thinktank.vision/en/media-en/publications/a-reform-of-cop-three-ideas-to-kickstart-the-debate

quarter. When each person believes that others will not act, nobody wants to be the only one who does, and failing political action confirms the belief. This is the real story behind what is called 'climate fatigue'[13]: people are less tired than they think others are.

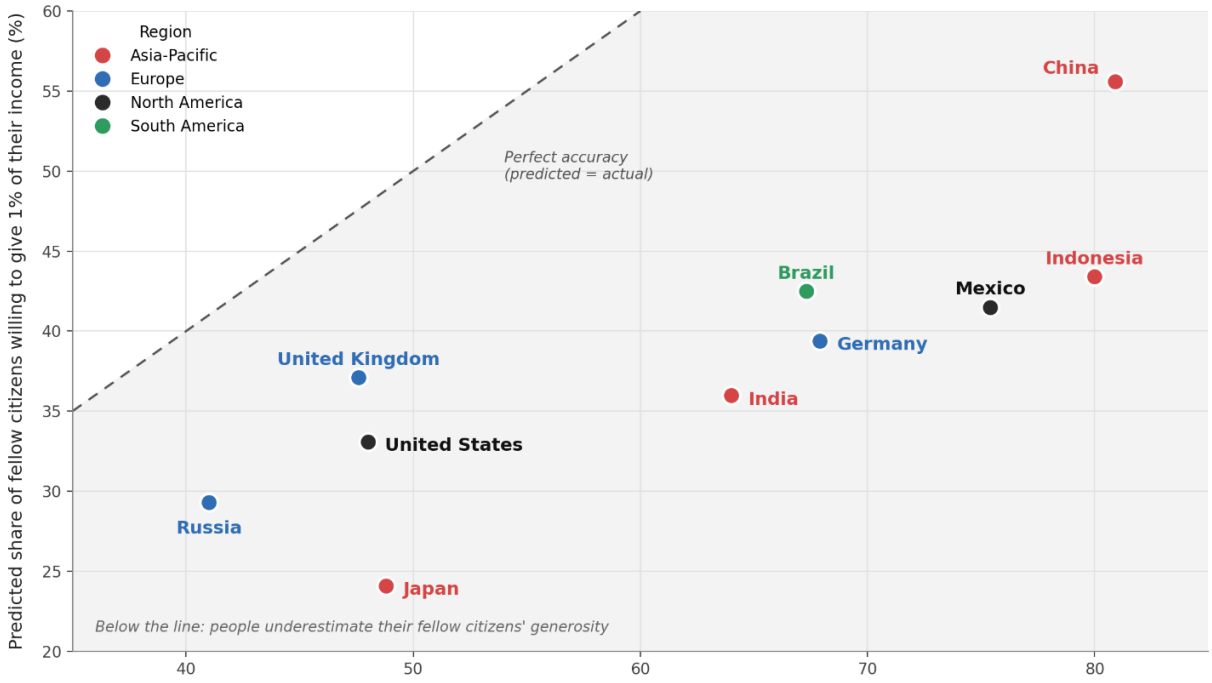


Figure 9. Share willing to give 1% of their income to fight climate change and their perception of the share of fellow citizens who would do the same in %, 2024. The dotted line marks equal perception.

Source: Vision on University of Oxford data.

If the deficit is one of trust, part of the answer lies in places where trust can be built. Trust grows from repeated work on shared, concrete problems, not from declarations. Companies, universities and policymakers rarely meet on equal terms: they usually speak to each other through lobbying, consultations or published papers. Places that bring them into the same room, to define a problem together and test solutions, are themselves a piece of climate infrastructure. This is what the semi-permanent hubs proposed in Section 3 are meant to be, and what this Conference has tried to be since its first edition.

We undervalue the future

Trust in the future is the other half. To act for a better future, one must believe that it is possible and account for it in decision making. Markets, prices and politics are bad at the second. Economists call it discounting: a cost that will be paid in thirty years, or by somebody else, weighs very little in a decision taken today. Some discounting is rational, but climate change pushes its costs so far into the future, and so far from those who cause them, that the future ends up discounted almost to nothing.

Firms do this when they leave environmental damage and climate risk out of their business plans. A recent Vision paper[14] found another case in housing rents. In Milan, rents rose from €14.5 to €22.6 per square metre between 2012 and 2024, while the number of non-tropical nights, those cool enough to allow proper rest, fell from 303 to 281 a year (Figure 10). Since many apartments are not equipped for

[13]Francesco Grillo, Climate fatigue isn't a sign that Europeans are in denial – it's a sign of their fear, 2023, in The Guardian, https://www.theguardian.com/commentisfree/2023/nov/08/climate-fatigue-europe-voters-green-costs

[14]Vision, Un Piano per la Casa, 2026, https://www.thinktank.vision/images/A_Plan_for_Housing_ITA_070626_FIN.pdf

the heat, tenants are paying more, year after year, for homes that offer fewer nights of decent rest. The market has not yet priced in a future that is already arriving.

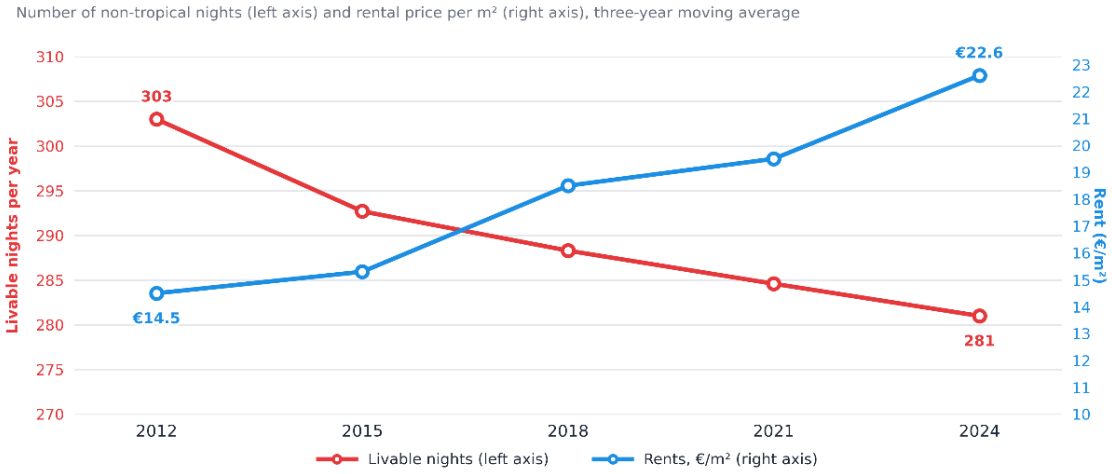


Figure 10. Non tropical nights and rents in Milan, three-year moving average.

Source: Vision on ISTAT and Immobiliare.it data.

Climate change is not the only problem of this kind. Pensions, public debt, the loss of biodiversity and the governance of artificial intelligence all ask us to weigh the interests of people who are not yet born, or who live elsewhere. Vision works on many of them, as its conferences on the Europe of the Future in Siena and on Skills for the AI World in Dubai show. But climate change is the problem that makes this blind spot visible, because it connects generations and regions, we usually treat as separate, and because its consequences are now close enough to touch. Food is where this is most immediate. Italy grows about half of the EU's rice, and the 2022 drought in the Po Valley cost it 26,000 hectares of paddy fields and more than 30% of its production[15]. The area suitable for growing Arabica coffee could roughly halve by 2050[16]. Above 2°C of warming, around 90% of the traditional wine regions in the coastal and lowland areas of Spain, Italy and Greece could no longer produce quality wine by the end of the century[17]. Rice, coffee and wine are everyday staples, not distant abstractions. Climate change turns intergenerational and interregional problems into something people can see, and that may be its most useful lesson: it teaches us how to account for the future.

Seeing the future is not enough: one also must believe that a better one is possible. And there are reasons to believe in it. The technologies needed to phase out fossil fuels are advancing faster than politics: one of the most visionary managers told the Vision team while drafting this paper that "for the renewables to more quickly replace fossil, governments should be asked to do … nothing. The cost of solar and wind is already well below fossil". Doing nothing has a price of its own, however: it leaves open the question of who captures the value of the transition. Europe once led the world in solar panels; today China does.

So, we face a global economic structure that creates climate change, an institutional structure that is not fit to modify it, and a deficit of trust, in each other and in the future, that makes any cooperation harder.

[15]Ente Nazionale Risi data, reported in O. Spaggiari, 'Le risaie della valle del Po a rischio per la siccità', Internazionale, 28 March 2024, https://www.internazionale.it/magazine/ottavia-spaggiari/2024/03/28/le-risaie-della-valle-del-po-a-rischio-per-la-siccita

[16]C. Bunn et al., 'A bitter cup: climate change profile of global production of Arabica and Robusta coffee', Climatic Change, 129, 89–101 (2015).

[17]C. van Leeuwen et al., 'Climate change impacts and adaptations of wine production', Nature Reviews Earth & Environment (2024), https://doi.org/10.1038/s43017-024-00521-5

How the conference responds

The Conference tries to respond to the three problems we have described: the inadequacy of the institutions vis-à-vis the challenges posed by climate change; the lack of trust in each other that is necessary to overcome collective action problems; and the lack of trust in the future. It takes place on the island of San Servolo, in the Venice lagoon, on 15 and 16 October, and at Palazzo Badoer, Iuav University, on 17 October.

Institutions that fit the century. Since its first edition the Conference has tried to put forward ideas to make climate governance work. This year, a problem-setting and solving group on Reforming COP, prepared with the European University Institute, develops a practical framework for reforming the COP process: connecting negotiation design with enforcement, inclusivity and tangible climate outcomes. It builds on the Climate Negotiation Workshops that Vision has been running with the EUI, which aim to produce a blueprint for reforming COP itself, a blueprint that may be useful to COP31 in Antalya. Antalya may and should be the first COP to be brave enough to pose the question of how to reform itself. The six problem-setting and solving groups (PSSGs) are an institutional experiment in themselves, in which PhD candidates, students and tutors from leading universities work with companies on concrete problems; their outputs feed the Venice Manifesto, presented in draft on Saturday and to be discussed with international (COP) and European institutions.

Trust in each other. Trust is built by working together on specific problems. Most sessions are co-organized by Vision with a company that has decided to use sustainability as a strategic lever, from agrifood, digital/AI and insurance to mobility, renewables, nuclear, waste management, real estate and advanced materials. The Conference brings business and academia, institutions and local communities, citizens and media into the same room, with participants from China, India, South America, the Middle East, Africa, Canada, the UK and the USA, and asks the EU to become a strong contributor to the negotiations among the macro-regions of the world and among the main stakeholders, not only to reduce its own emissions. It is a place where people can discover that others are more willing to act than they thought, and a working prototype of the kind of hub that a reformed COP would need.

Trust in the future. Trust in the future needs proof that solutions exist and can be implemented. The Conference works on concrete, implementable proposals rather than declarations, with the papers Vision presents this year on subjects such as insurance, mobility, the climate funds and artificial intelligence, and it looks at the technologies that could change the equation, from small modular reactors to geoengineering and AI. It gives a role to the young people who will live in the world we are discussing: students introduce the sessions and report on them. And it takes place in Venice, a city that has chosen to adapt rather than surrender. If one place can be defined as the world's "capital" of strategies to govern climate change, especially those based on adaptation, that place is Venice.

At the recent press conference presenting this edition, the Rector of one of the participating universities observed that it is much harder today to talk about sustainability. She is right, and that is exactly why it matters more. We must keep talking about climate change, and above all keep deciding and acting. Climate change is already hurting countries everywhere including those that had no part in causing it. But it is also an opportunity. Climate change reminds us that we share a planet, a global environment and a future still to be shaped. Few challenges push us so strongly towards solutions that go beyond borders and ideological confrontation. This is why work on sustainability is a moral imperative, and it is indispensable to do it with a method capable of crossing generations, countries, and professional languages.

THE PROBLEM SETTING AND SOLVING GROUPS

PSSG 1: THE MOBILITY OF THE FUTURE – A BUSINESS CASE FOR THE ETERNAL CITY

TiberConnect: turning the Tiber into Rome's green transport corridor



IN COLLABORATION WITH STUDENTS AND TUTORS OF THE TRANSFORMATIVE SUSTAINABILITY MASTER AT BOCCONI UNIVERSITY AND POLITECNICO DI MILANO, IN PARTNERSHIP WITH BCG

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Introduction

Rome was one of the first cities that came to mind when we started thinking about urban mobility. As the capital of Italy, one of the most beautiful cities in the world, and a primary destination for tourists, it is nevertheless affected by a critical challenge in terms of mobility and urban transportation. Our mission is to transform an underutilised resource into a new transport infrastructure capable of connecting different areas of the city: the Tiber River. Rome's growing population is placing increasing pressure on limited urban space and an already congested transport network. In 2025, average road congestion reached 45.2%, with drivers losing 115 hours a year in rush-hour traffic. The imbalance between transport modes is substantial: approximately 4.16 million daily trips are made by car or motorbike, compared with 0.93 million by public transport. At the same time, the 13.6 million shared-mobility rentals recorded in 2024 point to demand for alternatives to private vehicles. TiberConnect responds by using the Tiber, an underutilised corridor through the city, for a public transport service open to residents, commuters, students and visitors.

Our idea

Although several boat services already operate on the river, they are designed exclusively for tourists. Our goal, instead, is to create a service for residents: a mode of transport that Romans can rely on in their daily lives to commute to work, travel to school, or attend appointments across the city. The project aims to give the Tiber back to the people of Rome by creating two transport lines stretching from Ponte della Musica, in the northern part of the city, to Ponte Marconi in the south, providing a credible alternative to private cars and congested public transport. We have identified nine potential locations along the Tiber that would be suitable for this project, including Ponte Milvio/Foro Italico, Ponte Cavour, Ponte Sisto, Ripa Grande, Ponte dell'Industria, and Ponte Marconi. However, our pilot phase would start from five stations, and then, there will be the possibility to add more stops in other parts of the Tiber.

Other successful examples

While studying how to implement our idea in the complex environment of Rome, we took inspiration from other European cities that have already successfully implemented a fluvial transport system. Each of the three water transport models we studied offer a different lesson for Rome. Amsterdam's GVB ferries demonstrate the value of treating water transport as an accessible public service, designed around everyday mobility needs and integrated into the wider transport network. Venice illustrates how differentiated fares can keep the service affordable for local users while capturing additional revenue from visitors. London's Uber Boat by Thames Clippers provides an example of how a private operator can deliver a river service within an integrated public transport system.

TiberConnect combines these approaches through frequent, accessible connections for residents and commuters, distinct fares for local users and tourists, and a long-term public-private partnership in which Roma Capitale sets routes and service standards while a private partner designs, operates and maintains the system.

The project

The five stations

The pilot phase would begin with five stations: Ponte della Musica, Ponte Cavour, Ponte Sisto, Ripa Grande and Ponte Marconi. These locations were selected because they are the most accessible and best suited locations to Rome's residents' daily mobility needs. The river transport service would connect the northern part of the city with the centre and the south, allowing passengers to avoid the congestion that affects both road traffic and bus services every day. Moreover, all the stations are well integrated with the existing public transport network, making them easily accessible for passengers. The first station, Ponte della Musica, would serve as the northern gateway of the project and would significantly support the large number of people who regularly travel to the area due to the presence of the Olympic Stadium. Major events such as concerts and football matches frequently overload the public transport system in northern Rome, and this new transport option would help alleviate that pressure. Furthermore, the site is highly accessible, and construction activities would be relatively straightforward, particularly because the area has already been identified for redevelopment. The second station would be located at Ponte Cavour and would serve three main categories of users: commuters, thanks to the concentration of law firms and the presence of the Palazzo della Giustizia, and numerous office buildings; tourists and visitors interested in the city's cultural attractions; and residents simply looking for a faster alternative to congested roads. The station would be located on the Palazzo della Giustizia side of the river, as this location provides better connections to the densely populated Prati district and offers more direct access to existing riverfront infrastructure.

The third station would be in Ponte Sisto, the bridge immediately before Tiberina Island, which cannot be navigated. For this reason, the North Line will stop here, and it will be efficiently connected with the first station of the Southline, after Tiberina Island: Ripa Grande. Both of these two stations are going to be located at the left side of the Tiber. People will have multiple ways of going from Ponte Sisto to Ripa Grande: we plan to create a bike station in front of the wharf, but also an electric shuttle service will be provided for accessibility reasons.

Finally, the last station would be located at Ponte Marconi and would represent the operational southern terminal of the line. It would provide efficient access to key destinations such as the Basilica of San Paolo fuori le Mura, the Metro B station Basilica San Paolo, Roma Tre University, Ostiense, and the Marconi district. In addition, the nearby Tiberis area represents an ideal location for the station, as Roma Capitale is already redeveloping it into a permanent waterfront park.

Designed to be integrated with metro, bus, cycling and walking networks, the service would provide an additional mobility option while incorporating step-free access through ramps, lifts and floating pontoons that adjust to changes in river level. Its modular design lays the foundations for future growth, with the potential to bring the model to our cities with underused waterways.

Service schedule and features

The service will operate continuously from 6:30 a.m. to 9:00 p.m. for an estimated 350 days per year. This estimate is based on the average number of days on which the Tiber was not navigable over the past five years.

Service frequency will vary between peak and off-peak hours. The table presents a preliminary schedule based on weekday frequencies of other public transport services in Rome. Time slots will be adjusted after implementation in response to actual passenger demand.

Table 1. Preliminary service frequency (weekdays)

Time	Frequency
6:30 a.m. - 7:30 a.m.	15 minutes

Time	Frequency
7:30 a.m. - 10:00 a.m.	10 minutes
10:00 a.m. - 12:30 p.m.	15 minutes
12:30 p.m. - 2:00 p.m.	10 minutes
2:00 p.m. - 5:00 p.m.	15 minutes
5:00 p.m. - 8:00 p.m.	10 minutes
8:00 p.m. - 9:00 p.m.	15 minutes

Ticket prices will also vary by passenger category: residents and students will pay a lower fare than non-residents, while ATAC annual and monthly pass holders will pay only an additional fare. A 24-hour Tiber Experience pass will also be available, primarily for tourists. Further pricing details are provided in the table.

Table 2. Ticket prices by passenger category

Ticket category	Price
Roma resident ticket	€ 1.50
Student ticket	€ 1.00
Non-resident ticket	€ 4.00
Tiber Experience 24h pass	€ 15.00

The five proposed stations are located near existing public transport corridors, extending the service's reach beyond the Tiber. The north line would connect with tram, bus and Metro Line A services at Ponte della Musica, Ponte Cavour and Ponte Sisto. The south line would provide links to buses, trams, Metro services and rail connections at Ripa Grande and Ponte Marconi. These interchanges would allow passengers to combine river travel with other modes of transport to reach a wider range of destinations.

To assess the service's travel time competitiveness, we compared journeys along the full route by river, car, bicycle and bus. The river journey is estimated to take 56 minutes to one hour including waiting time. This is faster than the 1 hour 14 minute bus journey without changes. Cycling takes approximately 33 minutes, while driving takes 18-45 minutes, depending on traffic. Drivers would also need to allow time to find parking. Road, cycling and bus times are based on Google Maps estimates for a journey at 8:00 a.m. on a Monday; river times are based on the project's operating assumptions.

TiberConnect is also intended to be integrated into ATAC's mobility platform under the Mobility as a Service (MaaS) model, which brings different transport options together in a single digital service for planning and accessing journeys. Alongside bus, tram, metro and rail, the river service would appear in door-to-door itineraries and combinations of transport modes. Passengers could compare routes and view each leg's travel time, walking distance, transfers and estimated CO_2 emissions, helping them

choose the option that best meets their needs. Tickets and passes could also be purchased and accessed through the same platform.

Means of transport

Our objective is to collaborate with the advanced company TEMA to develop a vehicle specifically designed for the characteristics of the Tiber: fully electric and compact enough to navigate the river's narrower and more challenging sections.

We propose a fleet of small electric boats designed for everyday travel. Our starting point is Magenta, a sightseeing boat that carries up to 60 passengers on the Danube in Vukovar, Croatia. It is 15 metres long and 5.6 metres wide, has an aluminium hull, and can reach nine knots. The Italian company TEMA supplied its two 30 kW electric motors. Each motor has a 63 kWh battery, giving the boat 126 kWh in total. Ten solar panels on the roof add 3.5 kW of peak power. According to TEMA, Magenta can operate for up to ten hours without charging when its motors run at low power. We would commission TEMA the development of a very similar vessel in terms of features and dimension for Rome, with the addition of the equipment that supports fast charging. The cabin would be enclosed, heated and air-conditioned so that passengers could use the service in a comfortable way throughout the year.

Each boat would have step-free boarding, spaces for wheelchair users and an area for bicycles. A qualified skipper and a second crew member would assist passengers and manage boarding. These features would make the boat suitable for residents travelling to work, school or appointments, as well as for visitors. At an estimated service speed of seven knots (about 13 km/h), the northern line would travel from Ponte della Musica to Ponte Sisto via Ponte Cavour in 21-23 minutes in each direction. The southern line, between Ripa Grande and Ponte Marconi, would take 16-19 minutes in each direction. Our timetable allows five minutes at each stop for passengers to get on and off and, where the equipment permits, for a short battery charge. Including these stops, a boat would complete a return trip in about 60 minutes on the northern line and 45 minutes on the southern line.

During busy hours, a boat could leave each end of each line every ten minutes. This would require 12 boats in service: seven in the north and five in the south. At quieter times, a departure every 15 minutes would require nine boats. Two further boats would be kept in reserve, bringing the proposed fleet to 14. With 60 places on each boat, a ten-minute timetable could offer up to 360 places per hour in each direction on each line; a 15-minute timetable would offer 240.

The fleet would be moored and charged at two depots, placed at the end of each line. Each depot would have 22 kW AC chargers for overnight charging and 150 kW DC chargers for faster charging during off-peak service hours. Boats would take turns charging so that scheduled departures could continue. A 22 kW charger would take around 12 hours to recharge a nearly empty battery, while a 150 kW charger could restore roughly 60% of the proposed battery capacity in about 1-1.5 hours. Fast chargers at selected stops would also be available when an unscheduled charge is needed. The northern depot, at Ponte Sisto, would have mooring space for eight boats (seven for service and one reserve) along with eight slow chargers and five fast chargers. The southern depot, at Ponte Marconi, would accommodate six boats (five for service and one reserve) with six slow chargers and four fast chargers.

Catchment Area

ISTAT 2021 data processed using QGIS was used to estimate the population within the catchment areas of the proposed TiberConnect stops. A 15-minute walking isochrone was generated for each stop to estimate the number of residents, students and workers living or working within walking distance of the service. The analysis identified 136,463 residents and 43,326 students, with an assumed 20% overlap between students and residents. For simplicity, the estimates do not adjust for overlap between catchment areas. The worker analysis distinguished between people who live and work within the same catchment area, people travelling between different catchment areas, and workers commuting to them from the Rome metropolitan area. Of an estimated 100,000 inbound workers, 50% were assumed to travel along the corridor, resulting in approximately 50,000 potentially relevant workers. The assumption was informed by an origin-destination (OD) matrix map generated using ISTAT 2011 data,

the most recent publicly available dataset identified for this analysis. These estimates produced a total potential population of approximately 220,000 people, excluding tourists. The resulting estimates formed the geographic basis for defining TiberConnect's potential user base.

Using the shares of people travelling by different modes reported in Rapporto Mobilità Roma 2025, alongside assumptions about potential uptake of TiberConnect, a target audience of approximately 71,500 people was estimated. This includes 11,000 public transport users (5% of the total population), 27,500 people who walk or cycle (half of the 25% using these modes), and 33,000 car or motorbike users (25% of 60% using these modes). These figures indicate how many people could potentially use TiberConnect under these assumptions, it is not an estimate for how many passengers the service is expected to carry.

Load Factor

The load factor was estimated through a demand-based approach based on the analysis of the catchment area. Starting from an addressable user base of 71,500 people, and using the average mobility rate of 2.5 trips per person per day given by Rapporto Mobilità Roma 2025, the potential market corresponds to approximately 178,750 daily trips. Since 27.1% of trips in Rome are systematic work or study-related journeys (Rapporto Mobilità Roma 2025), this result is about 48,441 systematic trips per day, assuming one outbound and one return journey per regular user, this corresponds to approximately 24,220 potential daily systematic users.

Three demand scenarios were then developed by applying capture rates of 15%, 22% and 29.5%, resulting in approximately 3,633, 5,330 and 7,145 daily active users, respectively. Assuming that each user makes 2 journeys per day and travels an average of 1.5 river segments per journey, daily demand reaches between 10,899 and 21,435 passenger-segments depending on the scenario. Comparing these values with the network capacity of 25,920 seat-segments per day produces load factors of 42% in the conservative scenario, 62% in the base case and 83% in the optimistic one.

To estimate revenues, the availability seat-segment capacity is converted into passenger-journey capacity using the average 1.5 segments per journey and multiplied by the respective load factor. Over 350 operating days per year, this result corresponds to approximately 2.54 million, 3.75 million and 5.02 million annual passenger journeys. Applying a weighted average ticket price of €1.987, based on the expected mix of passenger categories, generates an annual ticket revenues of €5.05 million, €7.45 million and €9.97 million, respectively.

Tourist demand is deliberately excluded from the estimation, meaning that the analysis reflects only regular resident, worker and student mobility and doesn't incorporate potential additional tourism related revenues.

Table 3. Demand scenarios and load factor

	CONSERVATIVE	BASE	OPTIMISTIC
Catchment area	71,500	71,500	71,500
Daily active users	3,633	5,330	7,145
Journeys per user per day	2	2	2
Average segments per journey	1.5	1.5	1.5
Passenger-segments per day	10,899	15,990	21,435
Seat-segments per day	25,920	25,920	25,920

	CONSERVATIVE	BASE	OPTIMISTIC
LOAD FACTOR	42%	62%	83%

Table 4. Annual passenger journeys and ticket revenue

	CONSERVATIVE	BASE	OPTIMISTIC
Passenger segments per day	(25.920/1.5)*0.42 = 7,257.6	(25.920/1.5)*0.62 = 10,713.6	(25.920/1.5)*0.83 = 14,342.4
Annual passenger journeys (350 days)	2,540,160	3,749,760	5,019,840
Average ticket price*	€1.987	€1.987	€1.987
Annual ticket REVENUE	5,047,298	7,450,773	9,974,422

Costs and time

Table 5. Station infrastructure costs (EUR million, 2026 prices, excluding VAT)

Component	Ponte della Musica	Ponte Cavour	Ponte Sisto	Ripa Grande	Tiberis	Total
Preliminary surveys, bathymetry, geotechnical assessment, underground utilities, and site preparation.	0.15	0.20	0.25	0.25	0.20	1.05
Pier, gangway, piles/anchors, fenders, bollards, and marine structures	1.10	1.05	1.10	1.10	1.05	5.40
Waiting area, lightweight canopies, bike hub, furnishings, and technical room	0.18	0.18	0.22	0.20	0.52	1.30
Lighting, CCTV, SOS, PA, ticketing, and passenger information	0.22	0.22	0.22	0.22	0.24	1.12
Electrical power supply and shore power	0.08	0.08	0.08	0.08	2.20	2.52
Direct work	1.73	1.73	1.87	1.85	4.21	11.39

Analytical estimate of the work values in millions of euros, 2026 prices, excluding VAT

Table 6. From direct works to total CAPEX (EUR million)

Component	Cost
Direct work	€11.39 M
Design, construction supervision, safety, inspections, permitting, acceptance testing, and project management – 15%	€3.13 M
Technical and permitting contingency – 20%	€4.11 M
Inflation up to the project midpoint – 9,5%	€1.97 M
Total CAPEX	€20.6 M

The 20% contingency is important because the project is at a stage prior to the PFTE (Technical-Economic Feasibility Project) and involves hydraulic, archaeological, landscape, and electrical connection risks that have not yet been quantified.

The following figures also include the allocated portions for design, contingency, and inflation.

Table 7. CAPEX per station and probable range

Station	CAPEX	Probable range
Ponte della Musica	€3.13 M	€2.49–4.00 M
Ponte Cavour	€3.13 M	€2.50–4.03 M
Ponte Sisto	€3.38 M	€2.66–4.43 M
Ripa Grande	€3.35 M	€2.61–4.43 M
Tiberis/Ponte Marconi	€7.61 M	€6.02–10.89 M
Total	€20.60 M	€16.3–27.8 M

Fleet CAPEX and annual operating-cost estimate

The estimate starts from the approximately €1 million price indicated for the Danube Magenta, but it does not assume that TEMA could deliver a public-transport-ready version for the same price. The original vessel was launched in 2015 and is an open sightseeing boat, whereas the Tiber Connect version would require a more enclosed passenger cabin, climate control, public-transport equipment and potentially a larger battery and propulsion system.

Table 8. Fleet CAPEX and annual operating cost

Item	Central estimate	Realistic range
Fleet acquisition CAPEX	€23.5 M	€20–29 M
Annual fleet and service OPEX	€9.43 M/year	€7.9–11.2 M/year
Useful economic life	25–30 years	
Major battery replacement	Around years 8–10	Depending on charging cycles

Executive estimate. All figures are in 2026 prices, excluding recoverable VAT.

A favourable setting, as the project has been ideated, could be:

Table 9. Working vessel specification

Parameter	Working assumption
Passenger capacity	60 passengers
Length	15–17 m
Beam	Approximately 5.5–6 m
Propulsion	2 × 50–60 kW
Battery capacity	Approximately 250–350 kWh
Solar panels	3.5–6 kWp
Service speed	Approximately 7 knots
Maximum speed	8–9 knots
Charging	Overnight charging plus terminal top-ups
Crew	1 qualified skipper + 1 passenger/deck officer
Accessibility	Step-free boarding and wheelchair spaces
Passenger environment	Enclosed, heated and air-conditioned cabin

Table 10. Estimated price per customised vessel (EUR million)

Component	Estimated cost per vessel
Original Magenta-type vessel benchmark	€1.00 M
Enclosed superstructure, glazing, insulation and HVAC	€0.12 M
Larger propulsion system, battery and charging equipment	€0.18 M
Public-transport interior, wheelchair spaces and boarding equipment	€0.07 M
Navigation, CCTV, passenger information, communications and ticketing	€0.05 M
Certification and design allocation	€0.05 M
Series-production discount for 14 units	–€0.07 M
Estimated contract price per vessel	€1.40 M

The €1.40 million unit price is the theoretical price we considered, not the real one, since this would be a tailor-made project.

Table 11. Total fleet CAPEX (EUR million)

Item	Cost
14 vessels × €1.40 M	€19.60 M
Prototype engineering and first-of-class testing	€0.55 M
Delivery to Rome and commissioning	€0.42 M
Initial spare parts, diagnostic equipment and crew training	€0.48 M

Item	Cost
Owner's engineer, acceptance tests and classification support	€0.30 M
Procurement contingency – approximately 10%	€2.14 M
Total fleet CAPEX	€23.49 M

Financial model and consolidated economic analysis - a Public-Private Partnership

PPP Structure

TiberConnect would be developed through a long-term Design - Build - Finance - Operate -Mantain (DBFOM) Public-Private Partnership that will combine public control with private financing and operation management. Roma Capitale would have the role of the public contracting authority. It would launch the competitive tender that grants access to the use of public land and riverbanks, and it would ensure the integration of the service in the pre-existing transport network. The municipality would be responsible for providing a yearly fixed financial compensation to the operator, if necessary, to cover the gap between affordable ticket price and cost of operation.

TiberConnect would implement and operate the project, secure financing, develop the stations, procure electric vessels and operate them. The operator would collect ticket and advertising revenues, manage the infrastructure and monitor the overall performance according to the contractual KPIs. It would bear construction, lifecycle and service availability risks. This structure would allow Roma Capitale to retain control over the affordability and accessibility of the service, while leaving the private partner responsible for infrastructure development and day-to-day operations.

The PPP model presents some financial and operational risks, mainly related to the tender, when the private partner incurs preliminary costs without any guarantee of obtaining the concession. However, this uncertainty is addressed through an arrangement whereby the public authority covers part of the project costs if the contract is not awarded.

Consolidated economic analysis

The revised financial model combines the project's investment requirements, operating costs and revenue scenarios to assess the financial sustainability of TiberConnect during the first year of operations, with a 20-year concession period considered. The project requires an estimated €44.09 million CAPEX, assumed to be fully privately financed, while annual OPEX amounts to €9.43 million.

Commercial revenues, including fares and ancillary income, vary significantly according to demand, reaching approximately €5.60 million in the Conservative scenario, €8.00 million in the Base scenario and €10.52 million in the Optimistic scenario.

Before any public support, this produces operating results of - €3.83 million, - €1.43 million and + €1.09 million, respectively, considering that the operating break-even point is reached at an estimated 74% load factor.

Assuming a potential annual municipal fare compensation of €2.18 million, aimed at limiting the burden of ticket prices on passengers, the resulting year 1 profit/loss becomes approximately - €1.65 million in the Conservative case, + €0.75 million in the Base case and + €3.27 million in the Optimistic case. The analysis therefore shows that operating sustainability is highly dependent on actual demand levels, while the recovery of the initial private investment would require additional mechanisms, such as public or EU grants, a reduction in the privately financed share of CAPEX, higher-value tourist or premium fares, additional commercial rights, or a combination of these measures.

Table 12. Revenue, OPEX and funding gap by scenario (EUR)

	CONSERVATIVE	BASE	OPTIMISTIC
Annual ticket revenue	5,047,298	7,450,773	9,974,422
Estimated additional revenue stream from advertisments, sponsorships and chartering	550,000	550,000	550,000
Total commercial revenue	5,597,298	8,000,773	10,524,422
(OPEX)	9,430,000	9,430,000	9,430,000
Operating funding gap/(surplus)	3,832,702	1,429,227	(1,094,422)

Table 13. Year-1 results by scenario (EUR million)

Component – Year 1 in million euros		CONSERVATIVE	BASE	OPTIMISTIC
OPEX		(9.43)	(9.43)	(9.43)
TiberConnect operating margin	8% × €9.43 M€	0.75	0.75	0.75
Commercial revenue retained	Fares + ancillary revenues	5.60	8.00	10.52
Operating results before compensation	Commercial revenue - OPEX	(3.83)	(1.43)	1.09
Potential municipal fare compensation	Considering base case fare compensation	2.18	2.18	2.18

Component – Year 1 in million euros		CONSERVATIVE	BASE	OPTIMISTIC
Profit/Loss		(1.65)	0.75	3.27

Timeline of the project

The implementation of Tiberconnect is expected to take from 66 to 72 months and is divided into five phases.

The first phase (months 0-10) involves the creation of the team project and the engagement with stakeholders. This will allow to work on assessing demand, navigability and potential risks. At the same time the ten months will be used to define station layouts, operating model and financial plan. The second phase (months 11-30) involves obtaining all necessary concessions and heritage approvals from Roma Capitale along with the definition of funding arrangements and the preparation of the tender documents. During the third phase (months 31-45), the PPP would be finalized and financing would be secured, reaching financial close. The fourth phase (months 46-64) involves the construction of the stations, the manufacturing and delivery of the vessels and the installation of the charging infrastructure. Finally, the last phase (months 62-72) will be characterized by technical and operational testing, safety certification, employee training and the integration of the service into the ATAC Roma app.

Conclusion - Why invest in TiberConnect?

TiberConnect is an opportunity to address Rome's increasing mobility challenges by transforming an underutilized asset, such as the Tiber, to create an alternative public transport corridor that eliminates pressure from the existing road network.

Having a diversified revenue model, with the PPP model that combines public payments, ticket fares, performance-based adjustments and multiple commercial opportunities, TiberConnect reduces reliance on a single revenue source, with additional upside potential. Additionally, TiberConnect's modular stations and electric vessels allow phased implementation with limited irreversible construction. Finally, the project translates the objectives of Rome's Programma Strategico e Operativo del Tevere of making the river Tiber a key element of the city's sustainable mobility and urban regeneration into a concrete mobility service.

By combining public objectives with private-sector operational expertise, TiberConnect aims to deliver long-term economic, environmental and social value for the city of Rome.

PSSG2: REBUILDING VENICE

Housing, Climate Adaptation and Practical Urban Retrofitting: A Plan



IN COLLABORATION WITH TUTORS, STUDENTS AND PHD CANDIDATES FROM IUAV UNIVERSITY OF VENICE, IN PARTNERSHIP WITH VENEZIA CITY COUNCIL

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Introduction

Venice represents a prime example of the complex relationship between the conservation of historic heritage, housing affordability, and adaptation to climate change. Although these issues affect many European cities, they take on particular significance in the Venetian context due to the lagoon setting, environmental fragility, and the need to reconcile heritage conservation with the demands of contemporary life and its projections.

To understand this complex relationship requires recognizing how physical and social vulnerabilities are deeply intertwined. In Venice, tourism pressure, rising housing costs and the difficulty of ensuring adequate services all contribute to the displacement of residents and students to the mainland. This phenomenon threatens not only the continuity of the local community, but also the relationships and everyday activities that make the city a lived-in place, rather than simply a heritage site to be preserved. Therefore, housing is not merely a material necessity, but a fundamental element of social cohesion and urban vitality.

The limited opportunities for urban expansion also make the rehabilitation of existing buildings a central issue. The high costs of interventions, together with the risks associated with climate change and rising sea levels, call for a rethinking of regeneration strategies from a perspective that integrates economic sustainability, architectural conservation, and environmental resilience.

The history of Venice nevertheless demonstrates that its identity has never been immutable. As highlighted in Storia della resilienza di Venezia (De Marchi et al., 2025), the city has undergone profound economic, social, and technological transformations, adapting its relationship with the sea, the lagoon, and human activities over time. Resilience, therefore, does not consist in keeping existing conditions unchanged, but rather in the ability to address change while preserving the historical and cultural values of the built heritage.

This perspective aligns with the “right to the city” a concept advocated by social movements, theorists such as Henri Lefebvre, and global policy agendas like UN-Habitat (2019), which asserts that urban space should be shaped and defined by those who inhabit it. This framework demands a holistic approach to urban development, prioritizing access to decent housing, democratic participation, and sustainable adaptation to globalization and climate change.

These elements are viewed as essential, systemic components that enable a good quality of life and the effective use of urban space. Furthermore, this perspective allows for a holistic approach to urban development, one capable of adapting to the challenges and innovations brought about by globalization, while envisioning alternative urban futures and the renewal of cities. Consequently, this framework prompts an examination and definition of the diverse elements that must be taken into account when discussing human settlements, including their constituent background, sides, processes, and developmental phases and, above all, their evolution.

In this sense, linking it to the goal of enabling users to exercise their rights, while simultaneously upholding fundamental values such as historic heritage, the situation becomes complex. This is due to the significance inherent in such heritage and the need for interventions that address external factors that jeopardize the use of the space, the quality of life, and the preservation of the built environment.

Under these conditions, a fundamental question emerges: “Whose Venice are we planning for, and to whom does it belong?” Answering this question requires recognising the close relationship between urbs, the material structure of the city, and civitas, the community that brings it to life. Preserving

buildings without ensuring that people can continue to inhabit them risks safeguarding the image of the city at the expense of its vitality.

This reflection gives rise to **Rebuilding Venice: Housing, Climate Adaptation and Practical Urban Retrofitting**, a contribution that approaches Venice from multiple perspectives and is structured around three dimensions:

- **Living (housing, affordability, and urban vitality)**: placing habitability and a sense of belonging at the heart of everyday urban life, recognising students as active members of the community, and addressing the demographic imbalance driven by tourism pressure.
- **Adapting (climate resilience and heritage conservation)**: adapting to climate change without compromising architectural identity or local culture, assessing the durability of interventions at the building scale and their social justification in which it is necessary to acknowledge that major protective infrastructure like the MOSE are time-limited solutions.
- **Regenerating (intervention strategies, feasibility, and governance)**: developing shared-cost financing models with strong public participation, overcoming the fragmentation between the historic centre, the mainland, and the lagoon, and ensuring transparency in planning processes by clarifying "who benefits from what."

Rebuilding Venice thus conceived of regeneration not as a simple process of building rehabilitation, but as a project to restore habitability and social vitality. Rebuilding Venice means preserving not only its inherited heritage, but also the conditions that will allow the city to continue to be lived in, transformed, and passed onto future generations.

Living Venice: housing, accessibility, and urban vitality

The sustainability of a historic city depends on whether residents can remain living in their neighborhood and take part in daily civic life. From this perspective, housing is a fundamental dimension for understanding the contemporary transformations taking place in Venice. The city's resident population decreased by 11% in just over three years, dropping from 52,760 in April 2023 to 46,964 in September 2026 (OCIO, 2026). Residential stability is essential to maintaining the social, economic, and functional continuity of the city. This crisis is especially intense in Venice's historic center, where the surge of tourist rentals, increasing maintenance costs of historic buildings, and real estate market speculation are pricing out long-term residents (Figure 1-2).

Figure 1: Demographic and Accommodation Trends in the Historic Centre

Indicator	Previous Period	September 2026	Trend
Resident Population	52,760 (Apr 2023)	46,964	– 11.0%
Total Tourist Beds	44,484 (Apr 2023)	50,207	+ 12.8%
Tourist Rental Beds	19,016 (2019)	24,760	+ 30.0%
Traditional Hotel Beds	25,468 (2019)	25,447	Stable

Source: OCIO (2026) data.

Figure 2: Spatial Distribution of Demographic and Tourism pressure



The chart illustrates the acute concentration of tourism in Venice's historic centre. While housing only 19% of the municipal population, the historic city absorbs 69% of all tourist rental beds. Source: OCIO (2026) data.

As these figures shows, tourist rentals are actively consuming the physical fabric necessary for the residential property market. Venice's reality reflects a broader context of difficulties in accessing housing. The European Commission's European Affordable Housing Plan (2025) reports that, between 2013 and 2024, nominal house prices across the European Union increased by more than 60%, while average rents rose by approximately 20%. Although these dynamics affect urban areas across Europe, Venice pushes them to an extreme, an open market pressure collides with strict conservation rules and a restricted island.

Living in Venice means fostering social relationships, supporting local services, sustaining everyday activities, and contributing to the continuity of local communities, calling into question its ability to remain a lived-in place rather than simply a tourist destination. From this perspective, underused housing stock represents a potential resource. However, its recovery requires a distinction between genuinely vacant units, those requiring renovation or those tied up in legal or ownership constraints.

The estimate that 26% of the housing stock is unused, must also be verified against the definition adopted and the geographical area to which it refers. Furthermore, building renovation does not automatically guarantee affordability: the costs of refurbishment, rental prices, and the conditions that enable residents to maintain access to housing over time must also be taken into account. At the same time, incorporate potential modifications, taking into account the conditions under which the original structures were built as well as the new context (especially regarding climate), while also considering their materials and structural factors such as ventilation, permeability, and moisture. Housing must be addressed in relation to the overall spatial organisation of the territory. The concept of "Functional Venice", introduced in the *Scenario di sostenibilità urbana integrata* (De Marchi, Oliva and Pace, 2025), moves beyond an isolated view of the historic centre towards an understanding of the relationships between housing, employment, education, mobility, and services, including those connecting Venice with the mainland and the wider metropolitan area, as an integration between the mainland, the islands, and the coastal zone, with their diverse dynamics and interests.

Within this framework, university students represent a vital demographic for the city's future. Initiatives like the Venice City Campus project, promoted by the Venice Sustainability Foundation (VSF), seeks to diversify the local economy through research, higher education, and reuse of existing buildings. However, students must not be viewed merely as temporary visitors or consumers.

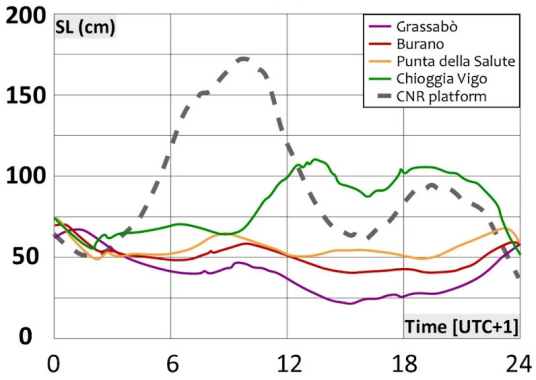
Current housing costs and leasing conditions present significant challenges for students, frequently leading them to look toward mainland dormitories for stability. Expanding affordable dedicated student housing through partnerships between private and public entities, is essential to maintaining social continuity in the historic centre. Students must have the physical and social conditions to experience Venice as an active, integrated part of the host community.

Ensuring Venice's vitality requires aligning property regulations, tourism rental quotas, public housing recovery, and affordability protections into a single strategy. Housing cannot be treated merely as an investment asset; it is the foundation of civic survival. Rebuilding Venice begins with giving residents, families, and students the security to remain, establishing the social fabric that must underpin any architectural or climate intervention.

Adapting Venice: climate resilience and heritage conservation

Climate change presents an existential challenge to the built fabric of Venice. While large-scale engineering works, most notably the MOSE (Experimental Electromechanical Module) barrier system at the lagoon inlets, provide essential protection against extreme high-water events (*acqua alta*), relying on them alone offers only a partial solution (Figure 3). As highlighted in PSSG 2, the MOSE essentially buys time: it shields the city from catastrophic storm surges, but it cannot prevent the slow, continuous physical deterioration of the urban fabric. Besides, the trade-offs in its use is questionable, as it has severe environmental and financial implications.

Figure 3: Sea Level



Sea level observations during the extreme storm surge of 22 November 2022, demonstrating the operational impact of the MoSE barriers. The external sea level (CNR platform, dashed line) reached approximately 173 cm, while the protected water level inside the historic centre (Punta della Salute, orange line) was maintained safely at approximately 60 cm. Adapted from Bajo et al. (2023).

Relative sea-level rise in the lagoon continues to accelerate. Recent data from *Istituto Superiore per la Protezione e la Ricerca Ambientale* (ISPRA, 2025) indicates the mean relative sea-level rise in Venice reached approximately 4.8 mm/year between 1993 and 2024, nearly doubling the historical average of 2.6 mm/year observed over the period 1872 and 2024. This phenomenon, influenced by both variations in ocean levels and local land subsidence, highlights the territory's growing vulnerability. The European Climate Risk Assessment report (EEA, 2024) places these issues within a broader context, emphasising the interconnections between climate risks, infrastructure, health, ecosystems and economic activities.

Recurring dampness, exposure to salts, overheating, inadequate ventilation and energy inefficiency all affect the conservation of the built heritage and living conditions. The publication *Storia della resilienza di Venezia* (De Marchi et al., 2025) provides a historical perspective on these issues by

examining urban transformations and the relationship between the city, the lagoon environment and infrastructure. It highlights the importance of understanding resilience not as freezing the city in time, but as the capacity to respond to environmental change while maintaining the essential civic and residential functions.

For this reason, the refurbishment of historical buildings requires specific strategies capable of reconciling climate change adaptation and energy performance with the conservation of architectural and cultural values. Retrofit should be understood as a considered transformation of existing buildings that improves living conditions and reduces vulnerability without compromising essential spatial qualities. Furthermore, as questioned during PSSG2 discussions, planning must critically examine the policies that govern these typologies. No single technical solution is suitable for every structure; heritage conservation policies must evolve to enable everyday habitability, avoiding rigid constraints that turn architectural preservation into a barrier to technical improvements, climate protection and housing access.

Heritage conservation and building retrofitting must also be incorporated into a broader urban strategy that considers the relationship between residential living, economic activities and tourism. As articulated in *Scenario di sostenibilità urbana integrata per Venezia e il suo territorio* (De Marchi, Oliva and Pace, 2025), tourism is a structural component of Venice's urban reality and must be assessed in relation to environmental fragility and the needs of the resident population. When applied to historic housing, circular adaptation frameworks, such as those promoted by the Venice Sustainability Foundation (VSF), should prioritise cyclical maintenance and the reuse of existing materials rather than continuous, disruptive rebuild. Crucially, as emphasized in PSSG2, adaptation measures should evaluate whether an intervention will endure over time and whether its social outcome justifies the logistical effort and cost. Upgrading the built fabric must not simply serve tourism pressure, public resources and retrofitting initiatives must ensure that environmental protection and structural investments directly sustain the everyday resident community.

The sources considered highlight the need to integrate climate risk assessment, heritage conservation, building refurbishment, and economic feasibility into a unified agenda. Venice's true challenge is to reduce climate vulnerability without compromising the city's historical identity, while ensuring that buildings remain functional, protected and habitable. Resilience must not therefore be understood as a purely defensive engineering effort, but as an integrated process that links environmental protection with social continuity, keeping the living community firmly at the center of Venice's future.

Regenerating Venice: intervention, feasibility, and governance strategies

Translating habitability and climate adaptation into physical reality requires clear operational and governance strategies. As outlined in *Venezia Città Circolare* (Colombara et al., 2025), urban regeneration cannot be treated as a collection of isolated architectural projects; it must be approached as a coordinated system that combines resource efficiency, structural maintenance, and long-term residential continuity.

Determining where and how to intervene requires moving beyond uncoordinated restorations to comprehensive assessment. Building selection must evaluate conservation status, ownership structures, refurbishment costs, and heritage constraints alongside the concrete potential to restore stable residential use. Moreover, the recommended scale of intervention is of entire building complexes or street fronts, rather than isolated flats, which may create economies of scale that can

significantly reduce project overheads and simplify technical coordination. Feasibility must also balance technical and environmental metrics with social outcomes, ensuring that public investments do not end up subsidizing real estate that slips out of the residential market.

The financial structure of the execution is a challenge that must not depend solely on private investment, submitted to profitability-driven choice. Regenerating the city requires innovative, shared-cost financing models that blend public subsidies, private investments, and civic resources. Where public funds are deployed, whether through direct renovation grants, subsidized loans, or tax incentives, they must be legally tied to binding affordability clauses. These clauses must guarantee long-term residential occupancy, rent caps, and ongoing maintenance obligations and flexible regulations, ensuring that public expenditure directly serves the local community rather than short-term real estate profits.

Sustainable regeneration requires overcoming the deep administrative and spatial fragmentation between the historic centre, the mainland, and the wider lagoon basin. As highlighted in *Scenario di sostenibilità urbana integrata* (De Marchi, Oliva, and Pace, 2025), Venice operates as an interconnected metropolitan system where housing, transport, university life, and employment are interdependent. While collaborative platforms like the Venice Sustainability Foundation (VSF) facilitate dialogue among public bodies, universities, and private actors, Venice still lacks a permanent institutional mechanism dedicated to delivering non-market affordable housing. Overcoming institutional divides requires transparent planning processes that explicitly answer the question raised in PSSG 2: **“who benefits from what?”** Decision-making must make clear how costs, risks, and tangible benefits of regeneration are shared among public institutions, private investors, and permanent residents in a multifunctional approach, considering the lifetime of each intervention.

To translate these principles into practice, an operational approach can be structured around four main stages:

- **Building Selection**: Identifying underused public and private assets based on structural condition, ownership, and residential potential.
- **Evaluation and Design**: Comparing technical solutions and balancing upfront retrofitting costs against long-term maintenance and heritage compatibility.
- **Financing and Management**: Structuring shared-cost funding mechanisms with clear commitments regarding rent affordability and resident access.
- **Outcome Monitoring**: Tracking indicators such as restored housing units, energy performance, maintenance costs, and residential stability.

Starting with localized pilot initiatives supports gradual adaptation over time, allowing technical and financial approaches to be refined before applying them more broadly.

Ultimately, urban regeneration must not be reduced to physical restoration alone. By pairing technical feasibility with shared-cost financing and transparent governance, Venice can move beyond stated ambitions toward measurable community outcomes. Regeneration succeeds only when it protects the city’s built heritage while guaranteeing that the social, economic, and environmental benefits remain firmly anchored in the lives of those who inhabit it.

Conclusion

Venice raises a fundamental question for the future of historic cities worldwide: how can an exceptional cultural and architectural heritage be preserved while securing the social, economic, and environmental conditions that make everyday life possible? Across the three dimensions examined, Living, Adapting, and Regenerating, it is evident that housing affordability, climate resilience, and urban governance are not separate technical sectors, but interdependent parts of a single spatial reality. Protecting the built fabric is tied directly to confronting the pressures that displace the local community.

Given the exceptional complexity of Venice, urban resilience cannot be delivered through rigid, top-down blueprints. Venice requires instead a process of gradual adaptation, mirroring the historical capacity of human communities to continually adjust their relationship with the lagoon environment. True sustainability extends far beyond green technology or flood barriers: it requires keeping local communities, craftsmanship, memory, and everyday social life alive, safeguarding the human foundations that make Venice a living city rather than a preserved stage.

Translating this perspective into practice requires overcoming the deep administrative and spatial fragmentation between the historic centre, the mainland, and the wider lagoon basin. Interventions cannot be planned in isolation. Public and private resources must be combined through shared-cost financing models tied to binding affordability conditions, preventing public investments from simply subsidizing short-term tourism conversion. Urban planning processes must maintain absolute transparency, continuously addressing the critical question raised during the conference: **"who benefits from what?"** The physical and economic benefits of urban regeneration must remain firmly with the people who inhabit the city.

In this light, Rebuilding Venice conceives of regeneration as a process of gradual experimentation. Rather than imposing sweeping changes, planning should move forward through targeted pilot initiatives, identifying underused buildings, testing retrofit strategies compatible with historic typologies, structuring fair financing models, and monitoring residential outcomes over time. Important open questions naturally remain: evaluating whether building-scale interventions realistically endure against rising sea levels to justify their logistical effort and cost, establishing where heritage conservation rules must evolve to permit essential habitability upgrades, and designing permanent governance frameworks that defend the rights of permanent residents and students.

Ultimately, the challenge is not to freeze Venice as an unchanging image of the past, nor to treat it merely as an object of material conservation. Resilience does not mean choosing between the stones of the city (*urbs*) and the community that brings them to life (*civitas*). Rebuilding Venice means ensuring that the city remains, sustainably and permanently, a place to live, study, work, and belong, preserving its inherited heritage by safeguarding the living community that will carry it forward into the future.

References

Bajo, M., et al. (2023). "Insights on the Extreme Storm Surge Event of the 22 November 2022 in the Northern Adriatic Sea". Journal of Marine Science and Engineering, 11(9), 1750.

Colombara, F., Tieri, E., D'Este, A., & Oliva, S. (2025). Venezia Città Circolare: Analisi e Soluzioni per il percorso di Venezia a città leader di circolarità. Venice Sustainability Foundation (VSF), Quaderno 4.

De Marchi, D., Oliva, S., Campostrini, P., & Urbani, C. (2025). Storia della resilienza di Venezia: Sfide e trasformazioni economiche, sociali e urbanistiche degli ultimi due secoli. Venice Sustainability Foundation (VSF), Quaderno 3.

De Marchi, D., Oliva, S., & Pace, G. (2025). Scenario di sostenibilità urbana integrata per Venezia e il suo territorio. Venice Sustainability Foundation (VSF), Quaderno 2.

European Commission. (2025). The European Affordable Housing Plan. COM(2025) 1025 final.

European Environment Agency (EEA). (2024). European Climate Risk Assessment.

Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA). (2025). Rapporto sugli indicatori di impatto dei cambiamenti climatici (Venice Sea-Level Data).

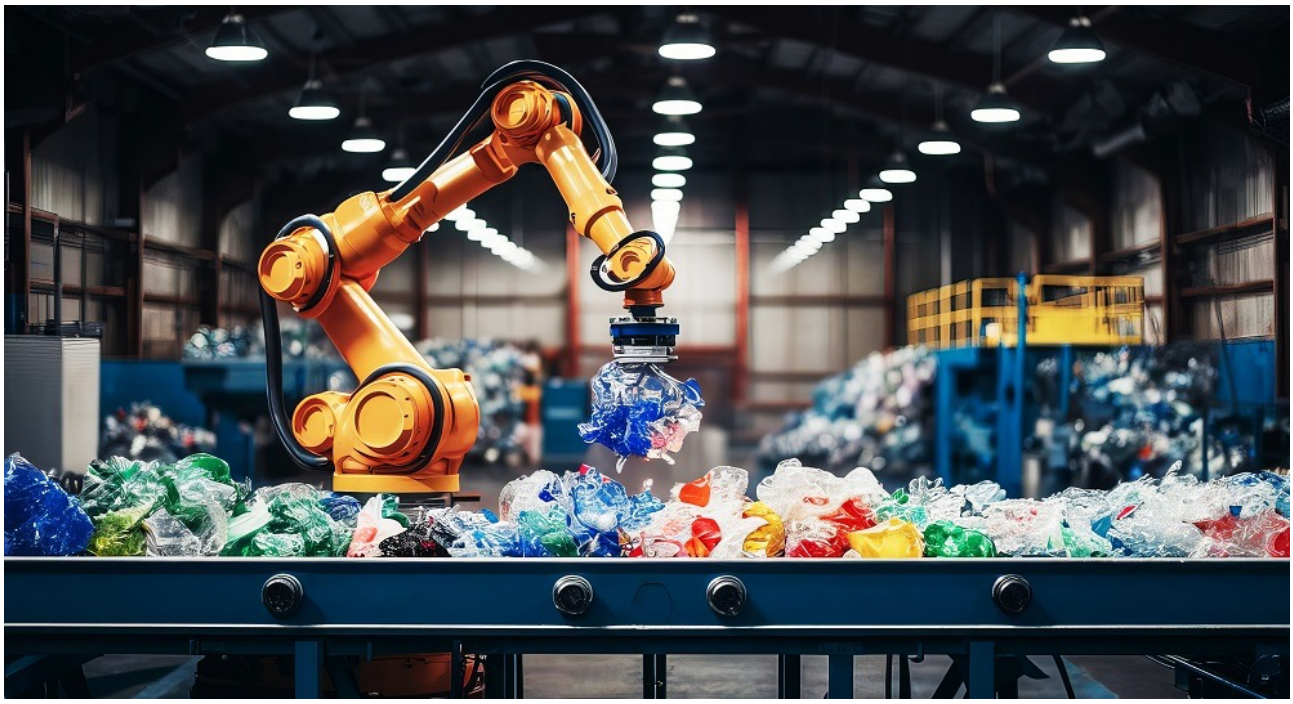
Osservatorio Civico Indipendente sulla Casa e sulla Residenzialità (OCIO). (2026). Report on Demographic and Accommodation Trends in the Historic Centre (September 2026).

UN-Habitat. (2017). New Urban Agenda. United Nations.

Settis, S. (2016). If Venice Dies. New Vessel Press.

PSSG 3: BEYOND DIFFERENTIATION

The Robotized Selector and the Future of Waste



IN COLLABORATION WITH STUDENTS AND TUTORS OF THE TRANSFORMATIVE SUSTAINABILITY MASTER AT BOCCONI UNIVERSITY AND POLITECNICO DI MILANO, IN PARTNERSHIP WITH AMSA

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Introduction

The management of municipal waste is one of the most pressing environmental and operational challenges of modern cities. According to the figures used by the group, the world generated about 2.1 billion tonnes of municipal waste in 2023, and UNEP projects that the figure will reach 3.8 billion tonnes by 2050. Population growth, urbanisation and consumption keep increasing the volumes we produce; landfills and poor management pollute air, water and soil and release greenhouse gases; and most of what we throw away could be reused or recycled but ends up lost.

Waste is therefore already a major challenge, but new technologies and regulations are emerging to tackle it. This paper looks at one specific, and so far neglected, part of the problem: the mixed residual waste that remains after households and businesses have done their share of separate collection. Milan is among the best performing large cities in Europe and offers a demanding test case. If a city that already separates almost two thirds of its waste can still recover valuable materials from what is left, the lesson is relevant well beyond Milan.

The group, made up of students of the Transformative Sustainability master of Bocconi University and Politecnico di Milano working with AMSA and A2A, asked a simple question: can Milan turn residual waste into recoverable value? The answer is built on a modular techno-economic model that combines eight sorting technologies into an integrated plant, and on a closer look at one of the most discussed of them, the AI-driven robotic sorter, to test whether it can be used for bulk waste.

Frameworks and regulation

From waste to resources: the 10R framework

The group adopted the 10R framework, which identifies strategies to retain resources and product value, ordered broadly from higher to lower circularity (Table 1). The framework makes explicit what is at stake in the choice between treatment routes: energy recovery (R9) sits at the bottom of the ladder, while recycling (R8) keeps materials in the economy. The challenge addressed by the group is to enable the transition of the municipal mixed residual waste stream from energy recovery to material recycling through advanced waste sorting.

Table 1. The 10R framework of circular strategies

Strategy	Meaning
Refuse (R0)	Avoid unnecessary products and materials.
Rethink (R1)	Use products more intensively, e.g. through sharing.
Reduce (R2)	Minimise resource consumption and waste generation.
Reuse (R3)	Use products again for their original purpose.
Repair (R4)	Fix damaged products to extend their lifespan.
Refurbish (R5)	Restore or upgrade existing products.
Remanufacture (R6)	Rebuild products using recovered components.
Repurpose (R7)	Give products or components a new function.

Strategy	Meaning
Recycle (R8)	Process waste into secondary raw materials.
Recover (R9)	Recover energy from waste.

Source: PBL Netherlands Environmental Assessment Agency, Circular economy: measuring innovation in product chains.

EU regulation as a driver of the transition

European legislation establishes increasingly ambitious targets that push cities from disposal to recovery (Figure 1). The Waste Framework Directive sets recycling targets for municipal waste of 55% by 2025, 60% by 2030 and 65% by 2035. The Landfill Directive limits landfilling to 10% of municipal waste by 2035, and the Packaging and Packaging Waste Regulation introduces packaging recyclability targets from 2030. Taken together, these rules reduce the room for the routes that dominate today for mixed residual waste.

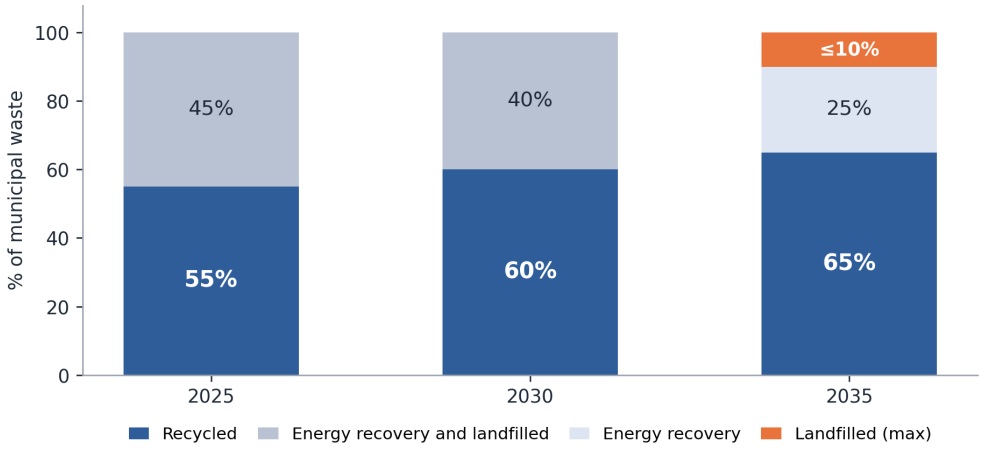


Figure 1. EU recycling and landfill targets for municipal waste (%)

Source: EU Directives 2018/851 and 2018/850; Regulation 2025/40, as summarised by the group.

Milan's waste profile

Milan collects about 638 kilotonnes of municipal waste a year. Of this, 63.8% is separately collected and already directed to material recovery through dedicated streams: organics, paper and cardboard, glass, plastics and cans. The remaining 36.2%, about 231 kilotonnes a year, is mixed residual waste. This is the stream that can still contain materials suitable for recirculation before it is sent for energy recovery.

Milan's separation performance is high when compared with other large European cities (Figure 2): 63.8% against 52% in Madrid, 40% in Barcelona, 32.7% in London and 27.1% in Paris. Milan is therefore already a benchmark, but the remaining 36.2% is still a large technical and economic challenge.

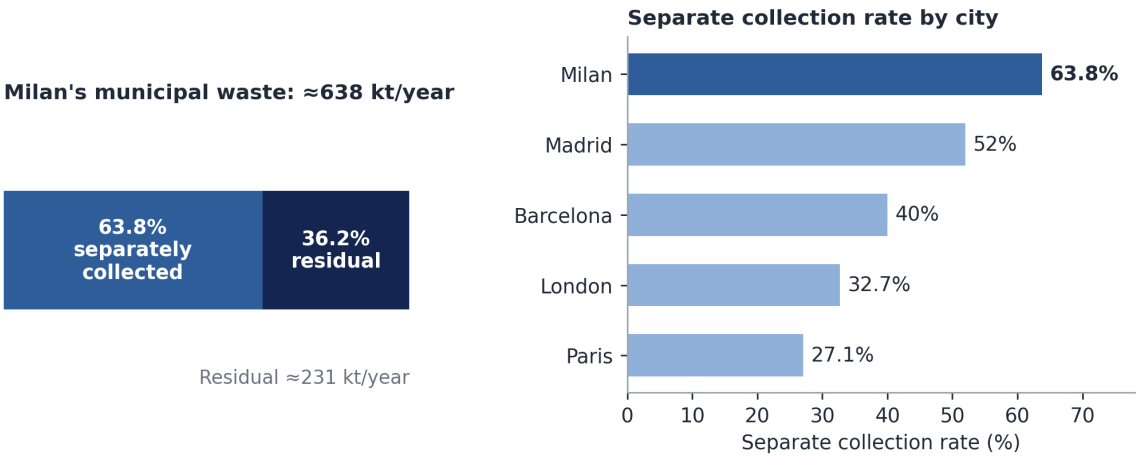


Figure 2. Milan's municipal waste and separate collection rates in major European cities

Source: group analysis based on data provided by AMSA and public statistics.

The composition of the residual stream shows where the opportunity lies. Paper and cardboard are the largest single fraction, at 31% of the residual waste, followed by the "other" category and by plastic bottles and other plastic packaging, at about 19% each. Organic waste represents only about 5.1% of the residual stream, a distinctive feature of Milan when compared with cities such as Rome (27.8%) and Berlin (38%), and one that is consistent with Milan's long-established separate collection of food waste.

Who does what in the current system

Four actors shape what happens to waste in Milan today. A2A is the parent group of AMSA and a wider waste and energy utility: it frames the industrial infrastructure, but waste does not physically pass through A2A as a step. AMSA is the local operator responsible for municipal collection and urban hygiene and manages both the separate streams and the mixed residual fraction. Packaging materials of sufficient quality follow the material route through the CONAI system and its material-specific consortia for paper, plastics, glass and other streams, where value depends on the tonnes accepted and on purity. Mixed residual waste that is not materially recovered follows the residual route to a third-party waste-to-energy operator: the route recovers energy, but the material is no longer recirculated and treatment costs remain.

The project challenge and the approach

The group framed its work around three questions. The first is economic viability: can automated sorting generate enough value to justify the investment and operating costs? The second concerns the benefits for Milan: how much material could be recovered, and what environmental and social benefits could follow? The third is to build a transferable decision tool: how do waste composition, energy prices and material remuneration change the result?

The approach is a modular techno-economic Excel model developed in cooperation with AMSA and A2A. The model was first built technology by technology and then combined into a full plant. Each technology was modelled as an individual processing step using a small set of operational and economic parameters: throughput and capacity, material-specific recovery efficiency, CAPEX, OPEX, electricity consumption, depreciation life and physical life. The quantity recovered at each step is calculated from the waste entering that technology and its recovery efficiency, while the remaining material is passed to the next stage. The results were checked at plant level with A2A, looking at

capacity (operating hours and machine processing capacity) and layout (space needed, conveyor belts and plant layout).

From individual technologies to an integrated system

The group researched eight technologies: bag openers, trommel screens, ballistic separators, air classification, ferro-magnets, eddy-current separators, spectroscopy and AI vision. They were first assessed individually, based on the EU best available techniques reference documents (BREFs) and of further innovations identified during the research. While the results were promising, each technology addressed only a part of Milan's residual waste issue. Since no single technology can sort every material, the group combined some of them in sequence to address the whole stream (Table 2).

Table 2. Technologies modelled in the integrated plant

Technology	Role in the plant
Bag opener	Opens incoming waste bags through controlled pulling and shearing, exposing the contents; the first preparation step before size separation.
Trommel screen	Separates waste by particle size into coarse, oversize and undersize streams; larger recyclable items tend to remain in the larger fractions, while smaller organics and fines concentrate in the undersize stream.
Ferro-magnets	An overband magnet extracts ferrous metals such as iron and steel from the conveyor.
Eddy-current separator	Separates non-ferrous metals by inducing circulating electrical currents.
Spectroscopy and air jets	Identifies materials from their near-infrared spectral signature and ejects targeted items with air jets.
AI vision and robotic arm	Uses AI-based visual recognition to identify target objects and a robotic arm to pick them from the conveyor.

In the full plant (Figure 3), residual unsorted waste passes through the bag opener and the trommel screen, which splits it into three flows. The oversize flow goes through an overband ferromagnet, an eddy-current separator and three spectroscopy-and-air stages (paper and plastics; textiles and glass; organics). The undersize flow goes through a ferromagnet and an eddy-current separator. The coarse flow, an optional line, is sorted by robotic picking. Each flow recovers its materials, and what remains is the final residual stream.

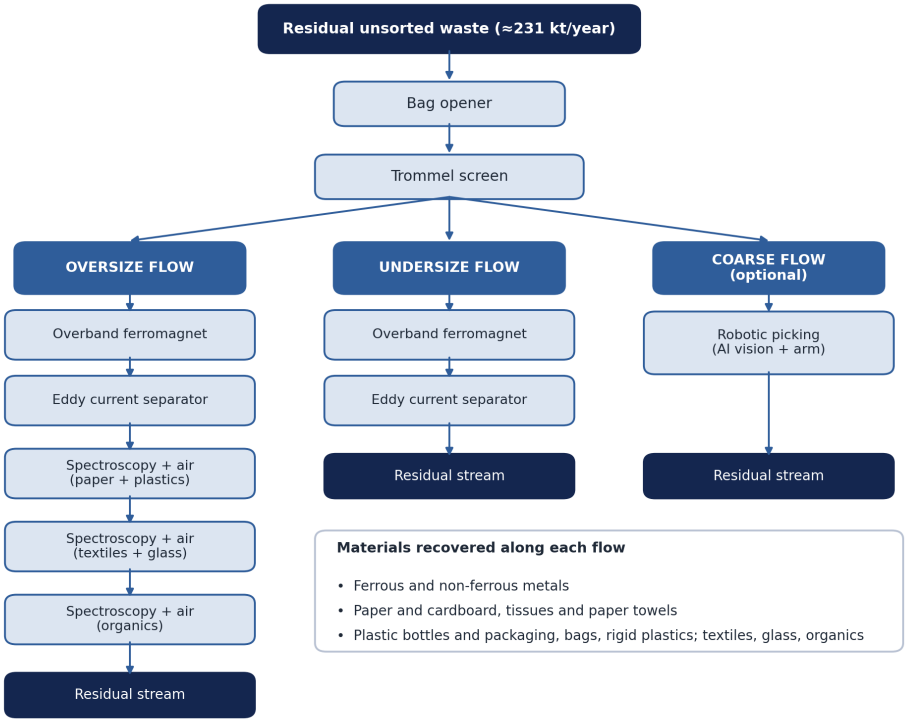


Figure 3. Layout of the modelled full plant

Source: group analysis; first review, 2 September 2026.

Results

The model estimates that the integrated plant could recover up to 64 kilotonnes of waste a year, equal to 28% of the 231 kilotonnes of residual waste, and save about 120 kilotonnes of CO_2 a year (Figure 4). The largest recovered fractions are plastics, at roughly 33 kilotonnes, and paper and cardboard, at roughly 25 kilotonnes, followed by metals and textiles at about 3 to 4 kilotonnes each.

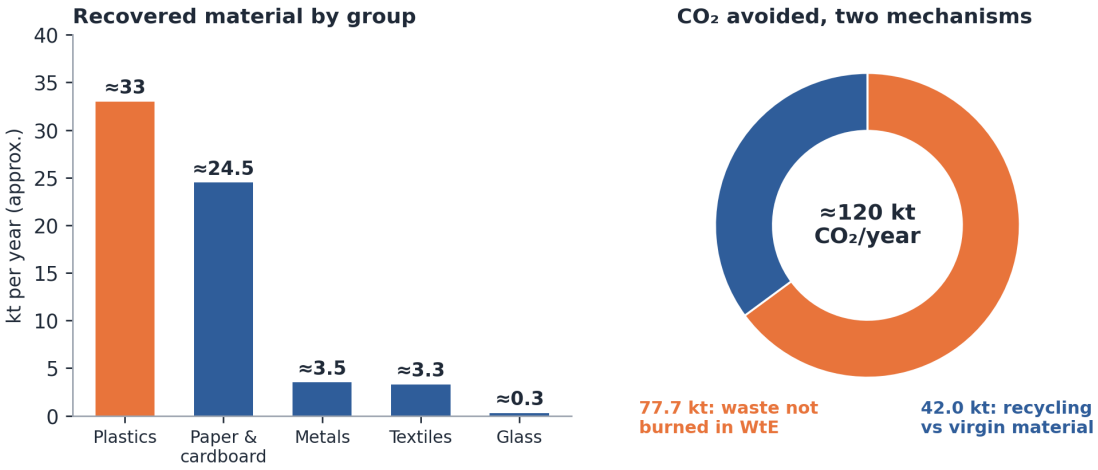


Figure 4. Recovered material and CO_2 avoided by the integrated plant

Source: group model. Material tonnages are read from the model output and are approximate; CO_2 values as reported by the group.

The climate benefit comes from two mechanisms. About 42 kilotonnes of CO_2 a year are avoided because recovered materials replace virgin ones, and about 78 kilotonnes because the recovered waste is no longer burned in a waste-to-energy plant. Energy accounting is more nuanced: recycling saves a gross 1.73 million gigajoules a year, from which the group deducts 0.49 million gigajoules of electricity forgone by no longer incinerating the material, for a net energy saving of about 1.24 million gigajoules a year. Water footprint is also reduced, mostly through paper and cardboard (in the order of 40 million cubic metres a year), followed by textiles and plastic packaging. These savings were derived from usage figures assigned to life-cycle stages in the Ansys Granta database.

The first review of the model, in September 2026, also estimated the economic dimension: cost savings of more than EUR 14 million and a potential value of materials of about EUR 9.5 million. These figures depend on waste composition, on energy prices and on the remuneration of materials, which are precisely the variables the Excel tool lets any city change.

Zooming in: AI in bulk waste management

An AI robotic sorter combines a 3D vision system, AI categorisation and a robotic arm. It identifies individual items on the belt, picks selected plastics, metals or fibre, and is remotely monitored. Today it is usually employed in quality control and in last-chance recovery lines. The group asked whether it could also be used for bulk waste recovery.

The test case places AI sorters at the end of a mixed coarse waste stream of about 60,000 tonnes a year, with one dimension exceeding 20 centimetres, picking only metals, plastics and paper. The cost structure is an installation fee plus an annual lease; the reference sorter has a simple efficiency of 76% and a pick rate of about 52.5 picks per minute, with an average weight of 28.57 grams per pick.

At current prices, AI robotic sorters are not yet economically viable for bulk waste management (Figure 5). To reach a non-negative net present value, recovery efficiency would have to increase to about 83%, or the pick rate would have to rise to roughly 57 picks per minute. The assessment does not include plant-level costs or the recyclability of the recovered material, which are significant variables and are likely to make the threshold harder to reach.

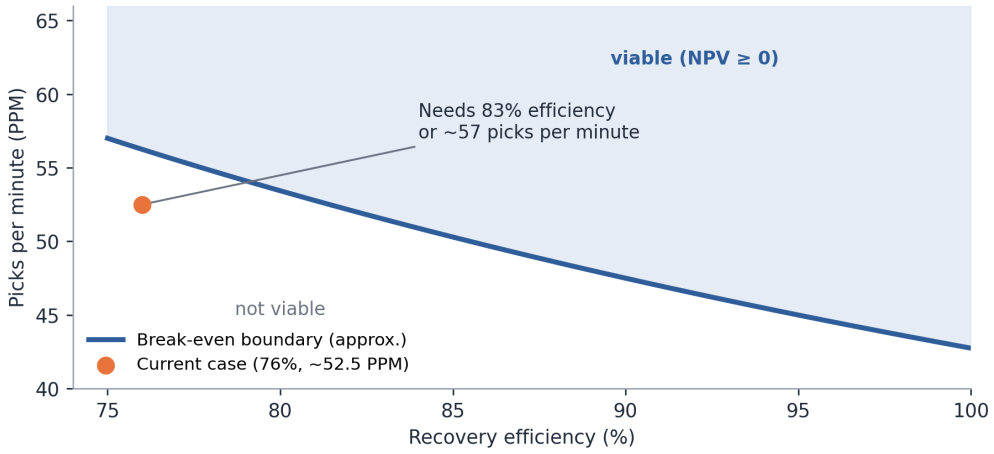


Figure 5. Pick rate needed for a non-negative NPV of an AI robotic sorter

Source: group analysis. The boundary is a reconstruction of the group's break-even curve and is approximate.

Conclusions and recommendations

- **The residual stream is a resource, not a remainder.** Even in a city that separates 63.8% of its waste, the 231 kilotonnes of residual waste still contain materials that can be recirculated: the model points to up to 28% of the stream and about 120 kilotonnes of CO_2 saved each year.
- **Combine complementary technologies.** No single technology can sort every material. An integrated line that opens bags, separates by size, extracts metals and then uses spectroscopy and air jets on the larger flows addresses the whole stream; robotic picking can be added as an optional stage.
- **Be realistic about AI.** Robotic sorters are promising, but at current prices they are not yet viable for bulk waste. They need either higher recovery efficiency (about 83%) or a higher pick rate (about 57 picks per minute), and their role will remain complementary until then.
- **Align the economics with the regulation.** EU targets for 2030 and 2035 (65% recycling, at most 10% landfill, packaging recyclability rules) will move the residual stream away from energy recovery. Remuneration through the CONAI system, which depends on tonnes accepted and on purity, is what will make sorting pay for itself.
- **Use the model as a transferable tool.** The modular Excel model lets cities change waste composition, energy prices and material remuneration to test their own case, and can be used wherever authorities and operators need to decide whether to invest in advanced sorting.

The results are preliminary: several assumptions, in particular material recovery efficiencies, plant-level costs and the quality of the recovered fractions, should be validated with operators before investment decisions are taken. The group's contribution is to show how a decision can be structured, and to give Milan and other cities a method to take it.

PSSG 4: REFORMING COP

A smaller, clearer and more transparent COP, and catalytic action outside it



IN COLLABORATION WITH TUTORS AND STUDENTS OF THE FLORENCE SCHOOL OF TRANSNATIONAL GOVERNANCE, EUROPEAN UNIVERSITY INSTITUTE

Paper's Authors: Fanta Darboe, Helena Marschall, Katie Nemergut, Saad Nahid, Jacopo Bencini, Kalypso Nicolaidis

Executive Summary

The problem: COP30 was meant to usher in an "implementation phase," yet the political momentum behind the 2015 Paris Agreement appears exhausted. COPs have been loaded with expectations that far exceed what a two-week, consensus-based negotiation among nearly two hundred Parties can deliver. Some of the format's shortcomings are inherent to the problem of climate change, and no procedural reform will remove them, but others can and must be fixed.

What COPs are for: Before turning to reform, we need to be clear about what the format can and cannot do. The UNFCCC fosters global climate governance unlike any other current forum: it sets goals with universal legitimacy, frames issues, keeps score through the Global Stocktake and rallies political attention. It is poorly suited, however, to act quickly in specific sectors such as; experimenting, representing non-State actors, and updating its own rules.

We argue for a two-pronged approach:

1. COP: Reform the COP to ensure its success in delivering action from commitments. The COP should be smaller and have a more streamlined agenda, more frequent intersessional work led by coalitions of the willing, and clearer decision rules. Universal participation would remain for goal-setting, adaptation, loss and damage, and finance.
2. COP ecosystem: Multiply catalytic action outside the multilateral perimeter and connect it back to the COP. Sector-, Region-, or topic-specific coalitions and conferences let early movers lower the costs of action for others. Engaging in plurilateralism to address the transboundary causes and effects of the climate crisis remains crucial to harmonize collective efforts of willing countries. To remain legitimate, they need open membership and a duty to report. Explicit "docking stations" would link them to the formal COP process.

Participation: Through this two-pronged approach, we suggest expanding the diversity of participants by both capping the delegation party size of each country at the COP itself (1) and lowering the practical barriers to attendance to the COP ecosystem as a whole (2). Recognized constituencies should then upgrade from observer status to consultation rights, as the Arctic Council does for Indigenous Permanent Participants. This approach would ensure productivity and emphasize broad strategic commitment to climate governance.

Finance: Neither prong is credible without greater finance justice. The new collective quantified goal leaves a wide gap between pledges and needs, and much of what is delivered arrives as debt-creating loans. The obligations of Article 9 of the Paris Agreement must remain central rather than be displaced by the voluntarism of clubs.

These changes can be introduced without amending the Convention or the Agreement, and they map onto existing efforts, notably the Climate Governance Commission's proposals.

Background

The formal closing of COP30, almost a year ago in Brazil, should have marked the beginning of the “implementation phase”, or, as COP30 President Andre Correa do Lago said, the “post-negotiation” phase. This shift in language was meant to signal a response to those who had argued for the need to find different ways forward in the face of the worsening climate impacts. As delegates prepare to travel to Antalya, Türkiye, for COP31, it is legitimate to ask them, global leaders, and ourselves, as a community of research and practice, whether things are moving in the right direction.

Part of the answer lies in a mismatch that this paper takes as its point of departure: COPs have been loaded with expectations that far exceed what a two-week, consensus-based negotiation among nearly 200 Parties can achieve.

This debate is not new, but COP30 can serve as a symbolic milestone on which to build a further case for change.

As global temperatures and emissions continue to rise, the debate on the political instruments available to address the crisis becomes more salient with every tenth of a degree. There have been positive steps in recent years, such as the establishment of the Loss and Damage fund, the reference to the transition away from fossil fuels in the first Global Stocktake and the new collective quantified goal on climate finance.

Existing proposals

The Club of Rome letters: The debate on reforming the COP is not new. In the open letter "Reform the COP Process," circulated by the Club of Rome in February 2023 and signed by leading figures including a former UN Secretary-General, the signatories argued that the UNFCCC system is not designed to deliver at the required scale and speed.

They proposed to:

- reduce the size of COPs drastically;
- allow for three to four intersessional meetings a year,
- coordinate action and decision-making through a troika of the incoming, outgoing and current Presidencies;
- give non-state actors, including civil society, business and indigenous peoples, a structured and legitimized role in the process;
- concentrate political energies on six pillars: knowledge exchange and technology co-development; aligning mitigation plans with science; adaptation; finance; delivery; and accountability.

A second letter, in November 2024, added:

- smaller, more frequent, solution-driven meetings at which countries report on progress.
- strict eligibility criteria for COP presidencies and host countries, requiring support for the transition away from fossil fuels and a demonstrated commitment to the goals of the Paris Agreement;
- stronger transparency and disclosure rules for lobbyists;
- standardized definitions and common reporting frameworks for tracking climate finance, given the growing share of pledges delivered as interest-bearing loans;
- a permanent scientific advisory body formally part of the COP structure, on the model of the one in the Convention on Biological Diversity;
- a stronger Global Stocktake, with peer review, independent scientific oversight and transparent tracking of pledges;
- a Climate-Poverty Policy Envoy, to anchor the links between poverty, inequality and planetary stability in the negotiations.

Vision's earlier proposals: Vision has made similar arguments at previous conferences, proposing transforming COPs into regional, operational forums organized by technology or topic. The paper

prepared for the 2024 Dolomite Conference (From Dubai to Baku: Three ideas to kick-start a debate) advanced three proposals that the present paper takes as its starting point:

1. **Finance:** the consolidation of a fragmented landscape of some twenty-nine multilateral funds, only three of which have ever disbursed more than one billion dollars, and a small executive body to monitor them between sessions.
2. **Decision-making:** negotiation through around ten geographical or interest-based blocs, with seats for actors currently absent from the table, namely cities, the poles and the oceans, a citizens' assembly and the scientific community.
3. **The COP as a global platform:** the conversion of its core from national pavilions into a knowledge-management hub organized around problems to be solved.

The Climate Governance Commission provides the most structured effort to date, working with partners such as CEEW, WRI Africa and Plataforma CIPÓ through its implementation platform, MEGA. With the support of key members of the COP30 Presidency, the Commission refined its priority proposals in July 2026; Slovenia, the Chair of the Circle of COP Presidencies, and the Organization of African, Caribbean and Pacific States have expressed interest in advancing them. Three strands stand out.

1. Strengthening the climate COP through foresight-oriented Earth system science and enhanced accountability under the Paris Agreement.
2. QA Planetary Emergency Platform to accelerate response across the international system, a model proposed by the UN Secretary-General and taken up in the Pact for the Future, supplemented by Earth system monitoring and a Policy Innovation Hub.
3. An International Environment Court, building on recent advisory opinions at ITLOS and the ICJ, and a Global Environment Organization.

As these efforts show, there has been a great deal of debate around COP reform, but little coordinated action. Proposals mostly float around without being concrete enough to act on. What we propose here is not entirely new. It reemphasizes certain points from these earlier efforts, builds on them, and, above all, calls for a wider, more concerted push.

Theoretical Lens

The Venice Conference took place weeks before COP31 in Antalya, Türkiye. Its aim was to provide the global debate on COPs with intellectual tools for what is now an unavoidable reform of the system. It did so by reading the COP through the lens of what Thomas Hale (2024) has called long problems.

Climate change is the archetypal long problem in Hale's sense: a problem whose causes and effects unfold over more than one human lifetime, through long and uncertain chains of causation, and whose nature changes as it progresses. Hale identifies three structural difficulties that follow from this:

1. **The Early action paradox:** the costs of action are certain and immediate, whereas its benefits are uncertain and distant, so that the incentive to act is weakest precisely when action would be most effective.
2. **The problem of shadow interests:** those with the largest stake in today's decisions, future generations and the populations that will bear the brunt of impacts, are absent from the deliberations.

3. **Institutional lag:** institutions designed for one phase of a problem persist into phases for which they are ill-suited.

This lens clarifies the reform debate in two ways.

1. Some shortcomings routinely attributed to the COP process are not design flaws but properties of the problem: the growing complexity of negotiations and the hard trade-offs between present and future, between regions and communities, and between incumbents and newcomers reflect a long-standing problem that no procedural reform can eliminate.
2. We must distinguish between what COPs can deliver and what the format is unsuited for. Hale's repertoire for governing across time includes foresight, long-term goals that endure, the lengthening of political time horizons, the representation of shadow interests, and institutions capable of adapting as the problem evolves. He labels this logic 'catalytic cooperation' (2020), whereby institutions work to shift actors' preferences and strategies toward cooperative outcomes over time, thereby creating 'domino effects'.

From this distinction follows the two-pronged approach that structures this paper. The first prong is to reform the COP so that it does better what it was created for: fewer participants, clearer decision rules, a clearer division of labor among countries, more transparency and more structured participation. The second is to multiply initiatives for implementation outside the multilateral sphere to do what the COP cannot, following the catalytic logic described by Hale, whereby early movers lower the costs and raise the benefits of action for those who follow, while connecting these initiatives to the COP through explicit channels so that their results flow back into the formal process.

Proposal

First prong: a smaller, clearer and more transparent COP

Previous proposals to reduce the scale of the COP should be the basis for every new idea. The Turkish Presidency of COP31 is reportedly preparing for more than 100,000 participants. That would make Antalya the largest COP ever, directly contradicting what experts and practitioners have long advocated. The first concern is the conference's carbon footprint. For COP31, it will likely surpass Dubai's total of 333,000 tons of CO2, equivalent to the emissions of 72,500 gasoline-powered passenger cars driven continuously for a year.

Part of the structural failure of recent COPs stems from conflating three very different gatherings into a single venue: a technical treaty negotiation, a broad citizens' summit, and a corporate/commercial trade fair. To unbundle this triple function and reduce scale without silencing civil society, the core treaty negotiation should be spatially and temporally decoupled from the citizens' summit and the commercial fair, i.e., the second and third functions. Restricting official negotiating sessions to a lean body of essential diplomats (~5,000 delegates), potentially hosted at a permanent technical hub such as the UNFCCC headquarters in Bonn, would eliminate organizational gridlock, reduce carbon footprints, and protect negotiators from lobbyist pressures, while allowing public and commercial summits to meet independently - with more productive representation in the technical treaty negotiations.

The problem is also structural. The COP faces a double risk of capture by dynamics external to its core membership:

1) Corporate interests, often intertwined with national ones: To address corporate capture, the UNFCCC should adopt a formal conflict-of-interest framework modeled on Article 5.3 of the WHO Framework Convention on Tobacco Control. This framework would require mandatory disclosure of fossil-fuel lobbying expenditures and prohibit fossil-fuel representatives from holding seats on official state negotiating delegations.

2) The consensus rule, which means the COP will always show the 'floor' of negotiations rather than the 'ceiling'

To ensure the COP delivers, we suggest a division of labor over time and space:

Division of labor in time

The COP should do less at each session and let more of the work happen between sessions.

1. A "back to basics" COP. Each COP should set clear aspirations and follow a streamlined agenda in which only a small number of items are negotiated.

2. Smaller, more frequent conferences throughout the year, led by coalitions of the willing. Most of the technical and political work would be done in advance. The annual COP would then endorse outcomes, rally political support and set direction, rather than start negotiations from scratch.

Division of labor in space

The second reform concerns where the work happens. A single global gathering cannot deliver action tailored to very different regional circumstances, and much of the practical implementation work is better done closer to where it happens.

The universal format treats the climate challenge as a single negotiation, even though countries differ widely in emissions, transition pathways, and capacity to implement. Parties do not have equal access to data, technology, and finance, and the largest annual gathering in history is expensive and distant for many of those most affected.

Part of the COP's work should be moved into regional and operational forums:

- Regional forums organized by technology or topic, as Vision has proposed at previous conferences, where countries with shared geographies or interests work on delivery together.
- Regional meetings throughout the year, which also carry the intersessional work described above and bring in actors who rarely reach the annual COP.

Second prong: catalytic action outside the multilateral perimeter through a COP ecosystem

Why now? Climate clubs and coalitions of the willing have been discussed since the start of the UNFCCC negotiations. What is new is why the debate is resurfacing. The UN has rarely been so openly contested and so financially constrained as under the second Trump administration, and groupings such as the BRICS, the G77 or the G20 now carry most multilateral dossiers, with no clear majority view on world issues. In response, key countries have begun launching minilateral, club-like or plurilateral coalitions outside the negotiating rooms. One example is the Open Coalition on Compliance Carbon Markets, launched at COP30 and co-led by Brazil, the EU and China to improve the transparency and interoperability of regulated carbon markets. These coalitions are not created for prestige. Those who act are trying to prevent the system from collapsing. In Hale's terms, they address the early action paradox directly, i.e., a subset of actors bears the certain costs of acting first, expecting to catalyze others. If they succeed, they could also shape the formal process, starting with issue framing, meaning

the emergence of new topics or workstreams that are extremely hard to introduce in today's multilateral setting. Such a role might even provide them with first-mover advantage.

Example: The first Conference on Transitioning Away from Fossil Fuels (Santa Marta, Colombia, April 2026), co-hosted by Colombia and the Netherlands, shows how this can work: a non-negotiated format, deliberately placed outside the UNFCCC, which gathered 57 countries around the issue that COP30 had been unable to put on paper and that the COP process overall had broadly ignored. It produced voluntary national roadmaps, three working streams, a science panel and a coordination group to ensure continuity until a second conference in Tuvalu in 2027. Crucially, its outcomes were designed to flow back into the multilateral process: formally submitted to the COP30 presidency, which is preparing the global roadmap announced in Belém, discussed with the COP31 presidencies with a view to the action agenda, and aimed at making the transition away from fossil fuels a central agenda item up to the second Global Stocktake in 2028.

The African Group of Negotiators has objected that such coalitions lack multilateral legitimacy. This is why the link back matters. It is also important to ensure that these groups remain open over time, as new countries apply to join.

Further possibilities: Sector- and topic-specific coalitions deserve particular attention as the natural unit of this second prong. They organize cooperation around a defined set of technologies, incumbents and standards, where catalytic dynamics operate most directly: a shared standard for low-emission steel or cement, or a common abatement regime for methane from fossil fuel operations, can shift costs and expectations across an entire industry. Precedents such as the Global Methane Pledge, the Breakthrough Agenda on affordable clean technologies, and the G7-initiated Climate Club have an uneven record, largely because they lack binding commitments, comparable metrics, and a channel back into the formal process. We therefore propose pushing for topic- or sector-specific coalitions and attaching docking stations to each, as described below.

Addressing Risks

Our proposals carry four risks, which we address in turn.

1. **Exclusion of countries and of people:** coalitions of the willing may leave out the unwilling or the unable and become a cartel of incumbents, while young people, indigenous peoples, local communities and future generations, whose interests are most affected, may remain without a voice both inside the COP and in the new formats.
2. **A missing link between inside and outside:** action outside the COP may remain disconnected from the formal process, so its results never feed back in.
3. A lack of accountability for results delivered outside the multilateral perimeter.
4. The voluntarism of clubs could displace binding finance obligations.

These risks ought to be addressed through four core commitments:

1. Ensure inclusion for all
Within the COP: Building on the Vision 2025 Conference, one may still ask why megacities such as Shanghai, Lagos and New York have no seat at the climate table, while microstates such as Andorra, Lesotho, and Liechtenstein do. The answer lies in the Westphalian nature of the UN system, in which only States hold seats.

The question carries more weight once the COP is understood as the governance of a long problem. Cities and even more megalopoles are often the most committed and sometimes the most capable of delivering effective action while the people most affected by its decisions, namely young people, indigenous peoples, local communities and future generations, are the “shadow interests” that Hale identifies as structurally under-represented.

Inclusion should therefore go well beyond observing the negotiations and delivering short statements in plenary. We propose two steps:

1. **Lower the barriers to participation.** Visa regimes, accommodation prices and the cost of attending a two-week conference on another continent decide who is in the room long before anyone asks who may speak. Host-country selection criteria should include guarantees of affordable access.
2. **Move beyond observer status by granting consultation rights.** A useful, if much smaller, precedent is the Arctic Council. Six organizations of Arctic indigenous peoples hold Permanent Participant status there and must be consulted before decisions are taken, without holding a vote. A comparable status for the recognized UNFCCC constituencies would give substance to the seats proposed in Vision’s 2024 paper.

These criteria would also apply to the suggested intersessional and regional conferences.

Outside the COP, club diplomacy carries exclusion traps that its advocates should not downplay. Every coalition of the willing implicitly defines a coalition of the unwilling or the unable:

- Least developed countries and small island States that cannot follow several formats at once.
- Producer economies whose transition is the most costly.
- Populations whom the chosen standards ignore.

Pushed too hard, club diplomacy becomes a cartel of incumbents. Its legitimacy therefore depends on three conditions: open membership, accession pathways, and an obligation to report back to the universal forum.

2. Design and provide docking stations

Issue framing is only the softest channel through which the outside can shape the inside. The coalitions, clubs, and conferences around the COP should be treated as an ecosystem with recognized docking stations into the formal process, rather than a loose cloud of side events. At least five such docking stations exist or could be created without amending the Convention:

1. Submission of outcomes to the incoming presidency.
2. Inclusion in the action agenda, with an obligation to report back to the plenary.
3. Recognition in COP decisions. A cover decision welcoming a coalition’s roadmaps, standards or finance turns outside momentum into multilateral acquis.
4. Structured input into the Global Stocktake, whose modalities already allow submissions by non-Party stakeholders.
5. Interoperability with mechanisms the UNFCCC runs directly, from the enhanced transparency framework to Article 6.

Fragmenting global climate action into specialized minilateral clubs creates a secondary risk of overlap, duplicate reporting, and "forum shopping" across competing platforms. To keep a multi-hub ecosystem from devolving into administrative chaos, the UNFCCC Secretariat could embed a light-

touch Global Coordination & Integration Hub. Its role would not be to dictate terms to independent clubs, but to track active minilateral workstreams, map regional initiatives, and oversee the division of labor across space and time so that decentralized efforts feed directly back into global targets.

3. Ensure transparency and accountability
If implementation moves in part outside the multilateral perimeter, who measures results, who verifies them, and who is accountable? Measurement and verification should stay multilateral even where delivery does not:

- coalition outcomes are reported in the metrics of the enhanced transparency framework;
- they are verified through its expert review;
- they are accounted for in the Global Stocktake.

A coalition that fails to deliver would then be visible to all Parties and, after the 2025 advisory opinion of the International Court of Justice, to the courts as well.

4. Commit to finance justice more credibly
Neither prong is credible without greater finance justice. The new collective quantified goal left a wide gap between pledges and needs, and much of what is delivered arrives as debt-creating loans. The obligations under Article 9 of the Paris Agreement and the contributions proportional to GDP and emissions proposed in Vision's 2024 paper must remain central rather than be displaced by the voluntarism of clubs.

To reflect credible commitment, the parties would need to stop treating finance as a pledge and run it like a budget. Meaning: a binding split of who pays (fair-share split based on national income and historical emissions with supplements to fill gaps), agreed accounting rules (e.g. report grant value of loans), steps with dates (such as starting date for adaptation), and new money sources that don't depend on shrinking aid budgets (such as payouts that start automatically after a disaster for the loss and damage fund) .

Conclusions: from Venice to Antalya

Building on the plethora of COP reform proposals already available, we argue for a clear division of roles:

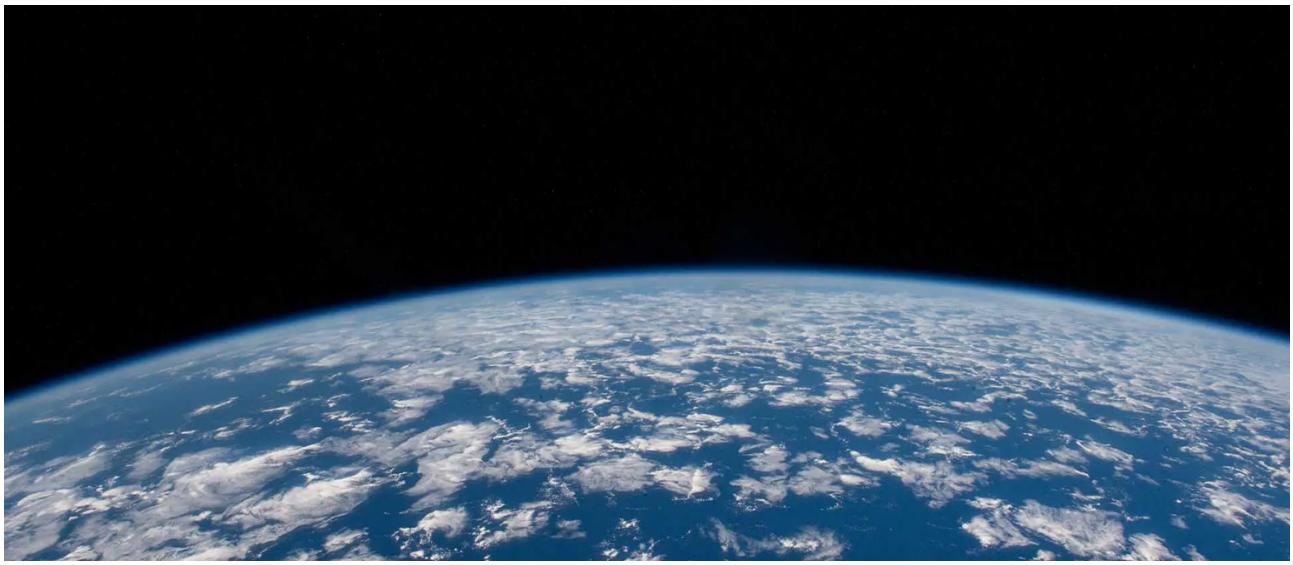
1. **COP:** The COP maintains its Westphalian setting, grounded in the representation of States, as a normative framework that guarantees universal participation. It remains the place where key goals, timelines, issue framing, and the limits of experimentation are collectively agreed. It keeps goal-setting as a core competence by shifting Global Stocktake cycles from retrospective accounting towards forward-looking action.
2. **COP ecosystem:** Implementation (what the Club of Rome calls delivery) happens outside it but in synergy with it, through a collectively orchestrated network of minilateral, club-like and plurilateral "implementation laboratories". These rest on mutual exchange, common but differentiated responsibilities and policy experimentation.

Additionally, Representation: The COP process should be reformed to promote equity, inclusivity, and climate justice, particularly for the most marginalized and climate-vulnerable countries and peoples. This requires ensuring their meaningful participation through inclusive consultations, fair representation in negotiating spaces, and opportunities to contribute to agenda-setting and decision-making.

These changes can be introduced politically and incrementally, COP after COP, without amending the Convention or the Agreement. Institutions governing a long problem must be durable enough to sustain long-term goals and adaptive enough to be updated as the problem changes, and coalitions and clubs provide the experimentation from which such updating can draw.

PSSG 5: MANAGING GEOENGINEERING

Risk, Responsibility and Global Oversight



IN COLLABORATION WITH TUTORS AND STUDENTS OF LUISS GUIDO CARLI, IN PARTNERSHIP WITH STARDUST

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Executive Summary

Climate change is progressing faster than many projected mitigation pathways can address. Even under ambitious decarbonization scenarios, global temperatures are expected to overshoot the Paris Agreement targets for several decades, exposing societies to increasing risks from extreme heat, sea-level rise, ecosystem collapse, and irreversible cryosphere loss. While rapid emissions reductions should remain the cornerstone of climate policy, growing evidence suggests that mitigation and adaptation alone may not sufficiently reduce the probability of catastrophic climate outcomes.

This policy brief argues that research into climate interventions such as Solar Radiation Modification (SRM), targeted glacial interventions, and marine carbon dioxide removal (mCDR) should become a formal component of national and international climate policies. This would enable development of scientific knowledge, governance frameworks, monitoring capabilities, and international institutions necessary to evaluate these approaches responsibly should future conditions make climate interventions a necessity. Another often discussed and less controversial approach, Carbon Dioxide Removal (CDR) is not discussed in this brief. This policy brief treats CDR as a pre-condition to climate change policies as mitigation will not reduce carbon dioxide already present in the atmosphere. While this brief gives an overview of mCDR proposed approaches that need to be studied more, it focuses on more controversial climate interventions, SRM and glacial interventions.

The paper suggests applying a diversified portfolio to manage climate risks. Under such a portfolio, climate policy has five components. Mitigation remains the primary mechanism for reducing long-term climate change, and adaptation reduces societal vulnerability to unavoidable impacts. CDR addresses legacy emissions. Solar Radiation Management and glacial interventions are potential risk reduction measures during periods of possible climate overshoot.

Both SRM and glacial interventions can reduce climate risks in scenarios where conventional mitigation coupled with CDR and mCDR prove insufficient. Ignoring climate interventions research today increases the likelihood that future decisions would occur under crisis conditions with inadequate scientific understanding, weak governance, and limited public oversight.

The Climate Risks: Context

Emerging evidence indicates that current climate policy that relies on mitigation (reducing greenhouse gas emissions) and adaptation (reducing vulnerability) may not sufficiently manage extremely high-consequence climate risks such as tipping points.[18] Even if global emissions rapidly decline, the long atmospheric lifetime of carbon dioxide from historical emissions will continue affecting the climate system for decades. Moreover, the IPCC mitigation scenarios for net-zero assume CDR at scale, but in reality that is far away from feasible implementation.[19]

Accelerating ice-sheet loss, increasing climate extremes, and the possibility of crossing Earth system tipping points highlight the importance of preparing for a broader range of future scenarios. As the current evidence suggests that temporary temperature overshoot of the 1.5°C warming limit will be difficult to avoid, managing these climate risks effectively requires that climate policy adopts a

[18]Armstrong McKay, D. I., Staal, A., Abrams, J. F., et al. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points. Science, 377(6611), eabn7950.

[19]IPCC (2022). Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Ed. P.R. Shukla et al., Cambridge University Press.

diversified portfolio.[20] This approach, widely applied in public health, national security, and disaster preparedness, will prevent emergency decision-making under conditions of limited evidence and stress.

SRM and glacial interventions can buy much-needed time to implement the strategies of mitigation, adaptation, and CDR without crossing Earth System tipping points.

SRM

SRM, sometimes referred to as solar climate intervention or solar geoengineering, comprises a class of proposed technologies intended to reduce global temperatures by increasing Earth's reflectivity (albedo) and thereby decreasing the amount of incoming solar radiation absorbed by the climate system. Incoming shortwave solar radiation is partially reflected back into space by clouds, atmospheric aerosols, snow, ice, and other reflective surfaces. SRM should not be a permanent solution to anthropogenic warming, but rather a temporary (at least a several decades of potential deployment to shave off peak temperatures) climate risk reduction measure. SRM encompasses several proposed techniques intended to modestly reduce incoming solar radiation (by about a percent) and temporarily offset a portion of greenhouse warming. Increasing planetary albedo by even a small amount reduces the net energy entering the Earth system and can partially offset warming caused by elevated greenhouse gas concentrations.

Proposed Intervention Strategies[21]

- **Stratospheric Aerosol Injection (SAI):** The most extensively studied approach involves releasing sulfur dioxide or alternative aerosols into the lower stratosphere using a high-altitude aircraft, balloons, or other delivery systems. Once converted into sulfate aerosols, these particles scatter incoming sunlight and increase planetary reflectivity. Climate models indicate that carefully managed SAI (scattering 1% of sunlight) could reduce global temperatures relatively rapidly by 1°C, potentially within months of deployment, while slowing sea-level rise and reducing heat-related climate impacts such as extreme heat, extreme precipitation and strength of hurricanes. While most research has focused on sulfates mimicking natural injections from volcanoes eruptions, the engineered particles are being increasingly studied (e.g., amorphous silica in the case of Stardust Solutions). The choice of the materials used will determine the risk profile of SAI.
- **Marine Cloud Brightening (MCB):** Marine cloud brightening seeks to increase the reflectivity of low-lying marine clouds by introducing sea salt particles that act as cloud condensation nuclei. Brighter clouds reflect more sunlight and could potentially provide regional cooling, particularly over subtropical oceans. Substantial uncertainty remains regarding cloud responses and long-term effectiveness as well as technological readiness.
- **Cirrus Cloud Thinning (CCT):** Unlike SAI and MCB, cirrus cloud thinning seeks to reduce the warming influence of high-altitude cirrus clouds by encouraging the formation of larger ice crystals that fall more rapidly from the atmosphere. It is a form of cirrus avoidance rather than modification. Because cirrus clouds trap outgoing infrared radiation, reducing their persistence

[20] Ibid.; Bustamante, M., et al. (2023). Ten new insights in climate science 2023. Global Sustainability, 7, e19.

[21] For an overview of SRM methods see Edward A. Parson, David W. Keith. 2024. Solar Geoengineering: History, Methods, Governance, Prospects. Annual Review of Environment and Resources 49:337-366. https://doi.org/10.1146/annurev-environ-112321-081911. Space-based methods have also been proposed to scatter or absorb sunlight before it reaches Earth. However, because these methods are unlikely to be feasible in the next quarter century, they are not helpful in the discussion of urgent climate risks reduction measures.

may allow greater heat loss to space. The current understanding of CCT remains considerably less mature than that of SAI.

Current state of research

Current climate model simulations suggest SRM could potentially reduce peak global temperatures, lessen extreme heat events, slow Arctic sea ice loss, and reduce some climate damages during emissions transition. While SRM has the potential to deliver these benefits, it is likely to create changes in regional precipitation, weakening of monsoon systems under some scenarios, alterations to stratospheric ozone chemistry. It is important to note, however, that some of the side effects (e.g., ozone chemistry and acid deposition) arise from the material (sulfate), not from reflecting sunlight as such. Hence, some of the side effects might be minimized if other materials are used. As some of the side effects are problems associated with design rather than fixed properties of SRM, more research can help establish which materials are safer to use. SRM also does not address the problem of continued ocean acidification because atmospheric carbon dioxide concentrations remain unchanged. Furthermore, if SRM (SAI specifically) were to be maintained for decades, and then abruptly discontinued (under a series of unlikely events) while greenhouse gas concentrations remained elevated, a "termination shock" i.e., rapid warming can occur, posing severe ecological and societal challenges. SRM research and potential deployment will also face governance challenges and geopolitical implications that would have to be addressed through transparent decision-making, accountable governance, and international cooperation. Lastly, one important point is worth mentioning regarding the SRM. The Climate Vulnerable Forum recently argued that the planet's albedo is changing and, thus, accelerates global warming. Distinct from any position on climate interventions, the Forum flagged the absence of any albedo or reflectivity item in the UNFCCC process as a governance gap.[22]

Glacial Interventions

Rapid melting of mountain glaciers and polar ice sheets poses one of the greatest long-term climate risks. Unlike SRM, glacial interventions are geographically targeted and aim to reduce localized drivers of ice-sheet instability and glacier retreat. Glacial intervention approaches seek to preserve vulnerable ice masses by modifying the physical processes responsible for accelerated melting. Most proposed interventions seek to reduce contact between warm ocean water and vulnerable glacier grounding lines. The Greenland and Antarctic Ice Sheets together contain enough ice to raise global mean sea level by more than 65 meters if completely melted. While complete melting would require centuries to millennia, accelerating ice loss is already contributing significantly to observed sea-level rise.[23] While glacial interventions are not a solution to anthropogenic warming, it is potentially a high consequence climate risk reduction measure. Given the trillions of dollars in projected coastal infrastructure losses associated with sea-level rise and potential relocation of millions of people from the coastal areas (not to mention potential loss of lives), investments in scientific research may produce substantial societal benefits.

[22] https://cvfv20.org/the-earths-energy-imbalance-and-the-reflectivity-crisis/#

[23] IPCC. (2021). Climate Change 2021: The Physical Science Basis. Cambridge University Press.

Proposed Intervention Strategies

- **Subsea Barriers:** Numerical simulations suggest that underwater berms or sills constructed on the seabed could reduce warm-water intrusion beneath ice shelves, thereby slowing basal melting and delaying glacier retreat.
- **Artificial Pinning Points:** Some ice shelves naturally stabilize when grounded on underwater ridges. Artificially constructed pinning points could potentially replicate this stabilizing mechanism by reducing ice flow toward the ocean.
- **Ice Shelf Stabilization:** Engineering concepts have also explored reinforcing floating ice shelves through localized structural modifications that increase resistance to fracturing and calving.
- **Surface Hydrology Management:** Because surface meltwater can penetrate through crevasses and accelerate glacier flow via hydrofracturing, proposals have examined engineered drainage systems to reduce meltwater accumulation on vulnerable ice shelves.

Current state of research

Although still highly experimental, modelling suggests that some interventions could meaningfully delay ice sheet collapse if technically feasible. Research on glacial interventions remains in its infancy compared with SRM. Existing evidence consists primarily of numerical ice-sheet models, oceanographic simulations, and engineering feasibility assessments. However, substantial uncertainties remain regarding engineering feasibility, construction logistics, environmental impacts, ecological consequences, costs, and long-term effectiveness. Unlike SRM, glacial interventions would require large-scale infrastructure in remote and environmentally sensitive polar regions, presenting significant operational and governance challenges. Thus, research is needed to determine engineering feasibility, environmental impacts, costs, governance and international legal requirements.

Marine CDR

mCDR techniques are gaining attention as potential tools to mitigate climate change by enhancing the ocean's natural capacity to remove and store CO_2. However, the potential deployment of these techniques raises complex legal, ethical, and policy questions that must be addressed to ensure responsible and effective implementation.

Proposed Intervention Strategies

- **Ocean Alkalinity Enhancement:** this approach aims to accelerate the ocean's ability to absorb and sequester carbon dioxide from the atmosphere by adding alkaline substances to seawater.
- **Ocean Fertilization:** Adding nutrients such as iron would stimulate the growth of phytoplankton that take up CO_2 through photosynthesis.
- **Direct ocean carbon removal:** similar to land base technologies that capture carbon at site, there are methods that would extract dissolved CO_2 from seawater
- **Blue Carbon Restoration:** methods involve restoring coastal ecosystems such as mangroves, seagrass meadows, and salt marshes, which can capture and store carbon.
- **Seaweed and Kelp Farming:** These marine plants have the capacity to absorb carbon via photosynthesis.

The mCDR research is a lot less controversial than the SRM and glacial interventions. Nevertheless, more research is needed to establish scalability, environmental impacts, ability to permanently store

carbon as well as to analyze the patchwork of existing legal regulations (e.g., BBNJ, the London Protocol) and their applicability to regulation of mCDR, especially in the high seas.

Diversified climate portfolio: SRM and glacial interventions as risk reduction measures

Research on climate interventions should be understood as a sequence of steps such as modelling, lab work, contained testing and outdoor experiments. Each step carries different risks and requires oversight specific to the step. Calls for expanded research are often misunderstood as advocacy for implementation and deployment. In reality, rigorous research provides the evidence needed to determine whether proposed interventions are effective, safe, economically feasible, ethically acceptable, and suitable approaches to achieve climate goals. Moreover, without recognizing the importance of incorporating SRM and glacial interventions in global climate policy, governance frameworks and international agreements to ensure safe, transparent and responsible research and potential deployment are unlikely to be developed.

Within the framework of a diversified portfolio to manage risks, SRM and glacial interventions occupy a distinct category compared to mitigation, adaptation and CDR. SRM and glacial interventions are potential risk reduction measures intended to lessen the probability or severity of high-consequence outcomes during periods of climate overshoot. SRM offers the potential for relatively rapid global cooling but introduces uncertainties related to atmospheric chemistry, precipitation, geopolitical governance, and termination effects. Glacial interventions, by contrast, are geographically localized and directly target mechanisms contributing to sea-level rise, but face considerable engineering and ecological uncertainties. Neither approach addresses the root cause of climate change nor eliminates the need for emissions reductions.

A diversified portfolio perspective therefore evaluates these interventions not in isolation but as complementary to existing climate strategies. From a risk management standpoint, research on SRM and glacial interventions functions as an investment in scientific preparedness. Analogous to vaccine research during public health planning without expecting a future outbreak or earthquake engineering without expecting seismic disasters, SRM and glacial interventions research will build knowledge before emergencies might arise.

The governance of the expanding research will require careful attention to common concerns such as moral hazard, slippery slope, risk of unilateral action and lack of transparency and accountability. Moral hazard, the possibility that research alone could reduce incentives for emissions mitigation, remain central to the opposition to climate interventions. However, properly designed governance can explicitly position SRM and glacial interventions research as a complement and not an alternative to aggressive decarbonization. Research funding should therefore be integrated within broader climate strategies that prioritize rapid decarbonization. Additionally, linking SAI authorization to emissions reduction performance as well as prohibiting any commercial models such as cooling credits can limit the risk of moral hazard.[24] Slippery slope arguments are often used to oppose climate interventions on the grounds that research will ultimately lead to deployment. However, as the empirical evidence shows some technologies were never developed and deployed despite the research into them. Moreover, viewing research as a sequence of steps can allow for “exit ramps” at any given stage preventing lock in situations. Another worry, the potential of a unilateral action by individual states or

[24] Dye, Jorden. Solar Radiation Modification Primer: An introduction to mechanisms, impacts, and governance. The Pembina Institute, 2026.

non-state actors can be minimized by international collaboration and scientific cooperation to build trust and reduce the risks of a state going rogue. The unilateral action problem is also not supported by the fact that, at least in the case of SRM, an effective deployment will require international collaboration.[25] Additionally, the unilateral-action concern can be addressed by monitoring and attribution - the ability to detect, track and attribute what is in the stratosphere (which will depend on the materials used in SAI). Lastly, any development of climate interventions with high stake consequences calls for transparent and accountable governance. In practice, this calls for independent oversight, open publication of results, measurement and monitoring capabilities in place, and meaningful public engagement.

Importantly, the central issue of any development of governance of climate interventions is the discussion of justice and equity. The geographic and intergenerational distribution of burdens and benefits of climate interventions, especially of SRM, is not uniform. It is essential that the most vulnerable to climate change risks regions have voice and ability to impact decision-making over the research of climate interventions.[26] Some of the main questions that should guide ethical and responsible governance of climate interventions are: who participates, who gains and bears risks, whose knowledge and authority count, and who inherits dependence and termination risks.

In sum, under the diversified portfolio framework, SRM and glacial intervention research should be viewed not as a substitute for mitigation but as complementary components of prudent climate risk management. Developing scientific understanding today will reduce the likelihood that decisions concerning potentially consequential interventions are made during periods of acute climate crisis with inadequate evidence. Governance can evolve alongside research to ensure inclusive international decision-making to allow for the most vulnerable communities to shape future development of climate interventions.

Policy Implications

A path toward a more comprehensive climate policy that includes evidence informed discussions on SRM and glacial interventions' feasibility, desirability and acceptability, calls for investment in research on SRM and glacial interventions. To ensure that this research is done in a responsible and accountable way that also minimizes the risks associated with climate interventions:

- Climate interventions research should be explicitly framed as complementary to rapid greenhouse gas emissions reductions. Policy statements, funding mechanisms, and governance frameworks should consistently reinforce that long-term climate stabilization ultimately depends on achieving net-zero emissions. Additionally, authorization to engage in SAI research may depend on mitigation performance.[27] Lastly, stopping at any stage must always be a legitimate outcome to ensure that research is not a presumption in favor of deployment.
- Governments should establish coordinated interdisciplinary research programs on SRM and glacial interventions involving atmospheric science, glaciology, engineering, ecology, economics, law, political science, and ethics.

[25]Joshua B Horton I, "Geoengineering and the Myth of Unilateralism : Pressures and Prospects for International Cooperation" 6, no. October 2010 (2011): 56–69.

[26]The Degrees Initiative is one such example. The non-profit builds research capacity and engages policymakers and scientists in developing countries to evaluate SRM.

[27]Parson, E. A. (2014). Climate engineering in global climate governance: Implications for participation and linkage. Transnational Environmental Law, 3(1), 89–110.

- Given the transboundary implications of climate interventions, research should emphasize international collaboration through institutional platforms, such as WMO, UNEP, IPCC, ATS and the Arctic Council (for glacial interventions) among others. A practical first step would be joint research programs and shared data among a group of willing states, with the most climate-vulnerable countries included from the start. Collaborative research will enhance transparency and strengthen global scientific capacity, and governance can develop alongside with the research.
- Governments and international institutions should establish governance frameworks that would define research standards, transparency requirements, public participation mechanisms, international oversight arrangements, and decision-making processes for any future consideration of deployment.[28] Importantly, a responsible governance will require technology to detect, measure and if possible - also attribute aerosols in the stratosphere in the case of SAI - who released what, where and how much. Without it, research standards and oversight arrangements are harder to verify.[29]

Conclusion

Climate change presents an increasingly complex cluster of risks that may exceed the capacity of mitigation, adaptation, and CDR efforts. Research into SRM and glacial interventions should therefore be understood as risk management rather than endorsement of deployment. Developing scientific understanding today will allow future policymakers to make informed, evidence-based decisions under transparent governance rather than responding to climate emergencies with inadequate information. A balanced climate policy portfolio should continue prioritizing emissions reductions while responsibly investigating additional tools that may one day help reduce the probability of catastrophic climate outcomes.

SRM and glacial interventions represent two fundamentally different classes of potential climate interventions. SRM seeks to modify Earth's radiative balance through temporary reductions in absorbed solar energy, while glacial interventions aim to slow specific processes contributing to irreversible ice-sheet loss and sea-level rise. SRM and glacial interventions remain experimental, both involve substantial uncertainties, and neither addresses the root causes of climate change. However, both require rigorous scientific investigation because they may expand future policy options during periods of elevated climate risk. SRM and glacial interventions can buy much needed time to successfully implement the strategies of mitigation, adaptation, and CDR without crossing Earth System tipping points.

Climate policy should integrate aggressive emissions reductions, adaptation, carbon dioxide removal, and responsible research on climate interventions. Whether SRM and glacial interventions ultimately prove feasible, unacceptable, or unnecessary, expanding knowledge will strengthen our capacity to respond to an uncertain climate future. Accepting the necessity of research on climate interventions does not predetermine outcomes of deployment. Instead, it will allow for future decisions to be guided by scientific evidence rather than urgency. Climate intervention research represents preparedness, not commitment. Lastly, preparedness should also mean preparedness for ethical decision, not only

[28] Although domestic legislation, what "research standards" and "transparency requirements" can look like in practice, is illustrated in Tracy Hester and Craig Segall's model bill for Texas (30 June 2026). It sets out: (a) permits for releases above a defined threshold; (b) a public register of applications and decisions; and (c) penalties for unpermitted activity. See https://law.uh.edu/eenrcenter/SRM-Texas-White-Paper-final-20260630.pdf.

[29] Waxman, Matthew C. and Spector, Amyad and Kushnir, Doron and Yahav, Robert, From Particles to Policy: Technical Building Blocks for Multi-State SAI Coordination (May 21, 2026). Columbia Public Law Research Paper No. 6814063, Available at SSRN: https://ssrn.com/abstract=6814063.

preparedness for technological choice. Thus, governance of climate interventions research should be guided by the questions of whose time climate interventions might buy, under whose authority, at whose risk, and for what political purpose.

PSSG 6: DEVELOPING RENEWABLES IN AFRICA

Grids, Finance and Distributed Solutions



IN COLLABORATION WITH TUTORS AND STUDENTS OF SDA BOCCONI SCHOOL OF MANAGEMENT, IN PARTNERSHIP WITH RES4AFRICA

Student rapporteurs: Melody Dean, Shrikant Bacha, Federico Puteri and Katrina Davis.

Abstract[30]

Strong renewable resources do not automatically produce financeable electricity projects. This brief examines how risks are allocated and public support is structured across eleven utility-scale solar photovoltaic projects in Morocco, Egypt and Tunisia. It brings together a comparative project database and the SolarRisk Calculator, a model for testing financing scenarios. The cases reveal distinct state-led, sovereign-guaranteed and development-finance-led approaches, with important differences in private participation, disclosure and time to financial close. The findings support testing bankability before procurement, directing support toward binding risks and reporting public exposure transparently.

Context and research purpose

Solar photovoltaic generation requires substantial investment before it earns revenue. Expensive finance, short loan maturities or uncertain payment arrangements can therefore weaken a project even where sunlight is abundant. Our central argument is that credible risk allocation is an actionable condition for bankability: investors need confidence that contracted revenues, infrastructure and public obligations will support repayment under plausible downside conditions. Sound underlying economics, community support and environmental safeguards remain necessary.

The research asks which risks constrain investment, how those risks are divided among parties, how public support changes financing outcomes, and which lessons can improve subsequent procurement. We compare eleven projects representing approximately 1 GW and USD 1 billion of investment, as reported in the full study. Morocco, Egypt and Tunisia provide contrasting financing arrangements within electricity systems where public entities play a central purchasing role.

The work developed in three stages: compiling publicly documented project information, comparing financing and contractual arrangements, and calibrating a cash-flow model to test alternative support packages. The database records project costs, financing sources, tariffs, milestones, risk protections and disclosure gaps. Financial close is the main reference milestone; where unavailable, the nearest documented loan-signing milestone is identified in the full paper.

Projects were selected for available financing documentation, so development finance institutions are over-represented. All eleven reached financial close and ten were operational at the study date. The comparison describes successfully financed projects; it does not establish why other projects failed or represent national markets. Storage projects were excluded for comparability.

Eleven Case Studies, Three Financing Models

The same technology is financed through different institutional arrangements. Power purchase agreements (PPAs) establish the buyer's payment obligations and allocate material risks. Their value to lenders depends on the financial strength of the buyer, the enforceability of the contract and the credibility of any public support.

[30] From resource potential to bankable power: financing utility-scale solar in North Africa. Risk allocation, derisking instruments and the cost of capital in Morocco, Egypt and Tunisia. By Katrina Davis, Shrikant Bacha, Melody Dean and Federico Puteri, SDA Bocconi School of Management (MSM), October 2026.

Morocco

The Moroccan sample comprises Noor Ouarzazate IV, Noor Laayoune, Noor Boujdour and Noor Tafilalt. For the first three, Masen combines procurement, purchasing, lending and a minority equity stake. Development lending and state-backed funding support the structure, while dirham financing matched to dirham revenues reduces currency mismatch at project level. Noor Tafilalt follows a separate public model: ONEE owns the project, financed through World Bank and Clean Technology Fund loans under a sovereign guarantee, without a PPA. Public institutions consequently retain substantial exposure.

Egypt

Kom Ombo, Al Subh and ACWA Benban One operate as independent power producers selling to EETC. All three benefit from Ministry of Finance guarantees of the buyer's obligations. Dollar pricing or indexation shifts much of the currency exposure toward the buyer. Development-finance-led lending and political-risk insurance support participation by commercial financiers. Shared grid infrastructure at Benban also addresses part of the connection challenge. This combination produces the highest private participation among the selected country samples.

Tunisia

Tozeur, Sidi Bouzid I, Kairouan and Sidi Bouzid II rely on concession arrangements with STEG, development finance and concessional funding. MIGA political-risk insurance covers equity in all four. Sidi Bouzid II also benefits from EU-backed lending and a grant for grid connection. However, the public documentation does not disclose payment guarantees or long-dated currency hedges; three projects have dinar revenues against euro debt.

Note: These are disclosure gaps requiring investigation, not evidence that protection is absent.

Exhibit 1. Selected projects differ in financing structure and private participation

Indicator	Morocco	Egypt	Tunisia
Projects in the sample	4	3	4
Average debt share	85%	76%	67%
Average public and DFI share	87%	41%	69%
Private USD per public or DFI USD	0.13	1.82	0.46
Average reported tariff	5.4 US¢/kWh	6.4 US¢/kWh	3.1 US¢/kWh

Simple averages of selected projects and disclosed values, not national averages. Private/public figures are averages of project ratios; contingent guarantees are excluded. Tariffs differ in currency, indexation and contractual context and are not a like-for-like measure of efficiency. DFI = development finance institution.

Comparison and Cross Case Findings

The SolarRisk Calculator translates the database into a project-finance cash-flow model using project costs, expected output, tariffs, capital structures and taxes. Commercial debt pricing combines a benchmark rate and lender margin with sovereign, buyer, currency and construction risk premiums. Several premiums and instrument terms are assumptions because actual financing prices are unavailable. Five support levers are tested: capital grants, concessional loans, guarantees, first-loss reserves, and foreign-exchange and liquidity cover.

Testing repayment and investor requirements

The model applies three tests: minimum debt-service coverage, an equity-return requirement and a target for the weighted average cost of capital (WACC). Debt-service coverage is cash available for debt service divided by principal and interest due. The model uses minimum thresholds of 1.3 times in Morocco, 1.2 in Egypt and an assumed 1.25 in Tunisia. Required equity returns are approximately 11% in Morocco and 17.5% in Egypt and Tunisia, based on country-risk benchmarks rather than observed sponsor requirements.

Exhibit 2. Commercial financing assumptions expose repayment constraints

Model output	Morocco	Egypt	Tunisia
Average unsupported WACC	7.7%	12.8%	13.4%
Assumed minimum debt-service coverage	1.30×	1.20×	1.25×

Results are modelled counterfactuals, not observed financing costs. Across all eleven cases, unsupported minimum debt-service coverage ranges from 0.44× to 1.07×, below the relevant thresholds.

At contracted or reference tariffs, every case fails the debt-service test under commercial financing assumptions. With support, nine of eleven pass all three tests. The least costly packages among those tested have modelled public costs of approximately 12–15% of project cost in Morocco, 12–13% at the two Benban plants, 37% at Kom Ombo and 41–42% at Kairouan and Sidi Bouzid II. These estimates depend on the instrument pricing and assumptions used; they are not observed subsidies or comparable national averages.

For Tozeur and Sidi Bouzid I, no tested package achieves the required equity return at 2.7 US cents/kWh. Both nevertheless reached financial close, indicating that actual financing or sponsor requirements differ from the assumptions. All successful modelled packages include substantial concessional debt; guarantees and currency cover also enter selected combinations. Because the model evaluates packages, it does not identify the independent effect of each instrument.

Using the tool appropriately

Users can compare unsupported finance, the least costly tested package and a chosen mix, including sensitivity to depreciation, lower output and interest-rate shocks. The tool supports dialogue before procurement; it does not recover actual project financing costs, establish a global optimum or determine fiscal affordability. Matching the contracted tariff is part of the model's design, not independent validation. Market evidence should replace assumed premiums wherever possible.

Implications for policy and investment

Test finance and contracts before tender

Governments and development institutions should test proposed tariffs and financing structures with lenders before procurement. Payment security, currency treatment, connection deadlines, dispatch and curtailment rules, termination provisions and land requirements should be settled sufficiently early to support credible bids. This also helps reconcile different public and private perceptions of risk. A low bid is of limited value if the resulting contract cannot attract finance or deliver electricity.

Build reusable agreements and institutional capacity

Standard PPAs, concessions and direct agreements can reduce repeated negotiation and make subsequent rounds easier to finance. Public agencies also need the capacity to prepare sites, coordinate network investment and meet contractual obligations. The selected cases suggest that repeat transactions can benefit from accumulated experience, although templates must remain appropriate to the technology, legal system and counterparties. Contractual clarity requires institutions capable of implementation.

Target support and disclose its costs

Support should respond to the binding constraint. Concessional debt can improve pricing and tenor; guarantees can cover specified payment or public obligations; currency instruments can address mismatches; and funded grid works can remove connection barriers. Packages should be compared against alternatives such as better preparation or contract reform. Decisions should report funded costs and contingent exposure, alongside private investment and consumer affordability. Risk transfer changes who bears a loss; it does not necessarily reduce that loss.

Where commercially feasible, a minimum disclosure standard should cover debt tenor and indicative pricing, tariff indexation, payment security, grid responsibilities, curtailment and key repayment assumptions. This would allow procurement agencies to benchmark new transactions and assess whether support addresses the risks investors consider material. Publicly accessible tools and consistent definitions can improve comparison, provided their assumptions remain transparent.

Assess regulation through its effects on cash flows

Feedback on the research calls for a more explicit treatment of regulation. The next analytical step is to distinguish rules on paper from implementation and connect reforms to measurable effects. Faster permitting can reduce development costs; credible connection obligations can reduce revenue delays; and enforceable tariff or compensation rules can change downside cash flows. Any additional reduction in financing margins should be supported by lender evidence, avoiding double counting benefits already included in revenues or costs.

Regulatory design must also preserve affordability and accountability. Foreign-currency indexation protects investors but can increase pressure on utilities and customers. Curtailment compensation protects revenue but may require public payment for unused output. Evaluating these arrangements therefore requires a system perspective that includes network investment, utility finances and the distribution of costs. The same logic applies to electricity trade with Europe: credible buyers can attract investment, but interconnection risks and domestic supply needs must be addressed.

Broader applications and further research

Discussion of the findings broadened the research agenda to reliable electricity across technologies and project sizes. Applying the framework more widely requires new evidence and financing assumptions.

Choose technologies around the service required

Solar, wind, geothermal and hydropower should be assessed alongside storage, grid reinforcement and demand management. The relevant comparison is the cost of meeting a defined electricity need at an acceptable level of reliability. Generation profiles, local resources, environmental constraints and operating requirements differ. The IEA's Africa Energy Outlook identifies complementary roles for main-

grid extension, mini-grids and stand-alone systems. These alternatives require different revenue models and financing structures. [1]

Develop modular systems and local networks

Modular solar and batteries can support staged expansion, while mini-grids combine generation with distribution, metering and customer service. Stand-alone household systems serve another segment. Financing must reflect demand growth, customer collections, appliance requirements and maintenance. National electrification plans should define how mini-grids integrate with future main-grid expansion, including interconnection or compensation arrangements where appropriate. Clear rules can reduce the risk of stranded investments. [2,3]

Existing business models provide candidates for further study. Release by Scatec offers pre-assembled, movable solar and battery equipment through leasing for utilities and mining customers. PowerGen's January 2025 platform announcement targeted a 120 MW portfolio of distributed generation, mini- and metro-grids, commercial supply and storage. These illustrate different approaches to modular assets and portfolio financing; the announced target is not completed capacity, and neither model was evaluated in the original sample. [5,6]

Finance operation and renewal throughout asset life

The discussion of Kenya's geothermal experience highlighted the importance of maintenance and renewal. A documented illustration is KenGen's March 2024 announcement of rehabilitation of the original Olkaria I units, intended to increase the older plant's capacity from 45 MW to approximately 63 MW. The first unit entered service in 1981. This is evidence of lifecycle investment needs, rather than a general conclusion about geothermal performance. [4]

Future assessments should distinguish geothermal resource and drilling risks from operating costs, steam-field management and rehabilitation. Solar and battery projects require attention to degradation, component replacement and local repair capability. Costed maintenance plans, replacement reserves and clear operator responsibilities should be tested against prolonged outages and lower output. Adding these features would extend the model from financing a plant to sustaining its service.

Conclusion

The study provides a framework for comparing risk allocation and testing support packages under explicit assumptions. Its findings support earlier bankability testing, reusable contracts, targeted public support and better disclosure. Extending the analysis to regulation, modular systems and operating performance can connect financing more closely to dependable electricity. This requires evidence from different technologies and business models, including delayed and unsuccessful projects.

References

[1] International Energy Agency (2022). Africa Energy Outlook 2022. Key findings on electricity access, generation technologies, energy efficiency and system integration.

[2] World Bank (2022). Solar Mini Grids Could Power Half a Billion People by 2030 – if Action is Taken Now. 27 September. Summary of the ESMAP handbook Mini Grids for Half a Billion People.

[3] World Bank / ESMAP (2018). Mini Grids and the Arrival of the Main Grid: Lessons from Cambodia, Sri Lanka and Indonesia. Technical Report 013/18. Used for integration and exit options, rather than as a statement of current African law.

[4] KenGen (2024). KenGen Awards Contract to Upgrade Oldest Geothermal Power Plant in Olkaria. 19 March. Announcement of planned asset rehabilitation.

[5] Scatec (2023). Flexible solar leasing solution Release by Scatec closes USD 102 million capital financing round. 27 October. Company description of the equipment and leasing model.

[6] Private Infrastructure Development Group (2025). Africa: Transformative renewable energy platform established by PowerGen and leading investors to scale clean energy access across the continent. 17 January. Announcement of the planned 120 MW platform.

The SolarRisk model is summarised as reported in the full study; it has not been recalibrated for the additional technologies or business models discussed in this brief. Figures refer to the study dataset and its stated scenarios, not current market-wide estimates.

THE PLENARY SESSIONS

THURSDAY 15 OCTOBER · PRESENTATION OF THE VISION–BCG PAPER

The mobility of the future: between science fiction becoming true and inertia holding us back

In partnership with ***BCG.***
Chair: ***Laura Hood*** *(The Conversation).*
Introduction: ***Giuseppe Collino*** *(Managing Director and Senior Partner, BCG) and* ***Francesco Grillo*** *(Director, Vision).*
Discussants: ***Pierfrancesco De Rossi*** *(CEO, Siemens Mobility Italy) and* ***Frans-Anton Vermast*** *(International Smart City Ambassador, advisor to Amsterdam City Council).*

The session presented the Vision–BCG paper on the mobility of the future. Public debate on mobility tends to be dominated by the question of electric versus non-electric cars, but this is only a fraction of what is actually changing. The broader transformation involves a shift from private ownership to sharing, the arrival of self-driving vehicles, vehicles able to make use of empty space, and the redesign of infrastructure and cities as a whole. The paper proposes a flexible roadmap built around three dimensions: technology, ownership and service models, and system integration. Every innovation is assessed against three criteria: accessibility, efficiency and quality of life. The starting point is a striking measure of inefficiency: today a car is parked about 95% of the time and, when it does move, it runs at roughly a quarter of the speed it was designed for.

Introducing the paper, Giuseppe Collino of BCG framed mobility as a system-level challenge. Changing a single vehicle, street or rule may bring improvements in isolation, he explained, yet still make the overall system work worse. Economists are good at understanding how systems function, but much less adept at managing the transition from one system to another, and it is precisely this transition that represents the real challenge.

Pierfrancesco De Rossi, CEO of Siemens Mobility Italy, argued that the first step should be to get more out of existing infrastructure before building new. New infrastructure is costly, generates emissions and, in some cities, is simply not feasible. In his view, relatively small measures can make a significant difference, such as repairing trains more quickly or optimising rail systems to make the most of existing tracks. Artificial intelligence, he added, can also be used to optimise how these systems operate.

Frans-Anton Vermast, advisor to Amsterdam City Council, identified the shift from ownership to availability as the decisive move. Through shared ownership models, people can still use a car whenever they need one without having to own it, which changes the relationship between individuals and their means of transport.

Despite the focus on technology and infrastructure, the speakers agreed that culture is the hardest part of the transition. Habits and expectations around car ownership are deeply rooted and slow to change. Vermast suggested that incentives can help shift behaviour, pointing to Amsterdam's experience of going as far as paying people to leave their cars at home.

Finally, the discussion emphasised that change should not be imposed from above. For new mobility systems to be meaningful and effective, users must be able to express their needs and interests, so that these systems are designed and optimised around the people who actually use them. The session closed on the idea that the mobility of the future is less a question of which engine powers our cars than of how cities, technologies and citizens can together build a system that works better for everyone.

FRIDAY 16 OCTOBER · INTERVIEW WITH IBRAHIMA CHEIKH DIONG

Loss and damage: turning global solidarity into timely support

*Interview with **Ibrahima Cheikh Diong** (Executive Director, Fund for Responding to Loss and Damage), conducted by **Pilita Clark** (Associate Editor and Business Columnist, Financial Times).*

The Fund for Responding to Loss and Damage is arguably one of the most significant achievements of recent COPs. It is pioneering new ways of fine-tuning its instruments and offers a compelling case study for new forms of global governance. Yet governments' reluctance to commit resources leaves it well short of what is needed, and it faces governance challenges within the landscape of multilateral climate funds and the UNFCCC. In this interview, the Fund's Executive Director reflected on its journey so far and on the changes planned for the future. Three priorities emerged from the conversation: expanding the Fund's resources, accelerating access to support, and keeping human needs at the centre of implementation.

The discussion began by clarifying what loss and damage actually means. It covers the impacts that neither mitigation nor adaptation can prevent. These include economic damage to homes, infrastructure and livelihoods, but also non-economic losses that affect lives, cultural heritage, identity and communities' connection to the places they live. Such losses cannot easily be given a monetary value, and responding to them requires approaches that recognise this.

Diong described the Fund as a landmark mechanism for global solidarity. Established at COP27 in 2022 and made operational at COP28 in 2023, it relies on voluntary contributions and currently counts 27 contributing partners, including Italy. Building its governance structure took time, which, as the interview made clear, makes the urgency of now delivering support all the greater.

The gap between available resources and demand was a central theme. As of 31 July 2026, pledges amounted to US$822.71 million, of which around US$486 million had actually been received. Meanwhile, 176 funding requests from 119 countries, together worth US$2.8 billion, had entered the pipeline. Under the initial Barbados Implementation Modalities, the Fund provides between US$5 million and US$20 million per activity, project or programme. This ceiling, it was explained, applies to individual interventions rather than to a country's overall needs.

Speed was another key concern. Diong stressed that the Fund's decisions shape people's ability to recover, rebuild their livelihoods and keep their communities together, so delays have real human consequences. He called for simpler and faster processes that nonetheless preserve due diligence, financial accountability and environmental and social safeguards.

The interview also addressed the type of finance the Fund provides. Its initial modalities are based on grants, which countries may combine with other instruments as part of broader programmes. For this reason, any combined package should clearly state which part is a grant, which part is a loan, and what each component finances.

Looking ahead to COP31, the priority is coordination and implementation. Delivering support depends on close cooperation with national governments, ministries and focal points. Stronger coordination among the five multilateral climate funds (the Adaptation Fund, the Climate Investment Funds, the Fund for Responding to Loss and Damage, the Global Environment Facility and the Green Climate Fund) could help connect their mandates and reduce fragmentation. The goal for COP31 is to mobilize additional resources, shorten decision times and demonstrate that international commitments translate into practical support for the world's most vulnerable people.

PLENARY 1 · FRIDAY 16 OCTOBER, 10:35–11:35

Insurance at a strategic crossroad: climate unpredictability, new products and artificial intelligence as a trigger of personalized risk management

*In partnership with **AXA**.*
*Chair: **Pilita Clark** (Associate Editor and Business Columnist, Financial Times).*
*Introduction: **Francesca Maria Claudio** (Partner, McKinsey & Company)[31], **Rithika Clifford** (Vision) and **Maud Deschamps** (Chief Customer, Brand and Sustainability Officer, AXA Europe & Health).*
*Discussants: **Lucia Silva** (Generali), **Alessandra Peres** (Swiss Re Corporate Solutions), **Dario Mangilli** (IMPact SGR) and **Colin Mayer** (University of Oxford).*

Two disruptions are reshaping the foundations of insurance. Climate change is making forecasts based on the past less reliable, and artificial intelligence is making it possible to assess and manage risk individually, which could change the nature of a business built on pooling and mutualising risk. As extreme weather becomes more frequent and costlier, entire areas are becoming harder to insure. The plenary asked how insurers can move from paying for losses to preventing them, how public and private actors can share the burden, and what role new products and technologies can play.

Opening the session, Francesca Maria Claudio of McKinsey set out the scale of the problem. Natural catastrophe losses are rising in both frequency and severity, and a large share of them remains uninsured. In parts of the United States, insurers are already withdrawing from high-risk areas, an early sign that some places are becoming uninsurable.

Rithika Clifford of Vision presented the Vision paper, which proposes that insurers move from paying for losses to managing risk together with their customers. AI-supported assessment can tell neighbouring risks apart, so that cover can stay available in exposed areas, while verified prevention leads to fewer losses and better terms. In this model, public policy funds extreme losses and rewards prevention, and the same approach can extend beyond climate to health and life insurance.

Maud Deschamps of AXA presented the company's investment in resilience as an example of insurers widening their role in prevention and mitigation. She described sustainability as a pillar of the sector's long-term viability.

Colin Mayer of the University of Oxford argued that the sector now faces radical uncertainty. Known unknowns are becoming known, but unknown unknowns are becoming harder to foresee. He recalled Jack Hirshleifer's insight, more than fifty years old, that better information can undermine insurance itself: once risks are clearly known, some places become uninsurable. His response was rapid learning after events, fast experimentation and knowledge transfer, an area in which he saw the private sector as better placed than central government.

Lucia Silva of Generali discussed parametric insurance, a hybrid between a financial product and insurance that pays out on a predefined trigger without requiring proof of loss. She also stressed that AI should work alongside human judgement rather than replace it. AI is strong at analysing the past, but understanding specific local conditions still requires people.

[31] The background paper on insurance was developed with McKinsey as a thought partner.

The discussion then turned to who should carry rising losses. Pooling high-risk exposures with lower-risk ones can help spread them, and the public sector can transfer resources from the fortunate to the unfortunate. Small and medium-sized businesses were singled out as especially exposed: few are insured against natural catastrophes, and many that acknowledge the risk still do not buy cover. Speakers also traced the wider economic effects, as extreme weather feeds into inflation, notably through food prices, and damage affects livelihoods long after the event itself.

Finally, the panel looked at what would make the shift to prevention possible. AI was presented as a tool for preventing losses, not only for pricing them. Participants noted that there is no standard resilience certification comparable to energy-performance ratings, and that regulation will reshape insurers' legal framework and liabilities. Delivery will depend on partnerships between insurers, public authorities, consultancies and the contractors who carry out prevention work.

Overall, the session made clear that insurance is moving from compensating losses towards preventing them. Keeping risks insurable will depend on combining AI with human judgement, sharing the burden fairly between public and private actors, and building the partnerships that turn prevention into practice.

PLENARY 2 · FRIDAY 16 OCTOBER

Cloud, AI and the climate transition: turning AI's energy challenge into efficiency, resilience and measurable climate value

In partnership with ***Sustainable AI Group****.*
Chair: ***Rachael Jolley*** *(The Conversation).*
Introduction: ***Sasha Luccioni*** *(Sustainable AI Group) and* ***Linus Wendel*** *(Vision).*
Discussants: ***Boris Gamazaychikov*** *(Sustainable AI Group),* ***Andrew Wyckoff*** *(EUI, former OECD),* ***Colin Mayer*** *(University of Oxford),* ***Giovanni Caturano*** *(MARE Group).*

Artificial intelligence and climate change are two of the defining issues of our time, and the relationship between them is the subject of a heated debate. On one side, AI is cast as an environmental villain because of its enormous appetite for electricity; on the other, it is hailed as a potential saviour, capable of producing hyper-precise forecasts of where disasters will strike. AI is also becoming a new layer of physical infrastructure, built on cloud capacity, data centres, energy, water and chips, and this is placing growing pressure on power systems and local resources. The plenary asked how AI can expand responsibly, through more efficient design, cleaner energy and transparent measurement, and whether it can move beyond the hype by delivering climate value that can actually be measured.

Sasha Luccioni of the Sustainable AI Group opened by challenging the very notion of "AI" as a single technology. She observed that AI companies are deliberately vague about what they mean by the term, blending large language models and chatbots with very different applications so that the public perceives only one kind of AI. This framing, she suggested, obscures the fact that some forms of AI can be put to work for the benefit of the climate.

Linus Wendel of Vision developed this point by arguing that AI can either help fight climate change or accelerate it, and that the outcome depends on whether it is embedded in the right system and regulatory framework. On the positive side, AI is already making energy grids more sustainable, supporting environmental monitoring and improving adaptation, for instance through more accurate weather forecasts. On the negative side, data servers consume vast amounts of energy that is often not produced sustainably, while water use and pollution remain serious challenges.

Building on these introductions, the panel stressed that not all AI is equal. Large language models and chatbots, speakers argued, contribute little to environmental goals while causing considerable damage through their heavy energy consumption. Other AI deployments, very different in nature but frequently lumped together with them, are the ones most likely to deliver genuine sustainability gains.

The discussion then turned to how AI's energy footprint can be reduced, and the answer was to use the right tool for the right task. Boris Gamazaychikov pointed out that large models are simply not necessary for specialised tasks, and that smaller tasks can be handled on local servers, avoiding the need to send data to a distant server and back. Giovanni Caturano added that optimising data for specific, smaller models can cut energy consumption drastically.

Finally, the panel addressed regulation. Colin Mayer and Andrew Wyckoff highlighted the information asymmetries that make AI difficult to regulate, as well as the fact that information flows freely across borders. As a result, local rules risk simply pushing companies to relocate to jurisdictions with lighter regulation. Mayer and Caturano further noted that some AI applications are both safe and supportive of sustainability, which means regulators must take care to target the right kinds of AI rather than treating the technology as a single whole.

Overall, the session made clear that the climate impact of AI is not predetermined. It depends on which technologies are developed, how efficiently they are designed and deployed, and whether regulation is precise enough to curb the most energy-hungry uses while allowing beneficial applications to grow.

PLENARY 3 · FRIDAY 16 OCTOBER

Small modular reactors at the edge of the energy transition: reliable low-carbon power, industrial competitiveness and the test of technological credibility

*In partnership with the **Institute for Free Enterprise**.*

*Chair: **Matt Steinglass** (The Economist).*

*Introduction: **Christophe Grudler** (Member of the European Parliament, Renew Europe).*

*Discussants: **Liliana Smiech** (Ludovika University of Public Service), **Florian Wagner** (Emerald Horizon).*

Small modular reactors (SMRs) are no longer just a subject of technical debate: they are becoming a strategic choice for Europe. Electricity demand is rising, industrial systems are decarbonising and grids are absorbing ever larger shares of renewables, which makes the need for reliable, low-carbon and flexible power increasingly urgent. Against this backdrop, the plenary asked whether SMRs can genuinely change the course of the energy transition, or whether expectations are running ahead of technological, regulatory and financial reality. The underlying question was under what conditions these reactors can become credible infrastructure for climate neutrality, energy security and industrial competitiveness.

Opening the session, Christophe Grudler, MEP and Renew Europe Coordinator for the Committee on Industry, Research and Energy, argued that the economics of SMRs depend above all on industrialising their production. Rather than building each reactor as a one-off project, the aim is to shift towards factory-based manufacturing, with standardised modules produced at scale and delivered to different sites. This approach, he explained, is meant not only to bring costs down but also to create jobs, skills and industrial capacity in Europe.

Grudler also made the case for European technological autonomy. In his view, Europe should develop its own SMR capabilities instead of depending on suppliers from the United States or China. Framed this way, SMRs sit at the crossroads of decarbonisation, energy security and industrial policy. The question is not only how Europe will generate low-carbon electricity, but also where the technology, the expertise, the manufacturing capacity and the associated jobs will be located.

Florian Wagner, CEO and founder of Emerald Horizon, focused on safety, presenting it as far more than a box to tick for regulators. Safety, he argued, underpins the entire commercial case: without confidence in a reactor's safety, it is hard to establish reliable costs, attract financing or win public acceptance. The technology therefore has to prove that it can move from promise to dependable implementation.

Liliana Smiech, Director General for International Affairs at Ludovika University of Public Service, reminded the audience that SMRs are not a single technology but a family of very different designs. Understanding where each stands today is essential, and deciding which technologies deserve support, and which designs can realistically be deployed at scale, remains one of the sector's most critical choices.

The discussion also turned to the politics of nuclear power in Europe. Member states hold sharply different positions on the technology, and there is a risk that these divisions slow progress. Central and Eastern European countries, for instance, have pursued different nuclear partnerships, including with Russia and the United States. The broader issue is whether Europe can move beyond ideological divides and build a more coordinated approach to nuclear investment, technology selection and industrial policy.

Ultimately, the panel agreed that the decisive test for SMRs is whether they can become bankable infrastructure. Beyond their technological appeal, important questions remain open on construction timelines, costs, regulation, supply chains and public acceptance. Harmonising regulation across countries and replicating the same designs over multiple projects will be crucial if factory-built nuclear is to deliver on its promise and become a commercially viable part of Europe's energy mix.

PLENARY 4 · FRIDAY 16 OCTOBER

The paradox of agrifood: from compliance to regeneration. Corporate strategies for climate-resilient supply chains

In partnership with Cereal Docks.

Chair: ***Andrea Gori*** *(Illuminem).*

Introduction: ***Giovanni Fanin*** *(Cereal Docks) and* ***Vitaliano Fiorillo*** *(Invernizzi AgriLab, Bocconi).*

Discussants: ***Camilla Lunelli*** *(Lunelli Group),* ***Ágnes Kovács Tahy*** *(PPCU),* ***Andrea Illy*** *(Illy Caffè),* ***Suruchi Bhadwal*** *(TERI),* ***Andrea Conzonato*** *(Herita Marzotto Wine Estates).*

Food supply chains link billions of consumers to producers around the world, and the agrifood sector sits at the centre of a paradox: it contributes to greenhouse gas emissions while being among the industries most physically exposed to the climate crisis. Italy's pasta makers illustrate the point, as their core input, durum wheat, has already suffered from drought and heat stress at home. Using Cereal Docks' experience as a case study, the panel asked whether regenerative and circular models, which shift companies from auditing suppliers to co-investing with farmers in soil health, biodiversity and water resilience, can scale quickly enough to outpace the climate risk to crops and be replicated across a fragmented, smallholder-heavy supply base.

The central message was that the sector faces a double challenge. It must reduce its environmental impact while protecting production from the growing effects of climate change. Because climate disruption is now a permanent business condition rather than an exception, companies need to move beyond sustainability commitments towards measurable action, investing in more resilient supply chains, regenerative agriculture and technologies that deliver both adaptation and mitigation.

Opening the discussion, Vitaliano Fiorillo warned that adaptation is not a simple fix. Climate, geopolitics and agriculture are deeply interconnected: new growing areas may open up in northern Europe, for example, but plant diseases can move north as well. The task is to adapt while continuing to mitigate.

Giovanni Fanin, President and CEO of Cereal Docks, described climate change as a permanent condition for the sector, making resilience a business priority. The company is developing regenerative agriculture through a project involving 12 farms and around 1,000 hectares. He emphasised that measuring impact is essential to avoid greenwashing.

Andrea Conzonato brought the perspective of the wine sector, arguing that the priority should be making vineyards more resilient to climate change rather than focusing solely on improving product quality. He echoed the call for tangible results, backed by clear KPIs and rigorous measurement.

Andrea Illy traced a line from initiatives launched around Expo Milan 2015 to later efforts, including a global coffee initiative. The wider ambition, he explained, is to demonstrate that regenerative practices can benefit both agricultural production and the environment, delivering adaptation and mitigation together.

Overall, the session made clear that the transition from compliance to regeneration depends on credible measurement, long-term partnerships with farmers and solutions that strengthen production and the environment at the same time.

PLENARY 5 · FRIDAY 16 OCTOBER, 18:00–19:00

A new Green Deal in a post-2.5 degrees Europe: accelerating and steering the energy transition. The Iberia approach

In partnership with ***Avanza***.
Chair: ***Lucía de Castro*** *(Avanza).*
Introduction: ***Bernardino León Reyes*** *(Future Policy Lab, Avanza; Sciences Po).*
Discussants: ***Roy Cobby*** *(King's College London; advisor to the Spanish Ministry of Social Rights, Consumer Affairs and 2030 Agenda),* ***Simone Gasperini*** *(UCL; IPPR),* ***Luca D'Agnese*** *(Cassa Depositi e Prestiti).*

As the concept paper of the fifth Venice Conference argues, summer 2026 was a violent reminder that Europe is among the regions hit hardest by climate change. According to Copernicus, the continent has already crossed the 2.0-degree red line and is approaching 3.0 degrees above the pre-industrial baseline. Heatwaves are making cities less habitable, excess mortality in June 2026 reached levels comparable to the COVID-19 pandemic, and tourism in Southern Europe is suffering. Against this backdrop, the plenary asked what Europe can do to accelerate mitigation while adapting to a new "normal", and what a new Green Deal might look like if it drew on the experience of the Iberian Peninsula.

The discussion began with the Spanish case as evidence that the energy transition can bring prices down rather than push them up. Energy in Spain used to be very expensive, but policies that drove the expansion of renewables have brought prices to roughly 30% below the European average. The country also benefits from a favourable mix of wind and solar resources.

Speakers stressed, however, that Spain's success was not simply a matter of natural endowment: it was a political project. It rested first on coordination, with a clear signal sent to all actors and the process organised together with every regional parliament and with companies. It relied on ownership, built through the participation of stakeholders, and on policy cohesion, combining incentives with obligations. New welfare plans also raised domestic demand, which, alongside industrial policy, made investment in renewables more attractive.

The panel then turned to the wider European picture. Most of Europe's primary energy still comes from fossil fuels, and the discussion located the roots of this dependence not in policy design but in the liberalisation and privatisation of public energy companies. This has led to fragmentation, to more volatile prices as long-term contracts give way to purchases on the spot market, and to underinvestment in parts of the system that private companies do not find profitable. As a result, energy prices across Europe are beginning to diverge.

Renewables, the panel noted, are already the cheapest source of energy; the real bottleneck is the grid, namely the ability to transport energy and keep the system stable. Speakers also argued that the share of renewables should be measured across all energy use, not only electricity, since focusing on electricity alone can flatter less electrified countries such as Italy.

Spain still imports 68% of its primary energy, which means that greater electrification would directly reduce its import needs.

One concrete proposal put forward was to allow European actors to buy carbon credits outside Europe at a discount. Saving one tonne of CO_2 in Europe costs about five times more than in China; under the proposal, two tonnes saved abroad would count as one tonne of credit, allowing Europe to help accelerate decarbonisation worldwide.

Several questions remained open. Participants asked whether Chinese carbon certificates can be trusted, and pointed out that Europe's goal is energy autonomy, not only lower emissions. The Chinese model also prompted reflection on pricing: there, two grid companies buy, transmit and sell electricity, while four state-owned companies produce it at fixed prices. Fixed prices make conditions easier for renewables, and China's system is moving towards them faster than the EU average, a comparison that raises important questions for the design of a new European Green Deal.

From Venice to Antalya: bringing it all together

The fifth Venice Conference started from a simple observation: after thirty years of COPs the climate problem has not gone away, but the means we have to solve it have not kept up. Institutions built for another century cannot reconcile very different interests, and trust, in each other and in the future, which is what collective action runs on, is in short supply. The six problem-setting/solving groups were asked to turn these failings into concrete proposals, and the plenary sessions to test them against the experience of companies, cities and institutions.

This section brings the work together. Its message is that the groups, working on very different subjects, from a river in Rome to the stratosphere, ran into the same difficulty: the costs of acting are certain and immediate, while the benefits are uncertain and distant. Each proposed a way to start with those who are willing, and to bring the others along.

Six groups, one logic

The table summarises each group's trade-off, proposal and evidence. Read across, three things stand out. The proposals are practical: a costed river service, an integrated sorting line, a test of bankability before tender, a docking station between a coalition and the COP. They are designed to begin without waiting for a universal agreement. And each makes explicit who bears the cost and who carries the risk.

Group	The trade-off	The proposal	Evidence from the group
1. Mobility: the Tiber	Congested roads and an underused river; affordable fares and a viable operator	A DBFOM public–private partnership: 14 electric boats, five pilot stations, resident fare of €1.50, municipal fare compensation	About 71,500 addressable users; load factor 42% / 62% / 83% across scenarios; break-even at about 74%; CAPEX about €44.1 million; 66–72 months to implement
2. Housing: Venice	Preserving the built heritage or keeping it habitable; returns from tourist rentals or homes for residents and students	Pilot retrofits of whole building complexes in four stages; shared-cost financing tied to binding affordability clauses; a permanent body for non-market housing	Historic centre residents down 11% (52,760 to 46,964, 2023–2026); tourist rental beds up 30% since 2019; 19% of residents but 69% of tourist rental beds; sea level rising about 4.8 mm a year
3. Waste: Milan	Energy recovery or material recycling; investment today against value tomorrow	An integrated sorting line built from complementary technologies; an open Excel model for other cities	231 kt of residual waste; up to 64 kt (28%) recovered; about 120 kt CO_2 a year; AI sorter viable only above about 83% efficiency or 57 picks per minute
4. Reforming COP	Universal legitimacy or delivery at speed; formal process or coalitions outside it	Smaller, streamlined COP; seats by emissions for delivery; docking stations for coalitions; consultation rights	198 Parties; the Santa Marta conference gathered 57 countries on fossil-fuel transition; more than 100,000 participants reported for COP31
5. Geoengineering	Reducing catastrophic risk or creating moral hazard and unilateral action	Research as complement to mitigation, in steps with exit ramps, under international oversight	SAI could cool the planet by about 1 °C by scattering about 1% of sunlight; Greenland and Antarctic ice hold more than 65 m of sea-level rise
6. Renewables in Africa	Public cost of derisking or private co-investment; speed or transparency	Test bankability before tender; reusable templates; targeted support; disclosure; the SolarRisk Calculator	Eleven projects (about 1 GW, USD 1 billion); private USD per public/DFI USD: 0.13 Morocco, 1.82 Egypt, 0.46 Tunisia

Aligning the short term with the long term

The first lesson concerns timing. TiberConnect would turn an underused river into a public transport corridor, but its operating result depends on demand. In the group's three scenarios the load factor

ranges from 42% to 83%, and the service breaks even at about 74%. In the base case, with a load factor of 62%, it loses EUR 1.43 million in its first year before any public support and earns EUR 0.75 million after a municipal fare compensation of EUR 2.18 million, which keeps fares affordable for residents and students; only in the optimistic case does it cover its costs on its own (Figure 1, left).

The same logic appears in Africa. In North Africa the sun is abundant and equipment is bought on global markets; what differs is how risks are allocated and priced, and public support is what brings the cost of capital down. The three national models in the eleven solar projects studied differ in how they share the bill (Figure 1, right). In Morocco's state-led model private capital adds only 13 cents for every public or development-bank dollar, in Tunisia's concessions 46 cents, and in Egypt's guaranteed independent producers about USD 1.82. Morocco's model is the fastest to reach financial close, but public money covers most of the cost; Egypt mobilises the most private capital, although part of its public commitment is a contingent guarantee that the ratio does not capture. The question is therefore not whether to support, but to judge support by its funded public cost, the contingent exposure it creates and the private capital it mobilises.

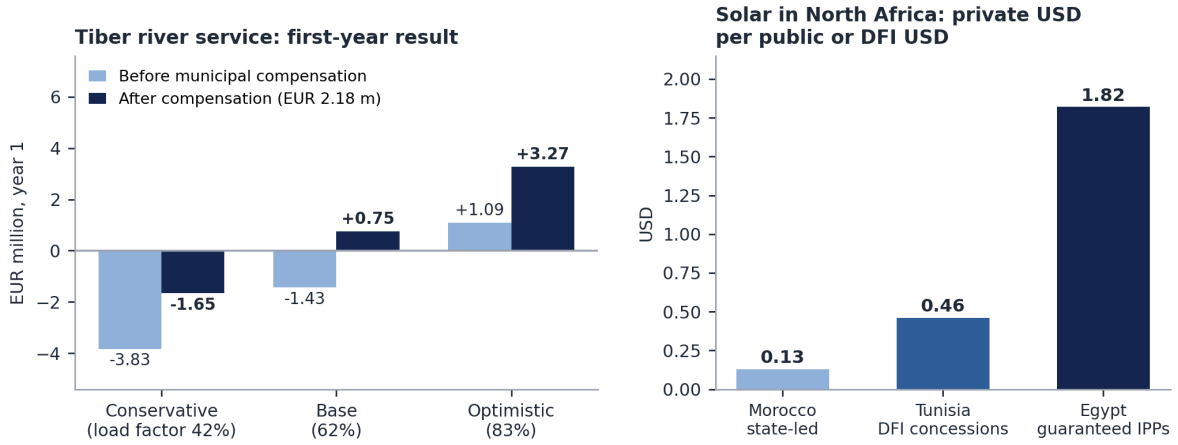


Figure 1. Who bears the cost: the Tiber river service and utility-scale solar in North Africa

Source: PSSG 1 (TiberConnect) and PSSG 6 (SolarRisk) papers, Vision elaboration. Left: year-1 operating result by demand scenario; the service breaks even before compensation at about 74% load factor. Right: private finance per unit of public or DFI finance, average of project ratios.

The waste and geoengineering groups make the same point in other terms. A sorting line for Milan's residual waste could recover up to 28% of its 231 kilotonnes a year and save about 120 kilotonnes of CO_2, but AI robotic sorters become viable for bulk waste only at about 83% efficiency, against 76% today, or at roughly 57 picks per minute, against 52.5. And research on climate interventions should be framed as complementary to mitigation, with authorisation of aerosol research possibly depending on mitigation performance. In each case a threshold, a condition or a compensation links today's cost to tomorrow's benefit.

Venice shows what happens when the short term wins. The resident population of the historic centre fell by 11% in just over three years, to 46,964 in September 2026, while beds in tourist rentals have grown by 30% since 2019; the historic city now holds 19% of the municipality’s residents but 69% of its tourist rental beds. The MOSE barriers buy time against storm surges, but they cannot stop the slow decay of buildings, while relative sea level in the lagoon rises by about 4.8 mm a year, nearly twice the historical average. The group’s answer is to treat housing, climate adaptation and heritage conservation as a single problem: to renovate entire building complexes or street fronts rather than isolated flats, to weigh upfront retrofitting costs against long-term maintenance, and to tie every euro of public support

to binding clauses on rents, residence and maintenance, so that public money sustains the resident community rather than subsidising short-term tourist conversion.

Coalitions, legitimacy and technology with conditions

The second lesson is about who acts. The group on reforming the COP argues that the COP, with its universal participation, should remain the place where goals and timelines are agreed, while delivery moves to a network of coalitions of the willing, organised wherever possible by sector and connected to the formal process through explicit docking stations: submission of outcomes to the incoming presidency, inclusion in the action agenda, recognition in COP decisions, input to the Global Stocktake and interoperability with the enhanced transparency framework. The first Conference on Transitioning Away from Fossil Fuels, held in Santa Marta with 57 countries on an issue the COP had been unable to put on paper, shows that this can be done. It also shows the risk: every coalition of the willing defines a coalition of the unwilling or of the unable, and club diplomacy becomes a cartel of incumbents unless membership is open and results are reported back.

Legitimacy runs through the other proposals too. Observer constituencies need consultation rights, as the Permanent Participants of the Arctic Council have, without a vote. Research on climate interventions needs independent oversight, open publication of results, monitoring and attribution capabilities, and a voice for the most vulnerable countries from the start; stopping at any stage must remain a legitimate outcome. Public support for solar needs disclosure: none of the eleven projects publishes its cost of debt, which makes it impossible to benchmark new tenders against past ones. In Venice the test is the question the group puts at the centre of planning, “who benefits from what?”: the city still lacks a permanent institution dedicated to non-market affordable housing, and every intervention should make clear how its costs, risks and benefits are shared among public bodies, private investors and residents. Measuring, verifying and disclosing is what allows others to learn from the first mover.

Technology, finally, is treated as a means with conditions. Electric boats, robotic sorters, stratospheric aerosols and solar plants all depend on more than the technology: on prices and thresholds, on contracts and grids, on governance. Deployment should be conditional on measurable outcomes.

What the plenaries add

The plenary sessions tested the same ideas from the side of business and policy. The session on mobility, which presented the Vision–BCG paper, stressed that mobility is a system-level challenge, that optimising existing infrastructure comes before building new, and that the key move is from ownership to availability, with culture the hardest part and users given a voice. The insurance plenary showed the cost of waiting: more than half of global catastrophe losses have been uninsured in every year since 2000, non-renewals in the United States are about 80% higher in high-risk ZIP codes, and verified prevention, as in Alabama, cut claims by 55–74%. The agrifood plenary insisted on measurable action rather than commitments, with regenerative agriculture as both adaptation and mitigation. The session on small modular reactors made the bankability point from the energy side: factory-built modules, safety as a condition of commercial credibility, and regulatory harmonisation. And the Iberian case showed that a transition can also be a political project: coordination, ownership through participation and policy cohesion brought Spanish energy prices to about 30% below the European average.

The plenary on cloud and AI, organised with the Sustainable AI Group, applied the same conditional logic to a technology that is becoming a new layer of physical infrastructure. Not all AI is equal: large language models and chatbots contribute little to environmental goals while consuming large amounts of energy, whereas other applications already make grids more sustainable, support environmental monitoring and improve weather forecasts for adaptation. The answer is the right tool for the right task, with smaller, specialised models run on local servers where possible, transparent measurement of energy use, and regulation precise enough to curb the most energy-hungry uses while allowing beneficial applications to grow, bearing in mind that rules set in a single jurisdiction may simply push companies elsewhere.

The interview with the Executive Director of the Fund for Responding to Loss and Damage added the question of speed. As of 31 July 2026 the Fund had received about US$486 million of the US$822.71 million pledged, against 176 funding requests from 119 countries worth US$2.8 billion. Its priorities are to expand resources, to accelerate access through simpler processes that keep due diligence and safeguards, and to coordinate better with the other four multilateral climate funds, because for the communities it serves delays have real human consequences.

From Venice to Antalya: what we ask, and of whom

The Venice Conference takes place weeks before COP31 in Antalya. To the COP31 presidency and the Parties we ask to put on the table a smaller COP with a streamlined agenda and more intersessional work, seats assigned by emissions for the parts of the process that concern delivery, docking stations for coalitions of the willing, and consultation rights for observers. Antalya may and should be the first COP brave enough to pose the question of how to reform itself.

To the European Union we ask to become a strong contributor to the negotiations among the macro-regions of the world and among the main stakeholders, not only to reduce its own emissions; to lead by example in experiments on selected policies; and to use guarantees and grants to fund the grids that make renewable projects bankable. To cities and regions, to open public tenders to partnerships that use underused assets, as the Tiber for Rome, to integrate new modes in one digital platform, and to share data with the operators who can turn residual waste into resources. To companies, lenders and development banks, to co-design problems with universities and public authorities, to test bankability with lenders before tender, to adopt reusable contract templates and to disclose financing terms. And to the research community, to study climate interventions as risk management, with the most vulnerable countries included from the start.

Climate change reminds us that we share a planet, a global environment and a future still to be shaped. Few challenges push us so strongly towards solutions that go beyond borders and ideological confrontation. This is why work on sustainability is a moral imperative, and why it is indispensable to do it with a method capable of crossing generations, countries and professional languages.

THE VISION TEAM

Who worked on this *visionary* project

Francesco Grillo, Director

Francesca Stefani, Communication and Policy Officer Intern

Alice Filippini, Junior Business and Policy Analyst

Linus Wendel, Junior Business and Policy Analyst

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