



CLIMATE REVOLUTION

OUR FUTURE IS RENEWABLE

Biannual magazine of
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in this magazine.



Leaders of the future

The human race has never faced a challenge on the scale of today's climate struggle, but we have never been more powerfully equipped to respond. We will not be saved by scientific ingenuity or technological advances, but by combining our strengths.



**CHRISTIAN
GOLLIER**

Director, TSE

Amid the dire warnings, there lies a glimmer of hope. Younger generations are emerging as powerful catalysts for climate action, mobilizing to demand bold policies, systemic change, solidarity and environmental justice.

Our new magazine is part of a major pivot by TSE towards the leaders of the future. Working across multiple disciplines at IAST and in our new Department of Social and Behavioral Sciences, our researchers can draw on a glittering array of talent, perspectives, and cutting-edge analytical tools. This issue shows how they are tackling the climate crisis.

Younger readers, we want to inform, inspire and empower you to take action. Engage with scientists, wrestle with politics, challenge businesses and demand climate solutions. You can make a difference!

OUR NEW MAGAZINE

In line with TSE's focus on the Common Good, each issue of the TSE Mag aims to increase public understanding on a scientific topic, sharing the insights of our world-class researchers.

We want to hear from YOU! Got an idea for an article? Share it! Confused about a concept? Ask away! Just want to say hi? We're all for it!

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THE POWER TO CHANGE

Climate change is a many-headed monster but TSE is fully committed to the battle. We are also firm believers in the power of economics to build a sustainable future. The scientific message is clear: carbon pollution is causing our planet to dangerously overheat. And we must act now on multiple fronts.

In this section, **Christian Gollier** and **Jean-Marc Jancovici** discuss the tools that governments can use to transform our societies, while **Ingela Alger** emphasizes the importance of feeling empathy for future generations. Younger generations are increasingly vulnerable to the various impacts of climate change, and **Gladys Barragan-Jason** suggests ways to overcome our growing levels of eco-anxiety.



TOMORROW'S WORLD

How to fight climate change

Climate change is not a distant prospect: it's happening now. Every year, droughts, floods and devastating fires remind us of the urgency of action. However, while there is broad agreement on the causes and consequences of global warming, scientists are often divided about the best solutions. The good news is that there are many ways to play a role in cleaning up the planet. At a special debate in Toulouse in October, TSE Director Christian Gollier and Jean-Marc Jancovici, a leading expert on France's energy and climate challenges, shared their views on the best tools and policies to help us win this fight.

“Energy and environmental transitions will radically transform our society. Never in history,” said Christian in his opening remarks, “has there been such an intense and rapid change. Most people are aware of what's at stake with the climate, and yet there is no consensus on the policies and instruments that should be used to make this transition.”

Two key actions will be required to decarbonize the

economy, insisted Jean-Marc: we must fight our tendencies to be lazy, accumulative animals and find out how to organize the physical flows that structure our economy so that carbon emissions fall by 5% per year, which is what we need to limit the rise in global temperatures to 2°C.”

These two climate specialists agreed on the urgency for action. However, in front of an audience of TSE students, journalists and members of the Shifters (a local association that works with the Shift Project, a think tank co-founded by Jean-Marc), they argued for the use of different tools. →

"We must fight our tendencies to be lazy, accumulative animals"



CHRISTIAN GOLLIER is TSE's Director. Since the mid-90s, he has increasingly focused on climate economics, with contributions to the public debate including his 2019 book *'Le Climat après la Fin du Mois'*. He was a lead author on the fourth and fifth IPCC reports.



JEAN-MARC JANCOVICI is an engineer specializing in energy and climate. He is a lecturer at the *École des Mines de Paris*, and a consultant to various public bodies. Since 2018, he has been a member of the France's High Council on Climate and president of The Shift Project. He is also the author of seven books, including *'Le Monde Sans Fin'*.

THE RISE IN GLOBAL TEMPERATURES WILL BE LIMITED TO

2°C

IF ANNUAL CARBON EMISSIONS FALL BY

5%



» WE NEED A PLAN

Government planning will be essential, believes Jean-Marc. "We need a plan. The development of transport infrastructures, the rewriting of urban planning documents, the construction of the electricity system, education and agriculture cannot be left in the hands of the market. For adjusting policies in the short term, the market is a great tool; but it is incapable of planning 30 years ahead. It is not designed to take structural decisions that will commit us for decades to come." A plan encourages the public to look ahead, he added: "People tend to make an effort if it helps to remove uncertainty."

CLIMATE AS A COMMON GOOD

Christian highlighted the benefits of carbon prices and regulation. "Without the State, the market is unable to send price signals that encourage the energy transition. The State therefore has a crucial role to play. For example, banning patio heaters in restaurants or coal-powered electricity are obvious interventions." A carbon price, meanwhile, encourages us to value the things we hold dear. "It makes us see the

climate as a common good that we must preserve for future generations. Each of us must be aware of the impact of our actions on the climate."

Economists find it hard to convince people about the carbon tax, Christian admits, "because it clearly shows that sacrifices must be made. But other policies, based on standards, subsidies and bans, are often even more costly."

EDUCATION

The experts found common ground on the importance of prioritizing the various actions we can take to decarbonize, while minimizing the impact on the well-being of society. They also agreed that education will be a major tool in the fight against climate change, and that the education system must be reorganized to produce the profiles, knowledge and skills needed to create tomorrow's solutions. ●



WATCH THE FULL VIDEO OF THE DEBATE IN FRENCH

THE CARBON TAX IS NOT THE ONLY SOLUTION but many economists believe it is the one that can achieve our climate goal with the least impact on purchasing power. To find out more, [read the Shifters' summary of the latest IPCC report](#).

WHY TAX CARBON?

Reduce green-house gas emissions

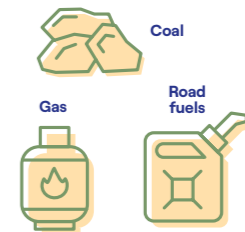
1 ton of CO₂ = €44,6

HOW? The polluter pays



This tax is added to the selling price of services and products according to the amount of CO₂ they produce.

This tax specifically targets



Several sectors are (partially) exempt

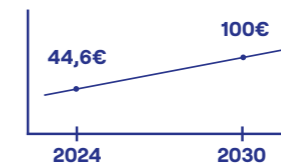


GOALS

Change behavior



Ensure tax is effective by increasing it





IN THEIR FOOTPRINTS Think of the children

To build resilient and sustainable communities, we need a comprehensive approach that considers social, economic and environmental dimensions. Growth can play a role, yes, but what kind? Economics can provide answers because it isn't limited to the study of monetary and financial concerns, it's also curious about society and behavior. Director of TSE's multidisciplinary Institute for Advanced Study in Toulouse (IAST), Ingela Alger has added a new role as Chair of the TSE Department of Social and Behavioral Sciences. She argues that success in the climate struggle will require citizens to make choices based on empathy for each other and future generations.

EMPATHY FOR FUTURE GENERATIONS

In the light of climate change and biodiversity loss, it's useful to consider two stark future scenarios. In the first, we continue to live and consume as we do today. In the second, we drastically reduce consumption of non-essential goods to redirect resources towards reducing our overall carbon and ecological footprints. Ultimately, the question is not whether we can combine economic growth and an ecologically sound society, but which kind of society we wish to build for current and future generations.

Behavioral drivers such as empathy may be fundamental for major transitions to

occur. Without empathy for people who are particularly exposed to climate change and climate policies, such as carbon taxes, we run the risk of reinforcing the already palpable divide between the big losers of climate change and those who are not much affected. Think, for example, of France's "Yellow Vests" crisis which flared up in 2018. Young people are particularly at risk: let's think about them and the conditions in which they will have to evolve. Empathy is really part of the solution. To think of society through the prism of growth, yes, but above all a growth in environmentally responsible behavior, a growth in empathy, and a growth in environmentally sound investments. That's where our power to change things lies."



STUDYING HUMAN COMPLEXITY

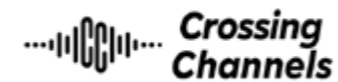
Ingela has lead IAST since 2021. Originally imagined by Jean Tirole in 2011, this social science research center builds bridges between disciplines and brings together experts from different, but complementary fields. The success of the IAST community led to the creation of TSE's Department of Social and Behavioral Sciences in January last year.

"Economists used to think of the human being as someone who sought only material well-being, but *Homo sapiens* is not this *Homo economicus*", says Ingela. "At IAST and in the Department of Social and Behavioral Sciences, we study the full complexity of human motivations, including morality, social norms, religious beliefs, cultural and institutional adaptations. Our economists collaborate with anthropologists, biologists, historians, psychologists, political scientists, and sociologists to achieve a holistic understanding of human behavior."



TSE AND IAST AT FUTURAPOLIS PLANET

For the 12th consecutive year, *Le Point* magazine organized its "Futurapolis Planète" event in Toulouse in December, dedicated to energy transition and innovation. This year, four researchers from TSE and IAST, including Ingela Alger, took part.



3 seasons of podcasts

in collaboration with the Bennett Institute for Public Policy at the University of Cambridge.

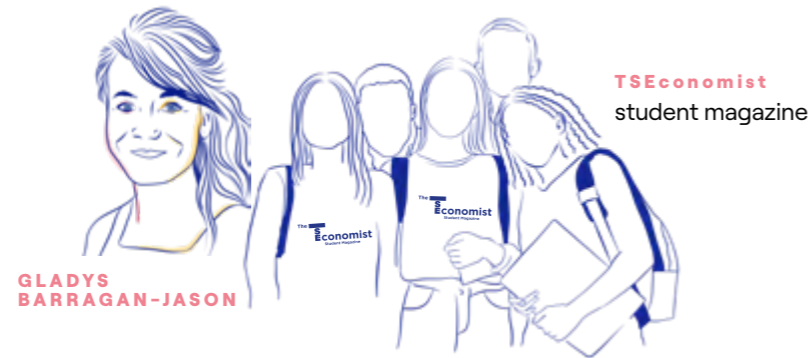
CAN ECONOMIC GROWTH AND SUSTAINABILITY COEXIST?

Find out what the experts say in this podcast episode with TSE's Stefan Lamp.



100 young scholars

from nine different disciplines have started their careers at IAST.



POSITIVE THINKING Turn eco-anxiety into action

TSE Mag conducted a survey of students on eco-anxiety. Although it has no scientific value, the 53 responses obtained show a striking tendency: 81% of students feel worry, fear or anxiety. Gladys Barragan-Jason, former associate researcher at the IAST and now researcher at the CNRS, helps us to understand these results.

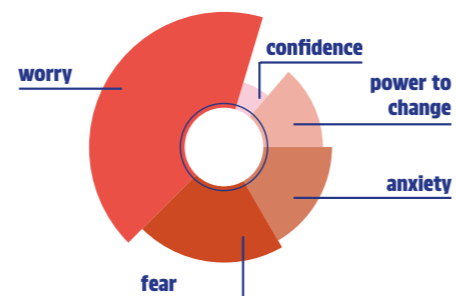
WHAT IS ECO-ANXIETY?

Eco-anxiety is emotional and psychological distress experienced in response to environmental challenges such as anthropogenic (human-caused) climate change and biodiversity loss. It is not a mental health disorder, but a normal psychological reaction to environmental challenges.

HOW CAN WE TURN ECO-ANXIETY INTO ACTION?

Acting to solve the problem that causes the anxious state has been shown to reduce this feeling, so getting involved in pro-environmental actions can help. This is especially true when actions are carried out in a group, as this gives them momentum. The notion of human-nature connectedness – which is the extent to which people see themselves as part

WHICH EMOTION WOULD YOU ASSOCIATE WITH CLIMATE CHANGE?



of nature - helps to improve physical and mental health, as well as boosting actions that promote nature conservation. Maintaining this connection can be done in a variety of ways, such as outdoor schooling or greening urban centers and schoolyards.

Explaining how our actions will concretely mitigate climate change is also a good way of motivating people! ●

LOOKING FOR INSPIRATION Climate culture

Spice up your understanding of climate change with these colorful pop culture picks from the TSE community.

This satirical comedy film directed by Adam McKay in 2021 serves as a cautionary tale about the potential for catastrophe if we ignore scientific warnings. As Ariana Grande sings, "Time is oh so precious!"

Don't Look UP



TOMORROW

Embark on a global journey with this 2015 French documentary by Cyril Dion and Mélanie Laurent. Through the experiences of four individuals, this film highlights positive initiatives combating climate change while also addressing the social, economic, and political crises the world is currently facing.

In Kim Stanley Robinson's 2020 sci-fi novel, an unprecedented heatwave kills thousands, prompting nations to establish a global ministry dedicated to implementing transformative changes. Spanning 103 chapters, the book offers an optimistic perspective, exploring the technological, political, economic and social shifts the planet undergoes.

THE MINISTRY FOR THE FUTURE



A WORLD WITHOUT END

What would life be like without fossil fuels? This 2021 French graphic novel by Jean-Marc Jancovici and Christophe Blain breaks down the complexities of transitioning away from hydrocarbons and how to secure our planet's future.

Confused about COP and the 1.5°C threshold? Get the facts in bite-sized episodes from this BBC podcast. It's your quick guide to becoming a climate expert!

THE CLIMATE QUESTION



Y'A PLUS DE SAISONS

Who says climate change can't be funny? Tune in to Swann Périssé's podcast and video series on Binge Audio and YouTube. Even when the news is gloomy, there's always room for laughs and positive vibes. ●

WHAT CAN WE DO?

To keep global warming in check, we have little time to clean up our hydrocarbon-thirsty economies. This will require collective and concerted efforts from across society. The scale of the challenge is daunting but we can all make a difference through our choices as engaged citizens, consumers, voters, innovators, leaders and professionals.

Forging a path ahead, this section highlights **TSE students** and **alumni** who are using economics to save the planet. We also feature advice from researchers aiming at three target zones: energy, food and transport. These sectors can be climate game-changers. For instance, Europe's carbon emissions have fallen to their lowest level since the 1960s, largely thanks to cleaner electricity.



MAKE A DIFFERENCE

Learn and act

TSE's mission is to equip students with the tools to build a better future. Even before graduating, many have begun to play a part, for instance, by participating in the 'Corporate Climate Action' challenge we recently organized with Getlink. Below, students from our Environmental Economics and Policy master share their experiences.



THU NGUYEN

“My dream is to be able to implement sustainable solutions, once I've finished my master's degree, for example as a CSR consultant or environmental impact analyst. My TSE training allowed me to deepen my knowledge of contemporary environmental issues, thanks in particular to optional subjects taught via mini-conferences and discussions with economic experts.

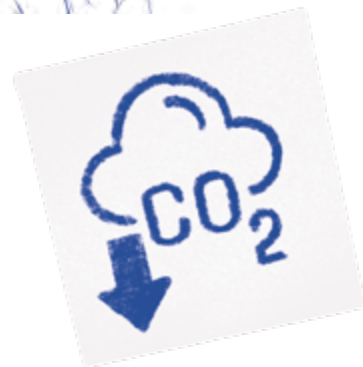
TSE opens a lot of doors. Last year I took part in the Sustainability Challenges expedition in Norway, a very rewarding program that aims to boost climate innovation.”

ANTHONY MEKDERIAN

“I want to have an impact. I joined TSE because it was one of the only master's in environmental economics in Europe, and it absolutely lived up to my expectations. I enjoy the quality of courses and being inspired by other students. We all want to do something for the planet and apply the skills we learn here to make it a better place.



I've already worked in a real-estate company where I did socio-economic analysis to limit urban sprawl and encourage the reuse of buildings. I'd love to do another internship to discover other issues related to the environment.”



LET'S TALK

“Climate change will have devastating effects on our lives, so we need to talk about it”, explains Aïssatou Diallo, president of Say it Aloud, TSE's public speaking association which aims to encourage discussion and debates among students.

Last November, it hosted a conference on 'Challenges of the energy transition for countries in the Global South'. The event aimed to give a voice to African actors on climate change, caused by years of pollution for which they bear little responsibility and yet are the most affected.



Bountouraby Yattara, former Guinean energy minister, and TSE professor Claude Crampes discussed climate issues with students.

CLIMATE FRESK

At the start of their third year, undergraduates take part in a “Climate Fresk” workshop, a new tool that facilitates participative learning about the ecological transition. Loïc Batté, associate professor of economics at TSE, has led some of these workshops. “The idea is to get students talking about climate change, its causes and consequences”, he explains. The playful and collaborative approach of the Climate Fresk helps to raise awareness “without anxiety creeping in”, and strengthens the will to act based on a shared scientific diagnosis.

The three-hour workshop concludes with a discussion and debate session, during which the participants evaluate their proposals. “A lot of people think they know enough about climate change, but that's often far from true”, says Loïc. ●



SCIENTIFIC SUPERPOWERS

Economics can save the planet

In the wake of al-Qaeda's terror attacks on September 11, 2001, PBS commentator Bill Moyes called on Americans to use the power of economists to create a better world. "If you want to fight for the environment," he insisted, "don't hug a tree, hug an economist."

That's because an economist can tell you that fossil fuels are heavily subsidized and promote vast inefficiencies. Or that it's better to invest in renewable energy sources that provide new jobs and cost less over time. Or that the price system is a potent tool for creating social change. Reducing emissions from fossil fuels, he noted, will cut the rate of asthma among children. Healthier kids, healthier economy... what's not to like?

Instead of hugging an economist, why not become an economist? From classroom to career, TSE alumni are discovering how their economic superpowers can combat climate change.


FILIPPO MARIA D'ARCANGELO

Economist at the Organisation for Economic Co-operation and Development (OECD)
Master and PhD in Economics

Filippo studies how to use economic policies to manage common resources, with applications to the environment and climate change. His research guides governments towards a quick, sustainable and just transition to net-zero emissions.


SARAH PALHOL

Energy Transition Consultant, ENGIE Impact
Master Environment and Natural Resources

Sarah works with more than 2,000 experts actively engaged in accelerating the green transition.


LUISA VAN DER PLOEG

Impact Evaluation Expert and Project Manager, ADE
Master Public Policy and Development Economics

Luisa works on impact evaluations for clients such as the World Food Program and country cooperation agencies, aiming to improve public decisions and the lives of vulnerable communities.

WHAT SUPERPOWERS DID YOU GET FROM TSE?

FILIPPO: If we want to stop climate change, we need to put climate action at the heart of government agendas. TSE taught me a language, economics, which is very powerful in doing that. Through economics, I can encourage public action on climate using numbers and rigorous analysis. The best part is that at the end of the month I get paid for doing it.

SARAH: My gap year in Japan solidified my passion for environmental economics. Motivated by inspiring TSE teachers, I chose the environmental economics master. The journey flowed smoothly, first through an internship at a sustainability consulting firm, and now shaping energy transition at ENGIE Impact.

LUISA: My time at TSE taught me that development issues are closely interlinked with the environment. People in the Global South bear the heaviest burden of climate change, largely attributable to the economic activities of Northern nations. Alongside drastically reducing our impact on the environment, we need to actively mitigate the adverse effects on vulnerable communities. Through my work at ADE, I can help public institutions to reach this objective.

WHAT'S YOUR SECRET WEAPON FOR TACKLING CLIMATE CHALLENGES?

FILIPPO: Today, we have more data than ever, surpassing what was unimaginable just a few decades ago. Leveraging this abundance for effective climate action is a challenge. In my projects, I often have access to data that is both exciting and sizeable. Economics offers a method to make sense of it, extracting vital lessons—even when the information feels overwhelming!

SARAH: ENGIE Impact and two groups collaborated to tackle climate change via the European Clean Transport Network (ECTN) Alliance. My role was to lead the economic modeling, for which we partnered with Carbone 4. Our integrated approach aimed to ensure project feasibility.

LUISA: I am currently working on a super cool study for a Belgian initiative in the Democratic Republic of Congo (DRC) which assesses young people's access to cultural activities and products. Culture can be a great vector of socioeconomic development and a key resource to mitigate and adapt to climate change.

ANY TIPS FOR HIGH-SCHOOL HEROES AIMING TO BE ECONOMISTS?

FILIPPO: Learn a method, not a subject. Prioritize becoming a well-rounded economist over being a specialist from the get-go. You might learn complex math that you think has no relationship with the environment and ask yourself whether you will ever use it. Guess what? You might!

SARAH: My pro tip is to embrace the diversity of economics applications. Find a passion, whether it's environmental sustainability or another field (sport, food...) and let it guide your journey!

LUISA: Follow your heart, dream big and trust your skills! ●



PLANT TREES
RECYCLE PLASTIC



FOLLOW THE SUN

GRACIAS

LA VIDA

PRESS PLAY



LISTEN TO OUR CLIMATE PLAYLIST

Take a break and enjoy songs that celebrate our planet, its resilience, and how we connect with nature.



CARBON BUDGET

How to spend it



For too long, the world has maxed out its resources, including our atmosphere's ability to absorb carbon dioxide (CO₂). The grudging acceptance at COP28 of the need for a 'transition' to sustainable energy is a welcome, if timid, step forward. But our profligate use of fossil fuels has left us with a paltry carbon budget if we want to stop ratcheting up climate change and avoid increasingly dangerous scenarios.

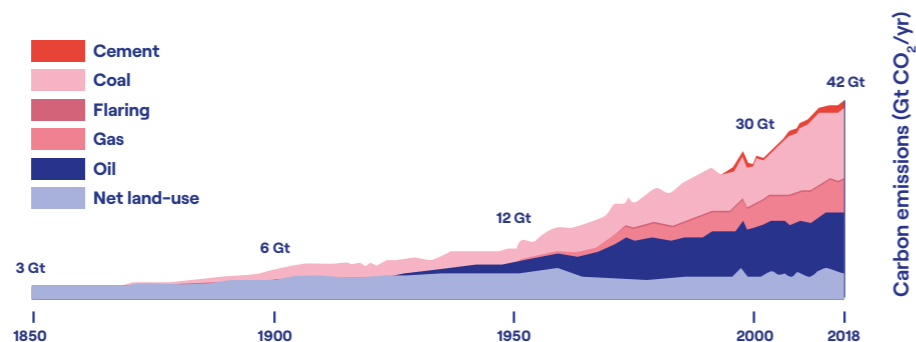
HOW MUCH MORE CO₂ CAN HUMANS EMIT WITHOUT TRIGGERING CLIMATE DISASTER?

1,000 gigatons. This is the amount of CO₂ that can still be emitted while limiting global warming to 2°C, according to the last IPCC report. It falls to about 400 gigatons if the target is set at 1.5°C. This carbon budget is quite small, looking at humanity's track record. Just in the past 30 years, we have pumped out 1,000 gigatons. At this rate, our carbon budget will be exhausted within five years for a temperature increase of 1.5°C, and 20 years for 2°C.

We have little time left to achieve carbon neutrality. Even at the 1.5°C level, the IPCC warns of devastating impacts including large-scale drought, famine, heat stress, species die-off, loss of ecosystems and habitable land, with more than 100 million thrown into poverty. At 2°C, the damage will be far greater.

CARBON BUDGET
 This is the amount of CO₂ the atmosphere can hold without global warming exceeding a given level, such as 1.5°C. Our carbon budget will be fully depleted when this temperature threshold is breached.

Long-term anthropogenic carbon emissions and sources



Carbon emissions have soared since 1950, with fossil fuels outstripping land use as the main source of pollution.

HOW SHOULD FOSSIL FUELS BE PHASED OUT?

The energy transition will take time, leaving the world dependent on fossil fuels for at least another decade. But coal, oil and gas produce different levels of CO₂ emissions, both during extraction and combustion. So we need policies that favor lower-carbon fossil fuels, while we push for their complete disappearance. Above all, we must not waste the meager carbon budget we have left.

We must first get rid of the worst offender. Coal produces twice as much CO₂ as natural gas, one third more than oil, and is a major contributor to local air pollution and acid rain. It also offers far less flexibility than gas-fired power stations for overcoming the intermittency of wind and solar energy. Financial compensation will be needed to ensure emerging countries keep coal in the ground. This may take the form of contracts such as the Just Energy Transition Partnership signed with South Africa. Movements such as the Global Coal Exit List can help to denounce the coal policies of investors and companies.

We must also optimize the use of other fossil fuels. Unfortunately, the lack of a global carbon price allows fossil fuel companies to neglect the carbon footprint of the deposits they exploit. In the case of oil, OPEC quotas artificially increase prices, boosting the profitability of high-emission deposits elsewhere. This leads to highly inefficient extraction that wastes our carbon budget. In Canada's oil sands, for example, emissions per barrel can be double those of Kuwait. Oil is still irreplaceable for transport. However, a recent study shows that optimizing its extraction could avoid 7.64 gigatons of CO₂ by 2050.

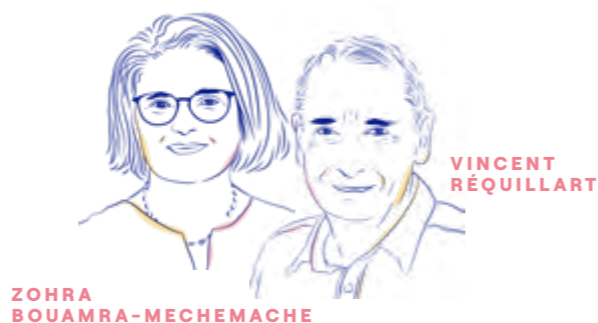
Only 1,000 gigatons of CO₂ can still be emitted while limiting global warming to 2°C, according to the latest IPCC report

This falls to 400 gigatons if the target is set at 1.5°C

HUMANS HAVE ALREADY RELEASED 1,000 GIGATONS OF CO₂ OVER THE PAST 30 YEARS

CLEAN CUISINE

Beyond beef



ZOHRA BOUAMRA-MECHEMACHE

VINCENT RÉQUILLART

Eating a healthier, plant-based diet is not just a personal choice, it's part of our collective responsibility for the planet. We need a revolution in the ways we produce and consume food, spurning beef-heavy 'Westernized' diets. Using the principles of public economics, TSE's Zohra Bouamra-Mechemache and Vincent Réquillart suggest how Europe can tackle this meaty problem.

In 2017, farming generated 11% of Europe's greenhouse gas (GHG) emissions, with livestock contributing the lion's share. By eating less meat, we could reduce land and water use, local pollution, global deforestation and loss of biodiversity.

Additional concerns relate to an excessive consumption of red and processed meat with possible public health consequences. As current EU policies fail to address these issues, our research makes the following recommendations:

- Existing farming subsidies must be reoriented towards greater sustainability and animal welfare.

- The Polluter Pays principle must be implemented at the EU level with taxes on the key causes of GHG emissions (nitrogen fertilizers and cattle) and environmental

damage (nutrients, pesticides). Alternatively, reinforce greening and cross-compliance requirements.

- As part of the Provider Gets principle, "virtuous" farmers should receive results-based payments for ecological services such as grassland management.

- Reform must support incomes during a transitional period, granting virtuous farmers a temporary risk premium.

- Trade agreements should plug pollution leakages and ensure a level playing field.

- Taxes and subsidies on food consumption should also be on the table to encourage low-GHG diets.

- Using information campaigns, labels, nudges and initiatives like "Meatless Mondays" will allow us to take steps toward sustainability. For now, these may seem to have only a limited effect, but in the long run they could greatly modify consumer behavior. ●

In 2017, farming generated 11% of European GHG emissions.

Farm animals produced 80% of this due to methane and nitrous oxide emissions from ruminants, manure and feed production.

In 2018, THE AVERAGE EUROPEAN CONSUMED

70kg of meat



& 256kg of milk



NICOLAS TREICH

UNIVERSITY CANTEENS

Step up to the plate!

Universities are key contributors to recent scientific reports that call for a shift towards plant-based nutrition. However, animal-based food served in canteens is bloating their own environmental footprint. In a Lancet Planetary Health white paper, Nicolas Treich and his coauthors urge universities to lead by example.

By reducing procurement of animal-based food, universities could mitigate their impact on climate change, ecosystem degradation, misallocation of water and land, pandemic risks, air and water pollution, and animal suffering. Plant-based menus could also save money and promote healthier diets.

HOW CAN UNIVERSITIES SPARK THE FOOD REVOLUTION?

- Ensure at least one affordable, satisfying, and healthy plant-based option every day; optimally, a wide variety of plant products would be offered, in line with evidence-based nutrition recommendations.

- Provide diners with information such as food literacy interventions and impact scorecards for dishes.

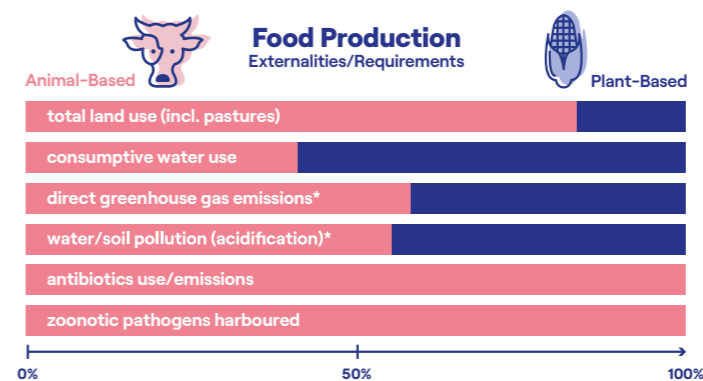
- Encourage dietary shifts through soft measures, such as small price incentives and reducing the animal component in a given dish.

- Universities should tap their potential for collective deliberation to win support for harder measures, such as large price incentives or reducing the offer of popular foods.

- The principles underlying campus food policy must also be debated. For instance, how are purchasing costs weighed against environmental and health impacts?

- To motivate swift and coordinated action, universities should aim to at least halve the consumption of animal-based food in canteens within three years. ●

THE HIDDEN COSTS OF MEAT



Source: Poore and Nemecek (2018), Heinke et al. (2020), Domingo et al. (2021)

*including emissions from packaging, transport, and retail

Animal-based food production's share in food-related total

DRIVING CHANGE

Can we travel without polluting?



ISIS DURRMEYER MATHIAS REYNAERT

Cars are a major contributor to climate change and local air pollution, which is the largest environmental health risk in Europe. Efforts to reduce drivers' impact on health and climate have produced a wide range of emissions standards, subsidies and taxes. Funded by the French National Research Agency (ANR), Isis Durrmeyer and Mathias Reynaert investigated their effects on car manufacturers, consumers and the environment.

HOW CAN THIS PROJECT HELP TO CLEAN UP CAR EMISSIONS?

ISIS: To design the best policy, regulators must specify their objectives and the weights associated with each outcome. For instance, my research shows how a policy that is good for the climate can have hidden costs for public health. I studied the winners and losers of the French "feebate", which sets taxes and subsidies for new cars depending on their carbon emissions. This favored diesel cars, which produce less carbon but have higher emissions of the most hazardous local air pollutants.

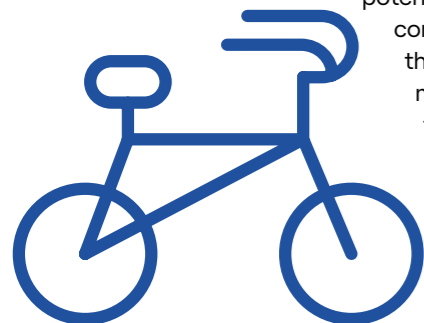
MATHIAS: When designing taxes and emissions limits, we need to consider the competitive environment and the potential responses of firms and consumers. Our work combines these elements in equilibrium models that try to understand the effects of these regulations. The ANR grant also allowed us to provide resources and data to TSE doctoral students such

as Kevin Remmy, who studied electric car subsidies and the effects of car taxes on neighboring countries.

SHOULD GOVERNMENTS INTERVENE?

ISIS: Economists can help to design and evaluate policies. I'm not sure we can say how much governments should spend, but if they spend €200 million, we can say what else could have been done with the same budget. We also try to show when a policy favors some individuals over others, as this can be crucial to public acceptance. For instance, France's "Yellow Vests" protests were sparked by a diesel tax increase that had little impact on the overall population but penalized drivers in rural areas.

MATHIAS: When drivers get into their cars, they do not consider they will harm other people. This pollution externality is a clear argument for government intervention. How we design regulation and taxes in these complex environments will determine the effects on the climate, local pollution, health, and the economy. ●



ELECTRIC CARS Chicken or egg?



KEVIN REMMY

Electric vehicles (EVs) can substantially reduce local and global pollution. Unfortunately, few will buy an EV without a network of charging stations, and a network has little value without EVs. To solve this coordination problem, Kevin Remmy's empirical framework examines how to design effective subsidies. Building on his research at TSE, he highlights the need for policymakers to understand how car makers will strategically adjust prices and

driving range in response to subsidies and indirect network effects. These reactions can lead to strong price and range distortions that shape consumer choices about whether to buy an EV, which in turn shape policy outcomes. In particular, focusing on maximizing EV sales may come at the expense of range improvements and the development of charging networks. ●

ROAD TRANSPORT PRODUCES NEARLY 11% OF GLOBAL GHG EMISSIONS

GLOBAL SUBSIDIES FOR EV PURCHASES REACHED NEARLY \$30 BILLION IN 2021

BLUE-SKY THINKING When will hydrogen take off?



ESTELLE MALAVOLTI

Hydrogen has the potential to revolutionize the future of air transport, with cleaner skies and a low-carbon footprint. New research by Estelle Malavolti uses evolutionary game theory to assess the prospects for successful adoption of green hydrogen solutions by airlines and airports.

Energy-rich hydrogen offers important advantages over conventional jet fuels, especially for the environment. It is the most common chemical element on our planet, can be produced using carbon-free electricity, and produces zero carbon emissions when burned. It can also be converted into electrical power via fuel cells.

costs. The percentage of initial adopters needs to be sufficiently high among both airports and airlines for the market to push everyone to adopt the technology.

However, our results suggest that hydrogen aircraft will only take off when consumption passes a threshold beyond which hydrogen's high energy content outweighs its high R&D and production

Arrival at this tipping point can be accelerated by green consumers, taxes, subsidies, or reduced airport charges for hydrogen aircraft. Otherwise, only fully hydrogen-powered aircraft using direct combustion can reach carbon neutrality by 2050, assuming the technology is available by 2030. In-aircraft fuel-cell systems will only be adopted if weight or energy losses can be reduced. ●

22 EASY WAYS TO GO GREEN

We all want to leave our mark. But it shouldn't be made of carbon... Compare your annual emissions with national and global averages, using the UN's "carbon footprint" calculator.



eco BINGO



Have I ever...

<p>Reduced heating and air conditioning</p>	<p>Taken shorter showers</p>	<p>Done full loads of laundry</p>	<p>Thought about when and how to drive</p>	<p>Driven at fuel-efficient speeds</p>	<p>Taken a train instead of flying</p>
<p>Switched to LED bulbs</p>	<p>Recycled, repaired and reused</p>	<p>Cleaned online cloud</p>	<p>Used stairs instead of the elevator</p>	<p>Cycled or used public transport</p>	<p>carpooled</p>
	<p>Mended and repaired</p>	<p>upcycled</p>	<p>Eaten locally and seasonally</p>	<p>Reduced meat consumption, especially beef in favor of a plant-based diet</p>	<p>Bought fish from sustainable sources</p>
<p>Bought second-hand or responsibly made clothes</p>	<p>Donated old clothes</p>	<p>Taken care of clothes</p>	<p>Shopped less to avoid waste</p>	<p>recycled food waste</p>	



SEND A PICTURE OF YOUR GRID TO .COM@TSE-EU.FR

If you ticked all these boxes, you are a carbon footprint champion, congratulations!

AND WE'LL SEND YOU A LITTLE SURPRISE.

WHY DON'T WE BEHAVE BETTER?

Why aren't we doing more to solve the climate crisis? In this section, our researchers reveal how humans are responding to the climate crisis. **Céline Nauges** and **Marijn Keijzer** examine what drives our environmental beliefs and attitudes, while **Sylvain Chabé-Ferret** asks whether policy nudges can improve our behavior.

Global warming also reflects global injustice, says **Jordanna Matlon**, who takes inspiration from the survival strategies of long-suffering communities. The poorest will continue to be hit hardest but research by **Anouch Missirian** shows that rich countries will have to adapt to accommodate a growing flow of asylum seekers driven from their homes by unbearable living conditions.



DON'T LOOK UP Who cares about climate change?

Despite the mounting evidence supplied by climate scientists, many people remain blithely dismissive of the scale of the crisis. Given the need for public awareness to spur governments into action, TSE's Céline Nauges wants to understand what drives our climate beliefs and attitudes.

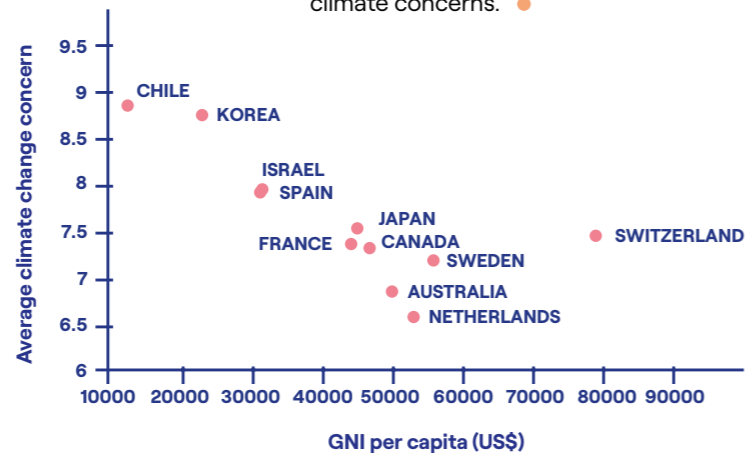
In a recent study, she uses survey data from 11 countries to show that wealth – for both households and nations – is linked to less concern about climate change. Her results suggest that wealth acts as a buffer against risk, reducing climate concern by increasing people's sense of control. She measures this feeling of control with a "readiness index" of countries' ability to adapt to climate change; and, for households, the extent of energy-efficiency improvements.

Céline proposes that as richer countries and households are better equipped to respond to climate change, they provide a reassuring sense of protection. This highlights a major obstacle to climate action: How can we inspire those with the power to act, when they may also be the least motivated?

DICING WITH DROUGHT

Another study explores climate attitudes and adaptation behavior in rural Australia, using two surveys of the same farmers over a five-year period. Céline finds that farmers exposed to higher risk – with higher debt, larger irrigated areas, more permanent crops, higher temperatures and less rainfall – were more likely to see climate change as a risk.

Interestingly, Céline finds evidence that farmers' attitudes towards climate change evolved over the five-year period and that these changes in attitudes may have been impacted by their actions on the farm. In taking action to reduce climate risks, such as changing the crop mix or reducing irrigated areas, some farmers reduced their initial climate concerns. Conversely, climate deniers were more likely to make riskier decisions, which eventually increased their climate concerns.



WHAT CRISIS?

Céline's research shows that households in wealthier countries exhibit lower levels of climate concern.

BEYOND NUDGES Governments must push us to go green



Nudges are often used by governments as a low-cost, 'light touch' way to encourage low-carbon behavioral changes. For example, telling families about their neighbors' electricity bills may 'nudge' them to use less energy. But the impact of such measures is a drop in the ocean, says Sylvain Chabé-Ferret. In a recent contribution with his TSE colleague Anouch Missirian to 'One Earth' journal, he argues that more forceful action will be needed to avert climate disaster.

WHY ARE NUDGES NOT ENOUGH?

Our review of the available evidence suggests that nudges, while often cost-effective, have very small effects. In my own study, we find that information letters and other non-monetary incentives only trigger pro-environmental behavior in at most 1%-2% of the French farmers who receive them. Nudges may also backfire, perhaps due to slippery psychological mechanisms. In another recent paper, my coauthors and I show that poorly targeted nudges can decrease the adoption of alternatives to chemical pesticides.

NUDGE

policies aim to steer us toward better choices, without using large carrots or sticks. Behavioral science shows even the smallest changes – to road markings, say, or the wording of a question – can encourage more responsible decisions by changing the way we look at our options.

WHICH POLICIES ARE MORE EFFECTIVE IN CHANGING BEHAVIOR?

Effective policies must be more assertive and guide all actors towards climate goals. Command and control regulations, or price interventions like cap and trade, taxes, and feebates (read more, page 26), have a much better track record at achieving environmental targets. For example, the EU's market-based Emissions Trading Scheme induced manufacturers to reduce carbon dioxide emissions by 14-16%, with no apparent contractions in economic activity. Making each unit of environmental degradation costly through tradable quotas has also been successful in improving air quality in the US and replenishing the world's fisheries.

HOW CAN THIS APPROACH BE APPLIED TO ALL CITIZENS?

The legitimacy and political acceptance of environmental measures that target consumer behavior will hinge on perceptions of fairness. Green taxes on heating, transport, and meat are unpopular and risk penalizing poorer families that spend a higher proportion of their income on these expenses. More attractive alternatives include allocating a free tradable carbon quota to each household, and policies that increase the price of carbon according to income or carbon consumption.

Less than 2% of French farmers enrolled in green schemes after being nudged

BEHIND THE SCENES

Are we ready for rising sea levels?



LILIAN REBAT
PhD student

“Floods, drought, vanishing coastlines... Natural disasters take different forms and it is essential to inform the public about the risks involved. In France, risk maps are drawn up by the local authorities. What impact do they have on housing values and urban development? Can they cope with climate change?”

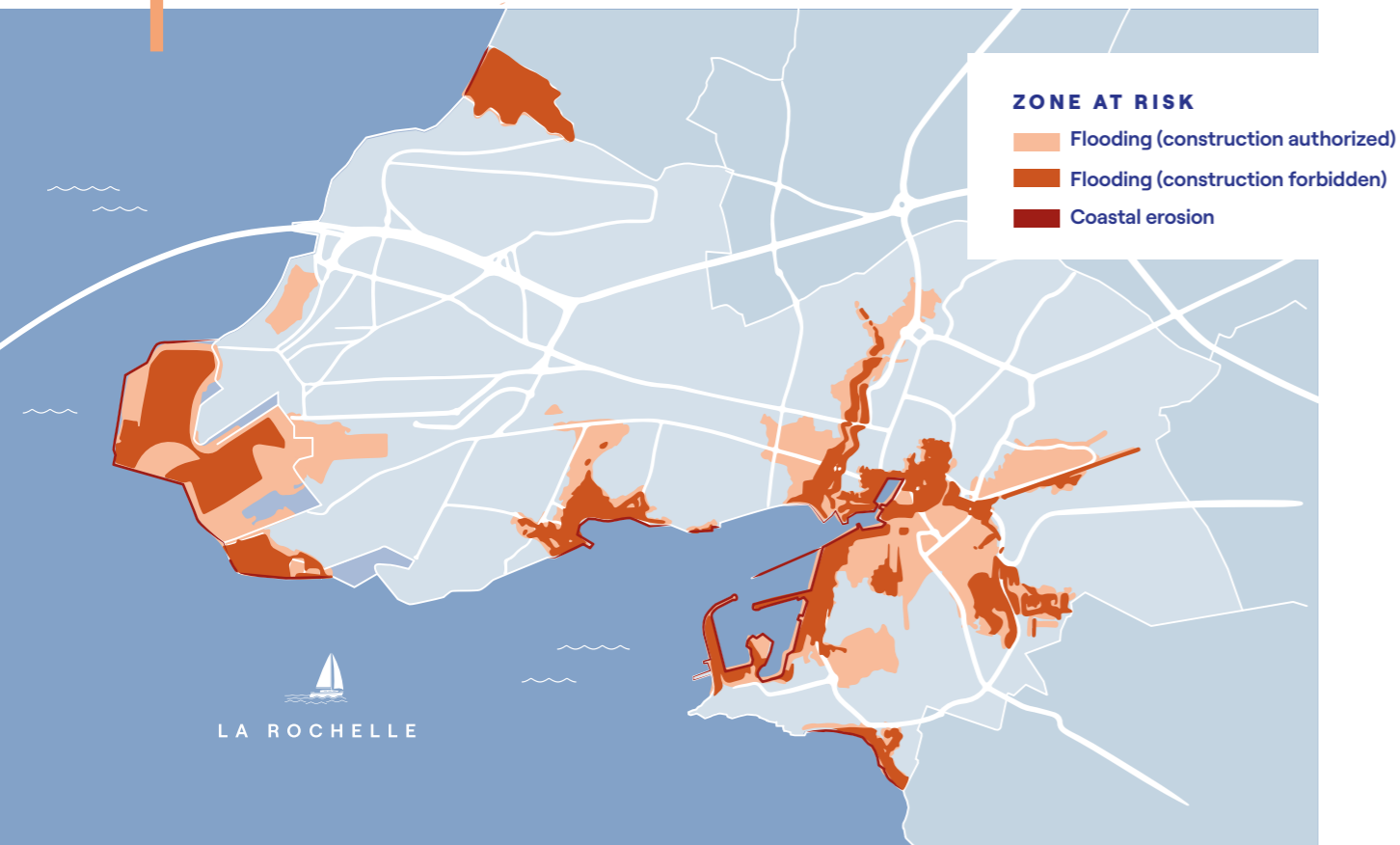
Since 2022, I've been working on these questions as part of my thesis at TSE. For this, I need to find out what research has already been done on the subject and to collect data. It's a painstaking process

that involves requesting data from local authorities, harmonizing it and cleaning it up. I then use econometric methods to estimate how zoning restrictions affect house prices, construction permits, etc.

Right now, I'm building a supply and demand model of the housing market. It will take several more months of work to apply it and draw conclusions that will improve our understanding of this subject.” ●

ENVIRONMENTAL RISK ZONES IN LA ROCHELLE, FRANCE

Source: Direction Départementale des Territoires et de la Mer - Charente Maritime



CROSSING BORDERS

Fight or flight

ANOUCH MISSIRIAN

Global warming hits poorer countries hardest. But just as pollution ignores national borders, so do the escalating impacts of climate change. Evoking the Pentagon's description of its role as a 'threat multiplier', TSE's Anouch Missirian finds that the impacts of weather fluctuations in agricultural areas are likely to spill over into developed countries by drastically increasing the flow of asylum-seekers.

Analyzing weather records in 103 low-income countries that send asylum seekers to Europe, Anouch and her coauthor Wolfram Schlenker found that migration increased when temperatures became colder or hotter than the moderate 20°C suitable for growing staple crops. This increase was nonlinear, which means that migration flows intensified as temperatures became more extreme.

Anouch's findings of the global scale of distress-driven migration add to a 2015 study showing that unrest in Syria was preceded by a record drought that forced farmers to migrate to urban areas. Although the authors do not attribute the Syrian conflict to the drought, they argue it added another stressor, worsened by political ineptitude or retribution.

COLLECTIVE RESPONSE

When presenting this research, Anouch often recounts the "year without a summer", when a volcanic eruption in 1815 darkened the skies and reduced global temperatures. Major crop losses followed and drew many peasants out of their farms in Europe and beyond; social unrest and famines completed the dire picture. Then and now, feeding the world is a climate-sensitive business, how will we cope when the planet heats up even further?

Today's climate migration will likely be dwarfed by future flows. However, much depends on our collective response. If the world fails to reduce carbon emissions, Anouch predicts that all else kept equal, asylum applications to the EU could rise by 188%, with an extra 660,000 migrants every year. If instead we can successfully clamp down on climate polluters, the increase in applications would be a far more moderate 28%. The "all else kept equal" is important: it's up to us to ensure that all else is not kept equal, and in particular, that we help the most vulnerable farming communities: using crops and techniques that will withstand the changes to come, or providing new jobs and homes in ways that preserve farmers' dignity. ●

Migration from low-income countries has doubled in the past **30** years

If carbon emissions continue at their present rate, asylum applications are projected to rise by **188%**

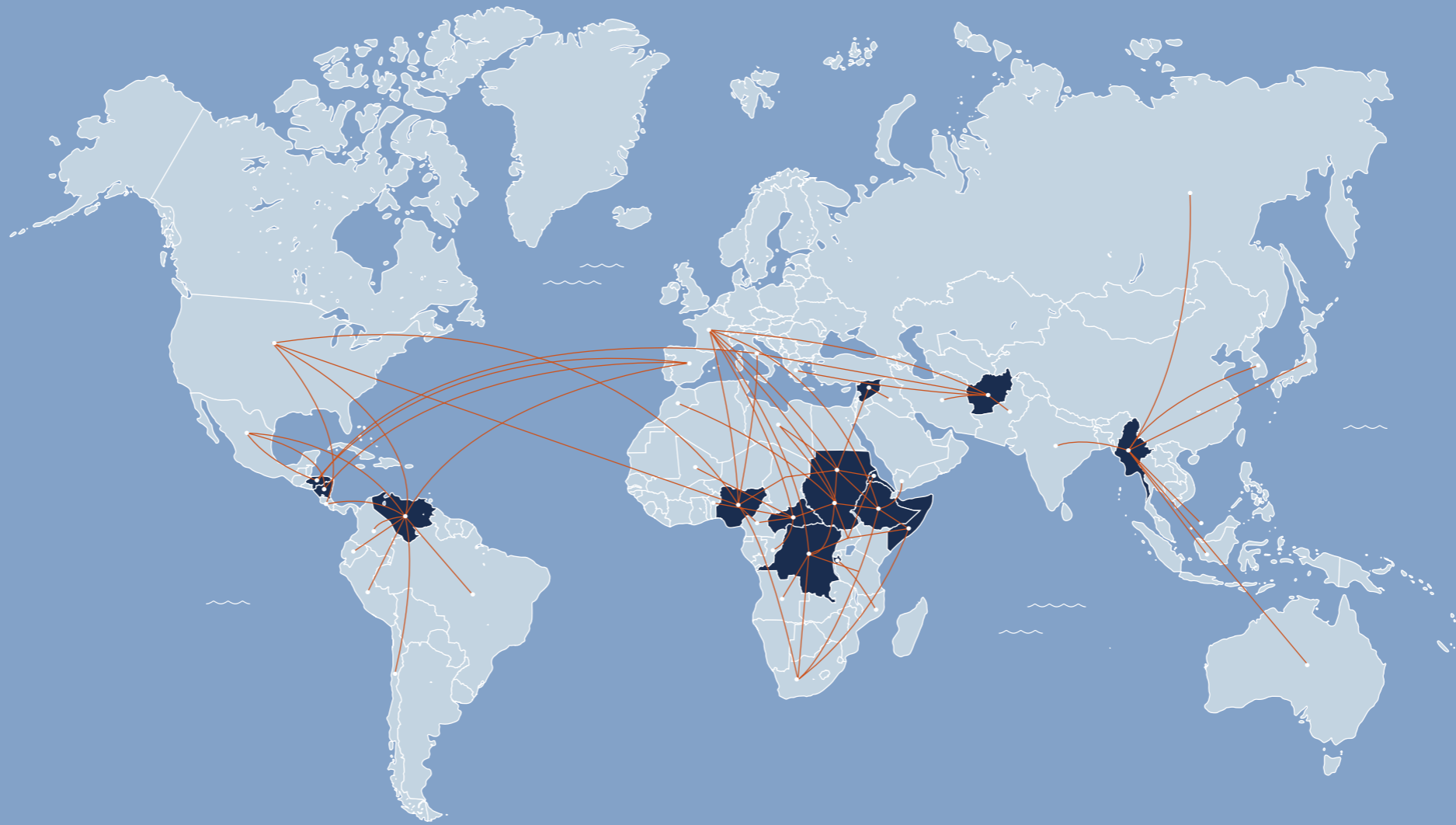
CLIMATE (IN)JUSTICE

The great escape

Around the world, the number of refugees and asylum seekers has soared over the past decade. By mid-2023, the UNHCR reports that 110 million people had been forcibly displaced due to persecution, conflict, violence, and human rights violations: a rise of 34% in just five years.

Global warming intensifies conflict, violence, political instability and economic adversity for inhabitants of these nations. Agriculture is weakened if not destroyed by heatwaves and droughts, more frequent natural disasters, and dwindling access to natural resources... And yet, by fleeing to neighboring countries to escape climate impacts, many end up in areas which may face increasing climate hazards in the future. ●

84% of refugees and asylum-seekers originate from 15 highly climate-vulnerable countries



- Afghanistan
- Burundi
- Central African Republic
- Democratic Republic of the Congo
- Eritrea
- Ethiopia
- Honduras
- Myanmar
- Nicaragua
- Nigeria
- Somalia
- South Sudan
- Sudan
- Syria
- Venezuela

Sources:
• UNHCR, Notre Dame GAIN Country Index (2020),
• 2023 Climate Inequality Report

10% of the world's population are responsible for almost half of global carbon emissions

Over 780 million people are exposed to the combined risk of poverty and serious flooding, mostly in developing countries

Many low-income regions face agricultural productivity losses of **30%**

COLONIZED PAST AND PRESENT

How to survive



JORDANNA MATLON

If human pollution is choking our planet, how can we call this progress? In a new book project, IAST sociologist Jordanna Matlon claims the historical experiences of Black populations – from colonial brutality to the precariousness of 21st-century jobs – offer valuable perspectives on the environmental and human costs of modern civilization.

WHAT CONNECTS SLAVERY WITH CLIMATE COLLAPSE?

The ecological devastation of the Industrial Revolution coincided with the destruction of cultures and communities of enslaved and colonized populations, trampled by a Eurocentric, man-conquers-nature vision of progress. As part of the relentless pursuit of growth and commodities, imperialism and the transatlantic slave trade fueled and foretold today's climate tragedy. Enslaved peoples have already endured the end of the world. This is why it is important to situate historical connections between developed and developing countries, between colonizers and colonized.

As Jeremy Williams writes in a 2022 BBC article, "Why climate change is inherently racist", climate change and racism are strongly intertwined with "a stark divide between who has caused climate change and who is suffering from its effects".

HOW CAN HISTORY LIGHT A WAY FORWARD?

The survival strategies I explore – in slave plantations, fugitive maroon communities, modern cities, and artistic imagination – reveal ecological harmonies and kinship systems that were not predicated on extraction, profit, or hierarchy. Adapting to scarce resources, forced migration, and the collapse of formal economies, Black stories show another way is possible. ●

The richest countries represent only **16%** of the world population but almost **40%** of global CO₂ emissions

Source: Guivarch, Taconet, and Méjean (2021)

In 2005, Hurricane Katrina was the deadliest hurricane to strike the US Gulf Coast since 1928. In New Orleans, Black adults were up to four times more likely to die than Whites.

FALSE DIVIDES

The myths of polarization



MARIJN KEIJZER

In contrast to scientific consensus on the origins and consequences of the climate crisis, the politics of climate action can be highly controversial. IAST computational sociologist Marijn Keijzer studies how pro-environmental attitudes form and how false polarization may impede collective action.

WHAT IS FALSE POLARIZATION?

People perceive that Western societies are increasingly polarized, yet there is little evidence to back that up. False polarization—the perception that society is more polarized than it actually is—is harmful nevertheless, reinforcing affective polarization, which describes the way people develop negative feelings towards those who think differently. This can prevent effective action.

HOW CAN NETWORK SCIENCE AID THE CLIMATE STRUGGLE?

My project 'Unpacking the Polarization Perception Paradox' investigates false polarization on climate action. I look at

how pro-environmental behavior can be explained through social influence. How do social networks impact our beliefs and actions? How does the alignment of beliefs within groups affect our willingness to adapt to others? And how does political identity affect the 'contagiousness' of environmentalism?

Vegetarians, for example, are often friends with vegetarians so selection or influence must play a role in their diet choices. But do vegetarian friends influence this choice directly or indirectly, by influencing pro-environmental beliefs that trigger an eco-conscious diet? And which friends are most important for changing our political beliefs? ●





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1 NOBEL
LAUREATE
150 FACULTY
MEMBERS
80 NATIONALITIES
2000 STUDENTS
96% OF ALUMNI
EMPLOYED WITHIN
6 MONTHS

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LISTEN TO OUR

CLIMATE PLAYLIST

